Measuring digital development for policy-making: Models, stages, characteristics and causes

Philosophiae Doctor (PhD) Thesis

Ismael Peña-López

Supervised by Tim Kelly

Information and Knowledge Society
Doctoral Programme

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Introduction

1. Introduction

Over the last 250 years or so, the Industrial Revolution and its effects have defined and shaped the World as we know it (Mokyr, 1997; 2000). Around one-third of the World's population have achieved undreamed of levels of prosperity. A further third are beginning to benefit from at least a basic level of welfare and the provision of services such as education, healthcare and housing. But the remaining one-third have not yet seen the benefits of the Industrial Revolution and, in the worst-case scenario, may even be a casualty of the trends that are benefitting the richest segment of society.

Now, a new revolution – the Digital Revolution – is again reshaping the World and is promising to overcome at least some of the disadvantages of place and time that marked the Industrial Revolution (Zysman & Newman, 2006). With the appearance of computers during the second half of the 20th century, the development of personal computers in the early 1980s, and the boom caused by the opening to the public of the Internet and mobile telephony during the last decade of the XXth century, the debate about the impact of Information and Communication Technologies (ICTs) has quickly heated up. One reason for the current debate is quite simple: if we are really living through a revolution, shouldn't we be doing something about it?

If it is indeed a revolution (Greenwood, 1999), then we are arguably only living through the very first stages, and that makes it difficult to understand the effects that are now happening, or are about to come. Furthermore, all countries face a challenge in understanding the causes of these effects, which are at best only blurry, and in attempting to master the Digital Revolution. If the Industrial Revolution caught many by surprise, no one can be excused for missing the latest train heading towards socioeconomic development (Boas et al., 2005). For this reason, there is a huge and urgent interest in measuring the impact of the Digital Revolution *before* it fully materializes (WSIS Executive Secretariat, 2002-2006).

The impact of the Digital Revolution has been observed by many authors in matters of productivity, competitiveness and other issues related to the survival of individual firms or the hegemony of a national sector in the international economic arena. But some authors also point at the fact that the impact of the Digital Revolution might cause countries to swap positions, with some being able to "leapfrog" development while others are in danger of missing this new train of progress.

The identification of the key factors that are likely to shape this revolution and the capability to measure them – both *ex ante* and *ex post* – would enable policy-makers and decision-takers to

a) Decide, according to the importance of the expected changes, how to intervene, and at what level; and
b) Determine how to measure the success of this allocation of resources.

But insofar as the outcomes of the Digital Revolution are still messy and blurry, then the same is true of its approaches, interpretations and models. Concepts like access, the lack of it, the digital divide, Information and Communication Technologies for Development (ICT4D), the tools that measure access or the impact of ICT4D or e-Readiness, to name but a few, have become a cloud of misunderstandings on a road that is paved with good intentions.

1.1. Goals

With this work, our aim is to analyze how and why the different approaches to model and measure the Information Society have determined what is meant by the concept of access to Information and Communication Technologies and digital development. And, based on this first analysis, work on and propose a 360° digital framework that can serve policy-making while, at the same time, be able to state whether and why governments should seek to foster the development of the Information Society.

Our approach is, necessarily, a multidisciplinary one, as our comprehensive approach to measuring the digital economy and its impact will imply working across several disciplines, including Economics, Political Science, Sociology, Law and Computer Science.

In this sense, it is also worth clarifying that we are not focusing on knowledge and its role in the economy, the society or personal identity, but in what enables knowledge to play this role: ICTs or, in other words, the transition from analogue to digital technologies. This is why we will be talking in general about the Digital Economy, and will also be using (almost) interchangeably concepts like Information Society, Knowledge driven Societies or Network Society, without entering in their differences.

On the other hand, and following the rationale of enablers, our intention in this work is not so much to measure the impact or the application of knowledge, but rather to measure how ready societies are to benefit from its use. Thus, we are focusing in the tools as sources, not in the targets or results of their application.

That being said, the goal of this research is to identify the relevant factors that promote digital development, to define and describe – on that basis – its different stages and to explain the causes why a particular country might therefore be classified as a digital leader or a laggard and, lastly, answer whether and why governments should foster the Information Society.

To address this goal we have split our research into three main areas:

- Clarification of concepts and their importance;
- Analyzing the available tools for measuring the digital economy; and
- Defining the stages of digital development, their characteristics and their causes; in particular, isolating the role of the public sector.

In the first area of research we cover the impact of ICTs, the concepts of access and the digital divide and the need to foster digital development. Our research questions in this area are:

- What is “access”? What are its components?
- What are the main approaches to defining access and why?
- Is there any evidence that access to ICTs has had a positive or negative impact on the general socio-economic development of a country?
- Why may there be a lack of access in a particular country or region, or to use a more familiar term, a “digital divide”?
- Is it worthwhile for governments to attempt to foster digital development to accelerate the positive impacts of access to ICTs?

The second research theme explores, broadly and in depth, the ways in which access, digital development and the digital divide have been measured over the years, in particular through the use of composite indices. The related research questions are as follows:

- What are the main models that depict digital development?
- What are the approaches that these models follow to describe digital development?
- What are the consequences of the different approaches followed in defining digital development models?

The third and final research theme focuses on the different stages, or phases, of digital development, their main characteristics and the reasons why digital development at the country level might be unevenly distributed.

- Can we group countries according to their different levels of digital development and thus define a comprehensive model for measuring it?
- What are the characteristics that enable us to cluster together countries according to their specific level of digital development?
- What are the characteristics that distinguish between different levels of digital development?
- Why some countries are more digitally developed than others?

The findings and reflections arising from these research questions should enable us to test the general hypothesis that guides our research. We believe that narrow institutional interests and a lack of appropriate data have led to a biased or fragmented measurement of digital development that is often focused on specific purposes. But if digital development is conceived as a continuum and described by means of a comprehensive model, then, at the country level, it can be observed that digital development happens in stages. These stages can be characterized by common features and distinguished by the scores achieved on certain key indicators. The improvement of its general economic indicators – such as income and wealth – characterizes the progression of a country along this continuum depends mainly on. Besides these basic economic aspects, if there is an appropriate Economic Incentive Regime, strong Government prioritization of ICT and a high importance afforded to ICTs in the Government’s vision of the future, then digital development is much more likely to happen. In some cases, these policies may allow leapfrogging so that a country can progress faster in its digital development than would be predicted by its general level of economic development.

Thus, our general hypothesis can be stated as follows:

- Institutional interests and lack of data lead to fragmented models to measure digital development that distort policy design. A comprehensive framework would improve such models and indicate in what ways the adoption of public policies would lead to higher stages of digital development.

This general hypothesis can be split into different partial or working hypotheses that make the research easier to approach.

Firstly, we want to highlight the fact that most approaches to modelling the digital economy and to measuring it have been biased either in their theoretical approach or in their practical implementation. We believe that several factors – such as the unavailability of data, the natural lack of definition of an emerging phenomenon, or specific interests in targeting narrower realities – have implied a complex landscape where comprehensiveness of measuring tools is still an issue.

The non-availability of data, lack of a solid theoretical framework or a focus on measuring specific measuring goals and targets have given existing models of digital development imperfect designs. Consequently, these models have evolved into incomplete, biased or fragmented models of the Information Society and there is a lack of consensus around concepts like Access, the Digital Divide and e-Readiness, despite – or perhaps simply because of – the constant evolution of these concepts.

In other words, our first working hypothesis is that

- A lack of quality data leads to fragmented models of digital development that make it both difficult to measure policies that foster the Information Society and to measure the impact of those policies on digital development, an implication being that these policies could have a better design either by focusing on filling conceptual voids or including feedback from better measurement.

Secondly, we think, nevertheless, that despite the existing problems in collecting data or the legitimate institutional interests in focusing on just a part of the digital economy, it should be possible to produce a comprehensive model, especially when targeted at policy-makers and decision-takers that have to deal with complex information and a broader sphere of intervention.

By contrast with other approaches, we think that this comprehensiveness can be reached with a combination of qualitative and quantitative tools in an iterative exercise. On the one hand, by overlapping the existing models so that there is an exhaustive inclusion of all possible approaches. On the other hand, by calculating and testing whether this comprehensive approach is statistically significant.

The growing availability of ICT indicators now means it is feasible to draw up a comprehensive framework that would combine all perspectives and approaches. Thus, it is possible to establish a middle ground among the various models on the best way of modelling and measuring digital development, despite the narrow institutional interests of those involved in this enterprise and/or the cost of putting such a model into practice

After this consideration, our second working hypothesis reads as follows:

- A 360° digital framework approach shows that Infrastructure – Availability and Affordability –, the ICT Sector – the Industry and the skilled Workforce –, Digital Literacy – the level of Digital Literacy and Digital Literacy Training –, the Policy and Regulatory Framework – Regulation and Policies – and Content and Services – Availability and Intensity of Usage – are the key components of digital development and such a comprehensive framework for analysis could be applied in policy design.

If we can draw a comprehensive model, it is that we expect countries to reach different levels of digital development, and this progress can be measured using the tool described above, which we have termed the "360°digital framework". We believe that we can describe these levels or stages of digital development and, more important, that it is possible to explain why some countries reach higher levels while other countries appear stuck at lower ones.

Indeed, we want to go one step beyond and state that governments have an important responsibility – and, hence, a commitment – in their respective countries to achieving a specific stage of digital development.

Our third working hypothesis is that

- Higher levels of wealth and economic development, education and the existence of digital infrastructures almost always coincide with higher levels of digital development. Nevertheless, Governments can accelerate the process of digital development through the adoption of public policies that frame and foster the Information Society – such as Government prioritization of ICT and assigning a high importance to ICT in government vision of the future – and establishing an appropriate Economic Incentive Regime. This will raise the probability of a country of reaching higher stages of digital development.

That said, we will mainly avoid dealing with the issue of leapfroggers in our work. Although this is a very interesting case of digital development, our main focus – the "mainstream" stages of digital development and policy-making – and lack of data – that would provide poor significance for this small number of countries – make it difficult to make strong statements about these group of countries, whose main characteristic is using the ICT Sector as a locomotive for development, although with unequal strategies and impact in the domestic economy.

1.2. Methodology and Structure of this Work

To verify these hypotheses we have gone through three different research stages – that correspond to the three parts of this work – moving from theory to practice, and from a qualitative methodology to a quantitative one.

Part I – chapters 2 and 3 – deals with Access to Information and Communication Technologies and their impact.

This part, mainly based on an extensive literature review, highlights what are the main approaches to the phenomenon of the digital revolution and impact of ICTs in the economy and other aspects of life, what are the different meanings given to the concept of access and whether and why should the lack of access (or digital divide) be fought.

Chapter 2 briefly highlights the major impact of ICTs in several aspects of life like the economy, work, the communication sphere, culture, engagement and empowerment, or politics and governance. It also presents some reasons why ICTs have generated a discussion around them being a tool to foster development – "ICT4D" – which is now a discipline in its own right.

Chapter 3 is centred on the concept of access. It explores the main approaches to its definition and how these approaches have influenced the debate around the lack of access – the Digital Divide – and whether it is widening or narrowing over time, and, if so, why and how. The chapter ends dealing with the importance of fostering access to achieve higher levels of development, especially in the poorest communities and countries.

Part II – chapters 4 to 10 – presents a qualitative analysis of some 55 different models of digital development (including composite indices) that have been defined, applied and or/used to describe and measure digital development.

The qualitative analysis performs an iterative study of the aforementioned models according to a specific structure of 5 categories with 2 subcategories each:

- Infrastructures: Availability, Affordability;
- The ICT Sector: Enterprises and Industry, Workforce;
- Digital Skills: Digital Literacy Level, Digital Literacy Training;
- The Policy and Regulatory Framework: ICT Sector Regulation, Information Society Strategies and Policies;
- Content and Services: Diversity and Choice, Intensity of Use.

For each model, a description and brief history is provided, accompanied by its performance on these categories and subcategories. A final review is made for each of them, identifying their strengths and weaknesses in the light of the purpose for which they were designed and in relationship with our goal to provide a comprehensive approach to measuring the digital economy.

Chapter 4 describes the qualitative methodology followed to perform such analysis, a recurrent iterative methodology that has built a framework based on the analysis of the 55 models, and analyzes the models according to that framework.

Chapters 5 to 8 list the four categories of models in which we have grouped the analyzed approaches:

- Descriptive Models (Chapter 5),
- Theoretical Models (Chapter 6),
- Indices (Chapter 7), and
- Sets of Indicators (Chapter 8).

The analyses include a brief description of the origin of the models, the main publications or places where they can be accessed, their categorized components and a final analysis of their strengths, weaknesses and suitability for the purposes for which they were intended.

Chapter 9 presents an analytical comparison of all the models, the way they were designed, and the elements that they have in common or that differ amongst them. We end up by revisiting the concept of access and to see how it has evolved according to how it is measured.

Chapter 10 closes Part II and draws some preliminary conclusions, which give rise to a proposal for a middle ground among the models by means of a tool ("the 360° digital framework") that arises from the combination of the models studied in this work.

Part III – chapters 11 to 14 – gathers all the quantitative analyses performed with statistical calculations and tests, and puts into practice the 360° digital framework and describes the characteristics and determinants of digital development.

The quantitative analyses are made at the country level with two country datasets. The first dataset is a larger one including 75 developed and developing countries belonging to the World Information Technology and Services Alliance (WITSA), and a second one with 28 countries belonging to the OECD. Some 156 indicators were extracted from 15 different databases and used to build the variables in our analyses.

The complexity of data was reduced using cluster analysis, which, in turn, also served to describe different stages of digital development by grouping countries that have small Euclidean distances amongst them and bigger ones in relationship with other countries, which can be reconstituted into other groups.

These derived clusters – or stages of digital development – were characterized by means of contingency tables – or cross tabulations – thus providing interesting insights about what constitutes a specific stage of digital development in terms of both digital and analogue variables.

Finally, logistic regressions were calculated using the clusters to find out what were the variables that determined (a) being a digital leader and (b) being a digital laggard.

Chapter 11 describes the quantitative methodology followed in the statistical part of this research, lists the sources of data and the tests applied to them.

Chapter 12 defines clusters of countries – based on the World Information Technology and Services Alliance (WITSA) set of countries – according to the selected indicators of chapter 11, each chapter being a different stage of digital development. In this chapter, clusters and categories are also described and characterized according to the factors they have in common.

Chapter 13 repeats the operations in chapter 12 applied to a subset of countries belonging to the Organisation for Economic Cooperation and Development (OECD).

Chapter 14 builds and calculates binary logistic regressions to suggest the determinants of digital development. The relationships of causality are listed and explained.

Chapter 15 features the conclusions, where we will revisit our research questions and hypotheses, while trying to find answers for the former and arguments to test the validity – or failure to validate – of the latter.

After Chapter 15, the references used in this work and other works consulted are listed in a Bibliography, followed by a glossary of authors and the corresponding annexes.

Part I:
Access to Information and Communication Technologies and its impact

2. ICTs and the Digital Revolution

It is difficult to categorically state when and where the Knowledge Society[1] began, if such a thing *happened* in a discrete way. We can go as far back as to Alan Turing (b.1912-d.1954), considered the father of computer science (i.e. the automated treatment of information using a stored-memory computer) or back to John Vincent Atanasoff (1903-1995), considered the father of the digital computer, who made a big difference in matters of computing speed and flexibility compared to the analogue computer, by changing mechanical components by electronic ones[2]. The leap from Information Technologies to Information *and* Communication Technologies (ICTs) should probably be credited to Vinton Gray Cerf (b.1943) and Robert Kahn (b.1938), usually considered the fathers of the Internet thanks to their work on TCP/IP protocols, that made possible two computers connect to the same network and communicate one to each other[3]. A last founding father is Tim Berners-Lee (b.1955), who arguably gave birth to the World Wide Web[4], currently the most popular platform for using the Internet.

Looking at it this way, the history of the Knowledge Society can be said to have its roots more than seventy years old. During most part of this time, information technologies were "in individual support systems, [evolving towards] the integration of these resources within organizations as […] 'management information systems'" (Williams, 1998, p.19). But it was not until the Internet was born in 1983, until it was launched commercially in 1992 and, indeed, at the release of the first web browser – in the early 1990s (Berners-Lee, 2000) – and its release to the non-scholarly community that the general public became massively aware of the power of ICTs in general (and the Internet in particular) and their huge potential, especially concerning the *communication* part in ICTs. "It appears as if the 1990s [would] represent the expansion of management information systems into networks extending far beyond individual organization" (Ibid.) and, indeed, "usage of the internet and email predictably mirrors computer usage" (Kohut, 2007, p.76). It is also after the early 1990s[5] that mobile telephony definitively took off[6] connecting everyone, everywhere, everywhen. It is, hence, only really during the last decade, that the increasing penetration of ICTs in everyday life has led to their absolute pervasiveness

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[1] We will use indistinctively the different terms that have been used to describe the social, technological, economic changes taking place in the postmodern times led by Information and Communication Technologies. Thus, concepts such as Knowledge Society, Information Society, Informational Society, Network Society… will be used interchangeably even if their coiners had different approaches or put the stress in some characteristics rather than others.

[2] Copeland, 2006

[3] Zakon, 2005. Leonard Kleinrock and Lawrence Roberts are considered the other two founding fathers of the Internet due to their development of ARPANET, based on their research on packet switching. See also Hafner & Lyon (1996)

[4] Zakon, 2005

[5] The first digital mobile network was put to use in Finland in 1991 (ITU, 2006, *ITU Internet Report 2006: digital.life*, p. 125)

[6] See, for instance, ITU's *World Telecommunication/ICT Development Report 2006* (p.1) for general data and *ITU Internet Report 2006: digital.life* for a more qualitative explanation.

among determinate social collectives and economic sectors, constantly reported by mass media.

The speed of the major adoption of these new technologies has been the concern of both politicians and scientists, wanting to measure the real impact of these technologies on the Economy, Culture… the Society in general and, moreover, the sign of the impact of being connected or being able to work with information at both intensive and extensive levels.

Of course, this awareness of being connected also brought to light another fact, the fact of *not* being connected. Hence, the term *Digital Divide* was hence coined in the mid 1990s and highlighted by the President Clinton US Administration[7], its meaning changing and evolving since. But keeping the focus on the same question: the differences in access to the Information and Communication Technologies, the differences in access to the Information Society, and what this meant in terms of progress, welfare, socio-cultural change.

In recent years, the commitment of the academic community to test and measure the impact of ICTs on society has only been paralleled by the commitment of most governments to foster the development of an Information Society within their country's boundaries. Indeed, the World Summit on the Information Society, promoted by the United Nations, with the International Telecommunication Union (ITU) taking the managerial role – in two phases: Geneva 2003 and Tunis 2005 – represented the major effort to bring awareness on the importance of being on the "right" side of the digital development, of the digital divide.

Notwithstanding, was are still far away from reaching consensus in lots of aspects concerning ICTs, the Knowledge Society or the Digital Divide, in part because of the consequences of riding on the crest of the wave: not only the consequences but the causes are way too recent in many cases to be able to have an objective, equidistant, calm approach to them in order to describe and analyze them, infer patterns and trends, and postulate policies or desired achieving. On the other hand, the target of research itself has broadly and quickly changed along time, making not only difficult the analysis of a given snapshot, but the comparison across time of supposedly consistent definitions and variables. Last, but not least, the fear of "missing the last train for development" quite often loosens the customary rigor with which reality should be analyzed, leaving place for speculation and hopes on the benefits of technology which, while not necessarily wrong, are often untested. Hence, policy-makers are frequently guilty of swinging between different policies, strategies, targets and goals, depending on whose speeches or documents were backing their arguments.

[7] Even if there is some consensus on the role played by the Clinton Administration in making of the concept a political issue and resonating in every household, the origin of the term is most unclear and, unfortunately, time will but help shed light on it. Laura Sartori, in the introduction to her book (2006), writes a brief history of the term going over the origins, evolution and the different meanings given to it.

2.1. The Third Industrial Revolution?

It is beyond any doubt that the way the world is today shaped is a direct consequence – *inter alia* – of how, where and when the Industrial Revolution took place. The concept of developed (underdeveloped, developing) country carries within itself all the economic indicators constructed since the mid XVIIIth century. Indeed, Economics as a discipline is said to have be born with the publication of *The Wealth of Nations*, by Adam Smith, in 1776.

It is, hence, easy to understand that not only economists, but policy-makers are deeply interested in measuring the socio-economic advances due to the Information Society and test whether we are facing a "revolution" or, on the contrary, it is just a passing phase. Besides the evidence on the impact of ICTs on economic growth and in the non-economic sphere of the society – culture, personal and public communications, etc. – the issue is still whether it is worth strongly committing to foster the Information Society at the highest level. The rationale behind this statement is that if the impact of ICTs is "just" is just a matter of context – e.g. increasing the productivity of a specific firm, business or sector – then it is arguable that the initiative to promote ICTs should be left to the private sector, to the decisions and free choice of individual consumers, as any other decision in the field of corporate or personal investment. If, on the other hand, the repercussions in both the economic and social levels, are so huge that we are facing a revolution of a similar – or greater – magnitude than the Agriculture or Industrial Revolution, then, maybe, action should be taken – or led – at a higher level.

2.1.1. The Industrial Revolution(s)

The Industrial Revolution is said to have begun circa 1760[8] with the appearance of the steam engine, iron and coal, which led to major social and economic changes, like manufacturing, the harnessing of power or the automated printing press. The former changed the way and the place production was undertaken, causing, among other things, the shift from agriculture to manufacture, and the exodus from rural areas to the city; the latter the way information and knowledge was diffused.

A second stage of the Industrial Revolution – the *Second* Industrial Revolution, in opposition to the *First* Industrial Revolution – took place between the 1860s and the 1930s[9]. This stage is characterized by the internal combustion engine and steel. It is also the time when the electricity and the chemical industry appear, as well as the telephone, and gain enormous strength, the shift being now from manufacturing to services.

Greenwood (1999, p.11) locates the beginning of the "era of computers" in the 1950s[10], splitting it in three stages:

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[8] Mokyr (1997, 1999), Greenwood (1999)

[9] Greenwood (1999)

[10] It could be argued that a better dating for the beginning of the computing era would be the late 1940s with the development of ENIAC in the USA and Ferranti Mark 1 in the UK, leaving the early 1950s as the beginning of *commercial* computing.

- During the 1950s, computers performed "calculations that were impractical or impossible to do manually"
- During the 1960s, "computers became file-keeping devices used by businesses to sort, store, process, and retrieve large volumes of data
- During the 1970s, they opened up the era of "remote accessing and networking" (*Ibid*.)

Notwithstanding, Greenwood places the start of a Third Industrial Revolution in 1974, when the price of equipment fell faster than on the previous years, on a sustained trend and, according to Greenwood, linked to IT development.

The question is whether a positive impact on equipment supply should suffice to qualify this impact as a revolution.

One might expect for a revolution to be so that changes where both deep and wide, affecting a huge range of human activities and, if not in an irreversible way, at least in a way that clearly showed an "after" from a "before" situation. As Mokyr (1997, p.33) puts it "There are different ways to judge technological breakthroughs; the obvious one and most appealing to economists is the impact on output and productivity. But there are others: I like the notion that pathbreaking inventions allow us to do something previously impossible such as flying or preventing infectious disease."

Mokyr insists in this aspect, in the fact that what is important in a revolution is not only its unquestionable mark on technology, but also "at the level of industrial organization"[11] at the broadest level, far beyond a single industry but reaching, if not the whole, at least a good part of the productive system, including "a huge spectrum"[12] of human activities.

Mokyr states it clearly when he compares the Industrial Revolution with the times we are living in. If the Industrial Revolution "was not the age of cotton, nor the age of steam, nor the age of iron—it was the age of progress"[13], we can then state that "we are neither the age of the microprocessor, nor the age of antibiotics, nor the age of the advanced plastics, but an age in which progress is like a steady rain"[14].

If the Industrial Revolution caused a tremendous technological change in the scale of production, skills and human capital, the distribution of income, and the bringing of globalization, we should expect no less from an Industrial Revolution v3.0 to be considered as such. Mokyr himself compares Netscape's contribution[15] to Rowland Hill's invention in 1840 – the penny post – or, citing Hal Varian, compares the

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[11] Mokyr, 1997, p.35
[12] Op. Cit. p.33
[13] Op. Cit. p.32
[14] Op. Cit. p.33
[15] Netscape Communications Corporation (Netscape) commercialized Mosaic – the first popular web browser – in 1993 and which became the Netscape Navigator in the mid 1990s. The company's strategy, establishing a *de facto* standard on web browsing, along with server technology to provide web services, is one of the factors responsible for the huge increase and popularization of the World Wide Web, which had been developed in the early 1990s at CERN in Geneva.

Internet to reading as an information revolution during the Industrial Revolution, brought about by the printing press[16].

So, what is that is reshaping the world and presumably revolutionizing it?

2.1.2. An Information Revolution?

Despite the insufficient knowledge about nowadays changes, there is a consensus – even if grading from absolute belief to moderate acquiescence – that a revolution is in progress. On behalf of the High-Level Group on the Information Society, Martin Bangemann stated back in 1994 –long ago, for today's standards – that "throughout the world, information and communications technologies are generating a new industrial revolution already as significant and far-reaching as those of the past" (Bangemann, 1994, p.3).

Bangemann's statement leads us to focus on what is that has characterized this so called revolution. We have already talked about computers, but it is important to put them in the broader context of information systems, in order to highlight what is important here: information.

These information systems are a full plethora of devices that have been recently split in two main groups. The first group would be composed by the printed press, the telegraph, the radio, the telephone or the television, to mention just a few of them.

The second group – often under the name of New Information and Communication Technologies – would include computers, the Internet, mobile telephony, and, to sum up, all kind of digital technologies enabling telecommunications and sharing and storing information in a digital format.

It is this last category of technologies – the digital ones, brought to us thanks to the diffusion of the transistor – that cause a third revolution from the mid-1970s onwards (Warschauer, 2003b).

For the first time in History, information has become input, capital and output in economies based on information systems. More and more there are processes whose one and only goal is enrich information in many ways: purify raw data out of "noise", cross it with other data so they make more sense and become information, changing the way information is presented or visualized, etc. Whether the output should be called data, information or knowledge or not is beyond the scope of this work[17], but the existence of a process to transform information is something quite recent and almost exclusively from this period of time.

One of the crucial aspects of the Industrial Revolution was a knowledge revolution, making possible not only the creation of more and better knowledge, but that the

[16] Mokyr, 1997, p.37

[17] Even if these are three very different concepts, we will be using "information" as a generic term that will generally include all of them, except when explicitly mentioned.

same existing knowledge could be better accessed and thus make a difference (Mokyr, 2000, p.33).

The focus now was not so much on the technical ability to access knowledge, as happened in the Industrial Revolution, but in the reduced cost of doing it: in the falling costs of accessing, transmitting and storing information and the knowledge embedded within. In a digitized economy, the marginal costs of storing data tend towards zero – specially when prices of storage devices drop as their capacity increases, thus increasing the effect per unit of storage measure – and the costs of transmitting it, although still important, also fall in comparison with purchasing power or technical capability[18].

And all of this is happening at a tremendous speed. As Martin R. Hilbert (2001a, p.13) put it, "the whole process [can be referred] as: "IT-high-speed-evolution"".

For this speed to be reached, a knowledge revolution is needed. Mokyr (2000) identifies three aspects that we can adapt to the digital revolution.

- First, the (physical) speed and efficiency with which knowledge can actually travel. We have already mentioned the growing computing power and capacity of telecommunication (wired and wireless) channels. But we could also add the virtual elimination of physical distance due to the higher possibility of replication that digitization implies. This replication can be either intended – through mirror sites – or unintended – as most digital accesses generate copies, which is how e.g. web proxy servers work. On the other hand, peer-to-peer (P2P) networks and grid computing also allow for a distributed access to information, which blurs our understanding of the concept of "original source" and, hence, sending information from (or travelling to) the source.

- Second, the standardization of information. It is absolutely relevant that almost all aspects of trade and industry – hence, quite everything – are if not regulated at least agreed by means of multinational agencies whose purpose is, precisely, the establishment of technical standards to ease interaction and interoperability between agents. Indeed, the global use of English as a *lingua franca* all over the world is nothing but contributing to a better understanding and to reinforce the establishment of standards, as they are expressed in a "standard" language.

- And third, mathematics as a language to dominate technical communication, thus lowering access barriers. In the case of the digital revolution, this language is clearly programming languages, that are, in reality, a derivative of mathematics, as it is a fabulous collection of algorithms that interact with the binary language of computers. Lawrence Lessig (1999) even dares to go

[18] For instance, the OECD biannual series of Information Technology Outlooks (OECD, 2000b, 2002b, 2004a, 2006, 2008e) always provide very interesting insight in this field.

one step beyond showing how code is more than algorithms that rule computers but also *real* laws that *de facto* rule the analogue world.

So, decreasing costs and increasing speed to create exchange and incorporate knowledge into every socioeconomic aspect of our lives, that's it. But the impact can be huge.

One of these impacts, if not the most notable, is globalization, a process driven by these "plunging communication costs which make much deeper international integration possible", very different than the globalization that took place in the 19th century, which was "driven mainly by transport costs" (The Economist, cited by Mokyr 1997 p.37).

The main (economic) effect of this globalization, as stated by Blinder (2006), is an expansion of tradable services and the consequent shift towards services offshoring[19]. In his opinion, this will be the main characteristic of the Third Industrial Revolution, as the shift from agriculture to manufacture represented the First Industrial Revolution and the shift from manufacture to services the Second one.

This globalization is but just the second out of the three fundamental features with which Manuel Castells[20] characterizes the *new economy* we are living in, being the other two the Informational Paradigm – "that is, the capacity of generating knowledge and processing/managing information determine the productivity and competitiveness of all kinds of economic units" (Castells, 2000, p.10) – and the fact that this new economy is networked. In other words, ICTs come to the eye of the hurricane in today's society, representing the end of the Industrial Paradigm and bringing a new Informational Paradigm whose most representative effect is the uprising of a Network Society at a global level. And "[b]ecause information processing is at the source of life, and of social action, every domain of our eco-social system is thereby transformed" (Castells, 2000, p.10). We understand from Castells' words that, in his opinion, it is not about a Third Industrial Revolution, but a brand new revolution, as powerful or more so, which he calls the Informational Revolution.

But, to what extent is it a powerful change that it is happening?

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[19] Richard Heeks, in his eDevelopment Briefing no.8 (2005) draws an interesting argument in favor of *more* offshoring, but relying on some preconditions so offshoring can benefit *also* developing countries.

[20] Castells's work in this issue is profilic and well known. We are using here "Materials for an exploratory theory of the network society" (2000) and "Informationalism, Networks, And The Network Society: A Theoretical Blueprint" (2004), two short and handy articles that present an overview to most of his late work in the field of the Network Society. This thesis is supported, for instance, by Jerôme Bindé (2005) when he presents UNESCO's "Towards knowledge societies: UNESCO World Report", quite a declaration of principles where the institution almost officially adopts the term *knowledge societies* – and all variations like *knowledge-based societies* –, thus differring from the ITU, that has adopted the term *Information Society*.

2.1.3. A Present Revolution

So, the general opinion is that changes are happening, changes are huge and changes are taking place right in the present. Of course, the problem of such recent changes – happening right now, provided they *are* really taking place – is how to measure them, especially in the long run. Indeed, if we are still trying to measure the impact of an Industrial Revolution that took place almost 200 years ago, the problem with the Digital Revolution – regardless if it is a Third Industrial Revolution or a new paradigm – is that (a) it has not already ended and (b) it began somewhere in the middle of the 20th century, being dated by some, as we have already said, accelerated with the advent of the web browser – that popularized the Internet – in the last decade of that century, which is very recent for measuring purposes.

Some scholars are, then, cautious, when stating what the impact is like in the Information Revolution. As Boas at al. (2005, p.107) puts it, "[o]ur most authoritative accounts of such transformations as industrialization, democratization, and the commodification of land, labor, and capital were not those written in the midst of events, but decades, if not centuries, later", making it "impossible at present to assess fully the scope of the social, economic,
and political transformations brought about by digitization and to evaluate their comparability to the Agricultural or Industrial Revolutions" Boas at al. (2005, p.95).

Some others, seldom tagged as technophiles or cyberoptimists[21] by authors more reluctant about the incontestable evidence of changes, are openly assertive when talking about the inevitable and deep effects in all the of digital technologies socioeconomic sphere, deeper – some say – than the ones brought by the Industrial Revolution.

In the next two sections we will try to summarize what has been said about the impact of ICTs in the Economy and the impact of ICTs in non-economic issues.

2.2. ICTs and the Economy

As in a pendulum movement, the reflections about the impact of ICTs in the Economy have swung from enthusiasm to realism and back to optimism, being each of these states really subjective and implying a wide range of shades within.
It is not difficult, especially outside of the scholarly literature written by economists, to find exaltations of the expected benefits of ICTs in the future. This kind of discourse, while still popular nowadays – particularly after the hype of the Web 2.0 – enjoyed high times in the last half of the 1990s decade, undoubtedly boosted by the popularization of the Internet and, thus, the realization that the power of the computer could have "no limits" if connected to the network of networks.

This technological utopianism is criticized, amongst many others, by Blinder & Quandt (1997) or Triplett (1999) and can be summarized in Robert M. Solow's

[21] See, for instance, Trujillo-Mendoza (2001) and Vicente (2007) for an overview of some of these authors, though they are not mentioned this way in their works.

words "You can see the computer age everywhere but in the productivity statistics"[22], soon dubbed as the Solow Paradox. In other words: though it might seem evident that computers are everywhere, and one might be prone to think they are everywhere for good, but we need evidence to back our assessments, and this evidence appears hard to find.

Even if the criticism against this utopianism might be right when directed against clairvoyants or enlightened bargainers, there is another approach led by politicians and, above all, civil society and international agencies committed with development cooperation that see ICTs as a last train to catch. Thus, while there might not be a lot to lose for those that did not develop during the Industrial Revolution, benefits could be many so the choice is obvious: bet on ICTs. As Analysys (2000) puts it in a report prepared for infoDev – The World Bank's Information for Development Program –:

> "Many commentators continue to challenge the provocative diagnosis that underpins this report – indeed these are easy to criticise, since they cannot be based on any truly robust statistical observations or analyses. However, by the time that the shape and dynamics of the emerging networking revolution can be rigorously assessed it will be too late – the winners and losers will be fixed, and the opportunity to steer and influence outcomes will be passed. If the profile of networking development is to be raised, it must be on the basis of the available evidence, even though much of this is subjective, uncertain and contentious".

So, even if the authors acknowledge that there is poor evidence and that great part of it is subjective, time runs against long-term research for a better planning. Talero and Gaudette (1996), Analysys (2000), Primo Braga et al. (2000), Rodríguez and Wilson (2000), Accenture et al. (2001) and other reports published mainly by the leading Development agencies (The World Bank, the UNDP, ECLAC, etc.)[23] are good examples of this *cyberoptimism*: there is a serious lack of good data, of good evidence, but there are already a good amount of good practices to think that the time has come to bet on ICTs as a driver towards development.

In reaction to this *cyberoptimism* – or just because their approaches are different and more focused into economics and not politics or civic engagement – other authors have been focusing on the impact of ICTs in economic growth, mainly in how they impact the GDP: its growth, the share of ICTs in GDP, etc.

Their main findings, while valuable, are somehow expected and, one dare say, tautological: after some decades of high investment in the field of ICTs[24] most authors find that ICTs have a growing weight in the total GDP and, hence, they are

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[22] Solow, Robert M. (1987) 'We'd better watch out,' *New York Times* (July 12), Book Review, 36, as cited in Triplett (1999).

[23] An quick read to most of these agencies' works listed in the Bibliography will demonstrate this statement of ours. It is very usual to find expressions like ICT's "can", "could", "will", "would" and so forth in these writings. Stronger statements – on the other hand normal in scholarly literature – such as "it has been demonstrated", "as evidence shows" or "data back that…" are rare if not unexistant in many of them. Examples of this can be found at UNECOSOC (2000).

[24] ICTs here include hardware, software, connectivity and services (desing, running, maintenance, etc.) related to all kind of information technology.

having a positive impact in economic growth. The positive part of these findings is that they were not that evident just some years ago, as Triplett (1999) himself shows when trying to find out the reasons for the Solow paradox. The negative part is that, when found, they become straightforward for many and, in some ways, disheartening: it was obvious that higher spending on ICTs would, sooner or later, affect the GDP, but the *relevant* question is still unanswered: do ICTs have some multiplicator effect besides the direct – and expected – effect on growth? Can ICTs become locomotives of growth by boosting the economy? Are there any effects on productivity *besides* a linear relation with growth?

A paradigmatic example of this approach – or this "realistic" findings – is the one taken by the International Telecommunication Union (ITU) or the United Nations Conference on Trade and Development (UNCTAD), whose reports normally show snapshots of the reality by crossing big national magnitudes, and usually avoiding to enter the field of predictions or forecasting[25]. Some examples shown by Navas-Sabater et al. (2002), The World Bank (2003), Souter (2004), Torero & von Braun (2005), The World Bank (2006), also fall in this category.

We want to stress that we find these observations absolutely valuable, insofar as they provide good and irrefutable evidence of the contribution of ICTs – and, normally, the ICT sector – to the growth of a country's economy.

For instance, Heeks (2005e) shows that, even if evidence to back it was weak, all seemed to support the theory that "the developmental gains from investing in ICT production are greater than for investment in ICT consumption". Another example is provided by Primo Braga et al. (2000) where they show, based on economic research papers, that "economic growth is being increasingly influenced by the availability of efficient telecommunications and informatics infrastructure" and that there is a "causal link between telecommunications development and economic growth; [...] high returns on investment in telecommunications equipment and, more generally, in the telecommunications sector". So, it is out of question that ICTs are not an increasingly important industrial sector in their own right.

Notwithstanding, we also want to stress the dichotomy whether these observations really find that ICTs are making a *huge* difference in these economies, in the sense of the Revolution we talked about in section 2.1, or if their behaviour is "just" the one of a good economic locomotive – e.g. like the building industry in a post-war scenario – that affects growth quantitatively but not qualitatively. In other words, are simply they (very) good for the Economy or are they *making a real difference*?

[25] *Box 4.3: ICTs and the Japanese economy* from ITU's "World Telecommunication Development Report 2002" (2002) is a perfect example of this: ITU shows how Japan has increased its investment in the ICT sector for the last six years and how this is mirrored in both the share of the ICT sector in the Japanese economy and how it has contributed to Japanese economic growth. From the charts and statements it can be inferred that ICTs have played an important role in reactivating the economy but the question is still there: Is it cause or effect. A similar pattern is evident in the building industry in Spain during the first years of the 21st century – just a matter of volume – or with a real effect on productivity and competitiveness – by focussing on the qualitative effects too?

The answer is crucial: developed countries, in the event of economic stagnation or recession, may have the resources to stimulate the economy by applying investment and consumption policies based, for instance, in the ICT sector. And the effort will pay off. On the other hand, developing countries, in general, are in need of highest returns of investment for each and every dollar put into a specific policy initiative because their needs are not simply in providing an economic stimulus but in implementing structural change in their economies[26]. Thus, we might not be looking for a linear impact on growth but a geometric impact based (also) on changes on productivity, industrial redesign and renewal, enabling changes in other sectors, etc. In Neto et al. (2005). after stating that the relationship between higher levels of investment in ICTs and more users of these technologies in rich countries "should come as no surprise" they declare that "[t]he more interesting question is the extent to which e-development can also be a *driver* of general development" (emphasis in the original).

The third approach has been in the line of giving a more satisfactory answer to this question. Of course, some of the previous authors we have mentioned *also* try and contribute to going beyond the simple "ICT Sector – GDP relationship".

As statistics are being refined, so they better fit the measurement needs of researchers. As reality lets herself be more and better measured by bringing more and more evidence to the surface, as more interest is being raised in ICT4D issues and hence more people are getting involved, the literature concerning the impact of ICTs in the Economy is growing quickly, bringing more (and sometimes better) insights about this subject.

We want to end this section by highlighting some of the evidence gathered, and encouraging the reader to follow the references for more information on their sources, methodologies, caveats, strengths and weaknesses of their respective findings. We present it here altogether, avoiding thus repetitions and putting together similar statements:

[26] Souter, D. (2008), for instance, does not find a clear relationship between ICTs and economic growth in developing countries, also finding that these countries might be less prepared to benefit from ICTs than developed ones. There are, thus, reasons to think that some things that work well, or are more affordable, for developed countries might not equally work in developing ones.

Economic Benefits of ICTs	
Growth	ICTs, in general, facilitate economic growth, having a positive impact on national GDP growth
	Specifically, the greater the size of the ICT sector (products and services), the larger the positive impact of ICTs on growth.
	Enabling a larger market coverage
	Increase in the reach of businesses (economies of scope)
	Reduction of economic downturns and dampening of business cycles
	Boost in economic output thanks to employment creation
	Allows more diversified growth strategies, especially due to changes in the terms of trade
Market	Promotes integration of isolated communities into the global economy
	New information-based products create new business niches
	Scaling-up of international competition thanks to more transparency and increased trade
	Energizing of the market due to a shortening of product life cycles
Investment	Growth in global investment
	Positive impact on system development cost, risk and timescale effects
	Reduction of information asymmetries, especially in banking and finance, thus improving market behaviour due to more transparency
	Positive effects on business confidence and risk assessment
	Impact of ICT-related capital investment on overall capital deepening
	Developmental gains from investing in ICT consumption
	Developmental gains from investing in ICT production (even greater than for investment in ICT consumption)
	High returns on investment in telecommunications equipment and, more generally, in the telecommunications sector
Efficiency	Facilitation of cost-effective public and private services
	Enabling of more efficient goods and services allocation
	Cost savings, in general, for industry
	Fostering of effective use of development resources: capital and natural resources
	Improvement of inventory management, better flow control, better integration between sales and production and, therefore, enhancing management of production
	Increased transport efficiency
	Reduction of transaction and search costs and information asymmetries in product, services and factor markets
	Improved performance in firms, increasing efficiency in combining capital and labour (multifactor productivity)
	Reduction of site dependency of data processing
	Enabling of higher quality products and services
	Improvement of quality monitoring
	Fostering of mass customization
	Enabling of dis-intermediation
	Creation of new intermediaries, new business niches
	Better access to knowledge and information by enabling of rich

	information flow
	Improved decision-making
	Greater flexibility on the part of firms in catering to a diversified customer base
	Network externality effects
	ICTs promote "green" growth, helping to mitigate the effects of climate change by carbon abatement effects in other sectors
Innovation	Lowering of technology cost
	Increase in the volume and innovation effects
	Benefits from international standardization
	Positive impact of rapid technological progress
	Impact on skills and organizational change
Productivity	Productivity boost in firms, industries and national economies
	Increase of labour productivity, especially in more skilled workers and/or after an initial period of adoption/training
	Increase in multifactor productivity
	Significant contribution to value-added by ICT skilled jobs
	Greater impact of broadband on productivity
	Contribution to the increase of capital input per worker (capital deepening) thus increasing efficiency and productivity
Trade	Growth in global trade
	Intensification of trade
	Growing trade in ICT goods and ICT-enabled services, increasing its share in total goods and services exports
	Emergence of a global information infrastructure
	Enabling of outsourcing, thus reducing costs – on one side – and creating business – on the other one.
	Increase of foreign investment
Employment	Positive effects on employment creation
	ICT-production enables better paid information-related jobs
	Energizing of occupational structure and changing demand for competencies
	Positive impact on high-skilled workers' wages
	Increased transparency and efficiency in labour markets, allowing better allocation of workers and skills
	Compensation of deficient growth of employment opportunities in manufacturing by significant increases in ICT business employment
	Creation of new kind of jobs
	Improved social development
Demand	Increase of user expectations
	Strengthening of ICT-products and -services demand
	Enabling of new forms of interaction between firms and other parties such as consumers thanks to networking

Table 1: Economic Benefits of ICTs[27]

[27] This table was built relying on: Talero & Gaudette (1996), Greenwood (1999), Analysys (2000), Primo Braga et al. (2000), Navas-Sabater et al. (2002), OECD (2003d), Souter (2004), Nishimoto & Lal (2005), UNCTAD (2006), Atkinson & McKay (2007), Bartel et al. (2007), OECD (2008)

The positive impacts and benefits of ICTs in the Economy shown in Table 1 are a roughly sorted gathering of different impacts listed by several authors[28]. As opposed to what we stated at the beginning of this section when we talked about *cyberoptimists*, we have tried to collect here not forecasts or predictions on what could or would happen in the Economy due to the implementation of ICTs, but theoretical claims which, in some cases, are backed up by real evidence of real impact as measured by the authors or by other works cited by these authors.

One caveat is due: as is clarified in most of the literature, evidence is not always subject to generalization. While sometimes it actually is, some findings apply only to specific contexts such as countries, economies, moments of time, constellations of conditions and so forth. We nevertheless believe that these impacts are worth listing because some were predicted – or expected – ten years or more before they could be measured (e.g., the employment creating effect of ICT investment which may have actually destroyed jobs in the short-term but have certainly created new employment opportunities in the longer term). On the other hand, some caveats about the applicability of these findings are mainly based on (non) availability of data. Last, but not least, because even if only some of these results apply, as we have said, to specific economic setups, nevertheless it may be possible to reproduce them in other contexts – e.g. in developing countries – in order to try to provide the same results.

Surprisingly – or not – there are few papers stating the *negative* impact of ICTs in the Economy. Some of them[29] do not dare to talk about negative impacts but of *changes* in the Economy: change of paradigm, organizational changes, turbulences in international markets, etc. and speak of them quite neutrally: they are neither positive nor negative on their own, but it will depend on a firm or a sector strength and position to benefit from them or to suffer them.

To be fair, the only potential negative impact we have found in economic papers – and also in sociological papers – is about employment. Again, a caveat: as we have shown before, most authors predict that the net effect on employment will be positive, and will be in the lines shown in Table 1. Nevertheless, some – among them Greenwood (1999) and Castells (2000) – portray some drawbacks of ICTs entering workers' life. While the former describes an impasse scenario where skilled workers will benefit while non-skilled will have to adapt to new technologies – losing productivity, competitiveness and earnings in the meanwhile – Castells is certainly more frightening, as he depicts the segmentation of workers according to two axes: networked vs. switched-off labour, and self-programmable vs. generic labour. The conclusions are similar to Greenwood's, but presumably to stay in the long run and with deeper consequences that spill from the labour market over the social and cultural arenas in a not really promising future for this kind of workers.

Which leads us to examine what effects ICTs might have outside the Economy.

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[28] See supra.

[29] See supra.

2.3. ICTs and non-economic aspects

It has been a constant since the appearance of ICTs – and we will return to this, as it is one of the key issues of this work – that the economic impact of these technologies has been better measured and, one dare say, with some more rigor than other aspects of the influence of ICTs in everyday's life.

The last years have seen the appearance of interesting and serious approaches from other disciplines different from Economics: in Law, led by the Berkman Center for Internet & Society at Harvard Law School and the Center for Internet and Society at Stanford Law School; in Political Science, led by the Oxford Internet Institute, at Oxford University; in Society in general, led by the Pew Internet & American Life Project; etc.

But two major differences have arisen with the research carried on by Economists compared to other disciplines.

The first difference is mainly about the nature of what is measured that one would qualify as "quantitative" in the case of Economics and "qualitative" in the other cases. Though the distinction is arguable and even controversial in most academic circles, it might well be useful to highlight the following reflection. In Economics most variables are more or less well identified and have their corresponding indicators, to a greater or lesser degree[30]. Thus the evaluation of findings is, simplifying to the maximum, quite straightforward: growth and productivity are good, unemployment and inflation are bad[31]. In other disciplines – and more the more we approach the concept of *humanities* – quantifying is not always possible and, indeed, stating what is good and what is not often is, if not impossible, a methodological prejudice and deviation to absolutely avoid.

The second difference is, precisely, about indicators and the quality of measurements: as we will be explaining in more detail in following chapters, the effort in the first stages of measuring the Information Society was put in infrastructures and/or investment in ICT equipment, and only seldom in other aspects of the Information Society. Measuring infrastructures or equipment might be well enough for economists, as it sheds a lot of light on capital and its relationship with other inputs (labour) and output (production, GDP). But it is clearly not enough to guess how it has affected e.g. health or culture.

So, when we talk about the impact of ICTs in non-economic aspects or in "society" in general we have to be very cautious and know what we are exactly talking about.

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[30] Many economists, like Mokyr (1997, 2000) or Blinder (& Quandt, 1997; 2006), would complain about the quality of stats but, as we have said, the point is not to assess their design but to compare the with other disciplines' tools.

[31] Let us insist that we are trying to keep things *very* simple.

When framing all the various impacts of ICTs on society – and not only at the economic level – it is unavoidable to speak of Manuel Castells's work. Summing up[32] and focusing on what is of interest here, Castells presents a society structured in three layers – relationships of production, experience and power – that by acting over matter (i.e. nature) – the former – and establishing relationships amongst them three layers, end up shaping a culture in a specific configuration of time and space. As technology plays an important role in both the relationships amongst layers and in the creation of culture, Castells theorizes on how ICTs are actually shaping contemporary culture in a very broad sense[33]. His thesis is that the Informational Paradigm[34] leads to a globalized Network Society that pervades each and every aspect of human life. Besides the effect on the Economy[35], it affects the overall way in which society is shaped, thus the way we work, how culture and communication take place, a redefinition of politics, and even the concepts of time and space.

We can summarize the preceding ideas in the following figure, which presents the three layered society structure in a drastically simplified way:

Figure 1: Mater, social relationships and culture
Source: Author, adapted from Castells (2000)

In order to get into the detail of what Castells usually explains at a general level[36], huge efforts have been put not only to show that society is changing due to the existence of ICTs, but also to point how and, indeed, due to exactly what causes. As we began saying at the top of this section, the fields of interest are many and different disciplines are trying to approach the issue from their own point of view,

[32] Since the publication of his acclaimed trilogy in 1998 (Castells 2001a, 1998, 2001b), Manuel Castells has written extensively about the Information Society. Even if *The Internet Galaxy* (Castells, 2002, for our Spanish edition) is often considered a good start – and somehow a version in short of his trilogy for a general audience –, as we have already explained in footnote 20, we believe that "Informationalism…" (Castells, 2004) and, above all, "Materials…" (Castells, 2000) have a more convenient approach for our purposes in this section and in our work in general, hence we base our analysis here mainly in these two works.

[33] Please see supra. for the proper definitions of each and every layer, culture, technology and so.

[34] See page 36

[35] See supra.

[36] Of course we are not saying that there was nothing before his trilogy but, outside of the economic arena – and sometimes the Development arena, which is usually tied to the former –, it is also true that the focus was not on social issues such as culture, communication, empowerment, health or education, and that the switch towards the analysis of these subjects comes with the XXI[st] century.

sometimes joining efforts to provide a multidisciplinary explanation, sometimes colliding in their respective findings.

As we did in section 2.2, we will briefly present next in Table 2 some of the proven or expected impacts on different aspects of the society by several authors[37]:

Economy (at large)	New economic rules
	New economic opportunities
	Improved business process efficiency and productivity
	Increase in global trade
	Increase in competition
	Increase in global investment
	Continuous shift towards intangible capital: raw labour, human capital, knowledge and skills, institutions, etc.
	Increase in capital-intensity – especially intangible capital – speed of obsolescence
	Improved economic efficiency and competitiveness
	Timely access to market information
	New ways of creating and delivering products and services globally thanks to global connectivity
	Business process outsourcing, value chain integration and disintermediation
	Opportunities to exploit low factor costs in international markets
	Changes in household expenditure
	Enabling of solution sharing and business collaboration
	Opportunities to increase social capital
	New opportunities to income generation and poverty reduction
	Unprecedented access to rural finance
	Enhancement of rural productivity, boosted by more and better information
Work	Positive effects on employment creation
	Changes in how people work
	Changes in the places where people work from
	Improved labour market facilitation and direct employment
	New opportunities for skilled labour
	Frictions between education, training, required skills and jobs typology
	Crisis of disconnected, non self-programmable labour
	New experiences in collaborative work
	Gift-economy based work
Education	New educational rules
	Increasing need for long life learning
	New sources of information and training

[37] Table 2 relies on Talero & Gaudette (1996), Analysys (2000), Primo Braga et al. (2000), Accenture et al. (2001), ITU (2006d), The World Bank (2006b), Best & Wade (2007), OECD (2008) and Best & Wade (forthcoming)

	Changes in the role of the expert and the educational system
	Shift towards blended and distance education
	Appearance of new jobs that increase the need to suitableness of education to job market
	Increasing creation of collaborative networks of learning and research
	Increased possibilities of customization of learning experiences
	Low marginal costs of simulation systems to improve learning
	Increasing need of digital literacy in a broadest sense
	Crisis in the engagement of new generations of students
	Increased efficiency and effectiveness of education administration
Socialization Communication	Deep reorganization of the society around networks, enhanced by new communication technologies
	New communication patterns with family and community
	Increase of communications, enhanced by improved and low-cost delivery of messages
	New channels of communication, global, quick
	Speeding up of everyday life
	Revolution of digital identities
	New sources of information and opinion creation, challenging the role of the expert and the formal channels
	Increased creation and exchange of information
	Emergence of citizen journalism
	New media
Health	New patterns to obtain health information
	Changes and shifts in the role of health agents, new health agents
	Deep changes in healthcare
	e-Health, telemedicine: remote consultation, diagnosis and treatment
	Increase of collaboration between health agents
	Revolution in medical research, especially in genomics
	Pervasiveness of information for prevention and epidemic response
	Increased efficiency and effectiveness of health administration
Empowerment Participation Democracy	Emergence of a global information infrastructure to create opinion
	Decentralization of power and empowerment of individuals and institutions
	e-Democracy, e-Voting
	New forms of censorship
	e-Campaigning
	New forms of political participation
	Cyberactivism, hacktivism
	Increase in power accountability and transparency, leading to more democracy
	Online Volunteering
Governance Administration	Increased efficiency and effectiveness of government quality and responsiveness

	Expansion of reach and accessibility of services and public infrastructure
	Increased demand for institutional accountability and transparency
	Opportunities to bypass failing domestic institutions
	Decentralization of processes of decision-making and citizenship empowerment
	Greater access to decision-making
	Rise of social agenda
Law Justice	New realities demanding new regulations
	Slow Law response to quick reality changes
	Appearance of new type of crime, cybercrime
	Fostering of collaboration, data sharing
	Obsolescence of the term jurisdiction and jurisdictional problems to crime and fiscal issues
	The power of code and technology as a regulator
	Changes in the concept of privacy
	Changes in the concept of security
	Surveillance and security-liberties trade off
	Changes in the concept of property, especially in intellectual property rights, copyright and patents
Environment	Rise of environmental agenda due to huge amounts of new information
	Increase of and easier environmental monitoring
	Enhancement of prevention and mitigation measures
	Increase of flexibility and focus of environmental disasters response
	Enabling of citizens as environmental enforcement agents
	Improvement of agriculture and industrial procedures, becoming more efficient
	Reduction of emissions by enabling population decentralization and large-scale telecommuting
	Exponential increase of e-Waste
Culture Leisure Daily Life	Changes in daily life habits: shopping, banking and dealing with government
	Changes in leisure habits
	New forms of entertainment
	Digital, interactive, collective entertainment
	Interactivity across social and cultural boundaries
	Multiculturalism and loss of identity
	New cultural and artistic movements
	Entertainment and culture business models crisis

Table 2: Non-economic impact of ICTs[38]

[38] This table was built relying on: Talero & Gaudette (1996), Donath (1998), Greenwood (1999), Lessig (1999), Analysys (2000), Primo Braga et al. (2000), Castells (2001), Prensky (2001), Wellman (2001), Navas-Sabater et al. (2002), Bimber & Davis (2003), OECD (2003d), Gillmor (2004), Lessig (2004), Pickerill (2004), Siemens (2004), Souter (2004), Cameron (2005), Howard (2005),

If when we spoke about what we presented in Table 1 we warned that some caveats should be taken into account, specially about generalization and the context that accompanied some of the findings and statements we briefly presented there, then the warning is even stronger and broader for Table 2.

If Table 1 could not gather all aspects from the discipline of Economics, it would be absolutely daring to try and collect here in a simple table the findings of *all other* disciplines except Economics. Even if Table 2 represents a good collection of works, their respective authors are but a smallest selection of the total of scholars doing research on the impact of ICTs in everyday life from such different disciplines as Sociology, Psychology, Media and Communication Studies, Political Science, etc.

So, if the list of authors and disciplines is far from being comprehensive – or even representative, one might argue – much less are, hence, the findings, ideas, theories presented in Table 2. As we already said at the beginning of this section2.3, if Economics had hard times trying to be as objective or trying to stick as much as possible to quantitative approaches that would permit social data comparison with economical series, this matter is being way much harder for humanities, where quantitative approaches are but rare and qualitative approaches difficult to carry on – in the case we are dealing with – because of the proximity in time of facts and the often impossibility for the researcher to keep the proper distance from the object of research.

So, Table 2 should be read as a tentative and incomplete collection of scientific trends towards explaining the non-economic impacts of ICTs in some areas, but keeping in mind that:

- Not everything applies
- And not everything can be extrapolated
- As most things depend strongly on the context
- Some of them have been widely tested and could count as evidence
- While some other are just guesses or potential impacts
- It is still too soon to make strong statements
- But there is evidence of changes and, above all, of more changes about to come

Actually, our purpose with this section in general, and particularly with Table 2, is to bridge the impact of ICTs on the Economy – former section – and how can ICTs enhance development – which is the subject of the next section.

Nishimoto & Lal (2005), Prensky (2005), Barnes (2006), Benkler (2006), boyd (2006), Escher et al. (2006), ITU (2006d), Jenkins et al. (2006), UNCTAD (2006d), Atkinson & McKay (2007), Bartel et al. (2007), Cobo (2007), Faris & Villeneuve (2007), Hood & Margetts (2007), Margetts & Dunleavy (2007), OECD (2008)

2.4. ICTs for Development

We have thus far seen that the impact that ICTs are having on the economy and on society in general seems undeniable. There might be debate and lack of consensus about the directions of these impacts and the depths of changes, but not about their existence.

Two corollaries quickly arise after this statement. The first one, as noted, is whether those impacts can be considered a revolution and, hence, a new driver of progress and poverty all over the world, just like what the Industrial Revolution brought in. The second one is whether these forces can be tamed to achieve equality and solve the pressing needs the major part of the population in the World is suffering. In other words, whether ICTs can be used to foster development?

Be it for the former reason, be it for the latter, the concern about the impact of ICTs grew so much during the latter years of the XXth century at the international decision-making level that, at the International Telecommunication Union Plenipotentiary Conference in 1998, it was proposed that a major event, an International Summit under the patronage of the UN Secretary-General, would take place to debate these issues – the World Summit on the Information Society – taking place in two phases: the first one in Geneva, in 2003, and the second one in Tunis, in 2005.

In 2000[39], the United Nations General Assembly agreed[40] the United Nations Millennium Declaration and defined eight development goals – the Millennium Development Goals (MDG) – composed by 18 development targets.

Is this, then, not surprising that almost from the beginning, development and ICTs went hand in hand and set up the agenda for the millennium that had just began. We can find, for instance, the following words in the report *Using ICTs to Achieve Growth and Development* (UNCTAD, 2006d, p.6):

> "Apart from measuring the impact of ICTs on productivity and growth, it is important to consider the impact of ICTs on poverty and inequality. The benefits of the information technology revolution are today unevenly distributed between and within countries (WSIS Declaration of Principles, 2003)[41]. While ICTs can contribute to economic growth and social development at the national level, it should be noted that 'in some cases the poor benefit proportionally less than the non poor'"

Fortunately – even if still today it is a matter of spurious debate – the focus went away from "bread or computers" towards "computers for more bread"; from trade-

[39] We could place the beginning of such a way of thinking after the United Nations Summit that took place in Copenhagen in March 1995: "Following the 1995 United Nations (UN) Copenhagen Summit, social development within the United Nations broadly encompasses four elements: poverty eradication and employment, inter-governmental support service and implementation, socio-economic policy and development management and social integration." (ITU, 2006d, p.70)

[40] On 8 September, 2000, though, as we have said (see supra.) one might suppose that the preparation of the text began some time before.

[41] WSIS Executive Secretariat. (Ed.) (2003)

off to complementarity (Accenture et al., 2001, p.5) and brought into the spotlight a global reflection on the role of ICTs for development. Among others[42], see for instance The World Bank (2003), Boas at al. (2005), Bridges.org (2005), Nishimoto & Lal (2005), UNDP (2005), ITU (2006), United Nations (2006) or Ndukwe et al. (2007). Actually, it was the work of the UN ICT Task Force (2003) that completely unleashed the reflections about ICTs for Development[43] (ICT4D) when the Millennium Development Goals and ICT Matrix was presented during the summit, serving as a starting shot for an increased collaboration to measure the Information Society, its evolution and, above all, its role in development (Simpson, 2004) [44].

We will not reproduce here the MDG/ICT Matrix, but we do want to highlight the subjects that were dealt with in two workshops about ICT4D in 2003 and 2004. These workshops debated around what sustainable development issues could be fostered with the help of ICTs. The report of the two workshops (Tongia et al., 2005) is highly valuable and highlights the following items as having a potentially important role in development:

Infrastructure Development
- Energy
- Water
- Transportation

Basic Human Needs and Development
- Food
- Healthcare
- Drinking water
- Primary education

Economic Growth and Poverty Reduction
- Agriculture growth
- Higher education
- Job creation
- e-Commerce

Alienation, Empowerment, and Governance
- National and International Inclusiveness
- Democracy
- e-Governance

A good thing[45] to see in this list – and, indeed, also in the matrix presented by the UN ICT Task Force – is the appearance of many issues not directly related with economic growth. In Wagner's words (Wagner, 2005), "[c]urrent development thinking posits that to foster sustainable development, [ICT] policies must go beyond

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[42] John Daly (2003), just hours before the WSIS Geneva phase – and completing it at the end of the meeting –, prepared for The World Bank's Development Gateway an interesting document that presented the then state of the situation.

[43] One can argue whether the UN ICT Task Force was really disclosing, at the international and media level, an already existing debate about ICT4D, thus riding a wave more than creating it.

[44] The matrix had been nevertheless previously issued by Marker et al. (2002), though it became widespread popular after its diffusion at the summit.

[45] Good in the sense that the list implies an evolution towards a more comprehensive point of view of ICT4D than preceding ones – see next chapters for a development of this idea.

simple market growth, and provide the human and social infrastructure for economic growth and development in the long term" and he states how MDGs are consonant with development as measured by the Human Development Index and other ways of measuring development different from economic growth. This development can be achieved by directly complementing with ICTs other development activities and projects aimed to poverty reduction, empowering communities so their livelihoods are enhanced, as good as directly attacking systemic barriers that generate poverty at the core of the system (UNCTAD, 2006d).

Both the MDG and ICTs applied to them have received, notwithstanding, some criticism. While Souter (2007) is more general and deals more with Internet governance, his basic arguments are almost the same as Heeks (2005e): namely that the developed countries have left aside the developing ones in the design of the policies… that will apply the development of the latter. Indeed, Heeks goes one step beyond criticising the whole pack because "the "e-Development" agenda has been pressed through the MDG filter, leaving many elements behind", being most of these elements historic lessons of failed projects[46] or due to this "northcentric" point of view of the MDG, forgetting, for instance, the locomotive power of the ICT sector to leapfrog development (Analysys, 2000, p. A18).

At this point, we want to maintain a difficult balance by agreeing with both the MDG/ICT point of view and the criticism stated by, specially, Richard Heeks, and also adding a second criticism. So, the first thing we agree with is that ICTs can have a role in development and, most important, it is not only about economic growth (i.e. GDP growth) but there are plenty of other issues to be taken into account. The second thing is that we find Heeks's arguments absolutely compatible with our former agreement: if one of the main successes of the WSIS was to bring into the spotlight ICT enhanced development and from a non-economic point of view, it is equally valid to qualify as a failure the non-participation of developing countries in the mapping Souter (2007) that led to "southless" designs[47].

Our third argument goes in the line of what is stated at ITU (2006d): "The issue for those wishing to affect positive social changes using ICTs is how best to understand how technology and social forces interact."

In their work, Welzel et al. (2003) describe a development framework that, to our appeal, is very interesting as it goes beyond economic development, overcoming the usual focus on infrastructures and can help to shed some light on what has been lacking, in our opinion, in these last years of Information Society fostering and measuring.

Even if their work has a good "flavour" of Sen's capabilities (1980) and bridges perfectly the traditional development approaches (based in capital, infrastructures)

[46] See Heeks (2002) for an interesting summary of such reasons for failure… and a model proposal on how to solve them.

[47] A quick glance at Simpson (2004) will clearly show the poor representation of developing countries in the composition of the work group.

with empowerment (based in education, information), it is their Political Science point of view that makes their model so appealing.

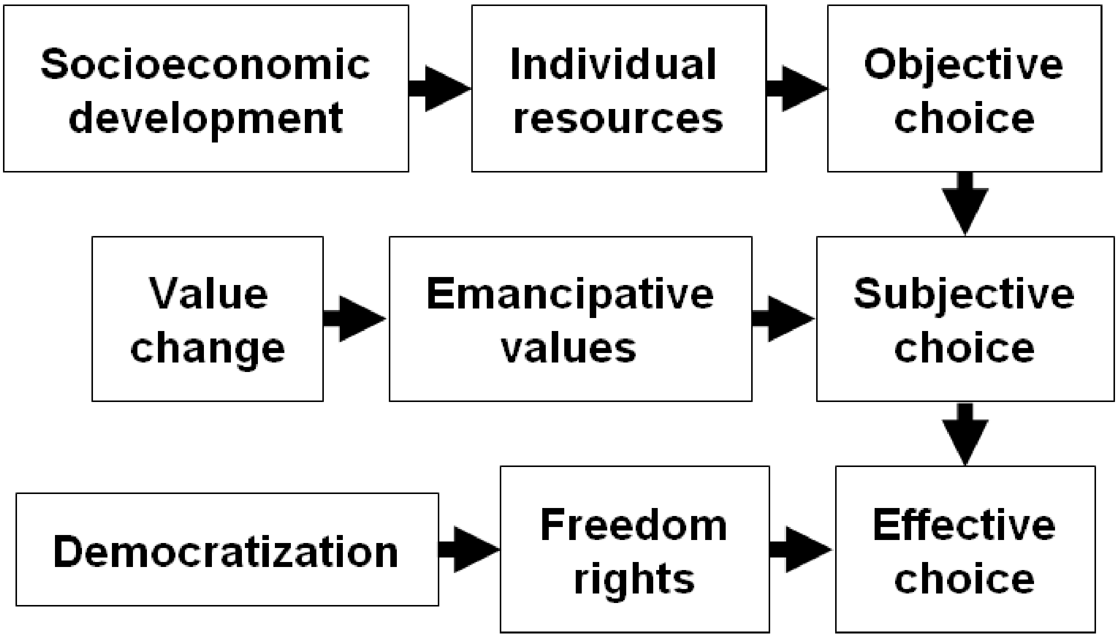

Figure 2: Three major trajectories of societal change
Source: Author, adapted from Welzel et al. (2003)

As we have tried to summarize in Figure 2, their three tier approach is based on the convergence of the three main trends in development studies:

- The first one is socioeconomic development, mainly based in Economy concerns (translated into indicators) plus some others mainly measuring Health or Education. Socioeconomic development ends up measuring the resources the individual actually has, thus enhancing his objective means of choice.
- The second one is value change shifting to emancipative values. In this case, what is enhanced is not the objective but the subjective ability towards human choice.
- The third one is democratization that, if accompanied – as might be expected – by an enhancement of human rights, would actually make possible the objective and subjective power of choice that the two former development trends explained.

We believe that both the second and, above all, the third tier are lacking in most definitions, reports and research about the Information Society, especially when trying to *measure* it. The scheme drawn in Figure 2 is compliant with the proposals of the big agencies gathered around the WSIS but also with the major criticisms at the same time. But, indeed, supplies a usually overridden third layer which goes beyond material and subjective empowerment: the system.

Hence, the concept of "access" will vary depending on what this access is for. And if access is tied to development, then the concept will vary depending on what we understand by development.

3. Access, Lack of Access and Universal Access

3.1. What is Access?

We ended the last chapter with a challenging question. We do not always mean the same things when we talk about the Information Society, so how can we begin to measure it?. Hence, trying to *measure* the impact of ICTs on the society requires a previous definition of what part of the society are we talking about. In other words, we need to clarify what do we understand by (having) access to ICTs, or participating in the Information Society.

An interesting first approach to defining access is provided by Raboy (1995, 1998). His work deals with means of communication, but we think it is worth covering it here given that ICTs, as their own name states, are *communication* technologies. It is probable that this is a rough approach for ICTs, and we will revisit it later in section 3.1.4. In Raboy's work, access to media has two interpretations: one coming from the ability to *receive* a message, and the other from the possibility to *send* a message, i.e. reflecting the viewpoints of the receiver and the sender. Raboy then sets up two models, corresponding to these different actors:

> "In the broadcasting model, emphasis is placed on the active receiver, on free choice, and access refers to the entire range of products on offer. In the telecommunications model, emphasis is on the sender, on the capacity to get one's messages out, and access refers to the means of communication." (Raboy, 1998, p.224)

This distinction is crucial for us, as we believe most analysis, emphasis and work has been put into the transmission rather than the reception of messages. For instance, the International Telecommunication Union has traditionally focused on infrastructure[48]. Even if it couldn't be any other way, given the origins, nature and mission of the International Telecommunication Union, it is also true that this position has evolved over the last few years[49] towards a more comprehensive approach. In the words of Gillwald and Stork (2007, p.15-16):

> "ICT indicators are commonly used in policy development frameworks. The most frequent indicators found are supply side access indicators collected by the ITU. These indicators are usually the most easily

[48] We will be pointing, in the following sections, and especially in chapter 4, to some relevant references to back this statement, but a good starting point are the World Telecommunication Development Reports and World Information Society Reports by the ITU (ITU, 2002; ITU, 2003; ITU, 2006c; ITU, 2006d; ITU, 2007c)

[49] See, for instance, UNCTAD (2007), to which the ITU has strongly contributed, or ITU (2007c), two reports where the ICT Opportunity Index is presented and represents a significant evolution in the traditional way the Information Society had been measured since.

> obtainable, which explains their preponderance in ICT measurement literature."

This– as we said, completely understandable – bias of the ITU can be exemplified, for instance, in the 2003 edition of the World Telecommunication Development Report (ITU, 2003):

> "Until recently, infrastructure had been considered as the main obstacle to improving access to ICTs. Existing indicators are therefore often infrastructure-based, measuring such variables as the number of main telephone lines, and typically use telecommunication operators' data. But there is growing evidence that other factors, such as affordability and knowledge, are an important part of the access picture."

As we can see, even if there is already some degree of awareness on the limitations of strictly measuring the existence of infrastructures, the proposed evolution is, still, bound to them: affordability and knowledge – *viz.* capacity or literacy – are, in our opinion, mainly still a part of the "physical" access to infrastructures, be it a financial barrier – affordability – or a matter of personal barriers to these infrastructures – capacity or digital literacy. This is also the case of Alampay (2006), Stern et al. (2006) or Kenny and Keremane (2007)[50], or even such a recent work as OECD's (2008a) *Global Opportunities for Internet Access Developments*, where access is also considered to be largely a matter of infrastructure.

It is important to see that, even if some authors try to bring shades to the crude conception of access as being able to make a phone call or send an email, they rarely escape from a general concept of access to infrastructure. For instance, DiMaggio et al. (2004) add to infrastructure the concept of connectivity and access to the Internet, and Gillwald (2005) and Gillwald and Stork (2007) begin to slightly consider use as a relevant part of access, but, nevertheless, their approach still remains in the realms of infrastructures, as happens with Mueller (1999), which also focuses on the Internet and only cautiously enters into the field of ICT applications.

As Clement and Share (1998) put it (emphasis added):

> "Access only enables further activities that can only partially be specified beforehand. There are three main questions to address: 1) Access for what purposes?; 2.)Access for whom?; and 3) Access to what? […] Most models of information infrastructure emphasize the purely technical aspects, notably physical connectivity. In order to define more fully what access to the information infrastructure encompasses, and to account for the intricate interplay of its social and technical aspects, a *broader model highlighting multiple dimensions of access needs to be delineated*".

This is, precisely, the path we are taking and that will lead most of this work: the need to consider Information and Communication Technologies (ICTs) not as something good in themselves, but as tools used in a very complex system of intrinsic

[50] Though it is important to point out that this work is about the concept of *universal* access, and not access itself, even if with some caveats, our reflection still applies.

relationships that cover most aspects of life. And hence, a corresponding effort should be made when measuring their impact.

So, it is in this field, the field of ICT applications, that we see an evolution towards a broader understanding of access. It is especially enlightening in this regard to see OECD's work on user generated content (2008c), where access without use, and even contribution, is increasingly seen as just a part of the picture, being the evolution of ICTs this where the user can actively interact and produce in a digital framework. Of course, this is approaching the upper limit of ICT use, but other authors as Tambini (2000) – perhaps due to their focus on citizenship, participation and activism – go beyond infrastructure to point out that how and how much ICTs are used is also relevant. We can see examples of this in UNPAN (2004), where e-Government is the use, or service, used to highlight this point, or Compaine & Weinraub (1997) when they declare that universal access implies "[a]ccess to advanced services: Access to advanced telecommunications and information services should be provided in all regions of the Nation", making clear that is not only a matter of infrastructure, but what comes through it.

It is then interesting to see what Katz et al. (2001) add to use – and the barriers to use –: the motivations to use or, in other words, "usefulness":

> "As to access, i.e., the "digital divide," we explored both usage and awareness, Internet "dropouts", and motivations. […] The first fundamental concern is access, including who has/does not have access to the Internet; what motivates people to use the Internet; what barriers there are to usage; and what characterizes those who stop using the Internet".

And, closely related to use of ICTs, the necessary derivative must be their role as communication tools "to articulate […] interests and push for social change" (Rahim, 2005, p.19) and the raw material of the Information Society, as we already exposed: knowledge (Navas-Sabater et al., 2002).

Summing up, Bridges.org (2002) list "real access criteria" as:

- Physical access to technology
- Appropriateness of technology
- Affordability of technology and technology use
- Human capacity and training
- Locally relevant content, applications, and services
- Integration into daily routines
- Socio-cultural factors
- Trust in technology
- Local economic environment
- Macro-economic environment
- Legal and regulatory framework
- Political will and public support

That, in our opinion, in one of the most completes definitions of access to the Information Society so far. The important point to notice here is the evolution from a concept strictly based on access to infrastructure to another where important but sometimes forgiven aspects like human capacity and training, or the legal and regulatory framework come into the spotlight, along with more ethereal concepts like trust in technology and political will and public support.

As we will be seeing in second part of this work, the Telecommunications Model can be easily identified with the approach based on infrastructure. As we have already shown in talking about ITU and the ICT Opportunity Index, it is difficult to find an approach that is strictly using only 100% infrastructure indicators or concepts, so the definition is, by no means, an exclusive or "pure" one.

On the other hand, the Broadcasting Model can be identified too as an evolved approach that tries to add to the measurement toolkit other socioeconomic aspects, mostly capacity, intensity of use and other indicators not necessarily belonging to the digital economy, but to the disciplines of growth and education.

3.1.1. The Telecommunications Model

Having among its most prominent proponents ITU, United Nations Conference on Trade and Development (UNCTAD) and the Organisation for Economic Co-operation and Development (OECD), the Telecommunications Model applied to measuring Information and Communication Technologies usually focuses on hardware and connectivity[51]. Most common indicators are, thus, the proportion of people with access to a fixed line telephone, the population covered by mobile cellular telephony, the proportion of people with access to a computer, subscription to fixed and mobile lines, subscription to Internet access and its quality, etc[52].

Among the main advantages of the Telecommunication Model, two are the strongest.

The first one is objectiveness. Even if choosing an indicator for a determinate variable might not be easy and even quite tricky[53], the fact that networks are somehow a tangible variable makes them easier to quantify. We do not mean to say that they are perfect, but they are much more objective than other variables to be measured such as digital literacy, government leadership or the availability of relevant digital content.

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[51] We will enter in full detail during the whole Part II.

[52] See sup.

[53] Let us put a couple of examples of this. The first one would deal about how to measure, for instance, the number of people that can do a phone call: while some might use the number of subscriptions to telephone lines, others might prefer the number of people covered by fixed telephone, using, for instance, as a definition for coverage a household. A second example is not about how to measure but about defining the measure itself: broadband is the perfect example of a definition that varies along time and, hence, needs updating as years go by. But, even if updated, comparison between different times of measure might not be direct or even valid.

The second advantage, and in part a consequence of the former, in part as a consequence of having been, historically, the most – if not the only – developed one, is the relatively easy availability of data and its richness. Without any shade of doubt, the dataset that ITU gathers directly from ministries, statistical agencies and network operators from all over the world has no rival so far. The reason, of course, is that it is mainly based in quantitative data and the legitimate position that the ITU (and OECD for a more limited range of countries) plays in the international arena.

The main disadvantage is, of course, the limited reach of the instruments used, as they measure, in our opinion, only a small part of what we consider the Information Society is, as demonstrated in section 2.3.

From our point of view – and following the purpose of this work – the main consequences of this advantages and disadvantages are twofold and can be pictured in Figure 2:

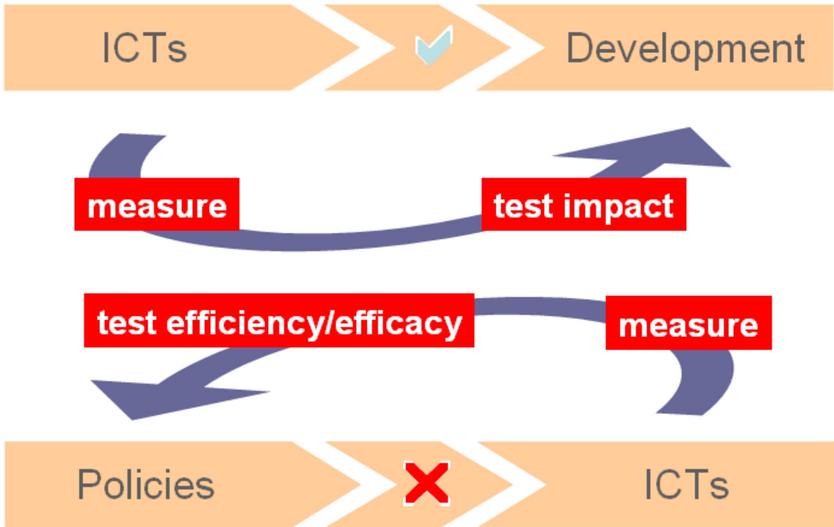

Figure 3: Pros and cons of the Telecommunications Model

On the one hand, and as we previously saw, the relationship between ICTs – and remember we are only dealing now here with infrastructure – and Development can be measured, if not in a straightforward way, then nevertheless with a degree of confidence. In other words: if the indicators state, for example, that infrastructure has doubled in one year, we can draw a regression and see whether this is correlated with the measured growth of the economy or the changes in labour productivity, to give just two examples. At the limit, causality could also be estimated by following the same reasoning – this is, exactly, what many economists have been trying to do during the last decades.

Of course, we would be leaving aside many other aspects of the Information Society that might affect the economy, like the degree of competition in the ICT Sector, or, as we have already said, the level of digital literacy of the workforce. But this should not affect being able to find a more or less accurate relationship between e.g. the number of home computers connected to the Internet and labour productivity.

On the other hand, what we believe cannot be tested is the impact of policies to foster the Information Society. As long as we take this Information Society in a comprehensive way, the impact of many strategies would remain unmeasured under a Telecommunication Model approach. If we take one of the former examples, an effort to increase the market competition levels in the provision of Internet access is not likely to be reflected in indices built from indicators that measure variables belonging only to the infrastructure category.

Indeed, and as Lenhart (2000), Compaine (2001), Parks Associates (2007) have found to their astonishment, there is a non-marginal amount of citizens in developed countries that are not connected to the Internet and the reasons are neither related with physical possibility of access nor affordability: even if they have reach to the networks, they do not use them because they find them useful. In this example, almost *any* policy to increase the adoption of ICTs from this part of the population will never get reflected in statistics or only slightly if that Telecommunications Model is enriched with variables about use.

3.1.2. The Conduit and Literacy Models

The Telecommunications Model, called the *device model* by Mark Warschauer (2002), is criticized for having a conception of access "as defined in terms of physical access to a computer or any other ICT device" which "does not in itself constitute complete access because full ICT access in current times also requires connection to the Internet as well as the skills and understanding to use the computer and the Internet in socially valued ways" (Warschauer, 2003b). In Warschauer's opinion, which we share, besides access, or *ownership*, there is a double need to maintain what was purchased, acquired or physically accessed. On the one hand, there is the physical maintenance of the equipment, which does not only relates to parts and replacements, but also everything that is intangible and is also part of access to ICTs: power supply, a telephone or broadband subscription, etc.

The shift from the Telecommunications Model to the Conduit Model (which would be an enhancement of the former) is part of what we could consider the change of philosophy that implies shifting from a concept of *access as ownership* towards *access as use*. It is precisely the costs of the *conduits* that cause innovative, non-ownership centred models of access to ICTs to flourish. This is most prominent in developing countries, but also in developed ones where poor districts in big urban areas or thinly-spread rural inhabitants could not afford highest costs of maintenance. This is the case of telecenters (Heeks, 2005i), libraries (Mphidi, H., 2004) or phone kiosks (Keogh & Wood, 2005).

The problem has been, fortunately, detected and we can state that, on the one hand, affordability – in the broad sense of including not only ownership but also maintenance of conduits – has progressively been dealt with and included in some indices, as was, for instance, the case for the World Economic Forum in its Networked Readiness Index, which includes now e.g. the lowest cost of broadband.

On the other hand, ways of measuring access as use and not as ownership are widely taken into account by major indices and assessments, that not only count e.g. number of households with subscriptions to fixed telephone lines, but also e.g. population covered by telephones[54].

But, as Warschauer (2002, 2003b) reminds, there is much more than infrastructures, electricity or connectivity: there is also the individual's capacity and ability to use their infrastructure for one's own purposes and benefit.

As we pointed out in previous sections, many issues related to economic and social development closely depend on the capacity of the individual to appropriate and productively use ICTs, as might be the case of the labour market and labour productivity, personal socialization and so.

On the other hand, as has been discussed (Peña-López, 2007a; Peña-López, 2007b) in an analysis to the conclusions of Ben Compaine's "Declare the War Won" (2001), considering access not only as infrastructure, and extending to affordability, but also as the ability to use networks, can have strong consequences in policy-making and the design that strategies – e.g. in the form of subsidies to access the Information Society – can have, depending on the model chosen.

One of these examples, debated in recent years, is Nicholas Negroponte's One Laptop per Child Project (OLPC)[55] and its goal to promote development and universal education in poor communities by means of low-cost laptops given for free to children. The debate, we say, again and again has been whether technology, by itself, would bring such benefits, and was therefore a goal in its own right, or, on the other hand, if it should be accompanied by other complementary measures and, if so, whether that was the case for the OLPC[56].

Of course, defining digital literacy is not an easy thing to do; the literature the discussion generates is enormous and, all in all, is beyond the scope of this work. We will just summarize here, based on some selected works (Larsson, 2000; Marquès Graells, 2000; Marquès Graells, 2002; Generalitat de Catalunya, 2003; Peña-López, 2006; Horton, 2008), four points we think are crucial to understand digital literacy as a growing set of competencies:

- Technological literacy, to be able to use the ICT tools;
- Information literacy, to be able to work with the information stored and retrieved by means of the tools;
- Digital presence and networking, to be present on the net and network with your peers;
- Media literacy, to be able to understand and create complex outputs made of multimedia digital information.

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[54] See the following chapters for more details on examples of what indices include such indicators.
[55] Also called the low-cost laptop or, more popular, the $100 laptop.
[56] For a very brief introduction, please see Peña-López (2008)

- e-Awareness, to be aware of the socioeconomic and philosophical implications of an Information and Networked Society

3.1.3. The Broadcasting Model

The three models briefly presented so far – Telecommunications, Conduits and Literacy – are, in this sequence, an evolution to a wider way of understanding what the Information Society is. As we have said, the Telecommunications and Conduits models could perfectly be grouped under a broader Telecommunications Model, and explain the physical possibilities to send a message. But the content of the message itself is not dealt with. Acting as a bridge, the Literacy model, centred on the user, can also be read as a "physical" barrier, to take into account or overcome, to be able to send the message (as part of the channel or the code), but also acts as a first cautious approach towards content and services.

With the Literacy Model being the hinge, the Broadcasting Model might be placed as the polar opposite to the Telecommunications Model. Not only, as we have described, by focusing on the receiver rather than the sender, but, due to this, in trying to establish a comprehensive and complete approach and introducing a framework in which content and services – the users' range of choice – are well-placed. For instance, the World Economic Forum's Networked Readiness Index and The Economist Intelligence Unit's e-Readiness Rankings are the two of the most important of the published indices. They include indicators from a broad range of categories, way beyond the field of infrastructure. It is difficult to briefly describe what these indicators look like[57], as the variability is huge and depends on the philosophy the index or the assessment was created with, and the purpose it was created for. In any case, we can divide them in two groups. In one group are indicators closely related with the Information Society: e-Government readiness index, quality of competition in the ISP sector or laws relating to ICT. In the other group are indicators from the "analogue" economic and social environment: tertiary enrolment, freedom of press or the extent and effect of taxation. It must be pointed out that, as we move aware from the "hard data" associated with infrastructure to the "soft" data associated with applications, we are also moving from objective to subjective measurement. Both the WEF and the Economist come from the liberal, market economy side of the spectrum, and this is indicated in the selection of indicators and the way they are measured.

Of course, we are not saying that these latter indicators have no relationship with the Information Society. Actually, the Broadcasting Model is often referred to as the "e-Readiness approach"[58]. A difficult concept, e-Readiness can be defined as the "ability or "readiness" to integrate and utilize information technology and e-commerce into its economy or society" (Bridges.org, 2001, p.41) or, more generally, as "the ability for a region to benefit from information and communications technology" (Bridges.org, 2002). So, what the Broadcasting Model does by means of e-Readiness indices is opening as much as possible the range of indicators that

[57] We will treat this issue in depth in Part II.
[58] And this is how we will be naming it from now on.

might give a key to, according to the definition, how "e-ready" is a particular economy. Hence the inclusion of indicators on the state of the Economy or the level of Education.

The pros and cons are, in this case, more difficult to draw, as the designs are many and much more varied. But, following the same rationale that we used in the previous section for the Telecommunications Model, we can at least describe both one strength and one weakness of the e-Readiness Model, as seen in Figure 4:

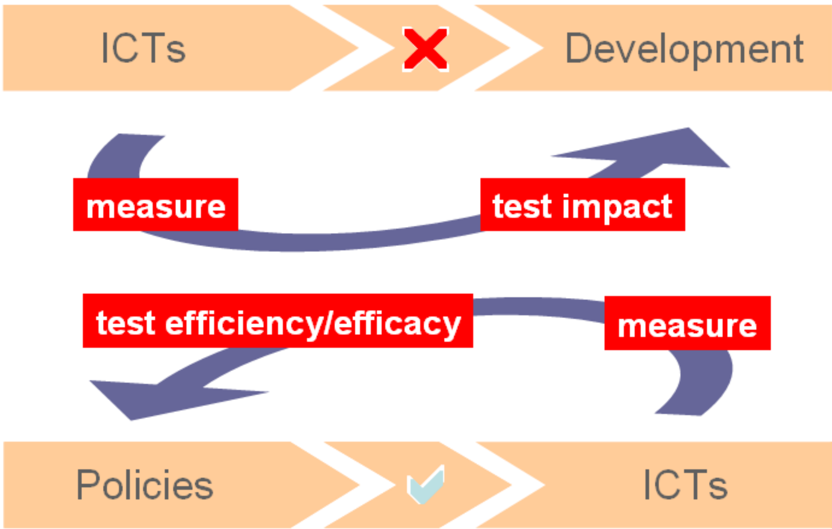

Figure 4: Pros and cons of the Broadcasting Model

Contrary to the case of the Telecommunications Model, the strength here lies in assessing policies, strategies, projects addressing the digital divide or fostering the Information Society in general. As the approach of the Broadcasting Model is more comprehensive and (almost) all aspects of the socioeconomic framework are considered and taken into account, it is most likely that, in one way or another, we might be collecting if not all then most impacts of any kind of policies. Most indices, as we will be seeing in Part II, start from infrastructure and encompass digital content and services, paying attention too to the ICT Sector, the regulatory framework or the capacity of enterprises, governments or citizens as individuals. As examples, the previous questions could be tracked by using high-tech exports, laws relating to ICT, quality of competition in the ISP sector, Internet access in schools or Internet users in general, secure Internet servers or e-participation index.

On the other hand, the quite easy and straightforward ability to draw relationships between ICTs and Development is now broken due to the addition of "analogue noise" to the range of digital indicators. For instance, efforts in providing greater broadband quality at greater affordability levels could be jeopardized, when aggregated into an index, by non-digital or analogue indicators such as a fall in the tertiary enrolment level, the quality of management schools, the in-company expenditure on R&D or the fiscal policy of a government that, in some cases, might even depend on external economic factors.

Take, for instance, an economy – as is the case of Spain – with strong dependence on imported fossil fuels, and having as a policy to foster local agriculture, subsidising oil for agricultural or professional and collective transportation uses. Examples are many, especially in customized assessments, where many other analogue indicators are included to framework the whole report. See, in this line, Peppers & Rogers Group (2006), that includes aspects like the GDP or oil prices. Even if we agree that these indicators are well placed in this kind of analysis, it does not help in investigating the performance of *just* the digital economy or digital initiatives of the country. As a last example, the UN Economic And Social Commission For Western Asia (2005) proposes the use, as a core ICT indicator for the Western Asia region, of the "total resident population" and the "total number of households". Of course, variations in these indicators can arise from many different sources and be notable in countries of Sub-Saharan Africa, with ongoing population convulsions. And all this, even if the strategy towards Information Society remained unchanged.

Even absolutely logical relative measures like the "percentage of ICT investment and expenditure (as a percentage vis-à-vis GDP and general Government expenditure)" have to be interpreted very carefully if the GDP can suffer sudden shifts or, more probably, if general government expenditure is not stable over time, especially when radical ideological changes take place in the design of economic policies.

3.1.4. Challenging the concept: access in the age of personal broadcasting

We have been talking so far about the traditional communication structure based in a sender that emits a message to a receiver. But the coming of the Web 2.0 might have changed the whole landscape. The Web 2.0 is both understood as a philosophy, a technology, and none of them at all (O'Reilly, 2005; Córcoles, 2006; Madden & Fox, 2006). Put short[59], the Web 2.0 would be a willingness to contribution and self-expression that, powered by easy and mostly free to use web-based technologies and open access[60] licenses[61], would blur the difference between the sender and the receiver, between the producer and the consumer.
Thus, blogs (Lenhart & Fox, 2006), wikis (Rainie & Tancer, 2007) or social bookmarking and tagging (Rainie, 2007), among other tools, might be transforming how people approach digital content, becoming, in a sequence of actions or simultaneously, both producers – or professionals – and consumers. The sender/receiver couple would then merge it what has been called the *prosumer* (Tapscott & Williams, 2006; Atkinson & McKay, 2007; Ghosh, 2007): somebody that is *pro*ducer and con*sumer* at the same time. Or, in our case, an individual that can act as the traditional receiver or, instead, broadcast his own content then becoming a sender.

This hatching and rapid growth of personal broadcasting, or *selfcasting*, has deeply affected how we used to understand communication and, hence, several fields where communication played an important role.

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[59] Please see the previous references for a general overview of the phenomenon, and all the references in this section for some more details and deep analysis about the most important parts of it.
[60] See, for instance, Suber (2005) for an introduction to the Open Access paradigm
[61] For an overview on Open Access licenses please see Liang (2004) or Chen (2004)

First of all, communication itself, shifting from one-to-one or one-to-many broadcasts to many-to-many or multipoint broadcasting. It is true that this was already possible with, for instance, personal radio transmitters, but the scope and, most important, reach of actual possibilities to send one's message out by means of Web 2.0 applications are beyond comparison with previous technologies.

Closely linked to the fact of being able to send one's message out is the amount of messages itself. As it has been evidenced (Lenhart. & Madden, 2005; OECD, 2007e) there is now much more content – and growing – generated neither by institutions or firms, but by individuals. And many of these individuals are teens or even kids (Lenhart & Madden, 2005), not only because they are used to technologies they see not as "new" but as a normal thing (Prensky, 2001), but because content and self-expression have increasingly become the currency to interact with their peers (Lenhart & Madden, 2007).

Which leads us to another transformation: schools and the educational system as a whole. On one hand, and speaking about communication (between the teacher and the student, among students) the possibilities of Web 2.0 technologies that – willingly or by the force – introduce changes in the design of the system and of teaching (Cobo Romaní & Pardo Kuklinski, 2007). On the other hand, and following the line of content, how personal broadcasting can boost self-publishing (or, at least, self-diffusion) of one's educational resources for teaching purposes (Albright, 2006; OECD, 2007; Atkins, Brown, & Hammond, 2007), thus questioning the scarcity of knowledge model that has historically been used as a pillar to sustain i.e. the University.

Last, but not least, it can deeply transform the relationship between enterprises and their costumers or between employers and their employees (Levine et al., 1999; Fumero & Roca, 2007).

In what relates to this work, we want to highlight four critical changes which, according to the experts (Fox, Anderson & Rainie, 2005; Anderson & Rainie, 2006; OECD, 2008) will be redefining some axial concepts we are dealing with here.

The first one is about access itself. In a landscape where there is no clear differentiation between the sender and the receiver, or what becomes more important – being able to send one's message out or being able to receive content – the definition of access is challenged itself and, with it, the matter of measuring access becomes even more difficult than it was.

Second, the change of roles is not the only factor that challenges the definition of access. Web 2.0 applications and philosophy are based in content: content creation – increasingly done online – and content diffusion. The more content is shared online, and the heavier is this content, the more connectivity quality matters, thus making compulsory to rethink what is understood by effective access to the Internet or by broadband. And the more activity takes place in online platforms instead of desktops and laptops, the more the previous point about connectivity is reinforced but, consequently, the more again the need to rethink what is power in terms of capacity of computers, more required to access the internet, less required to perform tasks that now are transferred to remote servers.

Third one is that digital literacy, in the broadest sense possible, becomes crucial. It is no more a matter of being able to boot a computer, use some desktop applications and browse the Internet. Informational and media literacy have to be mastered in a world where information grows by orders of magnitude and where, sooner or later, the audience will be required to be a creator too.

And fourth, the highest level of digital literacy, e-Awareness or strategic digital literacy, is also a must to understand the implications of content creation and publishing in sensible fields like intellectual property rights, the freedom of speech, the right to privacy or security.

We believe that these four axes – access for *prosuming*, changes in the definition of computer power and connectivity quality, digital literacy and digital rights – do challenge the way we understand the Information Society and, by construction, how we measure it. And this will be one of the focal points of reflection in the following pages.

3.2. The Digital Divide

The definition and the concept itself of what is the *digital divide* is a tricky one. Indeed, it is an unsolved question in an open debate that sometimes gets heated: depending on what we understand by the digital divide, how we measure it and whether there is or not a need to close it, policies, strategies and, most important, budget allocation can widely change, hence the need to reach a consensus and how delicate, passionate and even interested the question can become.

Put short, the digital divide is the negation of the Information Society.

How this negation has been captured and applied to reality has changed along the years, as it has happened with the understanding of access; but being the former a broader and holistic concept, as it includes both the actual fact of accessing and the opportunities that come with it, in the sense of being part of a networked society within an informational paradigm.

Our goals in this section are as follows:

- Briefly picture the main definitions of the digital divide
- List some manifestations and impacts of the digital divide
- List some “analogue economy” causes and consequences – sometimes interchangeably in a vicious circle – of the digital divide
- Develop a critique on how the main approaches to measure the state of evolution of the Information Society – the Telecommunication and the Broadcasting models – not always gather all these aspects and shadows

It is challenging to leap back in time and refer to some US National Telecommunications and Information Administration (NTIA) reports (see, for instance, 1999 and 2002) that clearly popularized the term. For a general "history" of the digital divide, Sartori (2006) and Vicente Cuervo (2007) both provide good introductions to the subject.

Arguably, Mark Warschauer (2002, 2003a, 2003b) was one of the first scholars to methodically advocate for an evolution of the term and so include (lack of) competences, capabilities (i.e. digital literacy) as a key factor for the digital divide. In our opinion, Paul DiMaggio and Eszter Hargittai (2001; DiMaggio et al., 2004) deserve credit for bringing under the spotlight the *inequalities* – causes and consequences – related to the digital divide as access and use, thus dealing with the subject in a quite comprehensive way.

A thorough critique of the term, while revisiting the most important milestones in the making of the concept can be read at the interesting review that Gunkel (2003) does of it, a critique that even if contemporary to Warschauer, DiMaggio and Hargittai's works, is in many ways sharper and, in some sense, more modern or farsighted.

William Tibben (2007) has a recent work that, even if it has some resemblances to some parts Sartori (2006) and Vicente Cuervo (2007), it brings on the table the question of social networks and knowledge management, which makes it a very contemporary approach to the actual debate of how people are appropriating ICTs.

3.2.1. Definitions

One of the first, simplest[62], and yet still used definition of the digital divide can be put as "the gap between the Internet haves and have-nots" (Walsh et al., 2001). It relates to the fact of actual possession of technology, of ICTs, mainly a computer or, in more general terms, a TV set or a telephone line[63]. It is what we usually find, for instance, when reading the NTIA reports.

This narrowest definition, nevertheless, has usually been deprecated towards a more widely accepted one, which not only means physical ownership of the devices, but the possibility to access a certain technology to use it, being then "the term 'digital divide' […] used to describe situations in which there is a marked gap in access to or use of ICT devices" (Campbell, 2001, p.119) as it is used, for instance, in Alampay (2006) or Primo Braga et al. (2000) – of course, we understand both devices and them being connected to the network (Loader and Keeble, 2004). It is worth noting that this possibility of access, while being an evolution towards comprehensiveness, it implies accepting a first subjectivity or, in other words, a loss in the accuracy of measurements: while owned TV sets is quite a subjective, easy to check measure, a potential access to technologies is not. For instance, the Partnership on Measuring ICT for Development defines (2006) the percentage of population covered by mobile cellular telephony – one of its Core ICT Indicators – as "the percentage of a

[62] NOTE: no value judgement intended.

[63] The generous reader will excuse we stating, for the benefit of clarity, that a "telephone line" can actually be "possessed".

country's inhabitants that live within areas served by a mobile cellular signal, irrespective of whether or not they choose to use it". Similarly happens when measuring households with a telephone line or a computer and measuring the individuals that have access to it by estimating the number of members in a family or household.

Hence, a first lesson learned is that the more comprehensiveness, the more difficult to measure, a trend we will see repeating on and on along the next pages.

Digital Literacy and Effective Use

In a sequential or logical linear progression, the next thing to be taken into account, after access, is use. And this use can be analyzed twofold: how and what for. In Mark Warschauer's words (2003a, p.44)

> The concept of a "digital divide" separating those with access to computers and communications technology from those without is simplistic and can lead to well-meaning but incomplete attempts at a solution based on merely adding technology to a given circumstance.

Or, in other words, on one hand we need to look at digital literacy, at overall computer technology skills (Carvin, 2001). On the other hand it is interesting to keep an eye on what the user is doing with his infrastructures and skills, the effective use, as "the key issue is not unequal access to computers but rather the unequal ways that computers are used" (Warschauer, 2003a, p.47). This is, as we will be seeing in the next pages, a crucial aspect and origin – and also consequence, to be true – of inequalities and social exclusion.

Concerning skills, Hargittai (2002) considers them the second-level digital divide, being the first one, as we have already explained, access to technologies and devices and connectivity – to infrastructures.

But it is not only having specific skills, but being able to use them *effectively* (Foley, 2002).

In section 3.1.2 we talked about the different shapes that digital literacy or digital skills could have. We then related four main categories – technological literacy, information literacy, media literacy and e-awareness – that could roughly categorize the complexity of human skills in the digital arena.

Some authors already consider media literacy (Prensky, 2001 and 2005; Gillmor, 2004; Kerckhove, 2005) and e-awareness[64] (Levine et al., 1999; Teten & Allen, 2005; Fumero & Roca, 2007) as the most important digital divides in terms of skills and literacy, because of their huge impact: it affects – not only, but above all – long established policy-makers and decision-takers, so their multiplier effect impacts on practically the whole population, especially on the productive economy. So, even if

[64] Even if they do not use this same word, the concept still applies.

we will go back to this question later, we just want to state here that the *effective* use of ICTs might be crucial – and so is stated by some authors – way beyond the existence of infrastructures to have access to.

Besides these two aspects of digital literacy – which we could tag as high-level digital literacies – we usually find the other two – technological and information literacy – that are more usually mentioned than the former two. The reason being is quite simple: they come before in the curve of apprenticeship and, indeed, they have a closer relationship with infrastructures and their direct use.

The evolution of the normal transition from access to infrastructures towards use, by means of basic digital literacy is well explained in Becta (2001), that perfectly links the role of technologies and skills, as Becta is, itself, an educational organization working in the field of ICTs, instructional technology and e-learning. They define the term 'digital divide' as "the broadest level to refer to the gap between those individuals and communities who own, access, and effectively use information and communication technologies (ICT) and those who do not".

It is precisely this "differential modes of use" (Barzilai-Nahon et al., 2004) that has put a red flag on our understanding of the digital divide, as it has been found that these different uses are often more related to the causes for inequality – and not only digital inequality – than infrastructures alone (Barzilai-Nahon, 2006), thus forcing a shift from infrastructural access towards more comprehensive approaches.

In this train of thought, DiMaggio and Hargittai (2001) picture and focus in the differences in access due not only between those who can access and those who cannot, but amongst the many different ways this access takes place, by considering such different factors as "digital inequality in equipment, autonomy, skill, support, and scope of use" and how is this then translated in inequalities that impact the real economy or welfare of these people[65]. As DiMaggio et al. (2004) put it, "access" became a synonym for use, conflating opportunity and choice".

We can sum up what we have explained so far by citing Fink and Kenny (2003, 16) when they list the four interpretations of the digital divide that they have found in the literature:

(1) a gap in access to use of ICTs – crudely measured by the number and spread of telephones or web-enabled computers, for instance
(2) a gap in the ability to use ICTs – measured by the skills base and the presence of numerous complementary assets
(3) a gap in actual use – the minutes of telecommunications for various purposes, the number and time online of users, the number of internet hosts and the level of electronic commerce
(4) a gap in the impact of use – measured by financial and economic returns

[65] For an interesting review of this transition from the consideration of the digital divide as infrastructures ownership and then access, towards use, please refer to DiMaggio et al. (2004).

Opportunity

We believe that these four interpretations are perfectly included and integrated in the model developed by George Sciadas (2002a, 2002b, 2003, 2004a, 2004b, 2005) that ended up in a major change in the strategy of the International Telecommunication Union (2007a). Even if we will deal with this way of measuring in chapter 7, we will here schematically point its philosophy. Sciadas acknowledges what we could call two kinds of capacities: technical (ICT infrastructure) and "human" (ICT skills), the combination of the two being what he calls *Infodensity*. On the other hand, in the field of consumption, he would be considering also two aspects: ICT intensity of use and ICT uptake, that would conform *Infouse*. The sum of these four factors would give an approach towards *ICT Opportunity*, which, as we have seen, would be a way of gathering from infrastructures to use and the inequalities – or opportunities, if read in positive – of ICT adoption.

We believe that this last holistic approach is a better one than the ones performed "through atomic, monotopical lenses" (Barzilai-Nahon, 2006) that only focused in smallest and tiny parts of the digital divide – i.e. infrastructures – even if, as we have said, it might be – because of its strictly quantitative focus – a more objective measurement. Thus, we are able to define now the digital divide "not only by inequality in access to technology but also unequal access to opportunities to participate in the ownership and management of these vital companies" so necessary for social engagement and participation, socialization, etc. (Kennard, 1999).

Before the last words of this section, we want to send the reader to Bridges.org's *Spanning The Digital Divide. Understanding And Tackling The Issues* (2001) as a good trip inside the history of the different conceptions – and their evolution – of the digital divide.

We want to end, now, this section with some reflections by María F. Trujillo Mendoza that we fully share and converge with some main axis of this work. In *The Global Digital Divide: Exploring the Relation Between Core National Computing and National Capacity and Progress in Human Development over the Last Decade* (2001) she defines two different categories from which researchers, policy-makers and the media in general approach the phenomenon of the digital divide: the *instrumentalist* approach and the *structuralist* approach.

> The "instrumentalist" approach considers digital information and communication technologies as a powerful instrument with the ability to act as a catalyst to "desirable" change in the structure of society. Another distinct type of work comes from a "structuralist" view in which the structure of the social actions, attitudes, and processes determine the use, or non-use of information technology within a society.[66]

The differences could not be deeper: while the former focuses on development, on evolution, the latter focuses on social *change*. Taken the impact of ICTs in positive,

[66] Trujillo Mendoza (2001, 31)

the instrumentalist approach speaks of "leapfrogging"[67] development while the structuralist of changes in the social structures. Taken in negative – lack of access or uneven distribution of access –, the results will be poverty or strengthening of prevailing power structures (Trujillo Mendoza, 2001)

In our opinion, the instrumentalist approach can be mirrored with the Telecommunication Model explained o far. But the structuralist approach goes beyond the Broadcasting Model, that would lay in between the other two. Even if Trujillo Mendoza cites authors to back the two approaches, the truth is that this exercise cannot be replicated in the field of the *measurement* of the digital divide. As it happened with sections 2.2 and 2.3, the "tangible" part of the Information Society is pretty well known, while the qualitative, the most "social" part of it is not.

We will leave the debate here for now, but not before putting some questions:

- Where is the legal framework? Does it have any impact in how ICTs are accessed and by whom? The lack of a regulation framework to wrap the ICT Sector and activities in, can it be considered a digital divide?
- And what happens with the ICT Sector itself? Is it necessary for a community to fully enter the Information Society? Is it OK to depend on foreign firm to have hardware, software or connectivity provides?
- And what about digital content[68]? Is it a part of access to the Information Society? Or a part of use?

3.2.2. A critique to the Telecommunications Model approach and the *have nots*

We have already described – in general terms, and will go back into detail in chapter 5 – what is the philosophy behind the Telecommunications Model. Mainly focused towards infrastructures, its conception of ICT adoption, the state of evolution of the Information Society and, hence, the digital divide, implies creating measuring instruments that mainly, and almost exclusively, look at indicators related to hardware, software and connectivity[69].

Some critical opinions (Luyt, 2004) have been raised to claim that "that the gap between ICT access in the developed and developing countries is now on the agenda [reflecting] a particular convergence of interests and their ability to collectively set the political agenda in such a way that the digital divide is now seen

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[67] For an introduction to the concept of *leapfrogging* please see learning materials by Barbara Fillip (2004): *ICT4D - Information and Communication Technologies for Development*

[68] Carvin (2001) slightly steps in this arena, and Open Educational Resources (see, for instance: Albright, 2006; Atkins et al., 2007; OECD, 2007) are increasingly referred as a means towards knowledge spreading, but nevertheless the issue of digital content, as we will be seeing, is mostly exempt from the debate on how to measure the Information Society.

[69] As we have nevertheless already stated, and as will be seen in the following chapters, there no more exists a black or white approach, but a full range of greys. So, when we speak of the Telecommunications Model we can no more understand a "pure" model "only" based in infrastructures, but a model where the share of infrastructure indicators is predominant and only partially complemented by other aspects of the Information Society.

as a serious and important social problem". In other words, all this Information Society data collecting and measuring would be but a market analysis at a global level, and far from being an exercise of awareness and policy-designing for development.

Besides whether we personally share this opinion or not, the truth is that national statistics come mainly from ICT producers and suppliers, so the circle of interests – produce, measure, feedback, produce – is absolutely closed, for good or for bad.

Of course we share Castells (2004) opinion – and it is one of the force ideas of this work – that "the inclusion/exclusion in the network society cannot be assimilated to the so-called digital divide, as the use of the Internet, and the connection to telecommunication networks does not guaranty the actual incorporation into the dominant networks or counter-domination networks that shape the society". So the Telecommunications approach is absolutely limited in this way, due to its lack of comprehensiveness. In line with Castells, this model cannot answer the relevant questions of "what is the relationship between 'access to ICT' and 'use of ICT' and how can we best consider the consequences of engagement with ICT" Selwyn (2002, 2004), which, to us, seem so much relevant.

On the other hand, "[y]et, the exclusion from the operative infrastructure of the network society is a good indicator of deeper structural subordination and irrelevance" Castells (2004).

So, and summing up, the main aspects of the Telecommunications Model are:

- It is good to measure the state of infrastructures.
- Might be used by the ICT sector in general to detect niches where to allocate their supply and new markets to be explored.
- Might be a good proxy to test a first level of digital exclusion.
- Its lack of comprehensiveness makes of it a very limited tool for policy-making and decision-taking at a broad, social level.

Besides these aspects, we believe that there are also four more issues in the Telecommunications Model worth highlighting. And it is worth because they represent a means to bridge this model with alternative models aiming towards broader visions.

The first one is *affordability*[70]. Affordability measures the relationship between income and cost of ownership or access to an infrastructure or service. This is, by all means, building a real bridge between infrastructures – considering connectivity as part of the infrastructure too – and households' or firms' economies, thus connecting the digital economy to the "analogue" economy. It represents some degree of humanization of such infrastructures, binding them to everyday's life and broadening the concept of access.

[70] See, among others, Campbell (2001), Foley et al. (2002), Sciadas (2005), Barzilai-Nahon (2006), UNCTAD (2006c)

The second one, and strictly related with the previous one, is *use*[71], a concept we have already talked about in this chapter. As will be dealt with later, when we analyze the different indices and the indicators they use, the Telecommunications Model includes measurements of use to more accurately reflect the effective access to infrastructures, being the logical sequence: ownership → access → use. Again, including use as a part of the set of infrastructures related indicators brings a new shade and gets closer to the effective use, to the opportunity, of ICTs. In fact, *use* can be interpreted as a proxy for different categories of the digital divide, then posing a dilemma on how to build indices and statistical models based on them. So, it can be interpreted as effective access to technologies, then categorized as a proxy for infrastructure measuring; it can be thought as a proxy for digital literacy, as only people trained in digital technologies will be able to use them; or it can also be considered as a good approach to measure digital content and services, as the lack of the latter would actually be reflected in lesser – or inexistent – use[72].

Related to use and digital services, most Telecommunications Model's indices include a measure of the existing *secure servers*. Thought a secure server is 100% an infrastructure, it is an infrastructure tied to the provision of secure digital services, namely e-commerce or online banking, among others. Again, then, as it happened with use and content, the model builds bridges towards more generalist models, be them the Broadcasting Model or Trujillo Mendoza's (2001) structuralist ones.

Last, but not least, Jakob Nielsen (2006) includes *usability* as part of the digital divide. While his approach is not exempt from serious criticism (Peña-López, 2007c), it is worth noting that usability is a concept in between infrastructures and digital skills very difficult to deal with, as it is human-computer interaction in general. Thus, taking into account how easy or difficult to use technologies are is, in our opinion, another way to blur the edges of the model and, on the other hand, challenge the concepts of access and use themselves, making necessary broader approaches to gather these shades of meaning.

3.2.3. A critique to the Broadcasting Model approach and the e-Readiness indices

Our critique – as we advanced in section 3.1.3 – to the Broadcasting Model and the e-Readiness indices associated with it is the contrary to the case of the Telecommunications Model: it is "too much" comprehensive. We have to admit, nevertheless, that it is precisely the ambition to extend at its maximum the reach of what can be measured – in opposition with the previous case – that makes of e-Readiness indices a fragile tool easy to suffer from any kind of attacks. Be so our critique but a constructive one.

[71] For an interesting compendium of uses, please see OECD's (2001b)

[72] We believe this last case, the case of use as an approximation to content and services is really rough: the whole population could be using but the only existing service intensively, or huge amounts of content could remain unused. But it is likely that a power curve could be drawn so to find a Pareto distribution of use of content and, thus, be able to estimate content through use.

In this train of thought, and as we said before, we believe that it would be an asset to split analogue economy from the digital economy – which is a thing we believe can be done[73] – as it would make possible to analyze two things separately:

- First, to know what is relevant to be measured – as cause or as effect – to evaluate the level of inequality (digital divide) in the Information Society due to unequal access or effective use of ICTs, and
- Second, to know whether these effects are a closed environment – hence, caused by and within the framework itself of the digital economy – or are just a part of a whole, wider framework – the globalized economy.

Regarding this second aspect, Bryan Luyt (2004, 2006) is hard in his criticism and, as we saw in the previous section, believes that "[t]he notion that the global economy might be responsible for the divide in the first place, or that a solution to the problem may lie in creating alternatives to this structure is not raised" in any set of indicators or any kind of indices, thus making "nations racing against each other to realize its amelioration". In his opinion, which we fully agree with, "more voices to be reflected in e-readiness measures", which turns out in the creation of "north" or "western" biased approaches that might not always work in each and every part of the World, or at different scales of observation. These holistic e-readiness indices would then become yet another tool for "transnational capitalist class" (Sklair, 1999) to keep a *statu quo* "favourable to a particular set of interests" (Luyt, 2006).

In the same line, but at a more conceptual and philosophical level, Kvasny & Truex (2001) defy the need itself for a definition of such a concept like the digital divide, and how it is used as a weapon or a marketing tool by politicians and lobbies: "information technology is a cultural commodity whose influence is spread through economic and political action".

Regarding the first aspect, about the composition of the indices themselves – without criticizing the whole thing but just the design – Karine Barzilai-Nahon (2006) also puts it crystal clear: "I do not assume that the e-readiness question overlaps the digital divide issue […]. For example, I do not think that trust in eCommerce relates directly to digital divide".

As can be easily understood, the author mostly refers to developing countries and really deprived areas from developed countries. If, as we think, this is the case, we agree that e-Commerce is not an issue for the severest cases of digital divide and e-exclusion. We would like to agree, nevertheless, that it would indeed be directly related for serious cases of digital divide due to age[74].

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[73] We are aware that this statement is quite strong. Most will argue that provided this was sometime possible to be done in the past, it will get more and more difficult to do in the future. Take, for instance, the paper and digital editions of a newspaper and try to separate the costs of one edition from the other one. Our argument is quite simple: while there is a possibility to separate analogue indicators from digital ones, it makes sense to have indices to measure the digital divide. Once the measuring is not possible, by construction, it is very likely that measuring the digital divide lost all sense.

[74] Please see next section for a deeper analysis.

We agree, indeed, more with a broader critique on these issues: "the integrative indices could benefit from a scientific validation of weights, reference to different levels, and *reference to internal dynamics* between the various variables" (Barzilai-Nahon, 2006, p.9; emphasis added).

In our opinion the study of the internal dynamics between variables is what offers major improvement and could bring great added value to these indices. Not because the weights are not seriously thought and deeply calculated – which we believe they are – but because, sometimes, the relationship between two inner (to an index) variables could shed more light on the subject of the digital divide than the composite index itself.

Should a government face the trade-off between spending its budget on infrastructures (i.e. a subsidized PC for a household) or on training (i.e. a course on an office suite), it would be of high value to know how these two variables relate one to each other: Is it strictly necessary to *personally own* one PC per person (and not per household) so it is advisable to subsidize PCs until a 100% penetration is reached? Or once a PC enters a household it is marginally better to invest in training (digital literacy) instead of more hardware?

This is one of the main questions we would like to answer in this work – or, at least, give some hints on how to answer it.

And we believe that this question is absolutely relevant as the digital divide does not always have the same origin and effects. And not only depending on how we measure it – what are our definitions for access or use or opportunity – but also depending on the framework of our study. It is our aim, in the following lines, to reinforce the two arguments that we have been using so far, but especially in this chapter:

- That access, use, and the digital divide are something more than a matter of infrastructures
- That the relationships between and inside different categories or concepts of the digital divide are relevant to bridge it, and
- That there are relationships between the "analogue" economy and the digital economy or, in other words, that there are non-digital barriers that affect the digital divide and vice-versa

The former two will be dealt with immediately below in the next section, and the latter in the section that will follow to that one.

3.2.4. Different manifestations of the Digital Divide

According to the terms we have been dealing with, the different approaches, the different perceptions, etc., the digital divide and how it takes place or manifests or affects population has been explored in the literature from the corresponding points of view and disciplines. Let us briefly summarize the main trends in next table:

Geography	Rich, developed countries vs. poor, developing countries
	Urban vs. rural areas
	Region and place of residence
Economy	Income
	Employment status
	Affordability
	Firm/enterprise size
	Other socio-economic factors
Technology	Physical access
	Quality in technical apparatuses
	Possibility of choice between platform of access (e.g. fixed line vs. mobile or wireless line)
Personal attributes	Gender
	Age
	Race, ethnicity
	Physical disability
Skills	Educational attainment
	Skills, digital literacy
	Awareness
	Interest, attitudinal factors
	Language (e.g. predominance of English websites)
	Digerati vs. late adopters
Social Context	Political awareness, Information Society strategies
	Leadership
	Legal framework (e.g. censorship)
	Social support
	Family structure
	Socio-personal factors
	Social participation, engagement
Use	Variation in use: purposes that ICTs are used for (e.g. entertainment vs. education)
	Autonomy of use: when, where, how and what for can ICTs be accessed
Content	Information rich vs. information poor
	Availability of digital content
	Supply of digital services

Table 3: Different manifestations of the Digital Divide[75]

Even if, compared with the total, geography related aspects is but a small part of the whole list featured in the table, the fact is that this approach is, by far, the one that more literature has generated in the last years. Although the origins, as we have said, of the concept and the term digital divide are rooted in a developed country –

[75] This table was built relying on: Kennard (1999), NTIA (1999; 2002), Norris, (2000, 2001), Campbell (2001), DiMaggio & Hargittai (2001), DiMaggio et al. (2001), OECD (2001b), Walsh et al. (2001), Foley et al. (2002), DiMaggio et al. (2004), Keniston (2004), Mphidi (2004), UNCTAD (2005b), Daniel. & West (2006), Yu (2006), Selwyn & Facer (2007), Vicente Cuervo (2007)

the US – and within its boundaries, the comparison of the Information Revolution with the Industrial Revolution and its effects in the global landscape during the last two centuries quickly shifted the debate towards the international arena, international relationships between countries, the unequal allocation of resources and the possibility of ICTs to be the last train for development.

The UNCTAD, in their report *The Digital Divide: ICT Development Indices 2004* (2005b) expresses that "[t]he digital divide between the information-rich and the information-poor is of increasing concern", a concern that was already stated by acknowledged work *Digital Divide: Civic Engagement, Information Poverty, and the Internet Worldwide* (Norris, 2001) were she defined the "global divide [as] the divergence of Internet access between industrialized and developing societies", an international divide mainly due to a deep lack of resources (Norris, 2000).

At the national level, but with close parallelism with the previous point of view, the urban rich and the rural poor were also seen as a place to look and find a digital divide (Kennard, 1999), though this distinction has been made also within cities, between rich and poor districts NTIA (1999; 2002) DiMaggio et al. (2004).

Regarding non-geographical issues, authors[76] usually explore the whole array of factors that could affect – or be affected by – the digital divide after a survey is done. Thus, in their research they have identified the list we present in Table 2, being the majority of the topics common ground in most researches, though just a few of them (Foley et al., 2002; Vicente Cuervo, 2007) put some emphasis in how different devices bring different responses in relationship with inequalities of access. The relationship with the existence of relevant content is, as the devices use, present but not mainstream, though the recent hype on open educational resources (Daniel & West, 2006) and open access in general might change this aspect in the short run.

We want to note that the major consensus in the findings and evidence arisen, there is still room for dissent. Walsh et al. (2001), for instance, argues that some figures show different things than the perception the researchers' usually have about minorities' adoption of ICTs, stating that "[e]thnic background alone does not explain the existence of a digital divide: Once statistical analyses take into account the impact of income, age, education, and technology optimism, ethnic background does not materially influence online adoption". In our opinion, we believe that what most researchers mean by "race" or "ethnicity" in their analyses is not just the colour of the skin but the whole constellation of facts that usually accompany minorities in suburbs or ghettos formed by immigrants[77]. On the other hand, this argument is rebated by Mphidi (2004) by looking at samples where *actual segregation* takes place.

Summing up, it is easy to find (Norris, 2001; Keniston, 2004) these factors grouped under three or four different *digital divides*, namely:

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[76] Please refer to note 38

[77] Of course, even if comfortable for the researcher, this not justifies a misleading tag for a determinate category.

- first divide: the international or global divide, between countries, developed and rich vs. developing or poor
- second divide: same, but within each country, among rich and educated people and poor and less educated people
- third divide: based on skills, both digital and (foreign) language skills
- fourth divide: about use and participation, engagement and highly benefiting from ICTs thanks to their understanding and mastering

3.2.5. Non-digital barriers adding up to the Digital Divide

These digital divides do not take place in an isolated way, segregated from the "real" world, but embedded in a continuum of causes and consequences that imply "a chain of causality: that lack of access […] harms life chances. While this point is undoubtedly true, the reverse is equally true; those who are already marginalized will have fewer opportunities to access and use computers and the Internet (Warschauer, 2003b) technology). As we have already been able to guess from the previous section, some digital factors can – at least potentially – be strongly tied to "analogue" factors (e.g. digital skills with overall education level). And the contrary also applies: some digital factors can have an huge and measurable impact on everyday life, as we saw in chapter 2. Trying to avoid repeating ourselves in what has been explored in that chapter, we want to point here some questions that reinforce this continuum or vicious circle of external conditions → digital divide → external conditions, etc.

We can divide these questions in two groups. On one hand, preliminary questions that shape the *statu quo* and the basements where the Information Society is going to be built upon. On the other hand, questions related with how this Information Society permeates the territory in a capillary action in both everyday's life and strategic decisions.

After an analysis of what had been done so far in the field of community informatics, and identifying when ICTs brought value for economic and social regeneration, Brian Loader and Leigh Keeble (2004) consider critical for the spread and appropriation of ICTs that there is a sufficient and comfortable physical access to infrastructures, that this access is properly regulated and that the user has a satisfactory educational achievement so he can build upon it a new set of digital skills.

As it has already been pointed at, economic inequalities play a fundamental role mainly in the first phases of de physical deployment of the infrastructures, be it at the international level (Serrano y Martínez, 2003) or within national markets in aspects like job efficiency, productivity gains or multi-factor productivity (Campbell, 2001). The influence of the economy and economic development is decisive in how this deployment will place, what technologies will be used and how. The differences in the starting point will then generate a crossroads that will determine the future uses – and benefits – of ICTs (Vicente Cuervo, 2007).

But being information the currency of ICTs, it is not surprising that much emphasis is put in education as the keystone of ICT adoption and diffusion (Warschauer, 2003a). On one hand, some authors (Vicente Cuervo, 2007) postulate about the role of Universities as (mainly) Internet spreaders. On the other hand, the international context, international pressure, economic competition, emulation of a country's socio-cultural neighbours or, in general, the "participation in international organizations might be a place where learning occurred, occurred; ideas would spread more easily as policy-makers from different countries spent more time together, exchanging ideas" (Milner, 2003).

Policy-making seems to be the junction and the hinge where past and future, the departing point and goals meet, having political institutions a highest responsibility in the affairs of the digital divide, e-inclusion and the fostering of the Information Society (Milner, 2004 and 2006).

The problem with policy-making and participation is, once again, that feedbacks itself. DiMaggio et al. (2001). "Social Implications of the Internet" list five domains where Internet has implications:

1. Inequality (the "digital divide");
2. Community and social capital;
3. Political participation;
4. Organizations and other economic institutions; and
5. Cultural participation and cultural diversity.

As can be noticed, all points but the first one are related to participation and civic engagement in a broadest sense that almost covers all means of socialization. A fact also pointed by Pippa Norris (2001), the problem here presented is the following: there is evidence that political institutions have a leading role to solve – or worsen – the challenges and inequalities of the Information Society; but there is also evidence that participation and real or factual access to these institutions depends highly on the incorporation of ICTs in everyday's life, in their use in communication and activism channels, in advocacy, in its mastering by groups of interest and lobbies and so. And the solution to this Gordian knot is not really clear, as all the debates around e-Democracy and electronic participation are wide open and the consensus far to be reached (Sánchez i Picanyol, 2005).

To end this section, we refer the reader to Table 4.1. in ICTs Vicente Cuervo's work (2007) were she lists some literature on the determinant factors for ICT diffusion. Among the main findings listed, the evidence that income is a main barrier is stated over and over, but the social context usually reshapes this fact with new shades of meaning. For instance, the GDP might not be as important as the regulation framework or the fact of living in an urban or a rural area – thus stressing the problem of the *last mile* –, though access to the Internet might be a luxury (elasticity-rent greater than 1) in the first stages of adoption, as it happened with mobile phones. Again, human capital and education in general come to be open or closed gateways for a major pervasiveness of ICTs, economic aspects aside.

3.2.6. The Web 2.0: the *prosumer* and the Broadband Divide

But things are changing.

We talked in section 3.1.4 that the phenomenon of the Web 2.0 has brought radical changes, especially in how the Web is making possible new ways of interaction and broadcasting, but also in ICTs as a whole, as interoperability of platforms and content prepared for multiplatform access is making possible the blurring of the edges between technologies, channels, etc.

As long as this Web 2.0 challenges established concepts as who the sender is and who the receiver, what is broadcasting, or the concept itself of the "prosumer" that both can consume and create, same happens with our means and constructs to approach this scenario: if we talked before about how the concept of access has changed, it is now the turn to see how our idea of the digital divide will have to include this brand new collaborative web.

As Mark Thompson (2007) puts it, the Web 2.0 has to be: "[v]iewed instead as an 'architecture of participation', ICT becomes an opportunity for generating, mediating and moderating a particular paradigm of social life; and this paradigm poses a direct challenge to much of the way in which 'development', with its associated visions for social life and supporting infrastructure, has been conceptualised and delivered to date".

For instance, evidence (Wells, 2008) shows a clear shift towards the Internet – and computers in general – when addressing problems, looking for complex information or just having, in detriment of Television, libraries or professionals themselves. This has not to be understood as a move towards isolation and anti-social behaviours – a hype that has been dismantled, among others, by Castells et al. (2006) – but to what is being seen as an increasing empowerment and autonomy of highly digitally literate users. This empowerment, as we have already argued along the last pages, can operate changes in people's life – acting as a digital dividend (Daniel & West, 2006) – or, if lacking, can act as a new divide to add to the other mentioned digital divides.

And it is worth noting that this autonomy or empowerment is not only related with a potential personal economic enhancement towards more welfare, but bound to social, psychological and emotional developments, as aspects as privacy are difficult to manage without the required skills, thus being able to cause potential harms in the future (Fox, 2008). So skills matter, and not only at an instrumental level, but at the most mature level of e-awareness to be able to foresee tomorrow's consequences of today's acts.

But these skills are so far very unevenly distributed (Horrigan, 2007a), ranging from a tiny front row vanguard that become the early adopters of every and each new technology to appear, and followed by heavy intensive users or technologies that exploit more the benefit – productivity, effectiveness – of the device rather than seek for the newest features. These two groups are clearly a minority in the US (Horrigan, 2007a) and taking out other heavy consumers on electronics like Japan and other top rank OECD countries. And it does not seem too adventured to state that in other countries these two groups have meagre sizes or are composed by just the economic elites of each community.

Added to a determinate level of skills, accompanied by the proper devices, a third axis in this Web 2.0 (r)evolution of ICTs is connectivity, or, in other words, broadband. "The impacts of high-speed connections extend beyond access to information to active participation in the online commons" (Horrigan, 2007b), because they are a condition *sine qua non* to be an active part in this new scenario where the receiver can broadcast back in response to the sender, adding his or her own content in the way. "Broadband users experience the Internet differently and that in determining who is likely to spend more time online, the type of connection is far more important than other digital divide
demographics such as education, race or gender" (Loader & Keeble, 2004).

Now, broadband is not just a continuous measure of *quality*. Now broadband has become a discrete switch that either connects or disconnects someone from the network. And this network, as we began in this work, can be a commercial network, a knowledge network or a social or personal network. The consequences of not being able to access this network will vary, but the result is the same: the node has been switched off.

A last aspect we want to highlight is how this change from a "traditional" digital divide to a participative-highly-skilled-broadband divide has also changed the ways to face it. As we have explained elsewhere (Peña-López, 2005), initiatives like the one fostered by Nicholas Negroponte to provide low-cost laptops to developing countries can be useless depending on the accompanying measures[78] that they come with.

The rationale is the following: on one hand, the exchange of rich media increases in the Web 2.0, making, as we have said, broadband to become one of the most important parts of infrastructures; on the other hand, we have been seeing how lots of desktop applications migrated to the web – because "the web is the platform" (O'Reilly, 2005) –, making it is likely to expect that less power in desktop computers will be required, a fact that reinforces the previous trend of more broadband needs.

If the initiatives to bridge the digital divide are focused to hardware and that was the reason that barred access to the Information Society, then the strategy had a correct approach and might be successful within its limits.

But these initiatives could keep on focusing on hardware trading off with the provision of good broadband connectivity, enabling access to web spaces – social networking sites, online office applications ,etc. – where interaction can take place, the creation of relevant content and the training of the skills to access these sites. And if not the former but these other questions should be the relevant ones to bridge the digital divide, the strategies would be headed to disaster.

[78] About these accompanying measures, please see also *Thank you OLPC, indeed — a comment to Teemu Leinonen* (Peña-López, 2008)

It is highly probable that this state of things is only taking place where a minimum level of infrastructures has already been set up. And then the lesson learned is twofold:

- The first one, that not one size fits all, and then "each" digital divide has to be approached in a different way and tied to its context
- The second one, that things are changing quickly and, most important, not following the linear path we used to see in the Industrial Revolution: some "leapfrogging" is possible and we can already see the mobile web accessed through broadband service in rural places where the fixed telephone line just never got there.

Time to rethink our strategies.

3.3. Fostering the Information Society

> "We, the representatives of the peoples of the world, assembled in Geneva from 10-12 December 2003 for the first phase of the World Summit on the Information Society, declare our common desire and commitment to build a people-centred, inclusive and development-oriented Information Society, where everyone can create, access, utilize and share information and knowledge, enabling individuals, communities and peoples to achieve their full potential in promoting their sustainable development and improving their quality of life."

This is how the Geneva Declaration of Principles (ITU, 2005e)[79] begins. Agreed and signed in Geneva at the end of the first phase of the World Summit on the Information Society, it represents the acknowledgement that ICTs have transformed the world and that they have – and will have – a key role in progress and welfare. Thus, it is necessary to foster the development of an Information Society, especially in those places where such development will have it difficult to be endogenous or self-emerging.

In the Declaration it is stated "the potential of information and communication technology to promote the development goals of the *Millennium Declaration*"[80] keeping in mind that "that ICTs should be regarded as tools and not as an end in themselves"[81].

These principles were translated into practice in the Geneva Plan of Action[82], which set 10 generic targets that should help governments to set their own Information Society national strategies:

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[79] ITU (2005e) WSIS Outcome Documents
[80] Geneva Declaration of Principles, second principle
[81] Geneva Declaration of Principles, ninth principle
[82] ITU (2005e) WSIS Outcome Documents

a) to connect villages with ICTs and establish community access points;
b) to connect universities, colleges, secondary schools and primary schools with ICTs;
c) to connect scientific and research centres with ICTs;
d) to connect public libraries, cultural centres, museums, post offices and archives with ICTs;
e) to connect health centres and hospitals with ICTs;
f) to connect all local and central government departments and establish websites and email addresses;
g) to adapt all primary and secondary school curricula to meet the challenges of the Information Society, taking into account national circumstances;
h) to ensure that all of the world's population have access to television and radio services;
i) to encourage the development of content and to put in place technical conditions in order to facilitate the presence and use of all world languages on the Internet;
j) to ensure that more than half the world's inhabitants have access to ICTs within their reach.

It is interesting to note that 8 out of 10 targets (a-f, h, j) make reference to just infrastructures – even in broad and indefinite terms – leaving just one target left for education (g) and content (i).

The outcomes of the summit were highly criticized[83] after a process that had it very difficult to reach a consensus between the delegates from 175 countries that took part in the Geneva phase (WSIS Executive Secretariat, 2006), and that was said to have left aside the major part of the civil society[84].

In our opinion, and based on what we have been presenting here so far, there is room for many improvements to be made. On one hand, there is no mention about the quality of this access to infrastructures, and no mention at all about the ICT sector, which is the one that would directly set up and manage them. And there is also not any point about how the whole package is going to interact with the legal framework through a specific sector regulation. On the other hand, the point about digital literacy is really little ambitious and speaks only about the future (i.e. kids in primary and secondary schools) but not about the present (adults, especially leaders). Last, but not least, even if there exists a target that speaks of content, digital services are not dealt with but with a slight, tangential mention to e-Administration in target (f).

Taking as a basis the existence of an almost global acknowledgement and commitment towards the construction of the Information Society – endorsed by so many countries and their respective rulers –, we will be presenting in the following two sections two crucial aspects of such commitment.

[83] See, for instance, Heeks (2005) and Souter (2007)
[84] Souter (2007)

On one hand, where is the limit towards fostering the Information Society or, in other words, what is *universal access*. After this, what are the strategies to reach it at the international level, and what the blanks left.

3.3.1. Towards Universal Access

According to Albery (1995), there are three relevant questions when talking about Universal Access:

1. What services are included within the definition of universal service?
2. How will universal service be funded as the industry migrates away from monopoly toward a competitive structure?
3. What level of penetration constitutes universal service?

First and third questions can be slightly reframed, or shaded, by adding a qualitative approach (Clement & Shade, 1998). Regarding the first question, besides the just descriptive "what", the purposes of access to these services could shed a light on exactly *what* services – as use can reshape the concept itself of a service – and help establishing some array of priorities. As per the third question, the quantitative approach – how many people should access specific services – a quantitative approach would also be able to tell us to which of these people or for whom the access is intended.

In the end, all three questions deal with the limits of policy-making: the first and third ones depict the goals to be achieved as where are the "physical" limits of universal access: width – what services – and depth – at what level. The second one focuses not in the goals but in the source, the source of the required founding to go beyond the point of equilibrium that the market is likely to establish.

Of course, this second question – as it happened with the other two – can also be reframed not only to include the how, but also the why, the reasons why a universal access is necessary (Compaine & Weinraub, 1997).

Thus, the main debate around universal access is how far goals from resources are one from the others and what should be done about it. Or, in other words, whether the market itself will achieve universal access – however it is defined – or such a thing will not happen without the intervention of public resources. As we will see, notwithstanding, the speed at which these ends would meet is also relevant for many.

Just to frame the next pages, we want to highlight how Stern et al.[85] define as *universal* in the sense of how far should societies go in providing access:

- Universal Access, achieved when 100 percent of a country has access to a public payphone or telecentre on a shared community basis.

[85] See both references, but especially the second one: Stern, P.A., Townsend, D. & Monedero, J. (2006). *New Models for Universal Access in Latin America*; Stern, P.A., Townsend, D. & Stephens, R. (2006). *New Models for Universal Access to Telecommunications Services in Latin America*

- Universal Geographic Coverage, achieved when 100 percent of the population living in population centres above a certain size can obtain a given telecommunications service if the user has the ability to pay for the service.
- Universal Service, achieved when 100 percent of individuals or households are subscribers to a given telecommunications service (i.e. the service is affordable to all)

Even if universal access, strictly speaking, is defined in the first point, the three definitions combined provided a good comprehensive approach. In this sense, universal access would mean physical access (universal access) for anyone and despite their socioeconomic circumstances (universal service), and independent from the place where this access should take place (universal geographic coverage).

What Services

Even if we agree in what is universal, the problem comes then in defining what technologies and services should be universalized. The debate is actually very similar to the one we have visited and revisited in this chapter when we have been talking about what was access and what did we understand by the digital divide.

For instance, in the previous definitions by Stern et al.[86] we can see that the focus is in fixed telephone lines. But, as we stated in this chapter, infrastructures can be a necessary but not sufficient condition to enter the Information Society.

Let us take the example of access to broadband. Broadband is seen to be crucial in the next years (European Commission, 2006; Reding, 2007)[87] despite the fact that its distribution is still quite uneven (Horrigan et al., 2006). Broadband is defined by the International Telecommunication Union Telecommunication Standardization Sector (ITU-T), in their recommendation I.113, as "transmission capacity that is faster than primary rate Integrated Services Digital Network (ISDN) at 1.5 or 2.0 Megabits per second (Mbits)" (ITU, 2003a). On the other hand, the OECD gives its own definition of broadband (OECD, 2001) stating that "for a service to be considered broadband, [the threshold] in respect to downstream access [should be up] to 256 Kbps". The fact is that, as , the OECD itself admits, "[n]etwork operators widely advertise DSL and cable modem services to users starting at 256 Kbps as being 'broadband'" (OECD, 2001). Actually, the Core ICT Indicators, promoted by the Partnership on Measuring ICT for Development – partnered by the ITU – also defines broadband as "technologies that provide speeds of at least 256 Kbit/s, where this speed is the combined upstream and downstream capacity" (Partnership on Measuring ICT for Development, 2006).

Summarizing, all of these are technical definitions, based on the fact of transmitting more than one data stream in the same wire by using different frequencies or channels. But for the not-technical end user, the citizen, broadband is strictly tied to "effective" speed, or, in other words, "subjective" speed, in relationship with the

[86] Ibid.
[87] As we showed in section 3.2.6.

speed your neighbours are accessing and, more important, in relationship with the required needs to fully access digital services. In Hudson's (1994) words, access, or the goals of universal access "not be stated in terms of a specific technology or service provider (such as optical fibre to the home provided by the local telephone company) but in terms of functions and capabilities".

Thus said – and leaving technical issues behind to focus in this "subjective" broadband perception – in the case of broadband an exercise would be building build a basket of tasks the way the calculation of changes in inflation is done based on a basket of products. This basket of tasks would also be likely to evolve with time, but what it is probable that it would demonstrate being a more robust definition than the ones seen here before.

Such a basket of tasks that should be possible to be comfortably performed with broadband could look as follows:

- Work in online, synchronous collaborative environments with rich media: VoIP, videoconference, screencasting, presentations/drawings…
- Work intensively/exclusively with online, asynchronous desktop/office applications: word processors, spreadsheets, math/scientific calculators…
- Usual access to online applications with richest graphical content: SIGs and mapping tools, 2D and 3D simulators and environments
- Have online environments as primary communication and information channel: e-mail, instant messaging, browser and desktop widgets. It includes software downloads and updates.
- Manage a website: upload files, install applications, change configuration/setup. It does not include writing on a weblog/wiki and other low-tech "webmastering"
- Work with remote computers or in grid computing, including intensive use of P2P networks

This basket of tasks and the minimum speed required to perform them correctly/comfortably should help in setting the threshold of what we could call broadband.

So, what we want to stress here is three aspects of the difficulty to choose between what services to promote for universal access. Firstly, and the most obvious one, is that there is no agreement at all on what services to be chosen. Secondly, even if there was such an agreement on what technology or service to foster, defining it could become a tricky thing to do, if not impossible, due to the evolution of a certain technology itself. Thirdly, even if this definition could be possible, the applications of a specific technology or digital service might widely vary among users, making, again, of the definition quite a subjective matter.

In this train of thought, Compaine & Weinraub (1997) declare that "[u]ltimately, the value consumers place on any product or service is what they actually pay for it [because] individuals have differing opinions on which technologies are more important to their quality of life and thus (at least on an individual basis) which technology has greater value". With this statement they want to report that no universal access policies are likely to work in such a subjective environment, being the market the perfect place where the equilibrium will be reached[88].

What level

Compaine & Weinraub (2007) raise the fact of the individuals' will and freedom of choice or freedom to decide. Besides the fact that we agree with them, the question is that their positioning about access "to what services" is strongly related with access "at what level". Letting aside Stern et al.'s[89] maximalist approach to achieve 100 percent access, mainly a physical access, we could shift the debate towards the *possibility* of access, seeing access not as a goal but as a gate that needs to be cleared out of barriers.

From a vision placed not in the present, or in the current state of the situation, but in the future and thinking on development, Hudson (1994) lists "four fundamental criteria" to define the width and depth of universal access:

- Accessibility, where everyone should have access to basic services.
- Equity, avoiding major disparities in availability and price, thus introducing affordability in the equation
- Connectivity, which should be universal
- Flexibility, so policies were sensible to the changing reality of evolving technologies – as we depicted in the case of broadband – and so adjust accordingly to these changes in both the path and goals

What resources: a matter of speed[90]

Width and depth of universal access are two dimensions that can be complemented with time, with the speed at which a community will head towards these dimensions and, if possible, reach full access.

That there is a "natural" needed time for innovations to take off and be massively adopted by the population is obvious, and has been treated in the literature as the 'S' curve of diffusion, being the first part of the 'S' shaped curve conformed by the initial vanguard of adopters and the last part for the minority of late adopters, leaving in between the steep part of the curve where massive adoption takes place (Compaine, 1986).

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[88] We are, of course, here simplifying their argument for the sake of clarity. We encourage the reader to go back to the original source – and to all Benjamin M. Compaine's works cited in our bibliography below – to enjoy well founded arguments towards a *laissez faire* in the field of policies to promote the Information Society.

[89] See note 85

[90] After analyzing what services, at what level and at what speed, we will leave for the next section whether there is a reason to publicly support these policies.

The relevant question being how much time is "natural" or, even more, what maximum amount of time is socially desirable to pass until achieving universal access. And again, the debate is wide open and being far from reaching consensus.

On one hand we find those authors (Compaine, 1986; Compaine & Weinraub, 1997; Mueller, 1999) frontally opposing to public intervention. The reasons they make are many – and well supported – and can briefly be listed as:

- High prices, supposing a barrier to access, will be lower along time, as far as the technology is improved and demand forces a more efficient supply
- Indeed, the immature state of the technology itself might recommend to wait until it is suitable for universal distribution
- The barrier of skills – to produce the new technology and to use it – will be gradually disappear as technology becomes popular and simpler
- Acting precipitously is a bad counsellor: lack of deep knowledge on a certain topic will easily lead decisions to the wrong path
- As we have seen with the complexity of what to be accessed and at what level, consistency across policies is not an obvious thing to be achieved

Some of the answers to these concerns, well summarized by Tambini (2000) are:

- Some of universality will never be reached without intervention, mainly regulation, but not exclusively
- Inequalities in skills and use can but broaden – instead of converging – due to already existing inequalities that will act as multipliers of the new inequalities
- Even if former inequalities are more important priorities, a holistic approach to exclusion makes it worth attacking all disadvantages at once, and not sequentially
- The whole network can be harmed if a percentage of the population with poor or no access drags down the rest, this dragging taking the form, for instance, of inefficiencies in the provision of digital services

We will explore in the next section more positions about why – or why not – fostering the information society. Notwithstanding, we want to state here that speed has proved being a fundamental characteristic of the Information Society, as we already explained in chapter 2. Both huge developments and progress and increasing inequalities have been based on speed: the speed of adoption of new technologies, the speed of adaptation to the new Informational Paradigm, the speed at which being switched on or off the network can take place, etc. In our opinion, this is, if not the most, a really relevant factor to be taken into account.

3.3.2. The need for policies of access

But the matters of what services or what level would not be an issue if the solution to the how was a trivial one. But it is not.

Though we can understand "'Universal service policies' [as] those regulatory and fiscal measures that governments undertake to make sure that as many people as possible are connected to the telecommunications infrastructure" (Mueller, 1999), the question is that regulatory measures usually have too an impact on the economy and on the economies of the involved agents.

This is why most criticism against and advocacy for policies of access normally replicate the liberal vs. progressive approaches to politics: while the former criticize an excessive intervention of the public sector in market matters, the latter demand this more intervention for the sake of solving market inefficiencies and failures.

Mueller (1999), for instance, believes that "universal service policy is about redistributing wealth [and] wealth redistribution is a political process", and claims for transparency in the political speech and agenda to acknowledge this fact. But, acknowledged this question, the step forward is not evident at all.

One of the hardest criticisms that Mueller gives is the one we could call the "natural sequentiality" of development, that is, as in Maslow's (1943) hierarchy of needs, development would follow a natural path impossible to alter: first things first, then technology. Although we agree that "[t]he strong positive correlation between per capita wealth and the geographic and social penetration of telecommunication and information services has been evident for decades" (Mueller, 1999), this show, by no means, *causality*, just correlation. There is now[91] plenty of evidence of the *huge* impact of mobile telephony in developing countries with poor or almost inexistent alternative infrastructures on which to build mobile penetration, a penetration that is becoming absolutely pervasive (Banks & Burge, 2004); Keogh & Wood, T., 2005; Vodafone, 2005; Castells et al., 2006; Lane et al., 2006;).

We have then to disagree with the statement that "[w]ealth causes penetration levels to approach universal levels, not the other way around" (Mueller, 1999). This statement is of course true in the first direction. But the reverse also is, the reason being that telecommunications, these days, are not a luxury, but a normal good after the first stages of adoption[92], so it is the *need* of it, not the *sake* of it, that makes it so demanded and thus making possible penetration rates over 100%. Besides the example already provided about mobile telephony, there are other examples of *leapfrogging* of technologies, where state-of-the-art technologies are adopted *before* the long ago established ones in other places of the world (Analysys, 2000; Accenture et al., 2001; Bridges.org, 2001; Hilbert, 2001b; Trujillo Mendoza, 2001; Haddad & Draxler, 2002; UNCTAD, 2003, 2005b and 2006c; gov3, 2005; Katz & Hilbert, 2003; Hilbert & Katz, 2003; UNPAN, 2004 and 2005; Schware, 2005; Tongia et al., 2005; ITU, 2006c and 2007c).

Our scheme, far from "wealth enables penetration; penetration requires wealth", is then the following one:

- Penetration enables digital skills

[91] To Mueller's discharge we have to state that such evidence was not easy to foresee in 1999.
[92] See reference to Vicente Cuervo's work (2007) in section 3.2.5

- Digital skills conform highly skilled human capital, then enabling labour productivity and cross-factor productivity
- It is the need to raise – or keep – productivity levels that demands for skilled labour that requires – at home or at the workplace – ICT penetration
- As *leapfrogging* is possible, ICT penetration takes place, not only despite wealth, but to achieve it[93]

There is a point left in Mueller (1999) that is quite easy to answer. The question is, in case our previous scheme could have some probability to take place, "[w]here would the countries get the capital to build it?" Evidence already shows that capital would be obtained from the same place that it has always been when not available within a country's borders: foreign investment (Heeks, 2005; Blinder, 2006; Kenny and Keremane, 2007). On the other hand, this capital could also be obtained within borders, through redistribution, making of it an absolute relevant policy at the margin (Mueller, 1999).

Adding to the question of development and leapfrogging, there is another thing that has radically changed in the way ICTs are being used. Compaine (1997) might be right at the moment stating that "[o]nline communication will likely continue to be a faster means to accomplish what can already be done with other methods. If this holds true, the value of online, at least for the near future, is more salient as an information resource than as communication resource" which, according to him, was a reason not to support universal access policies. But we have here shown that this statement is not true anymore: ICTs are used for both information and communication, and is precisely this last question that has brought on the Network Society.

So, even if in many ways we agree with Ben Compaine, Milton Mueller and other authors' critiques to policies to achieve universal access – transparency, the difficulties to focus on the appropriate technology, that the market will provide – we nevertheless think that there are some specific situations where some degree of intervention is good, as "[t]here needs to be a political recognition that the crucial issues of the digital divide are not just technological – they are social, economic, cultural and political" (Selwyn, 2004) that just cannot be solved by the market alone.

Kenny and Keremane (2007) show, for instance, that despite the positive evolution of penetration in Africa in the last years, there seems to be a difficult to solve gap of the remaining last people to have access to mobile telephony. And this gap can only be fulfilled by (a) public intervention (b) funded by foreign investment. In their case, subsidizing is not a matter of wealth redistribution, but a matter – the only one, in their opinion – to achieve universal access.

And letting aside humanitarian reasons for wealth redistribution – that, accordingly to critiques could make us implement non-rational heart-led strategies – one important reason for universal access is market efficiency itself. We have already pointed that

[93] We are aware that this is quite a strong statement and should be proved in practice and with real data and evidence. Nevertheless, the literature review we have done so far, and some other works and data we will relate to in the following pages make us confident about what we here defend.

Tambini (2000) thinks that the people not belonging to the network will "drag down the rest [and] [t]heir non-participation (or inability to participate) will hinder e-government, will restrict the development of e-commerce, make e-democracy illegitimate and act as a general brake on the development of the new economy". So, in his opinion is the efficiency in the provision of these digital services – some of them public, some of them provided by the private sector – that gives reasons enough to intervene, especially when the provision of e-Government or e-Education could be at stake (an argument also backed by Nishimoto & Lal, 2005).

So, even if it might sound contradictory to some, we see public intervention as a means to achieve more and better market efficiency.

Of course, this public intervention can take the shape of subsidies, but an important part too relates also in providing the proper legal framework and specific regulation for the sector, which sometimes might imply attacking asymmetric interconnection (Dymond, 2004):

> "The primary instrument used in Bank Group operations to narrow the digital divide has been, and will continue to be, policies and investments aimed at bridging the market efficiency gap. This involves, among others, support to the liberalization of the telecommunications market, the creation of a pro-competitive legal and regulatory environment and the privatization of the incumbent operator." (Navas-Sabater et al., 2002)

But not only universal access policies at the regulation level are about a proper legal framework for the ICT sector and the user as a customer.

On one hand, the design of strategies is always permeated by the flavour and ideology of who is leading the implementation of policies. Hence, leadership and the authors that play the role of Information Society drivers really does matter (UNCTAD, 2005b). Actually, not only political institutions matter, but can also either boost or play havoc on the development of the Information Society as a whole in a country or a region (Milner, 2006).

The OECD (2001b) identifies several issues as strategic for policy making in the arena of ICT access improvement, namely:

- Network infrastructure
  - Infrastructure development
  - Regulatory initiatives to enhance network competition
- Diffusion to individuals and households
  - • Access in schools
  - • Access in other public institutions
- Education and training
  - • Training in schools
  - • Vocational training
- Diffusion to businesses
  - • ICT support and training for small businesses

    - • Assistance to regions and rural areas
- Government projects
    - • Government services on line
    - • Governments as model users of ICT
- Multilateral co-operation

A list which is enhanced and complemented, by and large, by Loader & Keeble in their excellent reflection on a compendium of ICT policies: *Challenging the digital divide? A literature review of community informatics initiatives*. (2004)

Adding to efficiency and regulatory factors, there are other questions related to the user itself. Motivation, skills or trust (Foley et al., 2002) can be a subjective barrier to ICT adoption from the user's part (Parks Associates, 2007) that only through – or thanks to – the intervention of the public sector can be if not fully overcome, at least more easily and quickly (OECD, 2008b).

And, indeed, not only *finally* achieving universal access is important for all the reasons already depicted here, but also the rhythm of adoption and the speed to bridge the lags between the early adopters and the late comers can be also a variable to take into account. "Given that Internet Economy propagates the 'First Come-First Serve' rule, time is running and leads can be built which seem impossible to catch up, for the one who once lagged behind. By the same reasoning we could claim that the catch up is easier once you are in". Hilbert, (2001a, p. 103)

Last, but not least, we believe that policies to foster the Information Society can be good on themselves without any kind of consideration on the Economy, efficiency or even equality. As Robin Mansell (2002), we think that not fighting inequality on access to ICTs is "an infringement of human rights", as far as "citizens are using the new media to support their choices about their lives".

All in all, this is exactly what the Geneva Declaration of Principles (ITU, 2005e) is about.

3.3.3. The changing framework: from push to pull strategies

If something is clear from all the previous pages so far is the complexity of the whole situation:

- Concepts – access, digital divide, e-readiness – not always are understood equally everywhere, everywhen
- This is why one size does not fit all: neither the same technologies, nor the same policies apply for each and every community, region or country
- In part, this is due to there being different stages of development of the Information Society, across countries and within countries, making it difficult not only to apply the same solutions, but even to use the same tools to measure this state of development

- These different states can be generally split in two: main physical conditions of access – based in infrastructures and resources – and uses and point of view of the user – based in capacity and perceptions
- Measuring the state of development of the Information Society, or the impact and feedback of ICT policies, needs to take into account this changing context and makes it difficult to have universal ICT indicators[94]
- Provided such universal ICT indicators – or a unique ICT index – could be built, it should include the dynamics of ICT development, its different stages, and not only the snapshot of the current situation or an ideally set goal

For the sake of clarity and synthesis[95], we here propose revisiting, on one hand, Welzel et al. (2003) work on development[96]; on the other hand, Castells (2000) work on the Network Society and Informationalism[97]. Merging Figure 2 (left) and Figure 1 (right), we present the following scheme:

Development	ICT4D	Network Society
Socioeconomic Development (individual resources)	INFRASTRUCTURES	Matter (nature)
	ICT SECTOR	Production
Subjective Orientation Towards Choice (emancipative values)	(DIGITAL) LITERACY	Experience
Freedom Rights (democratization)	LEGAL FRAMEWORK	Power
	USES (CONTENT & SERVICES)	Culture

Figure 5: A structure of Information and Communication Technologies for Development

As can be seen in Figure 2, our idea is face a structure of development – as pictured by Welzel et al. (2003) – with a structure of society, the Network Society – as pictured by Castells (2000) –, in so trying to provide a comprehensive view on the role and impact of Information and Communication Technologies for Development.

This scheme will prove helpful, in the following pages, to structure a critique on how nowadays the state of development of the Information Society is measured and assessed.

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94 For instance, Karine Barzilai-Nahon (2006) declares: "I do not assume that the e-readiness question overlaps the digital divide issue, and therefore I do not believe all the integrated assessment tools compared in the Bridges.com [sic., referring to Bridges.org, 2001] study would fit our discussion here. For example, I do not think that trust in eCommerce relates directly to digital divide."

95 The reader will tell if we have achieved them or, instead, performed an illogical leap.

96 See section 2.4

97 See section 2.3

Indeed, and according to the review of the literature done so far, we are able to state the following:

- Policies to foster the Information Society radically differ – and should differ – from the first to the advanced stages of ICT adoption
- While the former focus on the minimum setup – infrastructures – the latter focus on the user – digital content and services –.
- According to this, the first stages of development have to be fostered and enabled – not only, but mostly – by a global consensus led by public commitment to provide funding and a proper legal environment.
- The latter stages of ICT development have to be demand driven, letting the market adapt to the customers' needs, leaving for the Government the role to correct structural inequalities[98]
- The maturity of technologies and users – paradigmatically described by the shift from the Web 1.0 to Web 2.0 philosophy – reinforces these trends

Which can be summarized in Figure 6:

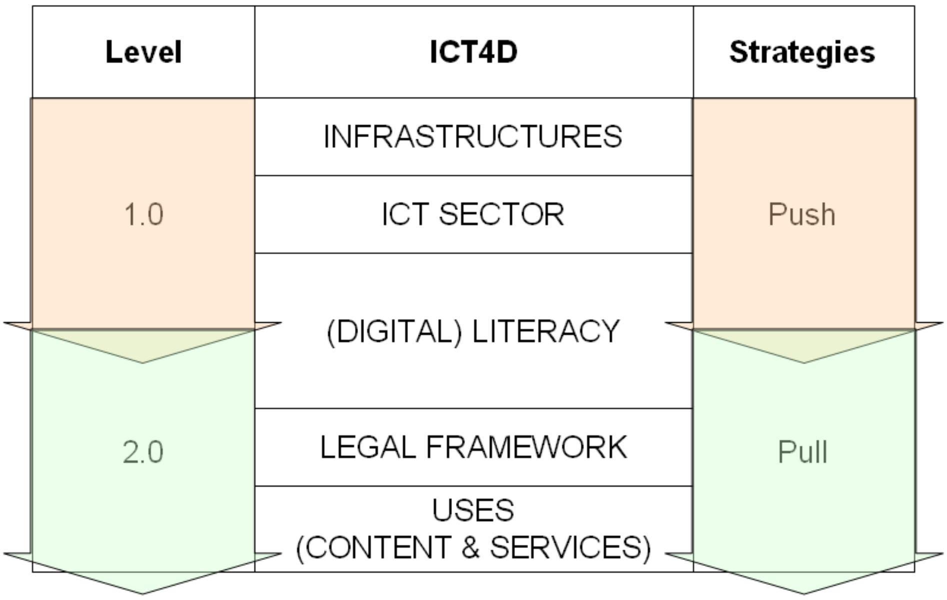

Figure 6: ICT policies: from push to pull strategies

In our opinion, many (almost) e-developed countries[99] are just at the hinge between an Information Society based on infrastructures and the creation of a strong ICT sector, and another one based on highly digitally literate people that demand high quality digital content and services in an adequate regulation framework (adequate not for incumbent carriers, but for digital content and services provision: privacy, intellectual property rights, cyberlaw, etc.).

[98] See, for instance, Sabaté (2007a and 2007b) combined with World Economic Forum (2007).
[99] *Íbid*. for the case of Spain

Not to stay forever at that hinge, the transition from 1.0 to 2.0 must be boosted. And it is our believe that, after a successful push strategies to set up the basements of a first phase of the Information Society – the ones actually needed in developing countries catching up with the Digital Revolution –, what is needed is pull strategies so that the growth, both in depth and width, of the Information Society is made socially sustainable according to citizens' needs and, at the same time, economically sustainable according to customers' will to pay.

Part II:
Modelling and Measuring the Digital Society

4. Measuring the Digital Society, measuring the Digital Divide: Theoretical Framework

In the preceding chapters – particularly the last two – we have provided an overview of the main concepts underlying the Information Society[100] and what are the different changes that it is bringing, especially at both the economic and social levels. After this first analysis, we have also described what the main interpretations are around the concept of 'access' and how these interpretations may imply different perceptions of the state of development of the Information Society in one community and, thus, what policy measures should be introduced to reach specific strategic goals.

The concepts, and the existing relationships amongst them, confirm our understanding of what the Information Society is and hence we build models that try to map them together. But beyond the fact of being accurate representations of the reality, the importance of such models is that they serve as blueprints for action:

- They help researchers design strategies to look for, find and test the relationships between the featured concepts drawn as variables
- They depict the landscape where researchers seek to find new variables affected by the ICT Revolution and what are the paths of change they might take
- They set the road for decision-takers so their strategies can be aligned with the forces of evolution and development
- They are departure points and guidelines for policy-makers to know what levers and switches have to be activated to achieve higher degrees of progress for their citizenry.
- From a practical level, these quantitative models help to evaluate the impact of different policy changes and to refine those policies.

Hence, as a natural follow up to these introductory and conceptual chapters, we want to study how the Information Society has been modelled to make it understandable – not as an abstraction, but as something 'real' and related to everyday life – and, above all, measurable. The next four chapters will deal with just that.

To be more specific, we want to find what progress has been made in modelling the Information Society. By "modelling the Information Society" we understand not the main sociological, economic, etc. theories that try to explain, at the macro level, the *effects* of the Information Revolution and how societies, economies and cultures are to evolve from now on[101]. On the contrary, we want to focus on how the Digital

[100] And all other different ways to mention the phenomenon of the appearance of the Information and Communication Technologies and their impact in the Society and the Economy

[101] En example of this would be the Network Society theory elaborated by Manuel Castells (see Castells 2001a, 1998 and 2001b).

Economy – even more than the Information Society at large[102] – is mapped, what are its main components and what are their relationships. We will focus on the process by which a Digital Economy is created, by analyzing all the factors involved in the process of digitization of a society and its economy. In this train of thought, our first question is how have evolved the different models of the Digital Economy.

When mapping or modelling the Digital Economy, some authors[103] usually focus in their analyses on the policies, strategies and plans that governments set up to foster the Information Society, or their commitments towards broader goals[104]. Our approach – a twofold one – in doing so wants to be complementary to those performed by these authors.

On one hand, we will look at theoretical and methodological propositions to model the Digital Economy. We are mostly interested in their conceptual points of view, though some of them have been also applied in surveys or assessments. Even so, the focus of the chosen papers still remains the reflection about the model rather than the provision of a new tool for periodic measurement[105].

On the other hand, we will leap from (almost pure) theory and models to the actual implementation of them: sets of indicators and indices whose purpose is to measure the development of the Information Society.

The reason for leaving aside all the policies part is two-fold. First, we want to be as near as possible to what has actually been done and not what has merely been stated should be done. Second, because the results of these policies have to be properly measured, to be aware of the real achievements and in doing so – in the measurement – tacit models arise from practice. Thus, we will look at measuring devices as the footprints of the actual models put into practice.

In the next two chapters we will analyze theoretical approaches, practical assessment guides, digital economy indicators and digital economy indices. We will first present them in schematic profiles, briefly commenting on them to highlight their main characteristics. Then, in the next chapter that will follow, some preliminary conclusions will be drawn.

---

[102] We have to note that neither broader concepts like Information Society, nor narrower ones like Digital Economy do fully apply to the concept we want to name. Even if Digital Economy is the closest one, we would like to understand it in a non strictly commercial or productive way, but being Economy as a whole that permeates most aspects of one's development.

[103] See, for instance, Guerra et al. (2008) – a very interesting work based on former publications from the Digital Review for Asia Pacific Project: Yoon. (2004), Yoon. (2006) and Librero, F. (Ed.) (2008) –, Lallana (2004), Sayo et al. (2004), or Labelle (2005) or OECD (2008f).

[104] In this sense, it is of especial relevance the outputs of the World Summit on the Information Society, mainly the Geneva phase (see, for instance, WSIS Executive Secretariat (Ed.) (2003) and WSIS Executive Secretariat (Ed.) (2004). World Summit on the Information Society - Report of the Geneva phase of WSIS)

[105] Of course, pure categories do not exist in reality. The reader might not agree with our way of grouping the works here presented. Some cases (e.g. Mosaic or the African ICT e-Index) really do challenge any categorization possible. At last, our final decision in assigning one model to one chapter – models – or the other one – indicators and indices – has been led by aim to weave the most didactic argument.

The analysis will be based on:

- The identification of the main theoretical categories dealt with in each chosen work;
- Counting and categorizing each and every variable measured with an empirical indicator – when available.

This double categorization should allow us to disclose the evolution and characteristics of the modelling of the Digital Economy based in the development of infrastructures and "tangibles", that has slowly shifted towards a second one, based on intangibles; and the evolution from a supply-side based modelling that has slowly included a demand-side point of view.

4.1. Methodology

The analysis that follows will have two differentiated approaches.

A first analysis – whose preliminary conclusions will be shown in chapter 9 – will be a qualitative one and, as we have already stated, will have been conducted iteratively by setting provisional categories to the models analyzed and then going back to them with adjusted sets of categories. Though the primary categories have remained unchanged along the analysis, the secondary categories have certainly been adjusted to gather all the cases appearing in the models.

A second analysis is performed after the preliminary conclusions. Its aim is, through a quantitative methodology, to polish and bring more detail to the findings that arise from the qualitative approach. We will describe this quantitative analysis in chapter 10.

The choice of models to analyze has been quite comprehensive.

For the first group of theoretical models, the work done by Bridges.org[106] has been a good starting point. It has, nevertheless, been updated according to the literature review. In this sense, we have set aside or included works depending on the relevance of the academic debate that they have generated or the development of the issues there presented that their authors have carried on later.

For the second group of composite indices and sets of indicators, comprehensiveness has been the rule, having as the two main drivers the tradition of the sets of indicators and indices, or them being "live" sets of indicators and indices being used today, or until very recently, or by international or globally acknowledged organizations.

[106] Bridges.org (2005a, 2005b, 2005c)

4.2. Main theoretical categories

To draw the main theoretical categories we have performed an iterative exercise throughout all the analyzed models[107]. So, after a starting point with a minimum set of categories, we have been completing the set to finally make it look as shown in Table 4:

Primary categories	**Infrastructures**	**ICT Sector**	**Digital Skills**	**Policy and Regulatory Framework**	**Content and Services**
Secondary categories	**Availability**	**Enterprises / Economy**	**Digital Literacy Level**	**ICT (Sector) Regulation**	**Availability**
	Affordability	**Workforce**	**Digital Literacy Training**	**Information Society Strategies and Policies**	**Intensity of Use**

Table 4: Main Theoretical Categories

In chapter 9 we will go deeper into what each category really means, especially under a dynamic approach where we will be analyzing the different shifts of the models between categories. Nevertheless, some rough definitions follow:

- Infrastructures: Information and Communication Technologies. Can be divided into three groups: hardware, software and connectivity.
  - Infrastructures, Availability: the presumed existence of these infrastructures.
  - Infrastructures, Affordability: the cost for the end user of the acquisition of such infrastructures in relationship with one individual or community's economic power – hence, the price in real terms.
- ICT Sector: The economic sector responsible for the provision of ICT Infrastructures[108]
  - ICT Sector, Enterprises / Industry: The existence of firms whose activities fits within the definition of the ICT sector.
  - ICT Sector, Workforce: Skilled employees that work directly in the ICT Sector or whose activities are closely related to it[109].

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[107] The reader can take as a reference chapter 9 and go to and fro.
[108] See, for instance, OECD (2007c)
[109] Though this workforce requires, necessarily, a high level of digital skills and could, then, be included in such category, we think that the use these employees make of their skills – a goal in themselves, more than a means for other uses – makes it more appropriate to see it as part of the industry's capability to supply with ICT goods and services.

- Digital Skills: Skills related relevant both to the use of electronic devices and the use of information in digital format[110]
    - Digital Skills, Digital Literacy Level: The measured levels of such skills in an individual or a community, both in relation to the number of literate people and the degree of their literacy.
    - Digital Skills, Digital Literacy Training: The existence of courses, curricula or other training plans to increase the Digital Literacy Level.
- Policy and Regulatory Framework: Whether there are explicit rules, laws, policies, etc. that directly affect and try to put in order the Digital Economy.
    - Policy and Regulatory Framework, ICT (Sector) Regulation: Rules created by the Legislative branch or other regulatory bodies to regulate the Digital Economy, especially the ICT Sector and its activities.
    - Policy and Regulatory Framework, Information Society Strategies and Policies: Policies, strategic plans, etc. created by the Executive branch or other functions of government to frame their Digital Economy related policies.
- Content and Services: Content and services in digital form.
    - Content and Services, Availability: The existence of such contents and services, including those arising from the private sector (for or without profit) and the public sector.
    - Content and Services, Intensity of Use: The use of such content, measured both quantitatively and qualitatively.

4.3. Indicators count

When possible[111], we will also count the *number* of indicators that each model introduces[112], as a surrogate way of assessing their focus. Presented as percentage of the total, we will group the indicators in three ways:

- According to the original categories set by the author(s) of the model
- According to a simplified model of the categorization defined in the previous section – simplified in the sense that only the primary categories will be taken into account for the sake of the clarity of the exposition.
- An extended mode of the previous one, now including all secondary categories[113]

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[110] This is a full discipline on its own. We will just refer the author to the following works for an introduction: Gilster (1997), Larsson (2000), Marquès Graells (2000a, 2000b, 2002) and Ortoll Espinet (2005)

[111] Meaning by possible that (a) the work actually goes on and uses a set of indicators and (b) these indicators are made available.

[112] It is worth noting that not all indicators introduced by an applied model are meant to be calculated by the promoters of that specific model. Thus, is is quite usual – especially in international organizations – to find different sources gathered together to build a new composite index. It is the case, for instance, of the Networked Readiness Index, that even if most data come from the World Economic Forum – its promoter – some other come from other sources.

[113] Categories are labeled in this case by using the name of the primary category and adding "Supply" or "Demand". "Supply" secondary categories correspond to the first row of categories in

Notwithstanding, a "Nondigital" category is added in the second case to gather the "analogue noise"[114] introduced in the model. This category will gather all the indicators not directly related to the Digital Economy, i.e. that do not strictly belong to any other of the categories.

A hypothetical set of indicators, perfectly balanced both in the original categorization and in our categorization (simple and extended) would look like Figure 7, Figure 8 and Figure 9, respectively:

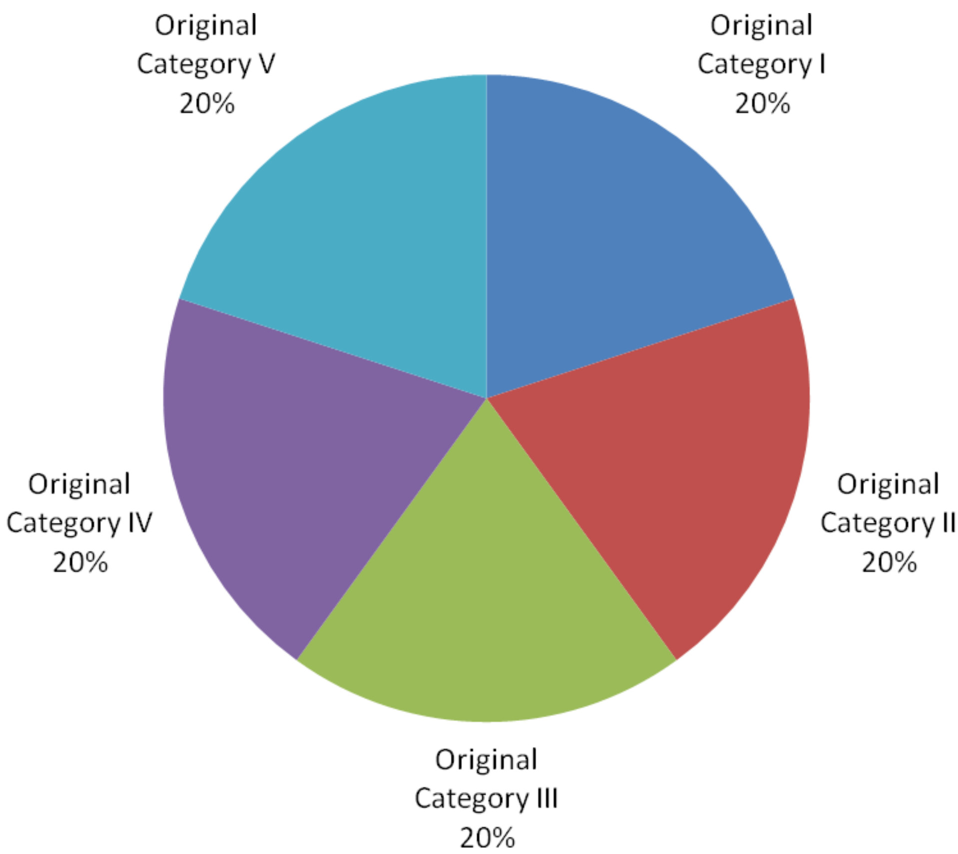

Figure 7: Distribution of indicators according to the original categories – a hypothetical case

To ease the understanding of the analysis that follows, we have split it in four chapters that mainly comprise the 52 models studied. Each chapter includes one set of models that roughly correspond with a classification of such models. Of course, the limits between each class are blurry and our sole intention in assigning a model within a specific typology is to bring some clarity to our exposition.

Table 4, corresponding "Demand" secondary categories to the second row. Further explanation about this distinction is to be found in chapter 10.

[114] See section 3.1.3.

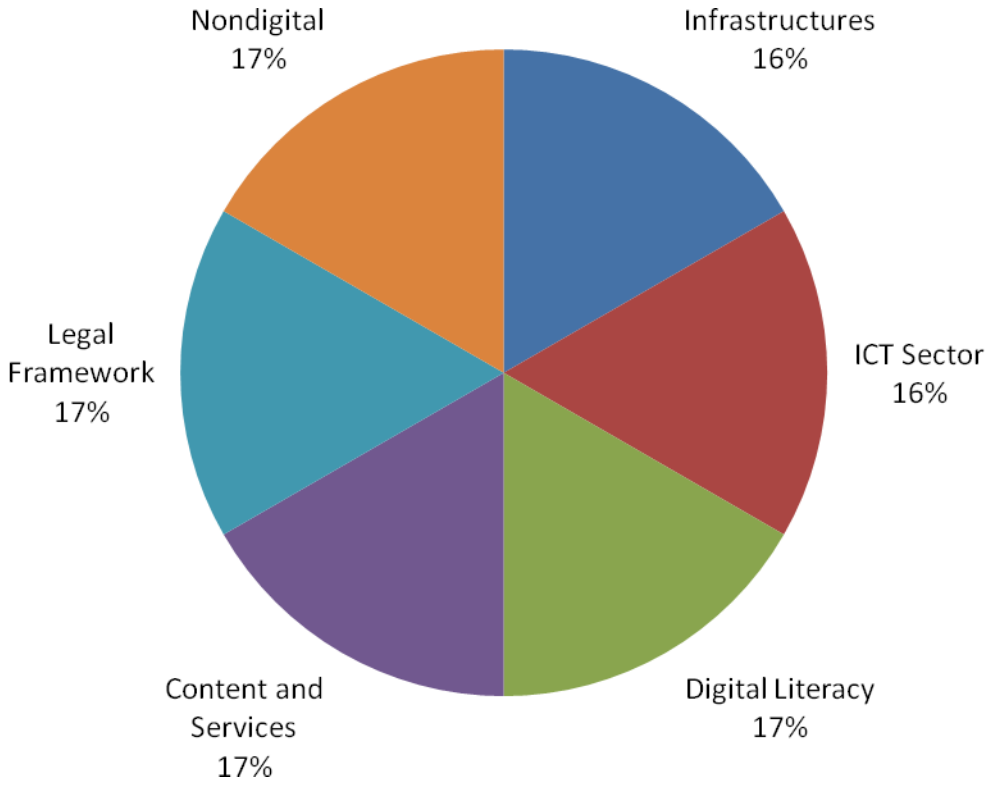

Figure 8: Distribution of indicators according to our primary categories – a hypothetical case.

Chapters and sections are usually organized following the same structure. First level sections correspond to the different models analyzed, normally sorted in chronological order[115]. Within sections, the analysis will usually feature a brief introduction, a list of the main[116] publications where the model was depicted or mentioned, the composition of the model according to the three previous distributions of indicators, and a brief, closing comment where the main characteristics of the model are highlighted.

[115] This chronological order is normally done taking into account the most recent publication or update of the model in question. Sometimes, the order is not strictly chronological in that way, but a conceptual one: first a "father" model is presented, being followed by other models that were based in that paradigmatic model. Last, sometimes the order is slightly altered depending on the relevance or wide acknowledgement of a specific model before another one, then first presenting the less relevant as an introduction to the more acknowledged one.

[116] We want to stress this point to avoid confussion to the reader. Even if in some paragraphs later we can read that a specific model was dealt with in just one work – or a couple of them –, we want to clarify that this work or these works conform the most representative literature about this model, and in any case a comprehensive literature about it.

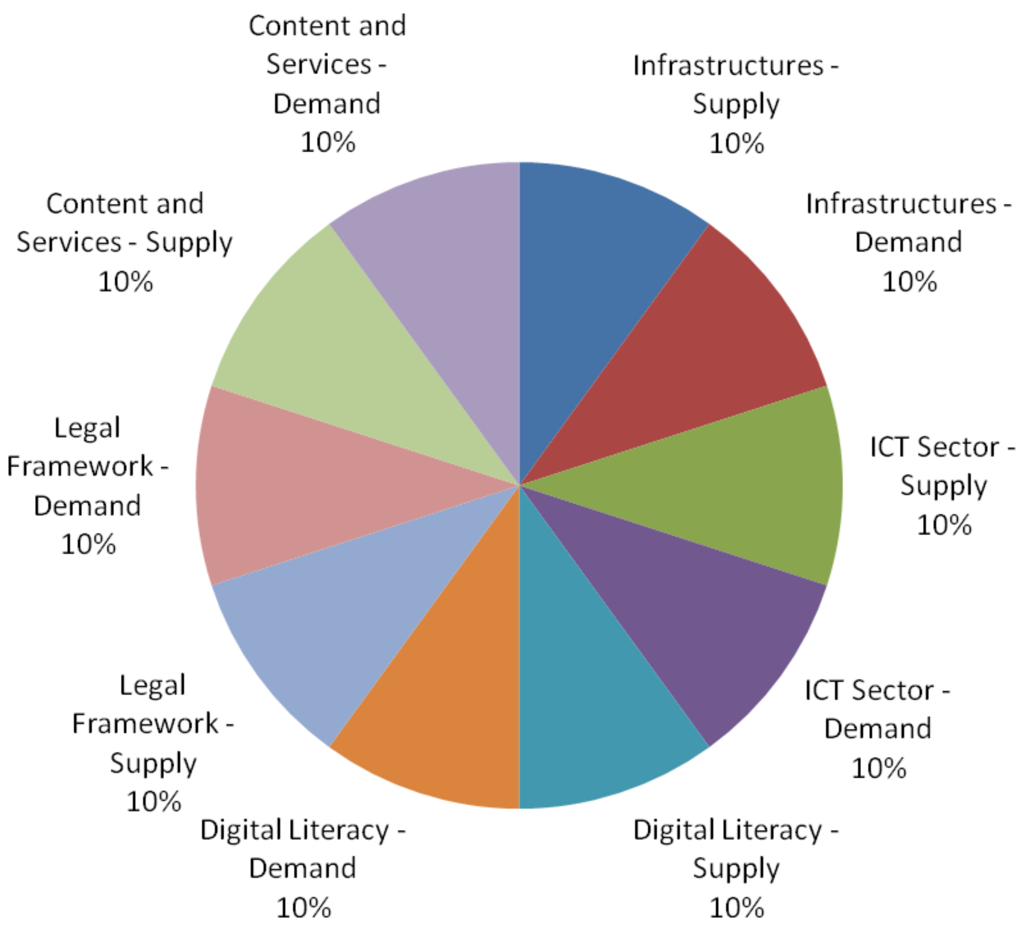

Figure 9: Distribution of indicators according to our categories, including secondary categories – a hypothetical case.

The introduction and comments, for the sake of clarity and economy of space, are presented here schematically and only in their main lines. We refer the reader to the original works to deepen the history, reflections, making of and details of each model.

5. Digital Economy Models: Descriptive Models

By *descriptive models* we mean the attempts to draw structures and rationales about the Digital Economy without the direct observation of any data, just relying on changes of patterns, trends and qualitative impacts that scientists have witnessed in the society.

We are not saying that, to draw these models, the authors are completely unaware of – or have completely set aside – the evolution of specific indicators, or that their descriptions are totally unbacked by evidence. On the contrary, our criterion when choosing them was, precisely, that they presented serious approaches to Digital Economy modelling. But these approaches have not been tested – or not directly by their authors – statistically against data from own or other sources.

The models chosen are:

5.1 The Access Rainbow 120
5.2 Global Action Plan for Electronic Commerce 122
5.3 e-Commerce Readiness Assessment Guide 123
5.4 Readiness for the Networked World. A Guide for Developing Countries......126
5.5 Readiness Guide for Living in the Networked World....................130
5.6 The Development Dynamic....................133
5.7 e-Readiness Guide (GeoSINC) 135
5.8 Models of Access 138
5.9 Layers, Sectors and Areas of the Information Society 139
5.10 Real Access Criteria – e-Readiness Assessment....................141
5.11 Comprehensive Metric....................144

5.1. The Access Rainbow

Andrew Clement and Leslie R. Shade "Access Rainbow" is probably one of the first efforts to try and model, in a comprehensive way, what we do understand by Digital Economy. As we have already stated in other chapters, we want to state the importance of the fact that the Internet was fully available[117] to the public during the years 1994 and 1995. Thus, the fact that the "Access Rainbow" was published in 1998 – and hence been worked with during the previous one or two years – gives us an idea of the first concerns to define a state of the question that, more or less, looks the same way it looks now[118].

In their work, Clement and Shade (1998) ask themselves three main questions:

1. Access for what purposes?
2. Access for whom?
3. Access to what?

coming up, as a concluding answer, with Figure 10, modelling a model of access that should:

> include support for a multiplicity of usage roles involving creation and dissemination as well as retrieval of existing information; encompass both conventional and new media; recognize the interplay of social and technical dimensions in the development of infrastructure; define what services are "essential"; identify "access gaps", those social segments likely to be "left out" by market forces acting alone, and hence in need of protection via collective public initiatives (Clement and Shade, 1998).

5.1.1. Main publications

Clement, A. & Shade, L. R. (1998). *The Access Rainbow: Conceptualizing Universal Access to the Information/Communications Infrastructure*. Information Policy Research Program, Faculty of Information Studies, University of Toronto. Working Paper No. 10. Toronto: IPRP University of Toronto.

5.1.2. Distribution of Categories

As Figure 10 shows, the Access "Rainbow" ranged seven categories from infrasctructures (carriers, devices and software) to governance, going through content and services and the digital competences to use them.

---

[117] Because of the factual openness of the system and because of the improvement of the graphic user interface Internet browsers.

[118] We are aware that there have been plenty of developments in both the technologies and uses of ICTs, specially in the field of mobility, but we think that the Internet represents *the last significative* milestone in the evolution of ICTs.

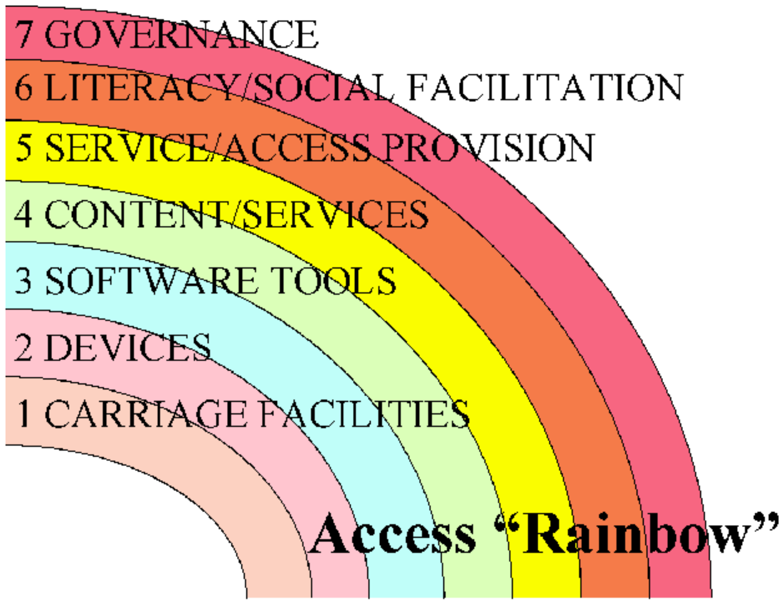

Figure 10: The Access Rainbow (Clement and Shade, 2008)

5.1.3. Comment

In our opinion, the most interesting thing to note in the "Access Rainbow" is, given the existing literature at that moment, its comprehensiveness. Their effort[119] in gathering all points of view possible is notable.

Nevertheless, as can be seen in Figure 11, their focus is put primarily on "stock" variables, being their analysis mainly put in the state of the question and how this enables or represents a barrier to access. The exception being policies, where they grant a key role to the policy-maker to foster strategies to achieve universal access, as long as to implant other issues (e.g. the 'electronic commons'[120]).

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Facilities, devices and software	Service / Access Provision	Literacy / Social Facilitation	Governance	Content / services
			Governance	

Figure 11: Clement and Shade's Access Rainbow – main topics covered

[119] See, for instance, the bibliography listed in Clement and Shade (1998)
[120] Clement and Shade (1998), Section II.7

Last, we want to point that, even if this work is has not the shape of an assessment guide as we usually understand it, the structure and, especially, the existence of Appendix 1, makes it useful as a first attempt to assess one's state of e-readiness.

5.2. Global Action Plan for Electronic Commerce

The World Information Technology and Services Alliance (WITSA) – an international consortium of Information Technology industry associations – has been also proactive in reflecting and advising the ICT Sector – and the society at large – about the impact of ICTs and how to foster the Information Society[121].

As it happened with Clement and Shade's Access Rainbow, WITSA began quite early – in 1998 – to define the redlines of what constituted, according to their criterion – a good strategy to promote and boost electronic commerce.

Through three editions of their Global Action Plan for Electronic Commerce[122], WITSA presented a collection of actions – hence the "action plan" – that both businesses and governments should be taking according to the experience gathered by the members and experts of the Alliance.

5.2.1. Main publications

WITSA (1998). *A Global Action Plan for Electronic Commerce*. Arlington: WITSA.

WITSA (1999). *A Global Action Plan for Electronic Commerce*. 2nd edition. Arlington: WITSA.

WITSA (2002). *A Global Action Plan for Electronic Business*. 3rd edition. Arlington: WITSA.

5.2.2. Comment

Even if the proposals made by WITSA's experts are mostly qualitative and difficult to categorize, the shift from tangible (e.g. infrastructure based actions) towards intangible (e.g. regulation based actions) aspects of the Digital Economy is evident, as can be seen in Figure 12, depicting the main topics covered by the Global Action Plans[123].

Doubtless, the main richness of these reports is the capability to extract the experience of the practitioners and turn it into strategies to be applied by decision-takers and policy-makers in the future. In this sense, the stress is put specially in all the issues concerning the Policy and Regulatory Framework, both in the regulation of the ICT Sector and also in the policies that need to be taken (by governments) to

[121] See also the section about the Digital Planet in section 8.5.
[122] The name changed 'Commerce' for 'Business' in the third edition of the report, obviously to imply a broader scope to the report.
[123] For matters of cretion of Figure 12 we used the third edition of the report (WITSA, 2002a).

build a proper environment to comfortably fit all other developments in the field of ICTs.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Availability	Enterprises / Economy		ICT (Sector) Regulation	Availability
		Digital Literacy Training	Information Society Strategies and Policies	Intensity of Use

Figure 12: WITSA's Global Action Plan for Electronic Commerce – main topics covered

We want to note too the importance given to a proper training in digital literacy skills, as it is an issue that is not very commonly taken into account in other models. In other words: while other models do speak of the need of a certain level of digital literacy, the inclusion of training actions of digital competences in syllabuses and corporate training – as it appears in the Global Action Plan for Electronic Commerce – is scarcely found in these models.

5.3. e-Commerce Readiness Assessment Guide

At the end of 1999, a partnership gathered around Asia-Pacific Economic Cooperation forum to debate about the factors that could bring to success e-commerce in the region. Moving "from proposal to execution in only a little over six months", the APEC E-Commerce Readiness Initiative (2000) published a guide to help the economies of the Pacific Rim region to engage in the measure of the development of e-commerce.

The Guide focused on six groups of indicators:

- Infrastructure and Technology
- Access to Services
- Current Level and Type of Use of the Internet
- Promotion and Facilitation Activities
- Skills and Human Resources
- Positioning for the Digital Economy

that provided practical tools – in the shape of a questionnaire – to be followed by policy-makers to assess the state of the question in e-commerce matters.

5.3.1. Main publications[124]

APEC e-Commerce Readiness Initiative (2000). *E-Commerce Readiness Assessment Guide*. Auckland: APEC

5.3.2. Distribution of Indicators

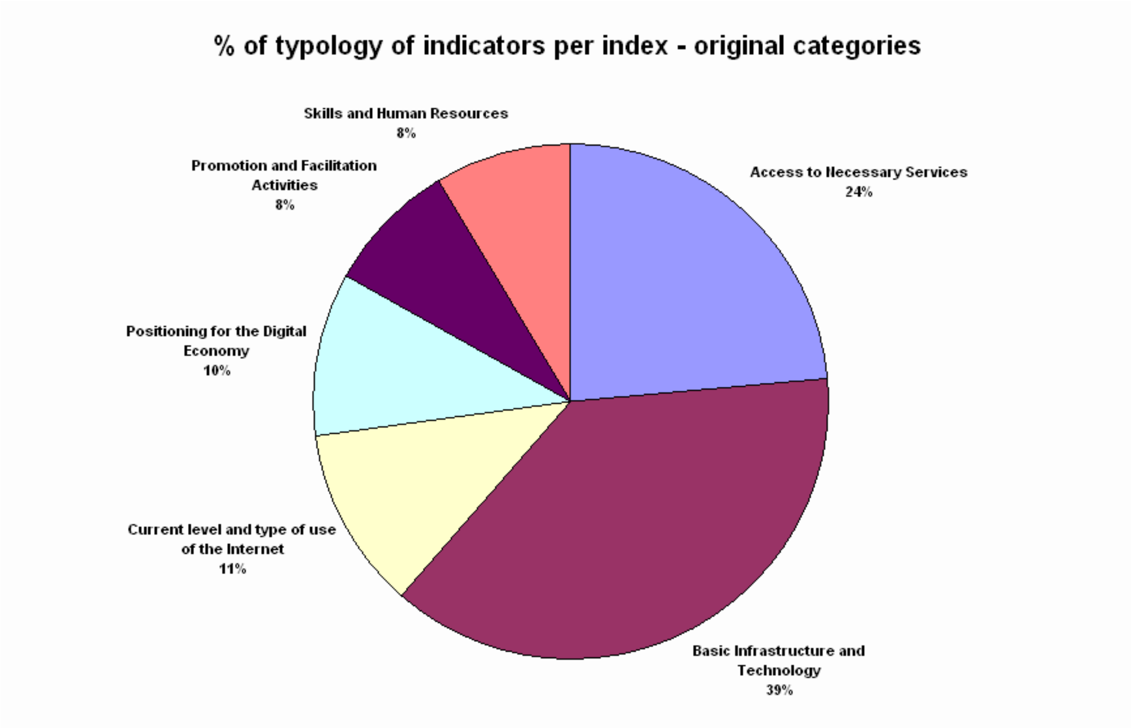

Figure 13: e-Commerce Readiness Assessment Guide. % of typology of indicators per index – original categories

[124] Though we could include here Bui et al. (2002) as a practical implementation of an e-readiness assessment in the APEC, it is evident that this work does not follow the Guide but a model on its own. Please refer to Chapter 6 for more information about this work.

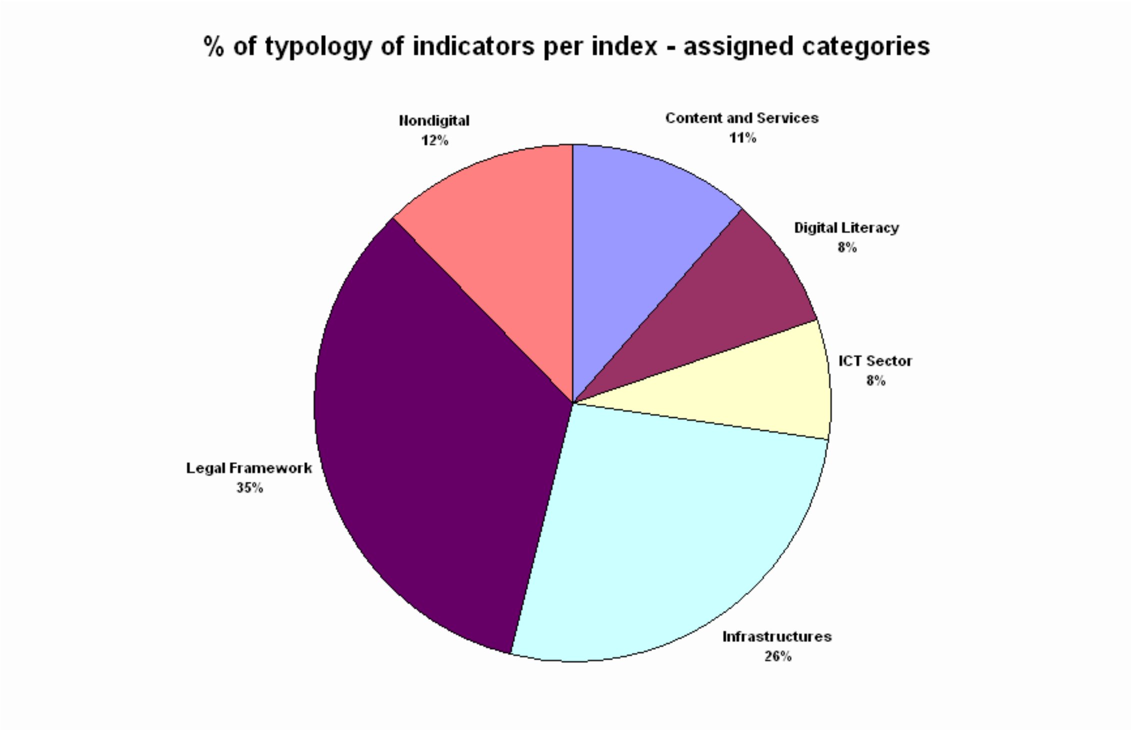

Figure 14: e-Commerce Readiness Assessment Guide. % of typology of indicators per index – assigned categories

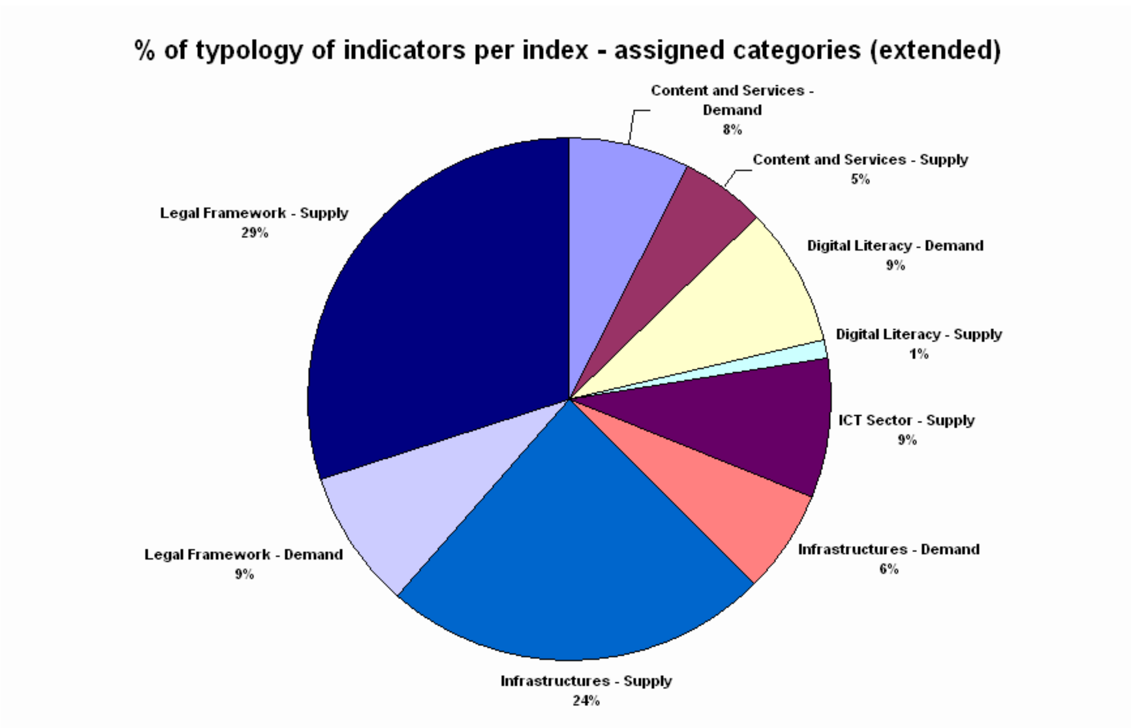

Figure 15: e-Commerce Readiness Assessment Guide. % of typology of indicators per index – assigned categories (extended)

5.3.3. Comment

As can be seen both in Figure 15 and Figure 16, comprehensiveness is the main achievement of the e-Commerce Readiness Assessment Guide. As it happened in the case of WITSA's Global Action Plan for Electronic Commerce[125], the Policy and Regulatory Framework is deeply dealt with, as it is again a guide aimed to policy-makers and decision-takers. Hence, the level of competition of the telecommunications market or the implication of governments in fostering Information Society policies or awareness raising are key to this model.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Basic Infrastructure and Technology	ICT Services	e-Awareness	Positioning for the Digital Economy	Content
Quality of Infrastructures		Skills and Human Resources	Promotion and Facilitation Activities	Level and type of use of the Internet

Figure 16: e-Commerce Readiness Assessment Guide – main topics covered

On the other hand, both figures (especially Figure 16) have to be read with caution. The level of digital literacy is almost and surprisingly forgotten, due to the high interest the model shows in measuring how ICTs are permeating schools and education in general. This interest is neither translated into the measurement of a digitally capable workforce.

Even if existent, the amount of content and the intensity of use of such content and digital services is measured shyly, behind more complex and holistic approaches that appear in more recent models. Similarly occurs with affordability: though the effort to measure it is highly valuable, other designs will show more systematic ways of measuring the relationships of cost of infrastructures.

5.4. Readiness for the Networked World. A Guide for Developing Countries

The Center for International Development at Harvard University published in 2000 – actually just short time before the APEC E-Commerce Readiness Initiative and the

[125] See section 5.3

Computer Systems Policy Project did alike – their e-Readiness Guide (CID, 2000). Led by renowned development economist Jeffrey Sachs, the Guide was aimed to developing countries, though their model can be perfectly applied to any kind of country or, to say the least, to any region lagging behind in ICT adoption (e.g. rural areas in most developed countries).

The guide is a help to assess the "numerous factors that determine the Networked Readiness of a community in the developing world" (CID, 2000) and categorizes these factors into five main groups:

- Network access
    - Information infrastructure
    - Internet availability
    - Internet affordability
    - Network Speed and Quality
    - Hardware and Software
    - Service and Support
- Networked learning
    - Schools' Access to ICTs
    - Enhancing Education with ICTs
    - Developing the ICT Workforce
- Networked society
    - People and Organizations Online
    - Locally Relevant Content
    - ICTs in Everyday Life
    - ICTs in the Workplace
- Networked economy
    - ICT Employment Opportunities
    - B2C Electronic Commerce
    - B2B Electronic Commerce
    - E-Government
- Network policy
    - Telecommunications Regulation
    - ICT Trade Policy

5.4.1. Main publications

Center for International Development at Harvard University (Ed.) (2000). *Readiness for the Networked World. A Guide for Developing Countries*. Cambridge: Center for International Development at Harvard University.

5.4.2. Distribution of Indicators

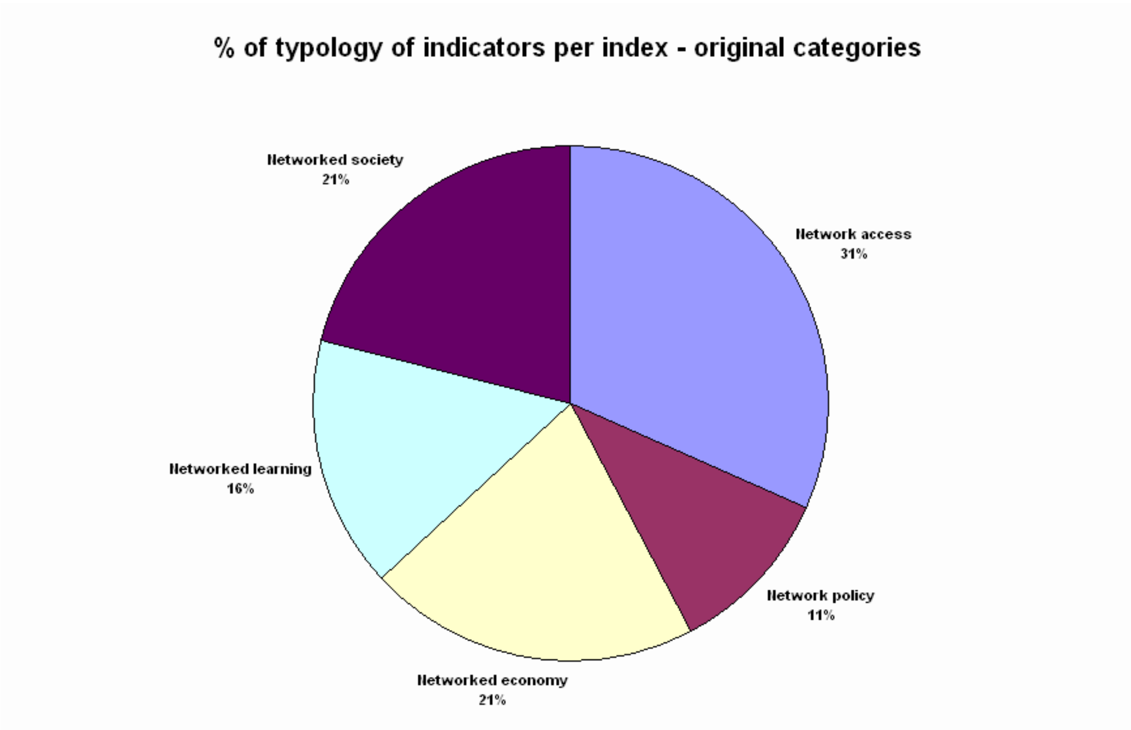

Figure 17: Readiness for the Networked World. % of typology of indicators per index – original categories

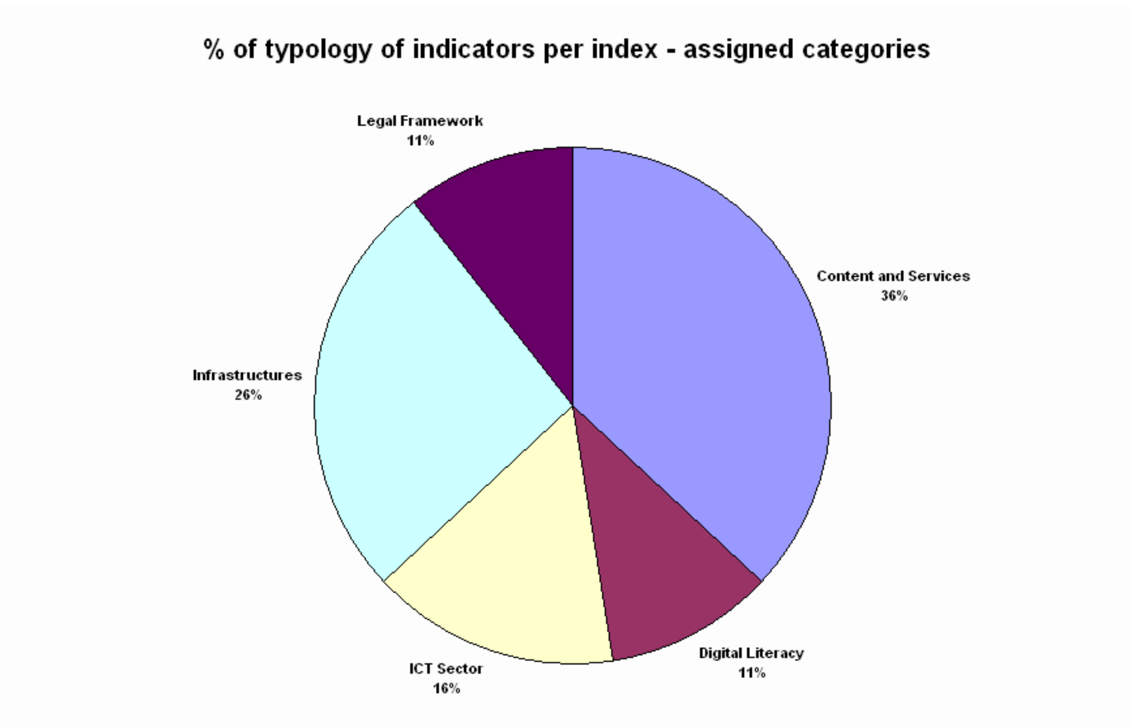

Figure 18: Readiness for the Networked World. % of typology of indicators per index – assigned categories

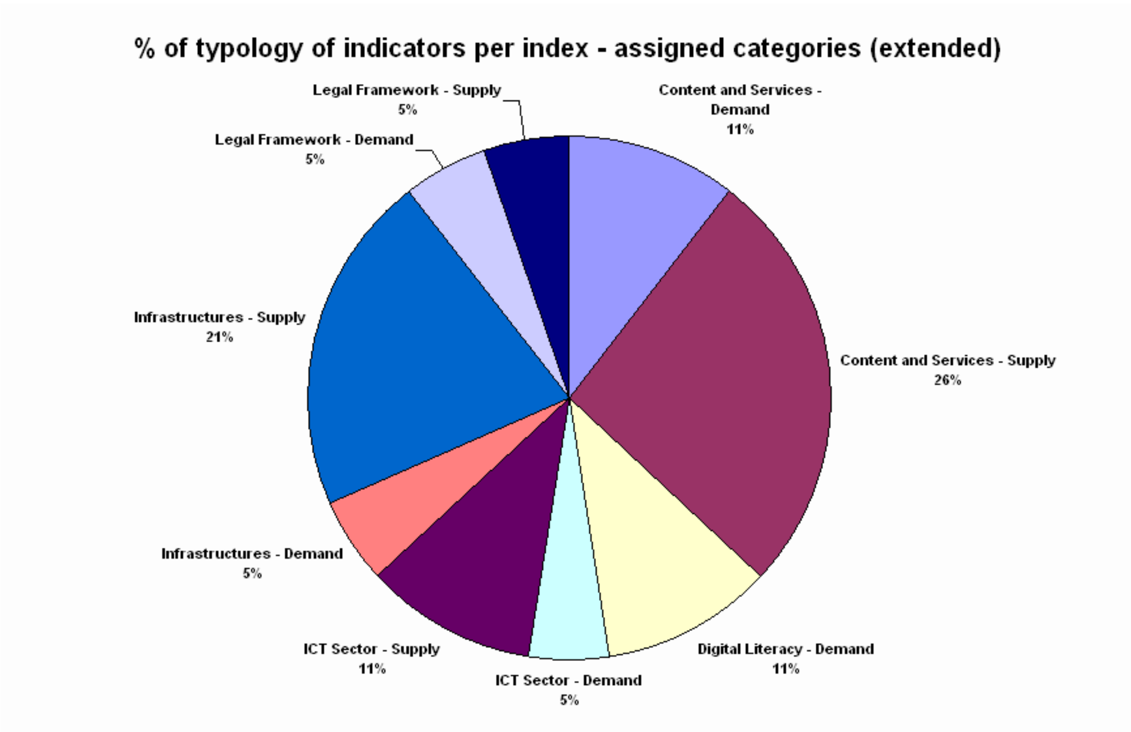

Figure 19: Readiness for the Networked World. % of typology of indicators per index – assigned categories (extended)

5.4.3. Comment

CID's e-Readiness Guide is a pleasantly surprising approach to modelling the Digital Economy.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Networked Access	ICT Service and Support		Network Policy	Networked Society
Affordability	Networked Economy (ICT employment)	Networked Learning	Network Policy	ICTs in Everyday's Life & Work

Figure 20: Readiness for the Networked World – main topics covered

First, it provides different levels of achievement or different stages of development for each indicator or factor. As we will be seeing, this aspect is not really common in other qualitative or discrete models[126].

Second, and as expected in a "for developing countries" approach, the first impression is that the Guide will heavily rely or focus in the more tangible parts of the Digital Economy, the ones related with Infrastructures and the ICT Sector.

As can be confirmed by looking at Figure 20, this statement is absolutely true. But two reflections arise from the look of that figure and Figure 19.

On one hand, it is important to note that, despite the evident weight of the supply side (availability of infrastructures, existence of an ICT Sector), the demand side (affordability, skilled workforce) is also present in the model.

On the other hand, and very meaningful to our understanding, the existence of digital content and services, and the intensity of use of such intangibles is also very important in the model, which represents a commitment with ICTs as a driver of sustainable development (ICT4D) beyond a perspective of ICTs as locomotive of middle term catalyser of the productive economy.

5.5. Readiness Guide for Living in the Networked World

If Harvard's CID Guide was born in an academic environment, it is not surprising that the guide that would come from the Computer Systems Policy – an association of the technology industry – had a high probability to be having almost an opposite approach.

The Readiness Guide for Living in the Networked World (CSPP, 2000), released shortly after CID's, is a clearly by the industry and for the industry guide.

The work is, in its structure, quite similar to CID's, though here split into five different categories:

- The Network (Infrastructure)
  - Speed & Availability - Residential
  - Speed & Availability – Commercial
  - Wired/Fixed Wireless
  - Mobile Wireless
- Networked Places (Access)
  - Business
  - Government
  - K-12
  - Higher Ed
  - Health

126 Of course, continuous indicators based on quantitative variables are easily converted into indices that do provide measures of the (relative) degree of development of such variable.

    - Home
- Networked Applications & Services
    - Business
    - Government
    - K-12
    - Higher Ed
    - Health
    - Home
- Networked Economy
    - Innovation
    - Workforce
    - Consumer
- Networked World Enablers
    - Ubiquity
    - Security
    - Privacy
    - Policy

that already give us a good hint that things are going to be different from the previous guide.

5.5.1. Main publications

Computer Systems Policy Project (2000). *Readiness Guide for Living in the Networked World*. Washington, DC: CSPP

5.5.2. Distribution of Indicators

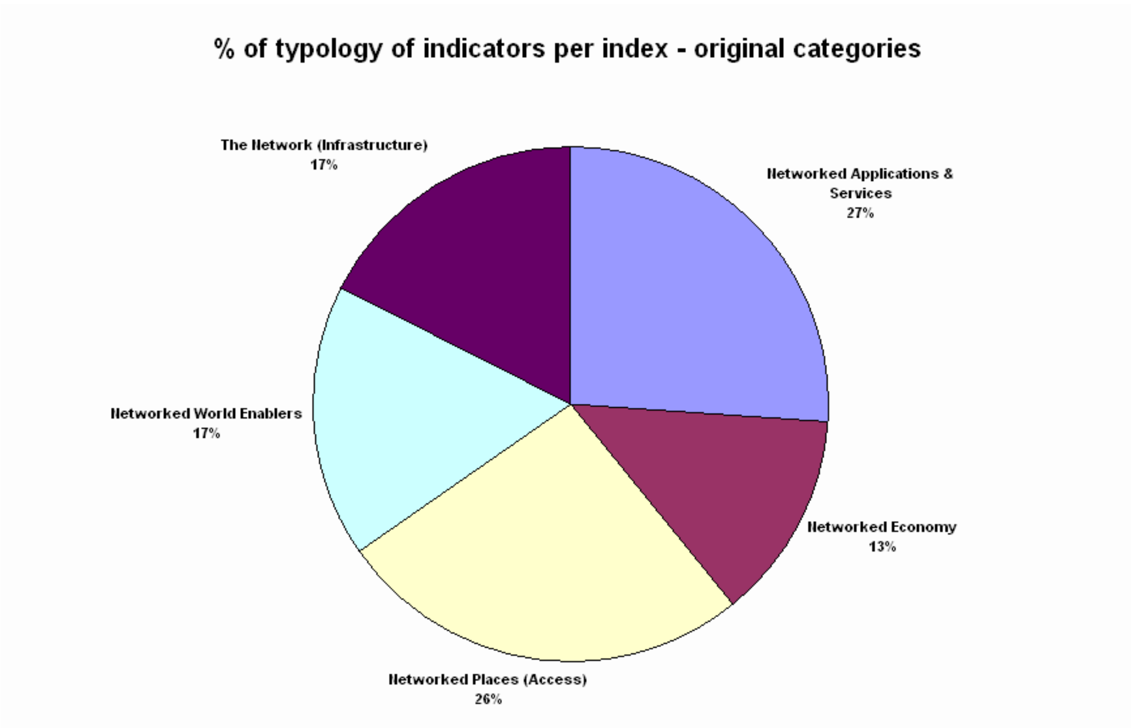

Figure 21: Readiness Guide for Living in the Networked World. % of typology of indicators per index – original categories

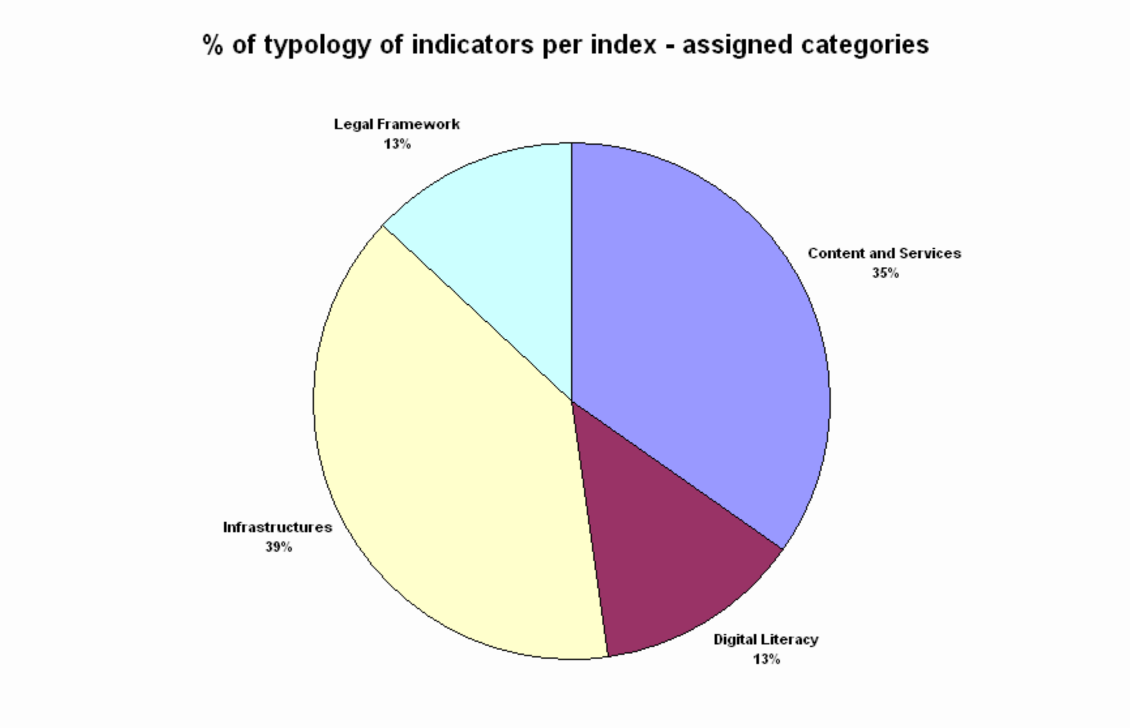

Figure 22: Readiness Guide for Living in the Networked World. % of typology of indicators per index – assigned categories

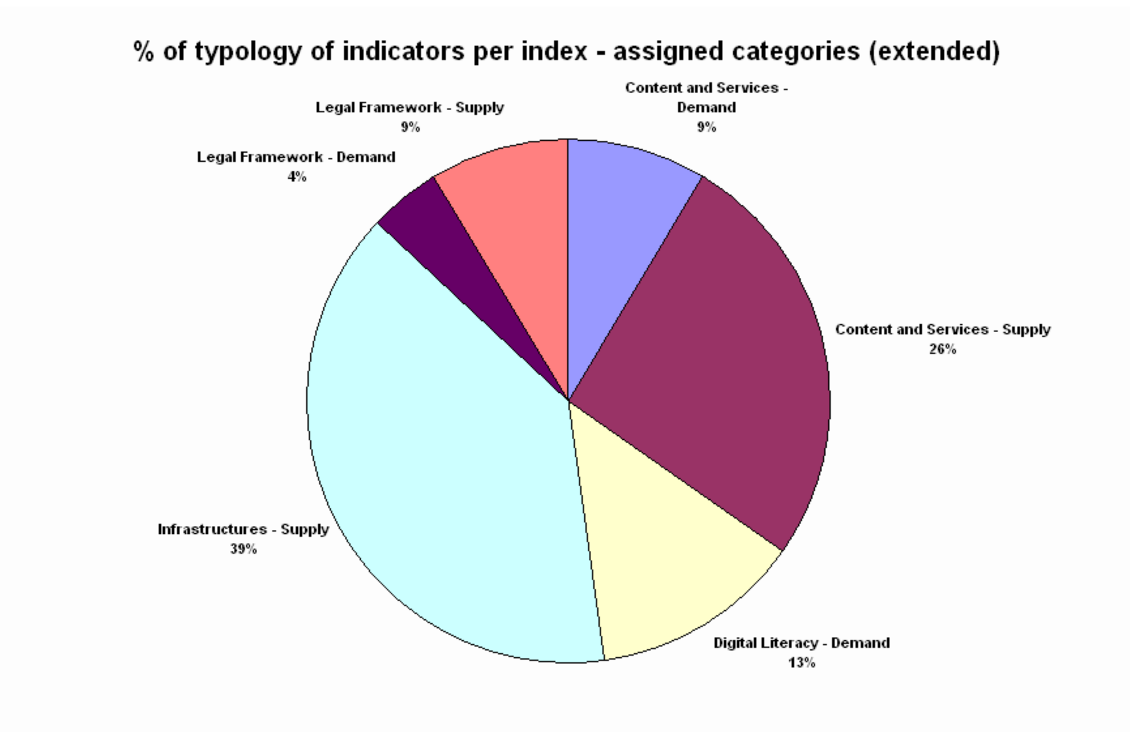

Figure 23: Readiness Guide for Living in the Networked World. % of typology of indicators per index – assigned categories (extended)

5.5.3. Comment

This guide strongly focuses in three main aspects: having strong infrastructures, provide good amounts of services and digital goods, and facilitate that the economic and technological transactions of these goods can easily happen.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Availability			Networked World Enablers	Networked Applications and Services
		ICTs at Schools and Higher Ed.	Policy	Innovation Consumer

Figure 24: Readiness Guide for Living in the Networked World – main topics covered

As we said, a very different – but interestingly complementary – approach from the one we saw in the previous section.

We want to note that, even if – according to our categorization – there is a total absence of indicators related to the ICT Sector, the industry is somehow indirectly included either in the infrastructures category or in the networked applications and services. Nevertheless, the lack of it being explicit emphasizes the philosophy behind the model: platforms to deliver goods, "forgetting" about the intermediaries or the required skills to comfortably perform such transactions.

5.6. The Development Dynamic

Accenture, Markle Foundation and the UNDP created in 2000 the Digital Opportunity Initiative[127] to identify the role of ICTs in development. After analyzing several practices all over the world, Accenture et al. (2001) divided the role of Information and Communication Technologies in developing countries national strategies in two types (and subtypes), according to their focus:

[127] http://www.opt-init.org/

- ICT as a Production Sector
  - Export market focus
  - National capacity / domestic market focus
- ICT as an Enabler of Development
  - Global positioning focus
  - Development goals focus

After their findings, they designed their "Development Dynamic" to help policy-makers to identify the main points that a policy to foster the development of ICTs – and their impact on sustainable economic development. Even if the authors were aware that there could not be just one and the same solution for every country, some common blueprint could be drawn (see Figure 25).

5.6.1. Main publications

Accenture, Markle Foundation & UNDP (2001). *Creating a Development Dynamic: Final Report of the Digital Opportunity Initiative*. Washington, DC: Digital Opportunity Initiative.

Markle Foundation (2003). *ICT Indicators. Mapping Resources and Issues*. New York: Markle Foundation.

5.6.2. Distribution of Categories

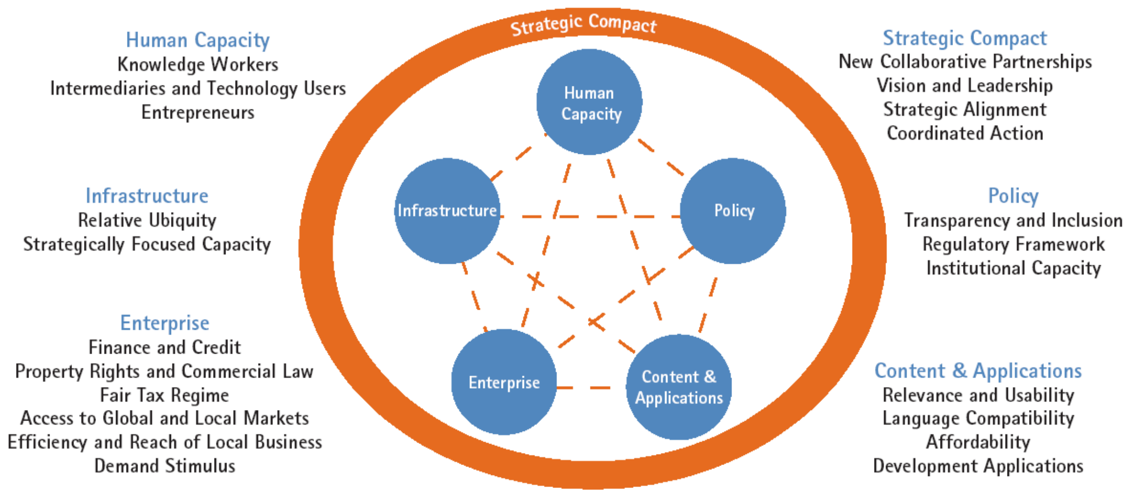

Figure 25: The Development Dynamic (Accenture et al., 2001)

5.6.3. Comment

Even if not strictly related to the Digital Opportunity Initiative, we want to include in this model the work done in 2003 by the Markle Foundation to map the existing ICT indicators so far (Markle Foundation, 2003), where a critique of (some of) the existing indicators is done by following the same philosophy that produced the Development Dynamic.

The main strengths of the Development Dynamic is that it arises from the observation of several national policies to foster development through the intense use of ICTs. Thus, it is understandable how the legal framework and the role of the policy-maker is stressed and somehow put in the middle of the model. On the other hand, not only the existence of infrastructures but its cost, the affordability of the model, is also made relevant. Last, an important contribution that is somewhat rare to be found in other models: the importance of not only a digital literacy, but of a trained team of "knowledge workers" that are specific of this Information Society and, hence, much needed for any national strategy to be able to succeed.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Infrastructure		Human Capacity	Policy	Content & Applications
Affordability	Human Capacity		Policy	

Figure 26: Accenture, Markle Foundation and the UNDP's Development Dynamic – main topics covered

5.7. e-Readiness Guide (GeoSINC)

The World Bank used its "ICT advocacy arm", the infoDev program, to lead and commission to GeoSINC the making of the Guide, within the framework of the e-Readiness Facilitation Center. Thus, GeoSINC's e-Readiness Guide is likely to be the first effort of an international governmental agency to step into the field of measuring the Information Society and fostering its development – especially in developing countries –, even if at a low level of commitment and mainly aimed at raising awareness[128].

[128] The reader can be shocked by the several controversial derivations of such a strong statement. Even if it is true that other international agencies – e.g. belonging to the United Nations System – had been engaged with the development of the Information Society long before the release of GeoSINC/infoDev's, it is also true that the whole machinery was not put into work until the planning and implementation of the World Summit on the Information Society. On the other hand, and as we will be seeing, the first international approaches were mainly focused on establishing ways to measure and compare telecoms infrastructures, which is an important part – but just a part – of the development of a Digital Economy, and way behind the higher goal of sustainable development.

As it has been said about the two former guides, the nature of the institution behind the creation of the e-Readiness Guide – The World Bank – is evident in the design and overall aim of the Guide. Hence the focus in policy-making and the recursive discourse around strategies and action plans, being assessment just the first stage to go on with the other two.

Indeed, the word "guide" gains full sense in this work, as it actually *is* a guide to help the users (governments, policy makers, lobbies, awareness raisers) to design and put into practice strategies more than just assessing one's Digital Economy.

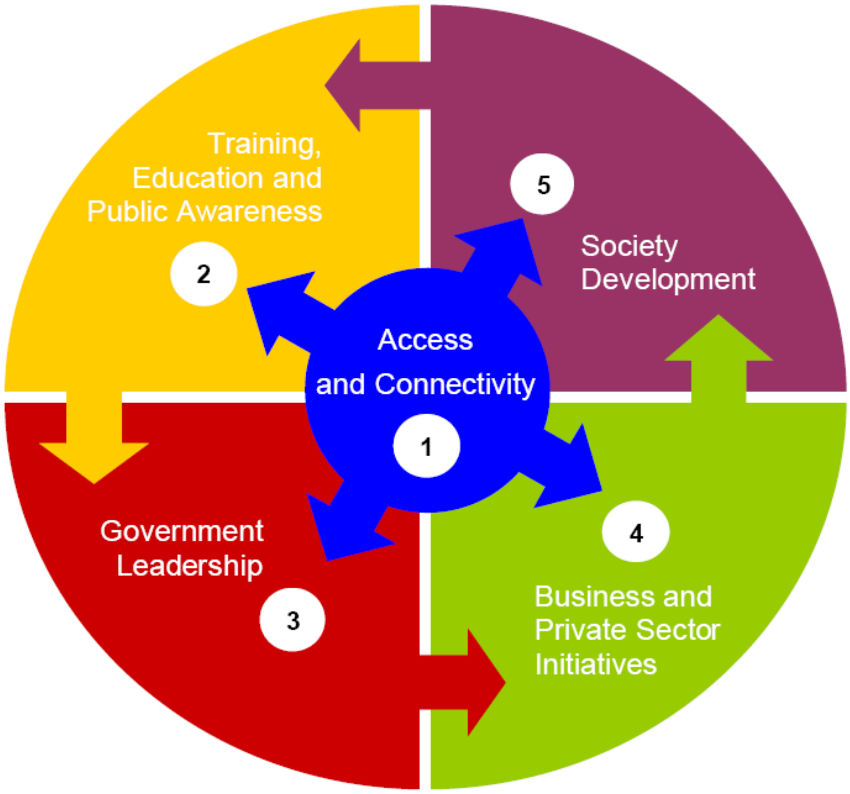

Figure 27: e-Readiness Guide (GeoSINC, 2002)

5.7.1. Main publications

GeoSINC International (2002). *e-Readiness Guide. How to Develop and Implement a National e-Readiness Action Plan in Developing Countries*. Washington, DC: infoDev - The World Bank.

5.7.2. Comment

As more a guide to design strategies than a tool to assess e-Readiness, the Guide lacks of an assessment methodology and limits itself to give brief information about other existing assessment methodologies[129]. On the contrary, the indications and advice to design a strategy are rich and well paced.

Even if there is this lack of indicators or of practical assessment of a Digital Economy, the Guide builds a descriptive model (Figure 27) that it is both used to analyse third parties' assessment tools and to frame the own Guide.

This model fits as follows in our own categorization of the Digital Economy:

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Availability	Enterprises / Economy		ICT (Sector) Regulation	Availability
Pricing	Workforce	Use and Training in Schools	Information Society Strategies and Policies	Use

Figure 28: GeoSINC's e-Readiness Guide – main topics covered

As can be inferred by following the framework (though it is not that evident by looking only at Figure 28), the strategies are focused on the enablers: on one hand, the enablers of Infrastructures – the ICT Sector –, on the other hand, the enablers of use and actual implementation – the Policy and Regulatory Framework.

Summing up, the strengths of this model are the weight put on the enablers as drivers of change that will make possible actual and growing use of the infrastructures.

[129] Except for University of Maryland's Center for International Development and Conflict Management
Negotiating the Digital Divide framework, we will be seeing all of them here in this work. The *Negotiating the Digital Divide framework*, a part of the United States Agency for International Development (USAID) Leland Initiative and in cooperation with the U.S. National Research Council (NRC), implied the development of the Internet Impact Indicator , "a set of more than 100 Internet Impact Indicator variables, designed to evaluate the impact of the Internet in various geographical and social settings" (http://www.cidcm.umd.edu/projects/leland.htm). To our surprise – or inability to succeed – no publications seem to have remained or even been the output from that project around the subject of indicators and e-readiness (being the sole exception some speeches and the book *Negotiating the Net: The Politics of Internet Diffusion in Africa* by Ernest J. Wilson III and Kelvin R. Wong, (eds.), that actually does not actually focuses on measuring the Digital Economy, but on the – mainly political – reasons for its development or underdevelopment).

5.8. Models of Access

Mark Warschauer work might not be exactly what we would call a model of the Digital Economy, but his contributions have by all means influenced many authors in general and this author in particular.

Along his work – and especially in Warschauer (2003b) – Mark Warschauer defines what he calls three Models of Access:

- Devices
- Conduits
- Literacy

Being the first two mainly related with Infrastructures and the latter with human skills, his point being that (digital) skills do determine the way individuals benefit from resources and transform them into output, an output that, in the almost infinite loop of the Information Economy, constitutes the basis of new resources, as pictured in Figure 29:

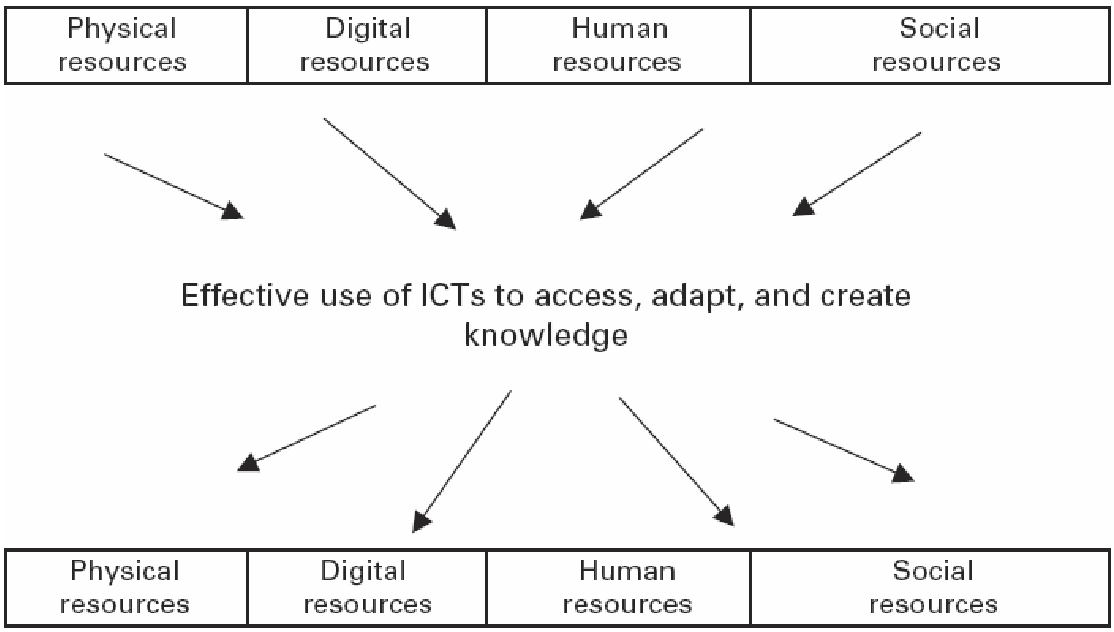

Figure 29: Resources contributing to ICT access (Warschauer, 2003b)

5.8.1. Main publications

Warschauer, M. (2002). "Reconceptualizing the Digital Divide". In *First Monday, issue #7, May*

Warschauer, M. (2003). *Technology and Social Inclusion. Rethinking the Digital Divide*. Cambridge: The MIT Press.

Warschauer, M. (2003). "Demystifying the Digital Divide". In Scientific American, Inc., *ScientificAmerican.com, august 2003*

5.8.2. Comment

Even if – as appears in Figure 30 – Warschauer's contribution might be discrete in picturing a holistic model of the Digital Economy, we believe that his work in bringing on to the spotlight the relevance of digital literacy represents a milestone in the evolving understanding of concepts such as access to and impact of ICTs.

As it will be seen later, our work relies heavily on the statement that digital literacy is central to the evolution of a Digital Economy, being the middle point between input and output, or between access and impact.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Devices and conduits		Literacy		

Figure 30: Warshauer's Models of Access – main topics covered

5.9. Layers, Sectors and Areas of the Information Society

Since the beginning of the XXI[st] century, the United Nations Economic Commission for Latin America and the Caribbean (ECLAC) has been very active in sensing the effects and impacts of Information and Communication Technologies in the development of the region, producing excellent reports that both assess the state of the question as far as elaborate guides and advice for policy-makers in this issue.

The effort done to prepare the World Summit on the Information Society brought out most interesting output in both fields: assessment and guidance, being "Building an Information Society: a Latin American and Caribbean Perspective" (by Martin R. Hilbert and Jorge Katz) a referent since.

In this work, the authors draw a model of the Information Society based in horizontal layers, diagonal areas and vertical sectors that would apply to any economy even if, as observed, "developing and developed countries set slightly different focuses in their national information society strategies" (Hilbert & Katz, 2003).

As can be seen in Figure 31, the structure would be:

- Horizontal Layers, including infrastructures and generic services, or in their words, 'digital products'
- Vertical Sectors, which are the results of the integration of ICTs into processes, thus 'digital processes': e-Business, e-Government, e-Health. e-Culture, e-Learning, e-Media
- And Diagonal Areas, interacting across the previous two by means of the regional framework, financing and human capital

5.9.1. Main publications

Hilbert, M. R. (2001). *Latin America on its path into the digital age: where are we?*. Santiago de Chile: ECLAC.

Hilbert, M. R. (2001). *From Industrial Economics To Digital Economics: An Introduction To The Transition*. Santiago de Chile: ECLAC.

Hilbert, M. R. & Katz, J. (2002). *Toward a Conceptual Framework and Public Policy Agenda for the Information Society in Latin America and Caribbean*. Santiago de Chile: ECLAC.

Katz, J. & Hilbert, M. R. (2003). *Road Maps towards an information society in Latin America and the Caribbean*. Santiago de Chile: ECLAC.

Hilbert, M. R. & Katz, J. (2003). *Building an Information Society: a Latin American and Caribbean Perspective*. Santiago de Chile: ECLAC.

Hilbert, M. R., Bustos, S. & Ferraz, J. C. (2005). *Estrategias nacionales para la sociedad de la información en América Latina y el Caribe*. Santiago de Chile: CEPAL.

5.9.2. Distribution of Categories

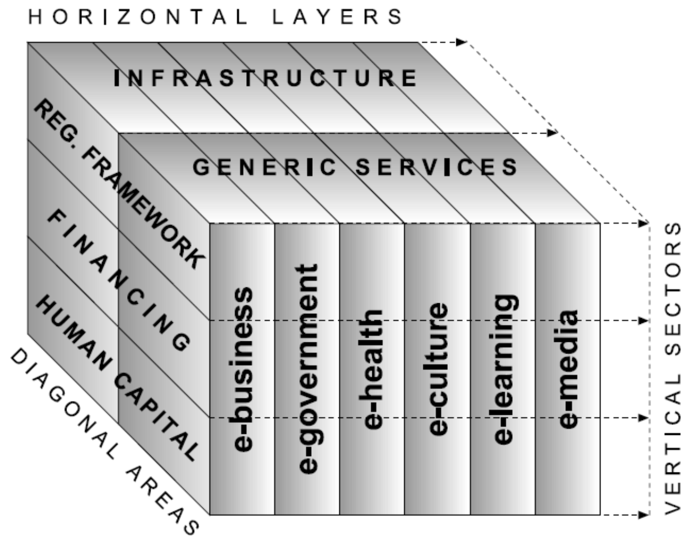

Figure 31: Layers, Sectors and Areas of the Information Society (Hilbert & Katz, 2003)

5.9.3. Comment

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Infrastructure	Vertical Sectors	Human Capital	Regional Framework	Generic Services Vertical Sectors

Figure 32: Hilbert & Katz's Layers, Sectors and Areas of the Information Society – main topics covered

We believe that the most important contribution by the ECLAC in the past years has been to provide a conceptual framework to be applied in the assessment of the several regional and national initiatives to foster the Information Society.

In this sense, the effort has produced, in our opinion, one of the first truly comprehensive approaches to the subject, as can be read in Figure 32.

Notwithstanding, this approach – and maybe due to the fast evolution of the World Wide Web in the last years[130] seems to be strictly focused, as we have seen in previous models, in models of supply and the measurement of stock variables, letting aside demand variables and the evolution (the flows) of such variables.

On the other hand, the distinction between horizontal and vertical layers and sectors has proven useful in ECLAC's work but has not permeated other authors and ongoing literature. In our opinion, while it is interesting to see two different dimensions of the same aspect[131], it brings complexity to the model while the benefits are limited.

5.10. Real Access Criteria – e-Readiness Assessment

Bridges.org was[132] a non-profit organization that from 2000 to 2005 carried out a brilliant job in raising awareness about e-readiness: what did the concept mean, who were working in the field, what were the existing tools and publications, etc.

[130] We will go back to this issue later in the next chapters.
[131] We can think here on Leontiev's input/output tables, for instance
[132] Even if it has not formally or publicly been dismantled, the organization does not seem to be having any activity since March 2006, when founder and executive director Teresa Peters left Bridges.org to join the Bill and Melinda Gates Foundation.

During these years they published[133] a collection of works that aimed to clarify and put in order the area of e-Readiness. By doing so, they at the same time created a new model based on their understanding of the Digital Economy.

This model was based on what was called "real access criteria"[134] (Bridges.org, 2002b):

- Physical access
- Appropriate technology
- Affordability
- Capacity
- Trust
- Legal and regulatory framework
- Local economic environment
- Macro-economic environment
- Socio-cultural factors
- Political will
- Relevant content
- Integration

These access criteria served as a basis to carry on a most interesting benchmark or e-readiness assessment tools that began in 2001 and ended up in three main publications by 2005[135]. The benchmark gathered not only the existing tools at that time, but also its components, classifying them into a homogeneous categorization:

- Technology
  - Infrastructure – Network, Tele-density
  - Pricing
  - Speed and Quality
  - Other Technology Issues
- Economy
  - Use within Businesses
  - E-Commerce
  - Market Competition / Privatization
  - Export Trade, Foreign Investment
  - Other Economic or Business Factors
- Government
  - Policy (Privacy, Trade, IP, E- Signatures) Regulations
  - E-Government
  - Political Openness, Democracy
- Education
  - Use in Schools
  - Tech Training in Schools

[133] See next section

[134] The original order has been slightly changed to fit our own schemes as explained in the previous chapter.

[135] Bridges.org, 2005a; Bridges.org, 2005b; Bridges.org, 2005c

    - Availability of Trained workforce
- Social
    - Use of ICT in Everyday life
    - Utilization of Tech throughout Society (Inequality)
    - Basic Literacy, Poverty, Other Social Factors
    - Locally relevant Content
    - Consumer Trust
    - Unique Political, Business, Social History

5.10.1. Main publications

Bridges.org (2002). *Real Access / Real Impact Criteria*. Cape Town: Bridges.org.

Bridges.org (2002). *e-Readiness overview*. Cape Town: Bridges.org.

Bridges.org (2005). *E-readiness assessment: Who is doing what and where?*. Cape Town: Bridges.org.

Bridges.org (2005). *E-Ready for What? E-Readiness in Developing Countries: Current Status and Prospects toward the Millennium Development Goals*. Washington, DC: infoDev - The World Bank.

Bridges.org (2005)[136]. *Comparison of e-readiness assessment models and tools*. Cape Town: Bridges.org

5.10.2. Comment

The main contribution that Bridges.org made to the e-Readiness arena – besides the needed task to make an inventory of what had been done in the last years – has been to analyze and make comparable different tools designed for different purposes.

Of course the categorization chosen is not exempt from criticism. For instance, the existence of a (national) ICT Sector is completely overridden (see Figure 33) which, in some cases is not a minor issue due to the impact on their commercial and/or financial balance. But it is, notwithstanding, quite comprehensive and managed to accommodate the different perspectives from a couple of dozen different models.

Last, but not least, it is thanks to the work done by Bridges.org that the concept "e-Readiness" sticks in the practitioner and scholar landscape, then, in our opinion, making a new discipline to be born.

[136] There is a first edition of this work entitled *Comparison of E-Readiness Assessment Models* dated March 2001, then downloadable at http://www.bridges.org/ereadiness/report.html

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Technology		Skilled workforce	Competition	Social Economy Government
Pricing		Education	Policy	Social Use

Figure 33: Bridges.org's e-Readiness Assessment – main topics covered

5.11. Comprehensive Metric

Karine Barzilai-Nahon is Director of the Center for Information & Society, University of Washington, and has been doing research about the facts that condition access to the Network – normally from a human rights and civil liberties approach. Two works of her (see below) deserve closing this chapter as they perfectly picture the essence of this whole work: Are we measuring the correct thing? Are the tools determining our conception of the Digital Economy? How could this be improved?

In what she calls a "Comprehensive Metric" she proposes the use of the following indicators to be able to glimpse all the factors that conform the digital divide (Barzilai-Nahon, 2006):

- Infrastructure access
  - Communication channels and capacity
  - Computers per capita
  - Number of ISPs per capita
  - ISPs: governmental incumbent or private
- Affordability
  - Is physical layer (infrastructure) affordable in comparison to the cost of other consumer expenditures and average income?
  - Is logical layer affordable (application and software)?
  - Is content affordable?
- Use
  - Frequency
  - Time on-line
  - Purpose
  - Users' skills
  - Autonomy of use
- Social and governmental support
  - Training

  - Active help
  - Support/Suppression/Apathy
  - Investments and funding
- Socio-Demographic Factors
  - Socio-economic status
  - Gender
  - Age
  - Education
  - Geographic dispersion
  - Ethnic diversity
  - Race diversity
  - Religiosity
  - Language
- Accessibility (disabled and special needs populations)

5.11.1. Main publications

Barzilai-Nahon, K., Rafaeli, S. & Ahituv, N. (2004). *Measuring Gaps in Cyberspace: Constructing a comprehensive digital divide index*. Workshop on Measuring the Information Society, the conference of Internet Research 5, Brighton, UK, September 2004. Brighton

Barzilai-Nahon, K. (2006). "Gaps And Bits: Conceptualizing Measurements For Digital Divide/s". In *The Information Society, 22*(5), 269-278

5.11.2. Distribution of Indicators

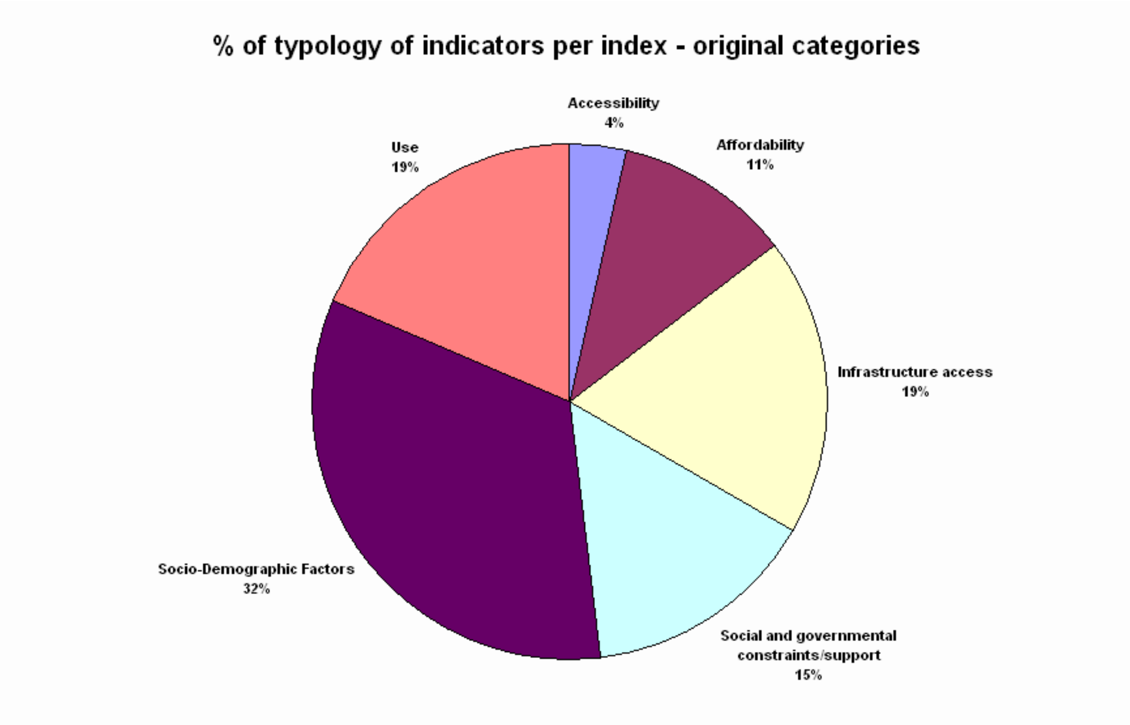

Figure 34: Comprehensive Metric. % of typology of indicators per index – original categories

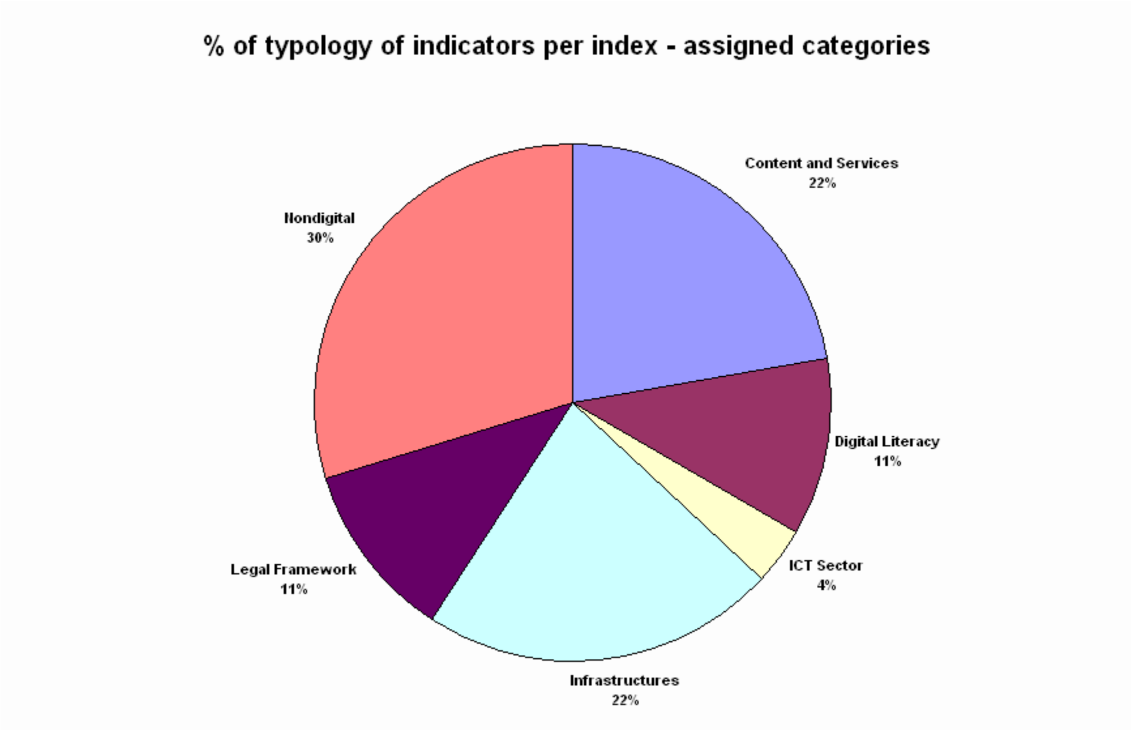

Figure 35: Comprehensive Metric. % of typology of indicators per index – assigned categories

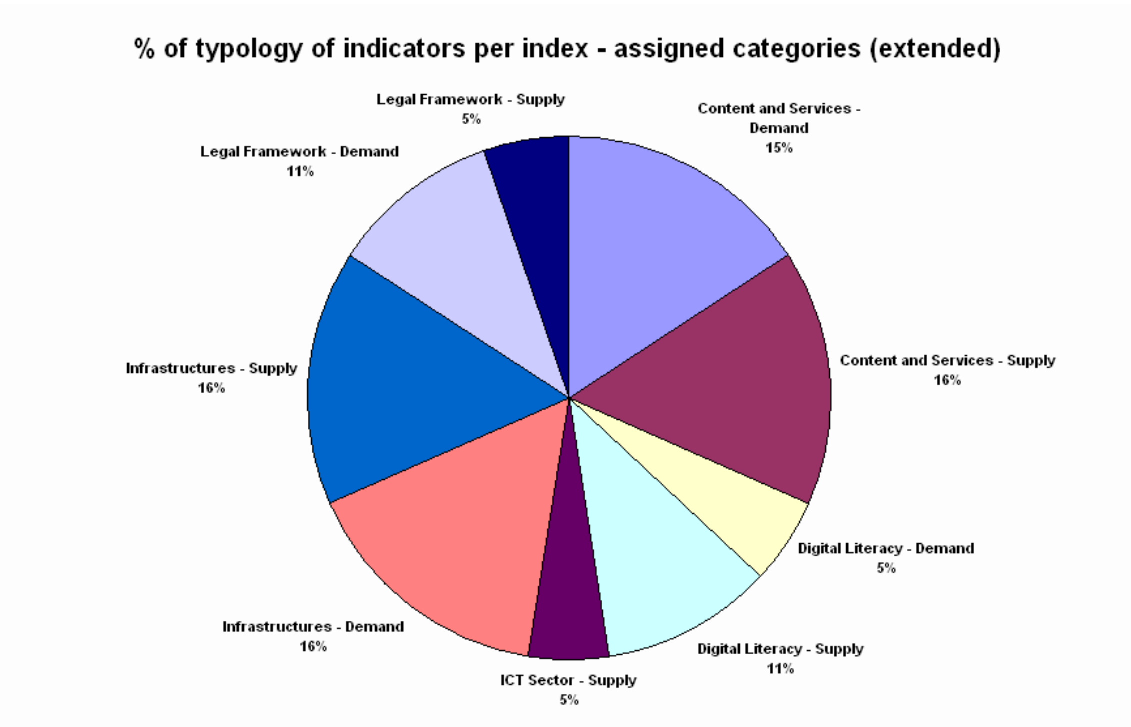

Figure 36: Comprehensive Metric.% of typology of indicators per index – assigned categories (extended)

5.11.3. Comment

Our interest in Barzilai-Nahon is, more than technical, philosophical. Figure 37 shows that her model is but comprehensive, at least under our own point of view. Crucial aspects like the existence of an ICT Sector or a proper ICT Sector regulation are left blank or just slightly dealt with.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Infrastructure Access	ISPs	User's skills Autonomy of use	ISP Regulation	Accessibility Websites Language
Affordability		Training	Social and governmental support	Frequency Time on-line Sophistication of use Purpose

Figure 37: Barzilai-Nahon's Comprehensive Metric – main topics covered

Concerning digital content and services, even if they can be implicitly gathered when talking about affordability, this concept does not say much about the effective amount (supply) of content or its actual relevance – indeed, affordability can be due to infrastructure costs and not to content or services themselves.

Hence, the most interesting part is, as we said, the philosophy underlying in her model. There is a major stress on the conditions of access from a subjective point of view, absolutely centred in the individual and their framework. This is what makes the model so powerful in our opinion, as it is a usual lack of many others.

And, over all, the comprehensiveness of Barzilai's approach, which actually is one of our own guiding lines too in this work of ours.

6. Digital Economy Models: Theoretical Models

Theoretical models put into practice once (not repeated along time).

By *theoretical models* we mean proposals to measure the Digital Economy whose origin comes from a theoretical reflection or analysis, but, differently from the case of the Descriptive Models, Theoretical Models have indeed come to practice at least once so to test them against real data.

On the other hand, they have not been established as periodical measuring tools on a e.g. yearly basis, so that several time series can be compared amongst them, but have remained a one-time-test or a punctual effort but not settled as a established model.

Hence, we think of this category as a middle way between the modes from the previous chapter – descriptive reflections, assessment guides, etc. – that never (or hardly) been put into practice, and those models selected for next chapter (and, even more, those of Chapter 8) that have been used as more or less standard or acknowledged measuring devices at the international level.

So, all the following models have been designed by researchers that after a first design, have tested the model and, not only that, but also extracted some conclusions both about the model itself and the targets (e.g. countries) of their analysis.

The utility of such models – and the aim of this chapter – lies in linking observation and practice, thus bridging the difficult gap towards a well founded measuring tool.

The models chosen are:

6.1 The Global Diffusion of the Internet........150
6.2 Global E-Readiness........153
6.3 e-Commerce Readiness in East Asian APEC Economies........156
6.4 Infostate / Digital Divide Index........160
6.5 e-African ICT e-Index........165
6.6 SIBIS Benchmarking Framework........170
6.7 Digital Divide Index - DiDix........173
6.8 The eInclusion Index........177
6.9 Sustainable ICT Framework........179
6.10 SIMBA........183

6.1. The Global Diffusion of the Internet

Known also as the Mosaic Project, the Global Diffusion of the Internet Project was a study performed in several countries of the Middle East and the Persian Gulf[137] to analyze the reasons and state of the Internet diffusion in the region.

Their model relied heavily on socio-economic (i.e. not related to the Digital Economy) factors to explain how the shape of a specific society (culture, organization, etc.) determined the degree of diffusion of the Internet (Figure 38) and linked them to how the Internet was effectively being used and was effectively spread in a specific country.

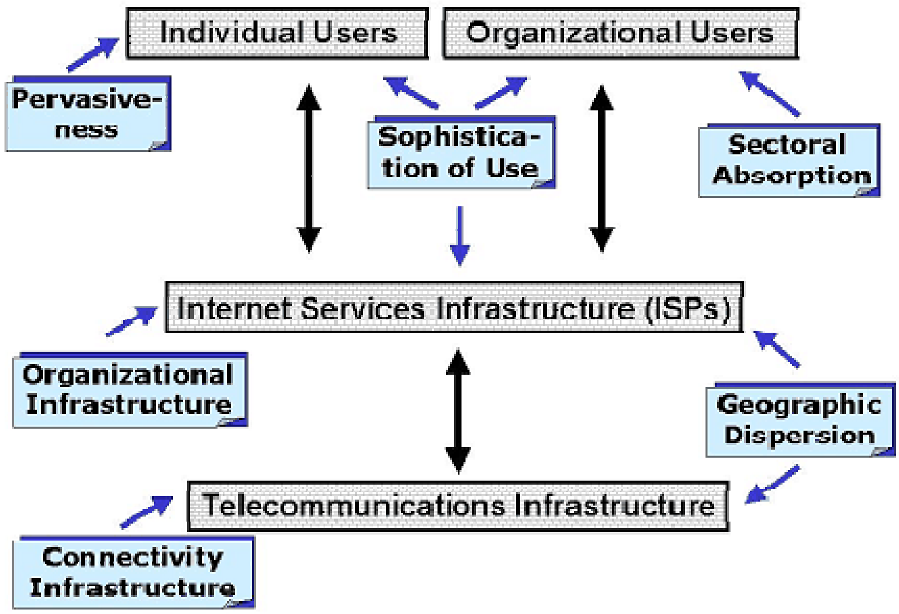

Figure 38: Constituents of the Internet Technology Cluster (Wolcott et al., 2001)

At this point, it is important to note that Mosaic's model deals only with the diffusion of the Internet and not of Information and Communication Technologies in general. To measure such state of diffusion, the Mosaic Group defined six, Dimensions of Internet Diffusion:

- Pervasiveness of the Internet
- Geographic dispersion of the Internet
- Sectoral Absorption of the Internet
- Connectivity Infrastructure of the Internet
- Organizational Infrastructure of the Internet
- Sophistication of Use of the Internet

[137] The authors also performed analysis in countries from the Caribbean and Asia Pacific. See Wolcott et al. (2001). See also http://www.itu.int/osg/spu/casestudies/ for a list of case studies with the application of the Mosaic model by the ITU.

6.1.1. Main publications

Goodman, S. E., Burkhart, G. E., Foster, W. A., Press, L. I., Tan, Z. & Woodard, J. (1998). *The Global Diffusion of the Internet Project. An Initial Inductive Study*. Omaha: The Mosaic Group.

Wolcott, P., Press, L. I., McHenry, W., Goodman, S. E. & Foster, W. A. (2001). "A Framework for Assessing the Global Diffusion of the Internet". In *Journal of the Association for Information Systems, 2*(6). Atlanta: Association for Information Systems.

6.1.2. Distribution of Indicators

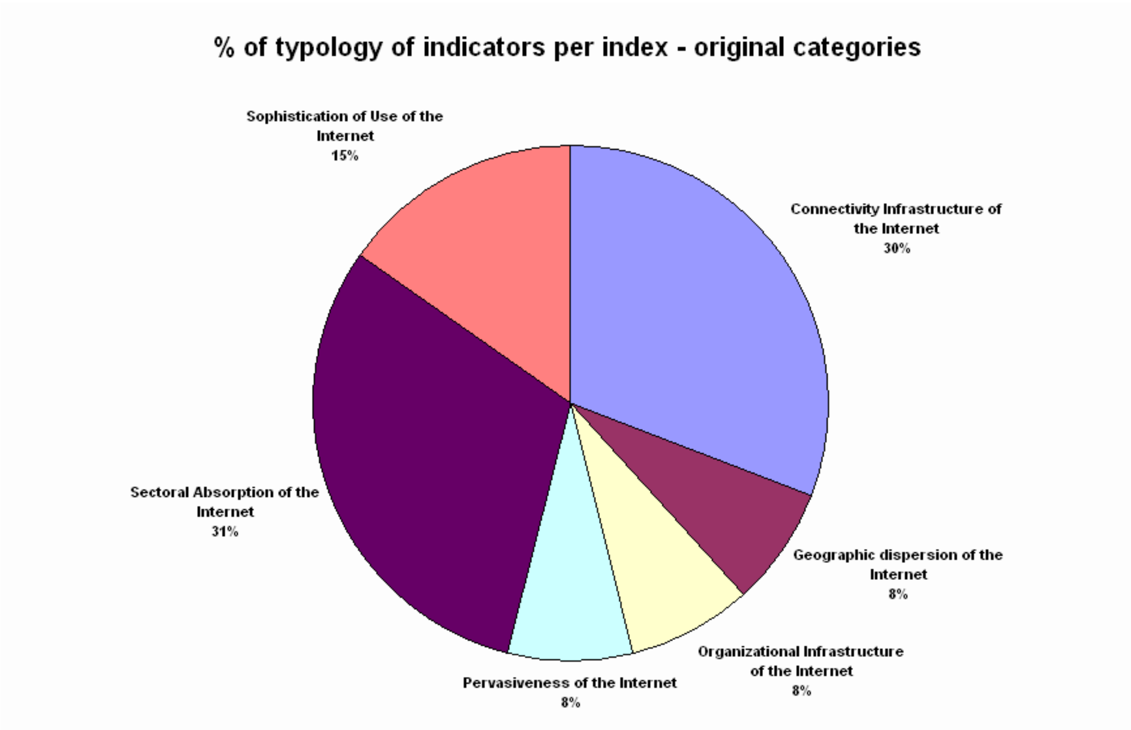

Figure 39: The Global Diffusion of the Internet . % of typology of indicators per index – original categories

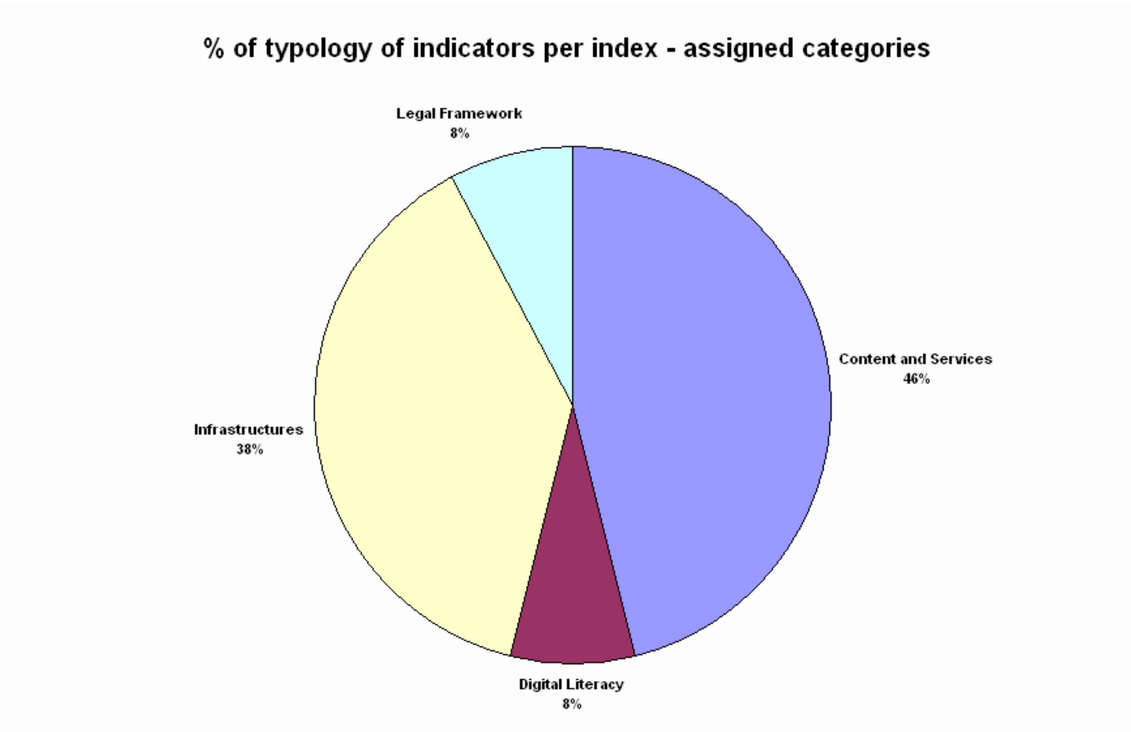

Figure 40: The Global Diffusion of the Internet . % of typology of indicators per index – assigned categories

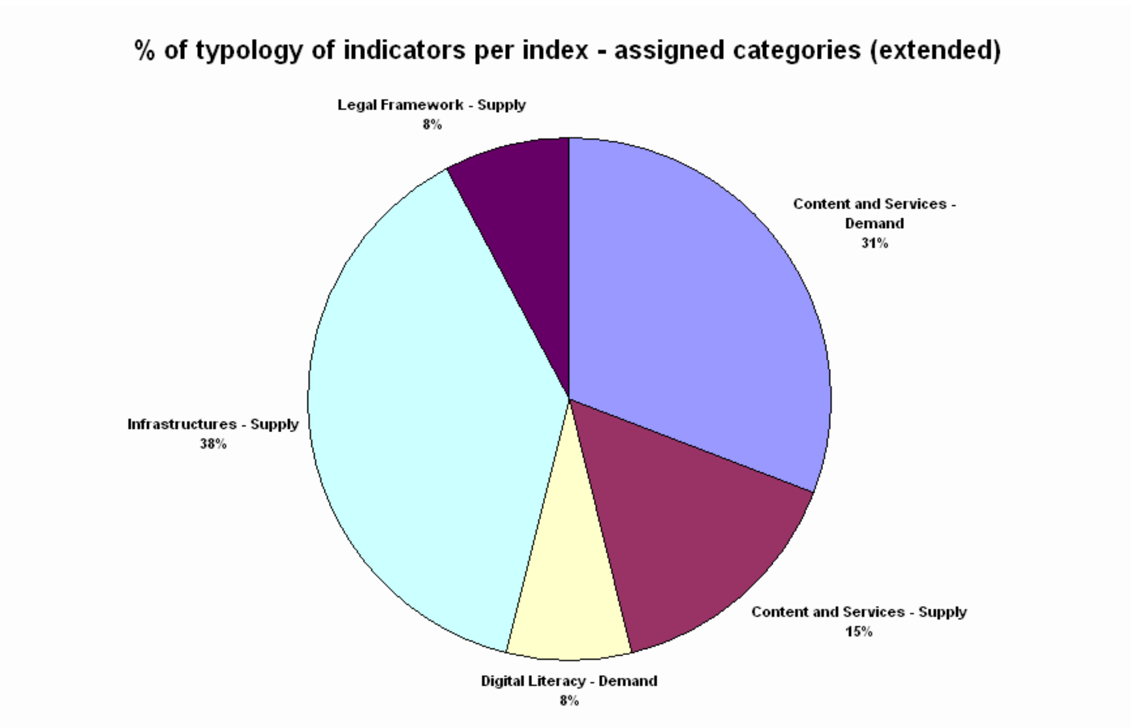

Figure 41: The Global Diffusion of the Internet .% of typology of indicators per index – assigned categories (extended)

6.1.3. Comment

It is inevitable to remark that the main criticism that can be made to this model is that it only covers Internet diffusion, letting aside the rest of technologies that contribute to the development of a Digital Economy[138].

Besides this fact, and maybe due to the early time the research was made, the model does not include other factors and dimensions that later models have, thus enriching and making more comprehensive the approach towards Internet/ICT diffusion.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Pervasiveness Geographic dispersion Infrastructure			ISP Regulation	Pervasiveness Sectoral Absorption (supply)
		Internet at the Education Sector		Sectoral Absorption (demand) Sophistication of Use

Figure 42: Mosaic's Global Diffusion of the Internet – main topics covered

Notwithstanding, it is worth noting the intensive effort in analyzing the specificities of Internet Use, both at the level of intensity – absorption – and quality – sophistication – and try to infer valuable conclusions on how this intensity and quality are absolutely relevant for the diffusion of the Internet as a whole.

6.2. Global E-Readiness

McConnell International collaborated with the World Information Technology and Services Alliance (WITSA)[139] and issued two e-readiness reports (McConnell, 2000; McConnell, 2001) that evaluated, respectively, 42 and 53 economies of all over the world. The collaboration was richest as it combined the availability of data and experience from the industries of the Alliance and the experience of a good team of experts in the field of economic consultancy and development. The experience being so positive that even an on-demand e-readiness assessment was performed later for the Hashemite Kingdom of Jordan (McConnell, 2002)[140].

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[138] In their defence, 1998 was quite early to have a perfect picture of the whole technological landscape that was to come in the following years.
[139] See also chapters 5 and 8.
[140] Peppers & Rogers Group (2006) later performed another e-Readiness assessment of the Hashemite Kingdom of Jordan with no methodological relationship with the model here presented.

The methodology followed by the assessment grouped the indicators in five groups:

- Connectivity
- e-Leadership
- Information Security
- Human Capital
- E-Business Climate

that, even if not related with the previous work done by WITSA in the field of e-Commerce[141], it indeed shared the focus on regulation and the public policies and strategies to foster the Digital Economy.

6.2.1. Main publications

McConnell International (2000). *Risk E-Business: Seizing the Opportunity of Global E-Readiness*. Washington, DC: McConell International.

McConnell International (2001). *Ready? Net. Go! Partnerships Leading The Global Economy*. Washington, DC: McConell International.

McConnell International (2002). *The National E-Readiness of the Hashemite Kingdom of Jordan*. Washington, DC: McConell International.

6.2.2. Distribution of Indicators

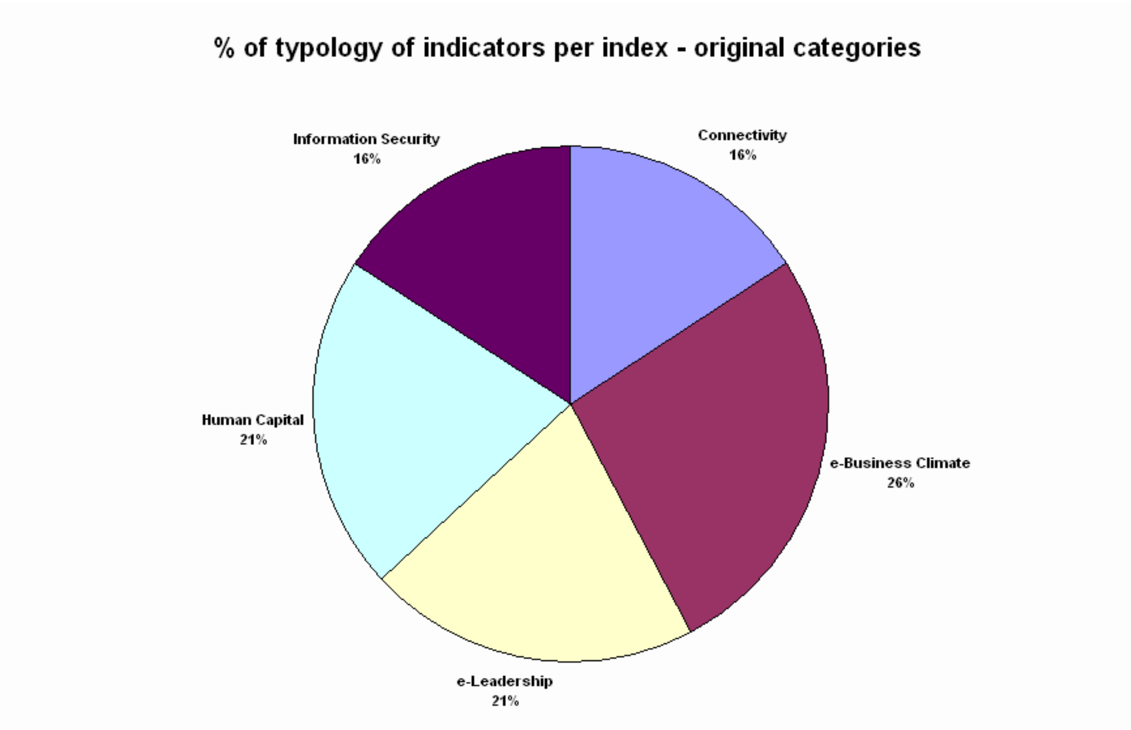

Figure 43: Global e-Readiness. % of typology of indicators per index – original categories

[141] See previous chapter

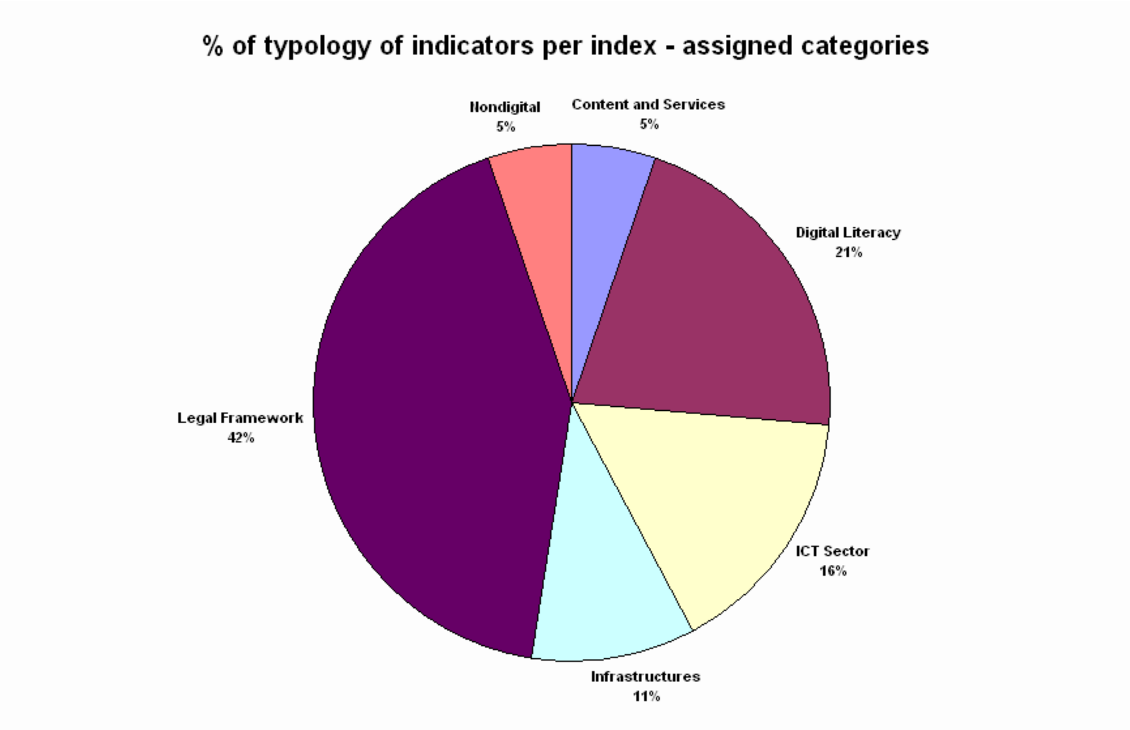

Figure 44: Global e-Readiness. % of typology of indicators per index – assigned categories

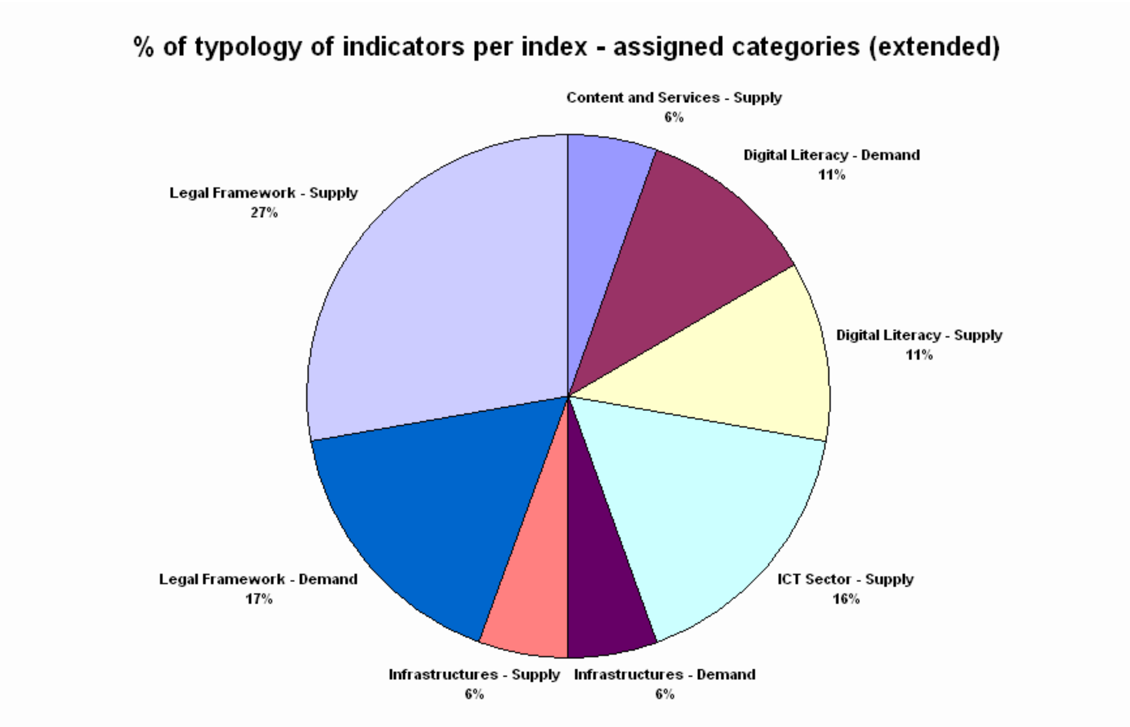

Figure 45: Global e-Readiness. % of typology of indicators per index – assigned categories (extended)

6.2.3. Comment

It is not surprising that at such an early stage – years 2000 and 2001 – all the eggs are put in the basket of the legal framework. The intensity with which the climate, the environment, and the leadership in digital issues is measured is the driving line of McConnell's Global e-Readiness assessment.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Connectivity	e-Business Climate	Human Capital	Information Security	e-Government
Affordability		Human Capital	e-Leadership	

Figure 46: McConnell's Global e-Readiness – main topics covered

This effort to measure the "feeling" of the Digital Economy is only equalled by measuring the main drivers beyond infrastructures: industry and manpower. It is noticeable, referring to the latter, the importance given to digital skills training and the presence – and effective use – of ICTs at formal education institutions.

The missing character in this model is digital content and digital services, almost symbolically represented by e-Government, even if the report stated to aim at helping companies to "evaluate international e-business opportunities, whether B-to-B, B-to-C, or B-to-G" (McConnell, 2000). We have, hence, to understand this statement as it is made: not the assessment of the availability of content and e-services, but of the opportunities to create such content and digital services.

6.3. e-Commerce Readiness in East Asian APEC Economies

In 2000 a research group released[142] a report on an e-Commerce readiness assessment conducted in 10 countries from the APEC region.

Mainly based on indicators from the World Bank's World Development Indicators, the Global Competitiveness Report by the World Economic Forum, the UNDP Human Development Report and some other data sources, they designed a model very similar, in essence, to other already existing e-Readiness assessments like the Networked Readiness Index[143] or the e-Readiness Rankings[144], where specific sets of indicators related to the Digital Economy were combined with other variables related

[142] Bui et al. (2000)
[143] See chapter 7
[144] See chapter 7

to the overall economy and other socioeconomic factors, as appears in the categorization made of the different groups of indicators:

- Knowledgeable Citizen
- Macro Economy
- Industry Competitiveness
- Ability, Willingness to Invest
- Access to Skilled Workforce (Supply Skills)
- Digital Infrastructure
- Culture
- Cost of Living and Pricing

which answered to a model based on a Digital Economy determined by demand factors, supply factors and different aspects related to the state of development of infrastructures and its related legal framework (Figure 47).

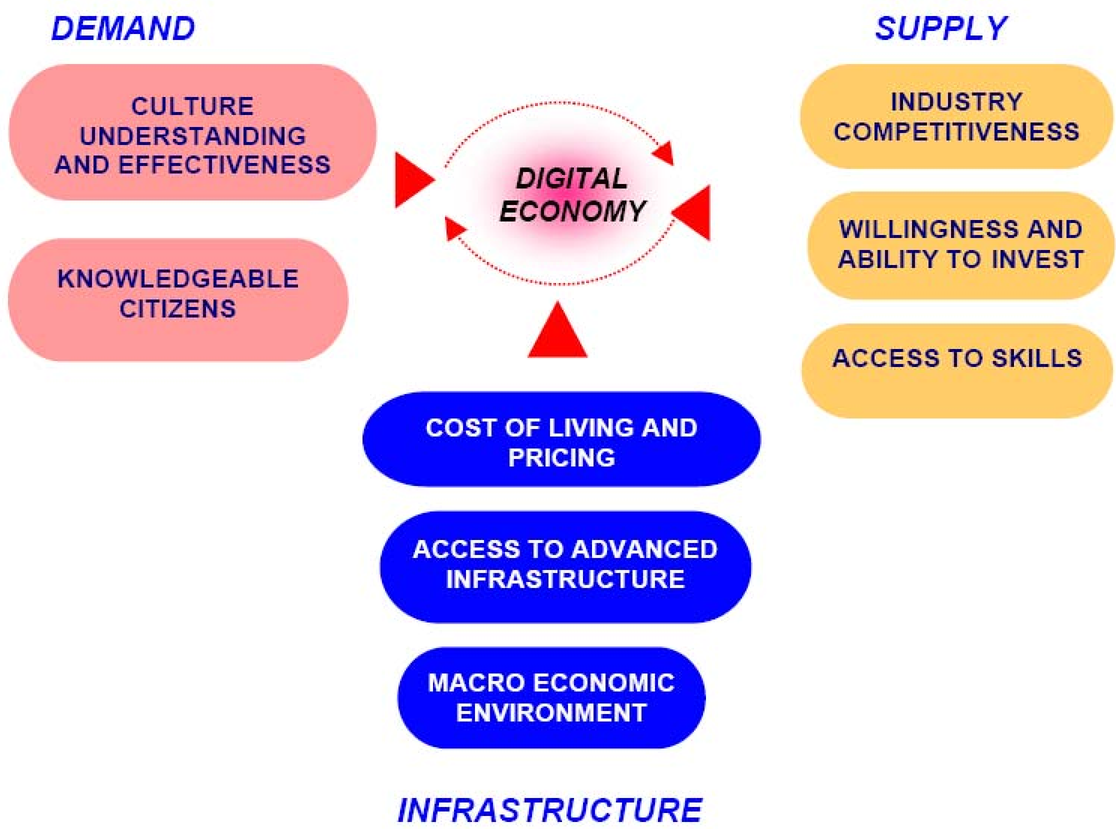

Figure 47: A Framework for Measuring E-Readiness (Bui et al., 2002)

6.3.1. Main Publications

Bui, T. X., Sebastian, I. M., Jones, W. & Naklada, S. (2002). *E-Commerce Readiness in East Asian APEC Economies – A Precursor to Determine HRD Requirements and Capacity Building*. Honolulu: PRIISM.

6.3.2. Distribution of Indicators

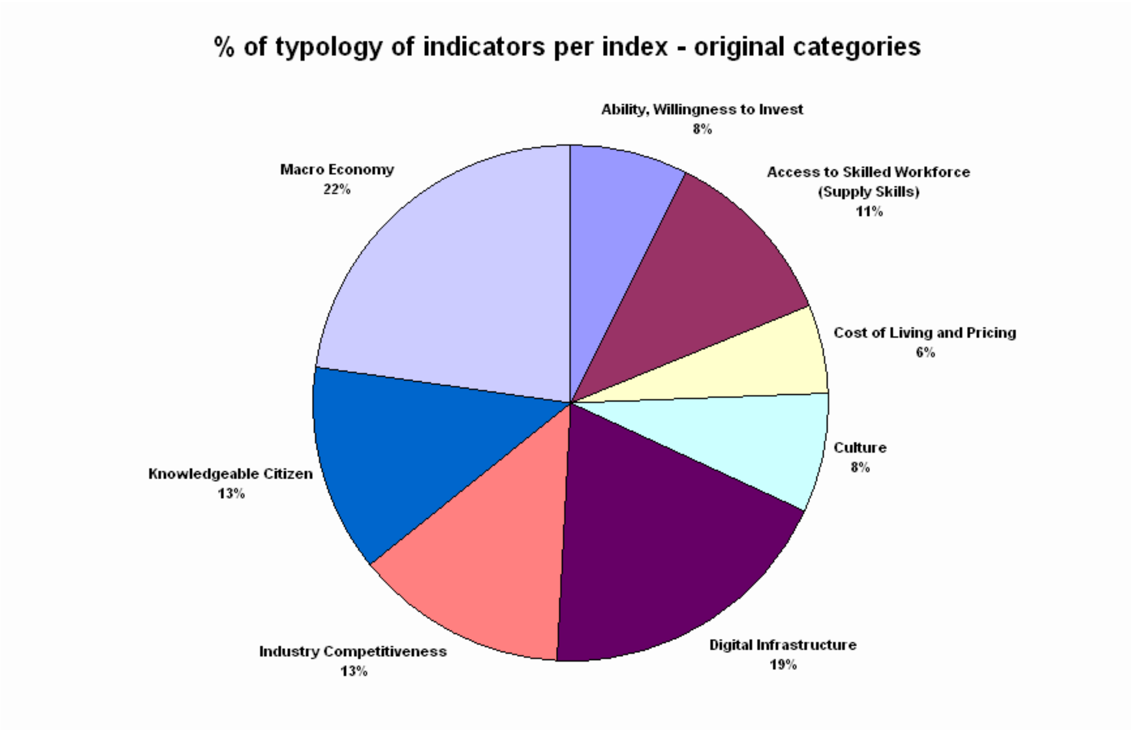

Figure 48: e-Commerce Readiness in East Asian APEC Economies. % of typology of indicators per index – original categories

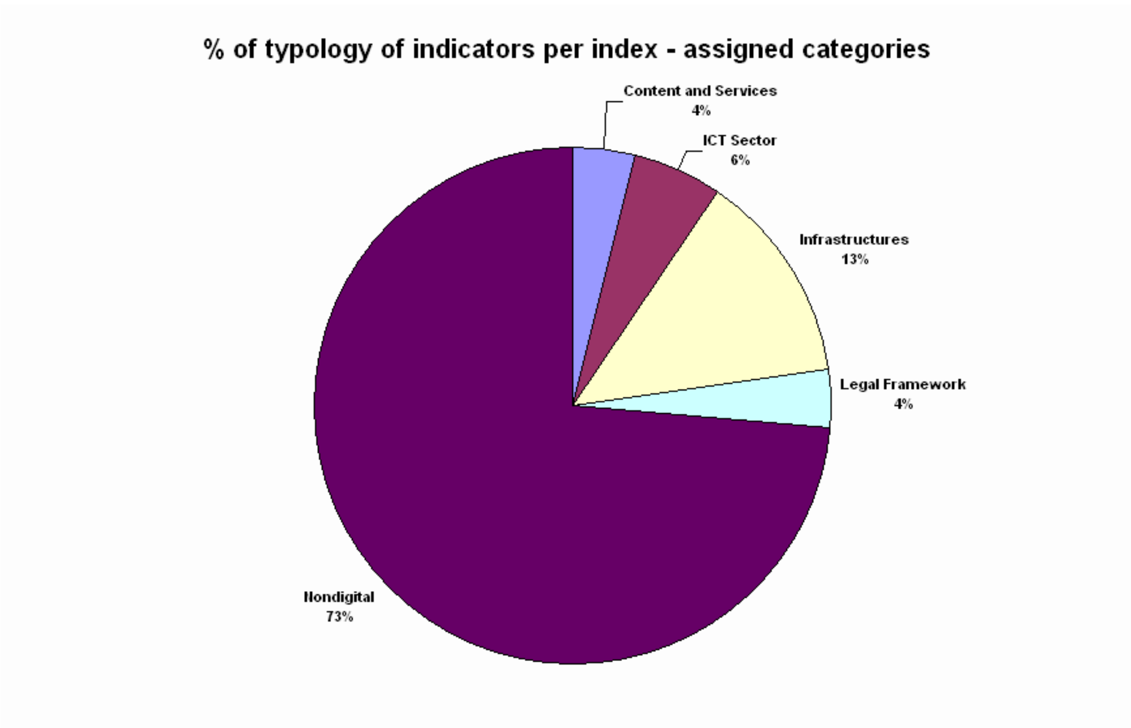

Figure 49: E-Commerce Readiness in East Asian APEC Economies. % of typology of indicators per index – assigned categories

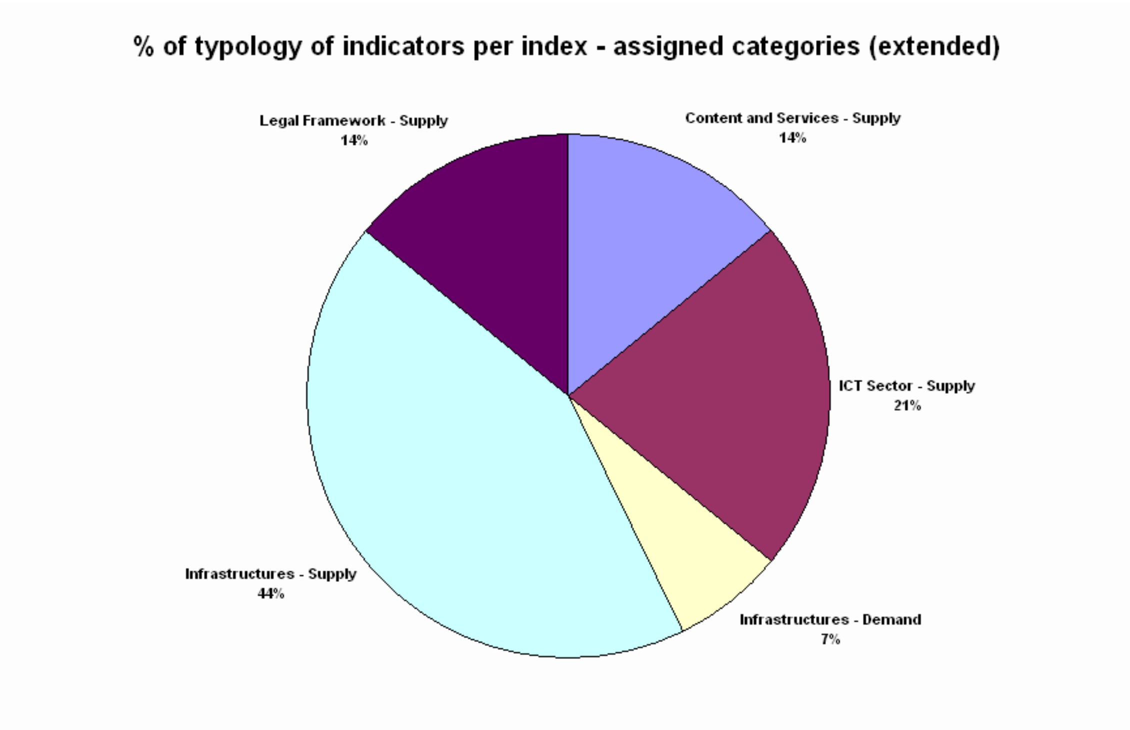

Figure 50: E-Commerce Readiness in East Asian APEC Economies.% of typology of indicators per index – assigned categories (extended)

6.3.3. Comment

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Availability	Enterprises / Economy		ICT (Sector) Regulation	Availability
Affordability				

Figure 51: Bui et al.'s Access Rainbow – main topics covered

As we will be commenting on next chapter and have also done in previous one, the strengths and weaknesses of this model are related to just the same factor: the inclusion of "nondigital" variables that, depending on one's point of view, represent a positive or a negative factor. On one hand, the inclusion of such variables introduces a proper framework that explains how several socioeconomic factors influence over the development of an Information Society. On the other hand, those factors, external to the Digital Economy itself, make it difficult sometimes to know the exact stage of development of purely digitally related matters, as some "analogue noise" is introduced in the model.

Another significant matter is the big weight that infrastructures have in the share of the overall set of indicators, something understandable at that state of the development and understanding of the Information Society.

We believe that the two most interesting points of this model are, first, the definition of the target of the research as 'Digital Economy' as a way to try and put in the middle of the model what is the goal of the research, namely how digitally developed is a economy, or how developed is the digital part of a specific economy.

Second, the distinction between two different tiers consisting on demand and supply, and their respective factors. Even if these two tiers are not developed in depth, the approach is worth being considered as an interesting contribution for the future and, specifically, to our own work, though it does not precisely fit our own conception of demand and supply, as we saw in chapter 4 and will revisit in chapter 9.

6.4. Infostate / Digital Divide Index[145]

The International Network of UNESCO Chairs in Communications (Orbicom) had quite early expressed their commitment[146] towards the need to reach universal access. So, it is not surprising that their involvement in the two phases of the World Summit on the Information Society (WSIS) resulted in what, arguably, has been one of the most important efforts to conceptualize the problem of the digital divide, including brand new frameworks and models on how to measure it.

A first effort, initially aiming to contribute to the Canadian debate in the first phase of the WSIS from the Canadian national statistics office[147], produced a model that could be applied to the whole world and was enhanced in Orbicom's research project *Monitoring the Digital Divide*[148].

The project had three phases: the first one covered 9 countries during 2002, which were rapidly increased in a second phase to cover 192 countries in total in 2003. The main output of these two phases was the Infostate Model (Figure 52) that included the Digital Divide Index (DDI)[149].

[145] Even if one of the outputs of this model was the Digital Divide Index, we preferred to deal in this chapter about this model – instead of chapter 7, devoted to indices – as it was the model's design itself what was the real novelty and brought most debate at that time.
[146] Paquet-Sévigny (1997)
[147] Sciadas (2002b, 2002c, 2004b)
[148] Sciadas (2002a, 2003)
[149] Not to be mistaken for SIBIS Digital Divide Index or DiDix (see section 6.7).

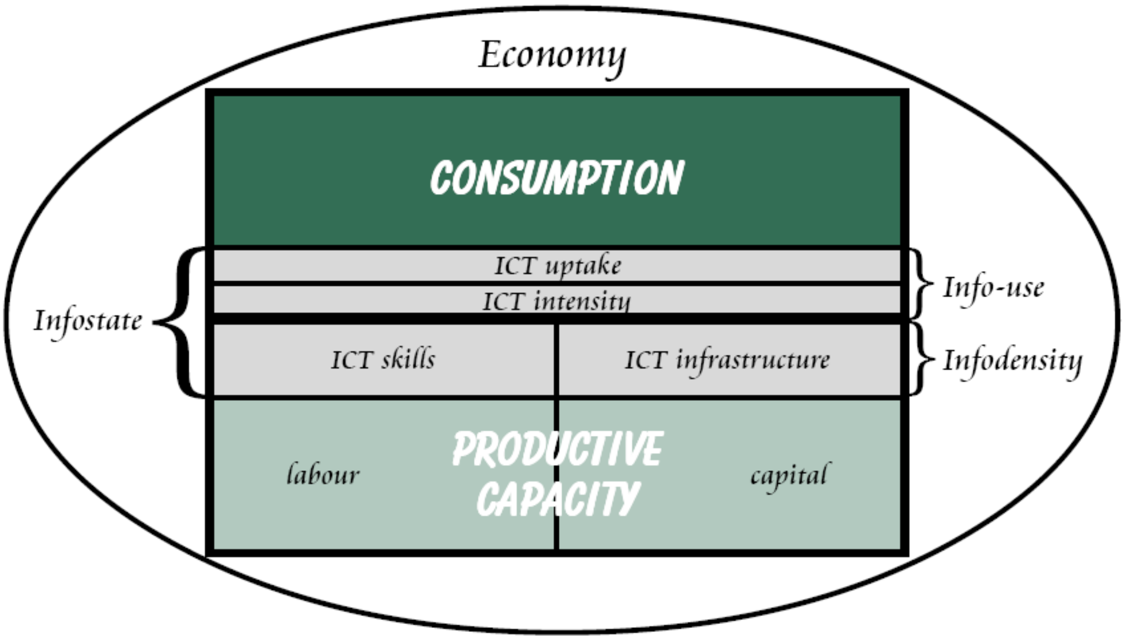

Figure 52: Infostate Model (Sciadas, 2002)

This model presented a two layers framework that clearly separated assets (Infodensity: skills, infrastructures) from use (Info-use: uptake, intensity) as two different tiers that required independent treatment as they impacted separately e-Readiness (Infostate). The model was arranged in a tree-like structure (Figure 53) in a way that allowed further deepening and made of it an expansible, comprehensive model.

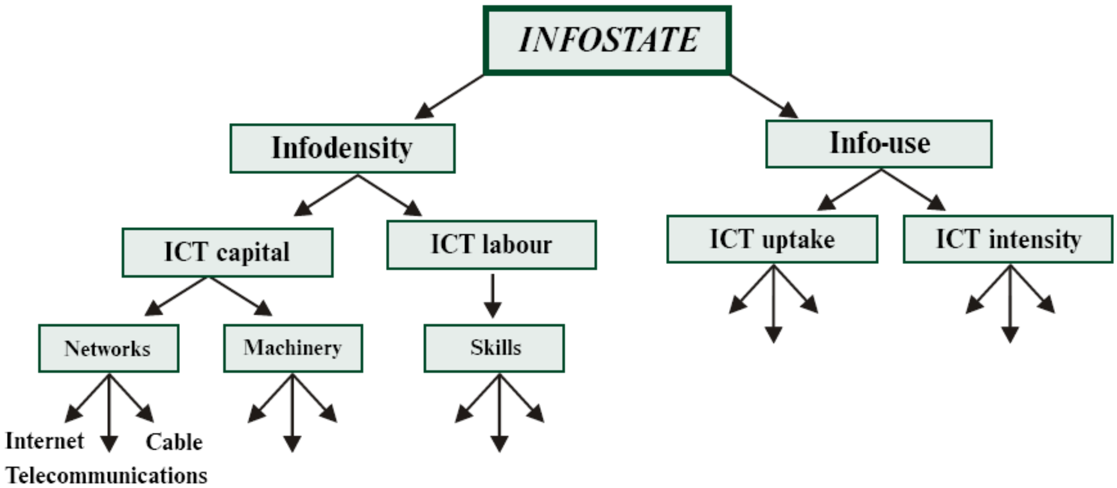

Figure 53: Tree-like structure of the Infostate Model (Sciadas, 2002)

The interest raised by this work led to a third phase (2004-2006) where the partnership that was involved in the project was increased to broaden the consensus around the results of the then collective effort. As is analyzed in chapter 7[150], the outcome was the merging of two different models and their respective emblematic indices – Orbicom's Digital Divide Index and ITU's Digital Access Index – into a new ICT Opportunity Index[151].

6.4.1. Main publications

Sciadas, G. (2002). *Unveiling the Digital Divide*. Ottawa: Statistics Canada.

Sciadas, G. (2002). *The Digital Divide in Canada*. Ottawa: Statistics Canada.

Sciadas, G. (2002). *Monitoring the Digital Divide*. Montreal: Orbicom.

Sciadas, G. (Ed.) (2003). *Monitoring the Digital Divide... and Beyond*. Montreal: Orbicom.

Sciadas, G. (2004). *The Challenge of Indicators. Lessons from the Information Society*. Presentation given at the Red de Indicadores de Ciencia y Tecnologia (RICYT), Buenos Aires, September 15-17, 2004. Buenos Aires: RICYT.

Sciadas, G. (2004). *International Benchmarking for the Information Society*. Busan: ITU.

Sciadas, G. (Ed.) (2005). *From the Digital Divide to Digital Opportunities*. Montreal: Orbicom.

[150] See also Annex II about the evolution of this and several UN System related indices.

[151] See chapter 7

6.4.2. Distribution of Indicators

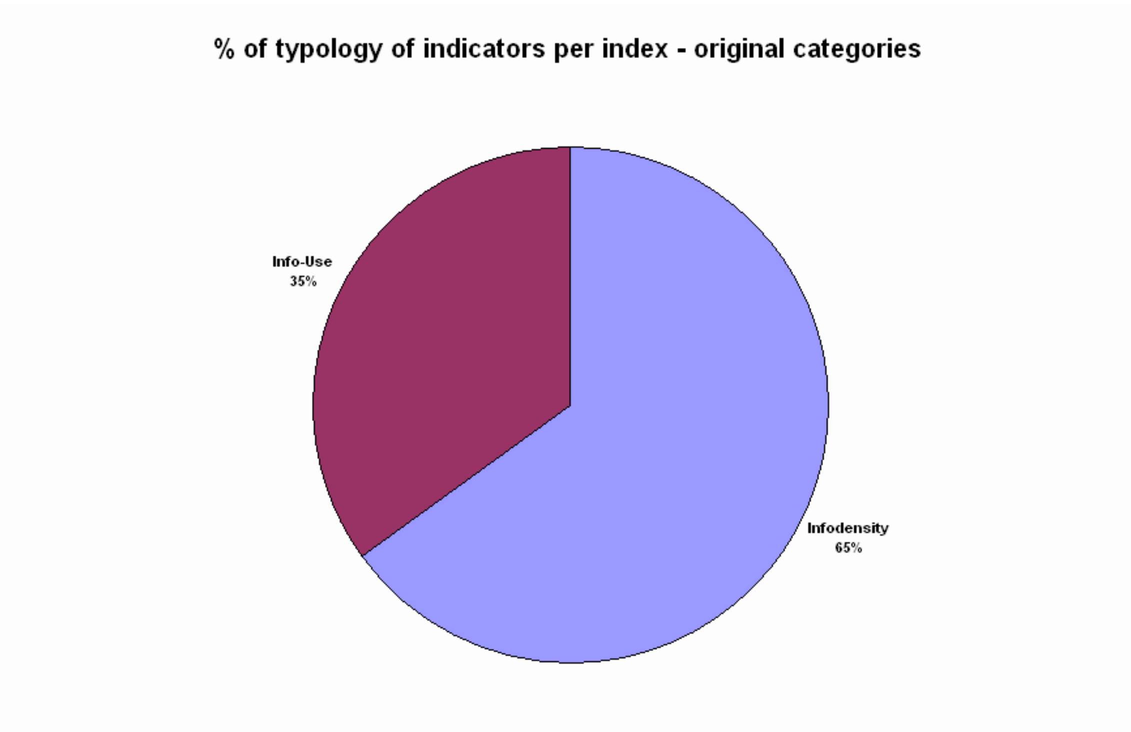

Figure 54: Infostate / Digital Divide Index. % of typology of indicators per index – original categories

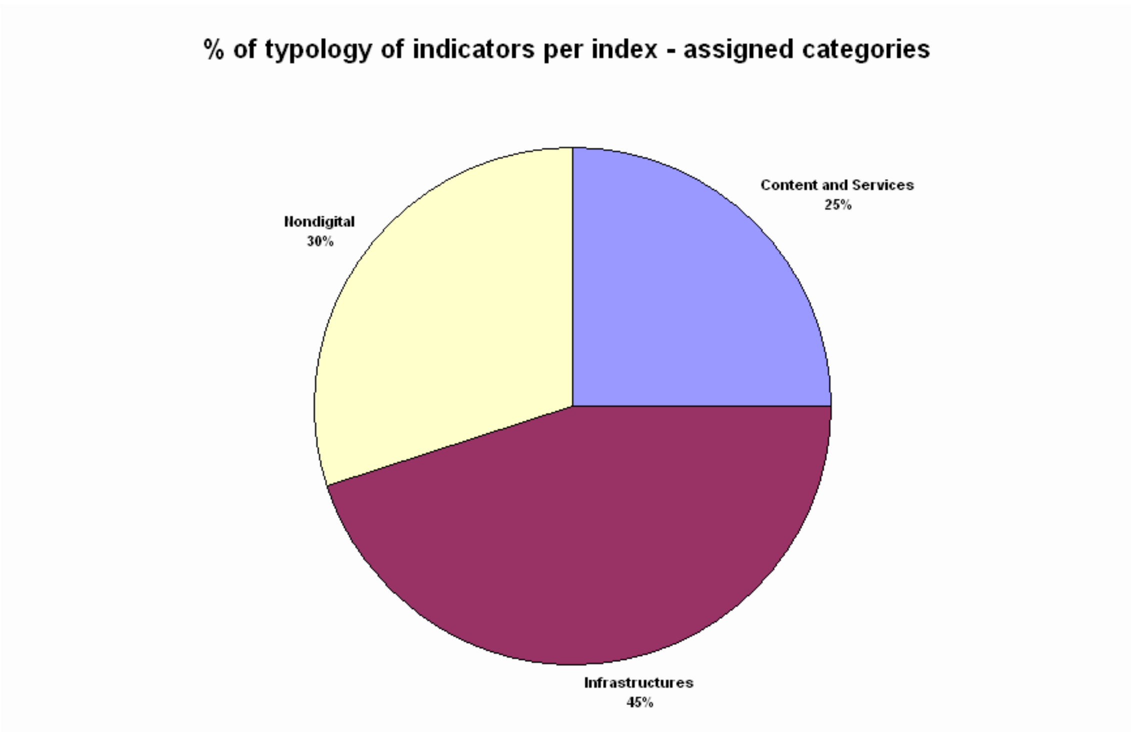

Figure 55: Infostate / Digital Divide Index. % of typology of indicators per index – assigned categories

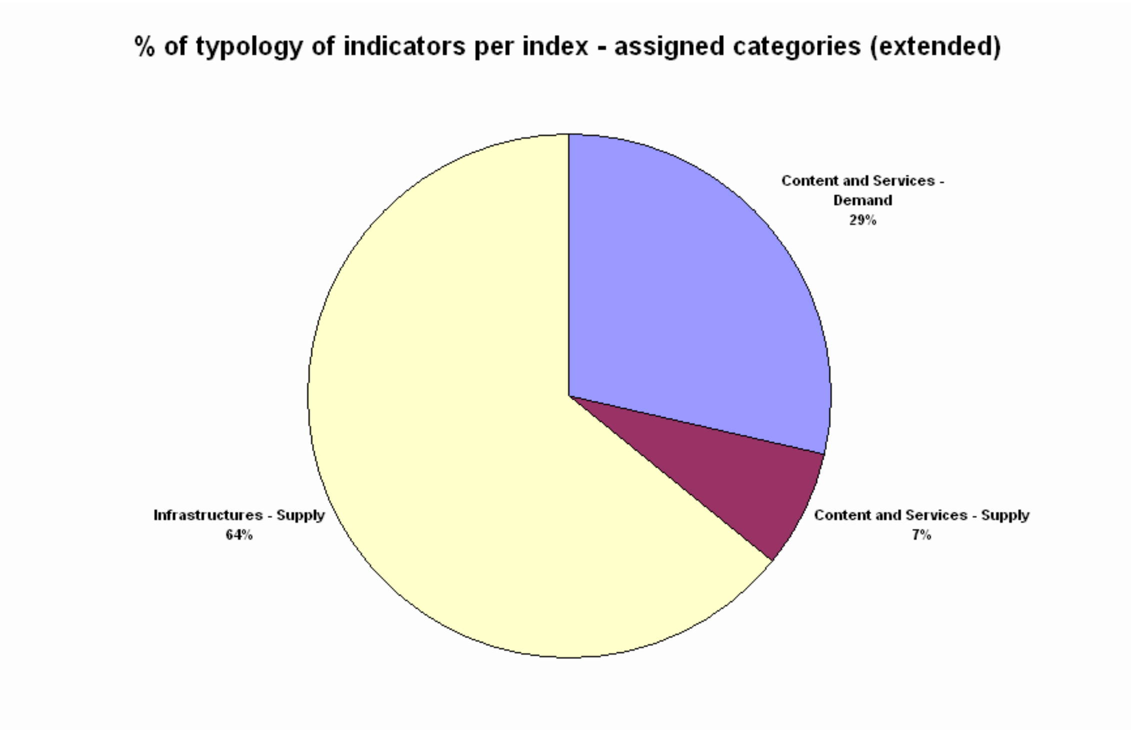

Figure 56: Infostate / Digital Divide Index. % of typology of indicators per index – assigned categories (extended)

6.4.3. Comment

The structure of the Digital Divide Index is truly in the line of other coetaneous indices – the like of the Networked Readiness Index[152] or the e-Readiness Rankings[153] – as it expands itself towards many socioeconomic variables, so to gather as much as context as possible.

The inconvenience in doing so, as we have already stated, is the inclusion of "analogue noise" to the model. In this case, the model is more comprehensive than other ones, and a significant milestone in the evolution of the design of measuring devices for the Information Society. But this aim of comprehensiveness turns itself into a problem when trying to separate from the Information Society what is just related to the Digital Economy.

Nevertheless – and besides the critical importance of the work done by George Sciadas and all the research teams and institutions implied in the project that changed the whole landscape at the international level – we want to stress the importance of two of the distinctions made within the model. The first one – ICT Infrastructure vs. ICT Skills – might have been previously gathered by other models, but this is one of the first times that the dichotomy is presented with such strength.

[152] See section 7.11
[153] See section 7.10

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Networks				Uptake
				Intensity

Figure 57: Infostate / Digital Access Index – main topics covered

Ironically, the resulting model materialized in the Digital Divide Index *does not* include *any* indicator concerning digital skills (i.e. digital literacy) but only approaches (e.g. gross enrolment ratios) that might give a clue, a proxy, to estimate those skills. In Sciadas (2003) words: "In the process of the exercise, severe informational gaps were identified, particularly for ICT skills. The report echoes calls for a concerted international effort to address them"[154].

The second one – ICT Uptake vs. ICT Intensity – is, in our opinion, an interesting contribution that has enriched the debate about the measurement of the effective use and impact of ICTs in everyday's society. But, again, the Infostate model is but roughly corresponded with the design of the Digital Divide Index, whose constrictions due to lack of available data make of it a second best awaiting better times.

6.5. e-African ICT e-Index

In recent years[155], the Research ICT Africa (RIA)[156] network has been analyzing the stage of development of the Information Society in sub-Saharan Africa. Their work has reported the ICT Sector performance, surveyed the individual, household and SME access or analyzed the telecommunication regulatory environment. Under the overall framework of "Towards an e-African ICT e-Index", the RIA has covered almost all areas of study in the field of ICT measuring and Information Society fostering. Reviewing all this work here would be out of question because of the breadth of their experience and the limitations of this space.

[154] At this point, we will add that, concerning ICT skills, the perspective is still distressing.

[155] As happens in many places all over the world, the preparation for the Geneva round of the World Summit on the Information Society was here too the spark that lit the engine of ICT concern and measurement efforts.

[156] http://www.researchictafrica.net

But as a round up to their previous work, and as the closing of a past research cycle and the opening of a new one, RIA decided to converge their own methodologies with those internationally increasingly been acknowledged, namely, George Sciadas's work on the Infostate model[157] and the ICT Opportunity Index[158] (Gillwald & Stork, 2007). It is this recent reflection that is of our interest.

Their concern is, notwithstanding, what they call the three different distinctions that can be made to an ICT indicator

- The dimensions and different understanding and application of the concepts of access, usage and impact
- Whether the indicator is measured on the demand side or on the supply side
- Who is the user of ICTs: households, individuals, governments or SMEs

The combination of this matrix of concepts would lead to a 3D space of indicators as pictured in Figure 58. Any simplification of this model would be either losing information or just measuring not very accurately what was to be measured.

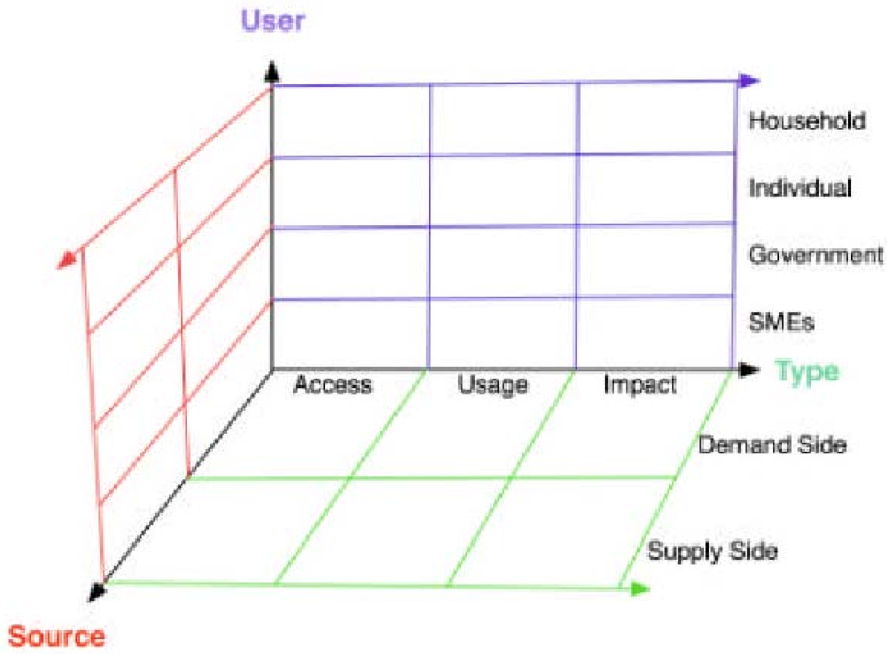

Figure 58: The supply and demand side according to Research ICT Africa (Gillwald & Stork, 2007)

Bearing this in mind, and trying to stick to their previous model, the RIA network commits to develop an evolving African e-Index based on the Infostate model. By adding to this model the Policy & Regulatory environment, which means including into the equation the competitiveness of the ICT Sector[159], the enlarged Infostate model would include now both the supply and demand side, as required by the RIA network.

[157] See previous section
[158] See section 7.5
[159] An area deeply covered and mastered by the RIA network.

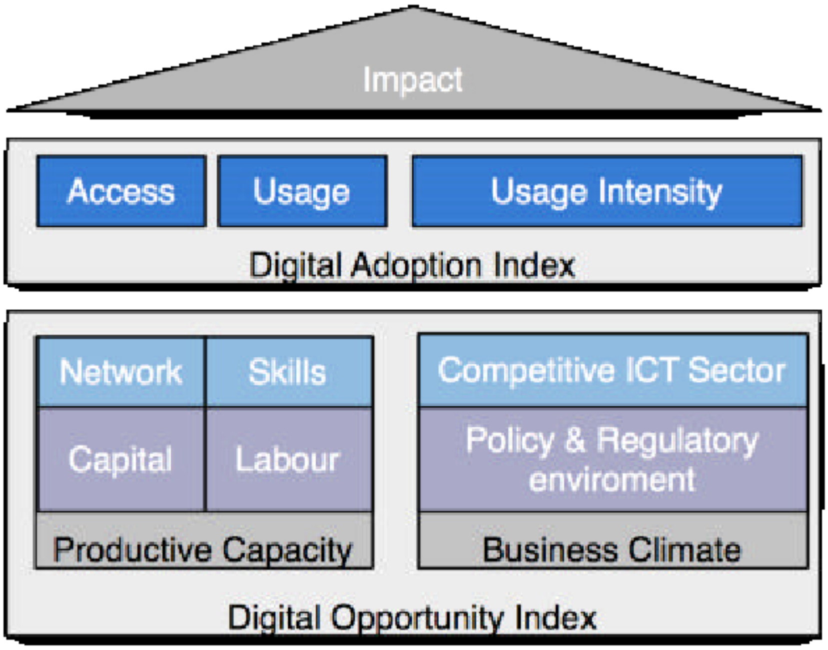

Figure 59: African e-Access & Usage Index (Gillwald & Stork, 2007)

Figure 59 also shows another addition: the coexistence of two subincides (Digital Opportunity Index, Digital Adoption Index) where "the RIA DOI only measures actual opportunity for households, individuals, governments etc to access and use ICTs but not their actual access and usage. Those are captured by the DAI." (Gillwald & Stork, 2007).

6.5.1. Main publications

Gillwald, A. (Dir.) (2004). *Fair Access to Internet Report*. Johannesburg: The Link Centre.

Gillwald, A. (Dir.) (2004). *ICT Sector Performance in Africa: A Review of Seven African Countries*. Johannesburg: The Link Centre.

Gillwald, A. (Ed.) (2005). *Towards an African e-Index. Household and Individual ICT Access and Usage in 10 African Countries*. Johannesburg: The Link Centre.

Stork, C. & Esselaar, S. (Dirs.) (2006). *Towards an African e-Index: SME e-Access and Usage in 14 African Countries*. Johannesburg: The Link Centre.

Gillwald, A. & Stork, C. (2007). *Towards an African ICT e-Index: Towards evidence based ICT policy in Africa*. Johannesburg: The Link Centre.

Esselaar, S., Gillwald, A. & Stork, C. (2007). *Towards an African e-Index 2007. Telecommunications Sector Performance in 16 African countries:*. Johannesburg: The Link Centre.

Gillwald, A. & Stork, C. (2008). *Towards the African e-Index: ICT access and usage in 16 African Countries*. Johannesburg: The Link Centre

6.5.2. Distribution of Indicators

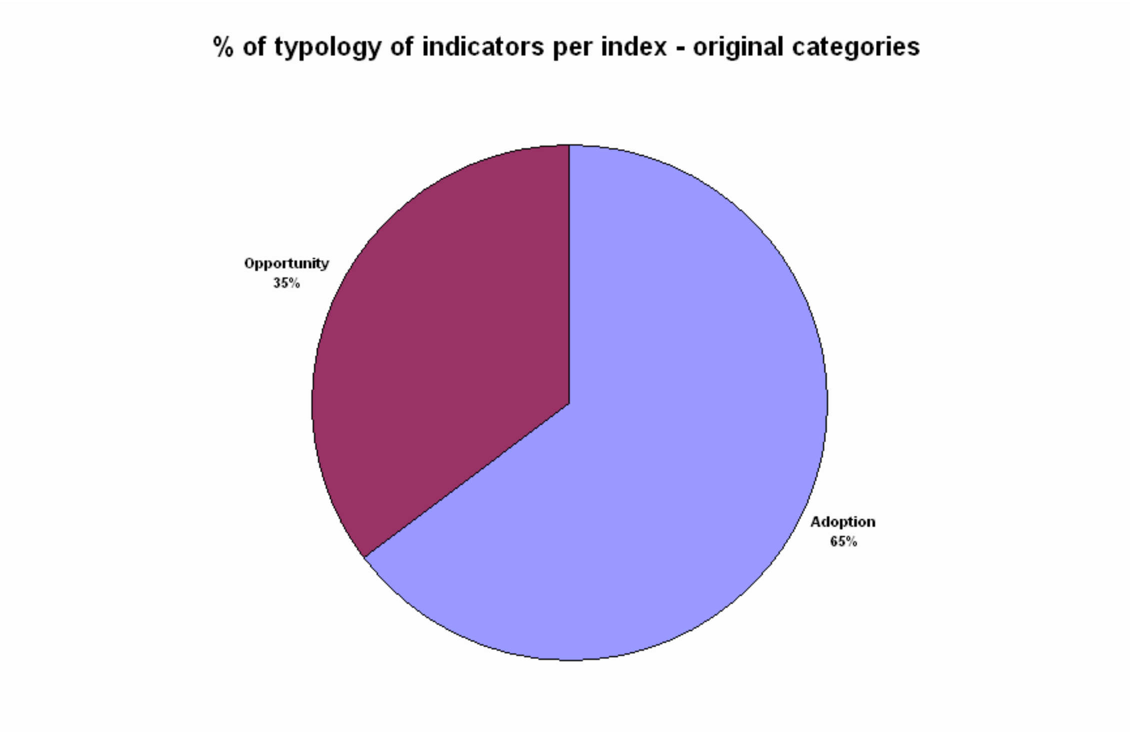

Figure 60: e-African ICT e-Index. % of typology of indicators per index – original categories (primary division)

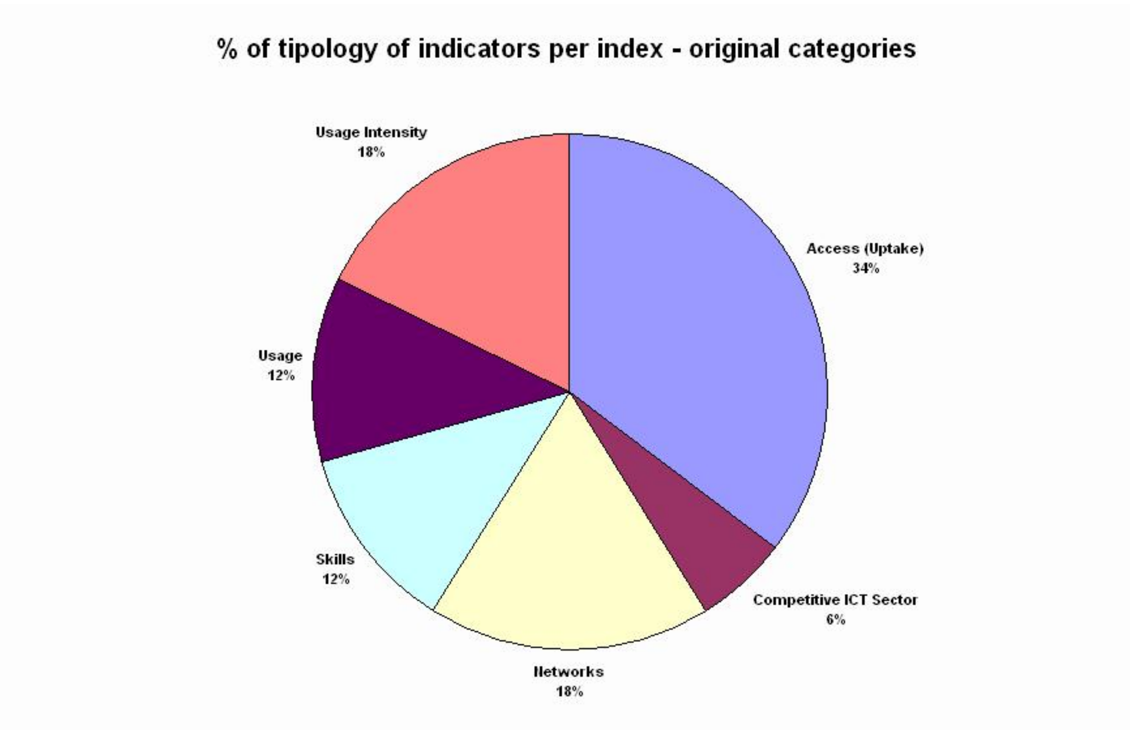

Figure 61: e-African ICT e-Index. % of typology of indicators per index – original categories (secondary division)

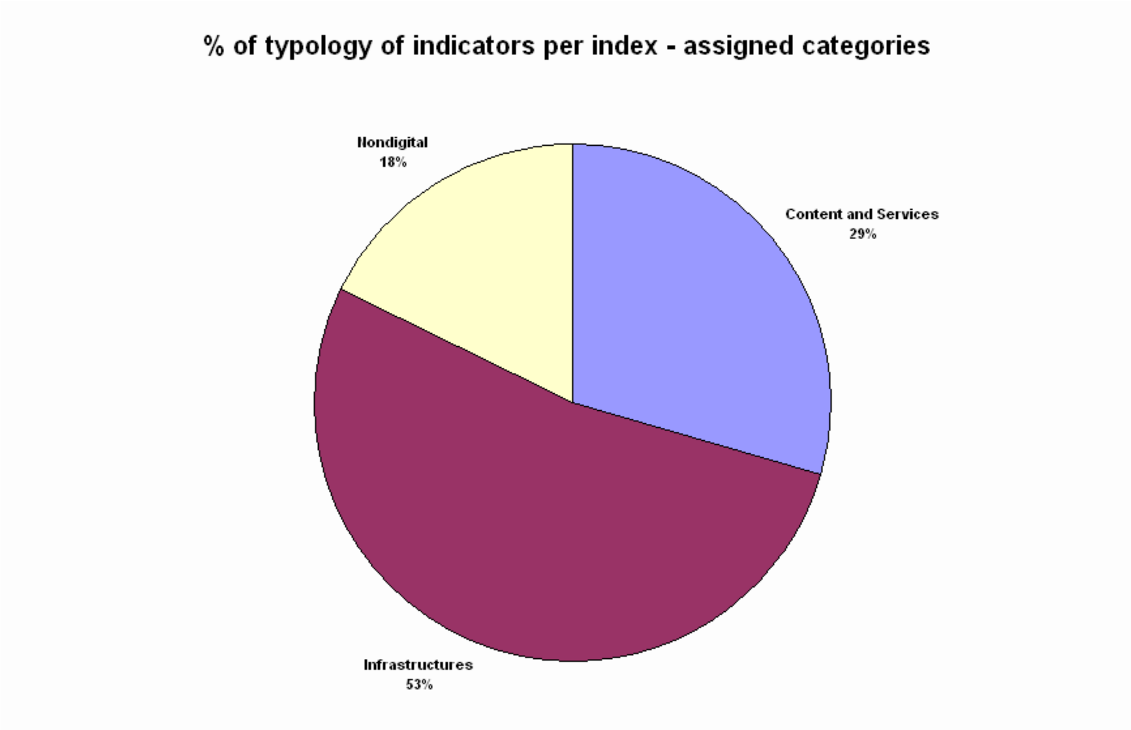

Figure 62 e-African ICT e-Index. % of typology of indicators per index – assigned categories

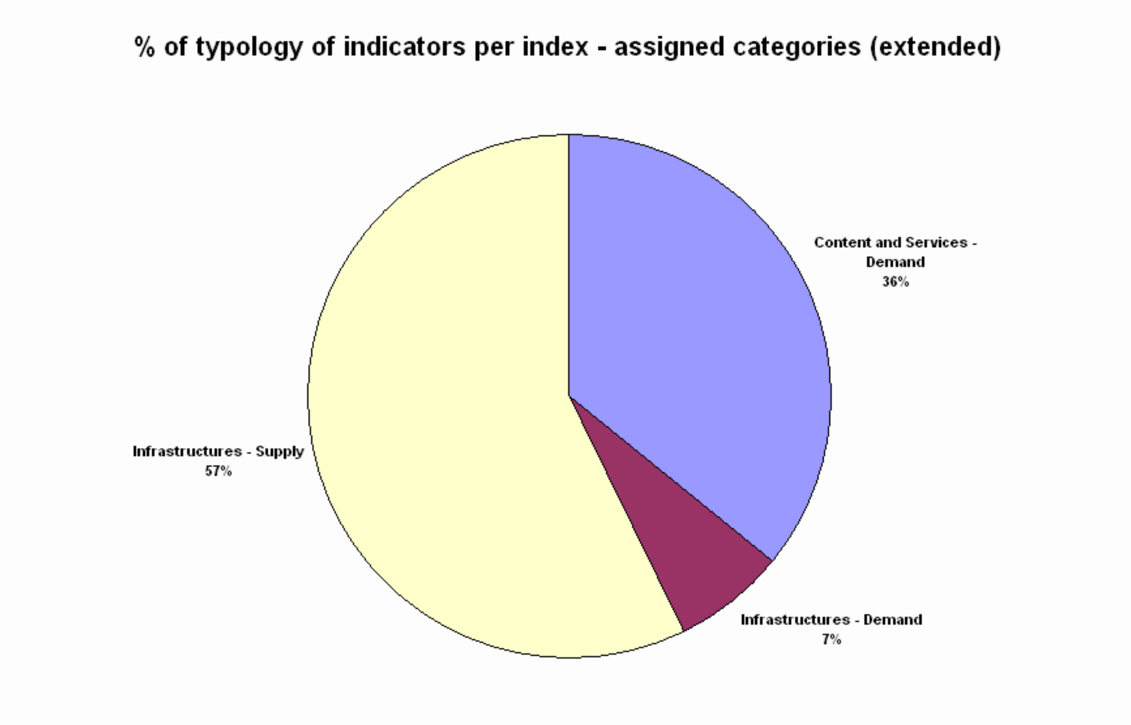

Figure 63: e-African ICT e-Index. % of typology of indicators per index – assigned categories (extended)

6.5.3. Comment

The comparison between Figure 57 and Figure 64 clearly shows that RIA's commitment with convergence of models (RIA's and the Infostate model) has been successfully achieved. The difference between both models can be inferred from Figure 56 and Figure 63, that shows how the e-African Index does include more indicators (in relationship with infrastructures) gathering content and services variables than Infostate's. Indeed, these added indicators are mainly covering de users' demand, as it was pursued by the RIA network, that wanted to keep into the model the importance of the demand side of ICT indicators.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Networks				Uptake
				Intensity

Figure 64: e-African ICT e-Index – main topics covered

6.6. SIBIS Benchmarking Framework

The Statistical Indicators Benchmarking Information Society (SIBIS) was a European Commission funded project that run from 2001 to 2003. A fruitful project that raised huge interest among practitioners and researchers, we will highlight here three of their outputs:

- The SISIB Benchmarking Framework
- The Digital Divide Index (DiDix)[160]
- The e-Inclusion Index (eIIx)[161]

The first task that SIBIS successfully succeeded in performing was an exhaustive benchmarking of the existing measuring devices used at the beginning of the XXI[st] century in Europe. With the lessons learned, SIBIS proposed a new framework that comprised 9 topic reports:

[160] See section 6.7
[161] See section 6.8

- Telecommunications and access
- Internet for research and development
- Security and trust
- Education
- Work, employment and skills
- Social inclusion
- e-Commerce
- e-Government
- Health

which covered almost all topics of the Digital Economy and at a quite deep degree – while the selection of key indicators was a compact collection of 18 variables, the entire indicator system was composed by 133 indicators.

6.6.1. Main publications

SIBIS Consortium (2003). *SIBIS. New eEurope Indicator Handbook*. Bonn: Empirica.

SIBIS Consortium (2003). *SIBIS Pocketbook 2002/03. Measuring the Information Society in the EU, the EU Accession Countries, Switzerland and the US*. Bonn: Empirica.

SIBIS Consortium (2003). *SIBIS Benchmarking Highlights 2002: Towards the Information Society in Europe and the US*. Bonn: Empirica.

6.6.2. Distribution of Indicators

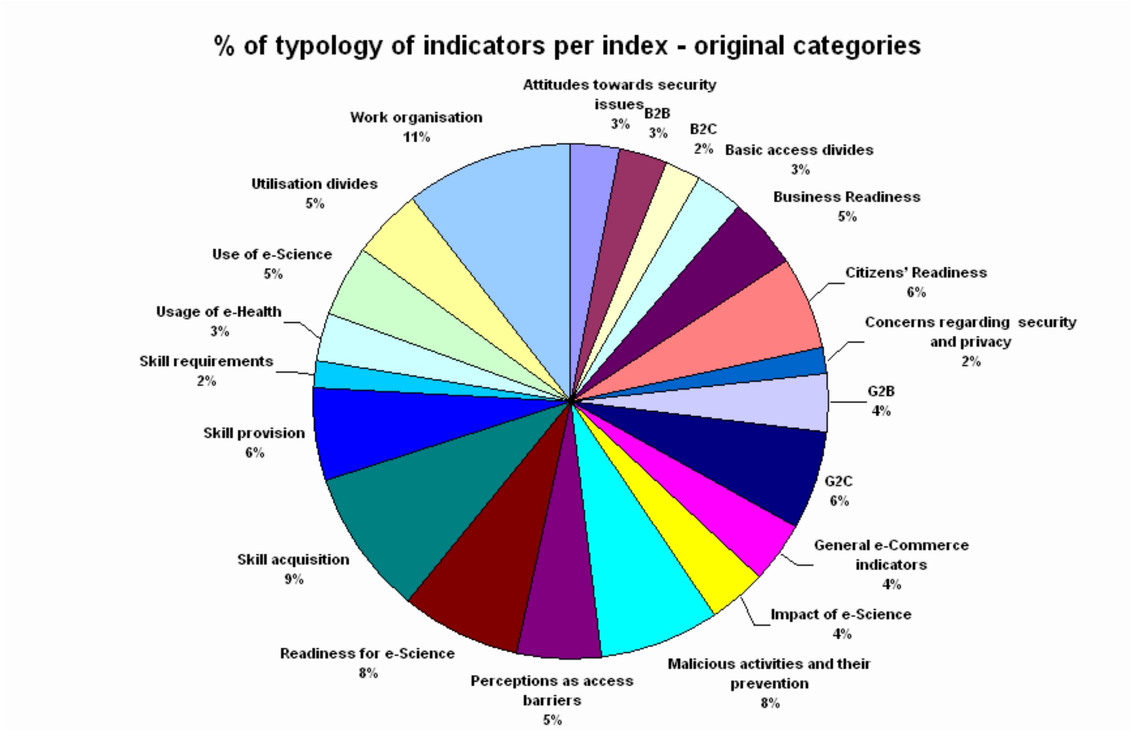

Figure 65: SIBIS Benchmarking Framework. % of typology of indicators per index – original categories

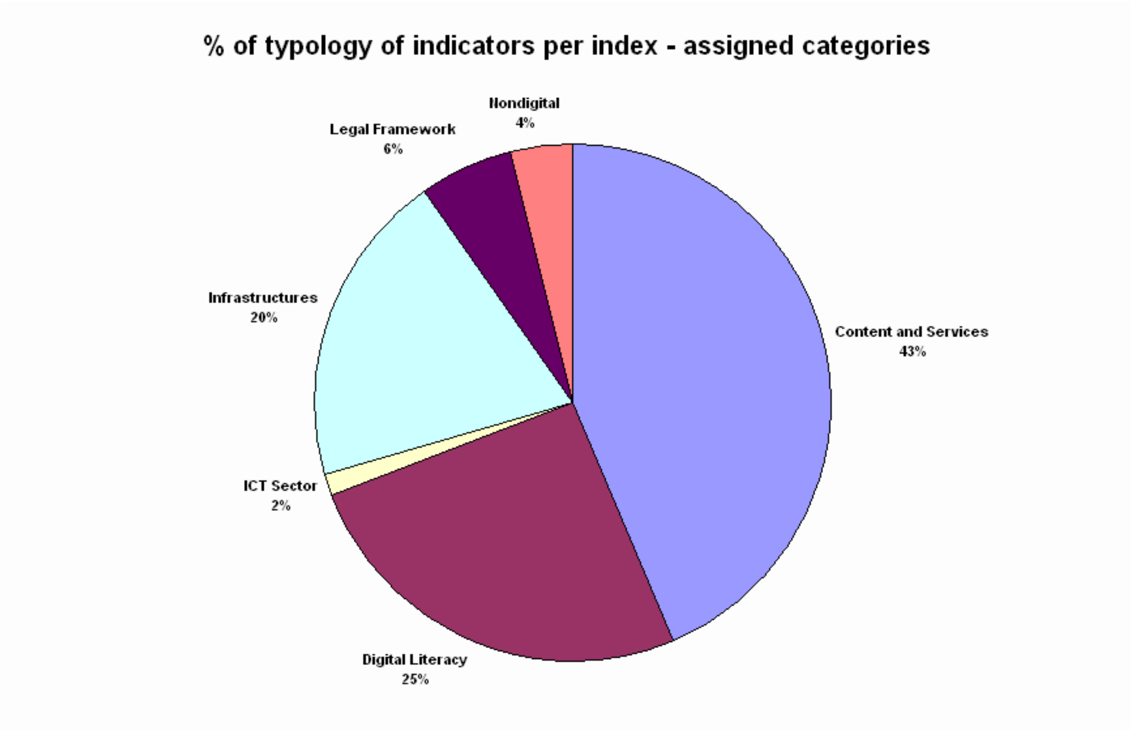

Figure 66: SIBIS Benchmarking Framework. % of typology of indicators per index – assigned categories

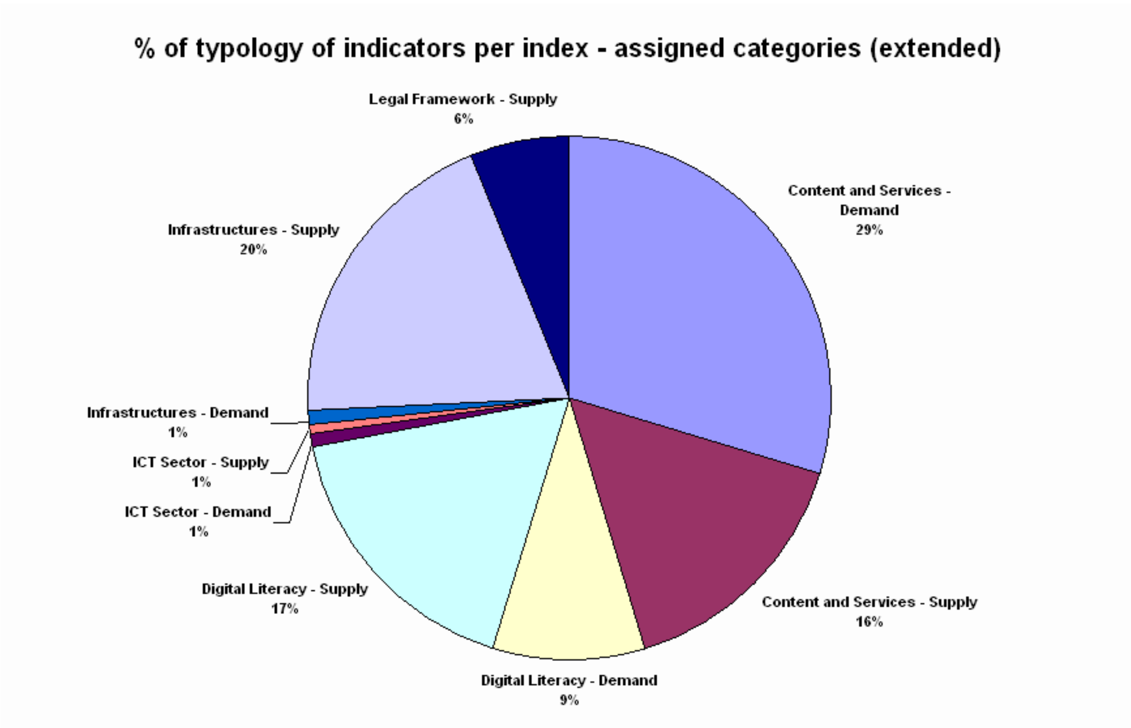

Figure 67: SIBIS Benchmarking Framework. % of typology of indicators per index – assigned categories (extended)

6.6.3. Comment

SIBIS work was impressive at least at three levels: appropriateness and relevance of the topic, breadth and depth achieved, and exquisite diffusion of the results in a constant search for debate, consensus and impact.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Access Internet	Competitive-ness	Digital Literacy Applied digital literacy	Security and Trust	e-Commerce e-Government Health
Social Inclusion	ICT Skills requisites	ICT Training		Intensity and purpose of use Confidence Telework

Figure 68: SIBIS Benchmarking Framework – main topics covered

Their effort is especially valuable in the part of content and services, which they covered well and in a way that had no previously been done, one of the reasons being a sincere concern towards e-inclusion and the digital divide, as we will see in the next two sections. Hence their detailed depicting of uses and barriers to use in the user end of the Digital Economy.

As a drawback, the model somehow left the ICT Industry and policies unattended, being governments only pictured as providers and users of digital content and services, but not as policy makers or institutions concerned with the strategic development of the Information Society. In the case of the ICT Sector and the legal framework related to it, the criticism can be a little bit harder, as the concern with access barriers expressed in the whole project seems not to have a correspondence in the quality of ICT regulation, the degree of competition in the supply of infrastructures and services, etc.

6.7. Digital Divide Index - DiDix

Another output that SIBIS worked with was the Digital Divide Index (DiDix)[162], as a specific measure of the digital divide in some specific collectives in risk of exclusion. With a simplest but most effective design, DiDix's first design covered four indicators:

[162] Not to be confused with Orbicom's Digital Divide Index (DDI)

- Computer use (30%)
- Internet use (at all) (30%)
- Internet use at home (20%)
- Access at home (20%)

that were cut into only three in the last version[163]:

- Percentage of computer users (50%)
- Percentage of Internet users (30%)
- Percentage of Internet users from home (20%)

These indicators were calculated for four segments of the population according to

- Income
- Education
- Gender
- Age

being the index calculated as DiDix = target average / overall average and applying an innovative Time-Distance Methodology that gathered not only the gaps in the development of the segment with the overall average, but also the evolution along time.

6.7.1. Main publications

Hüsing, T., Selhofer, H. & Korte, W. B. (2001). *Measuring The Digital Divide. A Proposal For A New Index*. IST Conference in Düsseldorf, Düsseldorf. Düsseldorf: IST.

Hüsing, T. & Selhofer, H. (2002). "The Digital Divide Index. A Measure Of Social Inequalities In The Adoption Of ICT". In Wrycza, S. (Ed.), *Proceedings of the Xth European Conference on Information Systems ECIS 2002 - Information Systems and the Future of the Digital Economy*, 1273-1286. June 6-8, 2002. Gdansk: ECIS.

Hüsing, T. & Selhofer, H. (2004). "DiDix. A Digital Divide Index for Measuring Inequality in IT Diffusion". In *IT&Society, 1*(7), 21-38. Stanford: SIQSS Stanford University.

Vehovar, V., Sicherl, P., Hüsing, T. & Dolnicar, V. (2006). "Methodological Challenges of Digital Divide". In *The Information Society, 22*(5), 279–290. Abingdon: Taylor & Francis.

Hüsing, T. (2006). *The Digital Divide Index. Exploiting cross national survey data to quantify levels of e-exclusion*. Bonn: Empirica.

[163] Actually, Internet use at home and access at home at already effectively been merged in some intermediate designs

6.7.2. Distribution of Indicators

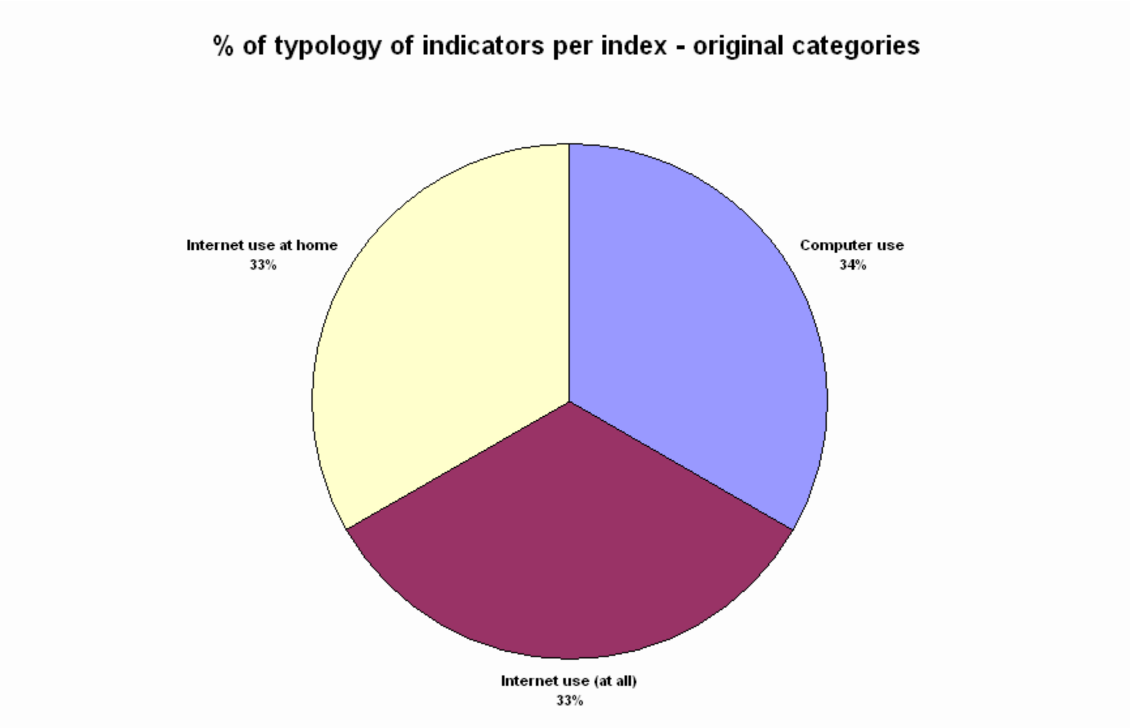

Figure 69: DiDix. % of typology of indicators per index – original categories

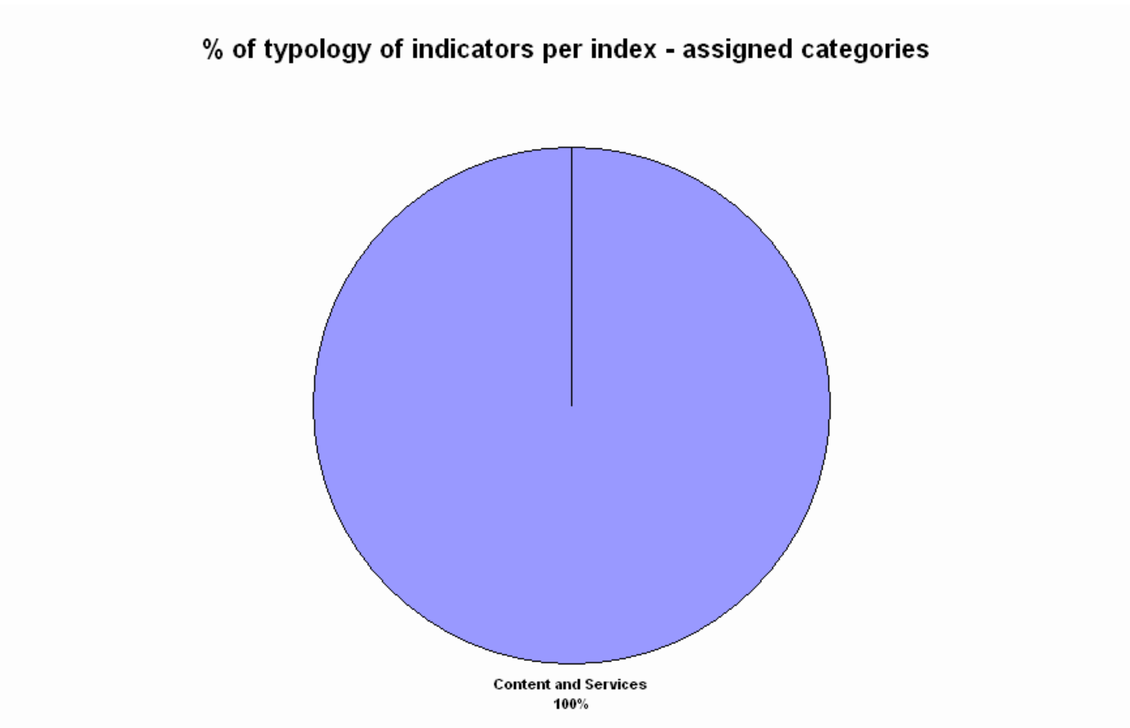

Figure 70: DiDix. % of typology of indicators per index – assigned categories

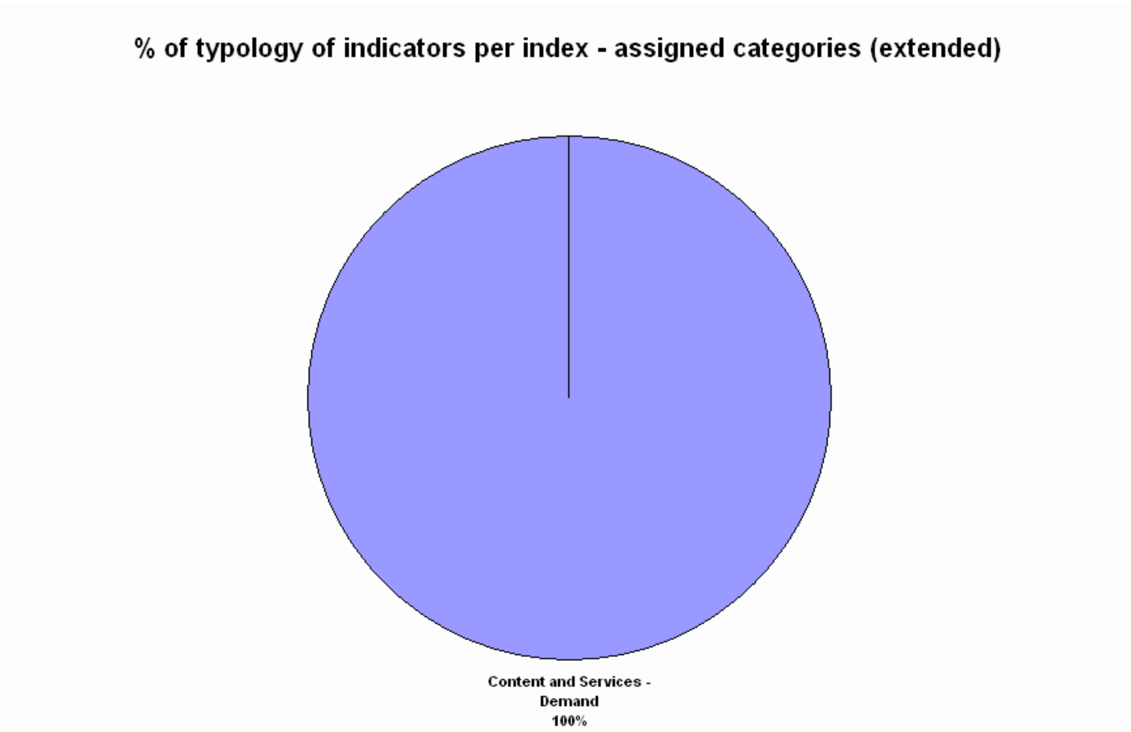

Figure 71: DiDix. % of typology of indicators per index – assigned categories (extended)

6.7.3. Comment

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Access				
				Use

Figure 72: SIBIS's DiDix – main topics covered

As it is made evident by Figure 69, Figure 70, Figure 71 and Figure 72, the topics covered are few. The added value of the index is, then, first, the focus – as was the case in the SIBIS Benchmarking Framework – in the effective use of technologies given a specific level of physical access. Second, the qualitative and quantitative analyses between the collectives in risk of exclusion and the averages in countries or in Europe in general.

6.8. The eInclusion Index

A last proposal, made by components of the SIBIS project after it was finished[164], and in the framework of the Riga Declaration (European Commission, 2006) was the building of an eInclusion Index (eIIx) as an evolution to SIBIS's DiDix.

The eIIx reprised the DiDix and include the dimensions of broadband and e-Government to enrich the original index. To our knowledge, the index remained as a theoretical effort and was never put into practice.

6.8.1. Main publications

Hüsing, T. (2006). *The Digital Divide Index. Exploiting cross national survey data to quantify levels of e-exclusion*. Bonn: Empirica.

6.8.2. Distribution of Indicators

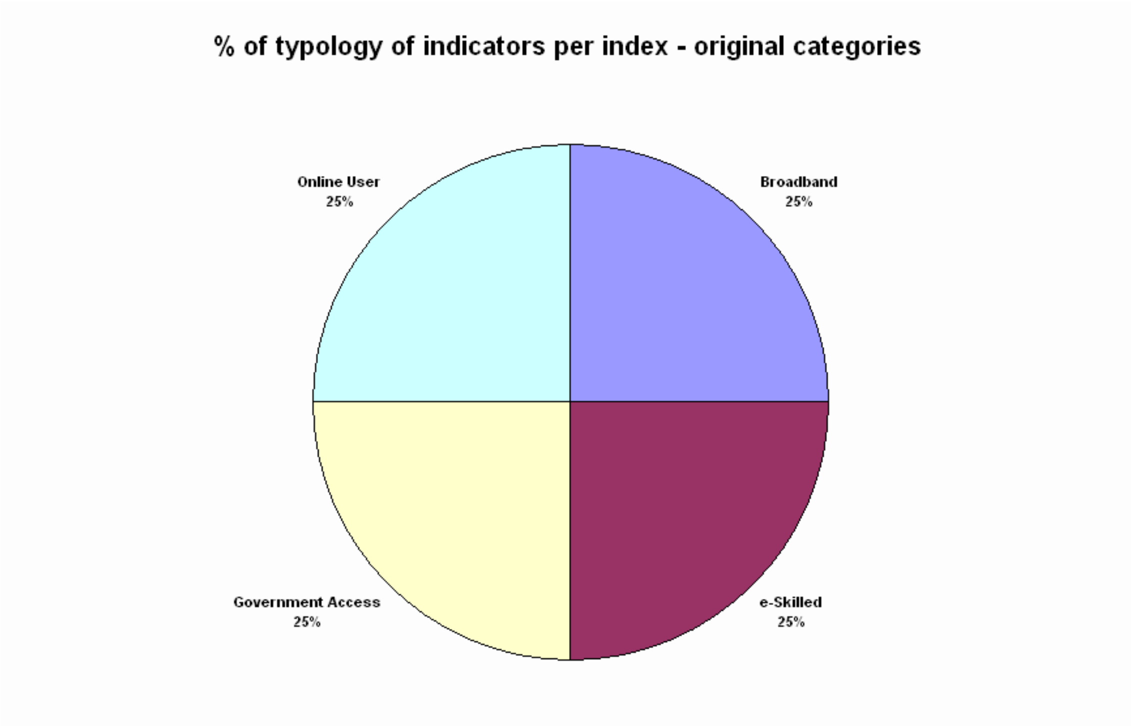

Figure 73: eIIx. % of typology of indicators per index

[164] Nevertheless, Empirica, the leader of the SIBIS project was also the leader of eUser (http://www.euser-eu.org) project, also related with eServices and the intensity of use of digital content and services (e-Government, e-Health and e-Learning).

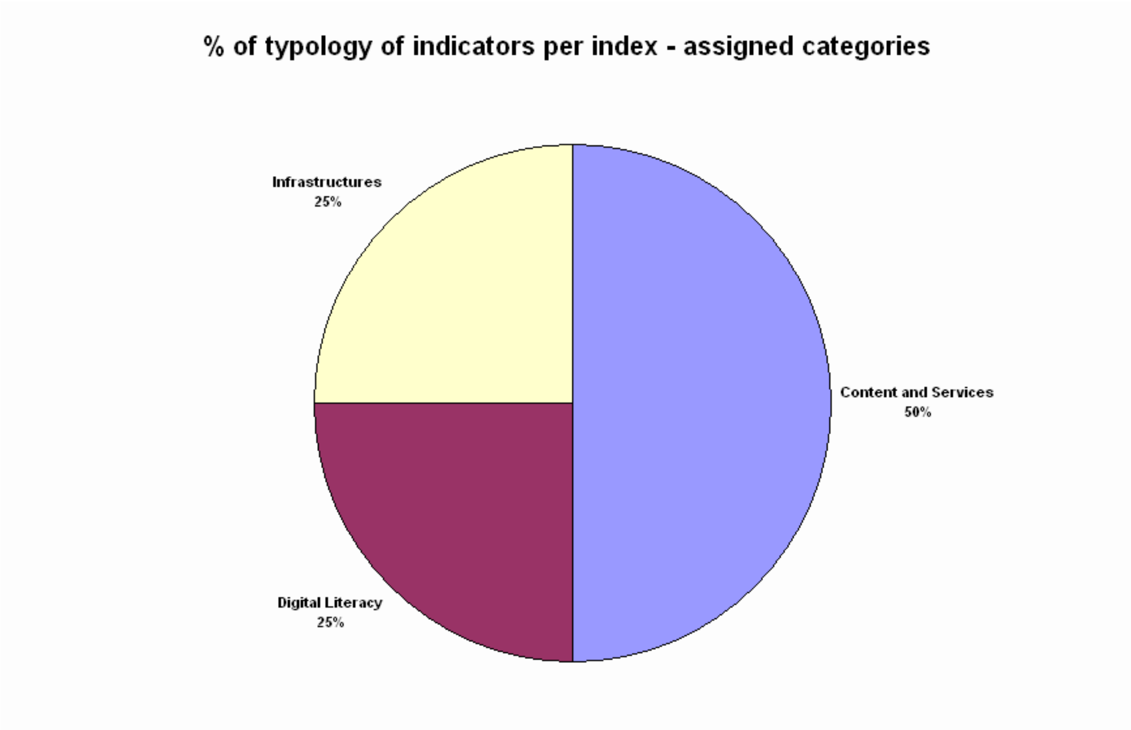

Figure 74: eIIx. % of typology of indicators per index

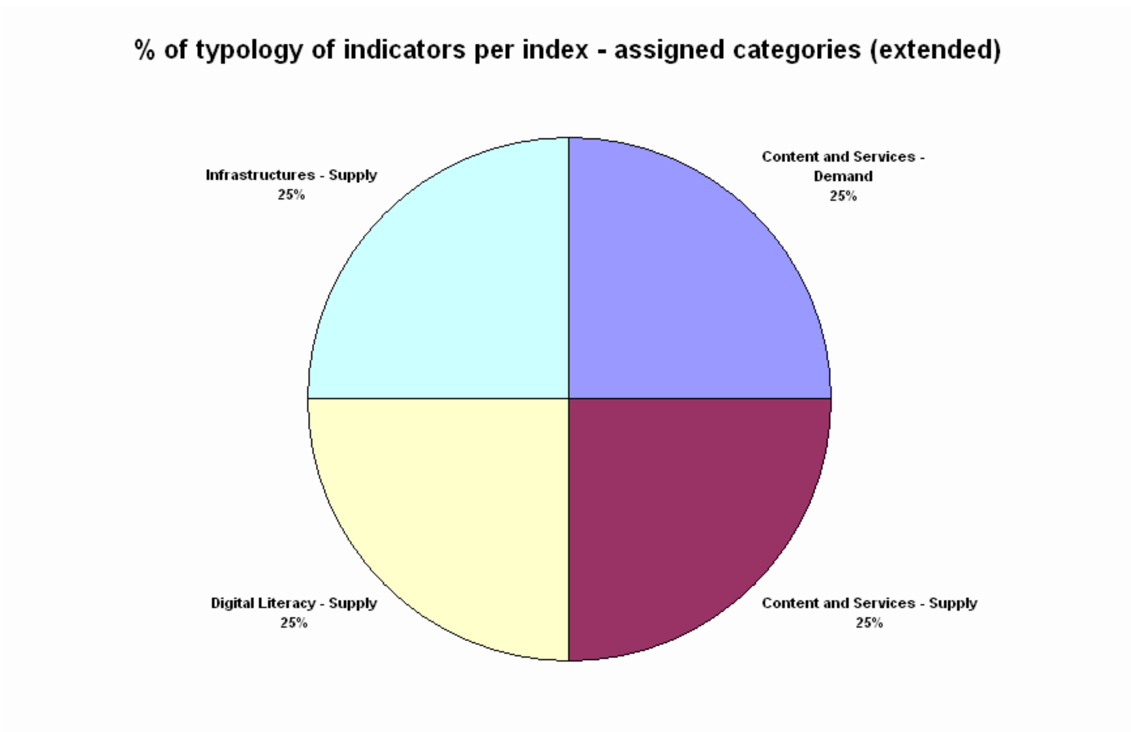

Figure 75: eIIx. % of typology of indicators per index

6.8.3. Comment

The existence of the eIIx is interesting as a witness of the evolution of the Information Society measuring from the "first" publication by Tobias Hüsing (Hüsing et al., 2001) and his "last" one in 2006 (Hüsing, 2006).

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Broadband		Skills		Government Access
				Users

Figure 76: eIIx – main topics covered

Even if the design is still simple, the comparison between Figure 72 and Figure 76 shows the notable qualitative improvement to gather the always evolving definition of access and the digital divide. The inclusion of broadband measuring is the answer to the need to include quality of access – or to update the concept of access in relationship to its quality – as a measure of it. On the other hand, not only use but a positive amount of content and e-services is included too to make the index more comprehensive. Third, a measure of skills – one of the strongest parts in the SIBIS Benchmarking Framework – acts as a bridge between infrastructures and e-content, e-services and use.

6.9. Sustainable ICT Framework

The Sustainable ICT Framework, developed by Susanne Sundén and Gudrun Wicander, is a micro – a project level, actually – model that might look a little bit off-topic in our macro, much broader approach. The reason for including it here is that it is quite easy to transpose Sundén & Wicander's reflections to the macro level and vice-versa, seeing that, despite the evident differences and specificities of each point of view, the main problems and the main questions are shared, even if the practical tools to measure or to develop a project might slightly differ.

The Sustainable ICT Framework describes five different "capitals" that explain the main cores of sustainable ICT projects for development.

- Physical capital
- Social capital
- Human capital
- Financial capital
- Content capital

each capital divided in their respective subcategories, each one comprising several different factors up to the number of 41 (Figure 77):

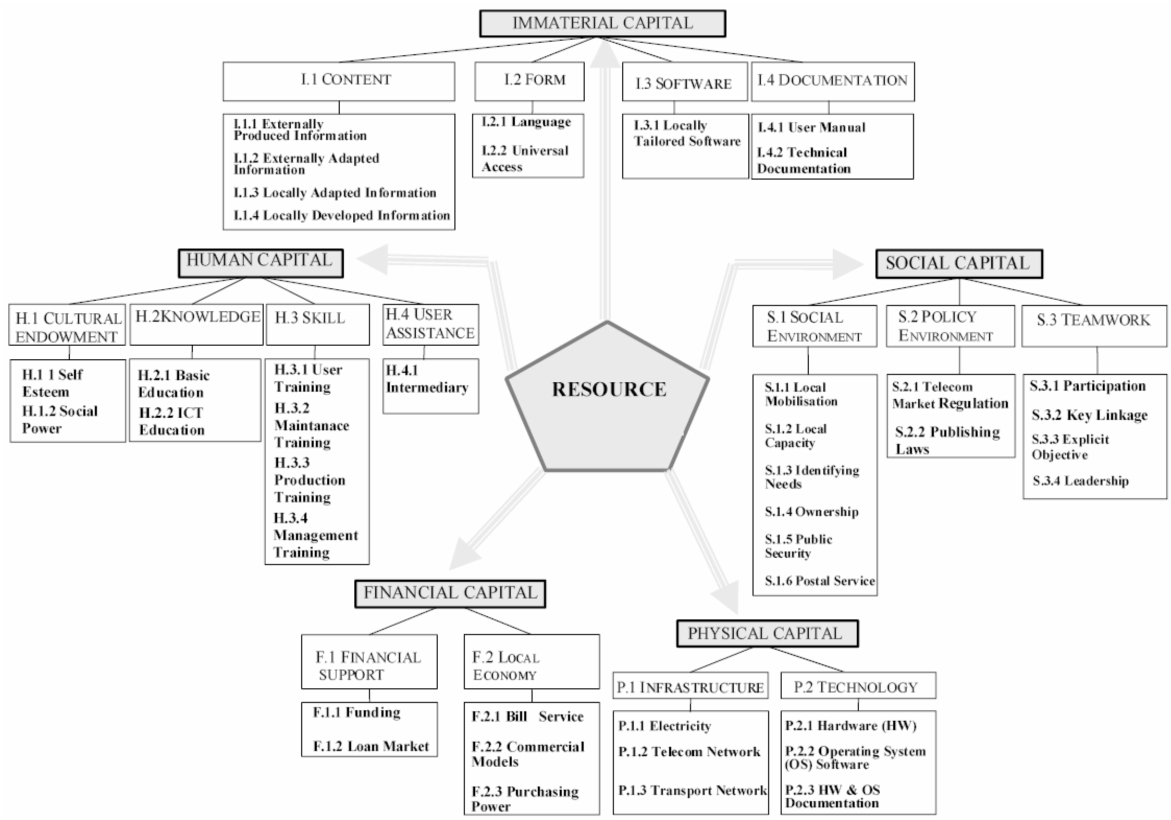

Figure 77: The Sustainable ICT Framework (Sundén & Wicander, 2006, p.247)

6.9.1. Main publications[165]

Sundén, S. & Wicander, G. (2006). *Information and Communication Technology Applied for Developing Countries in a Rural Context. Towards a Framework for Analysing Factors Influencing Sustainable Use*. Karlstad University Studies 2006:69. Karlstad: Karlstad University.

[165] Even if not strictly related with the model, the reader will find also interesting Sundén & Wicander, 2003.

6.9.2. Distribution of Indicators

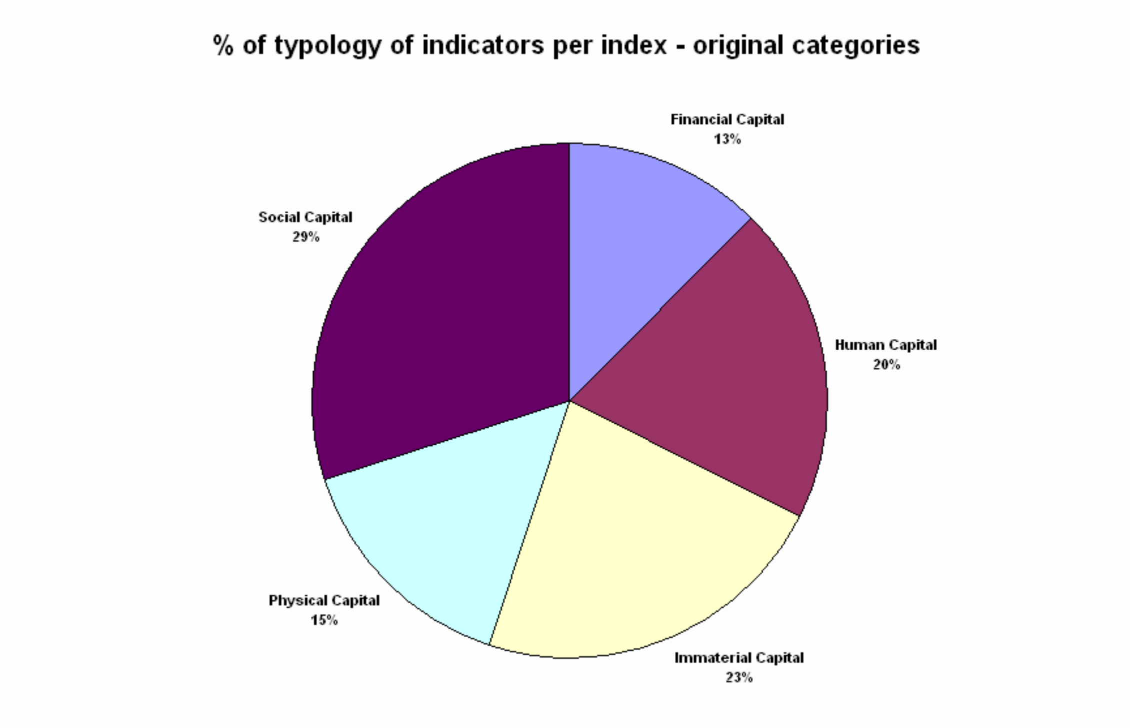

Figure 78: Sustainable ICT Framework – original categories

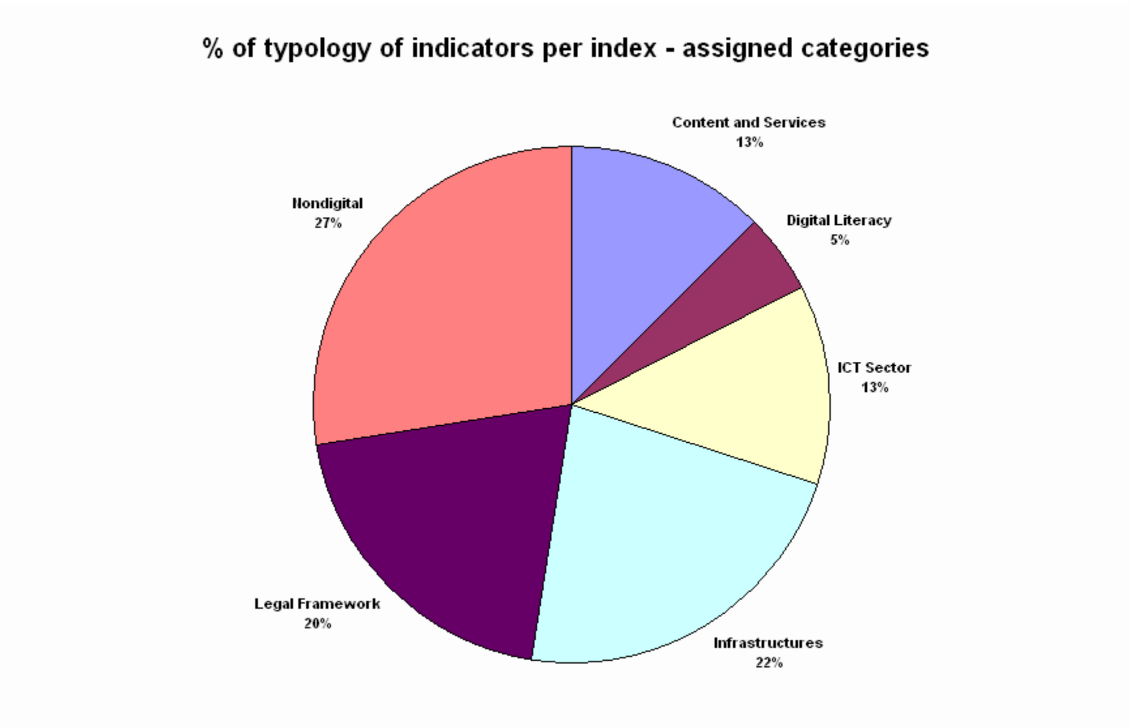

Figure 79: Sustainable ICT Framework – assigned categories

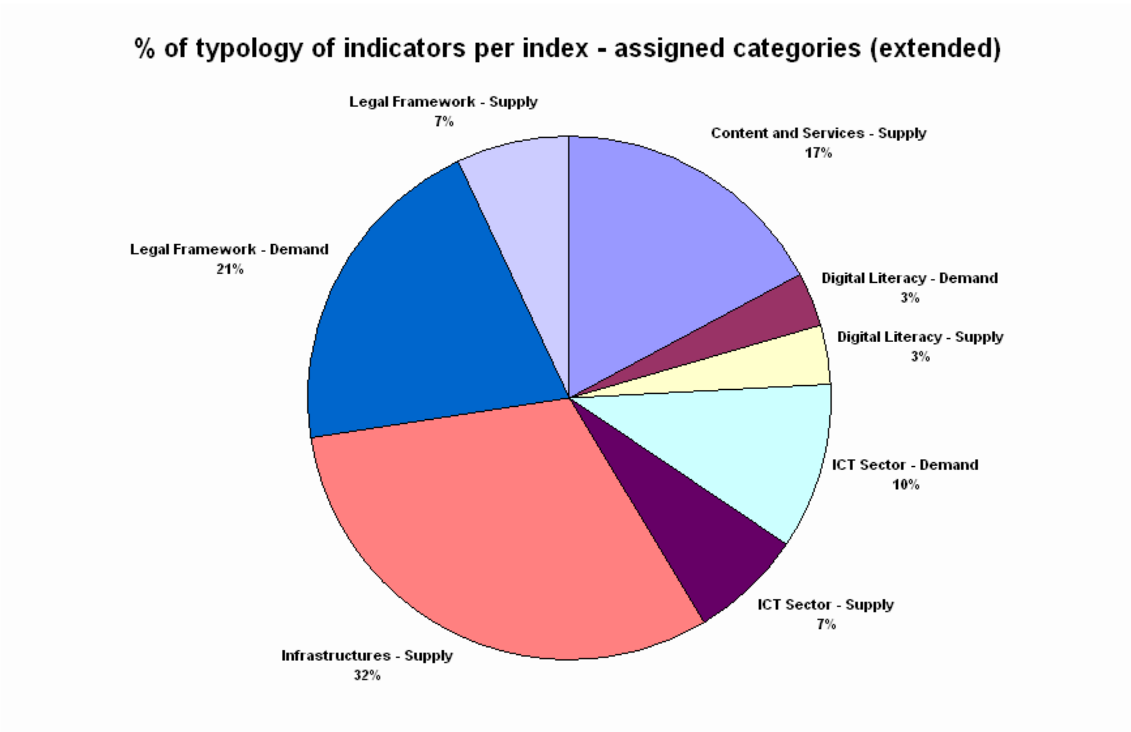

Figure 80: Sustainable ICT Framework – assigned categories (extended)

6.9.3. Comment

We would agree with the reader that our categorization of the Sustainable ICT Framework (Figure 79, Figure 80, Figure 81) might look a little bit forced if out of context or exempt of an explanation. As we stated at the beginning of this section, with a proper translation from micro to macro, things are easily understandable.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Physical capital	Financial Capital	Human Capital - Skills	Social Capital – Policy Environment	Content Capital
	Human Capital - Skills	User Training	Financial Immaterial Social Capital	

Figure 81: Sundén & Wicander's Sustainable ICT Framework – main topics covered

As a framework that aims at what makes a project successful – another way of saying this would be "used" –, use is a dependent variable that is left outside of the model.

Interestingly, human action before use – commitment, training, participation – have a key role in this model: the existence of trained ICT workers (at all levels), of a literate user (both in digital skills as in general education levels) and the effective participation and engagement of all the community (here classified within the "legal framework – policies" category) are essential to the best of achievements of an ICT4D project. The transposition into macro policies to foster the Information Society is direct and, in our opinion, one of the most eloquent statements of this model.

This model makes the two other ends meet in this human geographical centre: existence of sufficient infrastructures and the correspondent content. Again, the design, with the individual at the centre of it, interacting on one side with infrastructures and at the other side with content is what makes this model so appealing to us.

6.10. SIMBA

The Sustainable ICT – a Model for Benchmarking Activities with Broadband Focus (SIMBA) is a model proposed by Gudrun Wicander mainly aimed to "provide good guidance for an evaluation process" (Wicander, forthcoming).

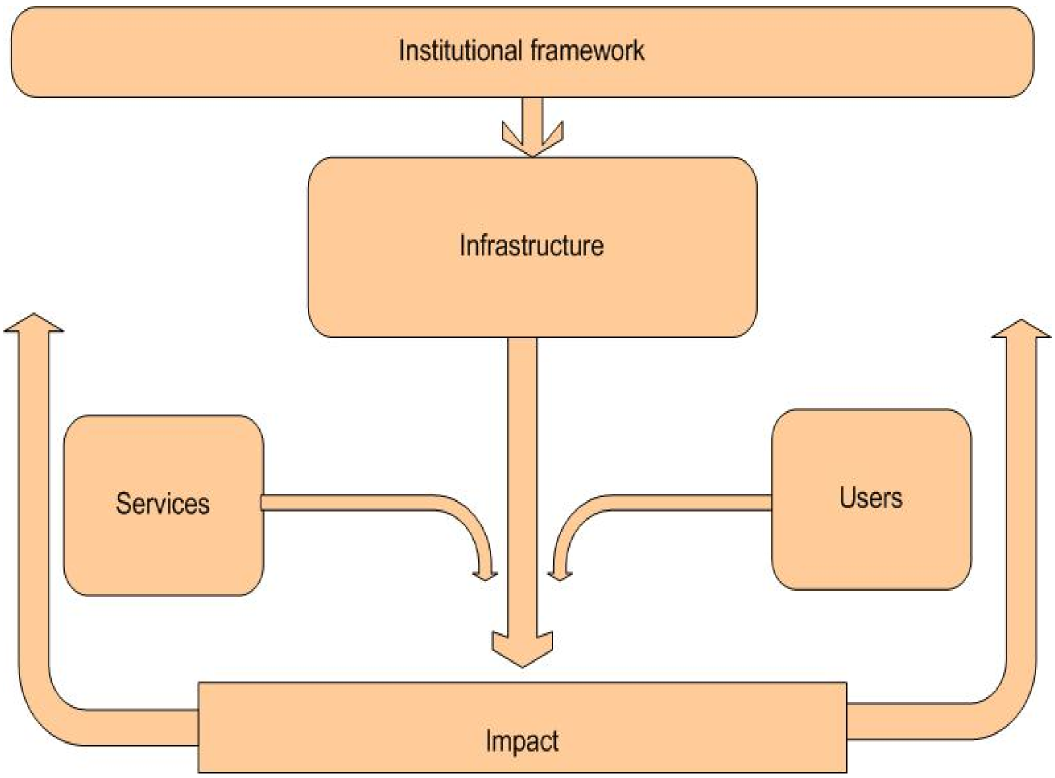

Figure 82: The SIMBA Model (Wicander, 2007, p.12)

Concerned with the question of sustainability, SIMBA emanates from the KaU Framework and the KTH Strategy, just as Sundén and Wicander's Sustainable ICT

Framework presented in the previous section, to present a new framework that took the coincident areas of them all and tested them into practice.

The resulting model (Figure 82) is then divided in four areas (Institutional framework, Infrastructure, Services, Users) leading to a fifth one, Impact.

Keeping impact as the dependent variable, the rest of the areas were measured with a total of 54 independent indicators, so to provide an estimated measure of the former.

6.10.1. Main publications

Wicander, G. (forthcoming). "SIMBA – a Tool for Evaluating ICT in Sub Saharan African Countries". In Christensen, C. (Ed.), *HumanIT 2006 - Technology in Social Context*. Cambridge: Cambridge Scholars Press

6.10.2. Distribution of Indicators

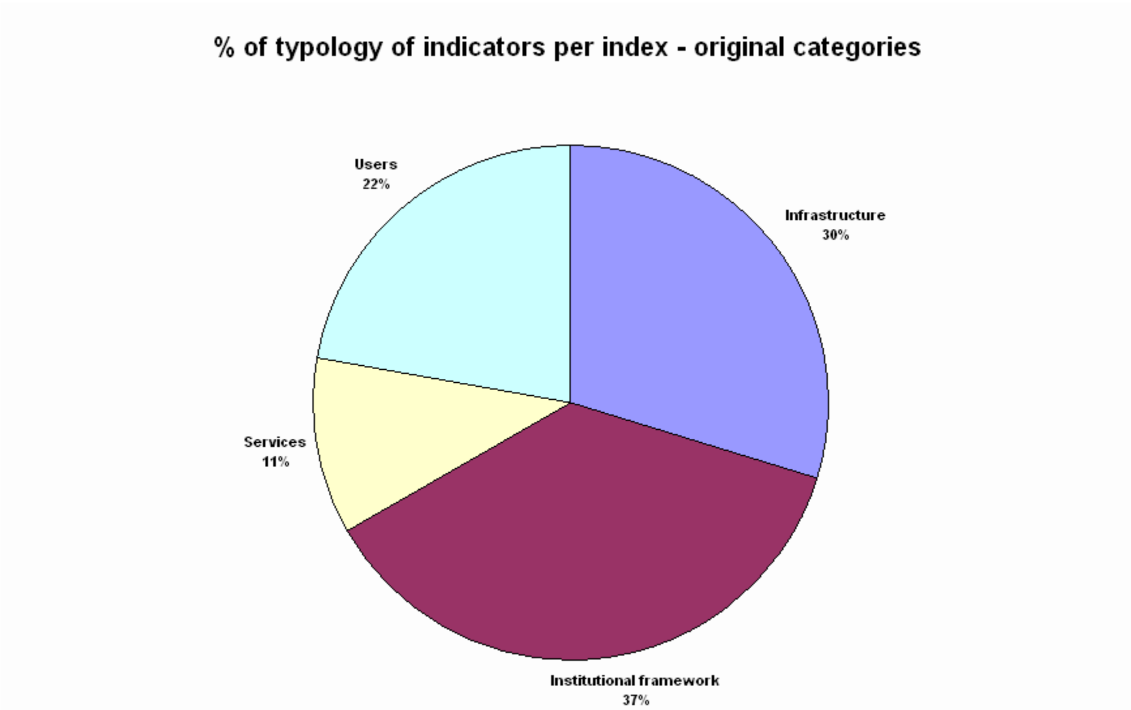

Figure 83: SIMBA Model. % of typology of indicators per index – original categories

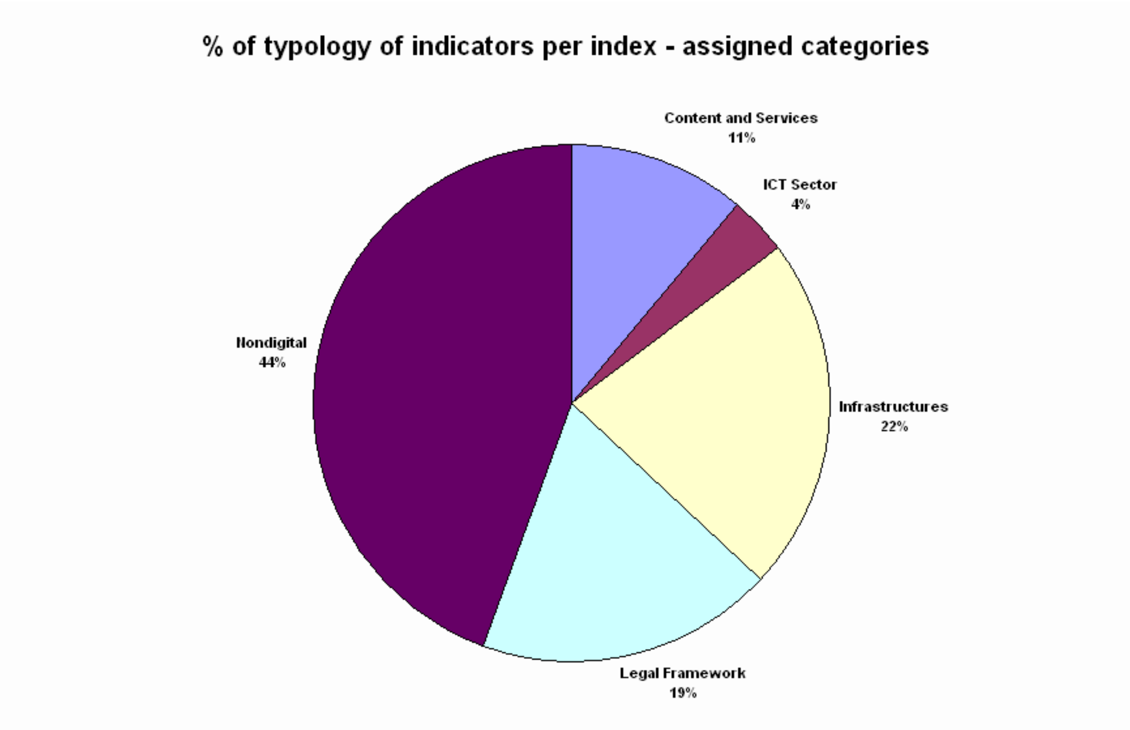

Figure 84: SIMBA Model. % of typology of indicators per index – assigned categories

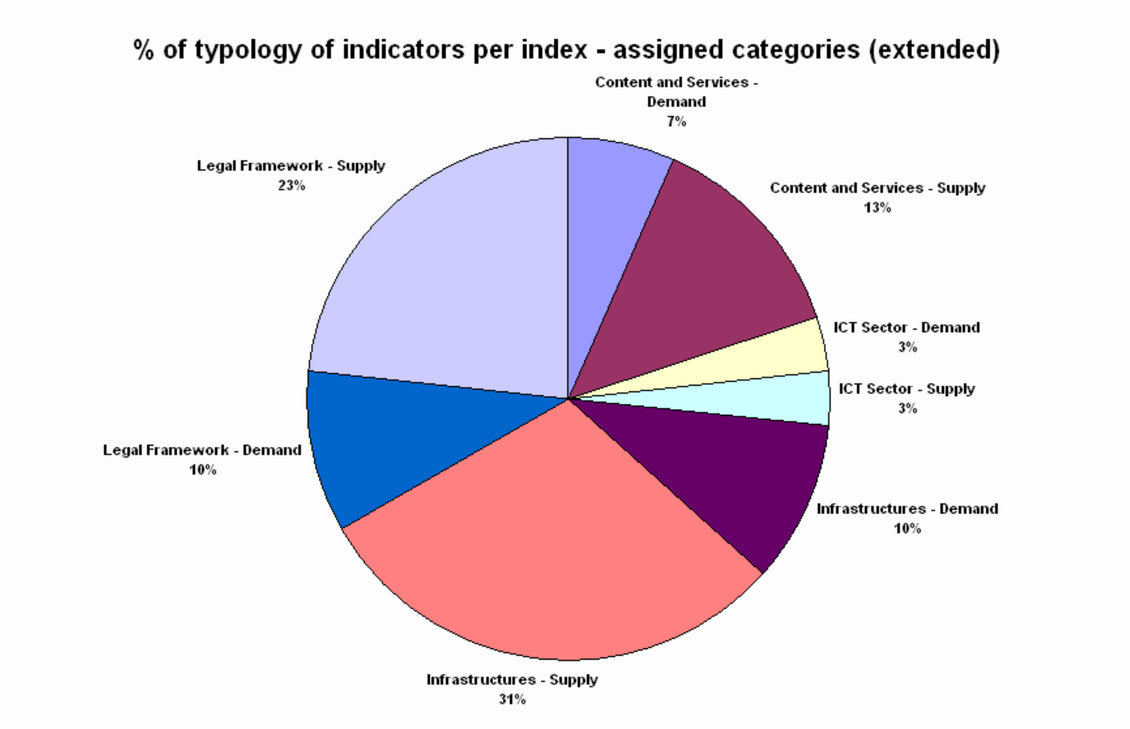

Figure 85: SIMBA Model. % of typology of indicators per index – assigned categories (extended)

6.10.3. Comment

By the look of Figure 86, it does not seem that the SIMBA model had a lot in common with the stated-to-be inspiring Sustainable ICT Framework. Nevertheless, by looking at the "nondigital" indicators we find that the commitment of the researchers with the user still applies, being the lack of available data in the field of digital skills replaced by other indicators related to general skills (i.e. education), so to somehow approximate the level of digital skills.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Infrastructure Users	ISPs		Institutional Framework	(e-)Services
Users (Affordability)	Professionals		Institutional Framework	Users

Figure 86: Wicander's SIMBA Model – main topics covered

In this model our stress is in its original design, very similar to our ultimate approach to model the Digital Economy[166] and the result of overlapping the different models analyzed in these chapters. It is somewhat expected that such a recent model[167] has a more comprehensive approach – if not the most comprehensive – that older points of view. In this sense, the division between Infrastructure, Users, Institutional framework and Services (which includes the ICT Sector) approaches ours composed by Infrastructures, ICT Sector, Digital Skills, Policy and Regulatory Framework and Content and Services. Nevertheless, and as we will be explaining in chapter 9, we believe that more emphasis should be put in the measuring of the ICT Sector and Digital Skills.

[166] See chapter 9.
[167] Even if still unpublished, this draft we are working with dates from 2007.

7. Digital Economy Models: Composite Indices

When we talk about *Indices* we think about then logical next step that would follow our concept of *Theoretical Models* as described in Chapter 6. In this sense, *Indices* gather multiple indicators repeated over a time series, so that a comparison of the chronological changes and trade-offs is made possible. These indices will have their origin in a positive or normative approach, but have been improved along the different editions issued e.g. yearly, thus evolving into an applied tool and a theoretical model that depicts some conception of the Information Society.

A second characteristic of these indices is that they are applied at the international level. Even if the availability of data and the nature of the promoting institution will determine the range of the sample, it is very usual to find that their commitment is always towards the more comprehensiveness possible (i.e. to include as many countries as possible).

Third, besides the direct quantification of a specific number of variables, the devices included in this chapter, as indices, have also the aim to provide a unique measurement of the development of the Information Society. This single measure – this single number – is normally used to compare the different countries among them and rank them in a unique list that would sort them. Hence, indices should provide over time two comparison tools: an absolute one, by comparing the value of the index of a specific country e.g. among different years; and a relative one, by comparing the index values of several countries in a certain moment of time.

The indices chosen are:

7.1 Technology Achievement Index 188
7.2 ICT Diffusion Index 191
7.3 Digital Access Index 194
7.4 Digital Opportunity Index 199
7.5 ICT Opportunity Index 203
7.6 ICT Development Index 207
7.7 Knowledge Economy Index 211
7.8 e-Government Readiness Index 215
7.9 Information Society Index 219
7.10 e-Readiness Rankings 223
7.11 Networked Readiness Index 226
7.12 Connectivity Scorecard (Innovation Driven Economies) 231
7.13 Connectivity Scorecard (Efficiency and Resource Driven Economies) 235
7.14 Freedom on the Net 239

7.1. Technology Achievement Index

The United Nations Development Programme (UNDP) Technology Achievement Index (TAI) was one of the first indices – if not the first one – to commit to measuring the impact of ICTs in Development, with a strong focus in the "development" part.

The 2001 edition of the Human Development Report[168] (UNDP, 2001) was fully devoted to analyzing how Information and Communication Technologies could – as stated in that year's report subtitle – "work for Human Development".

One output of that report was the TAI, aimed at capturing "how well a country is creating and diffusing technology and building a human skill base—reflecting capacity to participate in the technological innovations of the network age" (UNDP, 2001). The emphasis is, hence, put into knowledge and knowledge diffusion rather than into technology, at least at the theoretical level.

The Index was calculated for 72 countries and had 8 indicators distributed in four clusters:

- Creation of technology
- Diffusion of old innovations
- Diffusion of recent innovations
- Human skills

that somehow show that what was stated in theory was not applied in depth when put into practice[169].

7.1.1. Main publications

UNDP (2001). *Human Development Report 2001. Making New Technologies Work for Human Development*. New York: UNDP.

[168] The Human Development Index (HDI), calculated and published yearly along with the Human Development Report, is, arguably, the dean of many composite indices and its widely respected methodology has been adapted to other measuring tools like the Digital Opportunity Index or the e-Government Readiness Index, to name a few.

[169] Following Minges's opinion (2005), we also consider as a "refinement of the TAI" the ArCo index developed by Archibugi & Coco (2003).

7.1.2. Distribution of Indicators

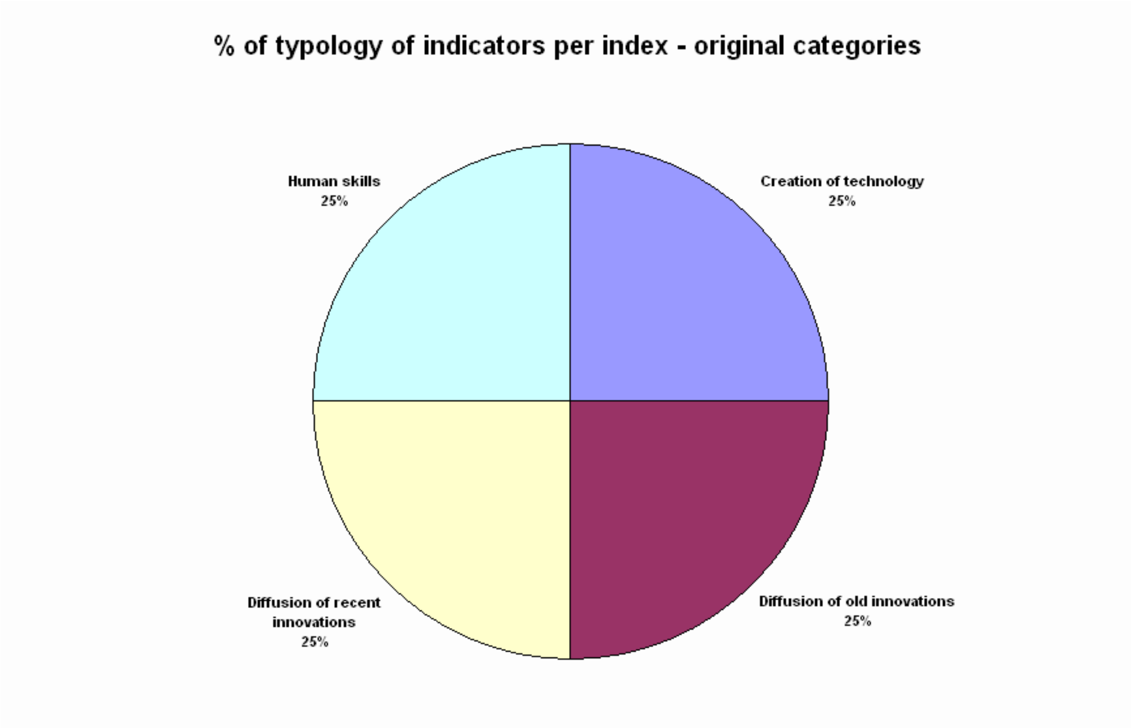

Figure 87: Technology Achievement Index. % of typology of indicators per index – original categories

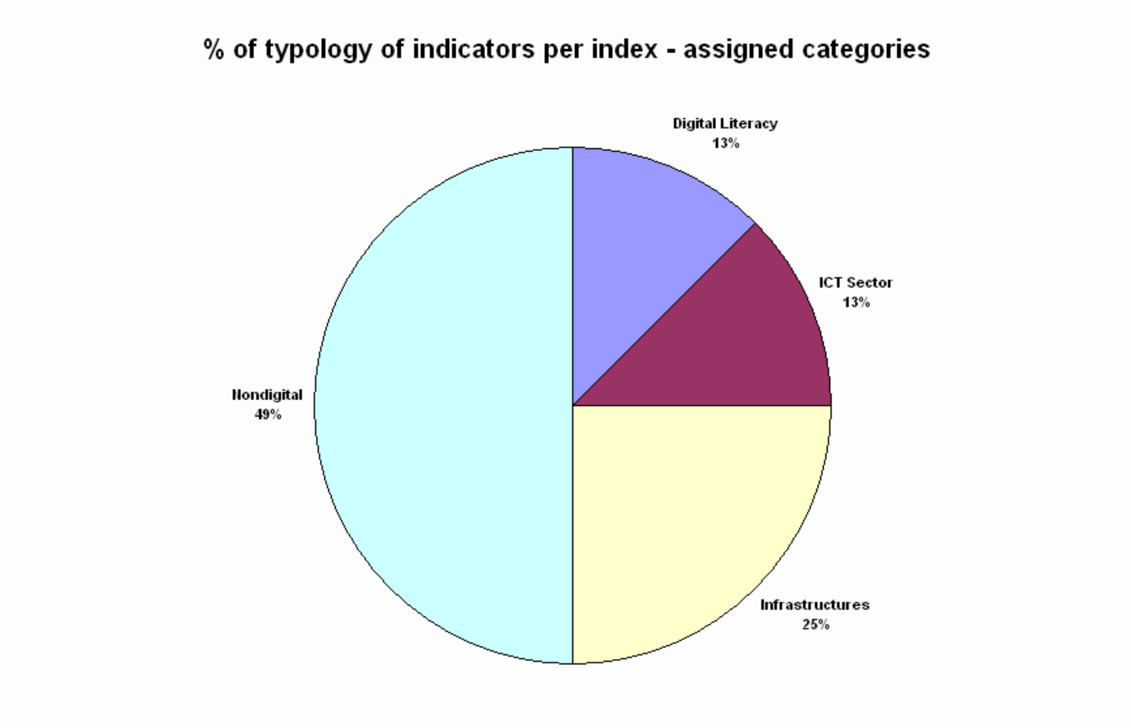

Figure 88: Technology Achievement Index. % of typology of indicators per index – assigned categories

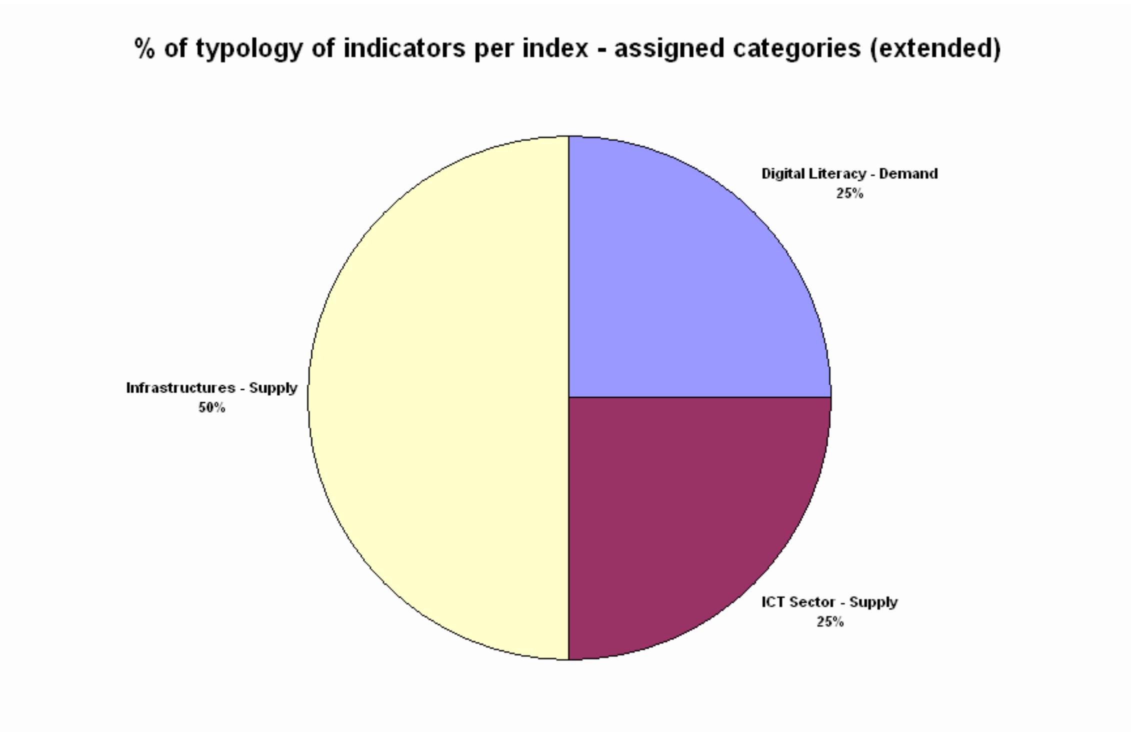

Figure 89: Technology Achievement Index. % of typology of indicators per index – assigned categories (extended)

7.1.3. Comment

Figure 90 is not a very fair representation of the TAI:

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Diffusion of Innovations	Diffusion of Innovations			
		Human Skills		

Figure 90: UNDP's Technology Achievement Index – main topics covered

In other words, it is precisely the knowledge based indicators in the TAI that are not reflected in Figure 90 as they are considered analogue – they measure patents and royalties not strictly based on the Digital Economy. As we said, this is unfair as the focus of the Index was much broader than just the ICT Sector.

Nevertheless, for a knowledge based index, other indicators should have been appearing that have not, especially those related with digital skills. Let us not forget that the composite index was about new technologies.

The same critique applies for content: by 2001, the web was already wide spread and its use was increasingly intensive and pervasive. But digital content and services are lacking from the analysis, presumably because these indicators would have limited the analysis to mainly developed countries.

Summing up, the index was interesting for a first approach to the subject, but it was quickly surpassed by later and more mature indices promoted within the UN System. Despite not being flawless, the importance of the index – in itself and as a general need that began to be covered – can be seen in the fact that the E-Commerce Readiness in East Asian APEC Economies[170] included the Technology Achievement Index as one of the components of its design.

7.2. ICT Diffusion Index

First presented at the United Nations Conference On Trade And Development (UNCTAD)'s Commission on Science and Technology for Development (CSTD) Panel on "Indicators of Technology Development", the Information and Communication Technologies Development Indices[171]) were the answer that UNCTAD found to the need to measure the development of the Digital Economy and the impact of ICTs into the development of regions and countries.

After a benchmarking exercise that analyzed some existing indicators at that moment[172], UNCTAD came up with a model based on three[173] clusters:

- Connectivity
- Access
- Policy

each one measured with a single index, and the three of them incorporated in a fourth, comprehensive, index, the ICT Diffusion Index.

Notwithstanding, after two iterations of the index, it was remodelled and lost the Policy category (see Figure 91) and was left with just the Connectivity and Access categories, which represented, in our opinion, a loss in the quality of the index. This loss was, indeed, not corrected neither in the subsequent indices, such as the ICT Opportunity Index[174].

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[170] See section 6.3.

[171] After 2006 on, the indices are no more related to in plural, as ICT Development Indices, but only known by their general comprehensive index, the ICT Diffusion Index. See also Annex II.

[172] Mosaic, McConnel, Harvard University, the Economist Intelligence Unit e-Readiness Rankings, and ITU's models, all of them analyzed in this work too.

[173] Some early papers feature also a "Usage" or "Telecommunications Traffic" category that was, actually, never included in the group of ICT Development Indices, as being considered only slightly related to the Internet.

[174] See section 7.5 in this same chapter.

7.2.1. Main publications

UNCTAD (2002). *Information and Communication Technology (ICT) Development Indices*. New York and Geneva: UNCTAD

UNCTAD (2003). *ICT Development Indices 2003*. New York and Geneva: UNCTAD.

UNCTAD (2005). *The Digital Divide: ICT Development Indices 2004*. New York and Geneva: UNCTAD.

UNCTAD (2006). *The Digital Divide Report: ICT Diffusion Index 2005*. New York and Geneva: UNCTAD.

7.2.2. Distribution of Indicators

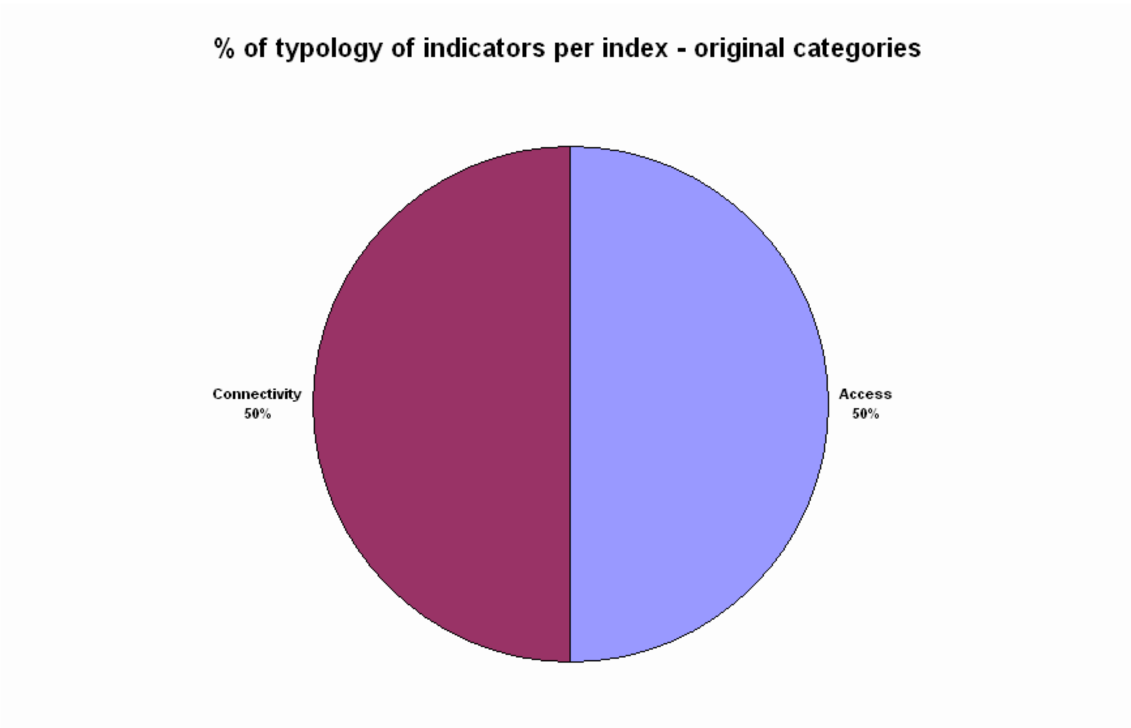

Figure 91: ICT Diffusion Index. % of typology of indicators per index – original categories

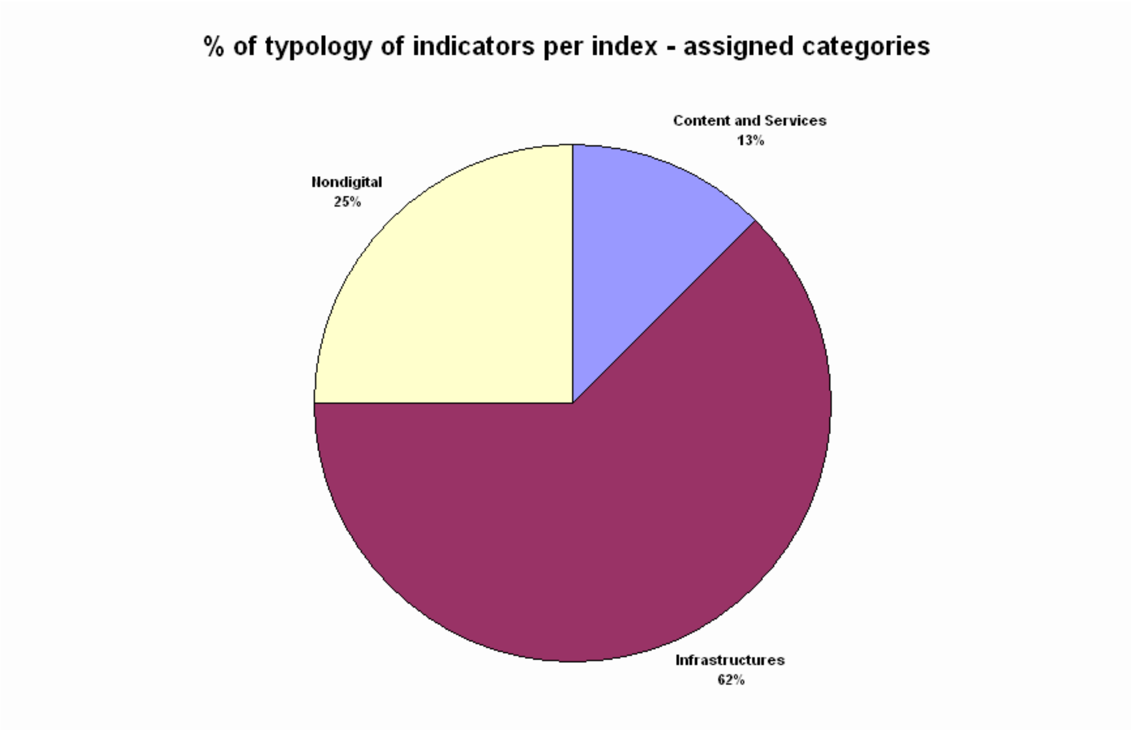

Figure 92: ICT Diffusion Index. % of typology of indicators per index – assigned categories

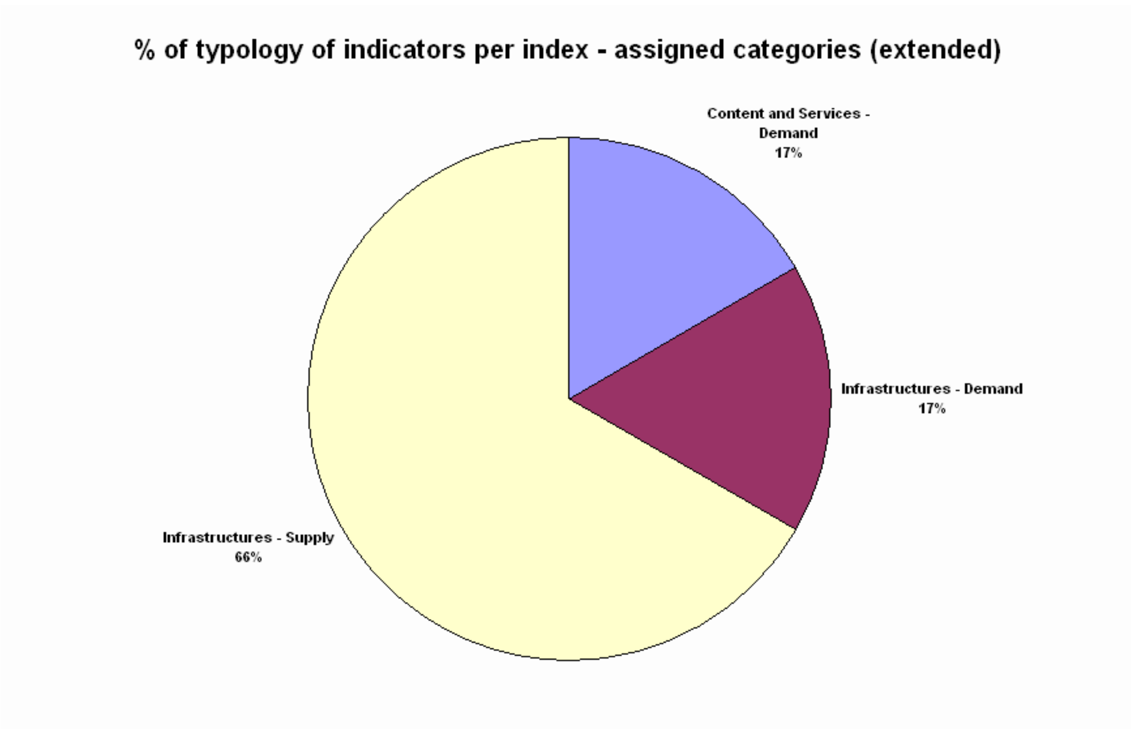

Figure 93: ICT Diffusion Index. % of typology of indicators per index – assigned categories (extended)

7.2.3. Comment

The ICT Diffusion index – and its subindices – represents one of the first truly global (or almost) attempt to measure ICT development at a planetary level, an enterprise arguably only possible for the United Nations or the World Bank[175].

As said, and though there might have been strong reasons concerning the quality of the indicators, their availability or the cost of getting them, we find that it represents a step back in the development of measuring tools the decision to have set aside indicators related to Policy like Internet exchanges, the levels of competition in local and international telecommunications, or the level of competition in the Internet service provider (ISP) market. The effect can be seen in Figure 11, where the dotted area represents what is missed in the redefinition of the index:

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Access & Connectivity Infrastructures			Policy	
Access & Connectivity Affordability				Connectivity Usage

Figure 94: UNCTAD's ICT Diffusion Index – main topics covered

To our understanding, despite being a limited tool, it already collected the question of affordability, a sensibility really relevant coming from an institution devoted to development. On the other hand, it also provided a tool where many countries could find themselves ranked among their peers and see how they were doing in their respective policies to foster the Information Society.

7.3. Digital Access Index

Especially prepared to be presented at the Geneva phase[176] of the World Summit on the Information Society, the International Telecommunication Union's Digital Access

[175] The World Bank and its Knowledge Assessment Methodology is compiled for about 40 countries less than UNCTAD's indices, though it still is a quite big sample. In May 2009, the World Bank's new "ICT Performance Measures" will be launched covering 150 economies.
[176] 10-12 December 2003

Index (DAI) was a highly anticipated[177] contribution by the ITU into the international debate of the Digital Divide and the Digital Economy.

Forming the core part of the 2003 edition of the World Telecommunication Development Report[178], the DAI responded to the need to have the broadest measuring tool that was available, something that, as we already commented for the ICT Diffusion Index, was likely to be only carried on by some organization within the UN System. And the ITU was the best possible candidate, according to both its mission and the data that it already collected from a lot of sources all over the world.

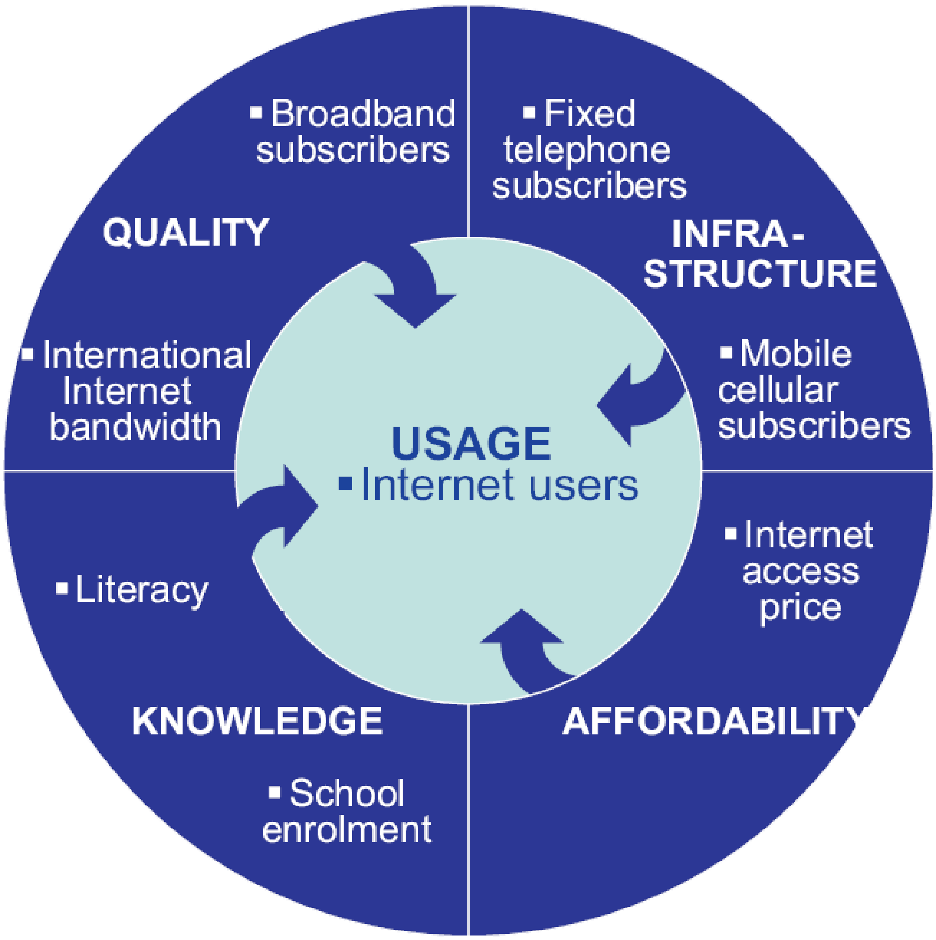

Figure 95: Constituents of the Digital Access Index (ITU, 2003b)

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[177] The press release from 19th November 2003 (http://www.itu.int/newsroom/press_releases/2003/30.html, last retrieved 21 August 2008) stated that it was the "World's first global ICT ranking". This would only be true if we considered the ICT Diffusion Index (issued in 2002) as not global for covering 171 countries, instead of the 178 countries that covered the DAI (issued in 2003).

[178] An earlier composite index, the mobile / internet index, had been published by ITU in its 2002 "ITU Internet Report: Internet for a mobile generation" (ITU, 2002a), but this only covered the two named ICT networks.

Not surprisingly for an infrastructure-centred institution, the new DAI relied heavily on technologies, being the main factors (Figure 95):

- Infrastructure
- Affordability
- Knowledge
- Quality
-

that would converge on a fifth factor measuring Usage.

The calculation of the Index was never repeated[179] but it did actually sow the seed of very interesting evolutions in the nearest future.

7.3.1. Main publications

International Telecommunication Union (2003) World Telecommunication Development Report 2003

7.3.2. Distribution of Indicators

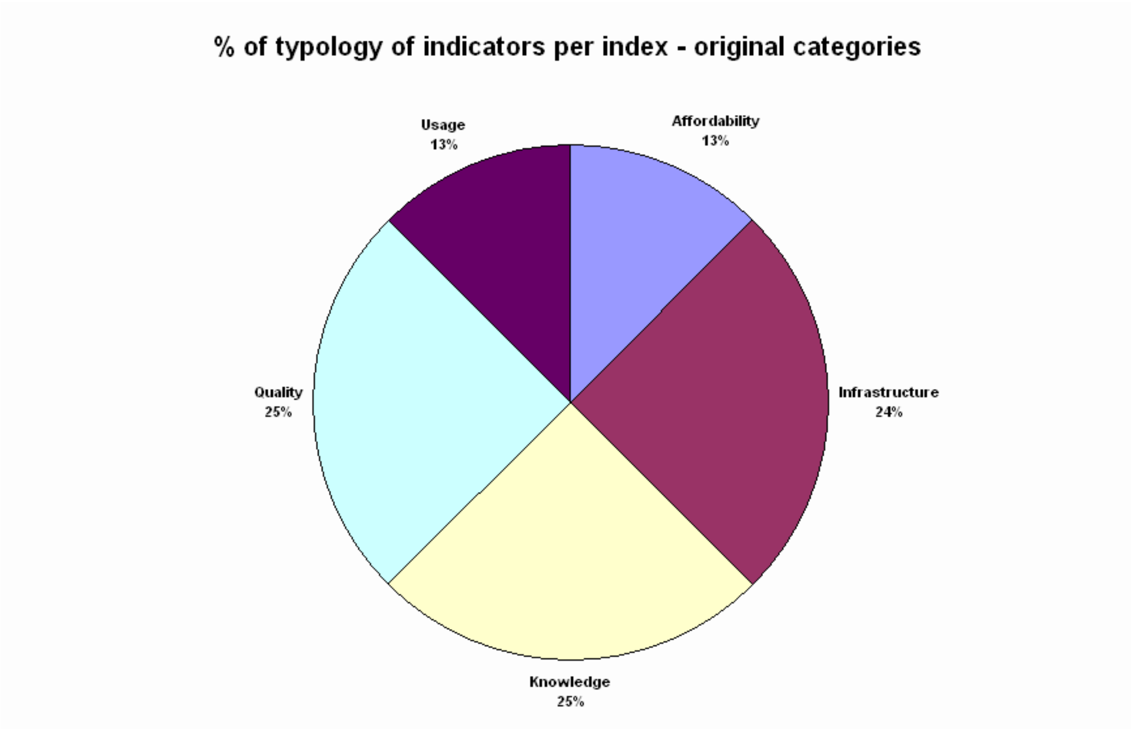

Figure 96: Digital Access Index. % of typology of indicators per index – original categories

[179] We know of one application of the index in the framework of the francophone countries (Simard, 2003) and another one for the different states of Brazil (Bonilha, 2003) that was repeated in 2006 (Bonilha, 2007).

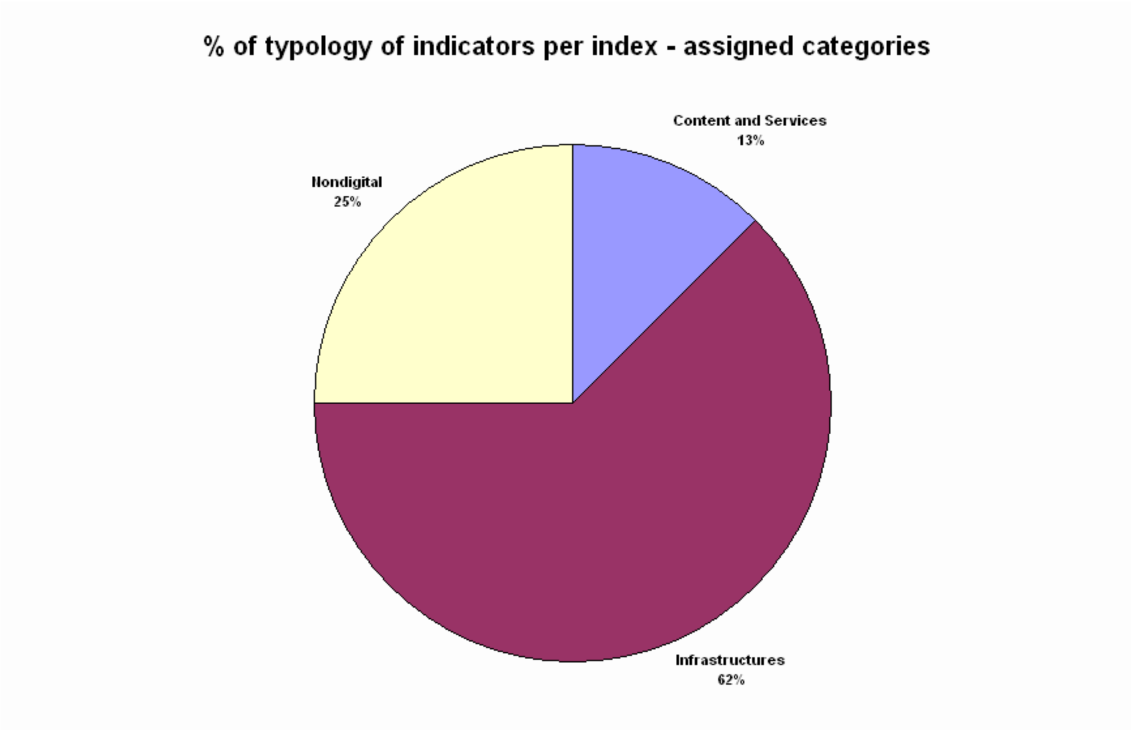

Figure 97: Digital Access Index. % of typology of indicators per index – assigned categories

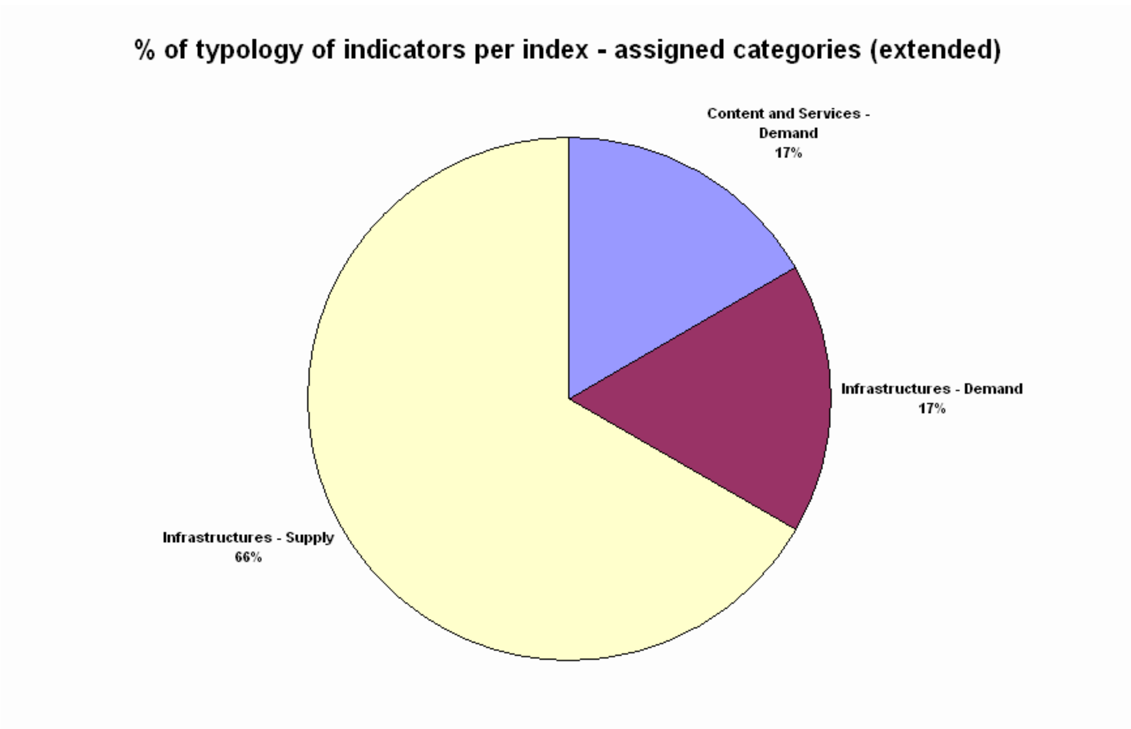

Figure 98: Digital Access Index. % of typology of indicators per index – assigned categories (extended)

7.3.3. Comment

We should not be mislead by the different names of the original categories that composed the index. Despite their names, the index is really about infrastructures. It is, on the other hand, an infrastructure-centred index that tries to cover all the different subtleties in the field of infrastructures, from the availability of hardware to its affordability, from fixed to mobile communications.

It also adds the human factor in the Knowledge category, measuring the degree of literacy and education of a country.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Infrastructure & Quality				
Affordability & Quality				Usage Infrastructure

Figure 99: Digital Access Index – main topics covered

But, without any doubt, the main outcome of the DAI is not the index itself, but the awareness it raised that measuring ICTs was a strategic matter to be solved and that international and joint efforts should be coordinated along this line: "A partnership between international organizations, national statistical agencies and ICT policy-makers can help achieve the objective of a core set of information society access indicators for a large number of countries" (ITU, 2003b).

- The *Partnership on Measuring ICT for Development* was created in 2004 at the UNCTAD XI at São Paulo (Brazil) and includes the ITU, UNCTAD, UNESCO, ECA, ECLAC, ESCAP, ESCWA, the World Bank, the OECD and Eurostat[180].

- The Core set of ICT Indicators were issued in 2005 as one of the first consensus of the newly born *Partnership* and became key of later developments in the measuring of the Information Society[181]. The Core set of indicators has been revised during 2007 and 2009 and presented to the UN Statistical Commission in February 2009 , including an additional set of ICT for Education indicators[182].

[180] The ICT Task Force was also a former member until its dissolution in 2005.
[181] See section Core list of ICT Indicators8.2, for a deeper analysis.
[182] See section 8.2

7.4. Digital Opportunity Index

The Digital Opportunity Index (DOI)[183] was the next ITU effort to measure the Information Society after the Digital Access Index. If the DAI was the homework that ITU presented, in 2003, at the Geneva phase of the World Summit on the Information Society, then DOI can be considered the result of assessing the DAI and the main output of the whole WSIS after the Tunis phase in 2005, using the same methodology as the DAI which in turn is built on the UNDP Human Development Index.

The Digital Opportunity Index was outcome of the joint effort of the afore mentioned ITU with UNCTAD and the Korea Agency for Digital Opportunity and Promotion (KADO), UNESCWA, London Business School, LIRNEAsia, LINKAfrica and the Republic of Korea's Ministry of Information and Communication – the Digital Opportunity Platform[184].

Published annually in the World Information Society Report, it had the broadest coverage of all indices – 181 economies – and was structured in three clusters of indicators:

- Opportunity
- Infrastructure
- Utilisation

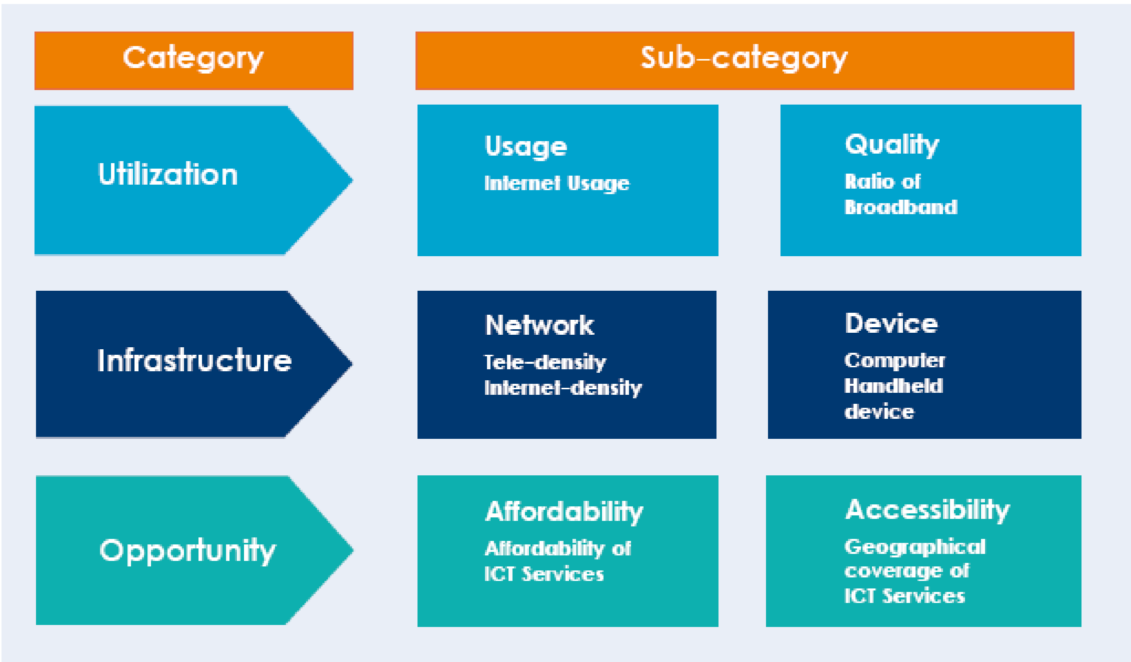

Figure 100: Structure of the DOI (ITU, 2006c)

[183] See http://www.itu.int/DOI.
[184] After Tunis, the United Nations Secretary-General approved also the UN Global Alliance for Information and Communication Technologies and Development (GAID) as an initiative to raise awareness and foster the role of ICTs in achieving the Millennium Development Goals (MDG).

It was calculated twice (in the two World Information Society Reports) but political pressure to merge measurement tools into one and only one acknowledged and comprehensive index, makes it likely to be discontinued in the future.

7.4.1. Main publications[185]

International Telecommunication Union (2006b). *World Information Society Report 2006*. Geneva: ITU.

International Telecommunication Union (2007b). *World Information Society Report 2007*. Geneva: ITU.

7.4.2. Distribution of Indicators

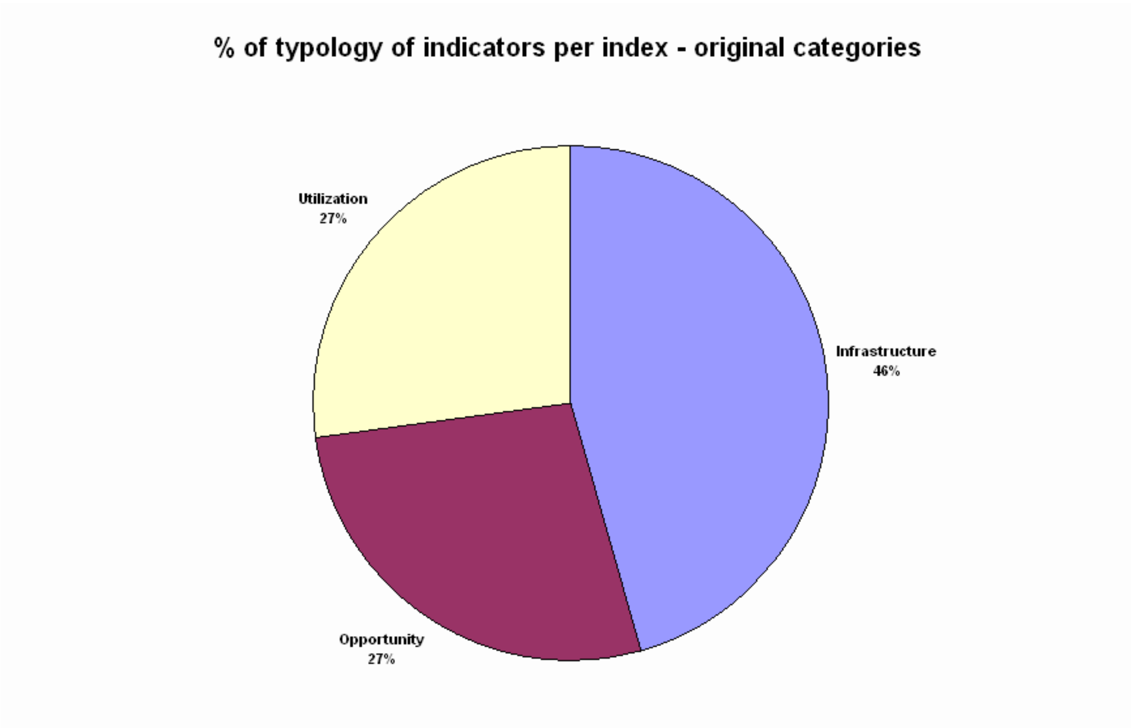

Figure 101: Digital Opportunity Index. % of typology of indicators per index – original categories

[185] See also Digital Opportunity Platform, 2006.

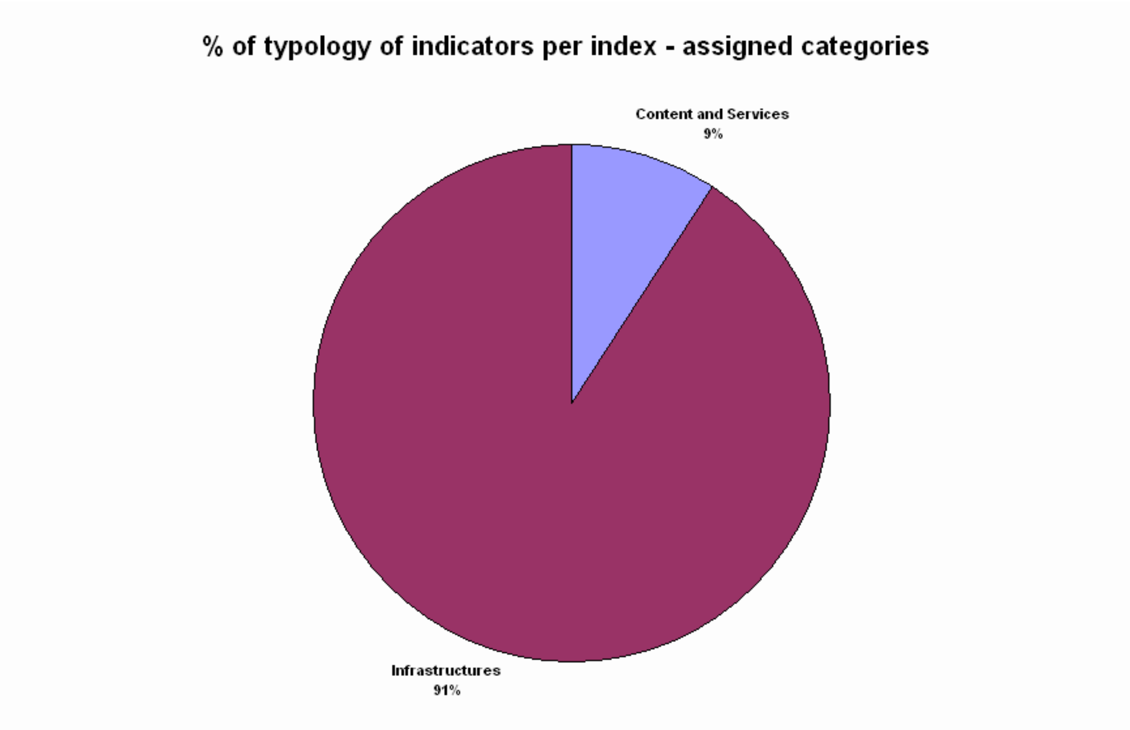

Figure 102: Digital Opportunity Index. % of typology of indicators per index – assigned categories

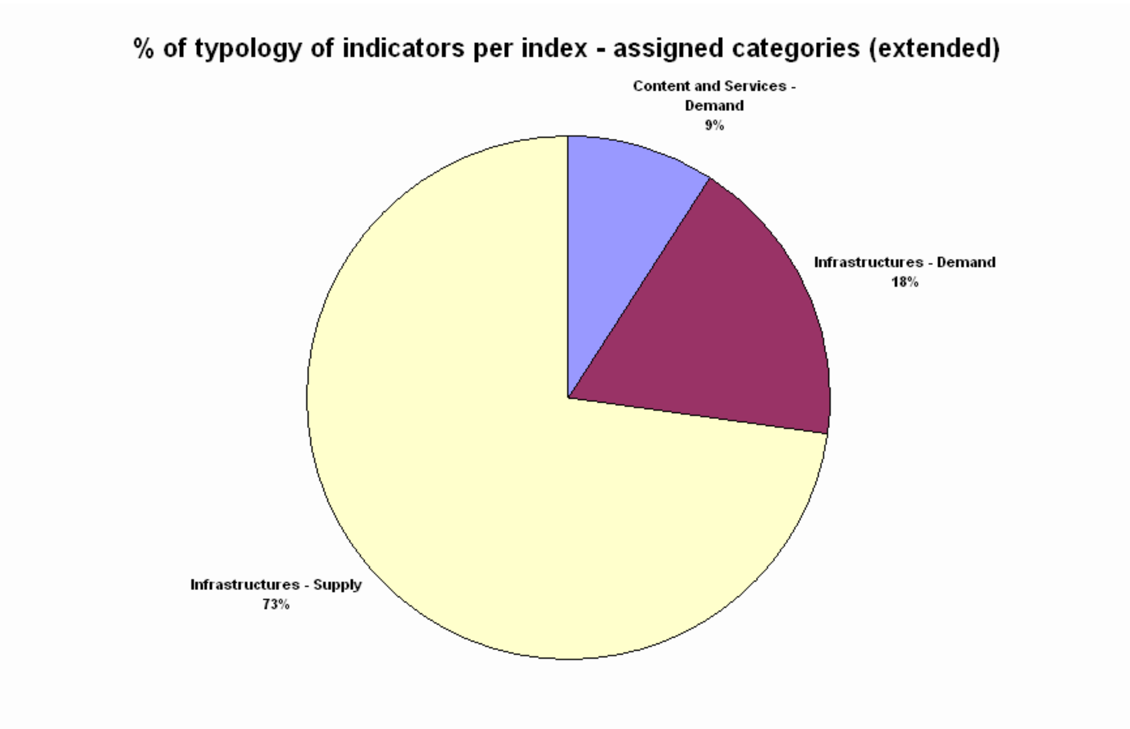

Figure 103: Digital Opportunity Index. % of typology of indicators per index – assigned categories (extended)

7.4.3. Comment

The DOI represents another step by ITU towards is new ICT Development Index (IDI)[186]. The name itself is paradigmatic: it already begins to gather the sensibilities risen by Orbicom's work[187] around the concept of Infostate and the actual opportunity – rather than "just" use – that ICTs represent for the citizen and the citizenry at large. In this sense, "the strength of the DOI compared to other composite indicators, is that it is more balanced"[188].

This can be seen, besides the name, with the inclusion of indicators that measure the presence of ICTs – in form of infrastructures – at the household level.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Infrastructure & Quality				
Affordability & Quality				Usage Infrastructure

Figure 104: Digital Opportunity Index – main topics covered

Thus, though at first sight it might seem as the contribution of the DOI is narrow[189], the difference is crucial and more stress is put at the micro level instead of the macro level.

Another really important aspect is that the DOI was fully aligned with the Partnership's Core Set ICT Indicators, which means that beyond the strengths or weaknesses of the index overall or the indicators individually, the result is the product of an achieved consensus. In our opinion, hence, regardless of the continuity of this index, or its intrinsic value, it represents a milestone in preparing the way towards a major – and unique – agreement to come in the following years. A further major advantage of the DOI was that it could be easily replicated, and had broad coverage. This facilitated a number of countries to conduct their own DOI exercises as a way of using the index to interpret policy outcomes[190].

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[186] See section 7.6
[187] See chapter 6
[188] Tim Kelly, as reported in Goswami (2006d).
[189] Compare, for instance, Figure 99 and Figure 104
[190] In preparation for the Digital Opportunity Forum, held in Korea 31 August – 1 Sept 2006, a number of national case studies were prepared using the DOI, covering Bulgaria, Egypt, India,

7.5. ICT Opportunity Index

Shortly after developing the DOI, ITU launched on a separate attempt to measure ICTs and their impact in the society, in the ICT Opportunity Index (ICT-OI). In fact, the ICT-OI was an attempt to merge Orbicom's Infostate / Digital Divide Index conceptual framework and model with some of the ITU's own work.

On the other hand, even though it might co-exist with the Digital Opportunity Index and measure different things[191], their approach is similar in the sense that they try to zoom on the reality and focus on the micro level, on the actual user more than big aggregates – though, of course, they work with these aggregates.

The comparisons with Orbicom's Infostate model are many, as can be easily seen from comparing Figure 105 and Figure 52, which represent, in fact, the same model.

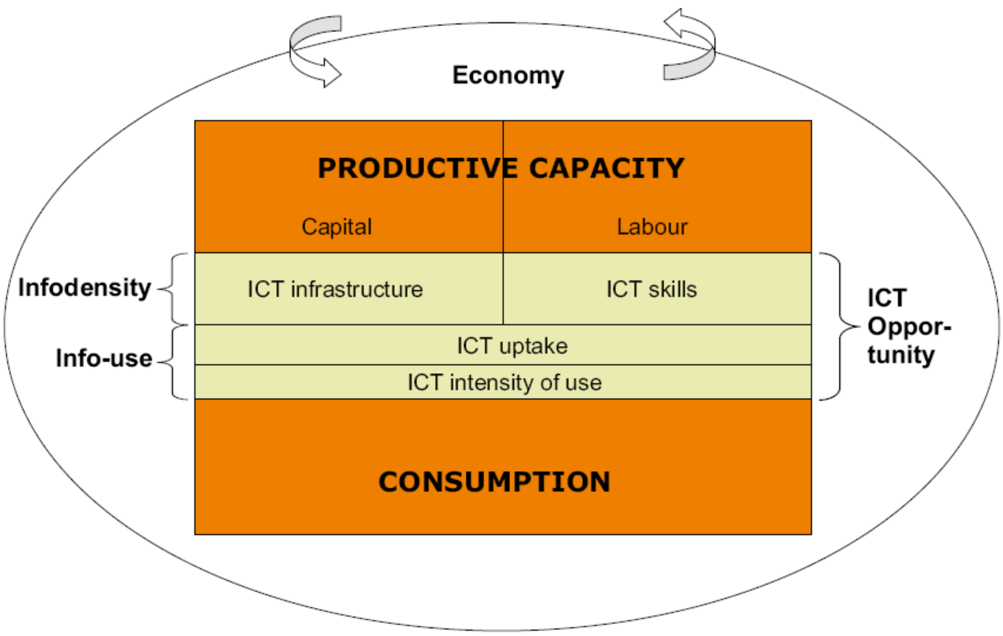

Figure 105: The ICT-OI conceptual framework (ITU, 2007c)

Indeed, including the original categories and subcategories are kept in the new ICT-OI:

- Info density
  - Networks
  - Skills
- Info use
  - Intensity
  - Uptake

Indonesia, Pakistan, Peru, Philippines and Tunisia (see: http:/www.itu.int/osg/spu/digitalbridges/forum/phtml).

[191] See, for instance, Table 1.2 at ITU's World Information Society Report, 2006 edition (ITU, 2006c, p. 17)

Digital Divide Index

Original Name	Category	Sub Category
Gross enrollment ratios: Primary education	Infodensity	Skills
Waiting lines/mainlines	Infodensity	Networks
Digital lines/mainlines	Infodensity	Networks
Cell phones per 100 inhabitants	Infodensity	Networks
Cable TV subscription per 100 households	Infodensity	Networks
Internet hosts per 1000 inhabitants	Infodensity	Networks
Secure servers/Internet hosts	Infodensity	Networks
International bandwidth (Kbs per inhabitant)	Infodensity	Networks
Main telephone lines per 100 inhabitants	Infodensity	Networks
Gross enrollment ratios	Infodensity	Skills
Gross enrollment ratios: Secondary education	Infodensity	Skills
Gross enrollment ratios: Tertiary education	Infodensity	Skills
Adult literacy rates	Infodensity	Skills
International Incoming telephone traffic minutes per capita	Info-Use	Intensity
Television households per 100 households	Info-Use	Uptake
Residential phone lines	Info-Use	Uptake
PCs per 100 inhabitants	Info-Use	Uptake
Internet users per 100 inhabitants	Info-Use	Uptake
Broadband users/Internet users	Info-Use	Intensity
International Outgoing telephone traffic minutes per capita	Info-Use	Intensity

ICT Opportunity Index

Original Name	Category	Sub Category
International Internet bandwidth (kbit/s per inhabitant)	Infodensity	Networks
Mobile cellular subscribers per 100 inhabitants	Infodensity	Networks
Main telephone lines per 100 inhabitants	Infodensity	Networks
Gross enrolment rates (primary, secondary and tertiary)	Infodensity	Skills
Adult literacy rates	Infodensity	Skills
International outgoing international traffic (minutes) per capita	Info-Use	Intensity
Total broadband Internet subscribers per 100 inhabitants	Info-Use	Intensity
Computers per 100 inhabitants	Info-Use	Uptake
Proportion of households with a TV	Info-Use	Uptake
Internet users per 100 inhabitants	Info-Use	Uptake

Table 5: Comparison of the indicators composition of the Digital Divide Index and the ICT Opportunity Index

One of the main differences between Orbicom's Digital Divide Index and the ICT Opportunity Index – as can be seen in the following figures and Table 4 – is the amount of indicators that compose the index. In the later, the number of indicators has been reduced. Thus, while keeping the explanation power of the model, errors (e.g. correlations) have been reduced and, over all, the cost to obtain the data drastically reduced.

7.5.1. Main publications[192]

Sciadas, G. (Ed.) (2005). *From the Digital Divide to Digital Opportunities*. Montreal: Orbicom.

International Telecommunication Union (2007b). *World Information Society Report 2007*. Geneva: ITU.

International Telecommunication Union (2007a). *Measuring The Information Society 2007: ICT Opportunity Index and World Telecommunication/ICT Indicators*. Geneva: ITU.

7.5.2. Distribution of Indicators

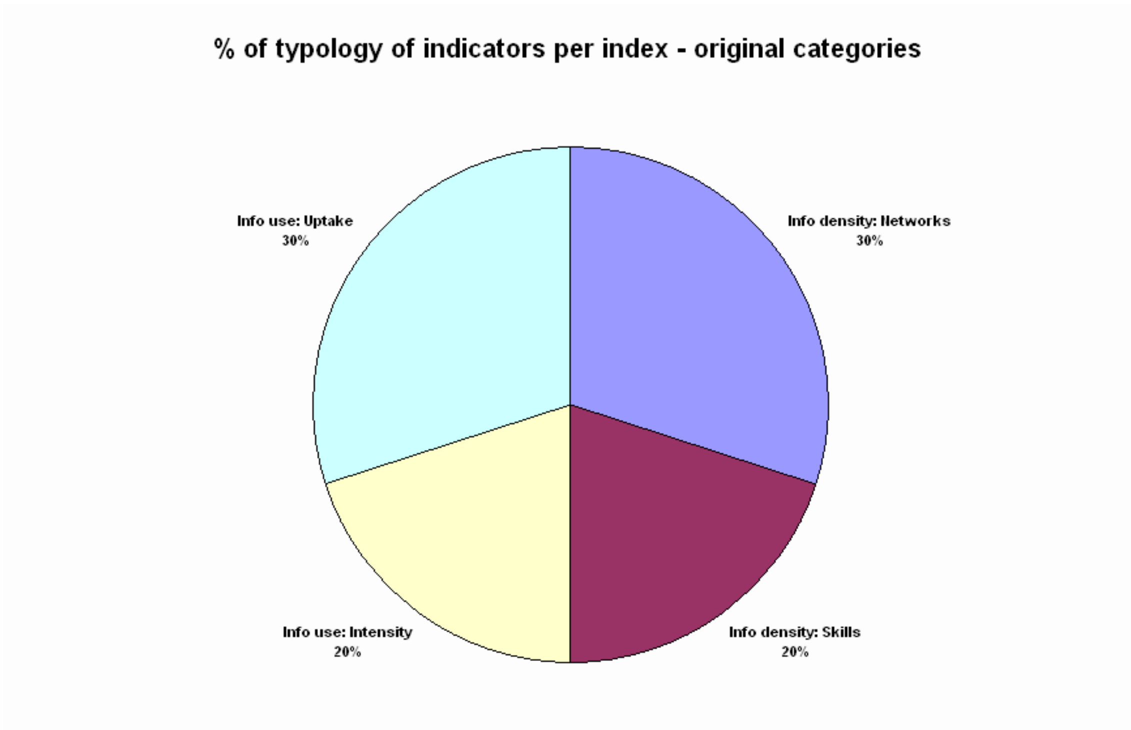

Figure 106: ICT Opportunity Index. % of typology of indicators per index – original categories

[192] For a better understanding of the framework of the ICT Opportunity Index, see also UNCTAD, 2006b; UNCTAD, 2006d; and ITU, 2006b.

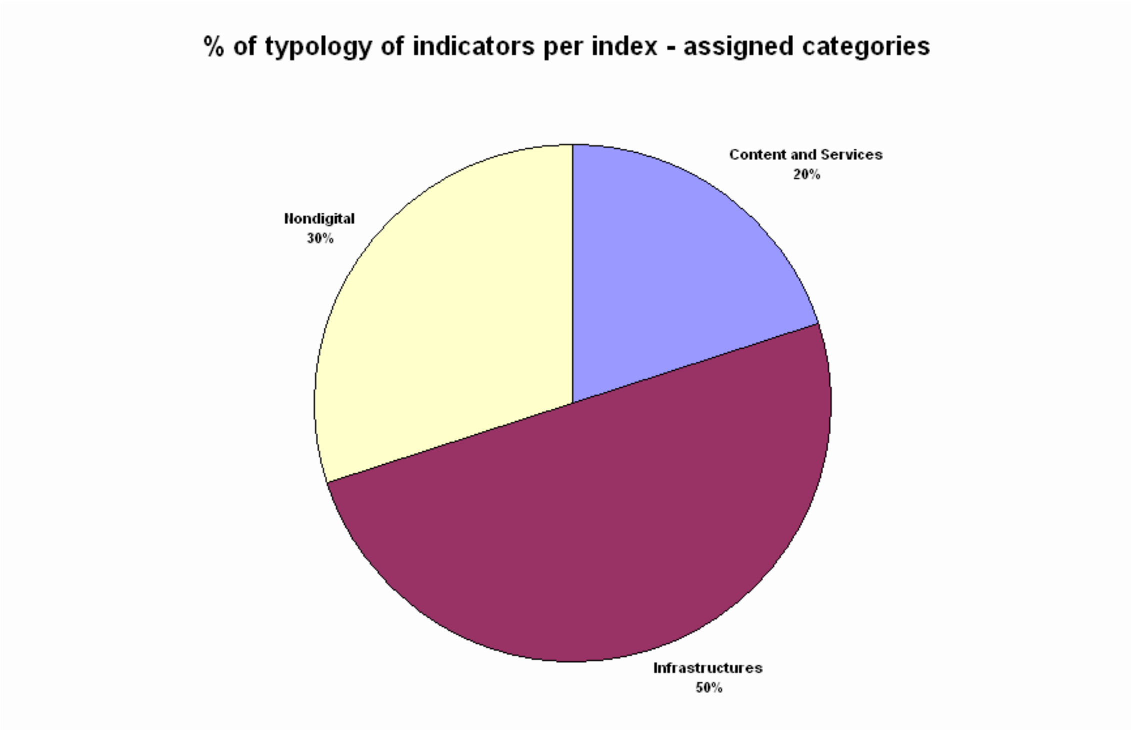

Figure 107: ICT Opportunity Index. % of typology of indicators per index – assigned categories

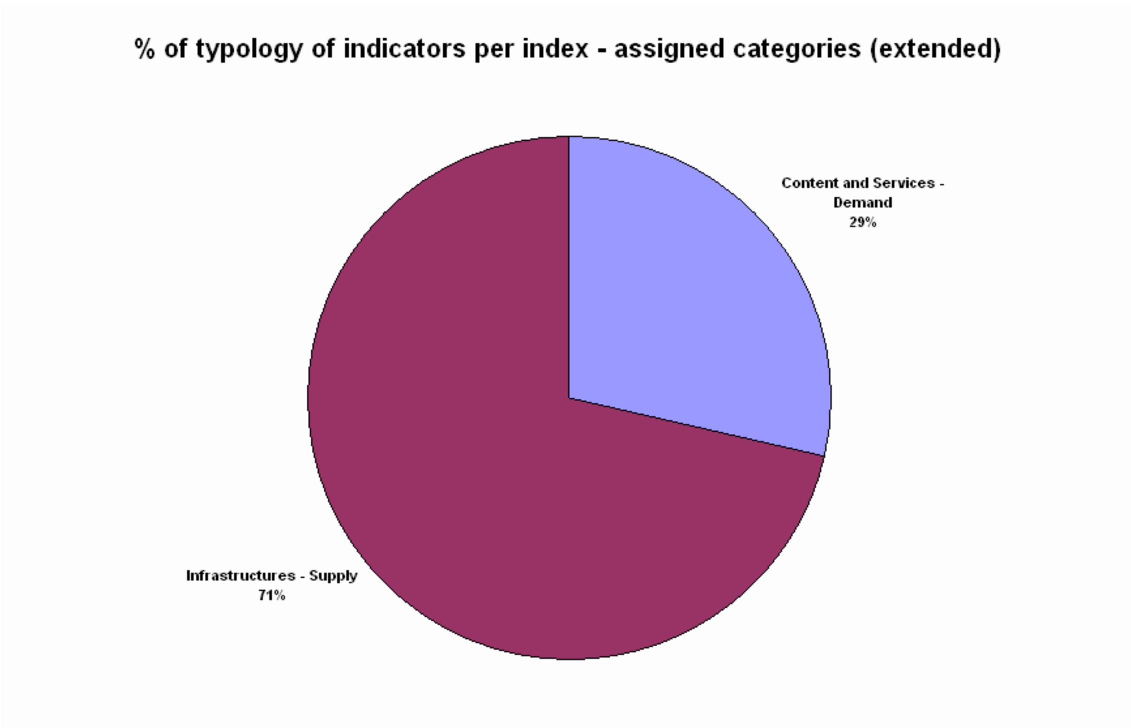

Figure 108: ICT Opportunity Index. % of typology of indicators per index – assigned categories (extended)

7.5.3. Comment

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Networks				Uptake
				Intensity

Figure 109: ICT Opportunity Index – main topics covered

The main comment to be made to this index, besides the ones already made about Orbicom's Digital Divide Index, is the supposed inclusion of digital skills along with ICT capital, as a means to capture the ability to absorb and use ICT's effectively. A caveat is to be made, notwithstanding, about digital skills. In reality, what the index is using is proxies, not real data about actual *digital* skills[193]. The problem here is, hence, that *only* if these proxies are good approximations to the real digital skills, the model has any value at all. And the problem, again, is that while intuition tells us that the level of education achieved or adult literacy rates might be correlated with digital skills, there is a lack of evidence – actually, a lack of research – in this field.

7.6. ICT Development Index (IDI)

Published in 2009 by the International Telecommunication Union in their report *Measuring the Information Society - The ICT Development Index 2009*, the ICT Development Index is not to be taken by the former name by which we know the ICT Diffusion Index[194].

The ICT Development Index (IDI) is a merger of two previous indices: the Digital Opportunity Index[195] and the ICT Opportunity Index[196]. From the DOI it takes "Indicators related to households, Indicators related to broadband [and] Simple and easy to understand methodology and presentation (goalposts)" (ITU, 2009), while from the ICT-OI it takes "Indicators related to skills (also included in the DAI),

[193] This is a problem we have also found ourselves and will be explained in more depth in following chapters.
[194] See section 7.2
[195] Section 7.4
[196] Section 7.5

Normalization method (distance to a reference value) [and] Digital divide analysis and methodology" (ITU, 2009).

This merger responds to the proposal – and need – of the ITU and other international agencies to concentrate all efforts in just one multi-purpose measuring device, instead of having several complementing indices fostered by different organizations.

In a time-series analysis, the new IDI is calculated for the year with most recent available data, 2007[197], but also for 2002, as data was also available for that year. Doing such, it is possible to draw some trends over time, and picture what the evolutions had been in the last five years before the index was first calculated.

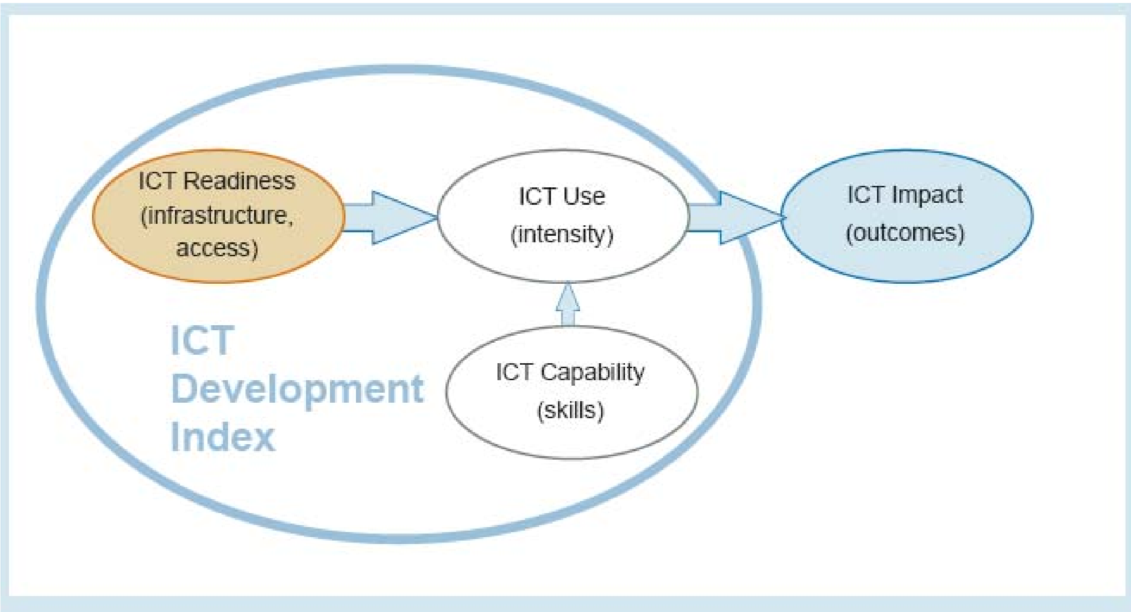

Figure 110: The IDI conceptual framework (ITU, 2009)

As Figure 110 shows, the conceptual framework of the new index is mainly still the heir of the original framework by George Sciadas, later adopted by the ICT Opportunity Index, but now incorporating some of the methodological advances made in the DOI.

7.6.1. Main publications

International Telecommunication Union (2009). *Measuring the Information Society - The ICT Development Index 2009*. Geneva: ITU.

[197] The IDI was first published in 2009 and calculated during 2008, hence the most recent data date form 2007.

7.6.2. Distribution of Indicators

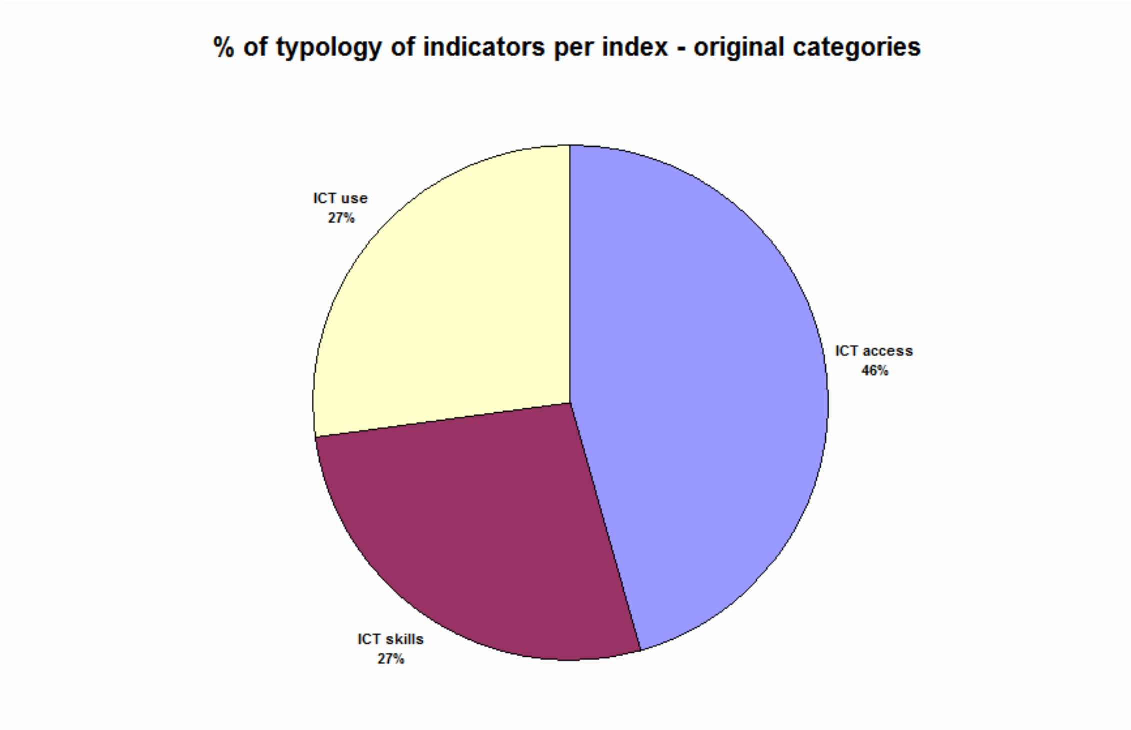

Figure 111: ICT Development Index. % of typology of indicators per index – original categories

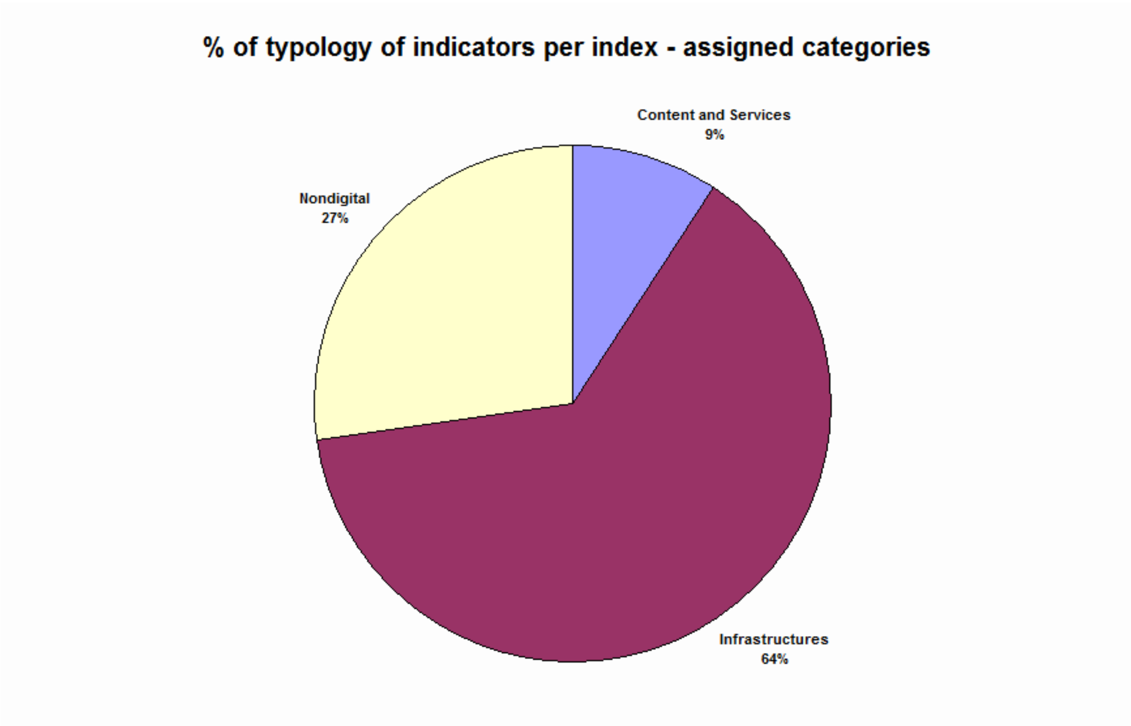

Figure 112: ICT Development Index. % of typology of indicators per index – assigned categories

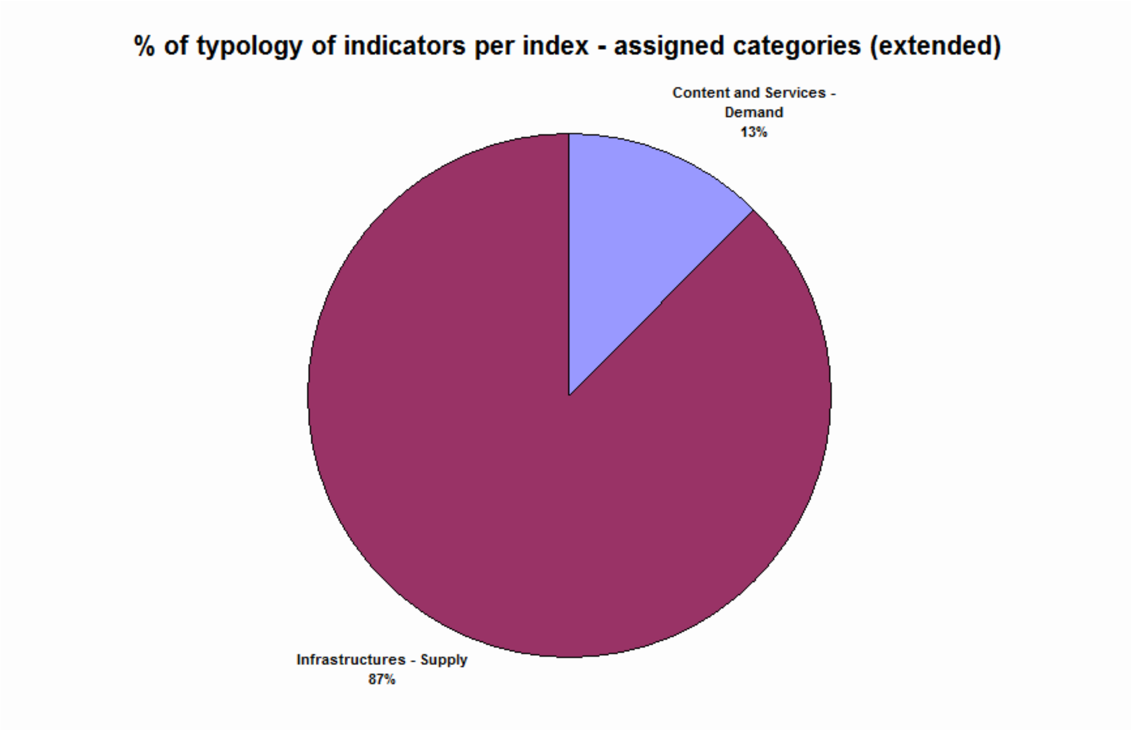

Figure 113: ICT Development Index. % of typology of indicators per index – assigned categories (extended)

7.6.3. Comment

As a merger from two previous indices, most of our comments can be inferred from the ones we have already made, to which we would add but three general impressions.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
ICT Access ICT Use				
				ICT Skills ICT Use

Figure 114: The International Telecommunication Union’s IDI – main topics covered

The most interesting thing to highlight from this index is that, unlike most other indices, the coefficients of the weights assigned to each indicator and subindex are calculated statistically, using principal components analysis. Undoubtedly, this provides much legitimacy to the final index values, at least at the formal level.

The first one is to celebrate the work towards a single measuring tool that can be acknowledged as a consensus in what the concept of access is and, thus, what is and how can the Digital Divide be overcome.

The second one is, while some consensus has been reached, the cost of is that the new index has evolved towards a lowest common denominator. In our opinion, losing the information that affordability brought to i.e. the DOI is a loss of shades that were of most utility[198]. This way, the new index is more polarized and is mainly intensively focussed on infrastructures and just slightly on usage and skills, leaving a big void in all other aspects of digital life. This narrow focus produces some surprising results. For instance, the biggest risers in the new IDI are all developed countries even though it is in developing countries where most of the recent ICT growth has taken place. By contrast, the more balanced indicator selection of the DOI generates a more expected result in which the main gains are made in developing countries.

7.7. Knowledge Economy Index

The World Bank Institute's Knowledge for Development Program created the Knowledge Assessment Methodology (KAM) to help to build capacity in and measure Knowledge Economies[199], based on a interactive tool so that policy-makers, decision-takers and researchers can easily identify the key aspects of a country's Knowledge Economy.

An internal tool that had its origins in 1999[200], the KAM was only made public outside of the World Bank since 2004, due to the fact that "Interest and demand for the KAM's applications, by both internal and external audiences, ha[d] been increasing dramatically" (The World Bank, 2004).

The assessment is made for 140 countries and measuring 83 variables. These variables are grouped by the World Bank Institute in

[198] It is true that ITU's report (ITU, 2009) does provide a measure for affordability called ICT Price Basket, a compound index that includes the monthly subscription to fixed telephone plus calls, a measure (calls plus SMSs) for mobile cellular costs and the monthly subscription to fixed broadband internet (divided by monthly GNI per capita). But it is nonetheless true that this ICT Price Basket is *not* included in the ICT Development Index, but just comes along with it in the same report, so the analysis is not comprehensive but split in two different measuring tools.

[199] We refer the reader to the Introduction about the different definitions and naming of the Information Society, Knowledge Based Societies, etc.

[200] Though data were collected and calculated for year 1995 onwards.

- The Knowledge Economy Index (KEI)
- The Knowledge Index[201]
- The Basic Scorecard[202]

The latter two are but simplifications of the same framework based on four pillars

- Economic and Institutional Regime
- Education and Skills
- Information and Communication Infrastructure
- Innovation System

understood as the main constituents of a Knowledge Based Economy and each one being also indexed and ranked individually[203].

7.7.1. Main publications

The World Bank (2004). *Benchmarking Countries in the Knowledge Economy: Presentation of the Knowledge Assessment Methodology (KAM)*. Washington, DC: The World Bank Institute.

Chen, D. H. C. & Dahlman, C. J. (2005). *The Knowledge Economy, the KAM Methodology and World Bank Operations*. Washington, DC: The World Bank.

The World Bank (2007). *Knowledge Economy Index (KEI) 2007 Rankings*. Washington, DC: The World Bank.

The World Bank (2008). *Measuring Knowledge in the World's Economies*. Washington, DC:: The World Bank.

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[201] The World Bank Institute's Knowledge Index (KI) is a simplified – though not a lot – version of its elder brother, the Knowledge Economy Index. The KI is equal to the KEI but leaving aside the Economy indicators, thus

KI = KEI - Economic and Institution Regime Index

We list its main components in Annex I.

[202] As with the Knowledge Index, we have included the Balanced Scorecard both in chapter 9 and Annex I, but was useless to analyze it here as it only brings less richness than the broader Knowledge Economy Index.

[203] This means that the KAM has, actually, six different (though complementary or supplementary) indices: KEI, KI, Economic and Institutional Index, Education Index, Innovation Index, and the Information and Communications Technologies Index.

7.7.2. Distribution of Indicators

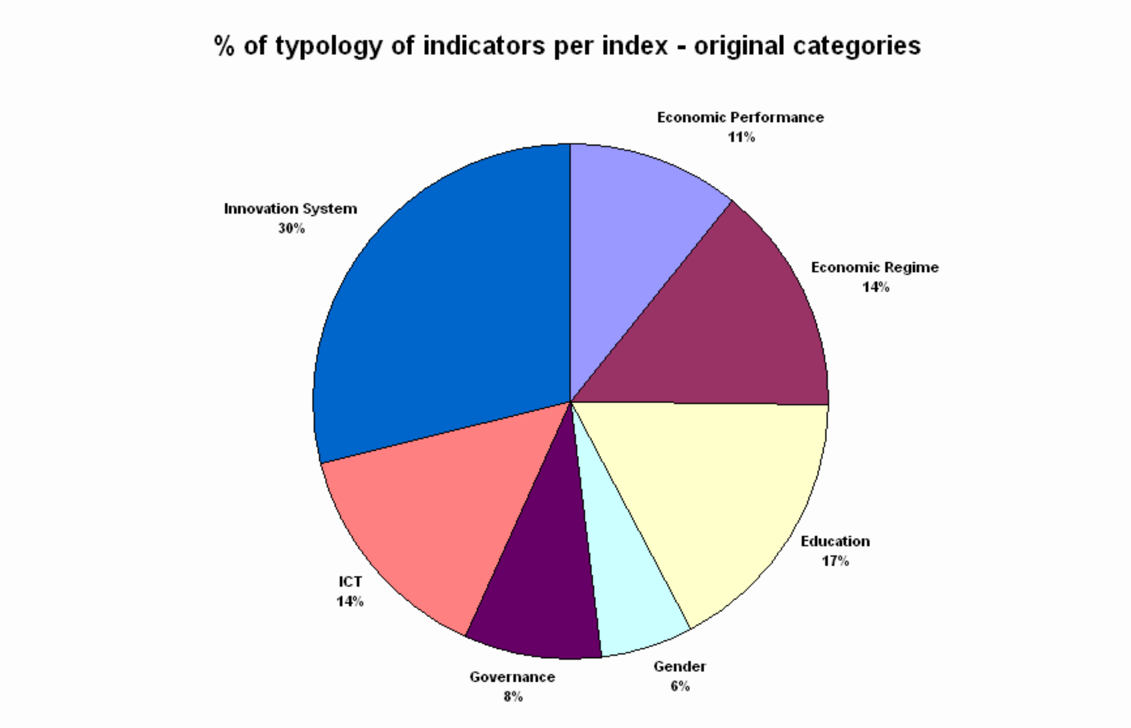

Figure 115: Knowledge Economy Index. % of typology of indicators per index – original categories

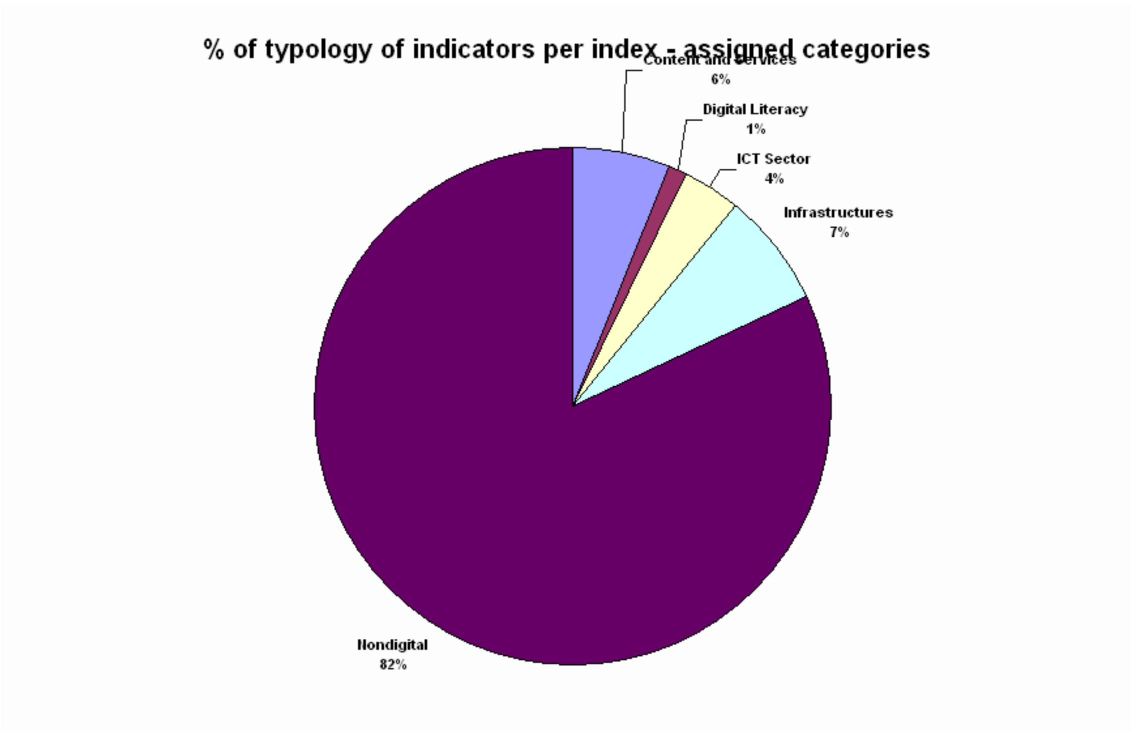

Figure 116: Knowledge Economy Index. % of typology of indicators per index – assigned categories

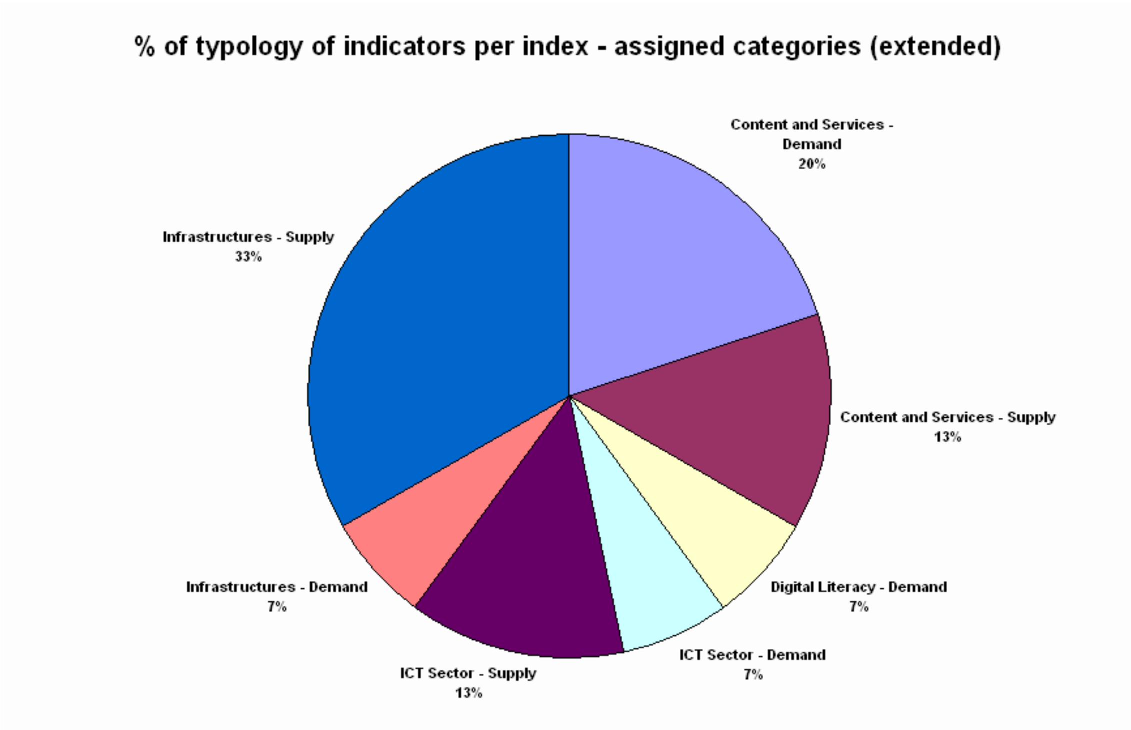

Figure 117: Knowledge Economy Index. % of typology of indicators per index – assigned categories (extended)

7.7.3. Comment

The Knowledge Economy Index is, doubtless, a most interesting tool that does try to give a sense of completeness when depicting a country. Even if roughly 20% of the indicators are related to digital variables, the remaining 80% are deeply related to knowledge and knowledge diffusion (information, communications, education) and the necessary tools to do so.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
ICT Infrastructures	ICT / System			ICT e-Government
ICT Price	Education ICT-related occupations	Education ICT at Schools		ICT Usage

Figure 118: The World Bank's KEI – main topics covered

Three main comments can be made about the Knowledge Economy Index.

The first one is about Digital Skills[204]. According to the indicators, no digital skills or digital literacy levels are measured. But, given the lack of data available in this field, the reason might be that these indicators were proxied by using data about the level (or levels) of education reached in a country and measured in several educational stages. This is, we believe, the case of the KEI and many other indices that have a strong commitment with comprehensiveness, an explicit will to measure digital skills and, afterwards, several education-related indicators appear in place.

The second one is about the Policy and Regulatory Framework, which is not covered by the index. In this case, though the general regulation of the economy is gathered by the index, some specific indicators would be very welcome. Some of them, especially the ones related to policy, can be guessed to be already included in the measurement of e-Governance. Notwithstanding, this is a clear matter of improvement of this index.

Third is that the ability to reinterpret the same indicators in six different indices is really useful as it provides the Knowledge Assessment Methodology with good flexibility without losing explanation power or having to deal with heavy calculations each time a shade or an specific approach is pursued in an analysis.

7.8. e-Government Readiness Index

UNPAN's e-Government Readiness Index was one of the outputs of UNPAN's first Global e-Government Survey (UNPAN, 2002) and formally presented in 2003 (UNPAN, 2003a and 2003b) as a tool to measure how governments were aware and benefiting from ICTs.

The reason to include it in this work is twofold. On one hand – and all along the different editions that UNPAN has done since 2001 – to establish a level of development of e-Government some country-wide measurement on the global e-Readiness of that country.

On the other hand, as governments affect with their behaviour the legal framework – through regulation and policies – and the usage or ICTs – by directly or indirectly affecting the aggregate demand – their role is too important to be overridden when analyzing different conceptions and models of the Digital Economy.

The structure – improved after the first proposal from 2002 (UNPAN, 2002) and unchanged since then – is based in three main pillars, each one measuring one key factor of e-Government as understood by UNPAN:

- Telecommunication Infrastructure
- Human Capital Index

[204] We will draw some conclusions about this aspect in chapter 9.

- Web Measure

These three pillars are, indeed – and as it happened, for instance, with the Knowledge Economy Index – indices on their own, to which a fourth calculated index is to be added:

- e-Participation

which tries to gather the citizenry side of the equation, collecting data in three different categories: e-Information, e-Consultation and e-Decision-Making[205].

In 2005, UNPAN released "Understanding Knowledge Societies in Twenty Questions and Answers with the Index of Knowledge Societies" (UNPAN, 2005b) as a follow up to "World Public Sector Report, E-government at the Crossroads" (UNPAN, 2003). In this work, a new Index of Knowledge Societies (IKS) is proposed as a measure of how deep into the "k-" are k-societies and k-governments (Knowledge Societies and Knowledge Governments, respectively) as opposed to e-societies or e-governments.

Because of this focus on knowledge rather than ICTs or digital technologies, we think it is a good complement to e-Government Readiness Index approach, even if "this measurement effort has been done on an experimental and illustrative basis" (UNPAN, 2005b). We will not be analyzing it here, but will be adding it to our further global reflections about the several models and include it in tables and annexes.

7.8.1. Main publications

UNPAN (2002). *Benchmarking E-government: A Global Perspective*. New York: UNDESA/ASPA.

UNPAN (2003a). *UN Global E-Government Survey 2003*. New York: UNPAN.

UNPAN (2003b). *World Public Sector Report 2003: E-government at the Crossroads*. New York: UNPAN.

UNPAN (2004). *Global E-government Readiness Report 2004. Towards Access For Opportunity*. New York: UNPAN.

UNPAN (2005). *Global E-government Readiness Report 2005. From E-Government To E-Inclusion*. New York: UNPAN.

UNPAN (2007). *Public Governance Indicators. A Literature Review*. New York: UNPAN.

UNPAN (2008). *UN e-Government Survey 2008. From e-Government to Connected Governance*. New York: UNPAN.

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[205] In this section we will only deal with the e-Government Readiness Index, but the e-Participation Index is included in all aggregates like Annex I.

7.8.2. Distribution of Indicators

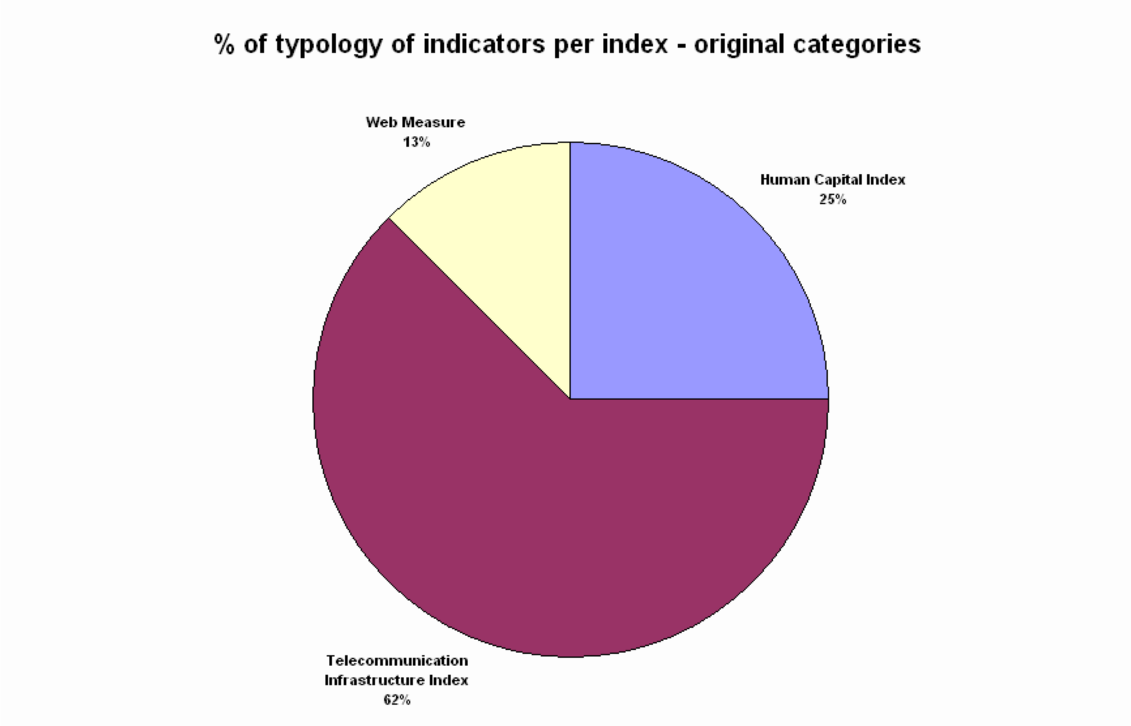

Figure 119: e-Government Readiness Index. % of typology of indicators per index – original categories

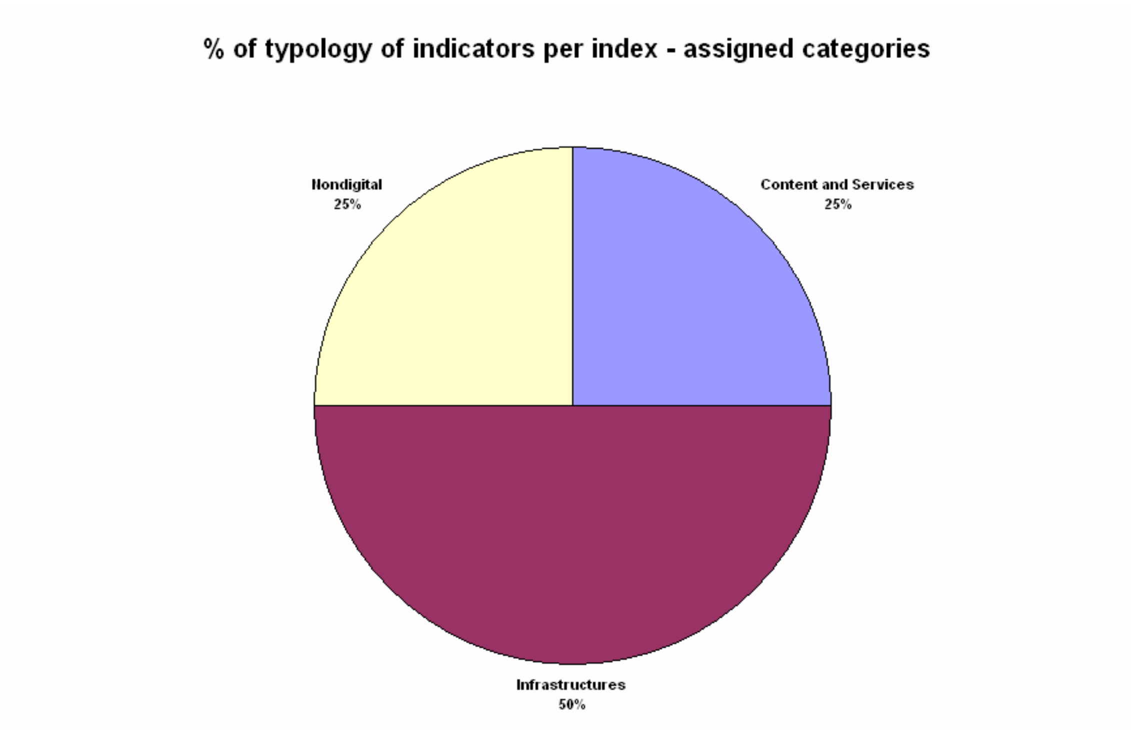

Figure 120: e-Government Readiness Index. % of typology of indicators per index – assigned categories

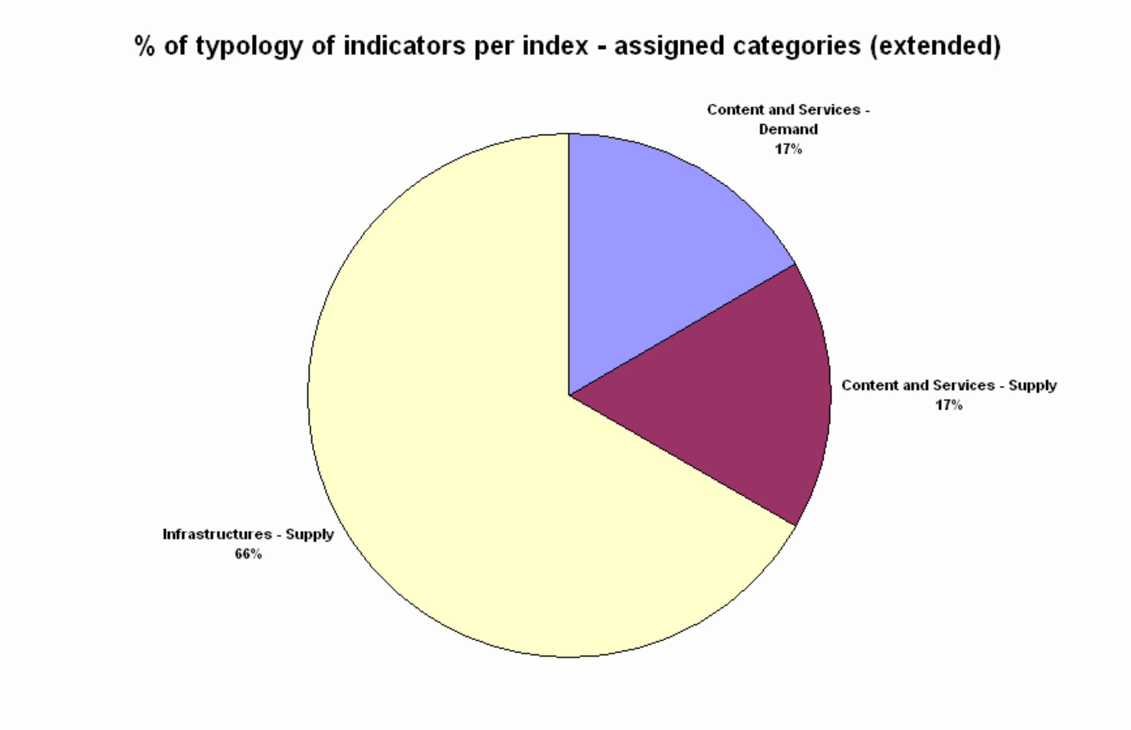

Figure 121: e-Government Readiness Index. % of typology of indicators per index – assigned categories (extended)

7.8.3. Comment

As we have already commented several times, the absence of good indicators on digital skills forces in this case UNPAN to estimate them through general literacy or education levels, which is more than arguable.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Telecom. Infrastructure				Web Measure
				Telecom. Infrastructure Internet Users

Figure 122: UNPAN's e-Government Readiness Index – main topics covered

The e-Government Readiness Index is strongly focused on usage and the availability of Content and Services, easily pictured in Figure 122.

The inclusion of the e-Participation Index to the e-Government Readiness Index only reinforces the share of Content and Services to the overall balance of the Index, making of them both – individually or as a whole – a richest source of information on availability and intensity of digital content and services by governments and the citizenry.

7.9. Information Society Index

The Information Society Index (ISI) was born in 1996 as the Information Imperative Index[206] as a joint effort by IDC and The World Times[207].

Following IDC's understanding of what the main components of an "Advanced Information Society" are (Figure 123), the model labels the 53 countries analyzed according to their level of digital development in four stages:

- Strollers
- Sprinters
- Striders
- Skaters

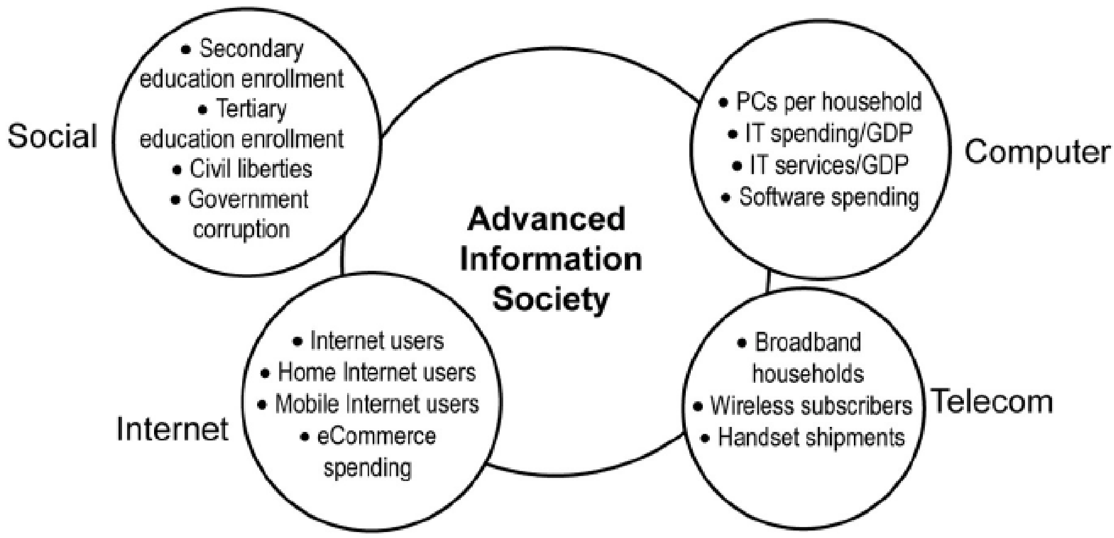

Figure 123: The Advanced Information Society (IDC, 2007)

As can be seen in Figure 123, the 15 indicators that the ISI consists of are categorized in four pillars:

[206] The name was changed to Information Society Index in the second edition of the Index in 1997.
[207] The effort ceased to be "joint" to be only IDC's in 2004.

- Telecommunications
- Computers
- Internet
- Social factors

7.9.1. Main publications

IDC & World Times (1996). *The 1996 IDC/World Times Information Imperative Index – Toward the Third Revolution*. Framingham: IDC.

IDC & World Times (1997). *The 1997 IDC/World Times Information Society Index*. Framingham: IDC.

IDC & World Times (1998). *The 1998 IDC/World Times Information Society Index – Strategic Insights and Planning Tools for Governments*. Framingham: IDC.

IDC & World Times (1999). *The 1999 IDC/World Times Information Society Index – Measuring Progress Towards a Digital Future*. Framingham: IDC.

IDC & World Times (2000). *The 2000 IDC/World Times Information Society Index – Measuring the Global Impact of Information Technology and Internet Adoption*. Framingham: IDC.

IDC & World Times (2001). *The 2001 IDC/World Times Information Society Index – Measuring the Evolution of Information Society*. Framingham: IDC.

IDC & World Times (2002). *The 2002 IDC/World Times Information Society Index – The Future of the Information Society*. Framingham: IDC.

IDC & World Times (2003). *The 2003 IDC/World Times Information Society Index*. Framingham: IDC.

IDC (2004). *Information Society Index 2004: Rankings and Data*. Framingham: IDC.

IDC (2005). *Information Society Index 2005: Rankings and Data*. Framingham: IDC.

IDC (2006). *Information Society Index 2006*. Framingham: IDC.

IDC (2007). *Information Society Index (factsheet)*. Framingham: IDC.

IDC (2008). *Information Society Index 2007: Measuring the Digital Divide*. Framingham: IDC.

7.9.2. Distribution of Indicators

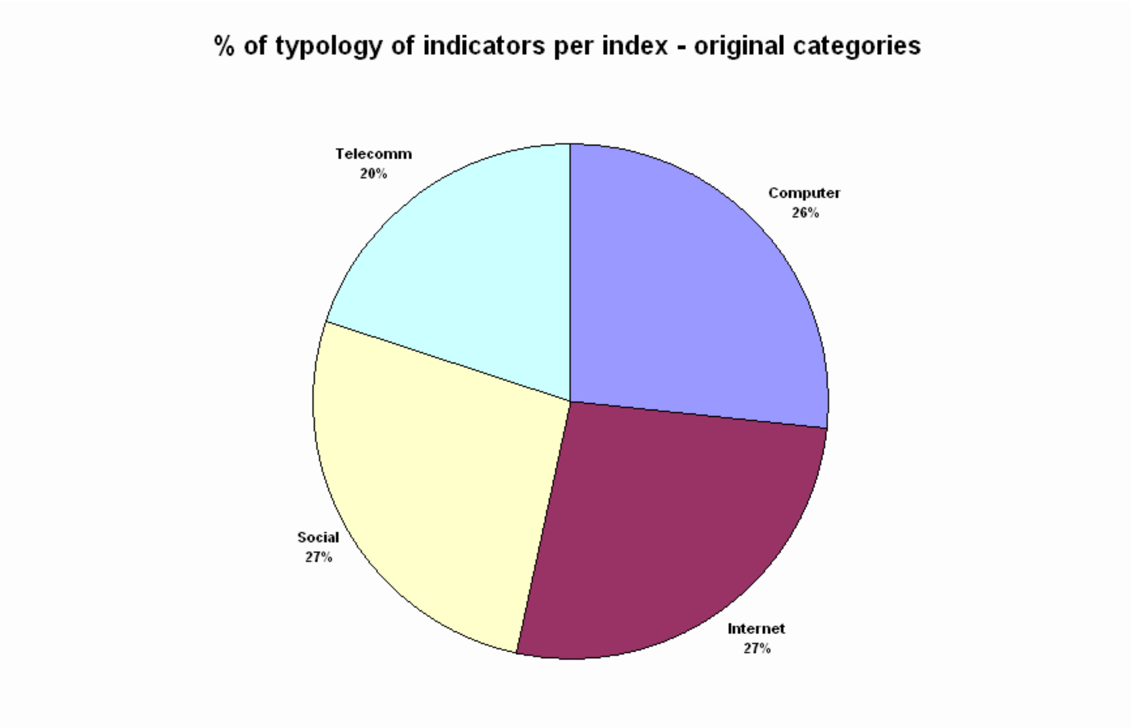

Figure 124: Information Society Index. % of typology of indicators per index – original categories

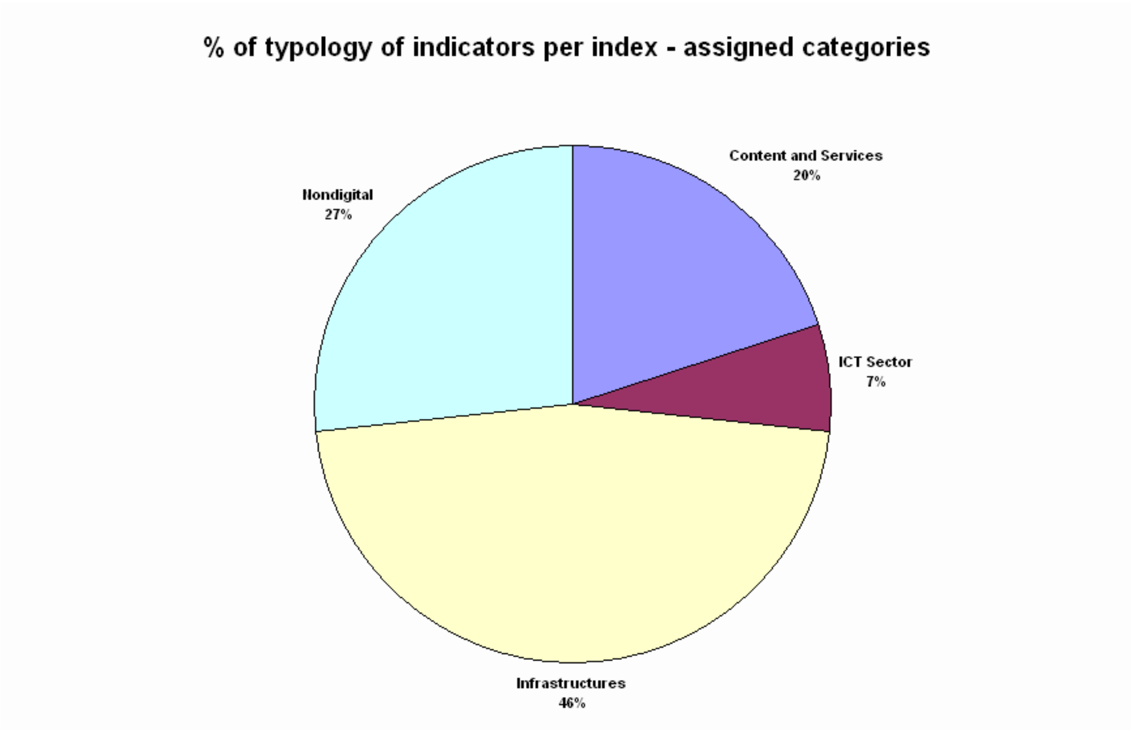

Figure 125: Information Society Index. % of typology of indicators per index – assigned categories

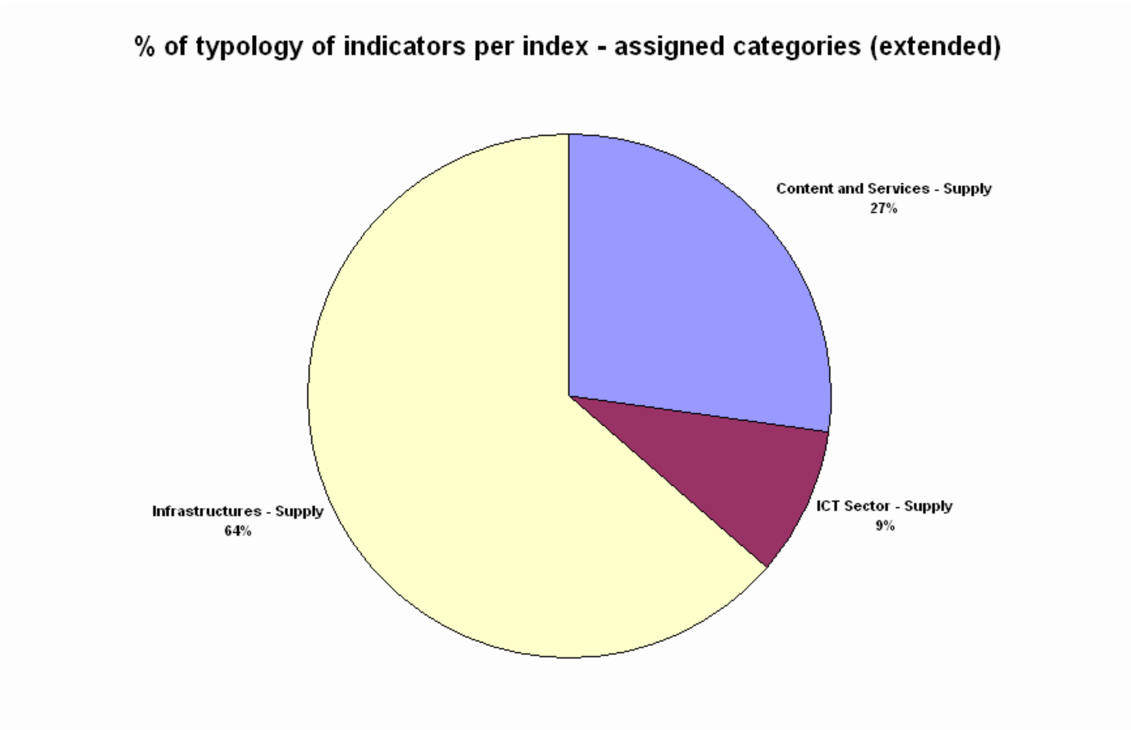

Figure 126: Information Society Index. % of typology of indicators per index – assigned categories (extended)

7.9.3. Comment

In our opinion, the Information Society Index is a tool that has the merit to have been one of the first ones to exist – if not the first one of its kind – but the demerit to have aged quite badly: we believe (and Figure 127 shows it very clear) that the exclusive focus (bias) towards infrastructures cannot explain as broad a concept as the Information Society.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Telecom. Computer Internet Infrastructures	IT Spending			Computer Internet Telecom Expenditure

Figure 127: IDC's Information Society Index – main topics covered

We would agree that indices should not be frequently changed for the sake of comparison of time series, but slight modifications along all these years would have made of it a most valuable tool due to its tradition.

On the other hand – and this will be discussed also in the next section for the e-Readiness Rankings – commercial indices (like the ISI) tend not to fully disclose the way they are calculated, which is a problem in itself. Of course, we are not saying that disclosure should be compulsory and rights on the indices given away, but it is also true that non-disclosure makes analysis and replicability more difficult and, hence, raises doubts on complex tools like indices that are far from being perfect and highly susceptible of being subjective.

7.10. e-Readiness Rankings[208]

The Economist Intelligence Unit, in collaboration with the IBM Institute for Business Value, has been publishing since 2000 the e-Readiness Rankings[209] to assess "the world's largest economies on their ability to absorb information and communications technology and use it for economic and social benefit" (Economist Intelligence Unit, 2008).

Compiled for 70 countries and featuring 37 main indicators[210], the EIU model is based on six main constituent categories:

- Connectivity and Technology Infrastructure
- Business Environment
- Social & Cultural Environment
- Legal Environment
- Government Policy & Vision
- Consumer & Business Adoption

These categories, as we have been seeing in other indices, have their own scores and rankings and can, thus, be used as separate subindices that make possible or ease the analysis of specific sectors of the economy or the society.

Along the years, the number of the categories and their respective constituents has been changing to adapt to the always evolving reality of the Information Society and Information and Communication Technologies.

Arguably, the Economist Intelligence Unit's e-Readiness Rankings – along with the World Economic Forum's Network Readiness Index[211] – are the most comprehensive and well known measuring tools in the field of the Digital Economy.

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[208] I'm profoundly grateful to Denis McCauley, Director, Global Technology Research at the Economist Intelligence Unit, for his predisposition to share his time, for insightful reflections and for most valuable information and comments about the EIU e-Readiness Rankings. But, over all, I want to thank him for his kindness.

[209] In 2000 the name was e-Business Readiness Rankings, but was changed in the following edition to reflect a broader point of view and reach.

[210] The whole set of indicators and subindicators numbers circa 100 different items.

7.10.1. Main publications

Economist Intelligence Unit (2000-2009). *The e-business readiness rankings*. London: EIU

7.10.2. Distribution of Indicators

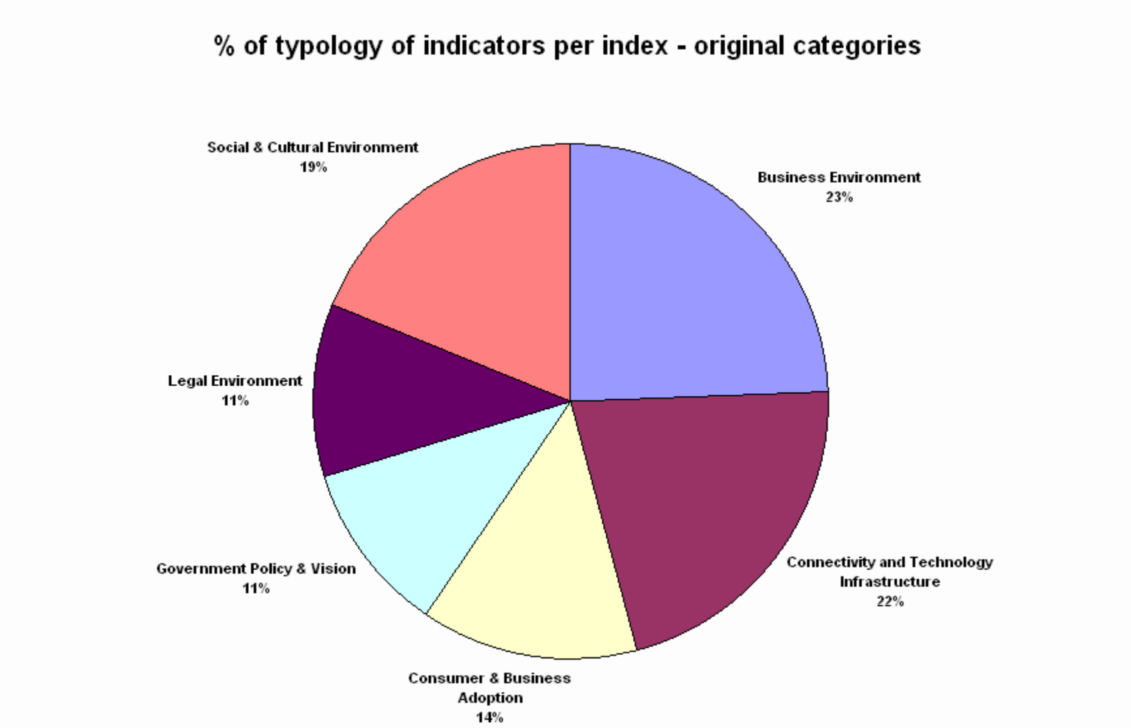

Figure 128: e-Readiness Rankings. % of typology of indicators per index – original categories

[211] See next section

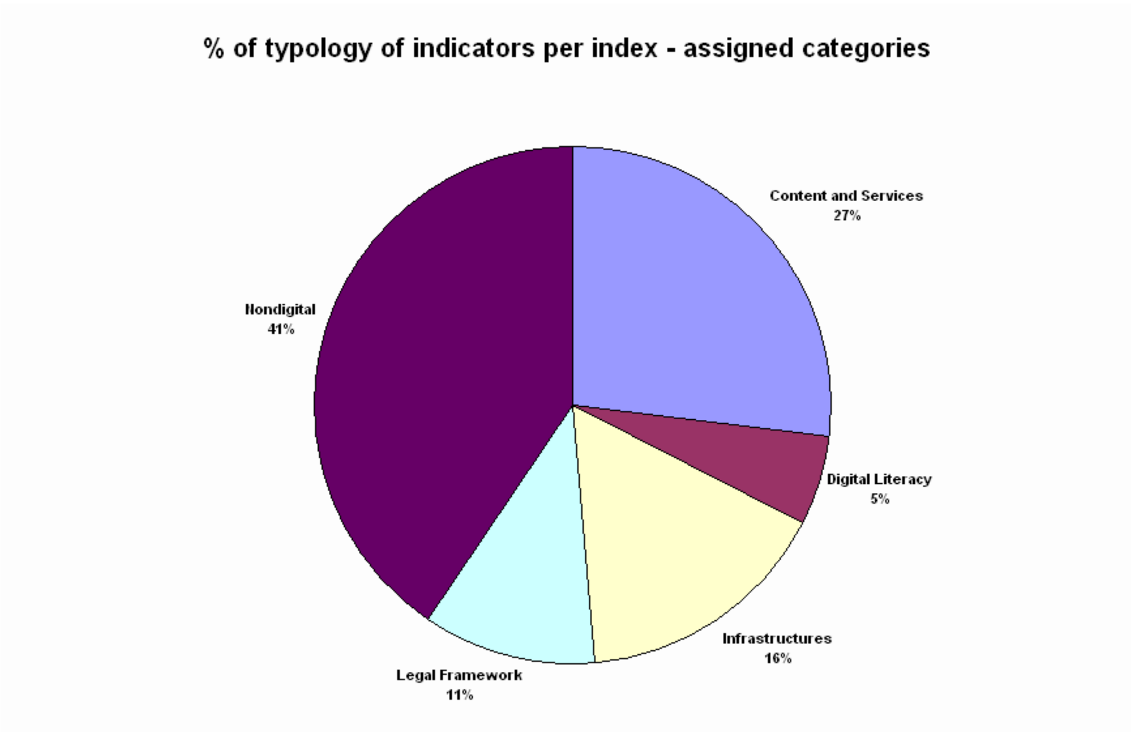

Figure 129: e-Readiness Rankings. % of typology of indicators per index – assigned categories

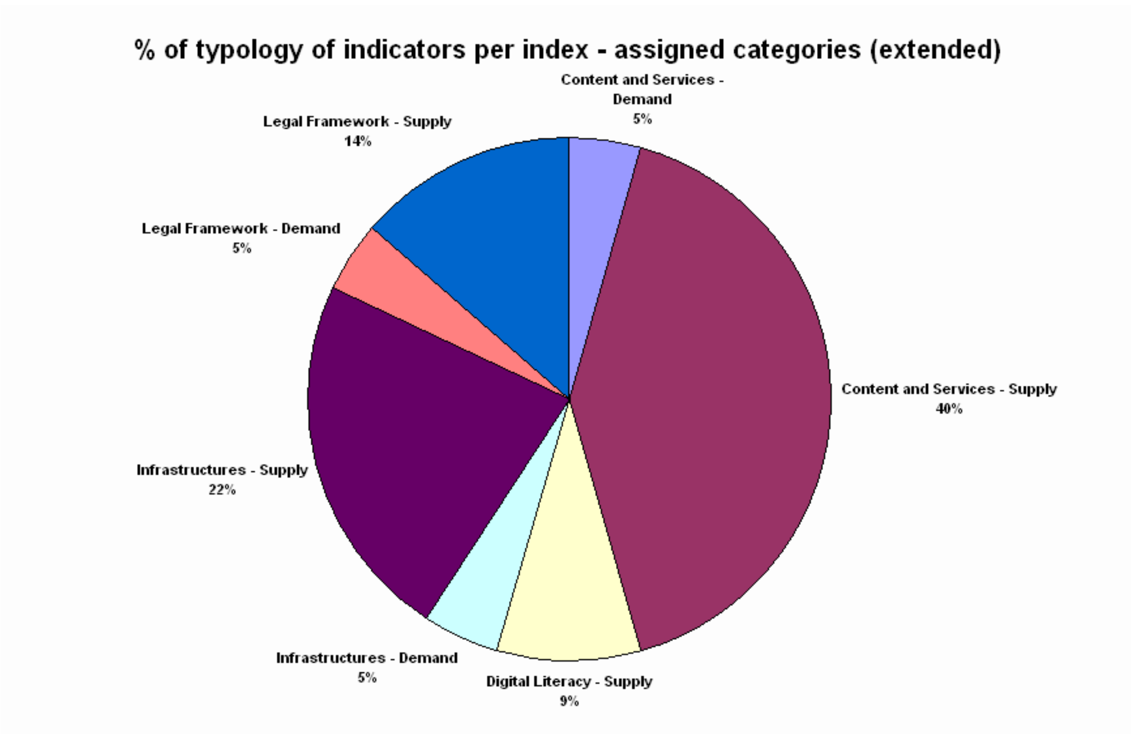

Figure 130: e-Readiness Rankings. % of typology of indicators per index – assigned categories (extended)

7.10.3. Comment

For policy-makers and decision takers, the e-Readiness Rankings is the perfect complementary tool to other measuring devices[212] more focused on infrastructures and the industry (i.e. the ICT sector).

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Connectivity and Technology Infrastructure		Social & Cultural Environment	Legal Environment	Government Policy & Vision Consumer & Business Adoption
Connectivity and Technology Infrastructure Affordability			Government Policy & Vision	Consumer & Business Adoption Spending on ICT

Figure 131: The EIU's e-Readiness Rankings – main topics covered

The e-Readiness Rankings are designed from the point of view of adoption, taking the concept of "e-Readiness" to its most strict definition. Of course, this shift towards usage, adoption or absorption leaves unattended crucial aspects – in our opinion – like the ICT sector and digital skills, though the latter are quite good covered by two direct indicators and one proxy.

The main criticism that has been made to the EIU is that it relies too much on subjective observations rather than qualitative data. Where some would find the insight of the analysts that the Economist Intelligence Unit has spread all over the World one strong asset, others consider that they represent but a second best to the desired optimum: reliable statistical data from national agencies.

7.11. [213]Networked Readiness Index

The Networked Readiness Index (NRI) was first published in 2002, as the leading axis of a new series of reports: the *Global Information Technology Report*.

The first Global Information Technology Report (GITR), published in 2002, was the result of cooperation between the World Economic Forum (WEF) and the Center for International Development at Harvard University. In 2003, the partnership changed

[212] See the two previous and the following chapter.

[213] I want to thank Tim Unwin – Programme Director of the World Economic Forum's Partnerships for Education initiative – and Irene Mia – Senior Economist, Global Competitiveness Programme at the World Economic Forum – for kindly providing some data about the Networked Readiness Index.

and the GITR was since developed by the WEF and INSEAD, with the World Bank's *info*Dev also taking part also in the 2003 and 2004 editions.

The Networked Readiness Index annually covers 122 countries with almost 70 different indicators – though some of them, as we have seen for other indices, actually are subindices composed by other indicators.

These indices are grouped in three main components

- Environment
- Readiness
- Usage

as pictured in Figure 132:

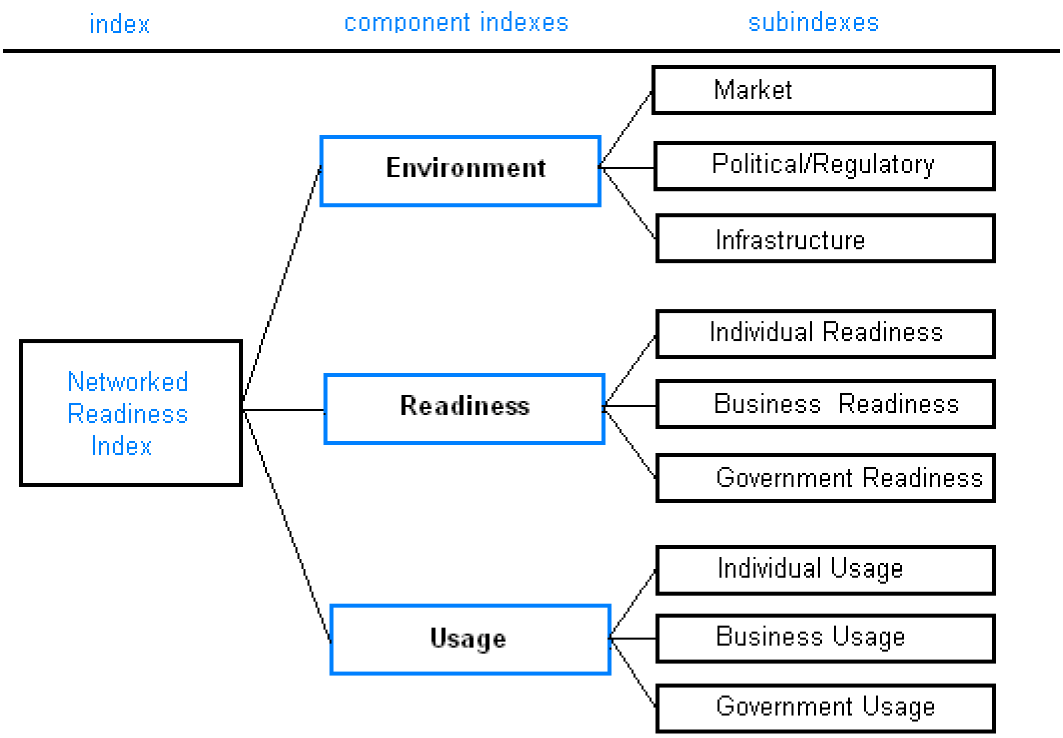

Figure 132: The Networked Readiness Index Framework (Dutta et al., 2008)

7.11.1. Main publications

Kirkman, G., Cornelius, P. K., Sachs, J. D. & Schwab, K. (Eds.) (2002). *Global Information Technology Report 2001-2002: Readiness for the Networked World*. New York: Oxford University Press.

Dutta, S., Lanvin, B. & Paua, F. (Eds.) (2003). *Global Information Technology Report 2002-2003: Readiness for the Networked World*. New York: Oxford University Press.

Dutta, S., Paua, F. & Lanvin, B. (Eds.) (2004). *Global Information Technology Report 2003-2004: Towards an Equitable Information Society*. New York: Oxford University Press.

Dutta, S. & López-Claros, A. (Eds.) (2005). *Global Information Technology Report 2004-2005: Efficiency in an Increasing Connected World*. Basingstoke: Palgrave Macmillan.

Dutta, S., López-Claros, A. & Mia, I. (Eds.) (2006). *Global Information Technology Report 2005-2006: Leveraging ICT for Development*. Basingstoke: Palgrave Macmillan.

Dutta, S. & Mia, I. (Eds.) (2007). *Global Information Technology Report 2006-2007: Connecting to the Networked Economy*. Basingstoke: Palgrave Macmillan.

Dutta, S., López-Claros, A. & Mia, I. (Eds.) (2008). *Global Information Technology Report 2007-2008: Fostering Innovation through Networked Readiness*. Basingstoke: Palgrave Macmillan.

Dutta, S. & Mia, I. (Eds.) (2009). *Global Information Technology Report 2008-2009: Mobility in a Networked World*. Basingstoke: Palgrave Macmillan.

7.11.2. Distribution of Indicators

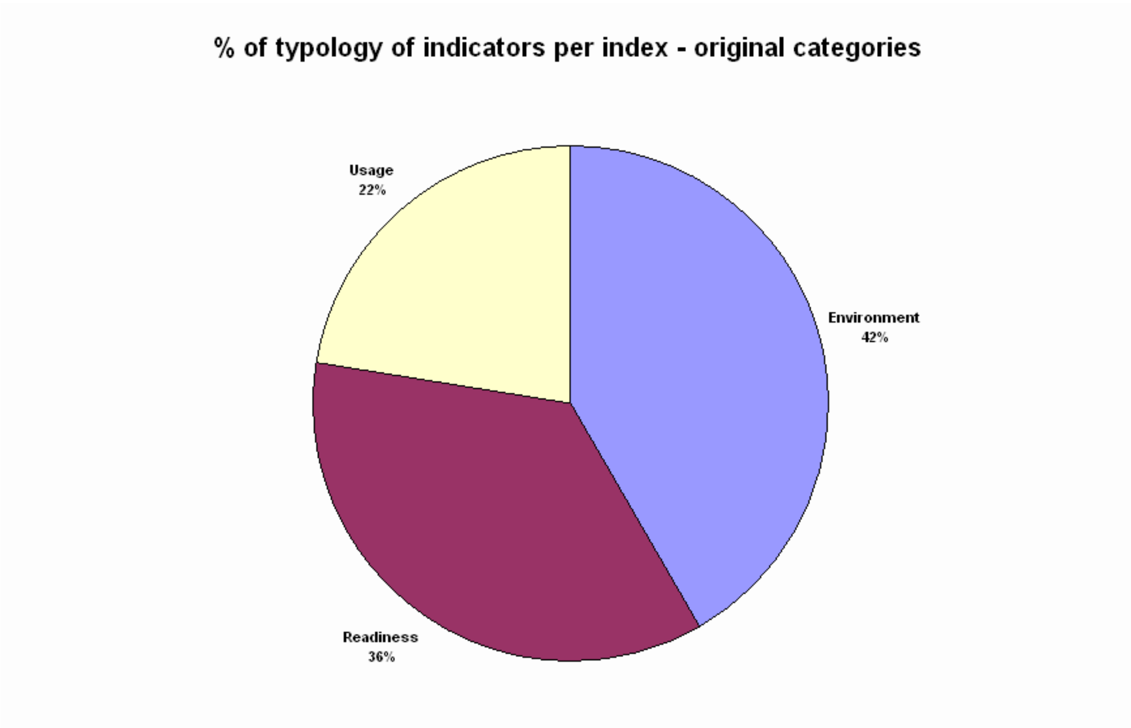

Figure 133: Networked Readiness Index. % of typology of indicators per index – original categories

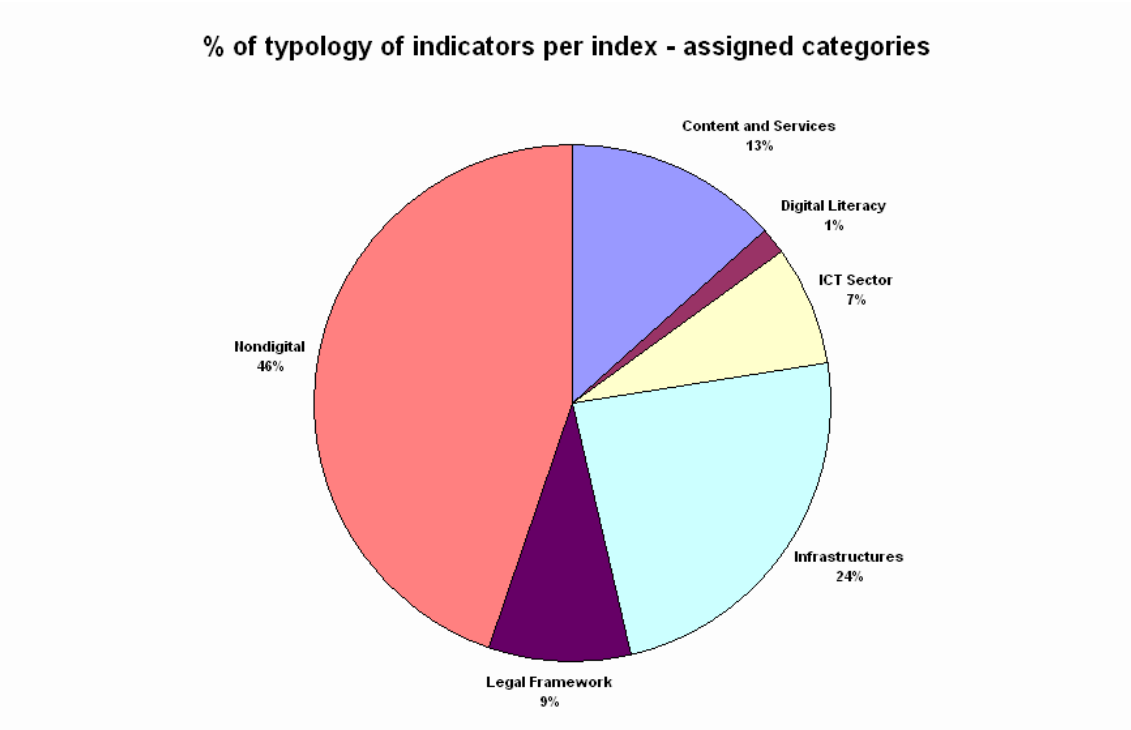

Figure 134: Networked Readiness Index. % of typology of indicators per index – assigned categories

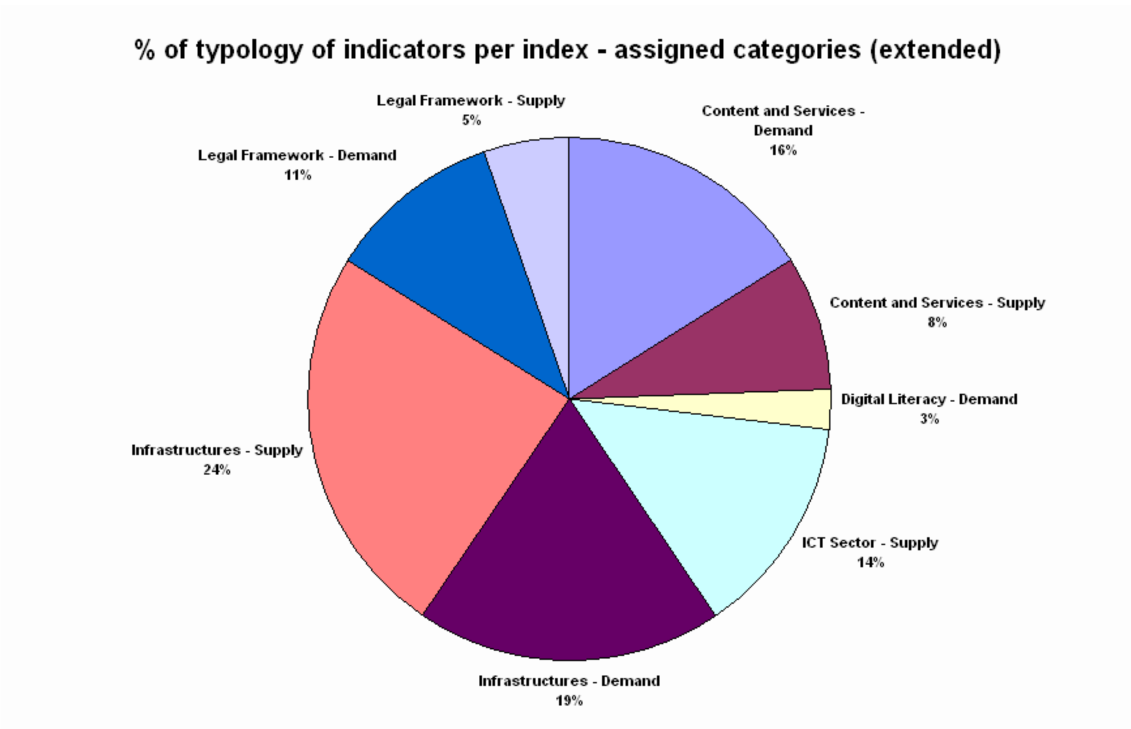

Figure 135: Networked Readiness Index .% of typology of indicators per index – assigned categories (extended)

7.11.3. Comment

The departure point of the Networked Readiness Index is exactly the same one as for the e-Readiness Rankings[214]: actual use, appropriation and empowerment of ICTs, as opposed to the existence of infrastructures or an ICT Sector.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Business & Individual Usage Infrastructure & Market Environment	Business Usage Market Environment		Political/Regulatory Environment	Government Readiness & Usage Infrastructure Environment
Business & Individual Readiness		Individual Readiness	Government Readiness & Usage	Business, Government & Individual Usage Government Readiness

Figure 136: The World Economic Forum's Networked Readiness Index – main topics covered

In this case, nevertheless, the ICT Sector is much more represented than in the e-Readiness Rankings, while digital skills are not, being here only measured by one indicator[215].

As also happened with the e-Readiness Rankings, the main critique of the NRI is that it heavily relies on soft data from the World Economic Forum's Global Competitiveness Report, data that is surveyed by directly asking to experts to rate or rank several indicators. This qualitative approach is not exempt from subjectivity and, thus, raises some questions about the validity of some indicators' values.

We have also commented here several times about using indicators that do not strictly belong to the Digital Economy and hence adding "analogue noise" to the whole set. Some of these indicators are even considered "superfluous" by some authors (Goswami, 2006a).

On the other hand, and commented also for the e-Readiness Rankings, we agree with Goswami (2006c) that, when comparing the NRI to the DOI, states that

> "Despite the NRI's many flaws that were dealt with in a previous article[216], it must be acknowledged that this composite Index is able to capture the ICT capabilities of countries like India that despite poor ICT infrastructure

[214] Though covering many more countries.
[215] And the usual proxies about education.
[216] See Goswami, D. (2006a). A Review of the Network Readiness Index. Lyngby: LIRNE.NET.

are able to play a significant role in the global market for ICT related services and products".

Summing up, the NRI is not an alternative but a good complement to Infrastructure centred indices as it includes socioeconomic factors and matters of usage and the legal framework usually overridden in other approaches[217]. Indeed, its broad coverage – 134 economies in the 2009 edition – and its long trajectory makes of it a recurring tool and the perfect companion for other international agencies promoted tools like the aforementioned DOI[218] from the International Telecommunication Union.

We wouldn't like to end this chapter leaving the reader with an unanswered question: how similar are, in the end, the e-Readiness Rankings and the Networked Readiness Index? We have been stating that their aim is almost the same one and their respective compositions are, while being different, birds of a same feather. We have carried out a small statistical exercise comparing not their structure, but their explanatory power, and tested how their measurements coincide. Put simply: despite their differences, at the aggregate level they are almost the same thing. Please refer to Annex III for detailed information about this comparative exercise.

7.12. Connectivity Scorecard (Innovation Driven Economies)

The starting point for Waverman et al.'s (2008, 2009) most recent work at this time is the following one:

- There is evidence that the economic impact of ICTs depends on them being appropriated by households, firms and governments
- The impact in productivity is closely related to (digital) skills and accompanying measures
- Measuring Connectivity[219] should focus, hence, in infrastructures but also in skills and these accompanying measures.

This is exactly what the authors have followed when designing their Connectivity Scorecard, strictly focussing in this group of variables: infrastructures, skills and usage.

According to the World Economic Forum definitions, actually two different indices – or scorecards – were calculated:

- The Connectivity Scorecard for Innovation Driven Economies
- The Connectivity Scorecard for Efficiency and Resource Driven Economies[220]

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[217] For a simple comparison between the NRI and the Human Development Index, we suggest Peña-López, I. (2006b). "Networked Readiness Index vs. Human Development Index".
[218] See section 7.4
[219] This is the word used by the authors, though it is somehow a concept that does not really fit with the approach and purposes of the paper.
[220] In this section we will deal with the general framework of the Connectivity scorecard and with the former one – for Innovation Driven Economies – leaving the later – Efficiency and Resource Driven Economies – and the comparison among both for the following section

so to adjust the model(s) for different stages of economic development[221].

The Scorecard is based in two ranges of variables (Figure 137). On one hand, the relationship between infrastructures and skills. On the other hand, the actors that appropriate ICTs, namely Consumers, Businesses and Governments.

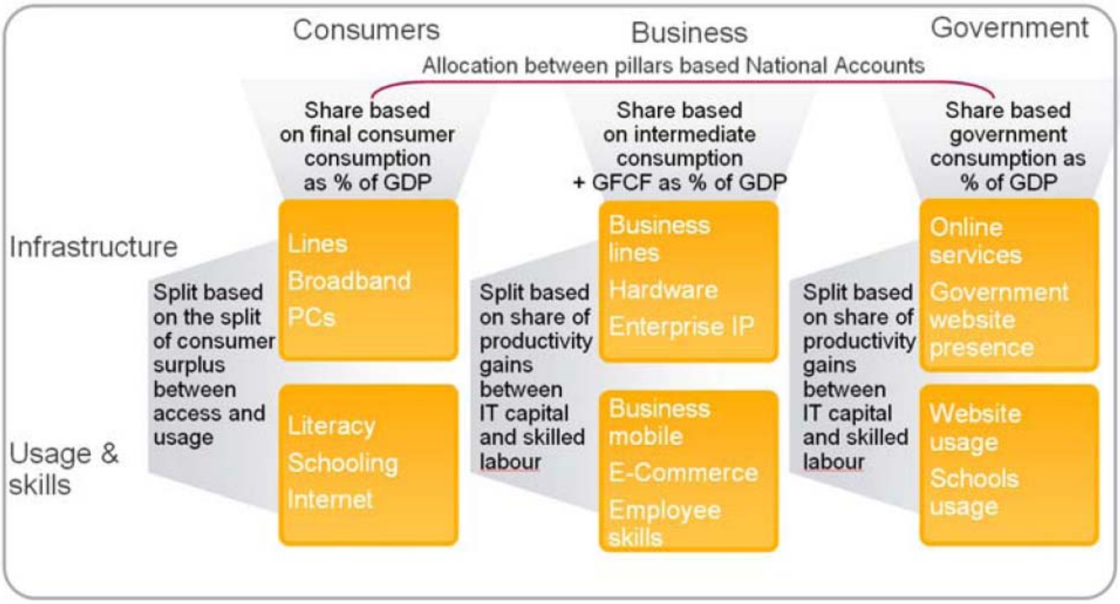

Figure 137: Connectivity Scorecard (Waverman et al, 2008, p.12)

7.12.1. Main publications

Waverman, L., Dasgupta, K. & Tonkin, J. (2008). *The Connectivity Scorecard*. London: LECG and Nokia Siemens Networks.

Waverman, L., Dasgupta, K. & Brooks, N. (2009). *Connectivity Scorecard 2009*. London: LECG and Nokia Siemens Networks.

221 This reflection can be also read – though in a more implicit way – in the works by Sundén and Wicander.

7.12.2. Distribution of Indicators

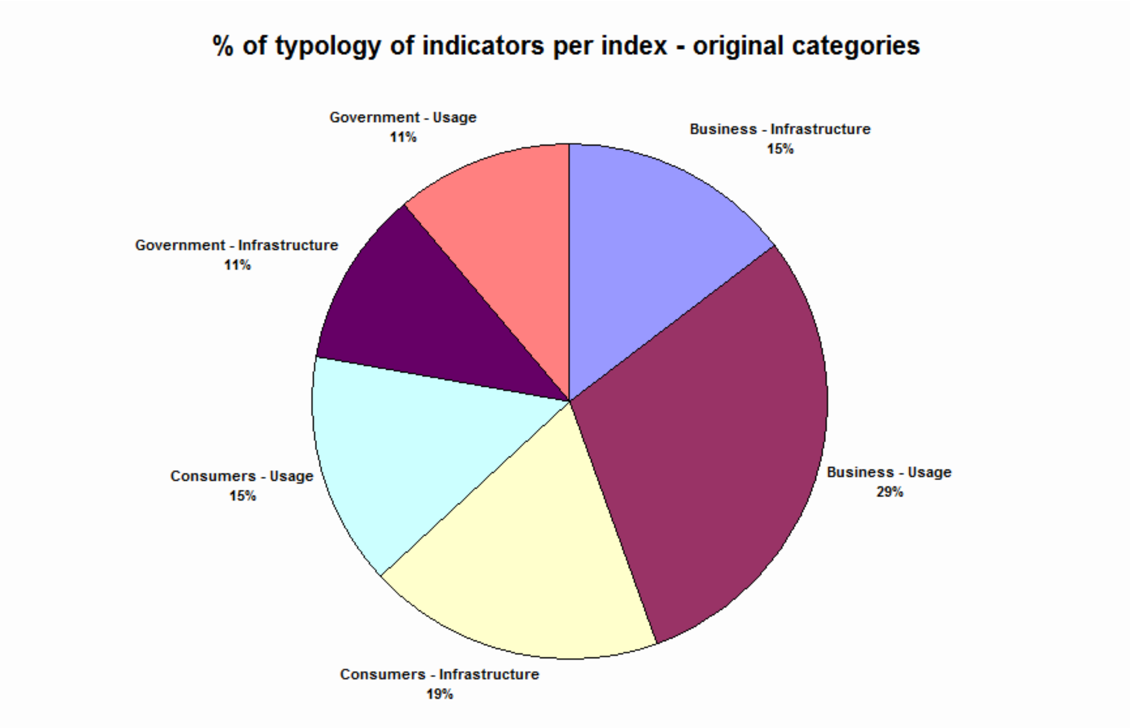

Figure 138: Connectivity Scorecard (Innovation Driven Economies). % of typology of indicators per index – original categories

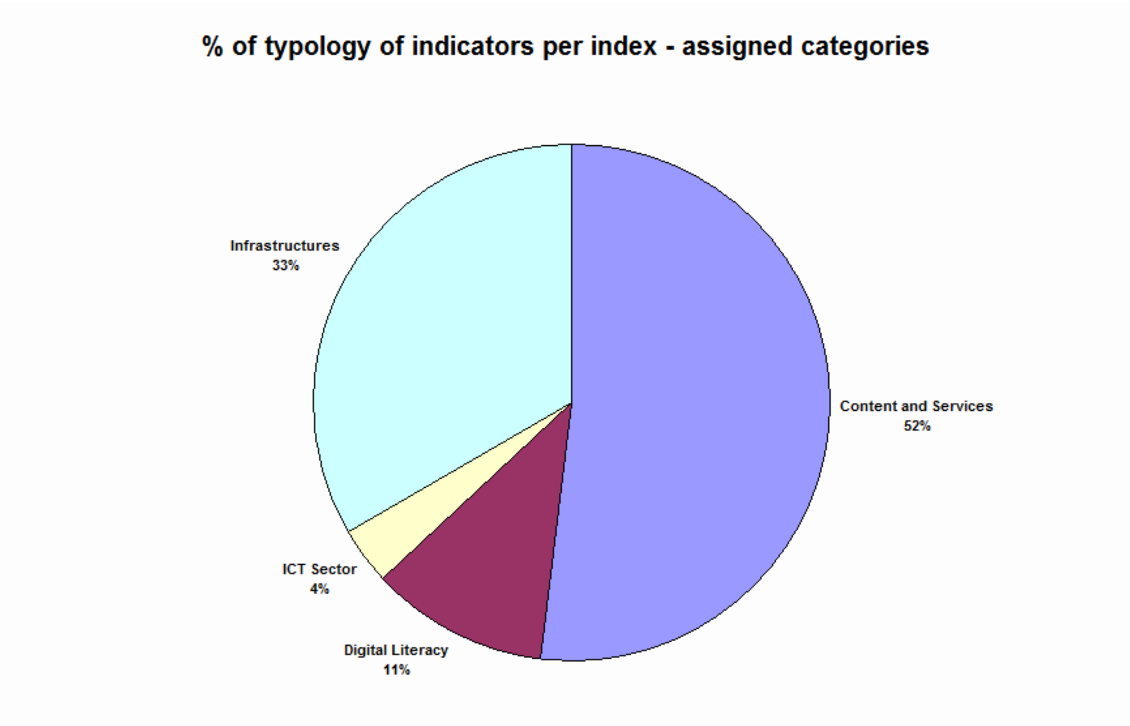

Figure 139: Connectivity Scorecard (Innovation Driven Economies). % of typology of indicators per index – assigned categories

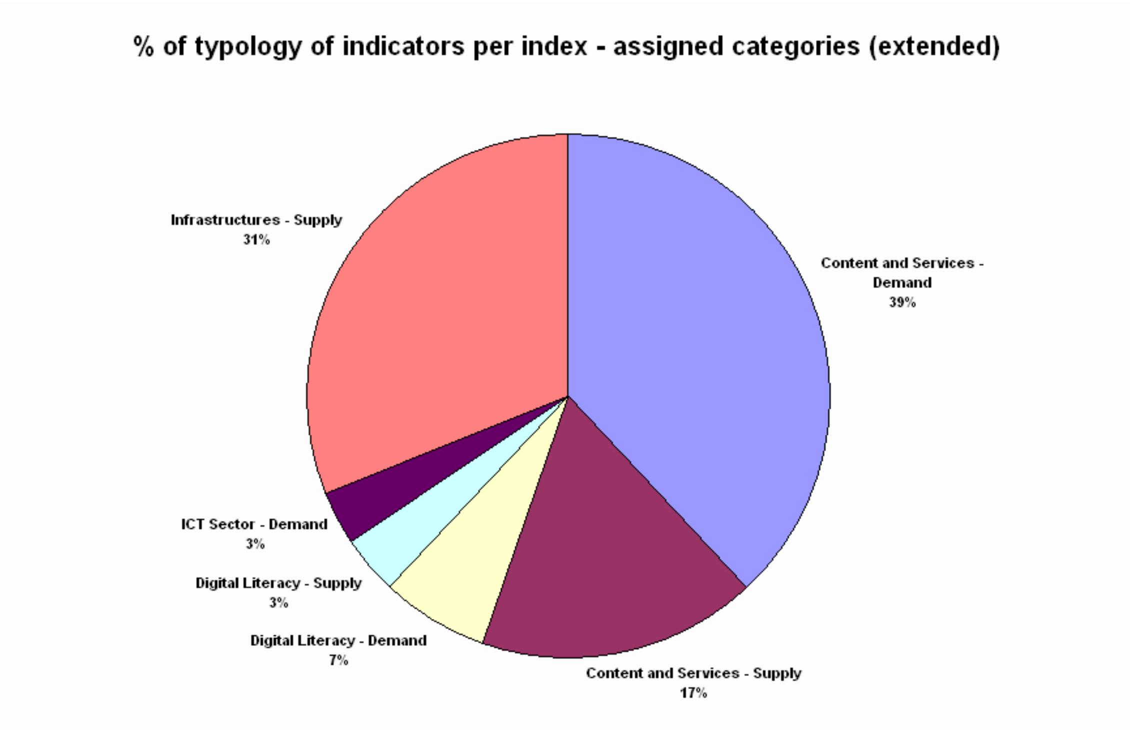

Figure 140: Connectivity Scorecard (Innovation Driven Economies). % of typology of indicators per index – assigned categories (extended)

7.12.3. Comment

Figure 141 graphically shows that the purpose stated when designing the Connectivity Scorecard (as pictured in Figure 137) does fit our own categorization of the indicators:

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Infrastructure		Skills		Usage Content
	Skilled Workforce	Digital Skills Training		Usage Intensity

Figure 141: Connectivity Scorecard (Innovation Driven Economies) – main topics covered

The emphasis is effectively put in infrastructures, content and services (usage and usage intensity) and the availability of human digital capacity, both as individuals and as workforce, and also present at educational institutions. This is, we believe, a strong added value of this model, as the weight of skills is scarcely measured and almost never at this level of detail.

Considering that one of the explicit goals of the research is that that "[t]he Connectivity Scorecard proves useful […] to governments assessing how ICT policy can be advanced", we are surprised not to be finding in the model no variables related to policy making or to the regulation of the sector, especially when other authors[222] have proven the importance of the legal framework (regulation, policies, etc.) in the development of the Information Society.

7.13. Connectivity Scorecard (Efficiency and Resource Driven Economies)

So, what is the difference between the Connectivity Scorecard designed for developed countries – Innovation Driven Economies – and the one designed for the developing ones – Efficiency and Resource Driven Economies?

As explained, the authors split countries in two groups and, thus, also recreate a new methodology for each set. Hence, it's mainly the composition of the indices and the selection of countries that changes, as do the selection of their compounding indicators based on the fundamental differences of the selected countries.

7.13.1. Main publications

Waverman, L., Dasgupta, K. & Tonkin, J. (2008). *The Connectivity Scorecard*. London: LECG and Nokia Siemens Networks.

Waverman, L., Dasgupta, K. & Brooks, N. (2009). *Connectivity Scorecard 2009*. London: LECG and Nokia Siemens Networks.

[222] Please refer to previous chapters.

7.13.2. Distribution of Indicators

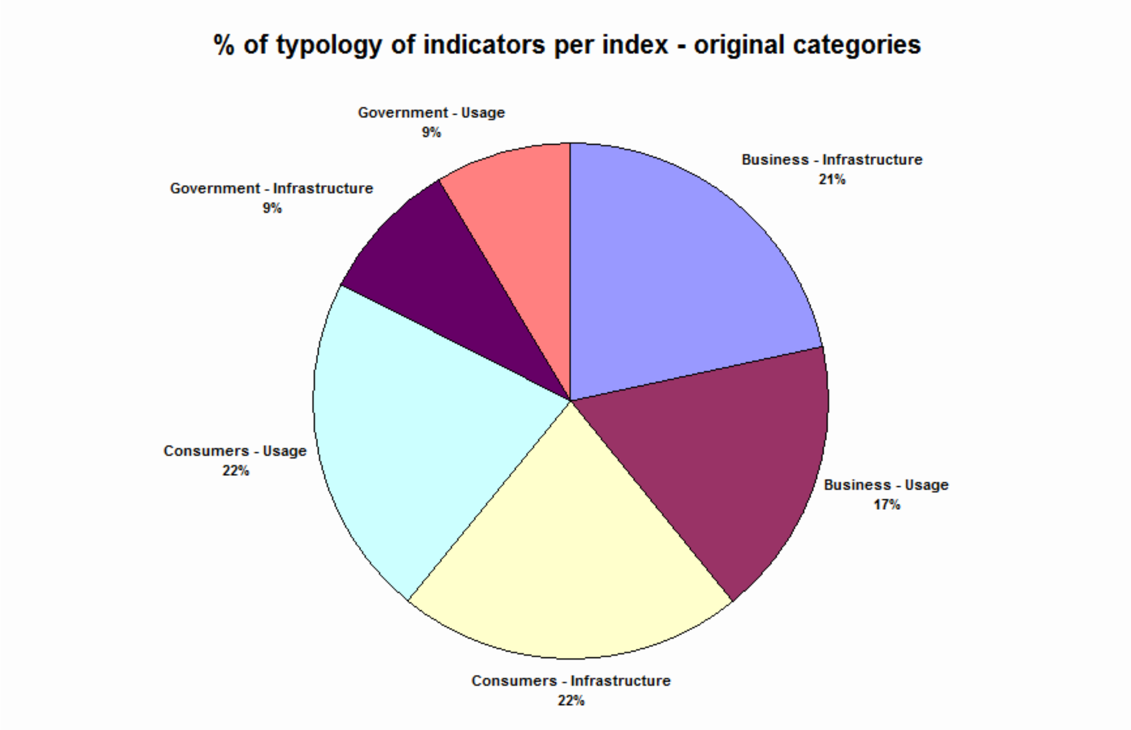

Figure 142: Connectivity Scorecard (Efficiency and Resource Driven Economies). % of typology of indicators per index – original categories

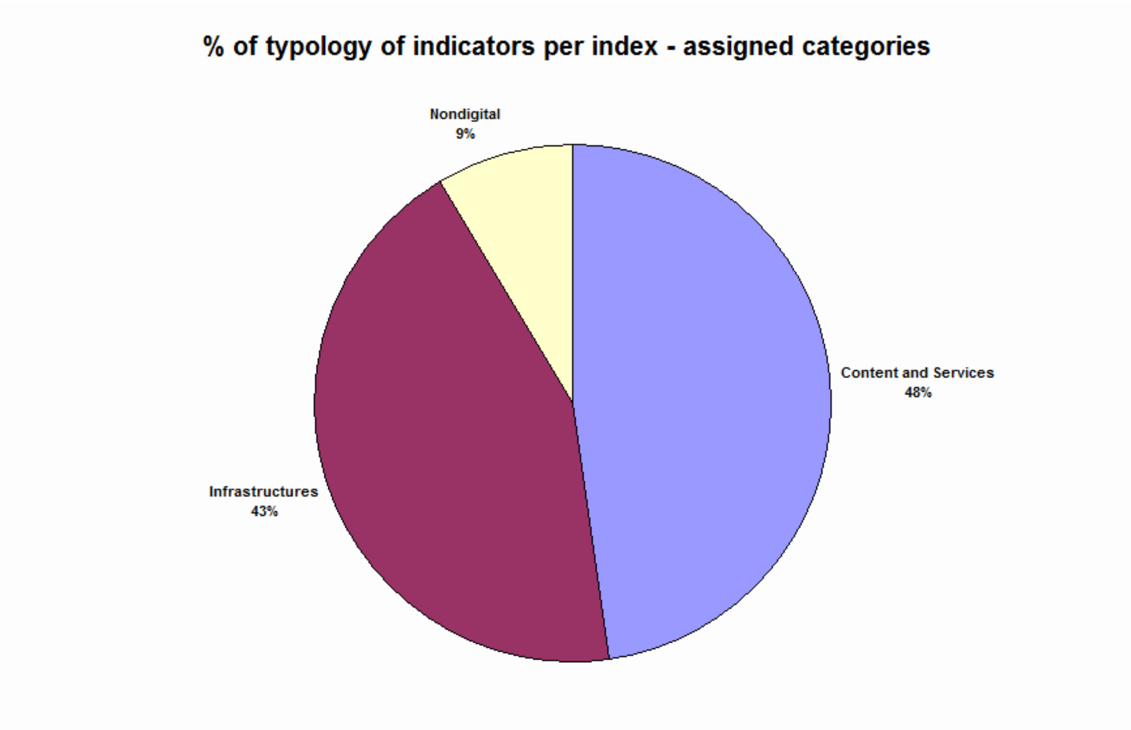

Figure 143: Connectivity Scorecard (Efficiency and Resource Driven Economies). % of typology of indicators per index – assigned categories

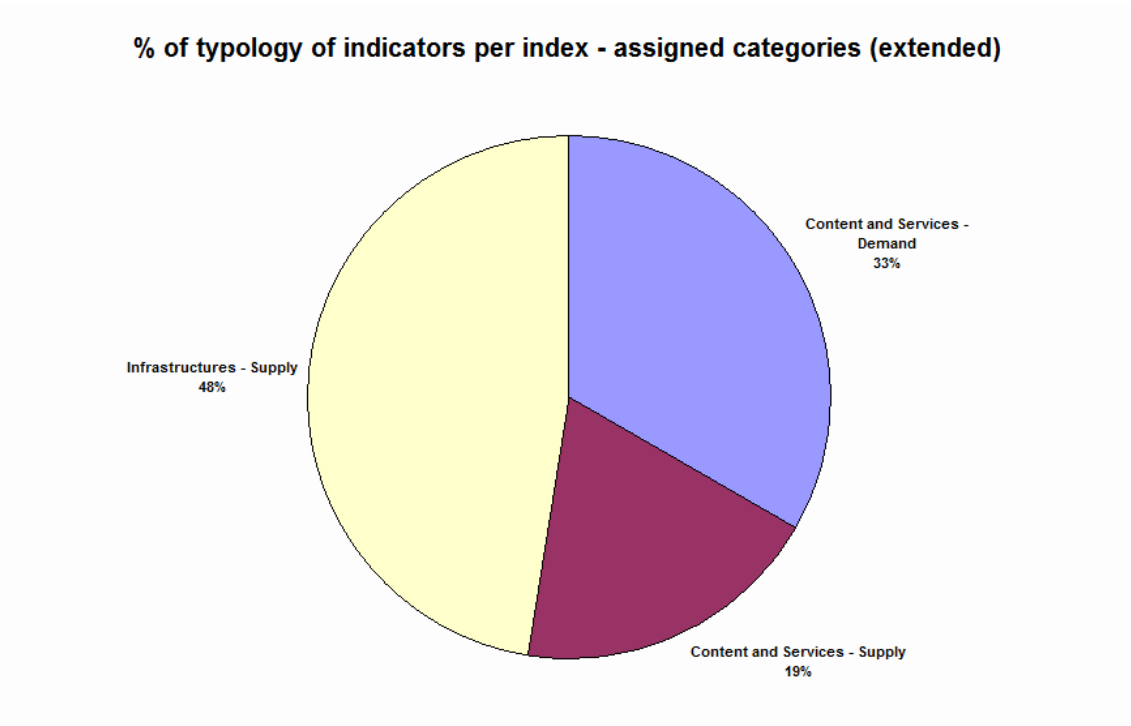

Figure 144: Connectivity Scorecard (Efficiency and Resource Driven Economies). % of typology of indicators per index – assigned categories (extended)

7.13.3. Comment

At first glance (Figure 142), it is evident from the relative distribution of the indicators that the authors believe that in earlier stages of development, the consumer – the citizen – has a major role in the development of the Information Society – of Connectivity – than in higher stages of development, where institutions – governments and firms – have a more balanced share of the "responsibility" of fostering the Digital Economy. This would fit with our own point of view that more and more the demand is a powerful driver of development, more than supply, as it was also stated by the RIA network in the e-African Index.

By seeing Figure 143 and Figure 144, the design is even more evident: on one hand, there is a strong focus the consumer when thinking about the investment in infrastructures and, on the other hand, a huge concern about these infrastructures being actually used. Thus, the path set – implicitly – by these two different scorecards is:

- Strong supply of infrastructures
- Foster the demand / the use of these infrastructures
- Translate this demand to firms and governments

So, evidently enough, the scorecard shares the same philosophy independently of the stage of development. But it is slightly biased towards more infrastructures and more centred in the population at large in the first stages, becoming more comprehensive and more content driven in higher stages.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Infrastructure				Usage Content
				Usage Intensity

Figure 145: Connectivity Scorecard (Efficiency and Resource Driven Economies) – main topics covered

7.14. Freedom on the Net

Freedom House had been reputedly reporting and mapping freedom in the World since 2002 (Freedom House, 2008). So, the publication in 2009 of their first report on the Internet – *Freedom on the Net* (Freedom House, 2009) – was a much welcome birth.

The methodology followed was very similar to that of the *Freedom in the World* series and the survey included 19 questions grouped in three main categories:

- Obstacles to Access
- Limits on Content
- Violations of User Rights

which weighted, respectively, 25%-35%-40% in the making of a final index.

Probably the most interesting thing about Freedom on the Net index is its coverage of both an obscure and forgotten area in policy and regulation. Even though e.g. censorship could be inferred to a certain degree by other regulatory issues (from the field or telecommunications or just communications and human rights in general), the fact that there is a devoted tool to measure these sneaky aspects of digital life is most worthy.

7.14.1. Main publications

Freedom House (2009). *Freedom on the Net*. Washington, DC: Freedom House.

7.14.2. Distribution of Indicators

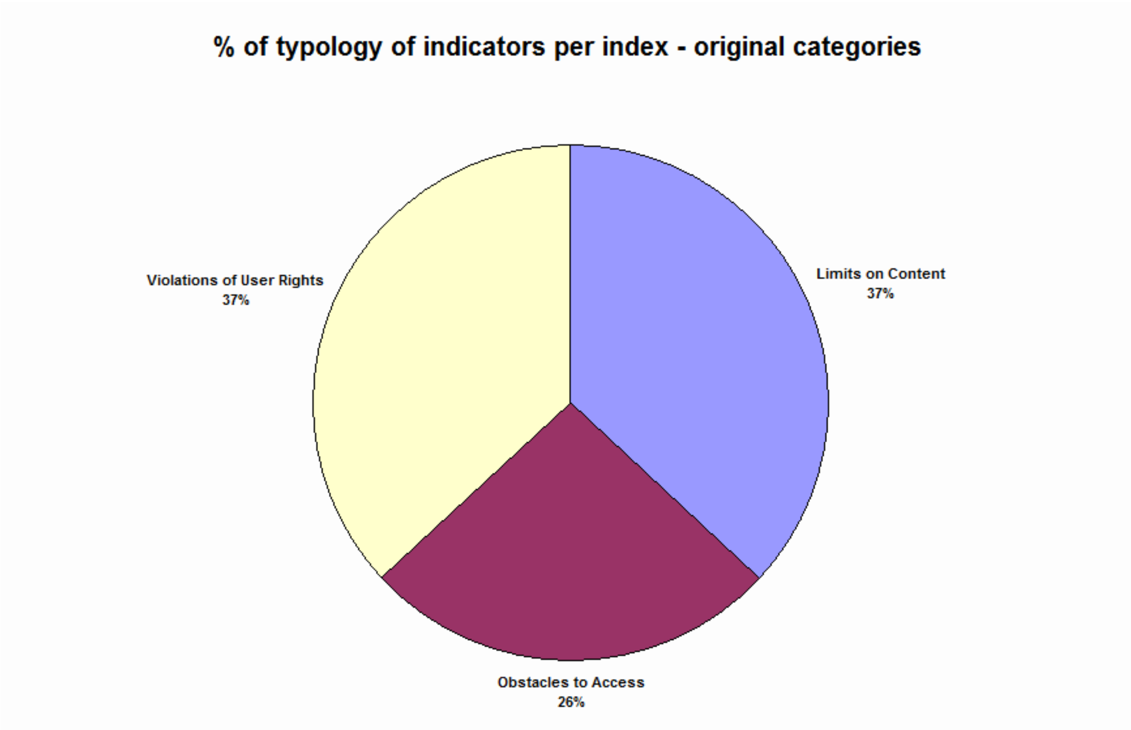

Figure 146: Freedom on the Net. % of typology of indicators per index – original categories

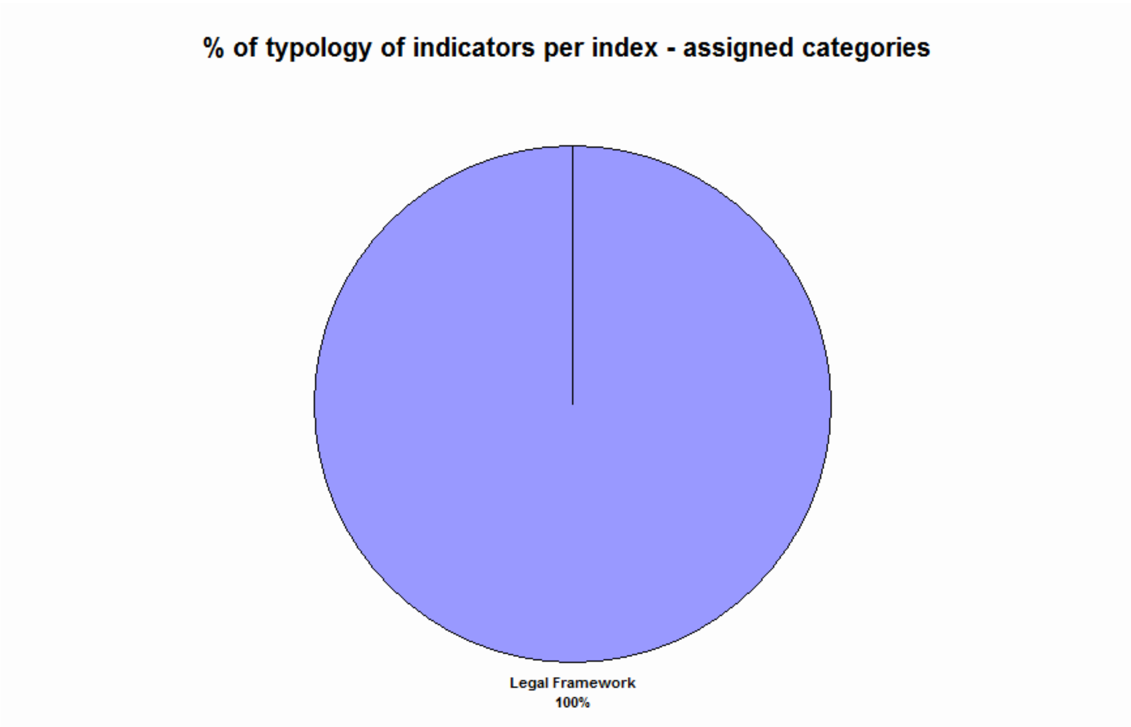

Figure 147: Freedom on the Net. % of typology of indicators per index – assigned categories

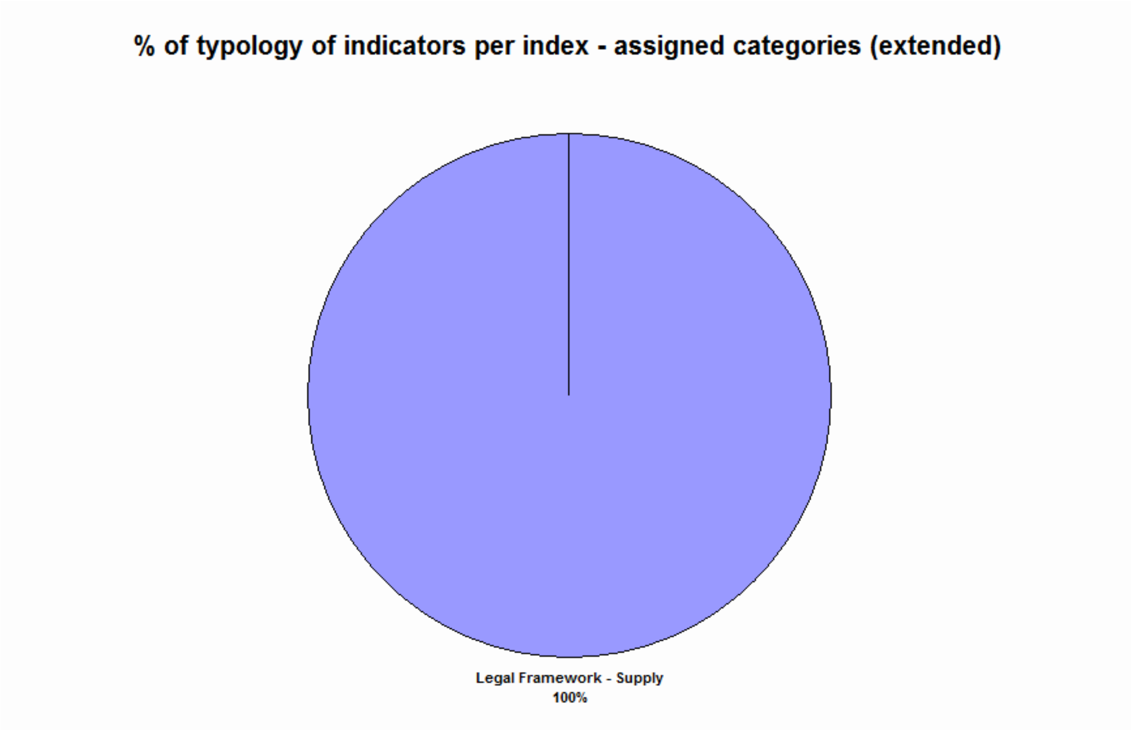

Figure 148: Freedom on the Net. % of typology of indicators per index – assigned categories (extended)

7.14.3. Comment

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
			Freedom on the Net	

Figure 149: Freedom House's Freedom on the Net – main topics covered

Little comment can be made on this index but to repeat its appropriateness and worthiness for the field we are doing research in.

Of course, the main critique is twofold and quite common in this kind of initiatives.

Firstly, the reliance on soft data that, though based on grounded opinions most probably having access to hard data, it still is a dataset whose sources come from a questionnaire.

Secondly, its (still) narrow reach (15 countries so far) that makes it very difficult to introduce in broader datasets so that in can enrich them.

8. Digital Economy Models: Sets of Indicators

In this chapter we will deal with a last group of models of the Digital Economy: the ones that implicitly describe sets of indicators collected by different institutions. Properly speaking, these are not actual models as the purpose of the sets of indicators or data sets is not explaining a conceptualization of the Information Society, but providing data (raw data or slightly treated) so that other models can have their needed input to do so.

Our purpose in dealing with them here is, nevertheless, twofold. First, because by analyzing them we are able to see, specially, what is not being measured and, then, what are the main voids in the landscape of measuring the Information Society. Second, because behind the decision to measure this or that variable, and to create one indicator and its respective data set to quantify it, there is a more or less implicit (and sometimes even explicit) model that drives the selection of such variables and indicators.

The sets of indicators chosen are:

8.1 World Telecommunication ICT Indicators....................244
8.2 Core list of ICT Indicators....................248
8.3 Core ICT Indicators for the ESCWA and the ECA regions....................252
8.4 ICT at a Glance Table....................257
8.5 Digital Planet....................261
8.6 OECD Key ICT Indicators....................265
8.7 European Information society statistics....................268
8.8 PISA....................272

8.1. World Telecommunication ICT Indicators

The World Telecommunication ICT Indicators are the *alma mater* of the International Telecommunication Union work in measuring the development of ICTs and, indirectly, the source to many other indices, analyses and research in general[223].

Collected in the World Telecommunication Indicators/ICT Indicators database with time series starting back in the 1960s, the World Telecommunication ICT Indicators have a special place in the World Telecommunication Development Report series[224], were they serve as the main axis from which to analyze the impact on socioeconomic development of ICTs.

As a dataset, their structure, or the categories the indicators are grouped in, do not correspond as much as a previous "concept" or "model" of the Information Society, but more to a functional categorization according to natural families of indicators, sources, etc.

In this case – as it will be in the ones gathered in this chapter – the interest is not in the explicit categorization and choice of indicators, but in the indirect modelling that it represents. Indeed, the collection and availability – or unavailability – of specific indicators *do* determine what third parties will or will not be able to do with their own models.

It is interesting to note that what the World Telecommunication Indicators/ICT Indicators database features has been changing along the years, as the direct consequence of periodical meetings to deal with the design of the database, the appropriate description of the variables to be measured and, more important, the indicators chosen to effectively measure them.

8.1.1. Main publications

International Telecommunication Union (2005). *Telecommunication Indicators Handbook*. Geneva: ITU

International Telecommunication Union (2005). *Key indicators of the telecommunication/ICT sector*. Presented at the fourth World Telecommunication/ICT indicators meeting (Geneva, February 2005). Geneva: ITU.

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[223] Though separate databases, sometimes reports that are fed by ITU's World Telecommunication/ICT Indicators also indclude information from ITU's World Telecommunication Regulatory Database, like ITU's ICT Eye (http://www.itu.int/ITU-D/icteye/) itself. We are not going to analyze in-depth the Regulatory Database as we are doing with most other models, as it represents – in our opinion – an accessory tool to other major databases. Nevertheless, the reader will find more data about it in the tables in chapter 9 as in the annexes.

[224] The series includes the global report and regional reports for selected groups of countries like Asia-Pacific, Africa, the Arab States or the Americas.

International Telecommunication Union (2007). *Definitions of World Telecommunication/ICT Indicators*. Final Version (April 2007). Geneva: ITU.

International Telecommunication Union (2007). *Measuring The Information Society 2007: ICT Opportunity Index and World Telecommunication/ICT Indicators*. Geneva: ITU

International Telecommunication Union (2006). *World Telecommunication/ICT Development Report 2006: Measuring ICT for social and economic development*. Geneva: ITU[225].

8.1.2. Distribution of Indicators

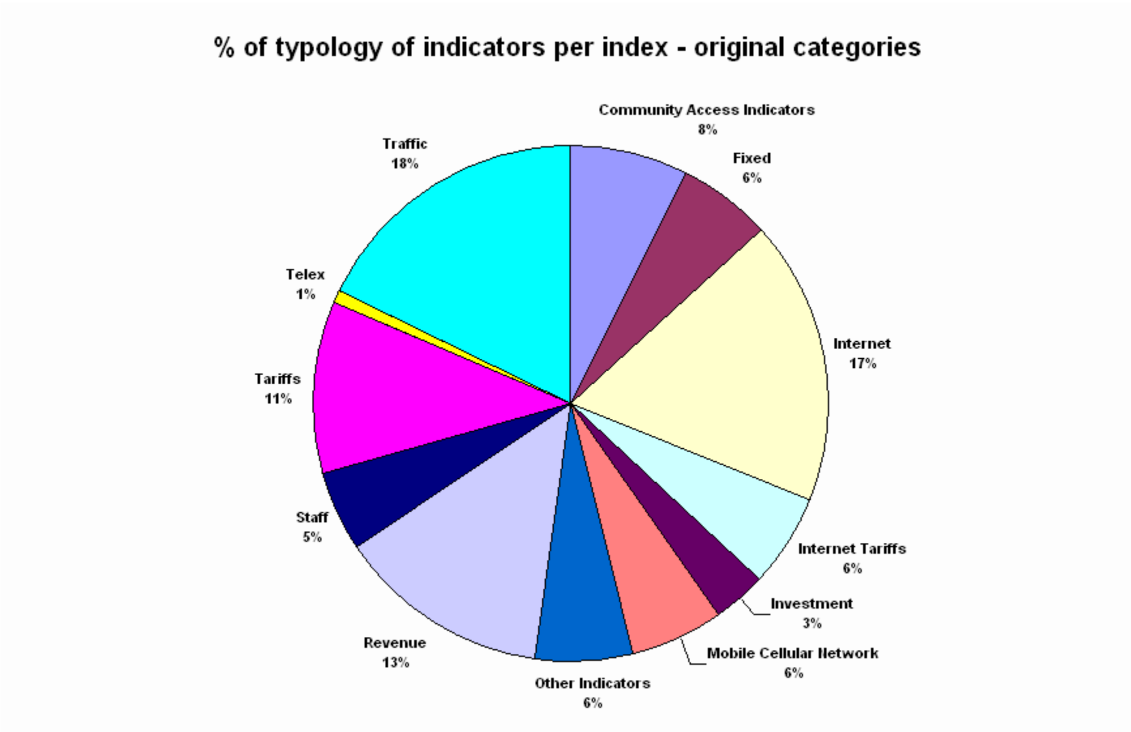

Figure 150: World Telecommunication ICT Indicators. % of typology of indicators per index – original categories

[225] This is the – so far – last edition of the World Telecommunication/ICT Development Report (the eighth), but the reader can go back to the preceding seven for further information and/or detailed information about specific regions in the regions' reports. Please see the Bibliography references.

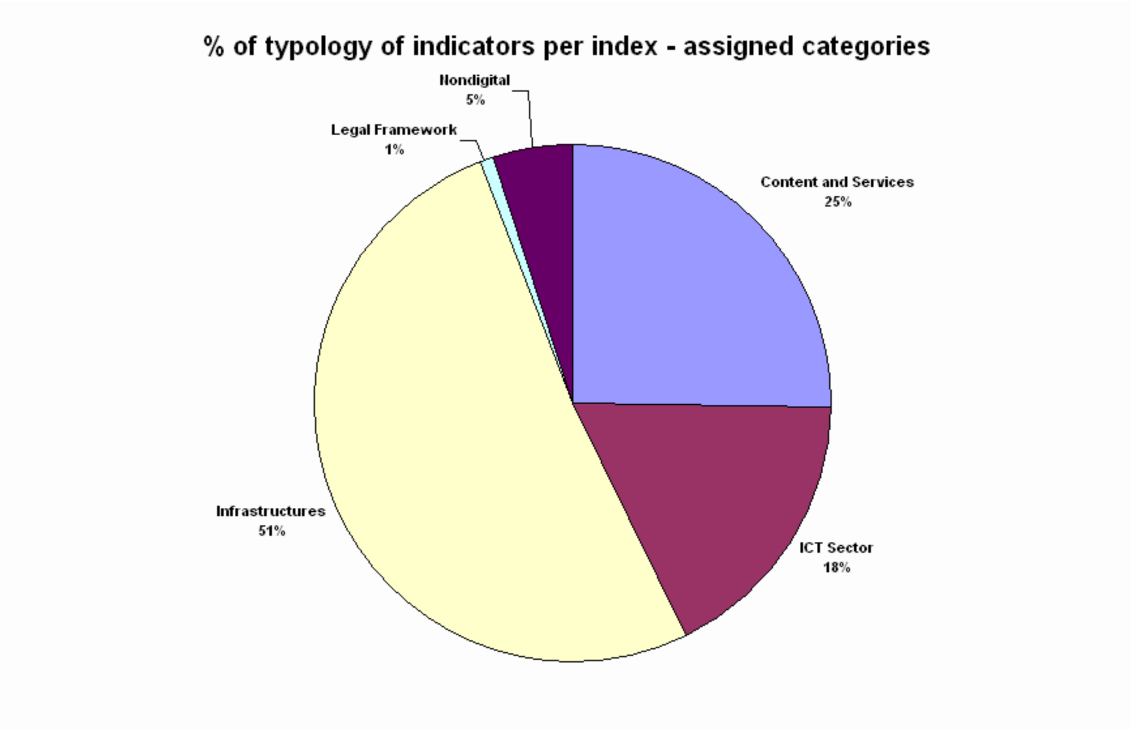

Figure 151: World Telecommunication ICT Indicators. % of typology of indicators per index – assigned categories

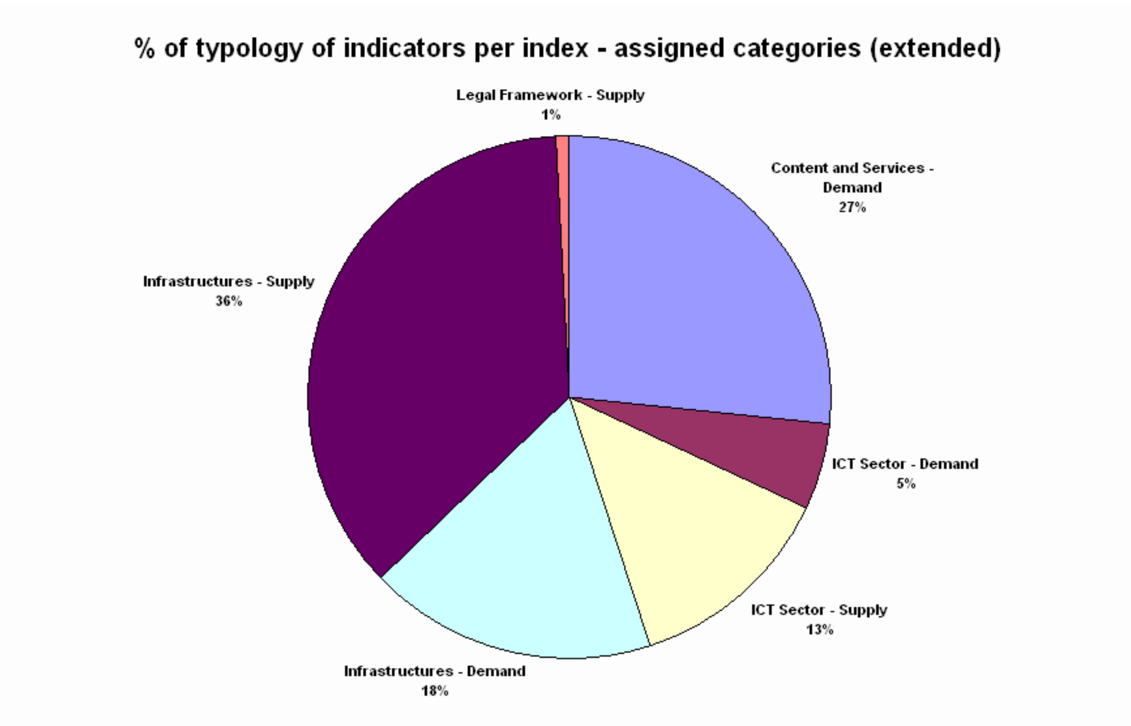

Figure 152: World Telecommunication ICT Indicators. % of typology of indicators per index – assigned categories (extended)

8.1.3. Comment

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Fixed Mobile Internet Access	Investment Revenue		Traffic	
Tariffs	Staff			Internet Traffic

Figure 153: ITU's World Telecommunication ICT Indicators – main topics covered

It is not surprising what our categorization shows: a strong focus towards Infrastructures and the ICT Sector. Actually, some of the indicators we have put under Content and Services com from usage measurements that could likely be categorized under ICT Sector, as a measure of its strength: e.g. communications traffic or revenue from consumption.

The doubtless best asset from the World Telecommunication ICT Indicators is twofold.

First, the length of the time series, longer than any other measuring device, that makes possible time analysis to see the evolution of some variables along the years.

Second, them being primary quantitative data obtained directly from the source. Of course they are not exempt of error, and not all national statistics agencies provide the same quality of data. But this is a "minor" issue when comparing these ITU indicators with other qualitative and/or subjective indicators that we have already talked about in previous chapters.

Indeed, the fact that the ITU and other international agencies are working together to improve the dataset, make it converge with other tools, and make it have a broader approach so it collects non-industry or non-technological aspects of the impact of ICTs in development is does put some hope in a future landscape where all necessary data could be provided.

And the World Telecommunication ICT Indicators database is a good starting point.

8.2. Core list of ICT Indicators

We stated in section 7.2 that the Partnership on Measuring ICT for Development was created in 2004 to work towards a consensus in the way the Information Society had to be measured, both in the model and in the tools to do it.

At the at the WSIS Thematic Meeting on Measuring the Information Society that took place in Geneva from the 7th to the 9th January 2005, a first list of Core ICT Indicators was agreed to serve as a basis for an evolving work that was formally recognized at the UNCTAD XI Partnership on Measuring ICT for Development on March 2007, where the UN statistical Commission endorsed the list.

As a set of indicators that does not come "naturally" from what the activity of the industry – which might be the origin or the determinant of the World Telecommunication ICT Indicators, for instance –, but that is built up with several specific objectives in mind, the Core ICT Indicators do have their own inner structure, facing towards the goals and ends instead of the sources.

Thus, four main groups made up the total list of 42 indicators:

- ICT infrastructure and access indicators
- ICT household indicators
- ICT business indicators
- ICT producing sector and ICT trade indicators

At their turn, each subgroup[226] is divided into the Basic Core indicators and the Extended Core indicators[227], which provides to the whole set maximum flexibility to zoom in or out of the whole economy or just a part of it while keeping the agreed framework.

In 2009, and after a process of deep revision of the Core list, a fifth category was added

- ICT in Education

to add some indicators related, as can be read, with ICTs in schools that UNESCO had been developing during years (UNESCO Institute for Statistics, 2008)[228], and including some revisions and exclusions on former indicators, now featuring a total of 48 indicators.

---

[226] Except ICT producing sector and ICT trade indicators

[227] ICT household indicators includes a third category with just one Reference Indicator: the Percentage of households with electricity.

[228] We are not analyzing individually UNESCO's ICT in education indicators anywhere else in this work, as all of the indicators are included within the ICT in Education category of the Core list of ICT indicators. Besides the already mentioned reference (UNESCO Institute for Statistics, 2008), more information can also be accessed at UNESCO Bangkok (2003).

8.2.1. Main publications

Partnership on Measuring ICT for Development (2005). *Core ICT Indicators*. New York: UN ICT Task Force.

Partnership on Measuring ICT for Development (2005). *Measuring ICT. The Global Status Of ICT Indicators*. New York: UN ICT Task Force.

UNCTAD (2005). *Information Economy Report 2005*. New York and Geneva: UNCTAD.

UNCTAD (2007). *Manual for the Production of Statistics on the Information Economy*. Geneva: UNCTAD.

Teltscher, S. (2008). *Partnership core list of indicators*. Presentation at the 2008 Global Event on Measuring the Information Society. Geneva: ITU.

Gray, V. (2008). Revision of core indicators A1-A12 infrastructure & access. Presentation at the 2008 Global Event on Measuring the Information Society. Geneva: ITU.

Partnership on Measuring ICT for Development (2008). *Global Information Society: a Statistical View*. New York and Geneva: UNCTAD.

Partnership on Measuring ICT for Development (2009). *Revisions and Additions to the Core List of ICT Indicators*. Background paper for the 7th World Telecommunication/ICT Indicators Meeting, Cairo, Egypt, 3-5 March 2009. New York: United Nations Statistics Division.

8.2.2. Distribution of Indicators

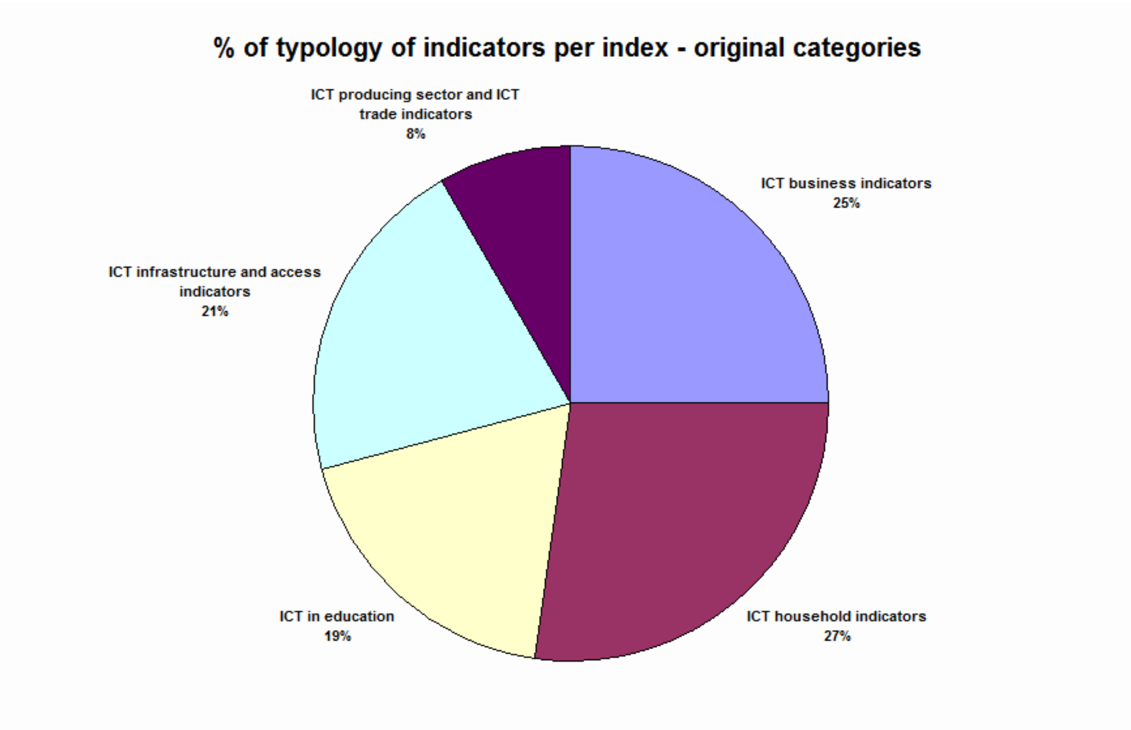

Figure 154: Core list of ICT Indicators. % of typology of indicators per index – original categories

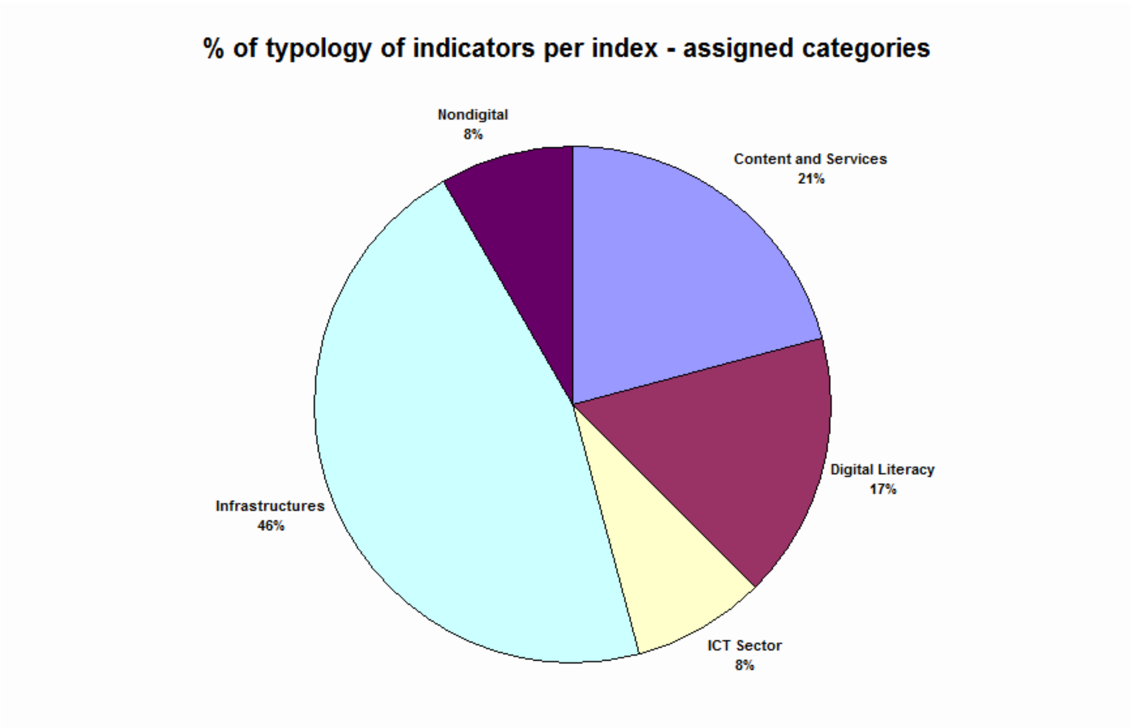

Figure 155: Core list of ICT Indicators. % of typology of indicators per index – assigned categories

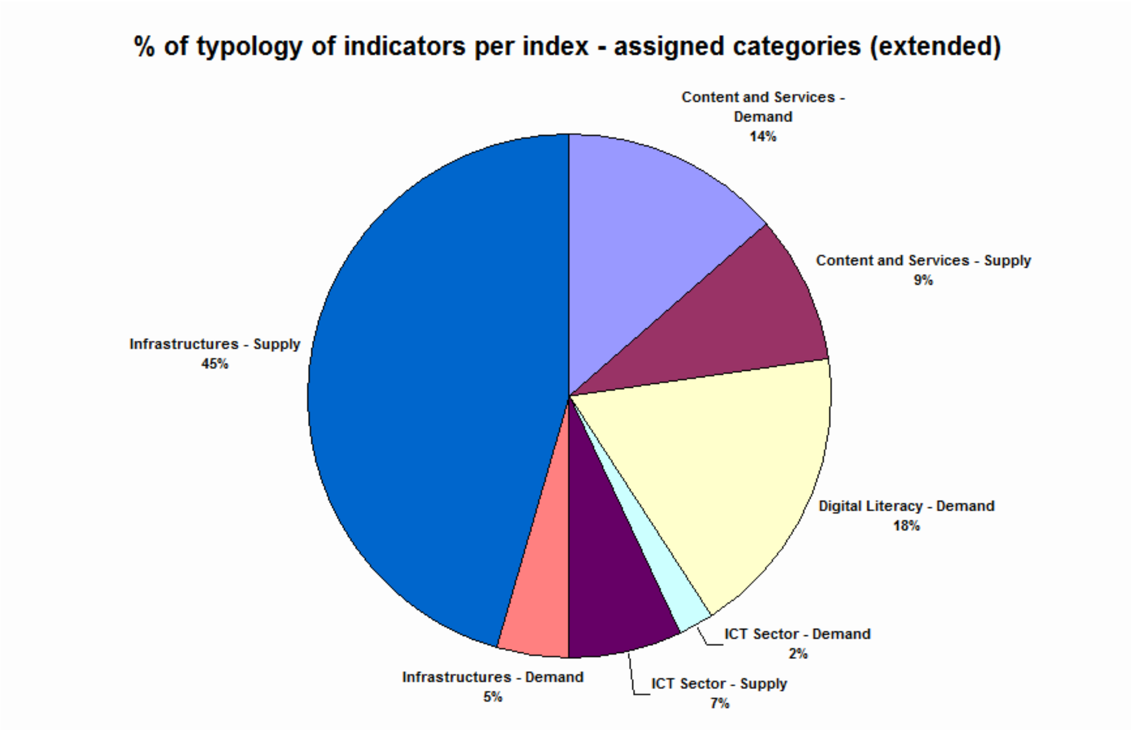

Figure 156: Core list of ICT Indicators. % of typology of indicators per index – assigned categories (extended)

8.2.3. Comment

So far we have – several times – praised the value of such an achievement as the creation of the Partnership on Measuring ICT for Development and their Core ICT Indicators.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
ICT infrastructure and access ICT business ICT household	ICT producing sector and ICT trade			ICT business ICT household
ICT infrastructure and access	ICT producing sector and ICT trade	ICTs in schools		ICT business ICT household

Figure 157: Partnership on Measuring ICT for Development's Core list of ICT Indicators – main topics covered

But Figure 154 Figure 156 and Figure 157 suggest us some critiques that, while constructive, are somewhat desperate too.

The first critique to be made to the ICT list of Core indicators – before its update in 2008 – was is the tremendous void in the measuring of skills. It was puzzling to realize that no measurement was at all is included at the skills level, especially being the fact that UNESCO counted among the members of the Partnership. Happily, the last revision included 9 new indicators related to ICTs in education, which is what now features Figure 157.

A similar critique – had the previous one remained unfixed – can be made regarding the Policy and Regulatory Framework, also a big void in the Core ICT Indicators scheme. In this case it is regulation and policies that are left aside. Surprisingly, some indicators measuring these variables already exist, some of them within the UN System itself (i.e. UNPAN's).

This leads us to a third critique. As can be seen especially in Figure 154 and our report of the constituting categories of the Core ICT Indicators, the public sector is left out of the equation. Regardless the debate whether disaggregation by sectors – governments, businesses and households – makes sense[229], coherence would advise including all – or none at all – sectors of the economy. Again, leaving the government aside with existing data about its behaviour online is disconcerting.

We hope – and we really believe so – that this is just the beginning of an ongoing process to achieve the best of the measuring devices, and thus, time is needed to build it, especially if technical *and* political consensus is required.

8.3. Core ICT Indicators for the ESCWA and the ECA regions

Some world regions have been adapting the Core ICT Indicators to their own reality. This is the case of Africa[230] and Western Asia[231]. We will deal with these adaptations in the conclusions and at the aggregate level (e.g. in Annex I) because data about the evolution of their indices is scarce and limited – at least to our knowledge – to the work referenced below.

As the work to obtain data is shared with different international organizations[232], these two agencies decided to take the advantage of having to collect several data to obtain specific indicators about characteristic issues of their regions.

Thus, the core indicators are just the Core ICT Indicators agreed at the Partnership, but they are enriched with the specificities that will make possible a higher degree of awareness of stage of developing countries that most agencies' members have in

[229] We believe it does, by the way, though maybe not as much as to deserve a category on its own.
[230] The Economic Commission for Africa (2003) had already been building their own measuring devices prior to the issue of the Core ICT Indicators.
[231] See Economic And Social Commission For Western Asia (2005) for a report collecting the work of both regions to adapt the Core ICT Indicators.
[232] Partnership on Measuring ICT for Development (2005)

these regions. As said, we will not enter in detail about these indices, but it is worth seeing the additions and how they shade the original Core ICT Indicators.

8.3.1. Main publications

Economic Commission for Africa (2003). *SCAN-ICT. Indicators of Information and Communications Technologies*. Addis Ababa: ECA.

Economic And Social Commission For Western Asia (2005). *Information Society Indicators*. New York: United Nations.

8.3.2. Distribution of Indicators for the ESCWA region

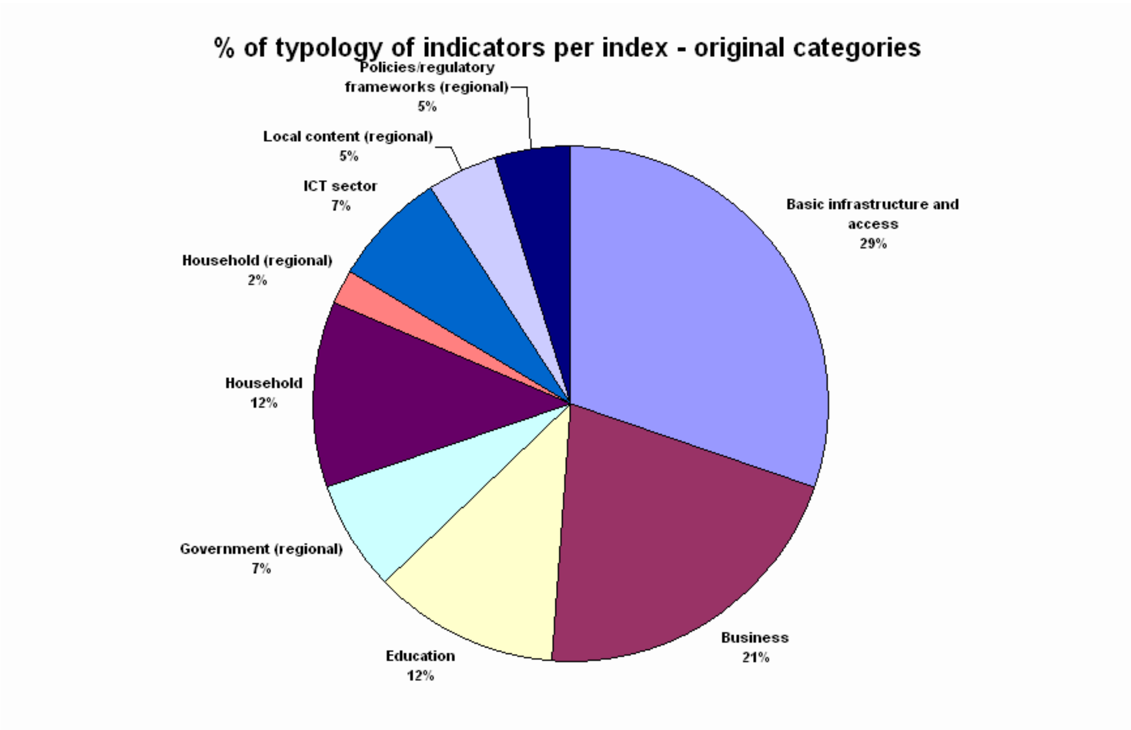

Figure 158: Core ICT Indicators for the ESCWA region. % of typology of indicators per index – original categories[233]

[233] We are here using the *sub*categories instead of the primary categories, as the later are only two (Readiness, Intensity) and provide little information to our analysis.

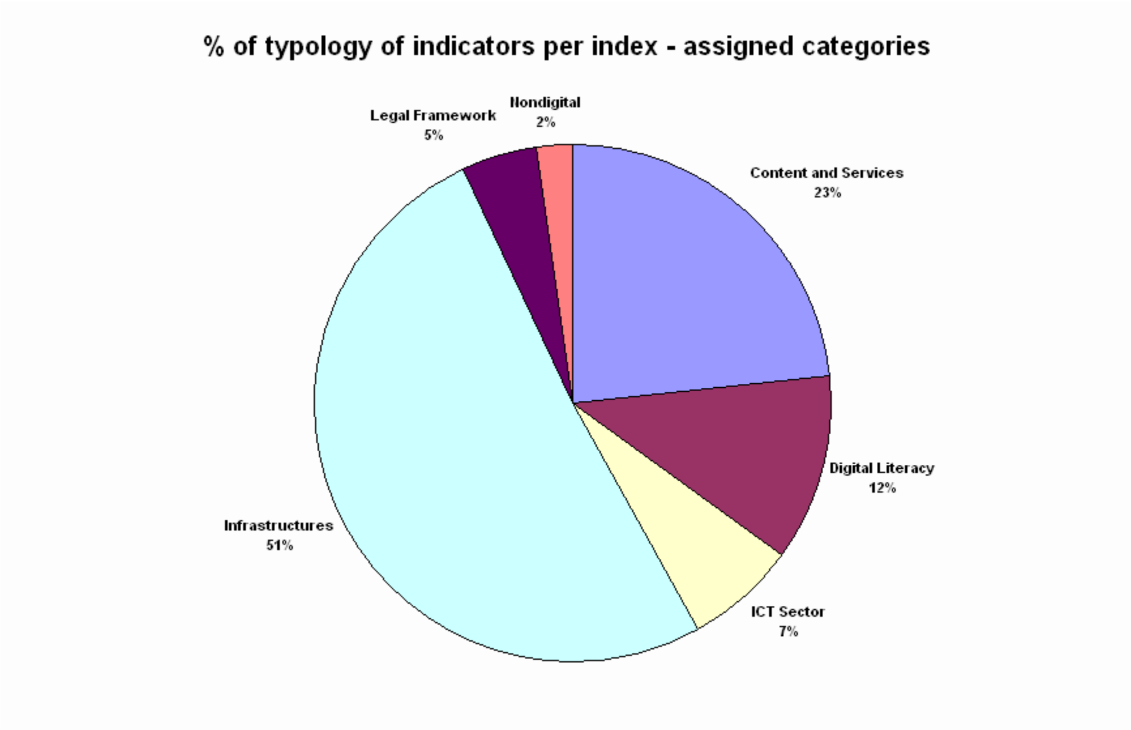

Figure 159: Core ICT Indicators for the ESCWA region. % of typology of indicators per index – assigned categories

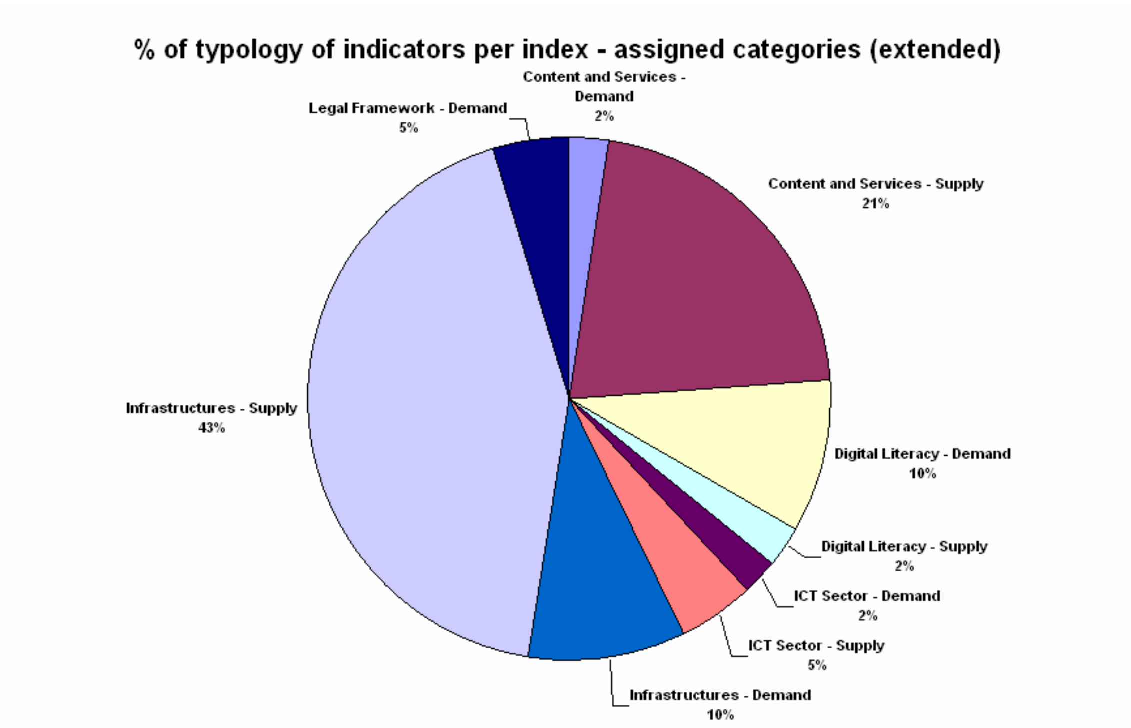

Figure 160: Core ICT Indicators for the ESCWA region. % of typology of indicators per index – assigned categories (extended)

8.3.3. Distribution of Indicators for the ECA region

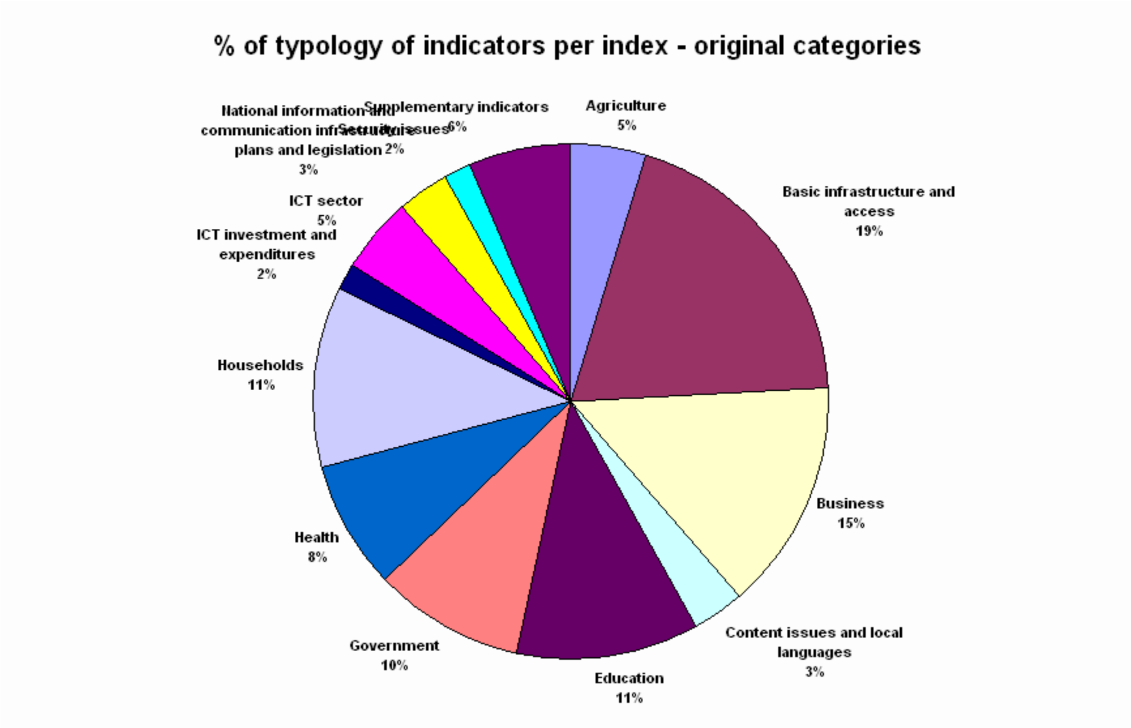

Figure 161: Core ICT Indicators for the ECA region. % of typology of indicators per index – original categories

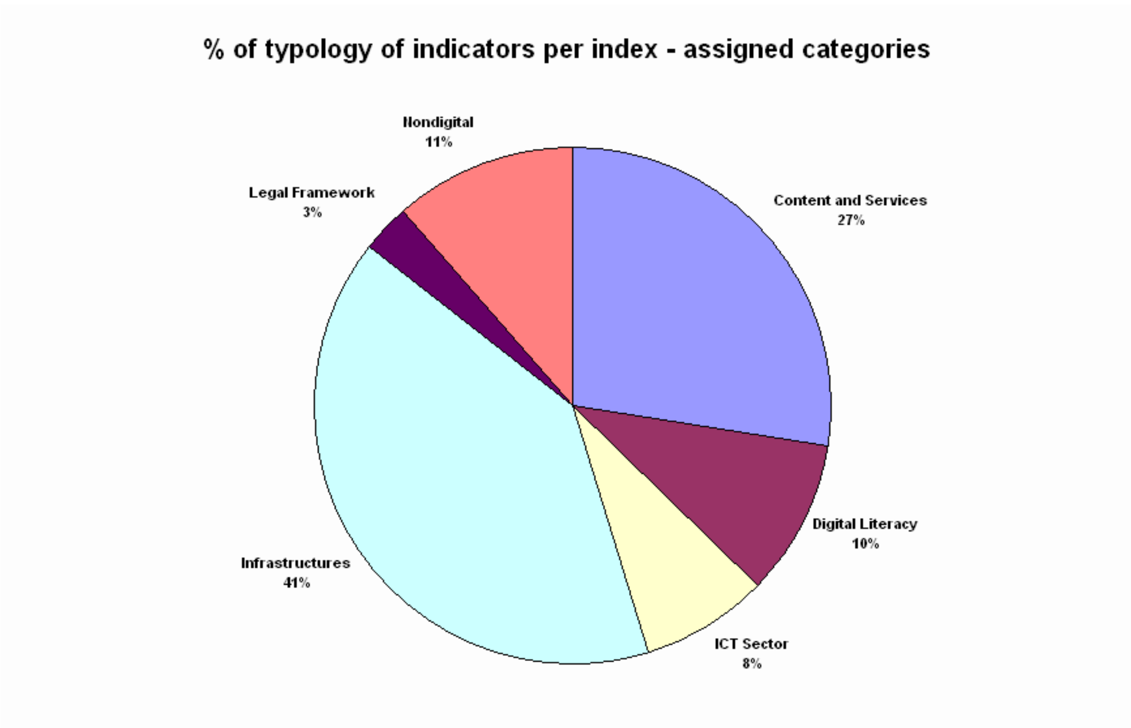

Figure 162: Core ICT Indicators for the ECA region. % of typology of indicators per index – assigned categories

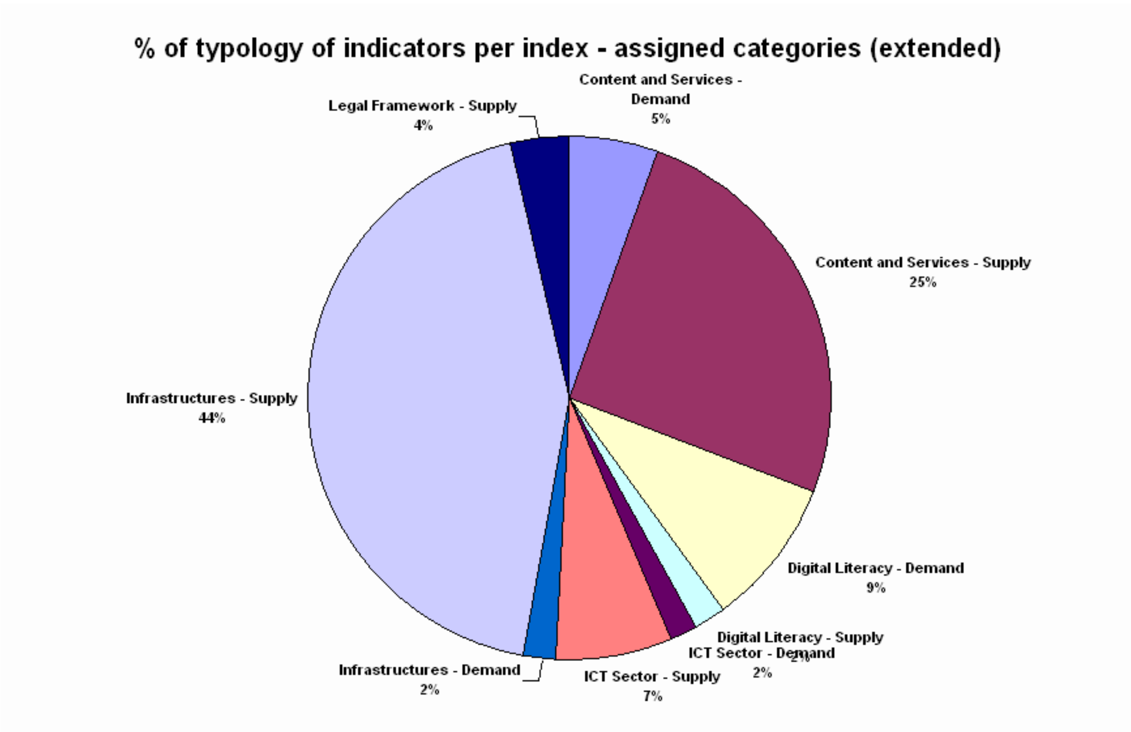

Figure 163: Core ICT Indicators for the ECA region. % of typology of indicators per index – assigned categories (extended)

8.3.4. Comment

Our first comment is obvious and is about how the indicators are categorized in a very different manner from the original Core ICT Indicators in comparison with ESCWA's and ECA's. Figure 154, Figure 158 and Figure 161 offer incomparable evidence on what are the concerns of the World as a whole (i.e. the developed world's hegemonic point of view) and the developing world. Issues like the importance of Local Content or Agriculture are usually overridden in other contexts.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Basic infrastructure and access Business Household	ICT sector	Education		Business Government Household Local Content
Basic infrastructure and access	ICT sector	Education	Policies/ regulatory frameworks	Business

Figure 164: ESCWA's Core ICT Indicators – main topics covered

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Basic infrastructure and access Health Business Government Households	ICT sector, investment and expenditures	Education	National inf. and comm. infrastructure plans and legislation	Agriculture Health Business Government Content issues and languages
Affordability		Education		Business Agriculture

Figure 165: ECA's Core ICT Indicators – main topics covered

As Figure 164 and Figure 165 show, the overall result according to our categories is also different and, to note, quite more comprehensive. Education becomes an important axis in the new framework, as do policies and regulation. As a trade-off, some other indicators such as the ones related to the ICT Sector are somewhat weakened and households are left aside. We believe this last issue is a matter of penetration and the characteristics of ICT penetration in these countries: ICTs are (mainly) either owned by businesses or at the community level, thus why the relevance of measuring Business usage instead of Households'.

The natural critique to this adaptation is straightforward: as an adaptation, it diverges from the commonly acknowledged general model the Core ICT Indicators represented, and splits the consensus in, again, a myriad of alternatives.

It is desirable, hence, to achieve a common tool that can be applied to whatever community or region despite of their level of development or digital economy development, so no rearrangements are necessary and without letting aside specificities that can otherwise not be forgotten in some contexts.

8.4. ICT at a Glance Table[234]

Even if both the ICT at a Glance Tables and the Knowledge Economy Index are created by The World Bank and are intended to explain, measure and enhance the

[234] The Commonwealth Telecommunications Organisation published the CTO Guide to the ICT (Commonwealth Telecommunications Organisation, 2008). Strictly speaking, it is a collection, as the CTO does not publish own data, but gathers – as it is the case of The World Bank's At A Glance Tables – data from several sources and also depicts the state of development of the Information Society in 54 commonwealth countries. Due to the lack of updating (last data are from 2001), we will not analyze in depth the CTO Guide to the ICT, but will be including it in all our aggregate sections. For a detailed picture of a country's development of the Information Society, we will point, then, to the ICT at a Glance Tables issued by The World Bank.

development of the Information Society, their approaches are quite different. While the emphasis in the KEI is the "Economy", ICT at a Glance Tables have it put on the "ICT" part.

With an original concept dating from 2000, ICT at a Glance Table were first compiled and made public during 2005 for the "Information and Communications for Development 2006: Global Trends and Policies" report (The World Bank, 2006a). The tables provide a set of 32 indicators measured for 144 economies with populations of more than 1 million population, being one of the explicit intentions of these "tables" to measure the ICT indicators that are related – directly or indirectly – with the Millennium Development Goals, indirectly defining what constitutes Information and Communication Technologies for Development (ICT4D). Indeed, the report was presented at the Tunis phase of the World Summit on the Information Society.

There are three categories or sections that group the data in the tables:

- Economic and social context
- ICT sector structure
- ICT sector performance

that clearly show a much higher weight or digital indicators in relationship with the Knowledge Assessment Methodology, where analogue indicators were not context – like in this case – but the core that defined the Economy.

Some indicators of the ICT at a Glance Tables are also used to picture "The Information Age" appearing in the late World Bank's World Development Indicators (The World Bank, 2008c), while a tiniest subset of indicators is created too used to include in the general picture countries not appearing (normally because of lack of more data or because them having a population under 1M inhabitants) at the ICT at a Glance Tables[235].

8.4.1. Main publications

The World Bank (2006). *Information and Communications for Development 2006: Global Trends and Policies*. Washington, DC: The World Bank.

[235] See these two subsets listed too in Annex I as "World Development Indicators – The information Age" and "WDI Key ICT Indicators".

8.4.2. Distribution of Indicators

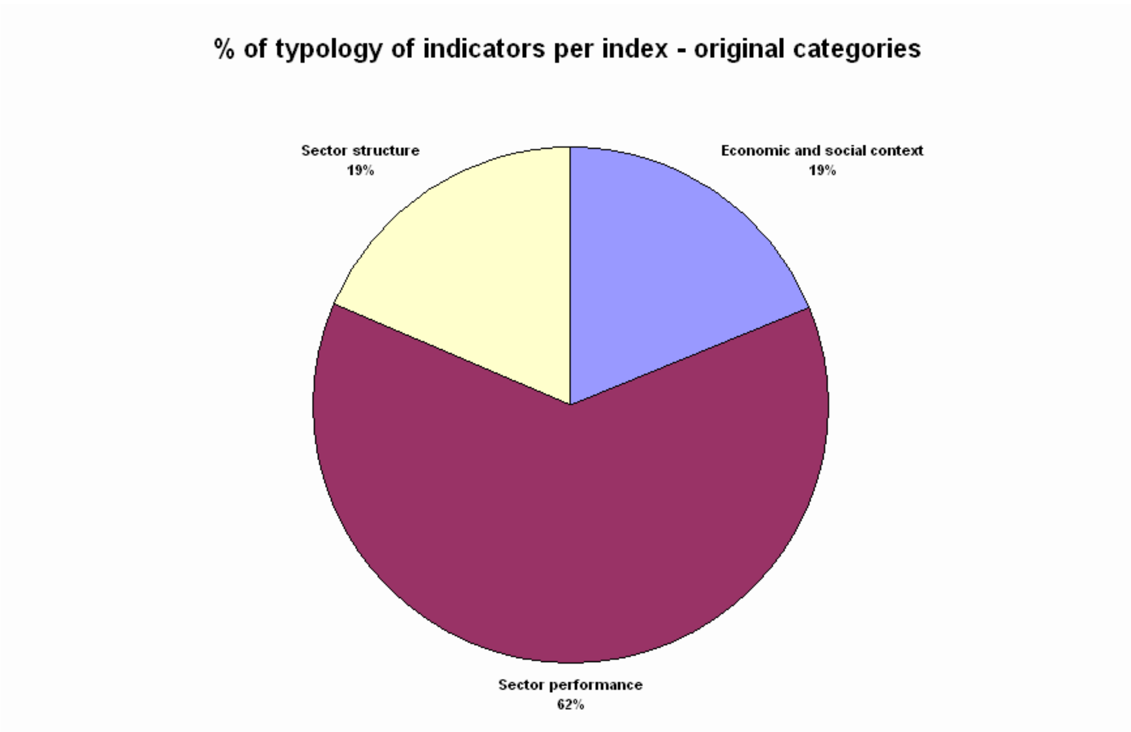

Figure 166: ICT at a Glance Tables. % of typology of indicators per index – original categories

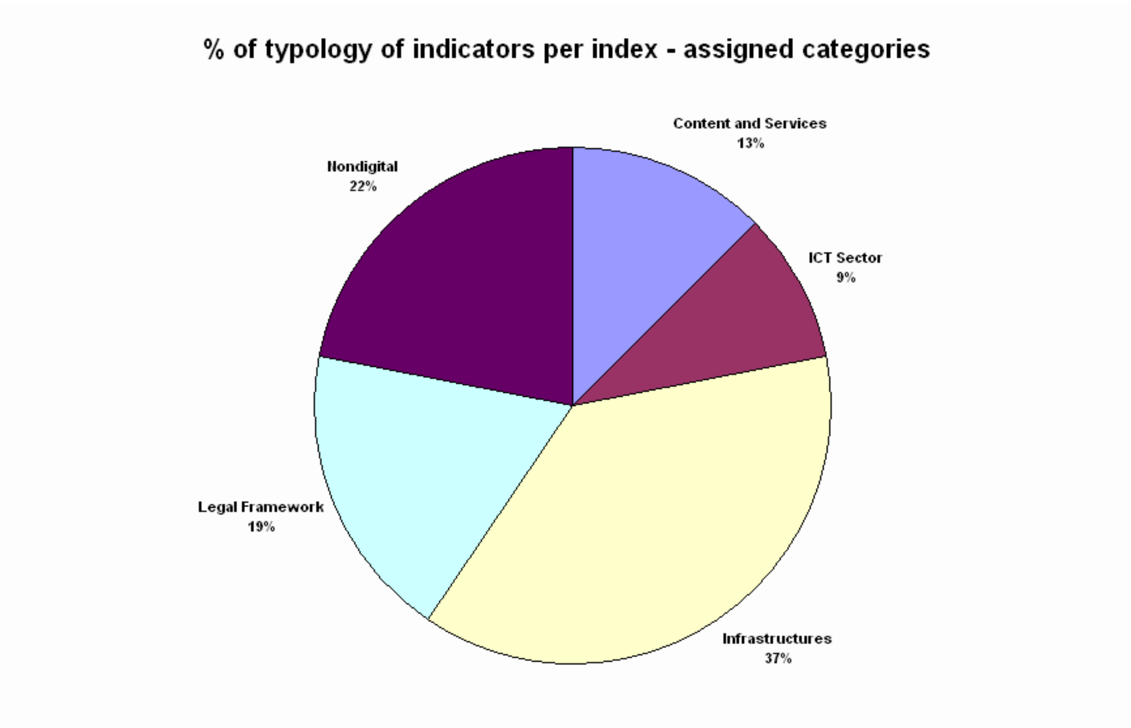

Figure 167: ICT at a Glance Tables. % of typology of indicators per index – assigned categories

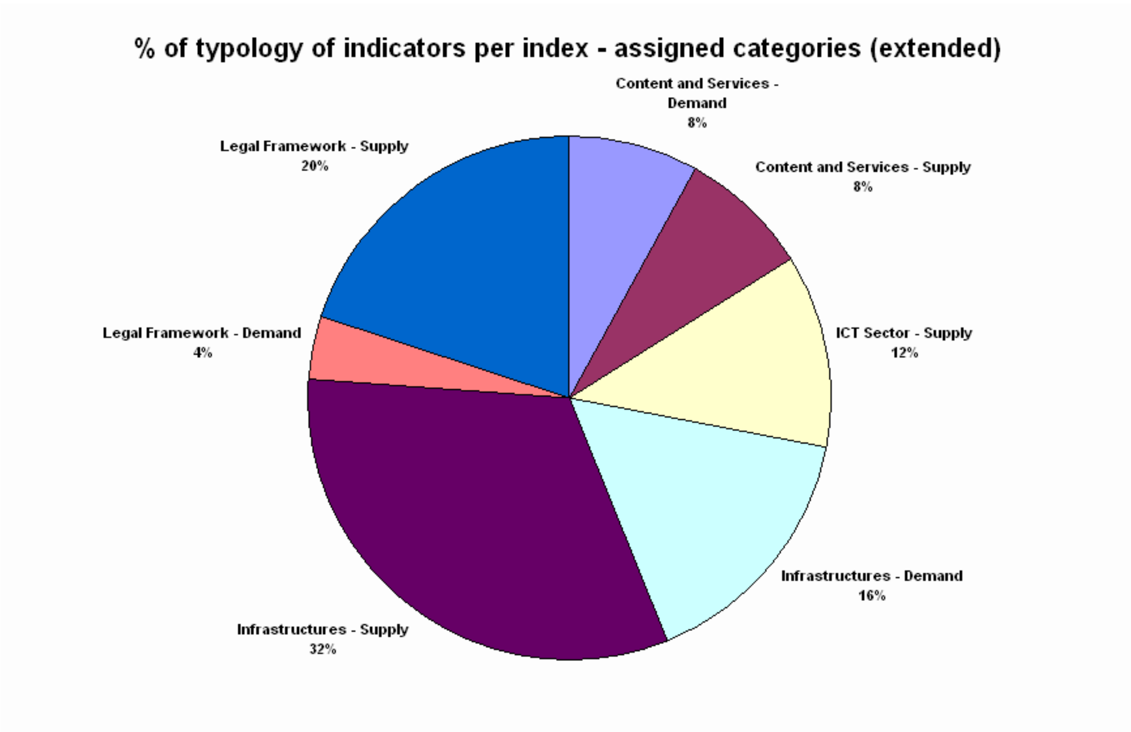

Figure 168: ICT at a Glance Tables. % of typology of indicators per index – assigned categories (extended)

8.4.3. Comment

ICT at a Glance Tables represent, if not the only one, at least one of the most clear and committed approaches to the ICT4D debate, their purpose being really clear on trying to develop some tools that can be useful to both measure and foster socioeconomic development based on the (positive) impact of ICTs.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Sector Performance Infrastructures	Sector Performance		Sector Structure Regulation	Sector Performance e-Government e-Business
Sector Performance Affordability			Sector Structure Policy	Sector Performance Usage

Figure 169: The World Bank's ICT at a Glance Tables – main topics covered

As the original categories already told us, digital skills are completely missing in this set of indicators. And, in fact, besides a measure of adult literacy rates, education is missing at all in this framework – which includes the lack of skilled workers, quite surprising as it is a strong asset in the value chain of the ICT Sector, what was measured in the ICT at a Glance Tables.

On the other hand, and as could also be expected, use and government implication are also measured through scarce indicators, while the Infrastructures and ICT Sector parts are quite convergent with other sets of indicators, for instance the Core ICT Indicators.

Summing up, a good test to the ICT Sector, but lacking use, skills and policy, which makes of the indicator not a comprehensive one.

8.5. Digital Planet

The Digital Planet report is issued biannually by the World Information Technology and Services Alliance (WITSA) using data from Global Insight. As it happens with many ITU, the nature of the Alliance – an association of technology industry related national associations – determines the final tone of the report. In this case, even if the indicators are not categorized in any way, we can group them by:

- Macroeconomic Factors
- Product Group
- Market Segments

as it appears in Figure 170.

The dataset comprises only the 75 first countries in ICT consumption at all levels: hardware, software, communications and services. This first level of disaggregation is complemented by disaggregating too by the type of consumer that is supporting the ICT expenditure: the public sector, businesses or final consumers, distinguishing also by economic sector.

8.5.1. Main publications

WITSA (1998). *Digital Planet 1998: The Global Information Economy*. Arlington: WITSA.

WITSA (2000). *Digital Planet 2000: The Global Information Economy*. Arlington: WITSA.

WITSA (2002). *Digital Planet 2004: The Global Information Economy*. Arlington: WITSA.

WITSA (2004). *Digital Planet 2004: The Global Information Economy*. Arlington: WITSA.

WITSA (2006). *Digital Planet 2006: The Global Information Economy*. Arlington: WITSA.

WITSA (2008). *Digital Planet 2008: The Global Information Economy*. Arlington: WITSA

8.5.2. Distribution of Indicators

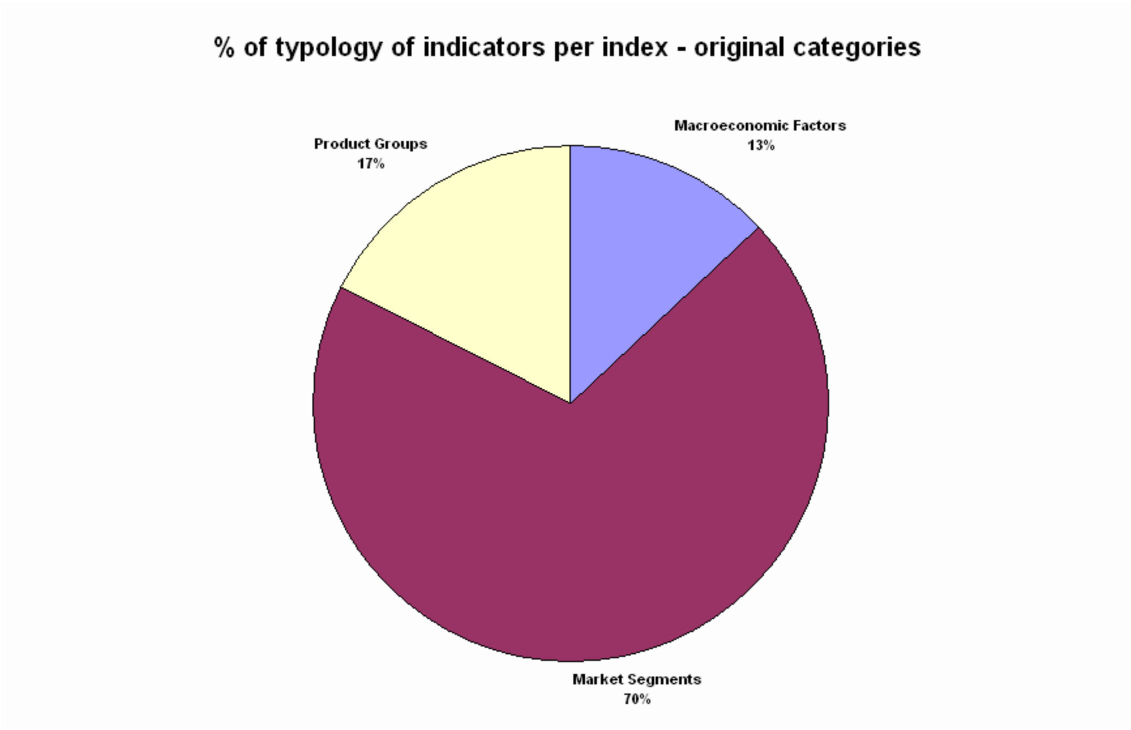

Figure 170: Digital Planet. % of typology of indicators per index – original categories

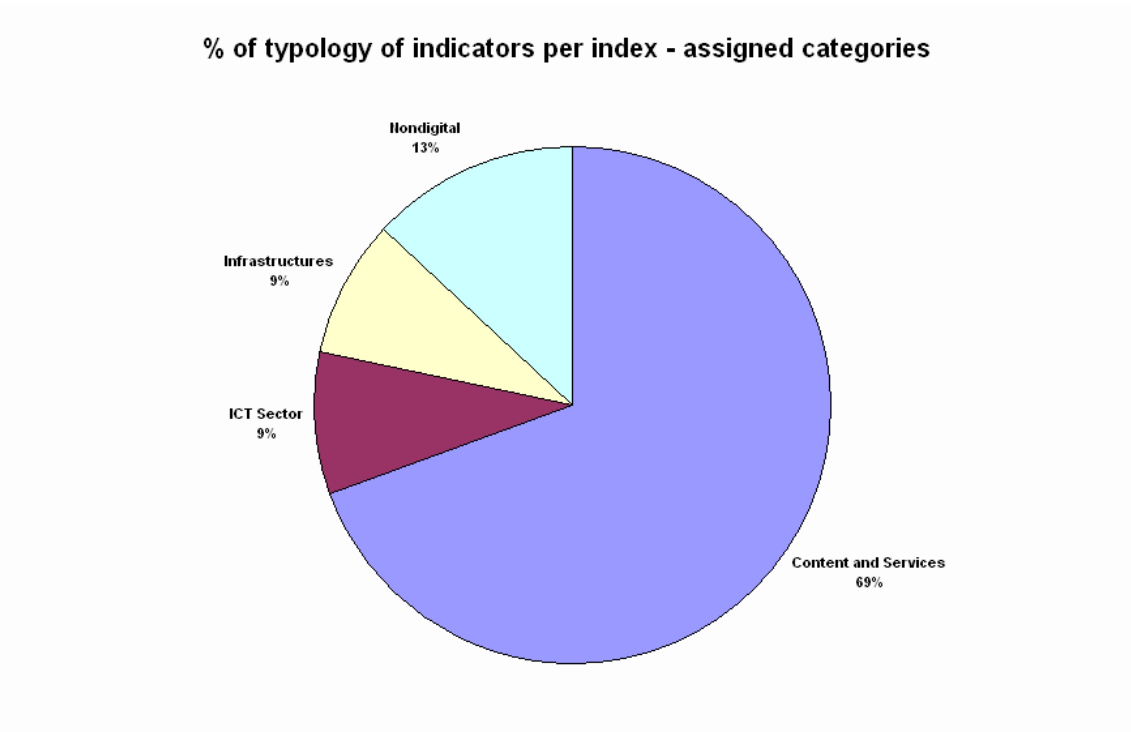

Figure 171: Digital Planet. % of typology of indicators per index – assigned categories

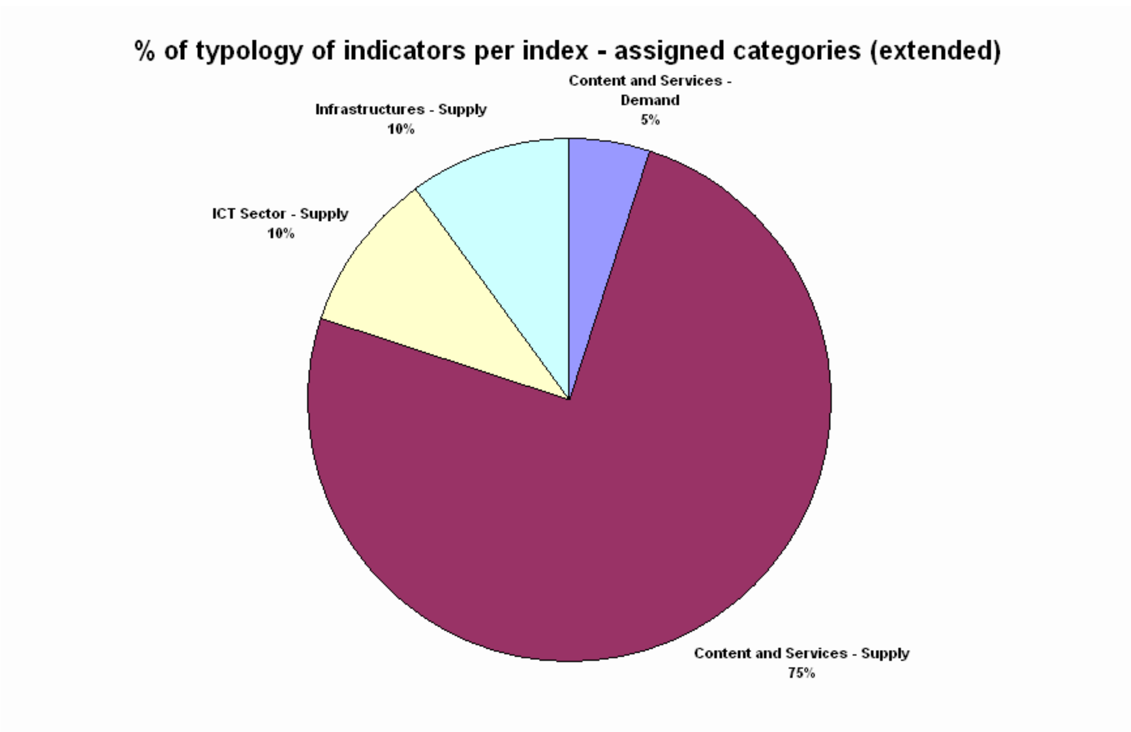

Figure 172: Digital Planet. % of typology of indicators per index – assigned categories (extended)

8.5.3. Comment

Before any comment is made, a first caveat is necessary when looking at our own categorization of the Digital Planet dataset: this is, by far, the most questionable categorization of our whole analysis of models of the Digital Economy. In fact, the easiest – by trivial – option would have been to put all the indicators (let aside the Macroeconomic Factors) under the ICT Sector category. But, being expenditure – and not turnover – questions might be raised about the suitability of such decision, and put the indicators instead under Usage. We decided neither the former nor the later, but did an essay and tried to allocate them along the whole model. Thus, we considered Consumers' expenditure usage, while all other economic sectors expenditure as involved in the provision of (digital) Content and Services.

Following this logic, the final picture is the one show in Figure 173.

As an specialised set of indicators, and coming from the industry, Digital Skills and the Policy and Regulatory Framework are completely set aside. In our opinion, this is not to blame – of course – as it is beyond the range of actuation of the Alliance[236].

But it is a pity that, staying in the framework of the ICT Sector and expenditure, that this expenditure is not contextualized and provide some measure of affordability.

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Hardware Software	Communicat. Services			ICT Spending
				Consumer

Figure 173: WITSA's Digital Planet – main topics covered

On the other hand, the same could be said about expenditure – from the industry point of view – in their own workforce or the degree of expenditure in R&D.

Without more data to draw a richer context, some of the forecasts that the Digital Report makes for the following 5 years[237] are a little bit daring.

[236] Though gathering the Policy and Regulatory Framework that affects the members of the Alliance would be (we guess) an easy thing to do and bring a lot of added value to the Digital Plante reports.
[237] As data are from the preceding year, the year of publication of the report is, actually, a forecast.

8.6. OECD Key ICT Indicators

The OECD has defined a collection of indicators related to the Information Society named Key ICT Indicators. The sources of the indicators are mostly related to three fields of study at the OECD – Telecommunications and Internet Policy, Science and Technology, and Information and Communications Policy – though they do not strictly or exclusively belong to any of these categories[238].

The purpose of the Key ICT Indicators is very similar to the one pursued by The World Bank when publishing the At A Glance Tables: to annually draw a picture of the ICT profiles of the OECD countries.

8.6.1. Main publications

OECD (2002). *Measuring the Information Economy*. Paris: OECD.

OECD (2005-9). *Guide to Measuring the Information Society*. (first and second editions) Paris: OECD.

OECD (2008). *Measuring the Impacts of ICT Using Official Statistics*. Paris: OECD.

OECD (2000). *OECD Information Technology Outlook 2000*. Paris: OECD.

OECD (2002). *OECD Information Technology Outlook 2002*. Paris: OECD.

OECD (2004). *OECD Information Technology Outlook 2004*. Paris: OECD.

OECD (2006). *OECD Information Technology Outlook 2006*. Paris: OECD.

OECD (2005). OECD Communications Outlook 2005. Paris: OECD

OECD (2005). OECD Communications Outlook 2005. Paris: OECD

[238] Thus why the shape of Figure 174

8.6.2. Distribution of Indicators

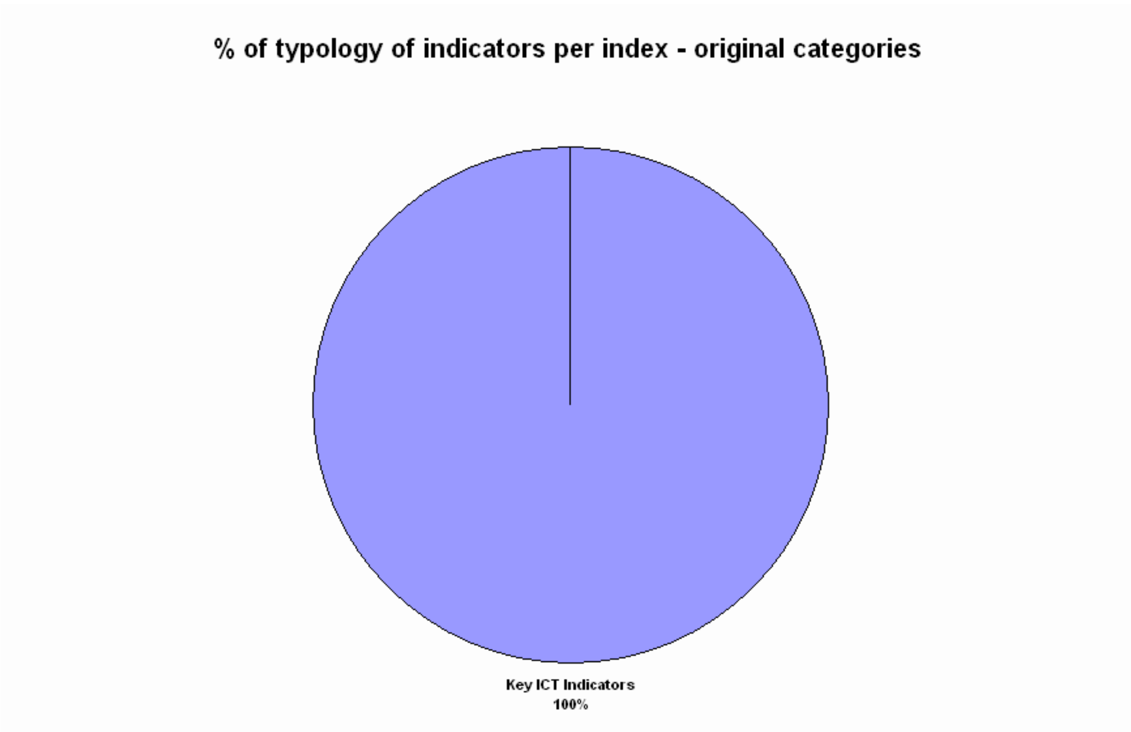

Figure 174: Key ICT Indicators. % of typology of indicators per index – original categories

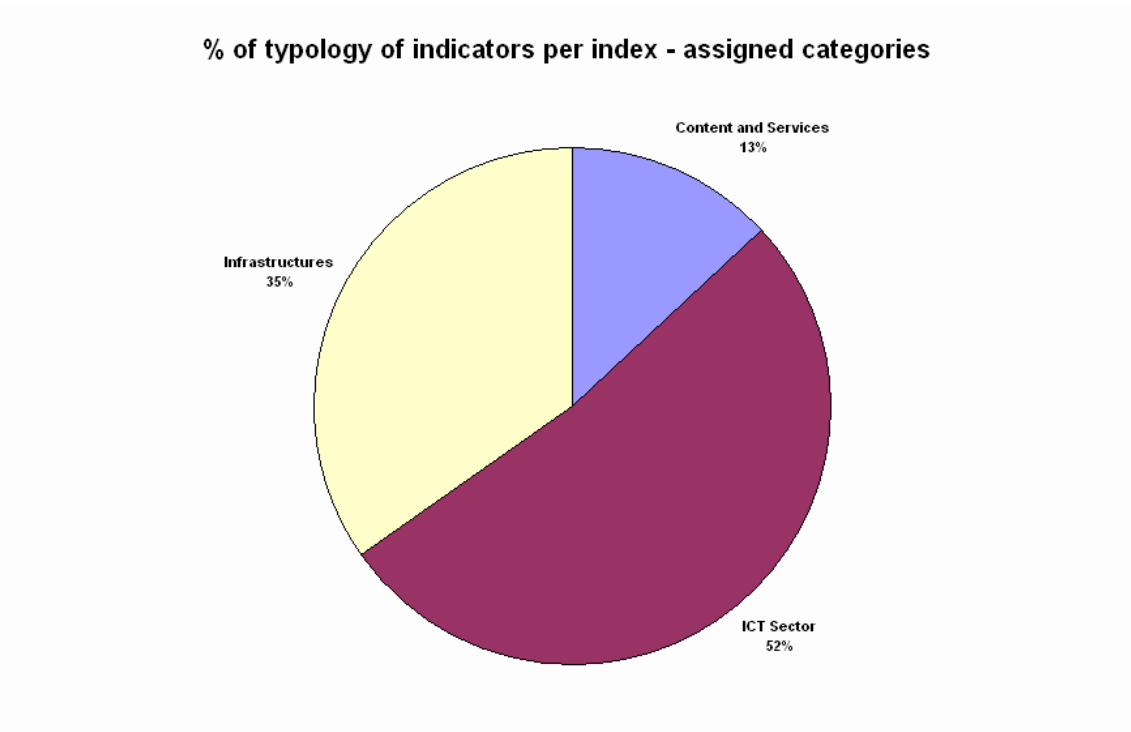

Figure 175: Key ICT Indicators. % of typology of indicators per index – assigned categories

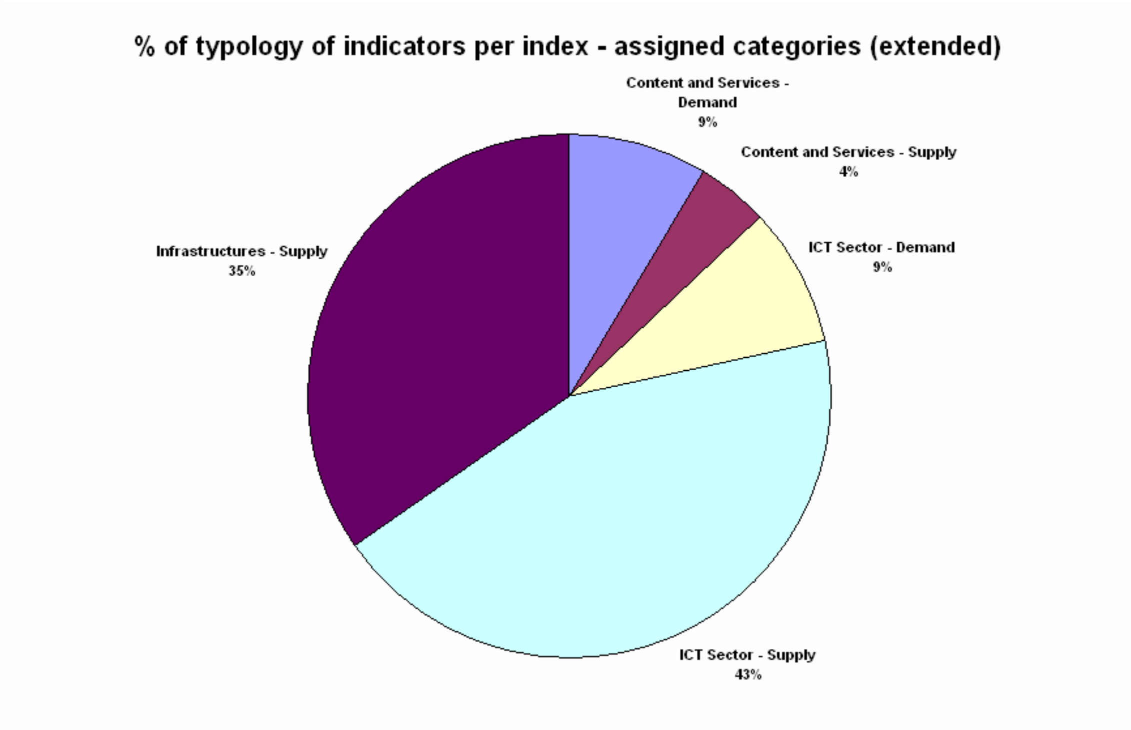

Figure 176: Key ICT Indicators. % of typology of indicators per index – assigned categories (extended)

8.6.3. Comment

By looking at Figure 176 and Figure 177 we can see that the focus is put in Infrastructures and the power of the ICT Sector. If we go back to the nature of the OECD, reasons come quite straightforward and the last design of the set of indicators is not (that) surprising[239].

Indeed, the OECD Key ICT Indicators do measure quite extensively and qualitatively the power of the ICT Sector, being, in our opinion, one of the best set of indicators in this area, including intensity of trade and, more important, the intensity and effective results – as measured e.g. by patents – of its R&D strategy.

It is somewhat surprising that the Key ICT Indicators do not reflect any kind of information about Digital Skills, provided that the OECD does have good data on this issue and already publishes them in other aggregates or individually in dedicated reports[240].

[239] We invite the reader to compare this measuring policy with the European Union's (section 8.7 in this chapter) and how two different international organizations can produce, according to their founding principles, so much different measuring devices and policies.
[240] See next section: PISA

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Infrastructures	ICT Sector R&D Investment Trade			Services
	Workforce			Penetration Consumption

Figure 177: OECD Key ICT Indicators – main topics covered

8.7. European Information society statistics

The European development strategy agreed in Lisbon in 2000 regained momentum in 2005 and included as a key issue to achieve growth and employment the role of ICTs:

> "A new initiative - i2010: European Information Society will stimulate the take-up of ICTs, to continue the eEurope agenda which the Lisbon Strategy fostered. It will do this by promoting a clear, stable and competitive environment for electronic communications and digital services; increased research and innovation in ICTs and an Information Society dedicated to inclusion and quality of life" (European Commission, 2005b).

A month later that role of ICTs to achieve an inclusive Information Society was (politically) defined in the "i2010 – A European Information Society for growth and employment" communication (European Commission, 2005a), that represented the follow-up to the eEurope 2005 Action Plan (European Commission, 2003).

Even if Eurostat – the European Statistics Agency – had already been gathering good amounts of information about ICTs and their use, now it had implicitly to back with evidence both the weaknesses and strengths of the European Information Society, especially at the uptake level, as the strategy was about inclusion and empowerment (the social approach) and not about building a powerful ICT Sector[241].

Even if Eurostat was already gathering Information Society data, the "i2010 Benchmarking Framework" (i2010 High Level Group, 2006) was agreed to

[241] At least not directly, as a locomotive for development or as a means to gain strategic positioning in the global market, but, in any case, indirectly, to serve the citizens needs and welfare.

adapt the existing methodologies and set up new measuring strategies and devices according to the new political needs that the i2010 strategic framework raised.

8.7.1. Main publications

European Commission (2003). *Council Resolution on the implementation of the eEurope*. Brussels: European Commission.

European Commission (2005a). *i2010 – A European Information Society for growth and employment*. Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions. Brussels: European Commission.

European Commission (2005b). *Working together for growth and jobs - A new start for the Lisbon Strategy*. Communication to the Spring European Council. Brussels: European Commission.

i2010 High Level Group (2006). *i2010 Benchmarking Framework*. Brussels: European Commission.

European Commission (2006b). *i2010 First Annual Report on the European Information Society*. Brussels: European Commission.

European Commission (2007a). *i2010 Annual Information Society Report 2007, Volume 1*. Brussels: European Commission.

European Commission (2007b). *i2010 Annual Information Society Report 2007, Volume 2*. Brussels: European Commission.

European Commission (2007c). *i2010 Annual Information Society Report 2007, Volume 3*. Brussels: European Commission.

8.7.2. Distribution of Indicators

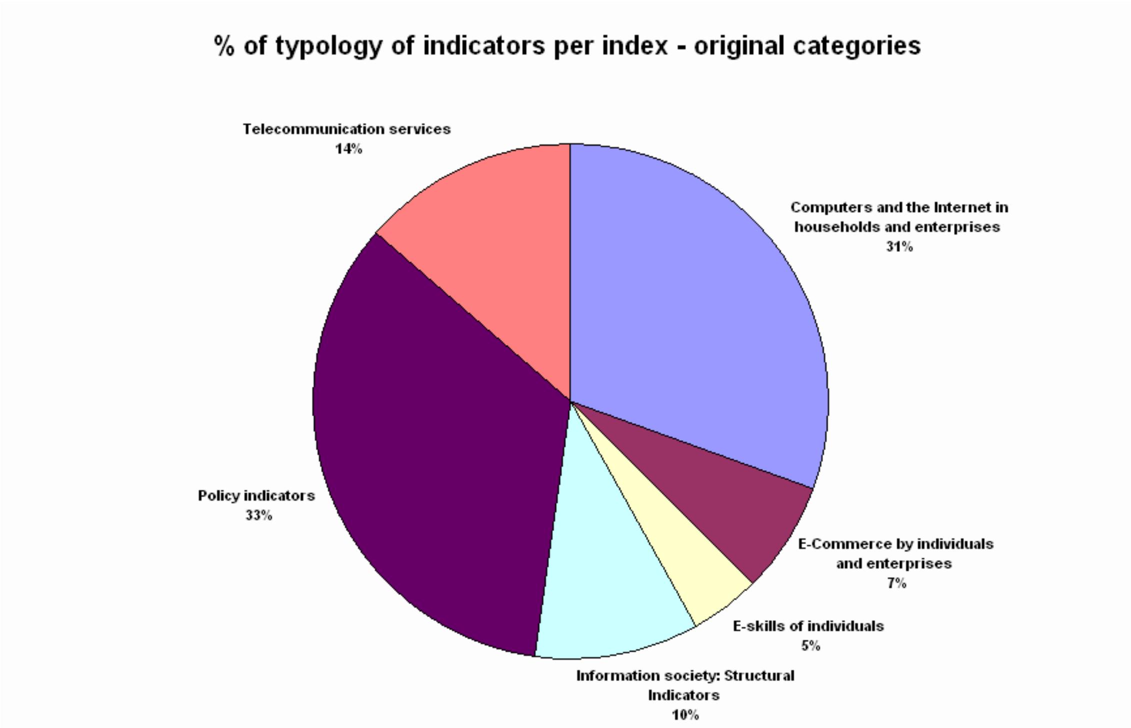

Figure 178: European Information society statistics. % of typology of indicators per index – original categories

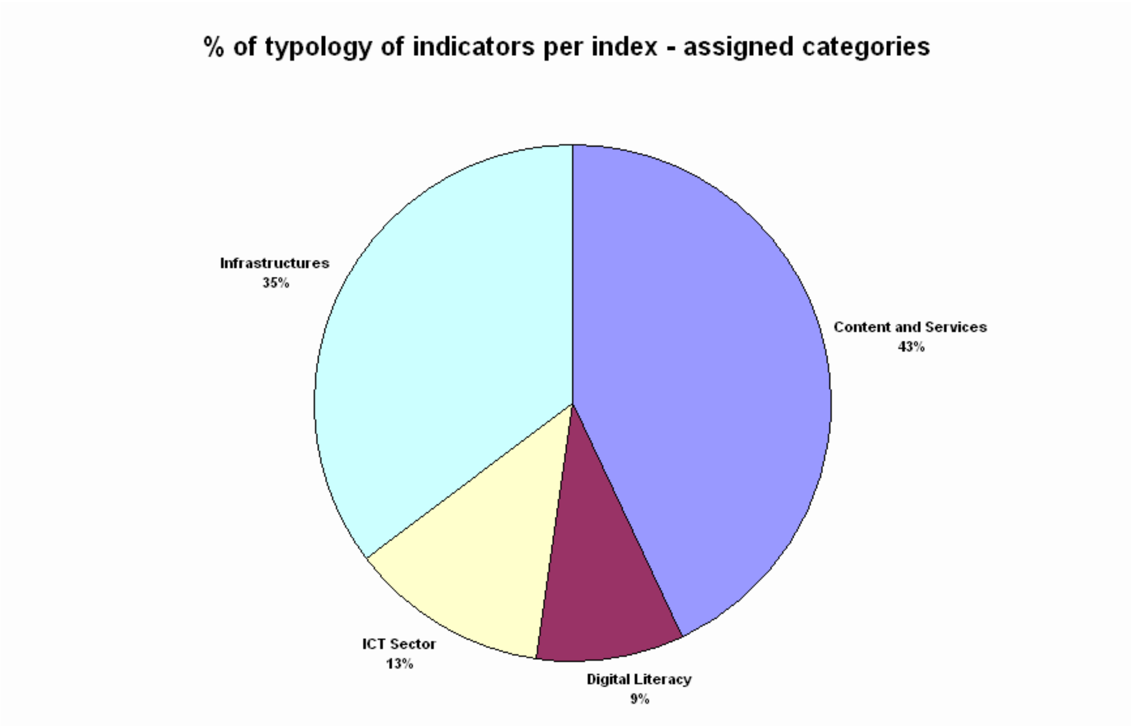

Figure 179: European Information society statistics. % of typology of indicators per index – assigned categories

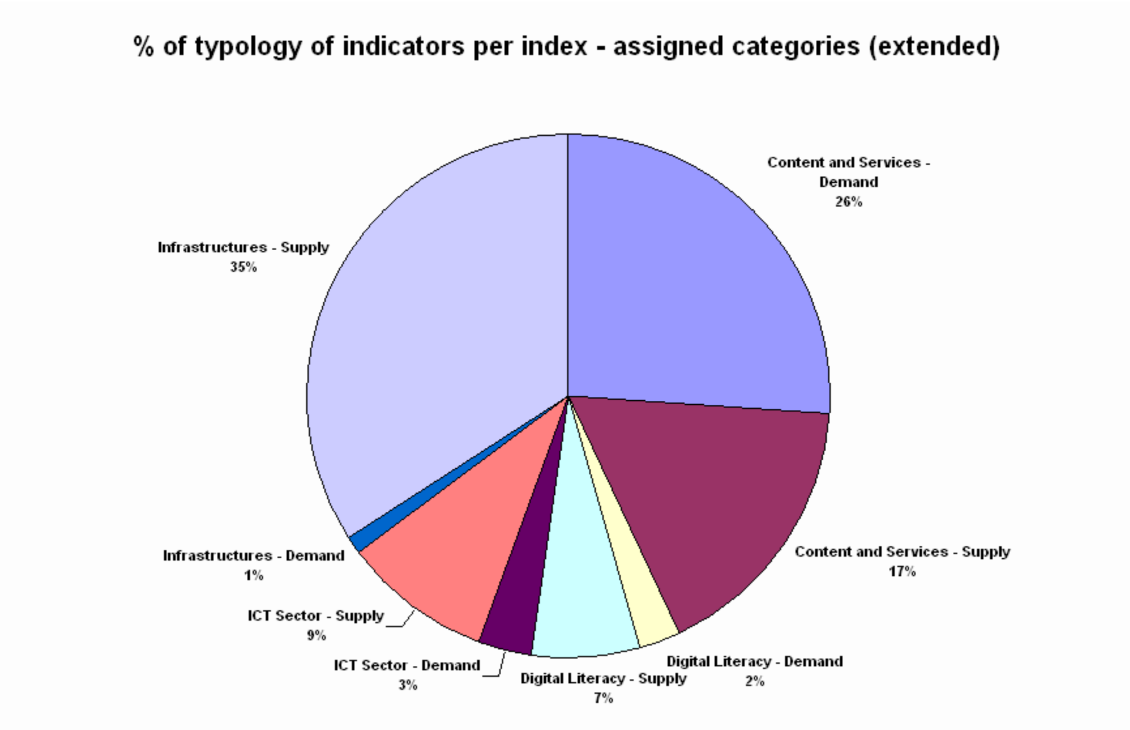

Figure 180: European Information society statistics. % of typology of indicators per index – assigned categories (extended)

8.7.3. Comment

Figure 178 shows perfectly how statistics have been accommodated to follow political needs, being the two focal points the provision of appropriate infrastructures and the measurement of suitable content and services.

We believe that Eurostat's are one of the best – if not the best – sets of indicators existing, with just some lacks. Figure 181 might be more explicit in some terms:

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
Computers and the Internet Policy Structural ind. e-Commerce	Structural ind. Policy Telecom. Services	e-Skills Computers and the Internet		Structural ind. e-Commerce Computers and the Internet Policy
Structural	Employment	e-Skills		Structural ind. e-Commerce Computers/ Internet Policy Services

Figure 181: Eurostat Information Society Statistics – main topics covered

First thing that clearly appears is the lack of measuring in the Policy and Regulatory Framework arena. But this explanation is straightforward: being a regional – quasi-federal, we would dare say – measuring tool, the Policy and Regulatory Framework needs no measuring as, increasingly, regulation and policies are fostered at the European Union level, and just transposed, complemented, etc. by the state members.

Another lack, not evident by looking at Figure 181, is the absence of a strong measure of the ICT Sector performance beyond the provision of the basic services (e.g. international ICT trade). As we said, this kind of indicators were not part of the i2010 benchmarking framework. Besides, they are already collected by other institutions, as we have been seeing.

On the positive side, the exhaustive detail with which usage is collected is one of the best assets of the European Information Society Statistics, allowing detailed analysis and clustering so to define the best policies and strategies to allocate efficiently the always scarce resources.

Notwithstanding, we believe that the supply side of the Content and Services category could be improved: while e-Government and e-Commerce are quite good covered (i.e. the Services part), the Content part is unattended, as are also the issues about affordability (Infrastructures, demand), maybe closely related.

8.8. PISA

The Programme for International Student Assessment (PISA), developed by the OECD, is not, in any way, neither headed towards fostering the Information Society nor intended to measure the e-Readiness of a country. Instead, it is aimed at assessing, as the name tells, student performance in the OECD area.

The interesting thing in the PISA – as what concerns our own work – is that the survey does include some questions about ICT access and usage. Even if these data are not usually published along with the PISA indices, the data are actually collected and treated apart afterwards, in order to test both the ICT access and uses from the youngsters and, even more important for policy-makers, to quantify the penetration and effective use of ICTs in Education (e.g. at schools)[242].

Our interest here is, then, commenting here some of the variables measured by the PISA to highlight, precisely, how some unusually considered dimensions are here treated with most interest.

[242] The last PISA survey was made up of four surveys: Students, Schools, Parents and ICT Familiarity. Here we will only deal with the full ICT Familiarity survey and the questions related to computing included in the Schools survey. The rest of the surveys (Students, Parents) also feature some questions related to ICTs (e.g. access and devices at home), but such kind of indicators have been already dealt with here extensively.

8.8.1. Main publications

OECD (2002). *PISA 2000: Technical Report*. Paris: OECD.

OECD (2005). *PISA 2003: Technical Report*. Paris: OECD.

OECD (2007). *PISA 2006: Science Competencies for Tomorrow's World*. Volume 1: Analysis. Paris: OECD.

OECD (2007). *PISA 2006: Science Competencies for Tomorrow's World*. Volume 2: Data. Paris: OECD.

8.8.2. Distribution of Indicators

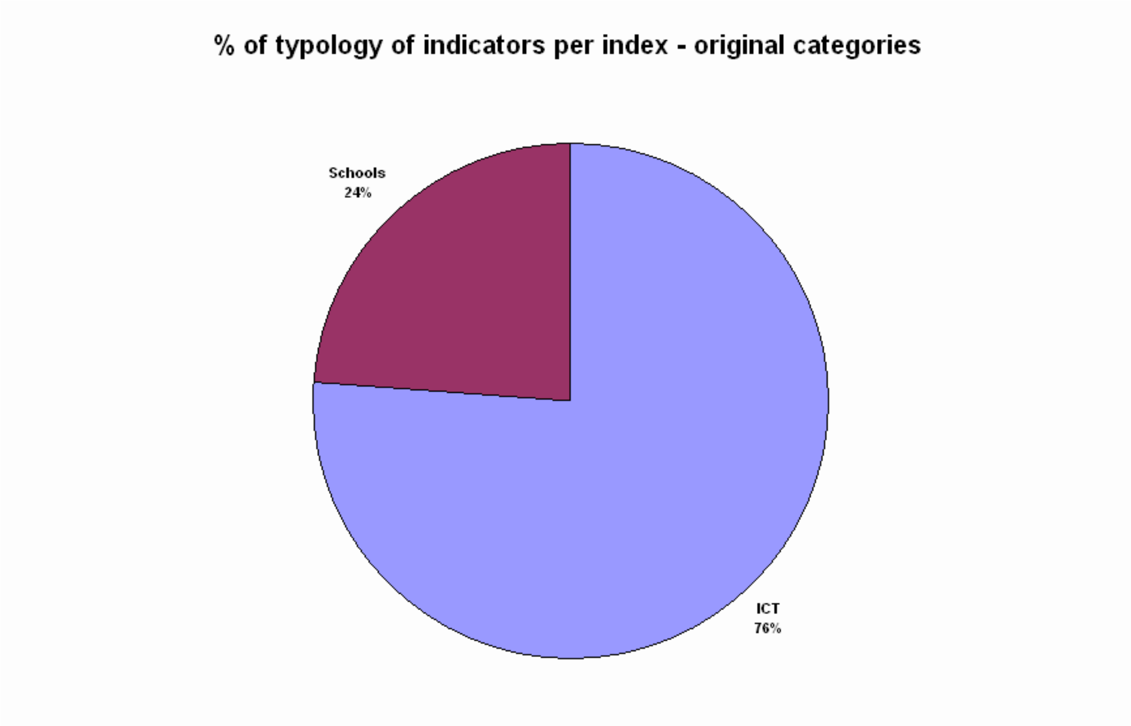

Figure 182: PISA. % of typology of indicators per index – original categories

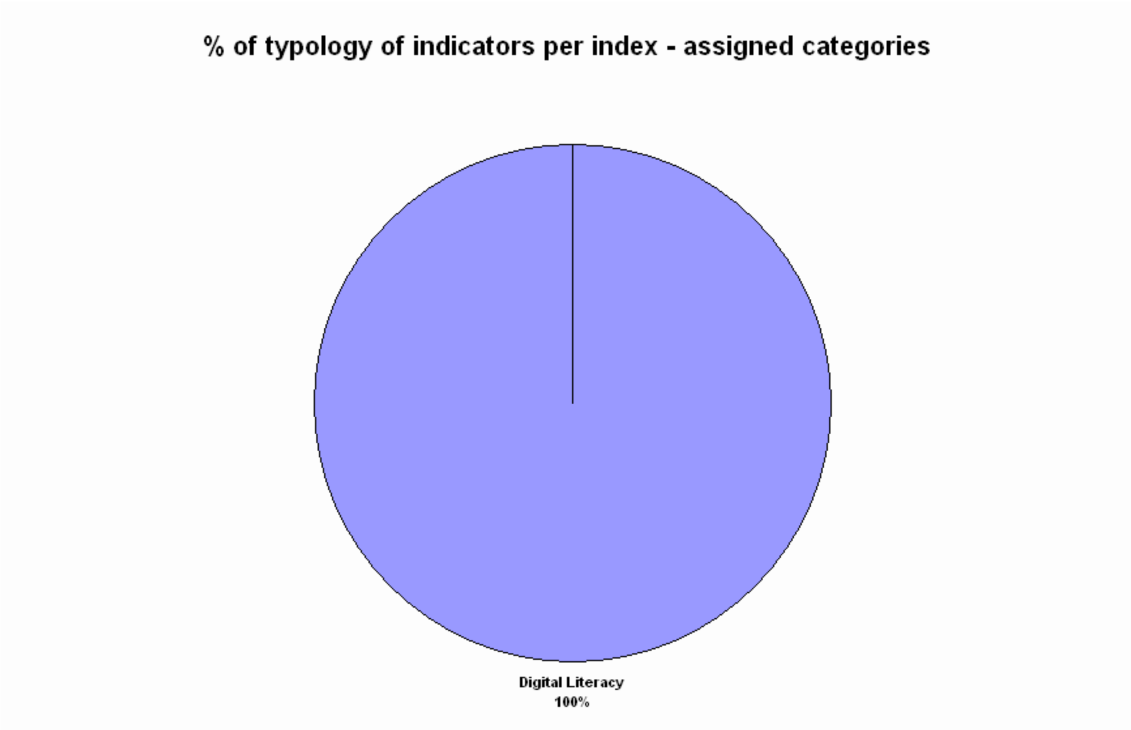

Figure 183: PISA. % of typology of indicators per index – assigned categories

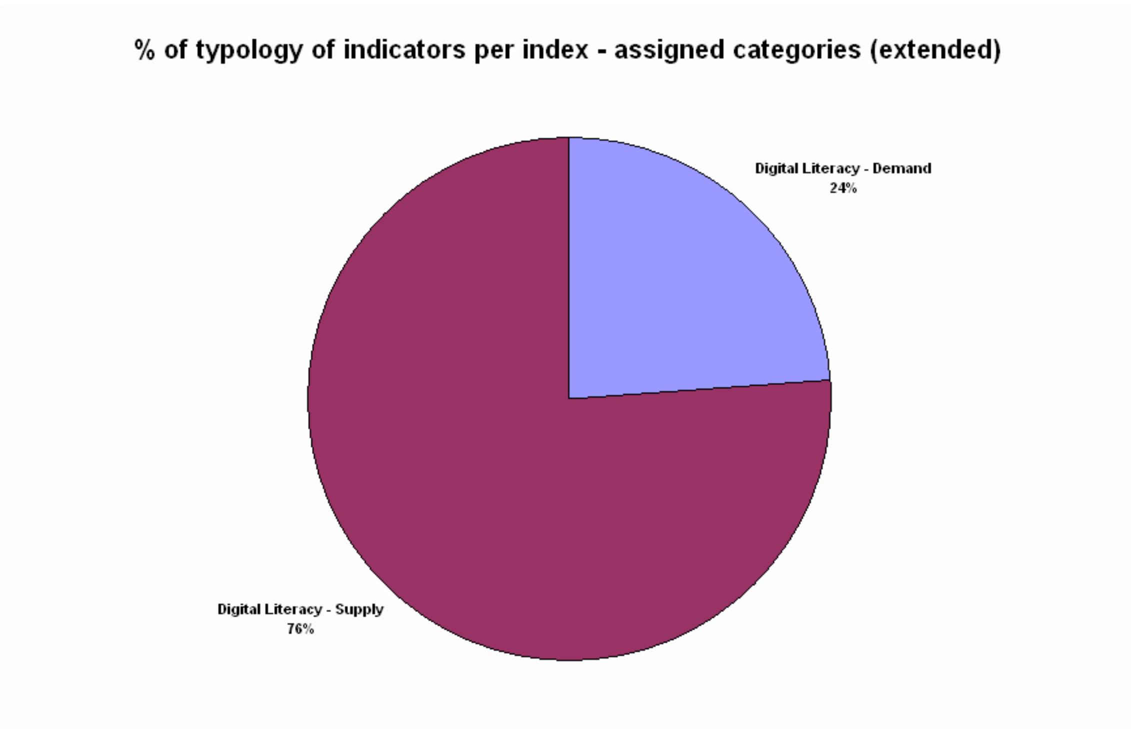

Figure 184: PISA. % of typology of indicators per index – assigned categories (extended)

8.8.3. Comment

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services
		Digital Abilities		
		ICT at Schools		

Figure 185: OECD's PISA – main topics covered

Few comments can be made that we have not already said in our introduction to this section. We invite the reader to visit Annex I to see the detailed composition of the indicators gathered by PISA.

The evidence behind PISA is that it is really possible to get some information about Digital Skills at both the level of capacity – Digital Abilities in Figure 185 – and how this capacity can be enhanced by acting though training – ICT at Schools. We are aware that carrying out the PISA survey is costly and is very difficult to be replicated[243] along time and across space. Nevertheless, it does provide some guidance for the potential design of indicators and their respective surveys so that these variables can be included in further more comprehensive measuring tools.

[243] The PISA survey itself, for instance, is replicated every three years.

9. Digital Economy Models: A Horizontal Analysis

In the first chapters of this work we dealt with the different understandings of the concept of access and the definition of what constitutes the Information Society. We believe – and have stated then – that distinct approaches to the question of access will determine our observation of the reality and, in the end, the actions we take towards it, hence the policies, strategies, goals, actions, etc. we design.

After the theoretical approach of the first chapters of this work – mainly based on a review of some of the existing literature on the topic – we have been presenting, through the last four chapters, the different approaches to the concept of access that try – directly or indirectly – to describe what the Information Society is by means of how it is measured.

This chapter is a roundup of these last four, where we will aggregate all the data presented so far[244]. As with any aggregate, charts, figures and conclusions have to be taken with care: some indices are continuing to evolve, some of them are constantly being updated, while some have remained unchanged for years, and though the trends – as we will be demonstrating – have not changed, the aggregate do not necessarily present reality with accuracy.

We invite the reader to have Annex I at reach as we will heavily rely on it for most of the following paragraphs. A summary is presented, nevertheless, in Table 6.

[244] And, as we have already stated, we will include some other models that did not deserve a section on their own, but that add value featuring them here.

Name	Promoter	Periodicity	# Countries[245]	From	To
African ICT e-Index	Research ICT Africa	Non periodical[246]	16	2002[247]	2007[248]
ArCo	Archibugi & Coco[249]	Non periodical	86	2000	2000
Basic Knowledge Economy Scorecard	The World Bank	Annual	140	1995	2008[250]
Broadband Performance Index	European Commission	Non periodical	28	2008	2008
Comprehensive Metric	Barzilai-Nahon, K.	Never	0		
Connectivity Scorecard - Efficiency and Resource Driven Economies	Waverman et al.	Annual	25[251]	2007	2008
Connectivity Scorecard - Innovation Driven Economies	Waverman et al.	Annual	25[252]	2007	2008
Core ICT Indicators	Partnership on Measuring ICT for Development	Never[253]	0		
Core ICT Indicators for the ECA region	Economic And Social Commission For Western Asia	Never (planned)	53		
Core ICT Indicators for the ESCWA region	Economic And Social Commission For Western Asia	Never (planned)	13		
Digital Access Index	International Telecommunication Union	Non periodical	146	2002	2002
Digital Divide Index	SIBIS	Non periodical	25[254]	1997	2002
Digital Divide Index - Infostate	Orbicom	Annual	191	1995	2003
Digital Opportunity Index	International Telecommunication Union	Annual	181	2005	2006
Digital Planet	World Information Technology and Services Alliance	Annual	75	2001	2007[255]
E-Commerce Readiness Assessment Guide	APEC e-Commerce Readiness Initiative	Never	0		
E-Commerce Readiness in East Asian APEC Economies	Bui, T. X., Sebastian, I. M., Jones, W. & Naklada, S.	Non periodical	10	2001	2001

245 When a time series exist, # Countries refers to the number of countries of the last assessment (i.e. higher amount of countries)
246 Non periodical states also for one time assessments.
247 The assessment has been done along several years, but always covering a different socioeconomic sector (see Gillwald & Stork, 2007). Number of countries refers to the study with the highest amount of countries analyzed (Esselaar et al., 2007).
248 Íbid.
249 A refinement of the Technology Achievement Index.
250 The upper year is only available for some variables.
251 The report only featured 9 countries in its first edition.
252 The report only featured 16 countries in its first edition.
253 Normally meaning that it is a theoretical model that never went into practice in a real assessment.
254 EU15 have all series while CEEC only are complete for 2002.
255 Values are estimated up to 2011.

e-Government Readiness Index	UNPAN	Every 3 Years	192	2002	2007
e-Participation Index	UNPAN	Every 3 Years	192	2002	2007
e-Readiness Guide (GeoSINC)	GeoSINC	Never	0		
e-Readiness Rankings	The Economist Intelligence Unit	Annual	70	2000	2007
European Information Society Statistics	European Commission	Half-yearly	27	2002[256]	2007
Freedom on the Net Index	Freedom House	Annual	15	2008	2008
Global Action Plan for Electronic Commerce	WITSA	Never	0		
Global E-Readiness	McConnell International	Non periodical	53	1999	2000
Global Internet Filtering	OpenNet Initiative	Non periodical	40	2007	2007
ICT at a Glance Tables	The World Bank	Annual	207	2000	2006
ICT Development Index	International Telecommunication Union	Annual	154	2002	2007[257]
ICT Diffusion Index	UNCTAD	Annual	180	2002	2004
ICT Opportunity Index	UNCTAD	Annual	183	2004[258]	2006
Index of Knowledge Societies	UNPAN	Non periodical	40	2005	2005
Information Society Index	IDC	Annual	53	1995	2007
Knowledge Economy Index	The World Bank	Annual	140	1995	2009[259]
Knowledge Index	The World Bank	Annual	140	1995	2008[260]
Layers, Sectors and Areas of the Information Society	Hilbert, M. R. & Katz, J.	Never	0		
Models of Access	Warschauer, M.	Never	0		
Networked Readiness Index	World Economic Forum	Annual	134	2001	2008
OECD Key ICT Indicators	Organisation for Economic Co-operation and Development	Annual	32	1991	2007[261]
PISA	Organisation for Economic Co-operation and Development	Every 3 Years	40[262]	2003	2006

[256] Some series are older, but the whole dataset is complete since 2002.
[257] Published in 2009 and calculated during 2008, the index features only two series so far: 2002 and 2007.
[258] 62 economies have data since 2000.
[259] The upper year is only available for some variables.
[260] The upper year is only available for some variables.
[261] Some series last update was prior to 2007.
[262] Some data are collected up to 57 countries.

Readiness for the Networked World. A Guide for Developing Countries	CID Harvard University	Never	0		
Readiness Guide for Living in the Networked World	Computer Systems Policy Project	Never	0		
Real Access Criteria	Bridges.org	Never	0		
SIBIS Framework	SIBIS	Non periodical	17[263]	2002	2002
SIMBA Model	Wicander, G.	Non periodical	8	2005	2005
Sustainable ICT Framework	Sundén, S. & Wicander, G	Non periodical	1	2000	2000
Technology Achievement Index	UNDP	Non periodical	72	2000	2000
The Access Rainbow	Clement, A. & Shade, L.R.	Never	0		
The CTO Guide to the ICT	Commonwealth Telecommunications Organization	Non periodical	54	1999	2001
The Development Dynamic	Accenture, Markle Foundation & UNDP	Never	0		
The eInclusion Index	SIBIS	Never	0		
The Global Diffusion of the Internet	Mosaic	Non periodical	25	1997[264]	2000[265]
WDI Key ICT Indicators	The World Bank	Annual	211	2000	2006
World Development Indicators – The information Age	The World Bank	Annual	153	1995	2008[266]
World Telecommunication ICT Indicators	International Telecommunication Union	Annual	209	1975[267]	2008[268]
World Telecommunication Regulatory Database	International Telecommunication Union	Annual	191	1998	2008[269]
Name: name of the model; Promoter: institution or persons developing the model; Periodicity: times the model has been put into practice (i.e. calculated with real data); # Countries: if put into practice, how many countries were sampled; From-To: if put into practice, range of years covered.					

Table 6: List of Models of the Digital Economy.

[263] EU15 + Switzerland + USA
[264] Years refer to when the first and last countries were studied, not to the extent of a time series, as these were one time assessments per country.
[265] Íbid.
[266] The upper year is only available for some variables.
[267] From 1960 to 1975 data are also available, but not on a yearly basis.
[268] Not all indicators are available for 2008.
[269] See supra.

9.1. On the Design of Digital Models

9.1.1. Distribution along categories

We have commented several times – including in our introductory chapters – that Infrastructure measures tend, in general, to be overrepresented by contrast with other types of indicators, especially those related with the users themselves and how they interact with infrastructures (through the ICT Sector) and with digital content and services (through the legal framework). This is because of the primary importance of infrastructure as a platform for the development of the Information Society, but also because they are easier to measure.

The next four figures show the share of each category in the total distribution of indicators. The shares are presented with and without taking into account analogue – here cited as "Nondigital" – indicators (e.g. Population) and distinguishing between primary (aggregate) an secondary (extended aggregate) categories.

A caveat should be made about these – and the subsequent figures – bys showing the distribution of the *amount* of indicators in each model: what we are making here is a quantitative analysis[270] of that said distribution. The caveat is that quantity might not, sometimes, be faithful to reality. For instance, a hypothetical index might be composed by five indicators: desktops per person, laptops per person, computers (total) per person, number of e-Books available in local language, number of e-Business transactions per person. In this case, Infrastructures category would have three indicators vs. two belonging to Content and Services. Notwithstanding, the reader will agree that the later would explain a bigger share of the reality.

[270] A more qualitative analysis will follow at the end of this section by looking directly to the source data listed in Annex I.

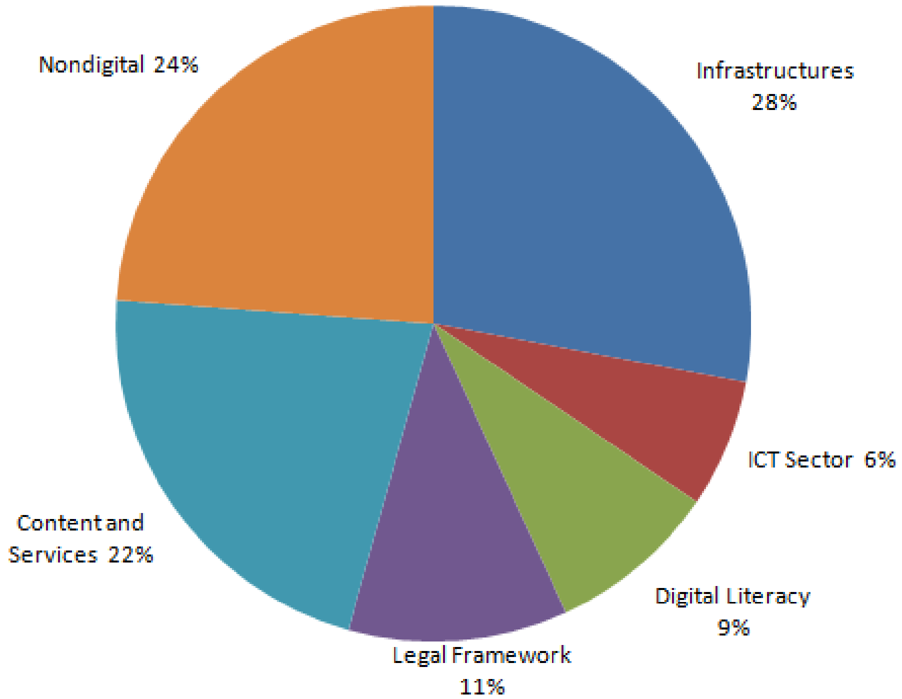

Figure 186: Distribution of the aggregate categories[271] – including analogue indicators

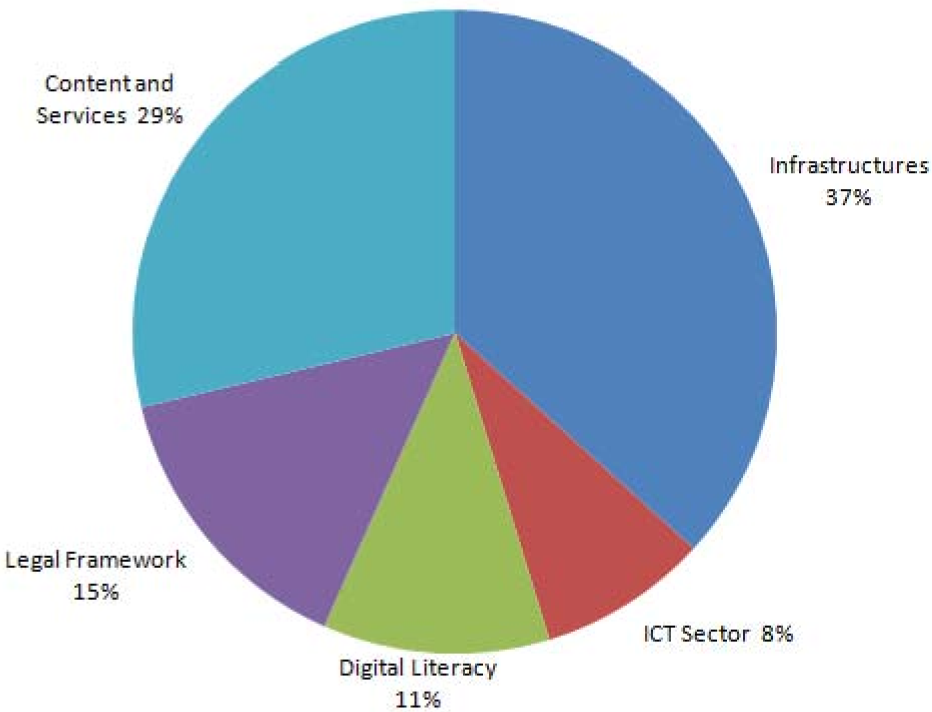

Figure 187: Distribution of the aggregate categories[272] – excluding analogue indicators

[271] The total number of indicators included in these categories can be seen in Table 7.
[272] The total number of indicators included in these categories can be seen in Table 8.

Figure 186 and Figure 187 show how the focus, historically, has been placed – as we already stated – mainly on Infrastructure measures. On the other hand, Content and Services closely follows in the final share of indicators.

Given the fact that most measuring tools have been developed by institutions that seek to serve policy-makers and decision takers, it is perhaps surprising to see that all the intermediate enablers of the Digital Economy – a strong ICT Sector, human capital in the form of Digital Literacy and a proper Policy and Regulatory Framework – share as a whole just one-third of the total "attention" of the Digital Economy models.

Thus, it looks like what is being measured is how infrastructure or capital is transformed into effective use, but bypassing the black box of how this transformation actually takes place.

- This lack of available indicators makes it difficult to measure the reasons of failure or success, not to mention taking the appropriate decisions given a state of the situation, the goals to be achieved and the resources at one's reach.

The detail of this lack of indicators is even more discouraging, as the following two figures show:

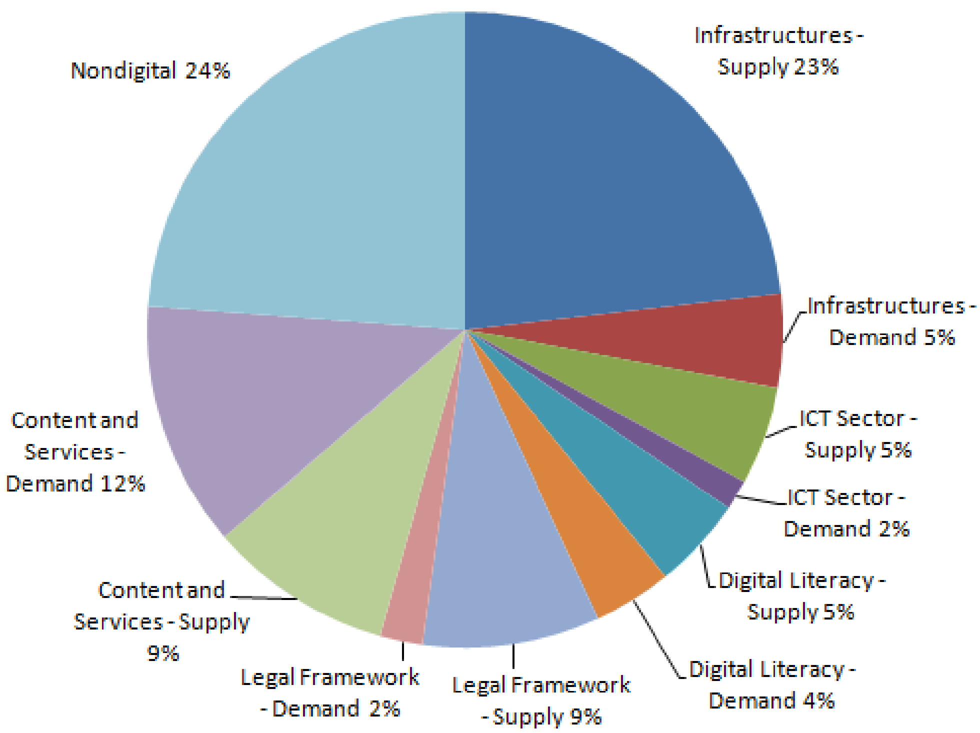

Figure 188: Distribution of the extended aggregate categories – including analogue indicators

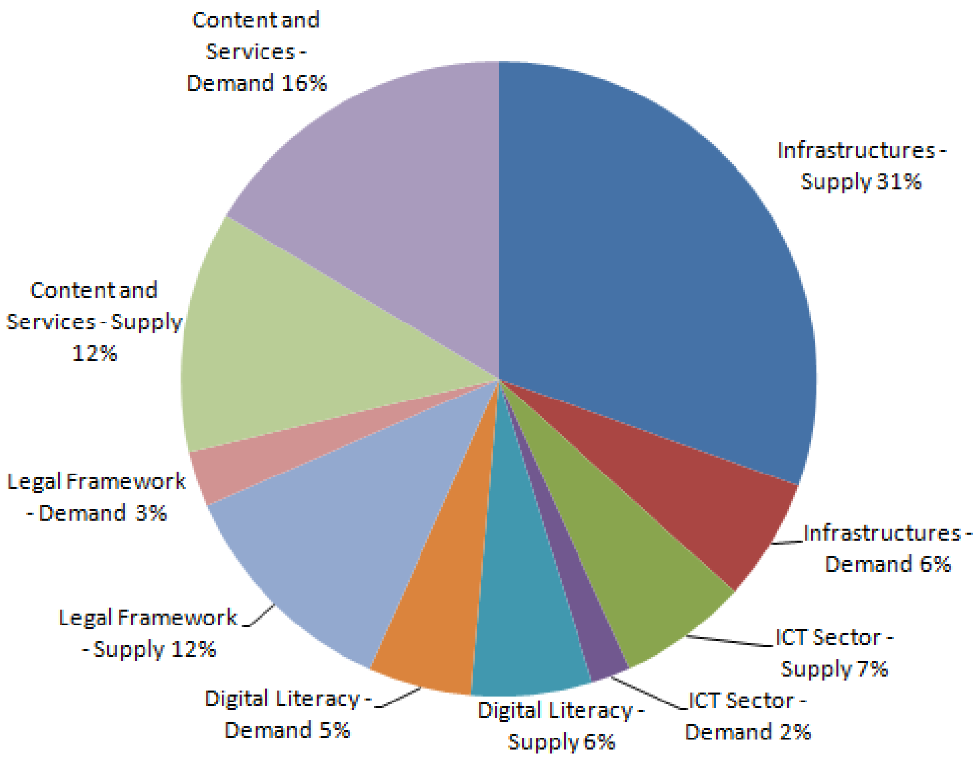

Figure 189: Distribution of the extended aggregate categories – excluding analogue indicators

Figure 188 and Figure 189 speak quite loud themselves. By splitting each category into their respective subcategories, the underrepresentation of some of them comes even clearer.

- There is little concern about the affordability of access to infrastructures. While the *amount* of the installed capital is constantly measured, in many ways, the same cannot be said for how these infrastructures are going to be effectively supported. Economic sustainability is often left out of the equation, which is quite a concern if these infrastructures are to foster development, as it is stated in many reports and articles backing the models analyzed here.

- If the role of the ICT Sector is, in our opinion, underrepresented in many models, the more dynamic part of it – a properly skilled workforce – is almost always forgotten. If, as we will try to show in the following chapters, the availability of skilled human capital is a crucial asset for some countries to develop by leveraging the power of ICTs, measuring the amount, flexibility, knowledge level, etc. of this human capital seems, to us, like a must not to be set aside.

- Following the previous train of thought, we are astonished to see how little effort is put into measuring the digital capacity of the population at large. And by "at large" we are not meaning the end users that may – or may not – use the technology at their reach, but also the leaders of the society that are supposed to be drivers of change and progress.

- Finally, a major concern is in how **few existing indicators measure both the regulation of the Information Society** in general and, specifically, the existing policies to foster it. Not only benchmarking is made difficult – though not impossible[273] – but quantitative analysis on the effects of policies and regulation on the development of the Digital Economy is almost impossible. And if policies are to be measured for performance, effectiveness and efficiency, the lack of this kind of indicators is worrying.

9.1.2. Distribution along categories and along models and time

This criticism of ours seems to be new, at least implicitly as can be seen by comparing Figure 190 to Figure 191 and Figure 192. The first one shows how indicators are distributed along categories in *theoretical* models, while the other two do the same exercise for one time assessments and indices and data sets updated periodically.

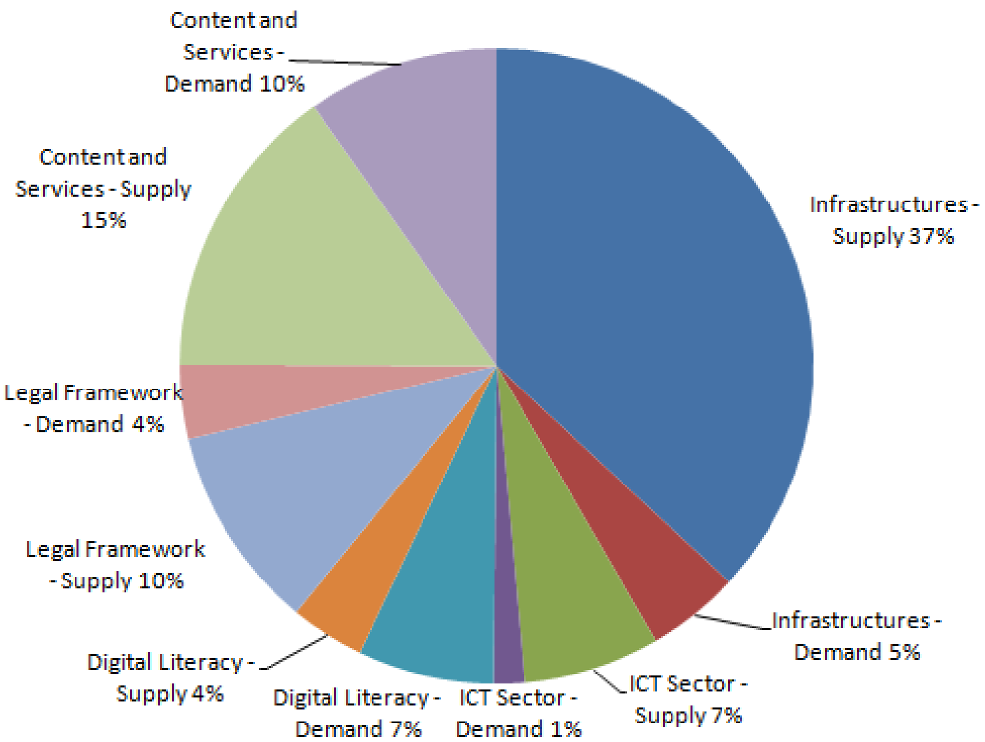

Figure 190: Distribution of the aggregate categories (theoretical models) – excluding analogue indicators

[273] That indices or general models do not gather legal framework issues does not mean that they are not published elsewhere.

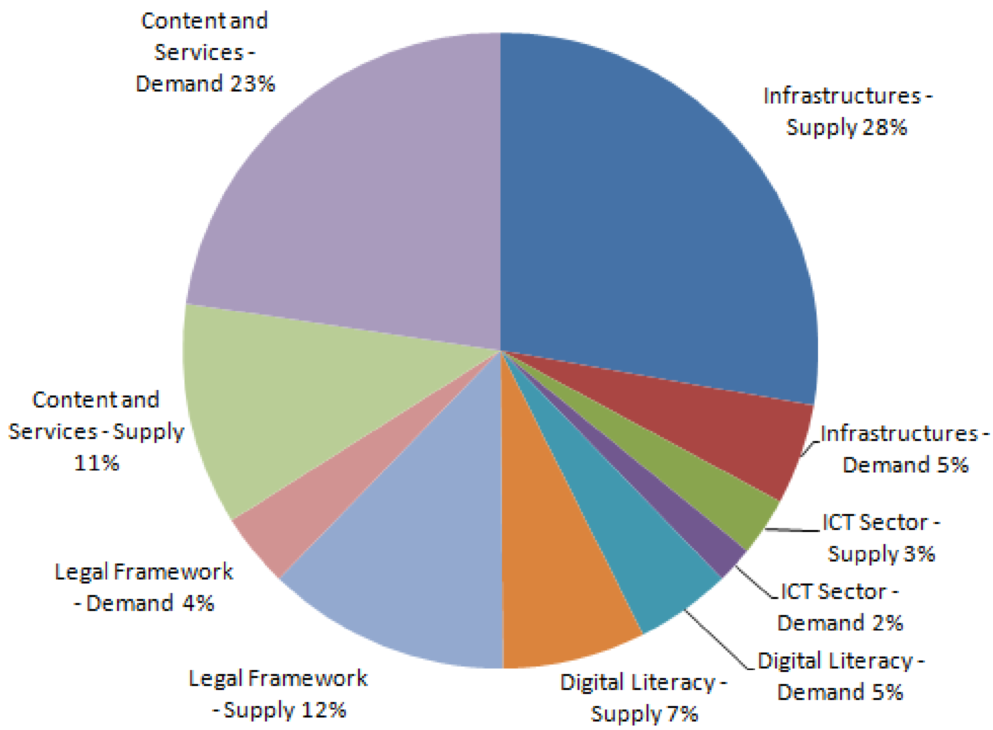

Figure 191: Distribution of the aggregate categories (theoretical models) – excluding analogue indicators

What we see is that there are no big differences in the distribution of aggregate categories between theoretical and practical models, being only slightly lower share of Infrastructures + Content-and-Services in theoretical models than in applied ones (59% vs. 63% in both applied cases). This is, to our understanding, astonishing, as one would argue that the main barriers when shifting from theory to practice would be defining the appropriate indicators for the desired variables to be measured… and obtaining the best data for these indicators. Theoretical models should, in our opinion, be either a little bit too conservative or just not challenging the availability of actual indicators, thus adapting *ex-ante* their models to what a hypothetical practice could provide.

9.1.3. Distribution between supply and demand

Concerning our distinction between the supply and demand side of one indicator, Figure 192 and Figure 193 show that

- there is an **absolute predominance of supply side indicators**, with demand related indicators usually left aside, as has been strongly criticised by, among others, the Research ICT Africa team[274].

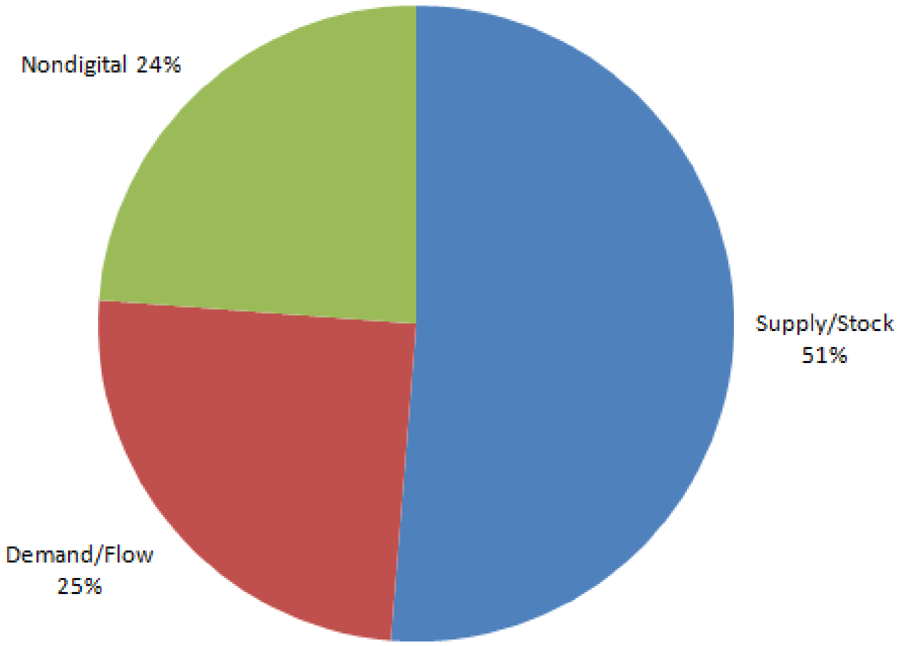

Figure 192: Distribution of the aggregate categories – including analogue indicators

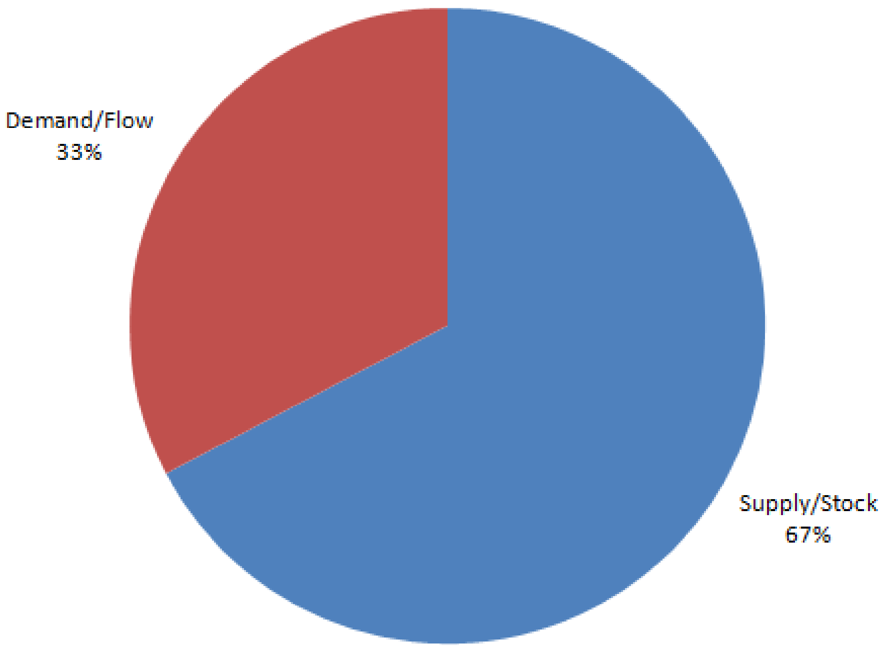

Figure 193: Distribution of the aggregate categories – including analogue indicators

[274] See, for instance, Gillwald, A. & Stork, C. (2007).

Considering that many of these demand-side indicators are closely related with the measure of usage[275], it is our opinion that the demand-side is neglected in view of how effective demand side (Keynesian) policies for stimulated development have proven in the past and how they are currently being employed in the new generation of stimulus packages.

Indeed, if we look at the major interest that user generated content – a 100% demand-side phenomenon – is increasingly generating[276], measuring devices seem to be lagging behind the pace of actual interest of society, researchers, policy-makers… and the content industry.

In Figure 194we want to show that this unbalance is not particular of a specific kind of model – though some models are more balanced than others – but a general characteristic of all models analyzed.

And in Figure 195 we sorted (ascending) the models by the last year when they were updated to see whether there has been a shift towards a higher weight in demand-side indicators along time.

Figure 195 shows there has not.

9.1.4. Distribution along categories: some qualitative analysis

To conclude this part of the analysis, we will add two more conclusions related to a more qualitative look at the 1489 specific indicators that have been gathered for this work.

- Regarding infrastructures, it is puzzling that almost *n*o software is taken into account. Some indicators measure software, specially its use or purpose of use (e.g. educational software), and sometimes affordability. But while hardware and connectivity are always present, software is usually not. This void is surprising at least for two reasons. First, because free/libre open source software has become a sociological issue that would require measuring. Second, because software is a crucial and unavoidable part of using infrastructure and, in many countries, a matter of concern because of costs, security issues, its power to develop e-services focused industry, etc.

[275] See Annex I for detailed data.

[276] Some examples, among many, are: Keats, D. W. (2003); Albright, P. (2006); Franklin, T. & Van Harmelen, M. (2007); OECD (2007e); OECD (2008d); and Hargittai, E. & Walejko, G. (2008)

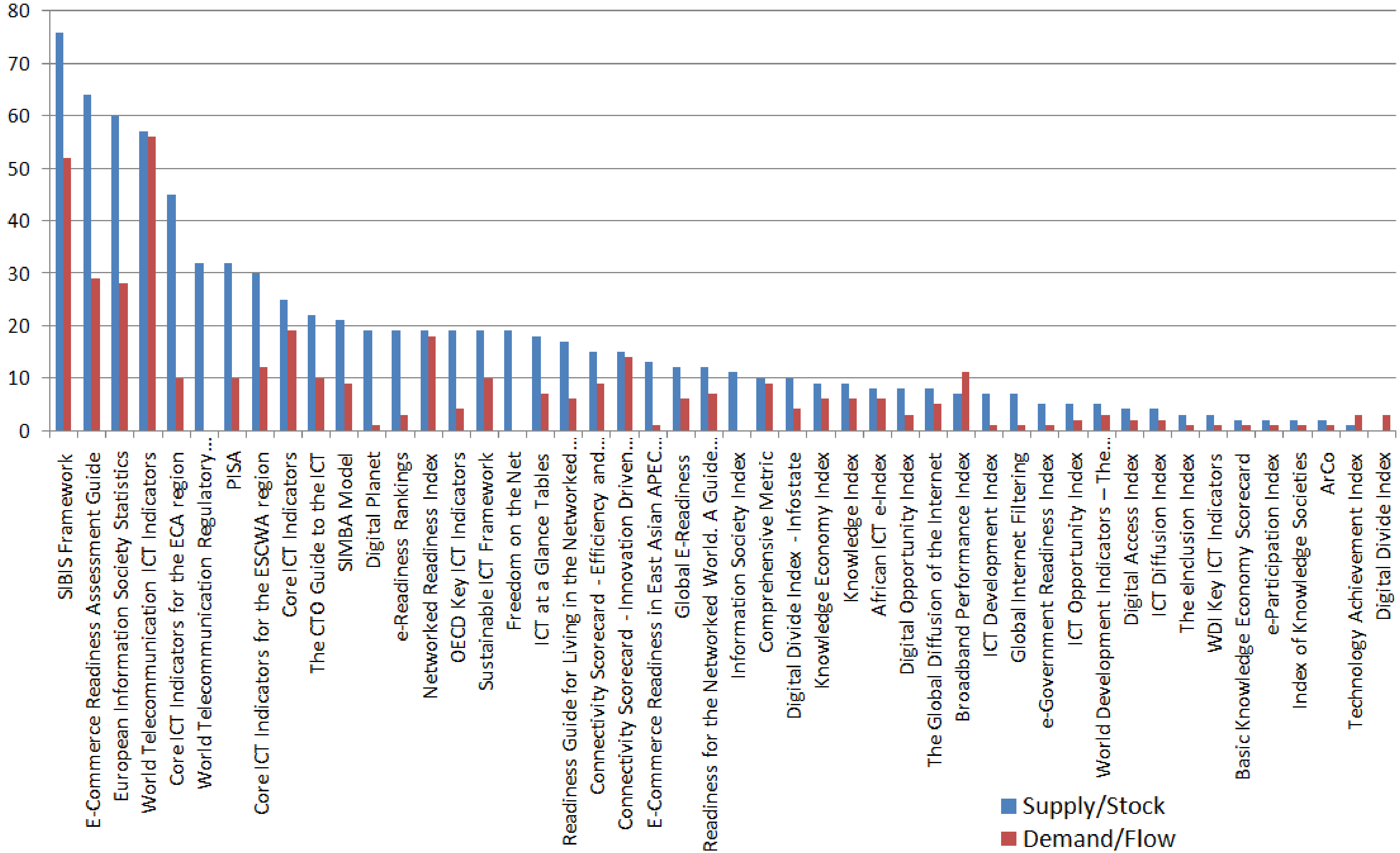

Figure 194: Distribution of indicators in supply and demand-side – sorted descending by supply-side

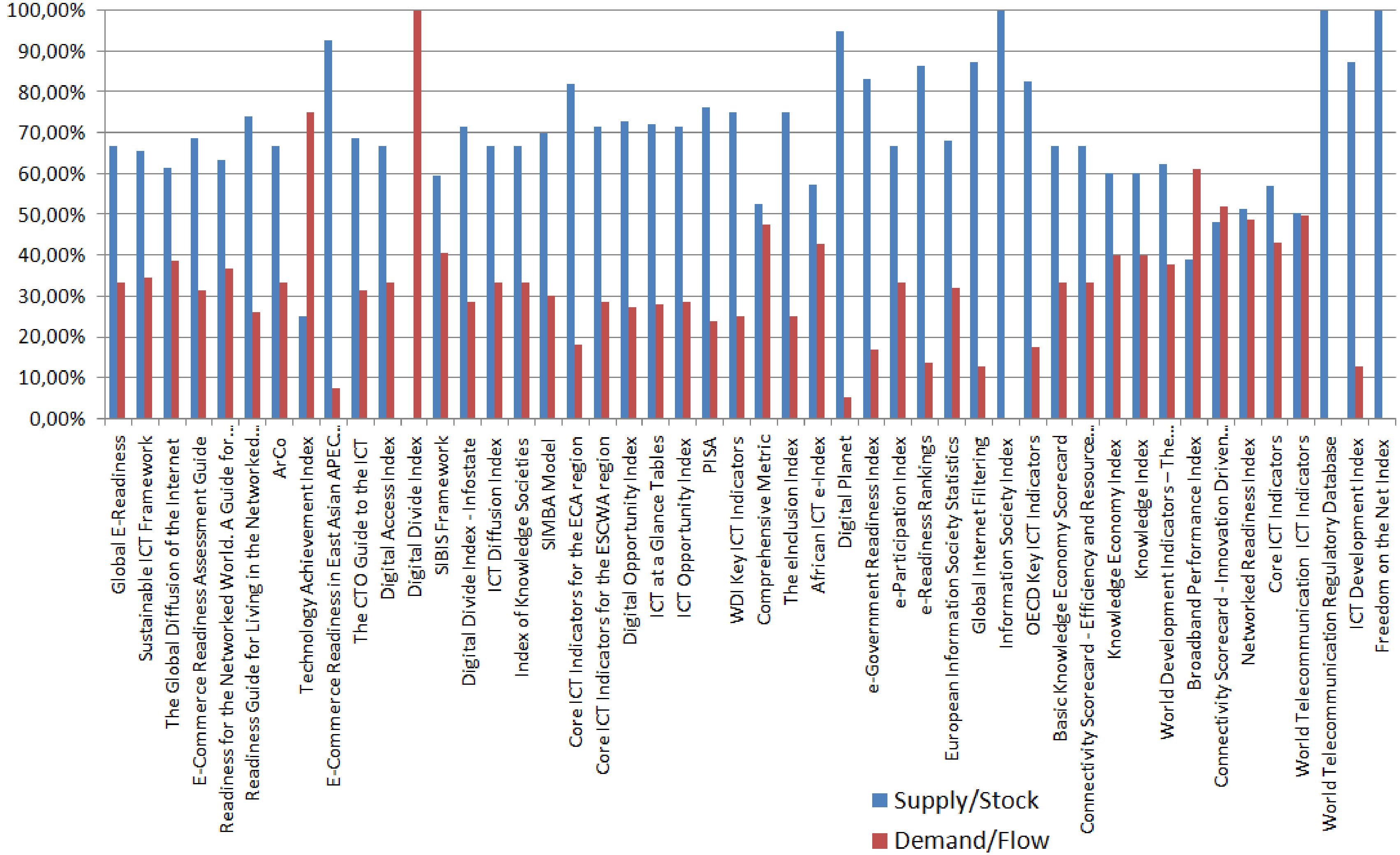

Figure 195: Distribution of indicators in supply and demand-side – sorted descending by year of last update

- Regarding Content and Services – and as it happened with software – **almost all measuring efforts have been put in digital services and *not* in content at all**. Though it could be argued that many measures about, for instance, e-Government do gather a direct or an indirect measure about content, it could be equally argued that content is but a part of public services, a means to perform a transaction. But content, an increasingly major commodity, is quite often left out of the equation, even if the entertainment and media industry are creating powerful corporations due to the increasingly importance of their invoicing and revenue.

9.2. Putting up into practice Measuring tools

9.2.1. On the quality of the measuring tools

When we look not at the aggregates but at the disaggregated level, two main observations can be made (Table 6):

- The first one is about the **scarcity of broad time series in terms of number of variables covered by the respective number of indicators**. Despite – or perhaps because of – the fact that ICTs are quite recent[277], the most complete series available do not last longer than five or six years with few exceptions. Even in these cases, it is likely to find they are focused on infrastructures, being usage and other more subtle variables just not kept into the measuring loop[278], so that long term series which include many countries and variables are almost inexistent.

- The second one is the number of countries for which these data are available. Lack of awareness and lack of resources are among the main reasons attributed to this lack of data. This fact generates, at its turn, a vicious circle, where **analyses are only performed for countries with available data**, and thus there are few incentives to collect data in other countries for use in cross-country analysis.

9.2.2. On the power of the measuring tools

Table 7 presents all Digital Economy models and the number of indicators they gather[279]. We have highlighted in orange the model that collects the most indicators in a specific subcategory (in light orange the second highest)[280].

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[277] Especially if, as we commented in our first chapters, year 0 is generally placed around 1994-1995 with the development of web browsers that made the World Wide Web available to the general public.

[278] The two main e-Rediness indices (NRI, EIU) probably being the most notable exception in measuring the Information Society in number of indicators and time considered.

[279] For some theoretical models, the number of indicators is not always such. For instance, Barzilai-Nahon's Comprehensive Metric features a list of variables that should be measured, but anywhere is stated that this should be done with one indicator per variable.

[280] Please remember what we said in section 9.1.1 about taking the number of indicators as a synonym for quality.

Name	# Countries	# Series	Infrastructures - Supply	Infrastructures - Demand	ICT Sector - Supply	ICT Sector - Demand	Digital Literacy - Supply	Digital Literacy - Demand	Policy and Regulatory Framework - Supply	Policy and Regulatory Framework - Demand	Content and Services - Supply	Content and Services - Demand	Nondigital	TOTAL
African ICT e-Index	16	6	8	1								5	3	17
ArCo	86	1	1						1			1	5	8
Basic Knowledge Economy Scorecard	140	14	2									1	11	14
Broadband Performance Index	28	1	4	3			1		1		1	8		18
Comprehensive Metric	0	1	3	3	1		2	1	1	2	3	3	8	27
Connectivity Scorecard - Efficiency and Resource Driven Economies	25	2	10					1			4	7	2	23
Connectivity Scorecard - Innovation Driven Economies	25	2	9			1	1	2			3	11		27
Core ICT Indicators	0	1	18	1	3	1		8			4	9	4	48
Core ICT Indicators for the ECA region	53	1	24	1	4	1	1	5	2		14	3	7	62
Core ICT Indicators for the ESCWA region	13	1	18	4	2	1	1	4		2	9	1	1	43
Digital Access Index	146	1	4	1								1	2	8
Digital Divide Index (DiDix)	25	6										3		3
Digital Divide Index (DDI)	191	9	9								1	4	6	20
Digital Opportunity Index	181	2	8	2								1		11
Digital Planet	75	7	2		2						15	1	3	23
E-Commerce Readiness Assessment Guide	0	1	22	6	8		1	8	28	8	5	7	13	106
E-Commerce Readiness in East Asian APEC Economies	10	1	6	1	3				2		2		39	53
e-Government Readiness Index	192	6	4								1	1	2	8
e-Participation Index	192	6									2	1		3
e-Readiness Guide	0	1												
e-Readiness Rankings	70	8	5	1			2		3	1	9	1	15	37
European Information Society Statistics	27	6	30	1	8	3	7	1			15	23		88
Freedom on the Net Index	15	1							19					19
Global Action Plan for Electronic Commerce	0	1												
Global E-Readiness	53	2	1	1	3		2	2	5	3	1		1	19
Global Internet Filtering	40	1	1						6			1	5	13
ICT at a Glance Tables	207	7	8	4	3				5	1	2	2	7	32
ICT Development Index	154	2	7									1	3	11
ICT Diffusion Index	180	3	4	1								1	2	8
ICT Opportunity Index	183	3	5									2	3	10
Index of Knowledge Societies	40	1	2									1	12	15
Information Society Index	53	13	7		1						3		4	15

Knowledge Economy Index	140	15	5	1	2	1		1			2	3	68	83
Knowledge Index	140	14	5	1	2	1		1			2	3	56	71
Layers, Sectors and Areas of the Information Society	0	1												
Models of Access	0	1												
Networked Readiness Index	134	7	9	7	5			1	2	4	3	6	30	67
OECD Key ICT Indicators	32	17	8		10	2					1	2		23
PISA	40	4					32	10						42
Readiness for the Networked World. A Guide for Developing Countries	0	1	4	1	2	1		2	1	1	5	2		19
Readiness Guide for Living in the Networked World	0	1	9					3	2	1	6	2		23
Real Access Criteria	0	1												
SIBIS Framework	17	1	25	1	1	1	22	12	8		20	38	5	133
SIMBA Model	8	1	9	3	1	1			7	3	4	2	24	54
Sustainable ICT Framework	1	1	9		2	3	1	1	2	6	5		11	40
Technology Achievement Index	72	1		2		1			1				4	8
The Access Rainbow	0	1												
The CTO Guide to the ICT	54	3	9	6	1				12	2		2	10	42
The Development Dynamic	0	1												
The eInclusion Index	0	1	1				1				1	1		4
The Global Diffusion of the Internet	25	4	5					1	1		2	4		13
WDI Key ICT Indicators	211	7	3									1	2	6
World Development Indicators – The information Age	153	14	2	2							3	1	2	10
World Telecommunication ICT Indicators	209	34	41	20	15	6			1			30	6	119
World Telecommunication Regulatory DB	191	11							32					32
TOTAL			366	75	79	24	74	63	142	34	148	197	376	1578

Table 7: Digital Economy models and indicators – Best model per category

Colours suggest that ITU's World Telecommunication ICT Indicators are the most comprehensive in measuring everything related to Infrastructures and the ICT Sector, as well as being the main data source from which EuroStat, the OECD or the World Economic Forum draw as "second bests" – though each with their own limitations, especially in the number of countries covered[281].

Digital Literacy is proficiently covered by SIBIS and OECD's PISA survey, but again, they only measure but a little fraction of the whole world – and, indeed, SIBIS was a one time assessment. Fortunately, the recent Performance Indicators on ICT Use in Education issued by UNESCO provide a promising framework from which to measure the dynamic side of digital literacy as approximated by the presence of ICTs in Education.

As for legal issues, the problem is again that the E-Commerce Readiness Assessment Guide does not provide any data at all, even if their design might be mint. Thus, the best *data set* actually up-to-date and available are the EIU e-Readiness Rankings, the

[281] The reason not to consider the Sustainable ICT Framework as a second best.

World Bank's ICT at a Glance Tables and the WEF's Networked Readiness Index[282]. In fact, most of these sources turn to the ITU World Telecommunication Regulatory Database to get some of their data on ICT regulation[283].

Finally, concerning Content and Services, WITSA's Digital Planet is the richest database for expenditure on the ICT sector (including all kinds of goods and services[284]) which provides very good information concerning the supply-side as proxied by expenditure. The demand-side (usage) is better covered, again, by ITU's World Telecommunication ICT Indicators. As second bests we could take into account the are the EIU e-Readiness Rankings, the WEF's Networked Readiness Index or the Partnership's Core set of ICT Indicators.

Outside of the Digital Economy, the World Bank's KAM, and its broader World Development Indicators, is probably the best option to look for an appropriate socioeconomic framework.

9.2.3. What is Access (revisited)?

Back in section 3.1 we presented three main different conceptions of Access, namely

- The Telecommunications Model (page 70)
- The Conduit and Literacy Models (page 72)
- The Broadcasting Model (page 74)

In Table 8 we have attempted to identify the two opposed models: the Telecommunications Model vs. the Broadcasting/e-Readiness Model.

Orange (and light orange) cells highlight the category with a highest (and second highest) number of indicators as compared *within* each model.

At first glance we can only see what Figure 193 had already shown: the concentration of indicators in the supply of Infrastructures and Usage. A thorough look will show us that models like the World Telecommunication ICT Indicators or the Core set of ICT Indicators are unbalanced towards the left of the table (Infrastructures, the ICT Sector), while others are more balanced across the table and even biased towards the right part of if (the user part): the e-Readiness Rankings, the Networked Readiness Index or the two Readiness guides.

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[282] SIMBA does not generate their own data but gathers them from several sources, as do for some of their indicators The Economist Intelligence Unit and the World Economic Forum.

[283] This database is yearly fed by ITU's Telecommunication Regulatory Survey (ITU, 2008c) and features almost 100 indicators on regulatory issues of the ICT Sector and the Telecommunication environment.

[284] To be true, the Digital Planet data set could be also be taken into account as a proxy to measure the extension of the ICT Sector.

Name	Infrastructures - Supply	Infrastructures - Demand	ICT Sector - Supply	ICT Sector - Demand	Digital Literacy - Supply	Digital Literacy - Demand	Policy and Regulatory Framework - Supply	Policy and Regulatory Framework - Demand	Content and Services - Supply	Content and Services - Demand	TOTAL
African ICT e-Index	8	1								5	14
ArCo	1						1			1	3
Basic Knowledge Economy Scorecard	2									1	3
Broadband Performance Index	4	3			1		1		1	8	18
Comprehensive Metric	3	3	1		2	1	1	2	3	3	19
Connectivity Scorecard - Efficiency and Resource Driven Economies	10								4	7	21
Connectivity Scorecard - Innovation Driven Economies	9			1	1	2			3	11	27
Core ICT Indicators	18	1	3	1		8			4	9	44
Core ICT Indicators for the ECA region	24	1	4	1	1	5	2		14	3	55
Core ICT Indicators for the ESCWA region	18	4	2	1	1	4		2	9	1	42
Digital Access Index	4	1								1	6
Digital Divide Index (DiDix)										3	3
Digital Divide Index (DDI)	9								1	4	14
Digital Opportunity Index	8	2								1	11
Digital Planet	2		2						15	1	20
E-Commerce Readiness Assessment Guide	22	6	8		1	8	28	8	5	7	93
E-Commerce Readiness in East Asian APEC Economies	6	1	3				2		2		14
e-Government Readiness Index	4								1	1	6
e-Participation Index									2	1	3
e-Readiness Guide											
e-Readiness Rankings	5	1			2		3	1	9	1	22
European Information Society Statistics	30	1	8	3	7	1			15	23	88
Freedom on the Net Index							19				19
Global Action Plan for Electronic Commerce											
Global E-Readiness	1	1	3		2	2	5	3	1		18
Global Internet Filtering	1						6			1	
ICT at a Glance Tables	8	4	3				5	1	2	2	25
ICT Development Index	7									1	11
ICT Diffusion Index	4	1								1	6
ICT Opportunity Index	5									2	7
Index of Knowledge Societies	2									1	3
Information Society Index	7		1						3		11
Knowledge Economy Index	5	1	2	1		1			2	3	15
Knowledge Index	5	1	2	1		1			2	3	15

Layers, Sectors and Areas of the Information Society											
Models of Access											
Networked Readiness Index	9	7	5			1	2	4	3	6	37
OECD Key ICT Indicators	8		10	2					1	2	23
PISA					32	10					42
Readiness for the Networked World. A Guide for Developing Countries	4	1	2	1		2	1	1	5	2	19
Readiness Guide for Living in the Networked World	9					3	2	1	6	2	23
Real Access Criteria											
SIBIS Framework	25	1	1	1	22	12	8		20	38	128
SIMBA Model	9	3	1	1			7	3	4	2	30
Sustainable ICT Framework	9		2	3	1	1	2	6	5		29
Technology Achievement Index		2		1			1				4
The Access Rainbow											
The CTO Guide to the ICT	9	6	1				12	2		2	32
The Development Dynamic											
The eInclusion Index	1				1				1	1	4
The Global Diffusion of the Internet	5					1	1		2	4	13
WDI Key ICT Indicators	3									1	4
World Development Indicators – The information Age	2	2							3	1	8
World Development Indicators – The information Age	41	20	15	6			1			30	113
World Telecommunication ICT Indicators							32				32
TOTAL	366	75	79	24	74	63	142	34	148	197	1144

Table 8: Digital Economy models and indicators – Best category within each model

It is noticeable too that some initiatives born with a strong "pro development" focus are amongst the most balanced ones in the whole set: the European Information Society Statistics were created within the eEurope 2005 and i2010 frameworks to foster the Information Society in the European Union as a tool for inclusion; the same happens with the SIBIS Framework, a European Commission funded project belonging to the European Sixth Framework Program's Information Society Programme[285]; the SIMBA Model and the Sustainable ICT Framework both belong to the KaU framework and KTH strategy and are absolutely aimed to developing countries; and even under the umbrella of the technology biased Core set of ICT Indicators[286], both the ECA and ESCWA adaptations do show this trend towards a more balanced approach; last, Barzilai-Nahon's Comprehensive model, a theoretical one, has achieved a good balance too, thus mirroring the commitment of the author with development.

[285] Also close to the eEurope framework.

[286] This bias has been slightly corrected in the February 2009 revisionof the Core set of ICT Indicators, where the ICT for education indicators developed by UNESCO Institute for Statistics have been included.

10. Towards a comprehensive framework of the Digital Economy: Conclusions to the Digital Economy Models Analysis

In the last chapters – in this second part – we have been describing up to 55 approaches that try to model – explicitly or implicitly – the digital economy, with the aim of measuring it. Pradeep Baijal (Goswami, 2006d and 2007), former Chair of the Telecom Regulatory Authority of India, states that this measurement should serve three purposes:

1. determine where a country stands in relation to its peers;
2. how well they are doing over time; and
3. for measuring the effectiveness of policy and regulatory measures.

In this chapter we will show how and why these purposes are – or are not – met.

Our argument will be that there is a lack of both *quantity* and of *quality* in the measuring tools that should fit these purposes, especially the third one related with policy evaluation. By this, we are not saying that the tools described above are not useful: we most honestly think that they serve specific purposes and, quite often, serve this purposes quite well. This is the case, for instance, of most of the best Telecommunication approach indices and sets of indicators, which were designed to measure the deployment of infrastructures. Rather, the problem is that they are also used to measure more complex issues that do not lend themselves to easy explanation.

As Barzilai-Nahon (2006) states, we believe that "more 'ready-to-use' tools would give decision-makers incentives to consider factors more diverse than infrastructure-oriented".

In recent years, we have seen several summits, workshops working groups[287] that have tried to address this point we are making. Some of them have ended up issuing brand new tools or refurbished ones – most of them presented here, if not all – and an evolution can somehow be seen in the figures appearing in this chapter.

Hence, in the next pages we will highlight this evolution, characterize the main features – common and divergent – amongst these measuring tools and infer some reasons why they have their respective designs.

[287] See, for instance, Minges (2005), Goswami, (2006d and 2007); Association for Progressive Communications & Instituto del Tercer Mundo (2007), Jensen & Mahan (2007), Partnership on Measuring ICT for Development (2009), just to name a few.

10.1. Evolution of digital economy frameworks and models

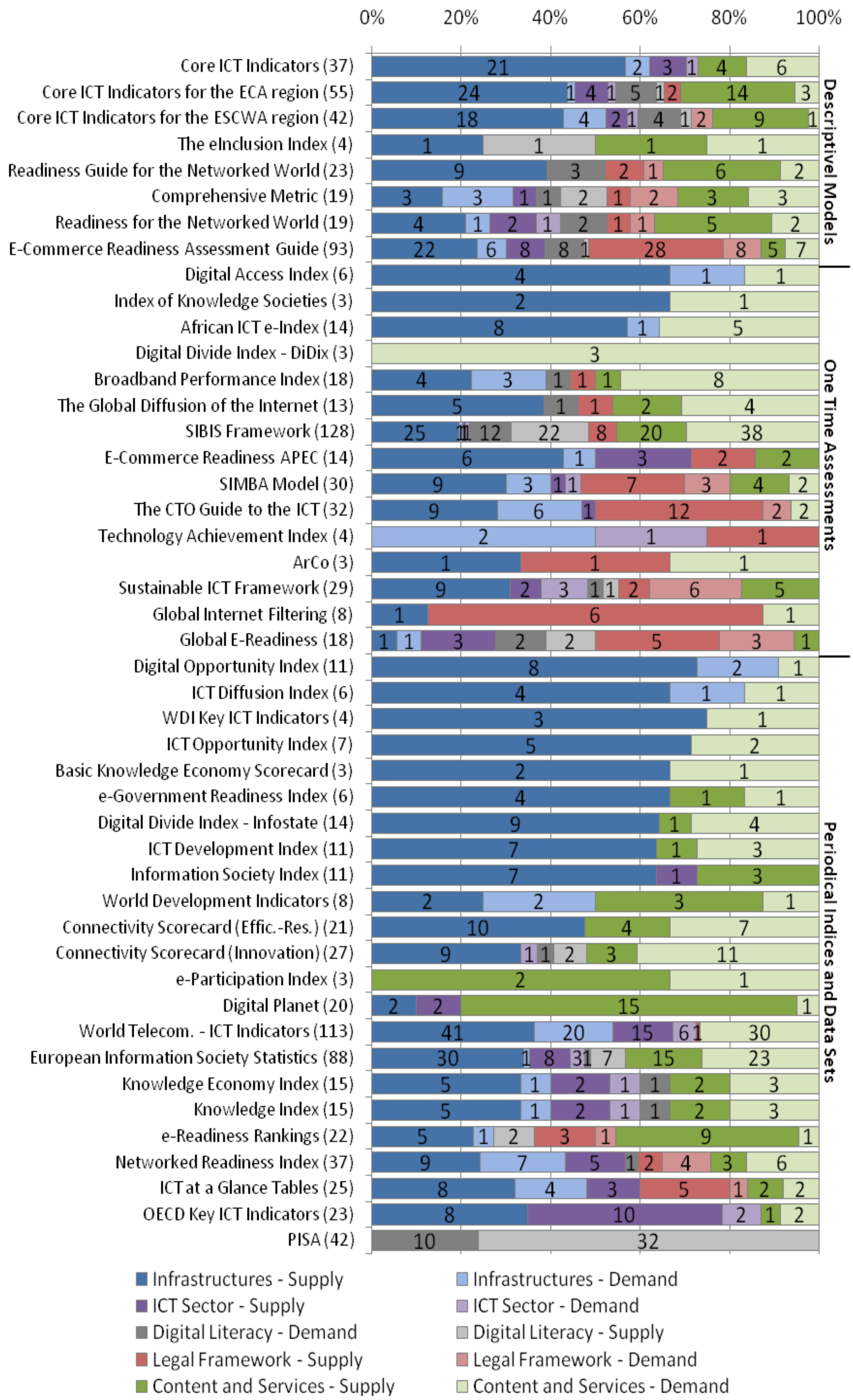

Figure 196: Composition of models (indices and sets of indicators) that measure digital development.

Numbers in parentheses show total number of components (indicators and subindices) of models; numbers in bars show components by category; bar lengths show the relative weights of each category within the model.

We will end the chapter with a proposal to frame the future path of e-Readiness research, a proposal that will be tested in Part III of this work, keeping the reflections in this chapter as a bridge between – in our opinion – such a necessary combination of qualitative and quantitative analysis.

In Figure 196[288] – which is afterwards split in Figure 197, Figure 198 and Figure 199 for the sake of clarity – we have plotted all[289] the models we have analyzed in the second part of this work. We have included information on both the number of indicators in each category for every model, and the share of the total that these categories represent within each model.

A first glance, Figure 196 clearly shows what we already discussed in the previous chapter: namely the absolute predominance of the proportion of indicators that measure Infrastructures, especially their availability (supply side, without affordability measures). And, following on from this, we also find again the big weight of usage on the demand side, as the quantity of use being made of content and services (not the supply of digital content and services). Added together, we see Figure 196 totally dominated by availability of infrastructures and their usage, leaving at a lower level the proportion of indicators measuring the ICT Sector, Digital Literacy and the Regulatory Framework[290].

10.1.1. Descriptive Models

But the interesting exercise in the figures appearing in this section is comparing them in relationship with the kind of measuring device, namely: theoretical models, one time assessments, periodical indices, and data sets.

Figure 197 shows only what we have called descriptive models[291]. If we take out the Core set of ICT Indicators, which even if being a descriptive model are totally bound to the actual availability of indicators in the infrastructures side, the rest of the set shows how there is an effort towards comprehensiveness.

For instance, the Core set of ICT Indicators for the ECA and ESCWA regions, though taking the Core set of ICT Indicators as a base, try and go a step forward and include some other indicators from the other categories that are usually underrepresented.

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[288] And then split in three in the following figures, one for each group of models except the Decriptive Models (see also note 289).

[289] Some 6 out of the 55 models had not made explicit what kind of indicators might make up a hypothetic measuring tool based on their points of view. These models are GeoSINC's e-Readiness Guide; the Global Action Plan for Electronic Commerce; the Layers, Sectors and Areas of the Information Society model; Mark Warschauer's Models of Access; the Access Rainbow and the Development Dynamic. These models are not included in the following figures, though their approach is similar to that of the Theoretical Models (Figure 197) and One Time Assessments (Figure 198).

[290] We present all this issues in more detail in chapter 9.

[291] See chapter 5 and also note 289.

This is even truer for the four models appearing on the bottom of Figure 197, where we can see most balanced and comprehensive models. Two main characteristics are common from them: they mainly come from academic or scientific origins and have also been designed quite early respective other later models[292]. So, it seems that, when unconstrained by the "reality" of limited data availability, the model authors tend to look at the Information Society from a wider perspective and taking into account more issues. Thus, the issues taken into account arise usually from literature and direct observation regardless of the fact whether they will be easy or difficult to measure, but based on grounded needs for policy making or the explanatory power of the model.

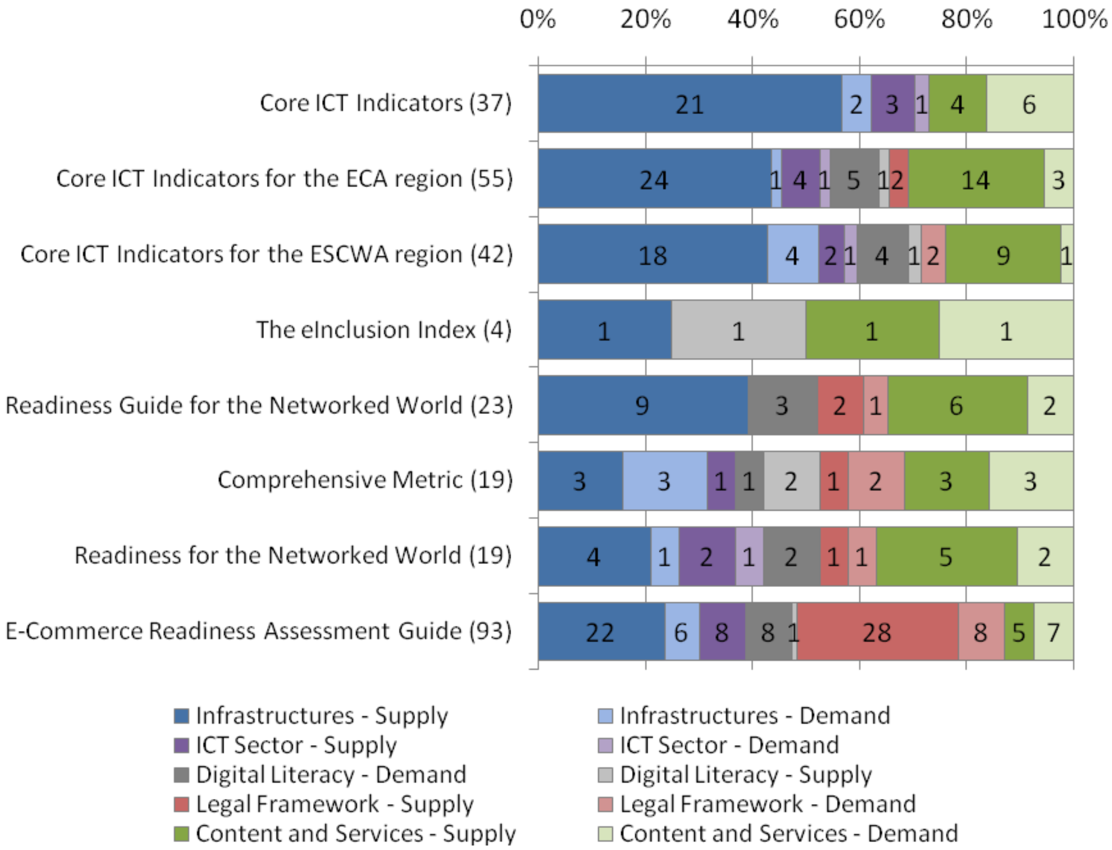

Figure 197: Composition of Descriptive Models.

Numbers in parentheses show total number of components (indicators and subindices) of models; numbers in bars show components by category; bar lengths show the relative weights of each category within the model.

10.1.2. One Time Assessments

The trend that appeared in the Descriptive Models is even stronger for One Time Assessments, which are theoretical models put into practice. Most exceptions to this rule have their explanation in the fact that the said models were not originally

[292] Barzilai-Nahon's model was last published in 2006, but had been along for some years at that time, in working papers and other articles.

intended to be One Time Assessments, but aimed-to-be indices with a periodicity that was not matched. This is the case of the DAI, the IKS or the TAI.

Most others show again a much needed approach towards comprehensiveness, a fact that is reinforced by a strong will to incorporate the regulatory framework. This intention is lead by none other than the wish to advise policy-makers of how their actions will affect (positively or negatively) both the development of the Information Society and digital development in the economy and society at large, as can be seen in the background documents that underpin these models or frameworks.

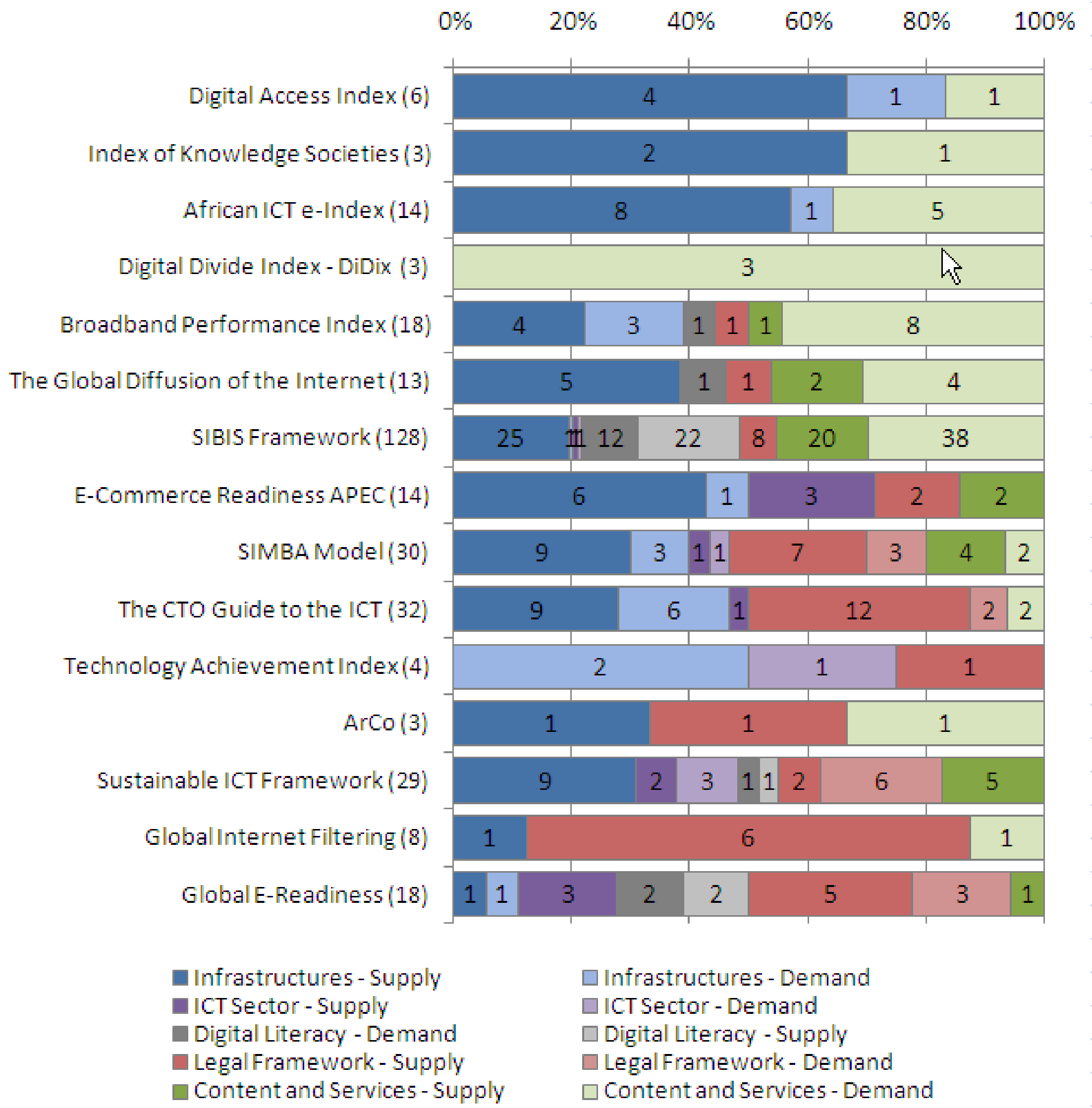

Figure 198: Composition of One Time Assessments.

Numbers in parentheses show total number of components (indicators and subindices) of models; numbers in bars show components by category; bar lengths show the relative weights of each category within the model.

It is interesting, then, to see that descriptive models and theoretical models put into practice (i.e. one time assessments) are more driven by the goals to measure as much as possible, infringe a change in the evolution of what has been measured and, in any case, are not bound by the constraints of existing measuring tools, setting up new indicators (e.g. surveys) or proxies (e.g. tertiary education for digital literacy) so as to cover the whole range of categories.

10.1.3. Periodical Indices and Data Sets

Unlike the preceding groups of models, when it comes to the most practical ones – Periodical Indices and periodically updated Data Sets – things change radically.

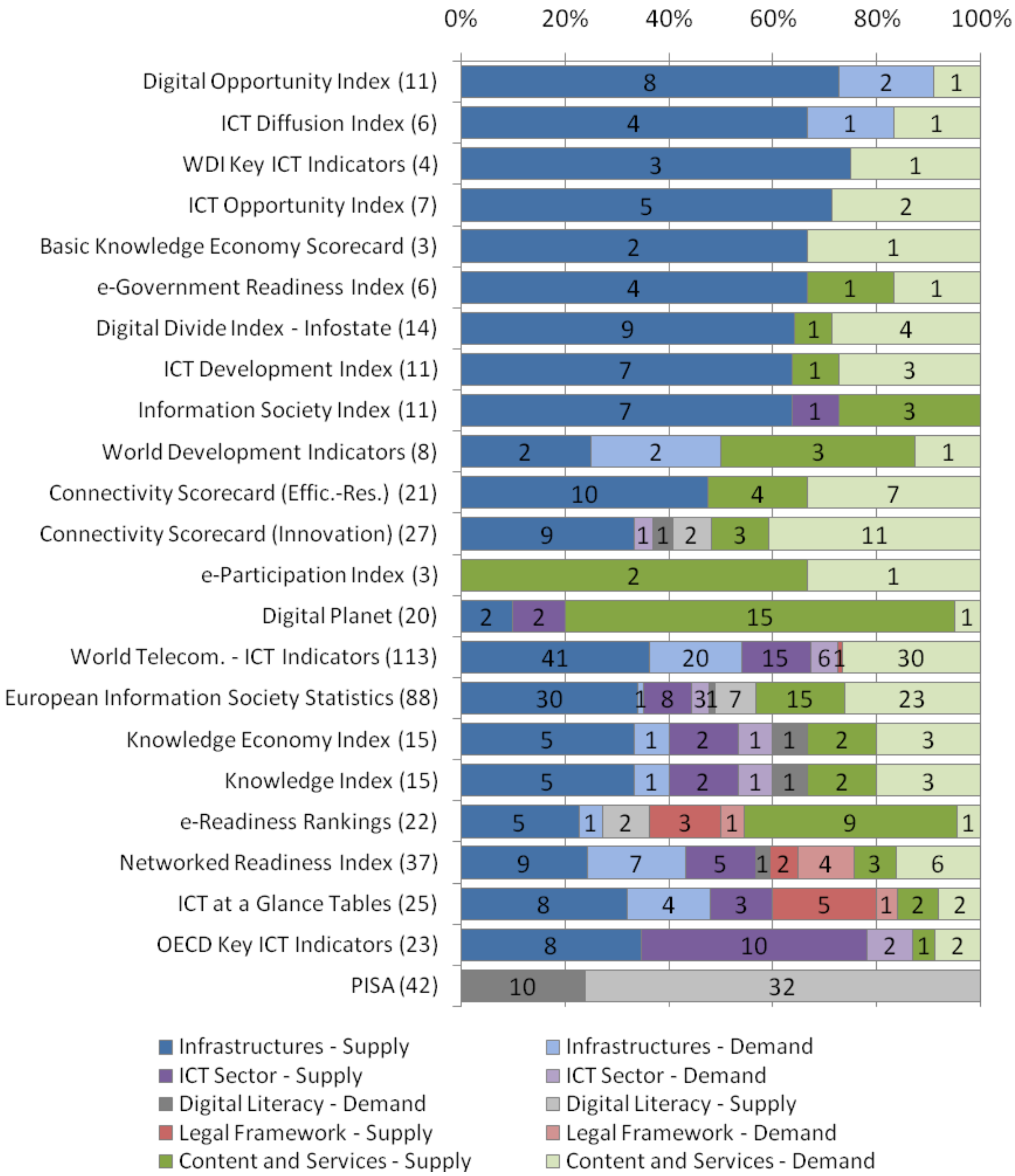

Figure 199: Composition of Periodical Indices and Data Sets.

Numbers in parentheses show total number of components (indicators and subindices) of models; numbers in bars show components by category; bar lengths show the relative weights of each category within the model.

The shift towards Infrastructures (supply side) and content and services (especially the demand side, though also the supply side) is more than evident. If we analyze who is fostering these indices and data sets and what are the reasons behind running such measuring tools, two main reasons arise for this bias.

The first one is that many of them are backed (explicitly or implicitly) by technological organizations, whose main reason for producing these data is, precisely, to measure their activity and the impact their activity has. Thus, it is but normal to see the bias towards this field.

The second one is availability of data, or, actually, the lack of it. When organizations producing data are not directly or indirectly related to telecoms, what we find is that these organizations have to rely on the available data. And, despite the efforts made by some of these organizations to include new sources and new indicators to broaden the range of data produced, the fact is that, at the aggregate and macro (country) level, these new data come only quite slowly.

A corollary to this second reason is that, when primary data is not available – but there is a strong need or focus on uncovered issues – organizations tend to produce data from any means at hand. This is the case, for instance, of the e-Readiness Rankings and the Networked Readiness Index, which include subjective data that comes from directly surveying experts in specific fields where primary data are just not available. It is worth noting, nevertheless, that the e-Readiness Rankings or the Networked Readiness Index are produced in a quasi-scientific environment (by EIU and INSEAD, respectively).

10.2. Preliminary conclusions on the evolution of digital economy: frameworks and models

10.2.1. On the concepts and theoretical grounds

The 55 models analyzed so far suffer dramatically from what we already saw in Part I of this work: there is little consensus about some fundamental concepts like access or (effective) usage, to name but two.

Van Dijk (2006) writes a harsh critique about the research made in the field of the digital divide and groups the main theoretical problems of this research as:

- lack of theory
- lack of interdisciplinary research
- lack and quality of qualitative research
- lack of a dynamic approach
- insufficient attention paid to the consequences of the digital divide(s) observed
- lack of conceptual elaboration and definition

We would add to these theoretical shortages the two approaches that we spoke of in chapter 3 and that, in our opinion, have been demonstrated throughout Part II of this work: the opposing points of view of the Telecommunications Model and the Broadcasting Model, replicated in the field of the Digital Divide as the Telecommunications Model and the e-Readiness Model.

We believe that it has been demonstrated that, as happened in the field of Communication, these two models represent such different approaches that, necessarily, either need to converge on a meeting point or will but give partial explanations of the underlying reality.

The reasons for these two approaches are many and have already been pointed out, the main ones being:

- the nature and purposes of the institutions developing a specific model, focusing on infrastructures and quantitative use if related to telecoms, broadening their scope if issuing from scientific or academic environments
- the specific interests (monitoring vs. explaining the reality) also determine institutions going deeper in their analyses
- availability of data also determines how far a measuring tool will go, being the trade-off very often between periodicity of measurements but narrower field of study vs. a broader approach but not easy to repeat (i.e. usually not repeated) due to higher costs
- last, but not least, we believe that some models are based on reasons of comfort: if data are unreliable[293] or just do not exist, theoretical models are shoehorned into what it is at hand.

10.2.2. On the sources

Minges (2005) lists “specific shortcomings with the existing e-indices”:

- Poor at tracking ICT evolution
- Categorization not consistent
- Lack of transparency
- Poor choice of indicators
- Subjective
- Exclusive, leaving some countries out for several reasons
- Limited extensibility
- Applicability to developing countries.

To which the author (Minges, 2005) adds some proposals for improvement:

- Harmonization and consistency
- Longevity to enable time series
- Inclusive “to incorporate as many countries as possible”
- Objectivity

[293] See below

- Transparency
- Data correctness, selecting the appropriate indicators
- Selection of the most relevant indicators
- Document all indices and the way they are built and sources.

To which we would like to add:

- Poor data: data are corrected, at an aggregate country level, quite inconsistently. Being aware on the difficulties and cost of collecting such data does not make it any better. Time series are, for the most part, non-existent. On the other hand, it is easy to take the year of publication of a specific indicator as the year (or the following year) of its calculation, when evidence shows it does not happen this way on a broad basis, finding, for a given year, "latest available" data actually coming from several timespans.

- The main data sources are for the telecoms sector, which implies a dire shortage of "social" data, ranging from literacy to effective (not quantitative) usage.

- Even when data exist, microdata and primary data are not usually available, so disaggregation – or going to specific features below the aggregate level – is almost impossible.

- Indeed, when data not coming from telecom sources are available, it is often subjective or non primary[294]. Even if surveys and calculations are carefully done, it is unavoidable that biases and inaccuracies occur.

- An inexplicable and yet puzzling omission in data about the Information Society is anything related to digital literacy and the use of ICTs for Education and in Education at large[295]. In our opinion, this issue inflicts a severe fracture in the continuum of Information Society analysis, as it splits assets from usage by not being able to tell about the skills that help applying assets into effective usage. While the effort of UNESCO with the Performance indicators on ICT use in Education is really important, it is still an ongoing project and, on the other hand, it is still insufficient. Awareness in this issue should be raised specially within policy-makers and decision-takers so that resources are allocated to measure this gap, given the attention we believe it deserves.

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[294] It comes in the shape of compounds or indirect measurements, not pure indicators.

[295] Help may be at hand, here, in the new set of ICT for Education Indicators that have been developed by the UNESCO Institute of Statistics and which have been added to the Feb 2009 revision of the core set of ICT Indicators. Basic data gathering is also occuring through the regional surveys being carried out by the *info*Dev unit of the World Bank. Regional surveys for Africa and the Caribbean have been published (see http://www.infodev.org) and a new survey of India and South Asia has just been commissioned.

10.2.3. On the targets

In general, we think most models to measure the digital economy serve two main goals:

1. To actually monitor the development of infrastructures and their usage, a goal that is satisfactorily achieved, but that explains only part of the picture, as we have been explaining above.

2. To compare countries but not on a qualitative basis, but on a quantitative one. The e-Readiness approach many times focuses on the comparison at the aggregate index level – the ranking – but not at other levels and, in very few cases, on the reasons that made a country score higher or lower beyond the mere weighted addition of its compounds.

Regarding the first point, we have already mentioned how partial and how incomplete is looking just at a part of the whole landscape. In Hargittai's (2003, p.9) words:

> "As more people start using the Web for communication and information retrieval, it becomes less useful to merely look at binary classifications of who is online when discussing questions of inequality in relation to the Internet. Rather, we need to start looking at differences in how those who are online access and use the medium."

And it is not a matter of designing the correct target, but also to benchmark research made in similar fields and try and find synergies that surely arise in multidisciplinary approaches. For instance, e-Government:

> "We suggest E-Government and the digital divide should be seen as complementary social phenomena (i.e., demand and supply) [.....] For practice, this new understanding has the potential to create a more comprehensive strategy that takes into consideration the alignment of E-Government initiatives and digital divide policies such as access, education, and identification of individual needs" Helbig et al. (2008)

Regarding the second point most analyses are made between countries at the index level, but little is made *inside* indices by using individual indicators or compound subindices. The latter is often impossible to produce for many reasons, most of them already highlighted by Minges (2005). On the other hand, relationships of causality are often overridden, focusing the results in the headline-like statements that will make it to the news[296].

[296] Our critique is not, of course, of those that make the indices, but to the way their results are reported to the population at large, very often narrowing the analysis in the final output instead of the way (not the index but) countries made it to achieve this or that indicator value.

This also makes it difficult to assess the real explanatory (in)capabilities of rankings beyond the mere ranking. Indeed, little is said about the dynamics of indices related to dynamics of public policies or the evolution of many other variables.

Besides matters of including (or leaving excluded) some relevant indicators, there is also the issue of which indicators to choose in relationship not with the category (e.g. infrastructures) that we want to analyze (a vertical selection), but to what kind of countries are we looking at (a horizontal selection). In this sense, Barzilai-Nahon (2006) states that:

> "I do not assume that the e-readiness question overlaps the digital divide issue, and therefore I do not believe all the integrated assessment tools compared in the Bridges.com study would fit our discussion here. For example, I do not think that trust in eCommerce relates directly to digital divide."

This is, approximately, the rationale behind Waverman et al. (2008, 2009) when calculating the Connectivity Scorecard[297], with which we partially agree. In our opinion, we should be able to separate description – or characterization – from the relationships of cause.

Thus, we agree that the determinants that drive the digital evolution of countries are by no means independent from their context, hence the need to look for different things depending on the country – or group of countries – that we are measuring. On the other hand, we also see digital development as a continuum, with plenty of variables interlinked and correlated one to each other. Thus, the snapshot should be made comparable (a) amongst countries and (b) amongst different moments in time for the same country.

10.3. A proposal for a comprehensive 360° digital framework

To sum up what has been said so far, we here propose a comprehensive framework that gathers all the sensibilities, points of view and approaches explored so far. In a sort of game of transparencies, we have taken the 55 models analyzed in this work and superimposed one over the other, so that all categories overlap in a final picture. In Figure 200 we have attempted to draw that picture.

By drawing this comprehensive framework we do not aim at designing yet another index, but rather to collect everything we have been seeing and gather it all together in a single place[298].

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[297] See section 7.12

[298] The reader will notice that we have been using, actually, this same comprehensive framework to categorize and describe all of the selected models for the whole of Part II of this work. Of course, it was an iterative and recursive exercise that began with the models, followed by identifying their main features and components, and then drawing this framework that helped to characterize the initial models when revisiting them for a final analysis.

Notwithstanding, we do not want to finish our work with a theoretical proposal, emanating from the qualitative analysis, but will go one step beyond and test whether this comprehensive map and be actually applied to reality.

Taking as a basis the scheme drawn in Figure 200, and looking at the more than 1,500 indicators[299] that make up the 55 models appearing in Part II of this work, we have selected a representative number of indicators that represent – in our opinion and on the basis of the analysis made so far – a comprehensive approach of the development of the digital economy.

[299] Some of them are, actually, compound indicators, sub indices or indices calculated outside of the models. See next chapter and Annex IV for further detail.

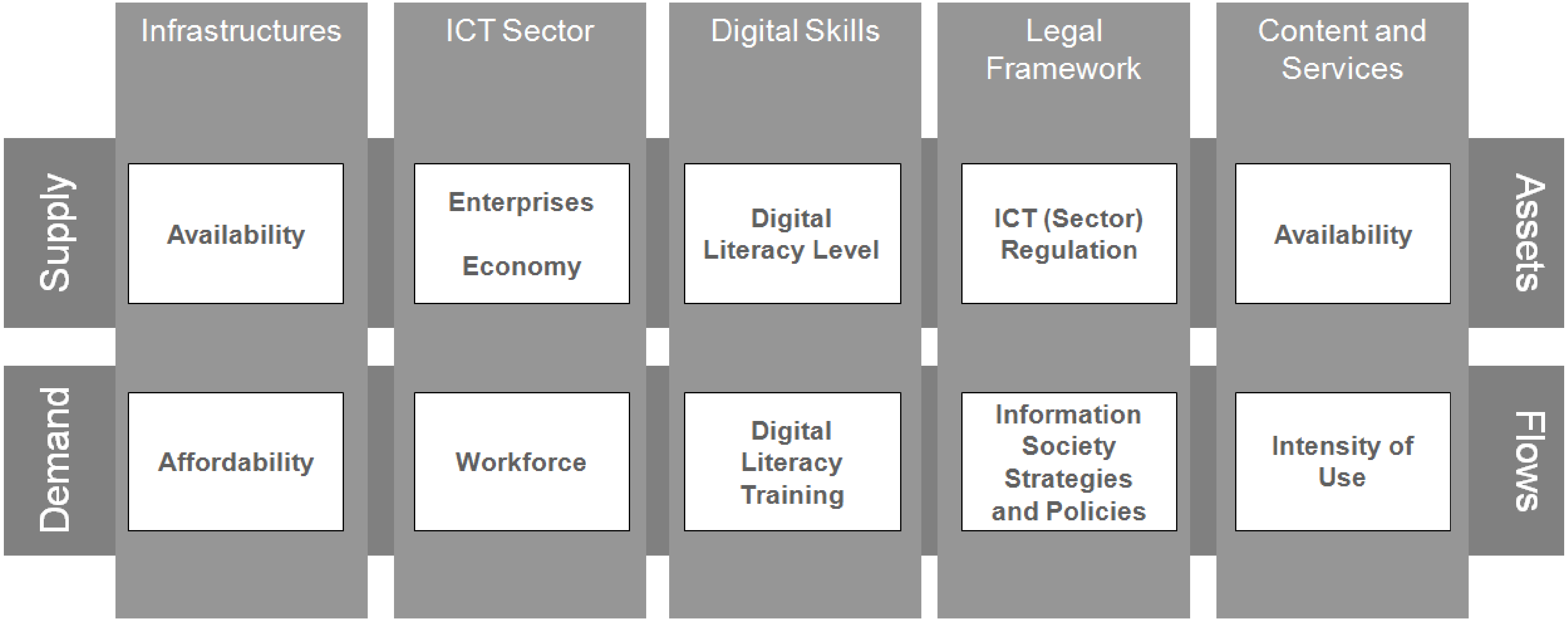

Figure 200: A comprehensive 360° digital framework to model the digital economy[300]

[300] More information about the individual components of this figure can be read in chapter 4.

Table 9 shows the proportion in which we have included the indicators per category[301]:

Infrastructures	ICT Sector	Digital Skills	Policy and Regulatory Framework	Content and Services	Nondigital
8	2	2	3	5	27
5	4	1	2	6	

Table 9: Share of indicators of the 360° digital framework

Table 9 can also be graphically seen in Figure 201, which features the share of indicators of the 360° comprehensive framework, and Figure 202, which also features the share of indicators of the 360° comprehensive framework, but leaves aside the analogue indicators and includes, instead, the subcategories we built into our 360° digital framework.

As can be seen in these two figures, ours is quite a balanced framework, and not only under a theoretical approach, but also at the practical level – and statistically significant[302].

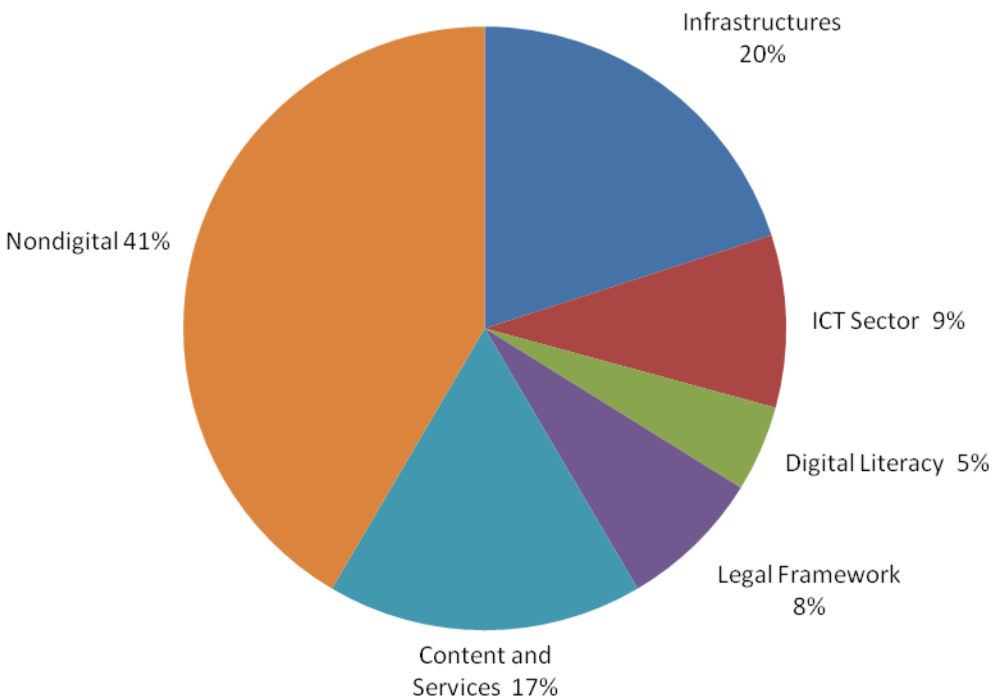

Figure 201: Share of indicators of the 360° digital framework – assigned categories

[301] See chapter 9 and following for further details on which, why and how the indicators were selected.
[302] In chapter 12 and following we use our 360° digital framework to select a set of indicators and use this set to draw and describe stages of digital development. As it is stated there, the indicators chosen are statistically significant when performing cluter analyses and building contingency tables that compare the values amongst clusters.

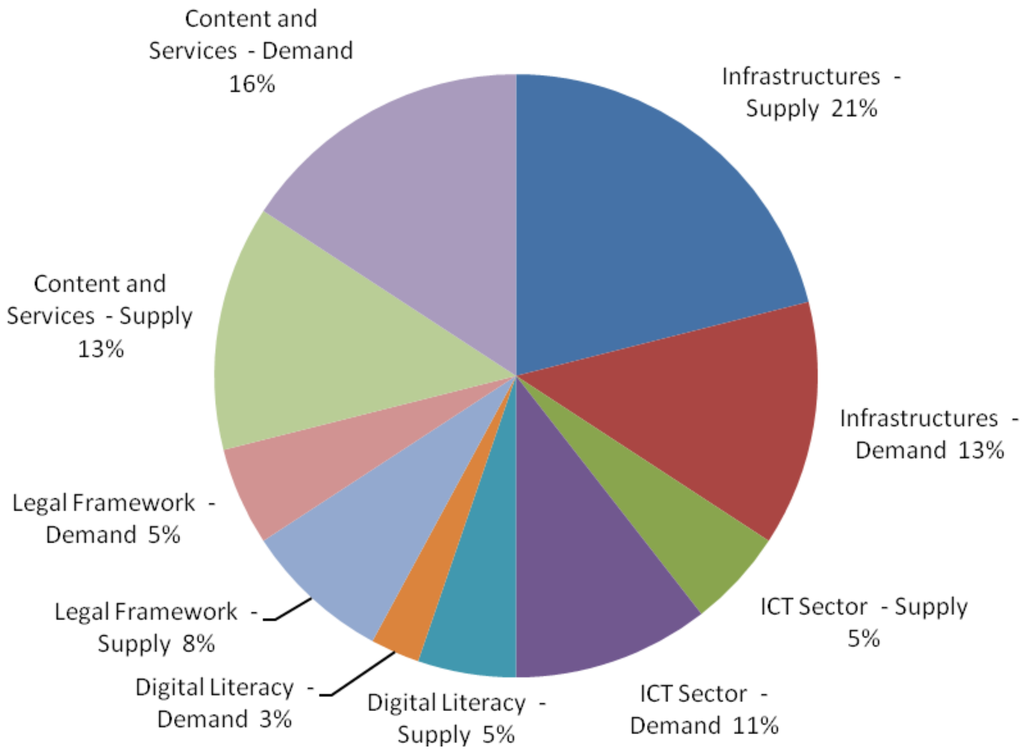

Figure 202: Share of indicators of the 360° digital framework – assigned categories (extended)

Last, Figure 203 pictures the proportion between demand side and supply side indicators for the 360° digital framework. It is clear that we have not been able to succeed in producing a framework where the demand side is more represented – neither in relative terms nor in absolute ones. We assume that an improvement in the measurement of the demand side of the digital economy (especially those aspects related to the ICT Sector, Digital Literacy and the Policy and Regulatory Framework) would help in building a more representative and balanced set of indicators.

In the next part of this work – Part III – we will rely upon and leverage this comprehensive approach to digital development (and its measurement) to perform a quantitative analysis that will bring a practical, statistical insight to the qualitative, theory-heavy one that has dominated this work so far.

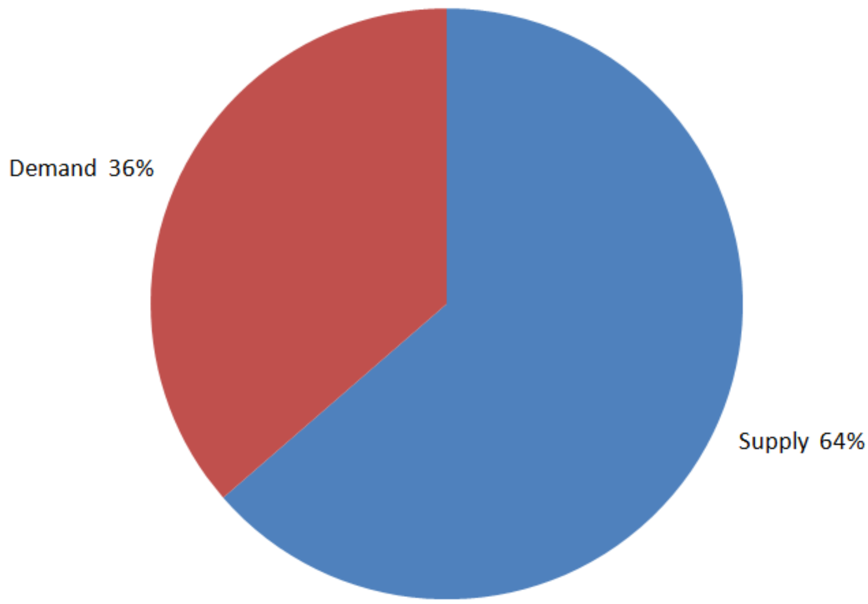

Figure 203: Share of indicators of the 360° digital framework – supply vs. demand

Part III:
Stages of Development of the Digital Society: definition, characterization and determinants

11. A Quantitative Analysis: Methodology

The first part of this work has provided us with a general overview of what have been the different conceptions of “access” during the recent history of Information and Communication Technologies, the problems around the lack of it and, most interestingly, the main impacts that this access have brought to the different dimensions of society, the economy, communication, etc.

During the second part we have explored several ways in which these conceptions of access have been modelled – implicitly or explicitly – with the aim either to reflect on how the issue of access should be addressed or with the purpose to measure the evolution and state of development of a digital society[303]. After a qualitative analysis, we ended that second part by identifying some weaknesses and deficiencies of the whole set of models and by stating some proposals to achieve a comprehensive way to tackle the subject; conclusions that can be found in the previous two chapters of this work.

In this third part, we will use the previous findings and the preliminary conclusions from the qualitative approach and test it statistically against reality. Hence, we will perform a quantitative analysis, at the country level, that will

- identify and describe the different stages of digital development at the country level;
- describe and characterize these different stages according to digital and analogue variables;
- determine the reasons why a country should have a higher probability
  - of being amongst the most digitally developed countries
  - of being amongst the least digitally developed countries

Based on the methodology used in the works by Ficapal & Torrent i Sellens (2008), Lupiáñez-Villanueva (2009), and using some insights from Çilan et al. (2008), Vicente Cuervo & López Menéndez (2006) and Vicente Cuervo (2007), we will take data from several databases[304] and, after having described them, we will simplify them to make them more easy to work with. The simplification will be pursued, on one hand, by means of factor and cluster analysis; and, on the other hand, dichotomizing data in binary values (i.e. “high” and “low”).

The resulting variables from the data simplification will, firstly, be used to define, describe and characterize different stages of digital development through cross tabulation. Secondly, these variables will also be used in binary logistic regressions to identify the variables that determine the causality of the relationship among the dependent and these independent variables, including the strength of this relationship of dependence.

[303] A definition, by construction, that varies according to the model applied.
[304] See below for further detail.

This chapter explains the general procedures stated above, while the following chapters will detail each one of the operations and show the specific results that they shed light on[305].

11.1. Sources of Data and Description of Variables

As has been stated in previous chapters, one of the main problems we – in this work and as a society at large – face when trying to measure and analyze the stage of development of a digital society is lack of data at the country level, especially for developing countries. And not only a lack of data, but a lack of data that is comprehensive, coherent and consistent in its inner structure: even if data might show up and end up being available, the sources are different and based on primary surveys whose quality is more than dubious due to differences and irregularities in the gathering of them.

The reasons for this are many, of which the two most important:

1. Organizations that (vertically) gather data for most countries in the World but only in the framework of a specific topic. This is the case, for instance, of the International Telecommunication Union and its work on technological infrastructures
2. Organizations that have a broader scope and (horizontally) gather data about a comprehensive set of topics, but that are restricted to a small group of countries. This is specially the case of regional organizations like the European Commission or the Organisation for Economic Co-operation and Development

The research we are here presenting has been no exception. Our data comes from no less than a dozen different sources, these sources in turn sometimes using data from each other[306].

On the other hand, scarcity of data happens not only across countries but across time. As we have been showing in previous chapters, time series in most cases are nonexistent or, at best, really recent. But even when time series exist, they are not always complete since a specific date, but are published according to their availability which in many cases does not come on a yearly basis. This means that some data might be available for some countries one year and for some other countries the preceding or the following year.

Last, but not least, the publication of data for a specific year speaks little about when they were collected, as sources are multiple (the different ministries and other institutions for each and every country) and very difficult to be enforced to follow the desired rules, even if agreed between institutions.

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[305] All calculations where made using SPSS 15.0

[306] As it happens with organizations within the United Nations System, or institutions presenting elaborated data from primary data from third parties (e.g. some indicators published by the World Economic Forum).

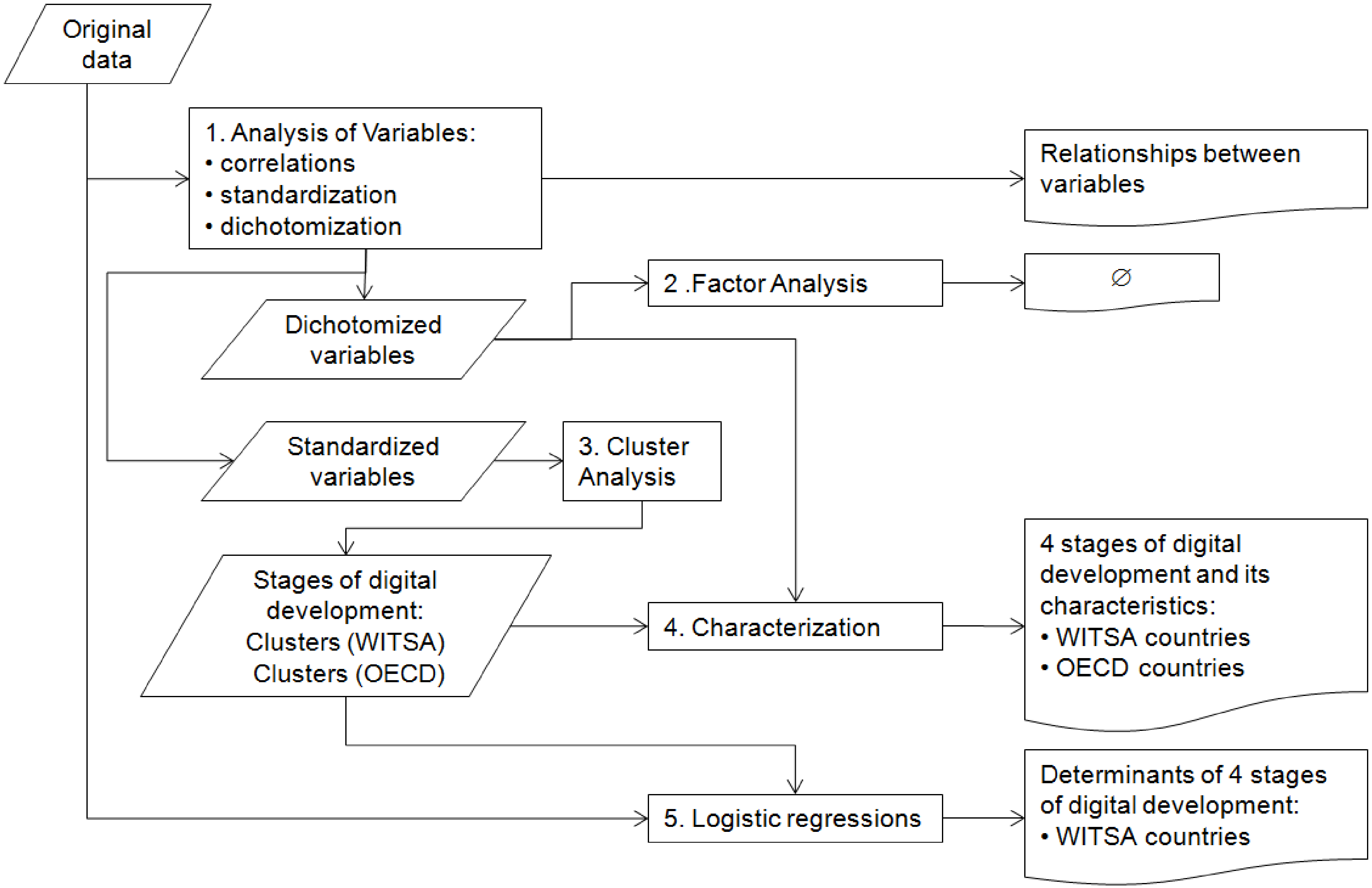

Figure 204: Scheme of the methodology for the statistical/quantitative analysis

With all these constraints in mind, we have nevertheless created a dataset[307] with some 156 variables for 246 economies corresponding, in time[308], to the last data available for such variables[309].

This is, of course, the point of departure. In the following chapters we will explain which of these variables have been directly used in statistical calculations, some of them because of methodological approaches, most of them because many of the potential 38,376 values[310] we had where simply – and sadly – void. In some cases, they are void because the data is missing but in other cases they are zero because the service did not exist in that particular country at that time.

11.1.1. The World Bank: World Development Indicators

The World Development Indicators, published by The World Bank, provide "direct access to more than 800 development indicators, with time series for 209 countries and 18 country groupings from 1960 to 2007, where data are available"[311].

We have used 69 indicators from this database, 22 for the digital indicators set and 47 for the analogue one. The values are usually taken from year 2007[312], though for some missing values it has been necessary to use data from previous years[313], normally from 2006[314].

11.1.2. International Telecommunication Union: World Telecommunication Indicators

The International Telecommunication Union has provided our database with 18 indicators from their World Telecommunication Indicators[315]. As happened with the

[307] See Annex IV for more details on the specific variables and their respective sources.
[308] It is important to note that we are not doing a time-series analysis here, though data might come from different years – though within a tight range of dates.
[309] As we will be seeing in the paragraphs that follow, this last statement is not strictly true, but it absolutely is the philosophical guideline behind the selection of data. Failure to follow this rule has been due to lack of data or adjustments necessary to achieve a higher degree of inner consistence in specific variables.
[310] 156 variables x 246 countries
[311] http://go.worldbank.org/B53SONGPA0
[312] Though this is the norm, the year actually taken as a base is the last one with the most complete data set. E.g. Infant Mortality Rate has no values for 2007, thus the base year taken was 2006. See also note 313 for further information about what we mean about the base year.
[313] After a base year is chosen according to maximum availability of data in the time series, voids are filled in with data from the previous year or the year previous to this one. If still no data is available, the field is left blank.
[314] When data are available for several years, it can be easily realized that values do not change dramatically from one year to another, especially in analogue indicators (e.g. population), thus why we believe that the representativeness of the final set is still of value. On the other hand, and as we have already stated, the collection of data is so irregular across countries that not even by taking data for the same year would we be sure that the sample is more consistent than the one built here.
[315] http://www.itu.int/ITU-D/ict/publications/world/world.html

case of The World Bank's World Development Indicators, data are but incomplete. Our choice as a base year[316] was, in this case, 2005.

ITU's WTI data have been used mainly to feed variables related with ICT infrastructures, the ICT sector and digital usage.

11.1.3. International Telecommunication Union: World Telecommunication Regulatory Database

The International Telecommunication Union also publishes the World Telecommunication Regulatory Database[317], from whence we used 12 variables, all of which relate to the legal framework (e.g., level of competition in national telecommunication markets).

The base year is in this case 2007. Unlike the case of the infrastructures, in the trade-off between more data or more actual data we chose here actuality, as this is indeed an issue that easily changes almost overnight and we considered it worthwhile to have less but more recent data.

11.1.4. The World Economic Forum: Executive Opinion Survey

The World Economic Forum's Executive Opinion Survey is a major component of both The Global Competitiveness Report and the Global Information Technology Report "and provides the key ingredient that turns the Report[s] into a representative annual measure of a nation's economic environment and its ability to achieve sustained growth, gathering valuable information on a broad range of variables for which hard data sources are scarce or, frequently, nonexistent"[318].

As stated in the quotation, we used the Executive Opinion Survey to feed 11 variables related with digital literacy, the legal framework and usage. We are aware – and have indeed talked about this before – that these are qualitative and subjective data that come from surveying experts in this fields.

Data come from the Executive Opinion Survey 2006-2007, which is the one used in Global Information Technology Report 2007-2008, (the 2009 edition having been published in late March 2009, after the conclusion of the research phase).

11.1.5. WITSA: Digital Planet

We have used 5 indicators from WITSA's Digital Planet for the ICT sector, digital literacy and usage. Even if the last edition is published in 2008, data for that year are still estimates, so we had to use instead year-end 2007 values.

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[316] See notes 312, 313 and 314.

[317] The data used in this work can be accessed at the ITU ICT Eye (http://www.itu.int/ITU-D/icteye/)

[318] http://www.weforum.org/en/initiatives/gcp/index.htm

It has already been stated in section 8.5 that the main problem with WITSA is that it constraints data down to 75 countries. In fact, though if not explicitly, this is the same problem with many databases, including lots of indicators coming even from the United Nations System or the World Bank. As explained below, it is precisely the WITSA country set that we will be using more intensively in this work for our calculations.

11.1.6. OECD: Key ICT Indicators

Used only for 28 of the OECD members[319] for which data are available, we have accessed from OECD's Key ICT Indicators[320], a set of "15 ICT indicators [...] drawn from various publications and databases produced by the OECD's Directorate for Science Technology and Industry"[321].

Most indicators date from 2007, though some of them were from 2006 or 2005.

11.1.7. UNESCO: UNESCO Stats

To complete our data about literacy – either used as is or as a proxy for digital literacy – we took 4 indicators from UNESCO Stats[322].

Data come from year-end 2006, the latest available at that time.

11.1.8. UNPAN: UN e-Government Readiness Survey

To complement issues of usage and human capital, we used 3 indicators from the UN e-Government Readiness Survey (UNPAN, 2008).

Data were published in January 2008, which means that the survey was carried out during 2007, for which the data are representative.

We have to note that the three indicators we used are, actually, composite indices built around several indicators that measure, for instance, several variables related with the presence of government websites. Detailed discussion about composite indices used as single variables will be discussed further in this work at the appropriate time.

11.1.9. UNDP: Human Development Report

Very similar to the case of UNPAN's is UNDP's Human Development Report, from whence we also use the composite Human Development Index and two different measures of inequality.

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[319] See Annex IV, Table 32
[320] http://www.oecd.org/sti/ICTindicators
[321] Even if, nominally, OECD lists as 15 the number of ICT indicators it publishes, some indicators are actually groups of two or three indicators, thus why we could get 24 indicators out of 15.
[322] http://stats.uis.unesco.org/

Even if the latest edition published of the Human Development Report so far is the *Human Development Report 2007/2008*, it dates from 2006 and includes the Human Development Index for 2005, which is the one we have used for our calculations, including both indicators for inequality.

11.1.10. The World Bank: Knowledge Assessment Methodology

Within the framework of the Knowledge Assessment Methodology[323], the World Bank calculates the Knowledge Economy Index (KEI) and the Knowledge Index. As we have explained[324], these are composite indices that contain four other composite sub indices. Two of them – ICT Index and Education Index – would be redundant and most probably have correlation problems with many other variables in our set.

But the other two – Innovation Index and Economic and Institution Regime Index – were both worth including here as they gather many aspects of the economy, especially those closely related with progress and the proper framework that fosters it.

Besides these two, we also included the *variation* of the KEI as a way to gather all knowledge related issues that we might be forgetting in our comprehensive set of variables.

Indices were built in 2008, which puts data back to 2007.

11.1.11. CIA: Factbook

In our quest to obtain the best and the more data available, we (partially) succeeded in finding figures for Internet Service Providers (ISP) per country published by the United States of America Central Intelligence Agency[325]. Unluckily, the most recent series date from 2003 (Central Intelligence Agency, 2003).

Due to data being clearly outdated, or just because the issue of ISPs is not statistically relevant, the number of ISPs per country was, ultimately, not included in any significant calculation we made.

11.1.12. Webhosting.info: Research Data & Tools

Webhosting.info[326] maintains several databases related with web hosting activities called Research Data & Tools that includes figures about domain names, web hosts, ICANN registrars, IP addresses or top level domain registries.

The total number of domains per country[327] for August 11th, 2008, was included in our database in order to catch the influence of this variable in our model.

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323 http://www.worldbank.org/kam
324 See also section 7.7
325 https://www.cia.gov/library/publications/the-world-factbook/
326 http://webhosting.info/
327 http://www.webhosting.info/domains/country_stats/

11.1.13. Facebook: Number of Users

In an essay to try alternate approaches to measure digital literacy rather than the usual proxies based on education, we included data about usage of social networking sites (i.e. Facebook[328]) and blogging tools (i.e. LiveJounal[329] – see next section).

Data from Facebook at the aggregate level – absolute total – is publicly available, but it is not so at the country level, at least not institutionally.

A rough approach can be obtained through the Facebook Advertising page of the site[330] by simulating the total number of audience of an ad put on Facebook targeting a country at a time.

The data we are using here date from August 13th, 2008.

11.1.14. NationalMaster: Internet Statistics

As with Facebook, LiveJournal does not publish data about its users.

NationMaster published, in its Internet Statistics for 2004[331], a list of LiveJournal users per country. This list has, to say the least, two big problems. The first one is that it is absolutely outdated, given the kind of data it shows and the time passed. The second one, even more important, is that, by that time, the United States almost holds 80% of the total users (this is because all .com domains are inaccurately allocated to the USA). This last problem renders totally useless the data series, not because it is not representative of blogging uses around the World – which most probably is not – but because, beyond doubt, it is not representative of the level and share of digitally literate people between countries.

All in all – and as happened with data from Facebook – this variable did not show any statistical significance in any calculation we made, even taking out of the sample the value from the United States of America.

11.2. Analysis of Variables

What has been stated in the previous section about the several weaknesses – and sometimes dire lack of quality data – led us to reduce the initial number of countries chosen (246)[332] down to 75[333], which are the ones covered by WITSA's Digital Planet.

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[328] http://facebook.com
[329] http://livejournal.com
[330] http://www.facebook.com/home.php#/advertising/?src=pf
[331] http://www.nationmaster.com/graph/int_liv_use-internet-livejournal-users
[332] Annex IV, Table 30
[333] Annex IV, Table 31

This list of 75 countries made it possible to perform some analysis, including quite a wide array of countries, ranging from the most developed ones to a large number of the more populous developing ones, following our initial purpose to include as many developing countries as possible. Lack of data for the poorest ones just made it impossible to perform any kind of significant statistical calculation with the smallest sample of data available for all of the listed countries in the extended set. Far from being an optimum, the remaining set of countries still made impractical the use of some of the variables chosen.

On the other hand, aware that developed countries might behave quite different from developing ones beyond a complex set of thresholds (wealth, infrastructures, innovation level, etc.), we built together a second set of countries only made up of 28 of the OECD countries[334]. We used this OECD set to perform some analysis just for the most developed countries in the world[335].

11.2.1. Choice of data, data availability and frequencies

The set of variables finally chosen was made up of 79 digital variables[336] (plus 24 more digital variables for the OECD set[337]) and 53 analogue variables[338], which adds up to 157 variables in total.

Notwithstanding, if we look at the tables of frequencies[339] of these data, we will see that there still are some variables that are void for all countries, and eight more values have only data for less than a half of the whole sample. Hence, even if we decided to include them in the working set of indicators, the "natural" selection of statistics – especially cluster analysis – excluded them from all relevant calculations.

We want to note a fact that might look shocking at first sight: the inclusion of some indicators like the Gross Enrolment Ratio (code DIGLIT_S_06) within the set of *digital* indicators. The decision comes from the qualitative analysis performed in the second part of this work: the digital variables belong *all* of them to one or many of the models analyzed in that part. Thus, when these indicators are not strictly measuring a digital variable (like e.g. the case of the Price basket for Internet), they are being used as a way to proxy one that actually is. In our previous example, the Gross Enrolment Ratio is used to approximate a non-measured level of Digital Literacy in the population.

Further in this work, when we speak about Cluster Analysis, this distinction and its utility will become clearer.

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334 Annex IV, Table 32
335 We believe that, arguably, these OECD countries represent the most developed countries in the world.
336 Annex IV, Table 27
337 Annex IV, Table 28
338 Annex IV, Table 29
339 Annex V, Table 33, Table 34 and Table 35

Summing up, in the following sections and chapters we will be talking about three sets of data:

- Digital Indicators – Full Set: 79 digital variables belonging to the sources listed above (except the OECD) for 75 countries (the ones in the WITSA dataset)
- Digital Indicators – OECD Set: 24 digital variables (from the OECD Key ICT Indicators) for 28 countries (the ones in the OECD dataset)
- Analogue Indicators: 53 analogue variables belonging to the sources listed above (except the OECD) for 75 countries (the ones in the WITSA dataset)

11.2.2. Correlation matrix

We have calculated the following matrixes of correlations[340]:

- Digital Indicators – Full Set
- Analogue Set
- Digital Indicators – Full Set vs. Analogue Indicators
- OECD Set
- OECD Set vs. Analogue Set

The rationale behind calculating correlations is that they give us signs that we are prone to have multicollinearity problems in our regressions, thus reducing the power and the accuracy of the calculated predictors.

But, a corollary of the previous statement is even more interesting at the conceptual level: multicollinearity can be interpreted as that the evolution – or the change – in a group of variables goes in parallel and cannot evolve in an isolated way without some difficulties.

While analogue indicators show little correlation among themselves (with the exception of such flagship indicators like the GDP per capita and other income related indicators like the GNI or public expenditure), digital indicators show broad, strong and statistically significant correlations.

Our reflections in this case are twofold. On the one hand, this fact will make it difficult to draw relationships of determination at the only-digital level. Indicators in the digital infrastructures group and the digital usage group are the more frequently measured ones and the more frequently used to explain digital development. If correlated, finding which is cause and which consequence is statistically difficult to state.

And, even more important at the conceptual level, the second reflection is about the validity of the leapfrogging theory: if all of them evolve in tandem, we cannot state that i.e. investment in infrastructures will boost usage so that a multiplier effect is made possible. Or, in other words, that investment in ICTs will jumpstart real

[340] See Annex VI

economy development and digitally empower the citizenry despite of their i.e. income status.

This approach is reinforced by the fact that the main digital indicators (again: infrastructures and usage) are strongly correlated with the main analogue indicators, especially those related with income, education and health. It seems quite straightforward – though deeper analysis comes in further chapters – that digital development is, to say the least, strongly related to real economy development, in both cause and consequence.

These are, of course, risky conclusions to be made at this point of our research, but they do provide valuable hints what to look for in our later statistical analysis.

11.2.3. Data Recoding: Standardization

Another problem we found with our data sets is that – independently from the source – they are measured in different units. Working with them makes it necessary to make them able for comparison, a must if we are to calculate distances as happens when performing cluster analysis.

Variables were, thus, recoded and standardized to be used in some of our calculations where comparable units were required, leaving the original data for other exercises like characterization and binary logistic regressions[341].

Standardized variables were used for cluster analysis by using z-scores.

11.2.4. Data Recoding: Dichotomization

Besides standardization, the fact that most data were continuous added a burden of complexity that made calculations even more difficult. Levels of digital development of countries may differ in orders of magnitude when compared as a whole, but might be very similar when treated in groups (i.e. amongst developed countries or amongst developing countries).

We found that it eased calculations and, most important, represented reality more faithfully to sometimes deal with dichotomic variables, recoding them and grouping the continuum of values in just two: high and low (represented by 1 and 0 in our tables).

Dichotomization was normally made assigning a value of “high” to the top percentile 25, and a value of “low” to the rest. Notwithstanding, this was sometimes not a good option, as – as we have already said – data did not evolve “smoothly” along variables, for the same countries and so on.

[341] The new standardized variables appear in our tables with an added “Z” before its original name. e.g. GEN03 (GDP Capita) becomes ZGEN03 when standardized.

A correction was, then, necessary to really derive what was really “high” in a given variable. Following the norm that the top percentile 25 was “high”, we then corrected the threshold that separated “high” from “low” by looking at the distribution of the variable, being histograms a helpful tool to find an evident “breaking point” in the continuum of data.

In this sense, some variables were corrected setting the threshold below the top percentile 25 (e.g. Broadband subscribers per 100), while some others had their thresholds set up higher than the top percentile 25 (e.g. Importance of ICT to government vision of the future)[342].

Dichotomized variables were used for factor analysis and the characterization of clusters as calculated in the cluster analysis.

11.3. Factor analysis

As dealing with 132 variables could be very complex, we approached two methods of data reduction, the intention being to use them both and sequentially: first, factor analysis; second, cluster analysis.

From the different techniques to develop factor analysis, we chose[343] Harman's Principal Components Analysis, with a correlation method and varimax rotation with Kaiser. The minimum eigenvalue used to control the number of factors extracted was set to 1 and the number of iterations to 25.

A first group of trials was performed on data with variables from the Infrastructures category[344], in three calculations with 10, 8 and 7 variables. Results brought, respectively, 4, 3 and 2 components.

A second group of trials was performed on data with variables from the whole set of digital indicators[345] in order to collect the maximum data from the whole framework. Three calculations were made with 41 and 43 variables[346], resulting in 10 components for the latter[347].

This methodology to reduce data is highly unreliable with a sample as tiny as ours, with 75 observations at its optimum and going down to two thirds this value when many variables are implied. Despite this fact, results were equally of poor interest as 10 components to explain over 40 variables did not make the analysis any easier. Indeed, it was difficult to establish a logical pattern that explained the main

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[342] The new dichotomized variables appear in our tables with an added “R” after its original name. e.g. GEN03 (GDP Capita) becomes GEN03R when dichotomized.
[343] Following Ficapal & Torrent i Sellens (2008) and Lupiáñez-Villanueva (2009).
[344] See Annex VII, first sections.
[345] See previous note.
[346] Two calculations were made with the set with 43 variables: with 25 – which reached no convergence at all - and 33 iterations.
[347] The former was inconclusive due to lack of data.

characteristics of each compound, which did not seem to represent any acknowledged mindset or framework depicted by the literature.

We thus decided to switch over the next method to reduce data, cluster analysis, which proved much more fruitful.

11.4. Cluster analysis

One of the main purposes of this work was, after designing a comprehensive model to define access to the digital society, to find whether there was such a thing as stages of development of the digital society according to that model.

Hence, our goal in proceeding with cluster analysis not only respond to a need to simplify data, but also to be able to draw a set of layers where we could accommodate countries according to their respective stages of development. Better put, we want to find that the Euclidean distances that separate countries taken by some indicators, are bigger amongst some of them while being smaller amongst some others. When distances are small, we will find we can describe some common characteristics of these countries that cluster together, as opposed to other countries that cluster away at a distance from other clusters.

We thus here perform non-hierarchical K-means cluster analysis to segment groups of countries whose variables have statistically significant similar values in opposition to the other groups.

We believe that the number of relevant clusters should be small. On the one hand, because the sample is so small that it would make poor sense to have plenty of clusters with two or three countries in each. On the other hand, because – within the complexity of development and with each country being a case on its own – we believe it worthwhile to draw a scheme were there are relatively few stages of development (e.g. low, intermediate, advanced) that will better serve our purpose in advising policy-makers and decision-takers.

Thus said, and after variables were standardized[348], we proceeded to apply the methodology of K-means cluster analysis with a preset of 2, 3, 4 and 5 clusters. The exercise is repeated for the WITSA and the OECD set of countries[349].

From the 11 groups of clusters resulting from the respective exercises, we chose the results from the 5-cluster analysis for both samples, but remapping it as a 4-cluster exercise where the United States, allocated in a cluster on its own, is merged with the following – in Euclidean distance terms – cluster.

As, statistically speaking, the results were very similar in all exercises, we chose to have a sufficient number of clusters so that we could, as we have said, establish a

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[348] A need in cluster analysis, so that Euclidean distances can be calculated properly and without the influence of different measuring units.
[349] Calculations and results can be found in Annex VIII.

few stages of digital development, while keeping aside a cluster which we considered special[350]. So, taking the 5-cluster calculation, and including the "United States-only" cluster into the next one, we could draw a picture with three stages of development (as said, low, intermediate and advanced) plus a fourth cluster with special features. The addition of a sixth cluster just added another intermediate level by taking some countries from the former intermediate level and the low one, which resulted in a more complex analysis that provided but obscurity to the overall results.

Clusters were calculated using two main sets of variables: the one we called the core set and the simplified version of this core set, the simplified core. While the core set was the biggest set of variables that provided significant statistics for the cluster analysis method, we wanted to test whether a choice of a single indicator for each category would provide similar results. The test proved quite successful, but, at the end, only the core set of variables was used for the final calculations, as the core set brought more information and a more complete explanation that the simplified core.

The same exercise was repeated for the OECD countries with similar results[351]. It is important to note, nevertheless, that the bigger heterogeneity of the WITSA set of countries made it possible to always use almost the same variables to calculate whatever number of clusters, while the relative homogeneity of the OECD country set forced us to use different combinations of variables for each cluster analysis we performed, varying with the number of clusters preset.

At the end of this exercise we had a new variable ascribing a value (1 to 4) to each country depending of the cluster it belongs to, and another one with the Euclidean distance of this country to the centre of the cluster.

Findings of cluster analysis are explained in depth in chapter 12 for the WITSA countries and in chapter 13 for countries belonging to the OECD.

11.5. Characterization

Once we had the countries grouped into four clusters[352] for the two sets (i.e. WITSA and OECD), we wanted to highlight the main features that they had in common.

Besides simple observation, we wanted to find statistically significant similarities and differences between clusters. To do so, we built contingency tables – or cross tabulations – facing the fact of belonging to one or another cluster against all the digital and analogue variables.

Three outputs rise from this exercise.

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[350] See chapter 12 for more details about this statement.

[351] We do not provide, in that case, detail about the Simplified Core set for the OECD countries in Annex VII because of economy of space.

[352] As we have already set, there actually were 5 clusters, two of which we merged into a single one.

First, we check the hypothesis of independence between a chosen variable and the distribution amongst clusters of the country set. A significant score for Pearson Chi-Square and Fischer's Exact test will reject the hypothesis of independence, meaning that a country's allocation to a particular cluster depends on its value for that selected variable.

Second, we measure the correlation of the distribution amongst clusters and that same selected variable by means of the Pearson and Spearman correlations. Again, significant results tell us that both variables (the cluster and the chosen one) are correlated.

Finally, and most interesting to us, we will calculate Haberman typified adjusted residuals. These residuals have a normal distribution. Taking a confidence level of 0.95, we can look for adjusted residuals with absolute value over 1.96, noting that there are more (or less[353]) cases than expected in comparison with the case where the two compared variables (the cluster and the other variable in our case) were independent.

These statistics – especially the significance of Pearson's Chi-Square and Haberman typified adjusted residuals – do not necessarily indicate any relationship of causality, but suggest that there are more cases than would be expected for a specific variable and therefore reject the hypothesis of independence. In this sense, they neither provide a degree of how high or how low are the specific values or the variables, but rather how powerful is the rejection of the hypothesis of independence or how significantly can we state that the actual results are higher or lower than expected.

At the end of the exercise, we are able to tell – for the WITSA and OECD sets of countries – what are the main characteristics or indicators that, from a statistically significant viewpoint, depict a specific cluster in opposition to other ones. Or, in other clusters, what variables are found with higher or lesser values than expected in a cluster, thus depicting the strength or weakness in this particular group of countries.

It is important to note that this is, by no means, a way to tell determination or relationships of causality between the variables analyzed and the clusters of countries compared with them. This test is left for the next exercise.

To carry out the characterizations, we used the dichotomized digital variables – in order to simplify digital development aspects – but the original (continuous) analogue variables.

The findings of characterization through tables of contingency are explained in depth in chapter 12 for the WITSA countries and in chapter 13 for countries belonging to the OECD.

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[353] If value is negative.

11.6. Determinants for the level of digital development

After finding distinctive ways of grouping countries according to their digital development, and identifying the main indicators that define their characteristics, we want to discover what are the reasons that statistically determine a country being tagged as most or least digitally developed.

So, after some first analyses that find out correlations and describing the models, we want to go one step further and seek relationships of causality.

For the sake or clearness and, most important, to be able to provide useful advice for policy-makers, we do not calculate the determinants for each and every stage – as defined in the cluster analysis – of digital development, but only for the top and bottom ones.

To do so, the variables that formed the cluster where a country was allocated were dichotomized, where 1 represented belonging to the cluster being analyzed and 0 indicating a relationship to one or more of the other clusters. Hence, two new variables were created:

- A variable that separates the top digital development cluster countries (most digitally developed societies) from the other three clusters (1 and 0 values, respectively)
- A variable that separates the bottom digital development cluster countries (least digitally developed societies) from the other three clusters (1 and 0 values, respectively)

These two new variables were used as dependent variables on binary logistic regression models to determine the reasons why a country had a higher probability of being a most digitally developed society or a least developed one.

With the guidance of the existing literature, the correlation tables and the results from characterization we performed several[354] trials in order to establish the relationships of causality, using as independent variables the ones we built with original data, that is, without neither standardization nor dichotomization. Chapter 14 shows only the two best results for each exercise (most and least digitally developed countries), providing some comment on the "second bests" found along the way.

In the presentation of the results, we will first look for the significance of the overall test by means of the Chi-square test and we will also look at the values of Nagelkerke's pseudo R-square to glimpse the explanation power of the model. We will also perform the Hosmer and Lemeshow's in order to test the goodness to fit of the overall model, with the aim to reject the null hypothesis that there is no significant difference between our values in the dependent variable and the ones predicted by the model.

[354] +250

Concerning the variables in the equation, we will analyze the usual items: the values of the coefficients and the exponentiations of the coefficients (or odd ratios for the predictors) and the significance of these calculated coefficients.

It is noteworthy to say that we could only find acceptable models for the WITSA country set, while the same exercises for the OECD did not provide any model with a minimum quality in all – or even a few – of the statistics listed above. As we have stated before, one of the reasons could be that the OECD country set is too homogeneous internally. Thus, even if we can find clusters by which to group some countries together, the factors that separate them are not as important as to be able to find the determinants of such differences.

This, in part, reinforces our belief that digital development might be more a *consequence* of real economy development, especially when considering the whole picture and the huge imbalances in the World, rather than a *cause* of the said development.

12. Stages of digital development: cluster analysis and characterization for the WITSA countries

As explained in chapter 11, we performed cluster analyses with the full set of standardized digital variables and the WITSA countries dataset. Thus, we were able to find different stages of digital development for a wide range of countries (from developed to developing ones), which we afterwards characterized with many other variables using cross tabulation.

12.1. Defining the stages of digital development through Cluster Analysis

From the initial set of 79 digital variables, we succeeded in defining 5 clusters by using 22 variables – listed in Table 10 – that significantly ($p<0.001$) differ between clusters.

49 countries were properly allocated amongst clusters according to their performance in the 22 variables used. The country distribution is as follows:

1. United States
2. Australia, Austria, Finland, France, Germany, Ireland, Japan, Rep. of Korea, New Zealand, Norway, Singapore, Sweden, Switzerland, United Kingdom
3. Brazil, Bulgaria, Chile, Greece, Hungary, Italy, Jamaica, Mexico, Panama, Portugal, Romania, Saudi Arabia, Spain, Thailand, Tunisia, Uruguay, United Arab Emirates
4. Argentina, Bolivia, Ecuador, Egypt, India, Indonesia, Pakistan, Peru, Philippines, Sri Lanka, Algeria, Cameroon, Vietnam, Zimbabwe
5. Jordan, South Africa, Senegal

Both the list of countries and the list of variables give us some hints about what we would be finding in our next step, the characterization of such clusters. By looking at Table 10 we can already see that the first two clusters – which we will merge for our characterization exercise – do better in almost all digital[355] indicators[356].

[355] Remember that we are using Human Capital here as it was found in other methods to measure the Information Society: as a way to proxy digital skills.

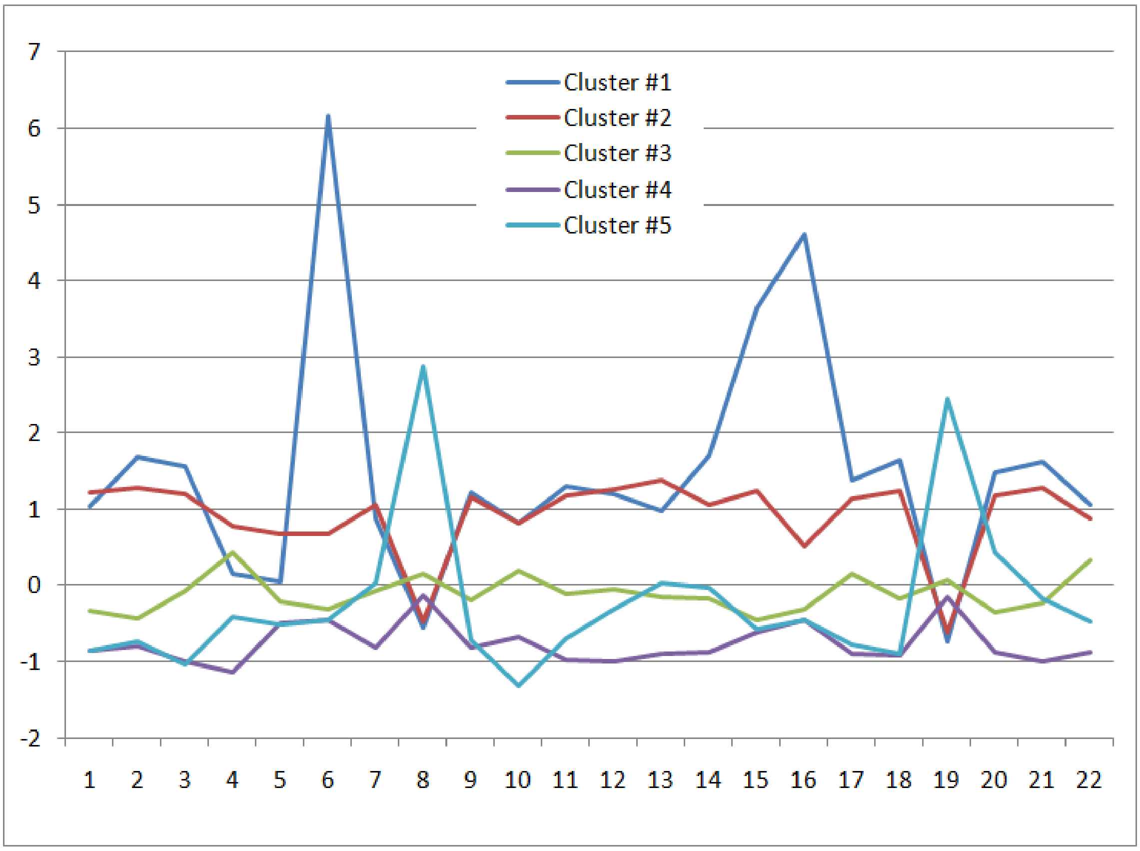
[356] To note here the extraordinary number of Internet Hosts per 10000 of the United States, not at all due to an impressively higher domestic differential usage of the Internet, but mainly to other reasons: hosting some of the most powerful enterprises that provide Internet based services (Google, Microsoft, Yahoo, eBay, etc.), and also being the remote host of foreign institutions that hire hosting services at the US. Same happens with the indicator measuring the total domains per 100 people (mainly due to general TLDs such as .com, .org and .net) and secure servers (though not as notable as security is a delicate issue). Besides these three variables, it can be seen that the rest of them show not such big changes, thus why our idea to merge these two clusters when going forward in our analysis.

Cluster centre values	1	2	3	4	5		
N =	1	14	17	14	3	F	Sig.
Broadband subscribers (per 100 people)	1.04667	1.22866	-.34155	-.85053	-.86041	48.356	.000
Personal computers (per 100 people)	1.67736	1.27371	-.44270	-.79603	-.73449	114.393	.000
Telephone mainlines (per 100 people)	1.56177	1.19149	-.06952	-.98955	-1.04907	34.612	.000
Mobile phone subscribers (per 100 people)	.14174	.77405	.42685	-1.14120	-.41905	19.935	.000
International Internet bandwidth (bits per person)	.04562	.67682	-.20754	-.49648	-.50644	8.096	.000
Internet Hosts (per 10000 people)	6.15884	.66590	-.30821	-.45300	-.44822	82.330	.000
Price basket for residential fixed line (US$ per month)	.88079	1.04927	-.07156	-.82146	.01933	12.761	.000
Telecommunications revenue (% GDP)	-.55495	-.47911	.14923	-.12833	2.87247	14.373	.000
GDP per Telecom Employee (US Dollars)	1.21288	1.15463	-.18897	-.81801	-.71298	27.838	.000
Human Capital	.80633	.80697	.18061	-.67854	-1.32514	9.784	.000
Internet Access in Schools	1.30500	1.18030	-.10689	-.97869	-.70432	39.068	.000
Laws relating to ICT	1.19461	1.26422	-.05538	-1.00651	-.32015	35.819	.000
Intellectual property protection	.97023	1.37306	-.15416	-.90268	.02490	49.867	.000
Gov't procurement of advanced tech products	1.69664	1.06272	-.17181	-.88409	-.02159	13.403	.000
Secure Internet servers (per 1 million people)	3.63169	1.23571	-.46409	-.60719	-.57369	54.592	.000
Total Domains (per 100 people)	4.60355	.50923	-.32014	-.45263	-.44611	57.592	.000
Availability of government online services	1.37203	1.14157	.14643	-.90301	-.77009	25.456	.000
Internet users (per 100 people)	1.64437	1.24347	-.17365	-.92196	-.89137	37.522	.000
Total ICT Spending, Consumer (% of GDP)	-.72841	-.61592	.06740	-.14250	2.45888	19.188	.000
Firm-level technology absorption	1.48415	1.17568	-.34672	-.87682	.43128	19.080	.000
Extent of business Internet use	1.63090	1.27923	-.23801	-1.00813	-.18159	35.312	.000
ICT use and government efficiency	1.05006	.86859	.32429	-.87663	-.47347	10.462	.000

Table 10: Results of k-means (quick cluster) analysis for the WITSA country set

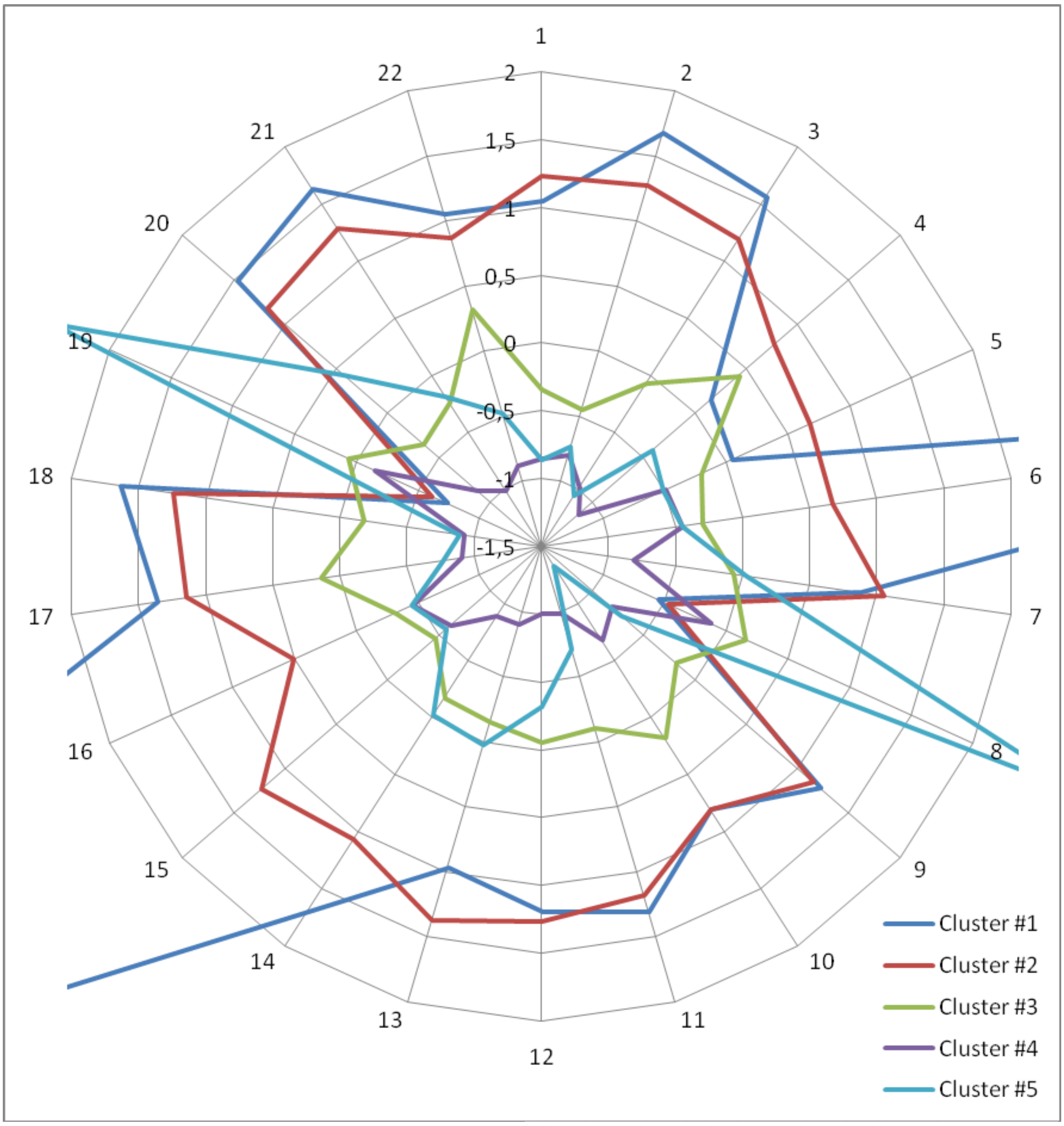
The next cluster (#3) is clearly lagging behind the first two, but some issues like the number of mobile phone subscribers (per 100) or the Total ICT Spending at the consumer level show us that the level of adoption of ICTs is trying to catch up with more digitally developed economies.

Other variables (Telecommunications Revenue, Human Capital, Laws relating to ICT, e-Government) can also show that the path is paved for a digital development to take place in the near future, if not just happening right at this moment, as they show that the framework is set or is beginning to be set.



1 - Broadband subscribers (per 100 people)
2 - Personal computers (per 100 people)
3 - Telephone mainlines (per 100 people)
4 - Mobile phone subscribers (per 100 people)
5 - International Internet bandwidth (bits per person)
6 - Internet Hosts (per 10000 people)
7 - Price basket for residential fixed line (US$ per month)
8 - Telecommunications revenue (% GDP)
9 - GDP per Telecom Employee (US Dollars)
10 - Human Capital
11 - Internet Access in Schools
12 - Laws relating to ICT
13 - Intellectual property protection
14 - Gov't procurement of advanced tech products
15 - Secure Internet servers (per 1 million people)
16 - Total Domains (per 100 people)
17 - Availability of government online services
18 - Internet users (per 100 people)
19 - Total ICT Spending, Consumer (% of GDP)
20 - Firm-level technology absorption
21 - Extent of business Internet use
22 - ICT use and government efficiency

Figure 205: Cluster centre values for WITSA countries (lines)



1 - Broadband subscribers (per 100 people)
2 - Personal computers (per 100 people)
3 - Telephone mainlines (per 100 people)
4 - Mobile phone subscribers (per 100 people)
5 - International Internet bandwidth (bits per person)
6 - Internet Hosts (per 10000 people)
7 - Price basket for residential fixed line (US$ per month)
8 - Telecommunications revenue (% GDP)
9 - GDP per Telecom Employee (US Dollars)
10 - Human Capital
11 - Internet Access in Schools
12 - Laws relating to ICT
13 - Intellectual property protection
14 - Gov't procurement of advanced tech products
15 - Secure Internet servers (per 1 million people)
16 - Total Domains (per 100 people)
17 - Availability of government online services
18 - Internet users (per 100 people)
19 - Total ICT Spending, Consumer (% of GDP)
20 - Firm-level technology absorption
21 - Extent of business Internet use
22 - ICT use and government efficiency

Figure 206: Cluster centre values for WITSA countries (radial)

The two last clusters depict the lesser digitally developed countries. While cluster #4 can be interpreted as just the opposite[357] of clusters #1 and #2, cluster #5 shares some common things with cluster #4 but also some others stand out from what would be expected. These are, for instance, Telecommunications revenue, Intellectual property protection, ICT spending at the consumer level, firm-level technology absorption or even prices for fixed lines. We are facing in cluster #5 a clear example of some countries taking advantage of ICTs not as part of the strategy to develop their real economy and achieve progress in general, but as a means to develop a brand new sector in itself that will – or will not – pull the rest of the economy and social welfare upwards.

What we are seeing in cluster #5 are the early stages of what can become a supernova: the growth of ICT expenditure and the ICT sector, while the rest of the economy lies undaunted behind.

Summing up, we will label our clusters the following way:

1+2: Digital leaders: they lead the digital development
3: Digital strivers: they have set the framework, but still have to strive to achieve a comfortable digital development
4: Digital laggards: they clearly lag behind other countries, especially digital leaders
5: Digital leapfroggers: at first glance, these are the only ones that seem to be aiming to leapfrog development, by intensively fostering the Information Society in a context of low income and low development in general (in relationship with other more developed countries)

which, combined with our findings, results in the following classification of countries:

- Digital leaders: United States, Australia, Austria, Finland, France, Germany, Ireland, Japan, Rep. of Korea, New Zealand, Norway, Singapore, Sweden, Switzerland, United Kingdom
- Digital strivers: Brazil, Bulgaria, Chile, Greece, Hungary, Italy, Jamaica, Mexico, Panama, Portugal, Romania, Saudi Arabia, Spain, Thailand, Tunisia, Uruguay, United Arab Emirates
- Digital laggards: Argentina, Bolivia, Ecuador, Egypt, India, Indonesia, Pakistan, Peru, Philippines, Sri Lanka, Algeria, Cameroon, Vietnam, Zimbabwe
- Digital leapfroggers: Jordan, South Africa, Senegal

Figure 205 and Figure 206 picture this scheme perfectly: digital leaders appear as soaring on an upper layer, with the exceptions of some USA indicators standing out

[357] From our sample, of course: unfortunately, there are two hundred countries (circa 80% of all the countries in the world) that do not even appear in this exercise. If lack of data is the formal explanation for them not to appear here, lack of what to be measured is the underlying actual reason. So, it is these two hundred countries the real opposite the digital leaders.

of that layer; on a bottom layer we have the digital laggards, really opposite to the digital leaders. In between, on an intermediate layer there are the digital strivers, following a "parallel" path to this of the leaders but at a distance. Last, digital leapfroggers lay across the different layers, sharing some characteristics with the digital laggards, but doing even better in other variables than strivers and even better than digital leaders: it is their bet on Information and Communication Technologies.

There is, we could say, a continuum of digital development that most countries follow with two exceptions: the United States of America, with its peculiar performance on specific indicators due to some of the reasons explained above; and the digital leapfroggers trying to "break the rules" of development.

12.2. Describing the stages of digital development through characterization: development stages

We explain in chapter 11 that, after having grouped countries into clusters, we then proceed to see what are the main characteristics that define them. We will perform, following, two analysis: the first one, by taking clusters one by one and see what are their most outstanding characteristics; the second one, by taking all clusters together and comparing how they perform in several categories. The bases for our analysis are Haberman typified adjusted residuals[358] and the significance of Pearson's Chi-Square

12.2.1. Digital leaders

Digital leaders are likely to be leading almost all indicators, both digital and analogue ones. So, it can be easier to define what they are lacking that what they actually have in comparison to other groups.

As can be seen in Table 11, they are likely to do better than expected in Infrastructures, the power of their ICT sectors, Digital Literacy[359], they Legal and Political framework, the Usage of digital content and services, and other socioeconomic factors.

Among the most powerful findings we have to undoubtedly point that more people is likely to have a computer, this computer will have Internet access through a broadband connection and this will all happen at a lower price. With the exception of mobile phones and Internet hosts, most countries tend to have higher values than expected in variables related to infrastructures.

The ICT Sector represents a powerful part of the overall economy in some countries while in others' values tend to be lower than expected. This happens both at the high-technology exports – a flagship of this sector in some countries – as with the

[358] The values shown in the tables below belong to the countries with a predicted value as "high" (=1) for a specific variable. The same value with opposite sign will provide the value for the typified adjusted residuals for the "low" (=0)value.
[359] As measured in our model

quite high degree of human capital hired in the sector, providing high added value both as an aggregate and in productivity related issues (e.g. per employee).

If the ICT sector power is unevenly distributed in this digital leaders group, human capital is not: all countries show higher values than expected when talking about Internet in schools and human capital as an aggregate. So, human capital is not only numerous in the sector – when it applies – but well qualified in the society at large. And not only this, Internet seems to be an asset at schools, so a magic triangle is built with technology-skilled workers, higher levels of human capital and increase of digital skills at school by means of Internet access at early educational levels.

Similarly happens at the legal framework level: the telecommunications market is well regulated with most countries scoring high, as are other knowledge related issues like intellectual property rights. Actually, the ICT sector in global is pretty much regulated, fostering market competition. Countries differ quite much in how their respective governments are actively involved in the promotion of the Information Society (here measured through government in the procurement of advanced technological products). Thus, we can say that frameworking the Information Society is differential in digital leaders, while government direct involvement seems to depend on different models of policy-making.

The usage of and the availability of content and services related with the Internet and ICTs is much higher than in other groups, though approximately only half of the group shows higher values than expected, being the rest below expectancies. Nevertheless, not only its usage is higher, but some measurements of the impact of such usage are also higher, as the amount of outgoing telephone traffic might show. On the other hand, this usage happens over all at the corporate level, where most countries have higher values for secure Internet servers or firm-level technology absorption. Again, a subset for half of the countries has their governments playing a very active role in the promotion of the Information Society.

It is important to notice the lower than expected value of the total ICT spending at the consumer level, which might be due to two opposite reasons: first one, that consumers are behind governments and firms in the adoption of such technologies; the second one, that lower prices imply lower consumption in relationship (%) to the total GDP.

Indicator	Hi.	Low	% of cluster	Adjusted residuals[360]	Sig. of Pearson Chi-Square	N (cluster)	N (sample)
Broadband subscribers (per 100 people)	8	7	53.3%	4.66	0.000	15	49
Personal computers (per 100 people)	15	0	100.0%	7.00	0.000	15	49
Telephone mainlines (per 100 people)	14	1	93.3%	5.73	0.000	15	49
Mobile phone subscribers (per 100 people)	8	7	53.3%	2.55	0.009	15	49
Population covered by mobile telephony (%)	13	0	100.0%	2.42	0.003	13	39

[360] See note 358

International Internet bandwidth (bits per person)	15	0	100.0%	5.15	0.000	15	49
Internet Hosts (per 10000 people)	10	5	66.7%	5.34	0.000	15	49
Internet subscribers (per 100 inhabitants)	7	2	77.8%	4.31	0.000	9	32
Price basket for Internet (US$ per month)	2	13	13.3%	-2.09	0.018	15	49
Price basket for residential fixed line (US$ per month)	0	15	0.0%	-1.90	0.004	15	49
Telephone average cost of call to US (US$ per three minutes)	6	6	50.0%	2.10	0.051	12	36
High-technology exports (% of manufactured exports)	5	10	33.3%	2.94	0.029	15	48
Telephone employees (per 100 people)	4	4	50.0%	3.09	0.020	8	32
Total full-time telecommunications staff (per 100 people)	7	4	63.6%	3.96	0.001	11	36
GDP per Telecom Employee (US Dollars)	11	4	73.3%	4.93	0.000	15	49
Enrolment in science. Tertiary. (per 100 people)	7	6	53.8%	3.37	0.010	13	29
Human Capital	15	0	100.0%	4.56	0.000	15	49
Internet Access in Schools	14	1	93.3%	5.73	0.000	15	49
Laws relating to ICT	15	0	100.0%	5.84	0.000	15	49
Intellectual property protection	15	0	100.0%	6.68	0.000	15	49
Level of competition - DSL	15	0	100.0%	2.37	0.014	15	45
Level of competition – Cable modem	15	0	100.0%	1.89	0.019	15	34
Gov't procurement of advanced tech products	8	7	53.3%	4.20	0.000	15	49
Secure Internet servers (per 1 million people)	13	2	86.7%	6.33	0.000	15	49
Total Domains (per 100 people)	6	9	40.0%	3.94	0.001	15	49
Web Measure	7	8	46.7%	3.40	0.006	15	49
Availability of government online services	8	7	53.3%	4.20	0.000	15	49
International outgoing telephone traffic (minutes) (per 100 people)	9	1	90.0%	4.38	0.000	10	31
Internet users (per 100 people)	10	5	66.7%	5.34	0.000	15	49
E-Participation	8	7	53.3%	4.20	0.000	15	49
Total ICT Spending, Consumer (% of GDP)	0	15	0.0%	-1.90	0.000	15	49
Firm-level technology absorption	13	2	86.7%	5.36	0.000	15	49
Extent of business Internet use	9	6	60.0%	5.00	0.000	15	49
GDP	7	8	46.7%	2.28	0.081	15	47
GDP Capita	7	8	46.7%	4.19	0.001	15	47
HDI	15	0	100.0%	5.84	0.000	15	49
Inequality-10	5	10	33.3%	-2.51	0.030	15	47
Economic Incentive Regime	12	3	80.0%	4.69	0.000	15	49
Innovation	15	0	100.0%	6.10	0.000	15	49
General Govt. final consumption expenditure (% of GDP)	4	5	44.4%	2.08	0.082	9	40
Health Public Expenditure (% of govt. expenditure)	10	5	66.7%	4.56	0.000	15	49
Health Public Expenditure (% of total Health expenditure)	10	5	66.7%	2.89	0.005	15	49
Education Public Expenditure (% of govt. expenditure)	0	11	0.0%	-1.91	0.065	11	33

Population in urban agglomerations > 1 million (% of total population)	5	9	35.7%	3.48	0.007	14	44
GDP deflator (base year varies by country)	3	12	20.0%	-5.22	0.000	15	48
GDP per capita, PPP (current international $)	7	8	46.7%	3.76	0.002	15	48
GNI per capita, Atlas method (current US$)	8	7	53.3%	4.54	0.000	15	47
GNI per capita, PPP (current international $)	4	11	26.7%	3.05	0.025	15	47
Life expectancy at birth, total (years)	15	0	100.0%	5.30	0.000	15	48
School enrollment, primary (% net)	8	5	61.5%	1.84	0.066	13	39
School enrolment, primary (% gross)	0	14	0.0%	-2.62	0.022	14	44
Mortality rate, infant (per 1,000 live births)	0	15	0.0%	-4.87	0.000	15	48
Improved water source (% of population with access)	12	0	100.0%	3.99	0.000	12	43
Interest payments (% of GDP)	2	12	14.3%	-3.79	0.001	14	37
Present value of debt (% of GNI)	1	12	7.7%	-2.08	0.018	13	27
Inflation, consumer prices (annual %)	0	15	0.0%	-3.21	0.000	15	47
Inflation, GDP deflator (annual %)	0	14	0.0%	-3.28	0.001	14	46

LEGEND: High: # of countries with "high" (1) and "low" (0) values for the variables; % of countries in cluster with "high" value; adjusted residuals; significance of Pearson Chi-Square; N for cluster and whole sample.

Table 11: Crosstabs for clusters 1+2 or digital leaders, WITSA country set.

Taken into account that laggards are the ones that have a higher-than-expected value for this variable, a combination of both reasons – and, in our opinion, the most plausible – might be the good one: consumers actually spend less in both quantity and cost. Cost, because of the lower price; quantity, because they have already reached a specific level of household infrastructures like a PC or a mobile phone, as the variables related with infrastructures show. In other words, while governments and enterprises are still making efforts to invest in ICTs – largest investments in most cases – the individual customer is already beyond some threshold where he can begin to spend less.

Analogue – socioeconomic – variables show no surprises except in some cases. Though far from being closely homogeneous between countries, some evidences come to light. First of all, what many authors have constantly being saying: higher wealth and income are characteristic from digitally developed countries.

As already pointed, a subset of these countries is characterized by the weight of the State in the economy, as can be inferred by looking at inequality or Health, that also characteristic from this subgroup of digital leaders, with highest values in all variables related with the presence of the government in everyday life.

Economic stability and incentivizing a proper economic framework are, probably, the most interesting findings in this analysis: while stability (inflation, debt) is highly important, everything related with fostering the economy (the economic incentive regime, innovation) are really significant in statistical terms.

Only education related values (public expenditure, school enrolment at the primary level) might be a little bit puzzling. As it happened with consumer expenditure in ICTs, we believe is a matter of ratios: governments put more stress in the economic sector – or even Health – than in Education in *relative* weights. In the same train of thought, primary enrolment should be seen low not in absolute levels, but in relative levels to e.g. secondary or tertiary enrolment, which is more important if we are thinking about highly skilled population and workers.

12.2.2. Digital strivers

Digital strivers – as we named them, and as we will show – lag behind digital leaders. Not a lot, especially compared with digital laggards, but quite significantly.

The first difference between digital strivers and digital leaders is how homogeneous the first group is in matters of expected values: with some exceptions – like competition in the DSL market, Public Expenditure in Education or debt – almost all countries behave alike in all variables.

At the infrastructures level, they have less computers and connectivity than expected. Even if prices or mobile penetration also lag behind, it is in the quality of Internet access that differences are more notable. In this sense, it is about what the individual is empowered to do in terms of independence or productivity that really lags behind, being basic consumption or access to ICTs as expected. So, the big difference with digital leaders is this one: quality of access, more than (though also) a deficient quantity or access level.

Indicator	High	Low	% of cluster	Adjusted residuals[361]	Sig. of Pearson Chi-Square	N (cluster)	N (sample)
Broadband subscribers (per 100 people)	0	17	0.0%	-2.25	0.000	17	49
Personal computers (per 100 people)	0	17	0.0%	-3.39	0.000	17	49
Telephone mainlines (per 100 people)	3	14	17.6%	-1.83	0.000	17	49
Internet Hosts (per 10000 people)	0	17	0.0%	-2.58	0.000	17	49
Internet subscribers (per 100 inhabitants)	1	12	7.7%	-1.87	0.000	13	32
Price basket for mobile (US$ per month)	3	14	17.6%	-1.83	0.046	17	49
High-technology exports (% of manufactured exports)	0	16	0.0%	-1.85	0.029	16	48
GDP per Telecom Employee (US Dollars)	2	15	11.8%	-1.71	0.000	17	49
Enrolment in science. Tertiary. (per 100 people)	0	10	0.0%	-2.20	0.010	10	29
Internet Access in Schools	3	14	17.6%	-1.83	0.000	17	49
Laws relating to ICT	3	14	17.6%	-2.21	0.000	17	49
Intellectual property protection	0	17	0.0%	-3.55	0.000	17	49
Level of competition - DSL	9	7	56.3%	-2.96	0.014	16	45
Gov't procurement of advanced tech products	1	16	5.9%	-1.65	0.000	17	49

361 See note 358

Secure Internet servers (per 1 million people)	0	17	0.0%	-3.07	0.000	17	49
Total Domains (per 100 people)	0	17	0.0%	-1.91	0.001	17	49
Availability of government online services	1	16	5.9%	-1.65	0.000	17	49
International outgoing telephone traffic (minutes) (per 100 people)	2	11	15.4%	-1.99	0.000	13	31
Internet users (per 100 people)	0	17	0.0%	-2.58	0.000	17	49
E-Participation	1	16	5.9%	-1.65	0.000	17	49
Firm-level technology absorption	1	16	5.9%	-2.91	0.000	17	49
Extent of business Internet use	0	17	0.0%	-2.42	0.000	17	49
GDP Capita	0	16	0.0%	-2.06	0.001	16	47
HDI	3	14	17.6%	-2.21	0.000	17	49
Inequality-10	12	3	80.0%	1.95	0.030	15	47
Innovation	3	14	17.6%	-2.02	0.000	17	49
Education Public Expenditure (% of govt. expenditure)	5	10	33.3%	2.06	0.065	15	33
Population in urban agglomerations > 1 million (% of total population)	0	15	0.0%	-1.71	0.007	15	44
GDP deflator (base year varies by country)	16	1	94.1%	2.63	0.000	17	48
GNI per capita, Atlas method (current US$)	0	16	0.0%	-2.23	0.000	16	47
Present value of debt (% of GNI)	6	5	54.5%	2.81	0.018	11	27

LEGEND: High: # of countries with "high" (1) and "low" (0) values for the variables; % of countries in cluster with "high" value; adjusted residuals; significance of Pearson Chi-Square; N for cluster and whole sample.

Table 12: Crosstabs for cluster 3 or digital strivers, WITSA country set.

The ICT sector, in comparison with digital leaders, is oriented towards the domestic market: it is developed enough to provide several services, but lacks the competitiveness to compete at the international level. In this sense, exportations are below expected as is the contribution to the GDP per telecom employee. It is, after data and in our opinion, still a weak sector that can barely support the national needs and has a strong competition from abroad. On the other hand, it is neither an economy facilitator nor – not at all, actually – a development driver or locomotive.

In part, this might be due to the lower (than expected) level of its human capital. Taken as an aggregate, Human Capital[362] is slightly higher than expected[363], the problem being not stock but flow of this human capital: tertiary enrolment in science or Internet access in schools is significantly much lower than expected and way much lower in relationship to digital leaders.

At the legal framework and policy making levels, we find lower values than expected for almost all critical aspects of ICT regulation, market competition and the role of the government in the procurement of technology.

The reasons because of this lack of framework can be grouped in two in relationship to usage, though more data should be available and deeper analyses performed to

[362] The World Bank's aggregate
[363] Though non-significant

state valid conclusions. In fact, the reason could be the same but with opposed causality: first, reason could be that low level of usage at the consumer, firm and also government levels have made it not very relevant, or needed, to draw and implant a strong set of laws and policies where to frame digital life. Second, and opposite, that this poor legal framework has played havoc on the development of the digital society that it should be ordering and fostering.

Indeed, we believe that both are possible at the same time in a sort of vicious circle. Notwithstanding, in following chapters we will be seeing that it is the second one the one that is provided with statistical evidence of being the more correct one.

Anyway, what we see is that in parallel with the poor legal framework, intensity of usage at all levels (private, public, for profit and non-profit) is relatively low if compared with digital leaders.

Analogue indicators bring us some ideas about what kind of countries are we dealing with when speaking about digital strivers. With Human Development Index values higher than expected, a reasonably low level of inequality and high public expenditures in education along with high present values of debt, these are countries in the fringe between what is commonly acknowledged as developed and developing countries[364].

But they perform poorly in digital indicators. If we go back to the digital leaders and compare some differential values among analogue indicators, and despite wealth as measured by GDP or GNI per capita, we will see two aspects that seem crucial: innovation and population in cities are much lower in digital strivers than in digital leaders. As it will become evident in following chapters, these are not only differences in digital adoption, but clear causes of it.

12.2.3. Digital laggards

We can think of digital laggards as the opposite[365] of digital leaders, leaving digital strivers in between. Digital laggards have lowest values than expected almost everywhere where digital leaders showed high values. But, different from digital leaders, and more like digital strivers, laggards is also a homogeneous group, with the exceptions of prices and inflation, closely related in the medium term.

Digital laggards usually score worse than expected for most infrastructures and their associated prices are high. Their ICT sector especially shows a lower provision in terms of staff or employees. This under-provision goes in parallel with others indicators related to human capital or the presence and utilization of Internet in schools.

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[364] Italy being, probably the only surprise, though in the last years the country has arguably been loosing economic and political power at a tremendous speed.

[365] There are, unfortunately, more than two hundred countries that are even farther from digital leaders in digital development than digital laggards. We are here speaking, of course, in terms of the countries that were included in our clustering exercise.

Notwithstanding, the legal framework does present some optimistic trends. On the one hand, the more active aspects of it (laws relating to ICT, intellectual property protection, the government procurement of advanced technological products) actually score much lower than expected. But, on the other hand, the levels of competition, while not scoring at the same level than digital leaders, they are neither bad and are even better than digital laggards. This is probably because of a different point of departure from these digital strivers that could be leveraged to achieve higher – and faster – evolutions in the degree of their respective digital development stages.

It is in this same train of thought that performance should be looked at in the issues related to usage: even if indicators do show lower values than expected, it is also true that they do not differ much from digital strivers.

In other words, their place as digital laggards can be defined in opposition to digital leaders, but also as a previous stage of evolution behind digital strivers: they share similar stages of usage and of digital awareness (as proxied by the legal framework), being the big difference the indicators related to the push side: infrastructures, the ICT sector and a slight difference in human capital. Indeed, these differences in what we could call capital (infrastructures, private capital and human capital) might not come from differences in awareness or usage – as we have just stated – but from the initial supply of wealth and resources.

Indicator	High	Low	% of cluster	Adjusted residuals[366]	Sig. of Pearson Chi-Square	N (cluster)	N (sample)
Broadband subscribers (per 100 people)	0	14	0.0%	-1.96	0.000	14	49
Personal computers (per 100 people)	0	14	0.0%	-2.94	0.000	14	49
Telephone mainlines (per 100 people)	0	14	0.0%	-3.23	0.000	14	49
Mobile phone subscribers (per 100 people)	0	14	0.0%	-2.80	0.009	14	49
Population covered by mobile telephony (%)	3	6	33.3%	-3.54	0.003	9	39
International Internet bandwidth (bits per person)	0	14	0.0%	-4.00	0.000	14	49
Internet Hosts (per 10000 people)	0	14	0.0%	-2.24	0.000	14	49
Internet subscribers (per 100 inhabitants)	0	8	0.0%	-1.89	0.000	8	32
Residential monthly telephone subscription (US$)	5	5	50.0%	2.98	0.027	10	31
Price basket for Internet (US$ per month)	9	5	64.3%	2.75	0.018	14	49
Price basket for mobile (US$ per month)	9	5	64.3%	2.75	0.046	14	49
Price basket for residential fixed line (US$ per month)	6	8	42.9%	3.61	0.004	14	49
Telephone average cost of call to US (US$ per three minutes)	0	9	0.0%	-2.15	0.051	9	36
Telephone subscribers per employee	8	0	100.0%	1.73	0.079	8	32
Total full-time telecommunications staff (per 100 people)	0	10	0.0%	-1.99	0.001	10	36
GDP per Telecom Employee (US Dollars)	0	14	0.0%	-2.66	0.000	14	49

[366] See note 358

Human Capital	1	13	7.1%	-3.89	0.000	14	49
Internet Access in Schools	0	14	0.0%	-3.23	0.000	14	49
Laws relating to ICT	0	14	0.0%	-3.52	0.000	14	49
Intellectual property protection	0	14	0.0%	-3.08	0.000	14	49
Gov't procurement of advanced tech products	0	14	0.0%	-2.10	0.000	14	49
Secure Internet servers (per 1 million people)	0	14	0.0%	-2.66	0.000	14	49
Total Domains (per 100 people)	0	14	0.0%	-1.65	0.001	14	49
Web Measure	0	14	0.0%	-2.10	0.006	14	49
Availability of government online services	0	14	0.0%	-2.10	0.000	14	49
International outgoing telephone traffic (minutes) (per 100 people)	0	6	0.0%	-2.02	0.000	6	31
Internet users (per 100 people)	0	14	0.0%	-2.24	0.000	14	49
E-Participation	0	14	0.0%	-2.10	0.000	14	49
Firm-level technology absorption	1	13	7.1%	-2.41	0.000	14	49
Extent of business Internet use	0	14	0.0%	-2.10	0.000	14	49
GDP	1	12	7.7%	-1.73	0.081	13	47
GDP Capita	0	13	0.0%	-1.77	0.001	13	47
HDI	1	13	7.1%	-2.87	0.000	14	49
Economic Incentive Regime	0	14	0.0%	-3.08	0.000	14	49
Innovation	0	14	0.0%	-3.37	0.000	14	49
General Govt. final consumption expenditure (% of GDP)	0	12	0.0%	-2.07	0.082	12	40
Health Public Expenditure (% of govt. expenditure)	0	14	0.0%	-2.52	0.000	14	49
Health Public Expenditure (% of total Health expenditure)	1	13	7.1%	-2.72	0.005	14	49
GDP deflator (base year varies by country)	12	1	92.3%	1.99	0.000	13	48
GDP per capita, PPP (current international $)	0	13	0.0%	-1.89	0.002	13	48
GNI per capita, Atlas method (current US$)	0	13	0.0%	-1.92	0.000	13	47
Life expectancy at birth, total (years)	0	13	0.0%	-3.72	0.000	13	48
School enrolment, primary (% net)	1	8	11.1%	-2.08	0.066	9	39
School enrolment, primary (% gross)	6	6	50.0%	2.35	0.022	12	44
Mortality rate, infant (per 1,000 live births)	13	0	100.0%	4.05	0.000	13	48
Improved water source (% of population with access)	1	12	7.7%	-3.75	0.000	13	43
Interest payments (% of GDP)	8	1	88.9%	2.41	0.001	9	37
Inflation, consumer prices (annual %)	8	5	61.5%	2.69	0.000	13	47
Inflation, GDP deflator (annual %)	8	5	61.5%	2.39	0.001	13	46

LEGEND: High: # of countries with "high" (1) and "low" (0) values for the variables; % of countries in cluster with "high" value; adjusted residuals; significance of Pearson Chi-Square; N for cluster and whole sample.

Table 13: Crosstabs for cluster 4 or digital laggards, WITSA country set.

This is exactly what the analogue – real economy – indicators just tell: less wealth, education and health than expected, and worst than expected economy performance indicators. In our opinion, this fact again reinforces our double belief that digital development relies heavily on two key facts: (1) the will to promote it and (2) the economic starting point in which each country has to frame its digital development.

Nevertheless, the next group, digital leapfroggers, come to add an exception – the one that proves the rule – to these statements.

12.2.4. Digital leapfroggers

First of all, we have to be aware that this is a very narrow group (3 countries[367]), which makes any statistically grounded statement to be taken with extreme care. In line with this, when not all countries are in the same range of values ("high" or "low"), we find that two thirds belong to one end and one third to the other one, again making comparisons a horrible thing to be done.

Indicator	High	Lo.	% of cluster	Adjust. Resid.[368]	Sig. of Pearson Chi-Square	N (cluster)	N (sample)
Telecommunications revenue (% GDP)	2	1	66.7%	5.65	0.000	3	49
Telephone subscribers per employee	1	2	33.3%	-1.97	0.079	3	32
Human Capital	0	3	0.0%	-1.82	0.000	3	49
Level of competition – Cable modem	0	1	0.0%	-2.78	0.019	1	34
Total ICT Spending, Retail Trade (% of GDP)	1	2	33.3%	3.91	0.002	3	48
Total ICT Spending, Consumer (% of GDP)	3	0	100.0%	4.38	0.000	3	49
Gross National Expenditure (% of GDP)	2	1	66.7%	2.61	0.037	3	40
Population growth (annual %)	2	1	66.7%	2.49	0.090	3	44
Mortality rate, infant (per 1,000 live births)	3	0	100.0%	1.72	0.000	3	48
Inflation, consumer prices (annual %)	3	0	100.0%	2.61	0.000	3	47
Inflation, GDP deflator (annual %)	3	0	100.0%	2.45	0.001	3	46
Tax revenue (% of GDP)	2	0	100.0%	2.61	0.017	2	38
LEGEND: High: # of countries with "high" (1) and "low" (0) values for the variables; % of countries in cluster with "high" value; adjusted residuals; significance of Pearson Chi-Square; N for cluster and whole sample							

Table 14: Crosstabs for cluster 5 or digital leapfroggers, WITSA country set.

Nevertheless, and keeping all these caveats in mind, we will draw some analysis by especially taking the cases where all countries in the group behave alike.

Digital leapfroggers present a completely different scheme from the three preceding groups of countries. They are young economies still growing in population, with higher than expected infant mortality rate, low human capital, inflation and higher tax pressure. This facts differ much from developed countries – in general – and from digital leaders – in particular –.

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[367] And, for some values, only two or just one case could be analyzed, making of statistics sort of a curiosity.

[368] See note 358

On the other hand, these countries seem to be betting strongly for ICTs as a sector. With all the caveats previously listed, telecommunications play an statistically higher important role both at the GDP share level as in consumption.

This could be a trace of an incipient attempt to use ICTs to leapfrog development, as many conceptual conditions (low development level, high stress on ICTs) seem to converge in this group.

12.3. Describing the stages of digital development through characterization: categories

As we have been doing with the four groups or stages – digital leaders, strivers, laggards and leapfroggers – of digital development on a vertical basis (i.e. stage by stage), we will now perform the same analysis but on a horizontal basis, comparing groups among themselves within each of the six categories that we have drawn.

Figures picture the percentage of countries for each stage of digital development that score "high" in each category. Thus, we are able to see the relative weight of each variable within each country[369]. Note that figures do not picture how good or bad the aggregates perform in each category, but just the percentage of countries that have a high value. So, it is a measure of how many are doing well, and not how well are these doing – though, of course, it is related.

Most comments have already been made before in this chapter, we our intention in the following sections is just to highlight things that might have been missing so far.

12.3.1. Infrastructures

As stated – and Figure 207 puts it quite clearly – digital leaders are usually well supplied in the field of infrastructures, being digital strivers behind them, but at a considerable distance. Digital laggards specially struggle with prices, a major barrier in comparison to other groups of countries.

Hype or truth, it is worth noting how leapfroggers leverage on the coverage of mobile telephony as, by far, their mainstream infrastructure, despite high prices in some[370] cases.

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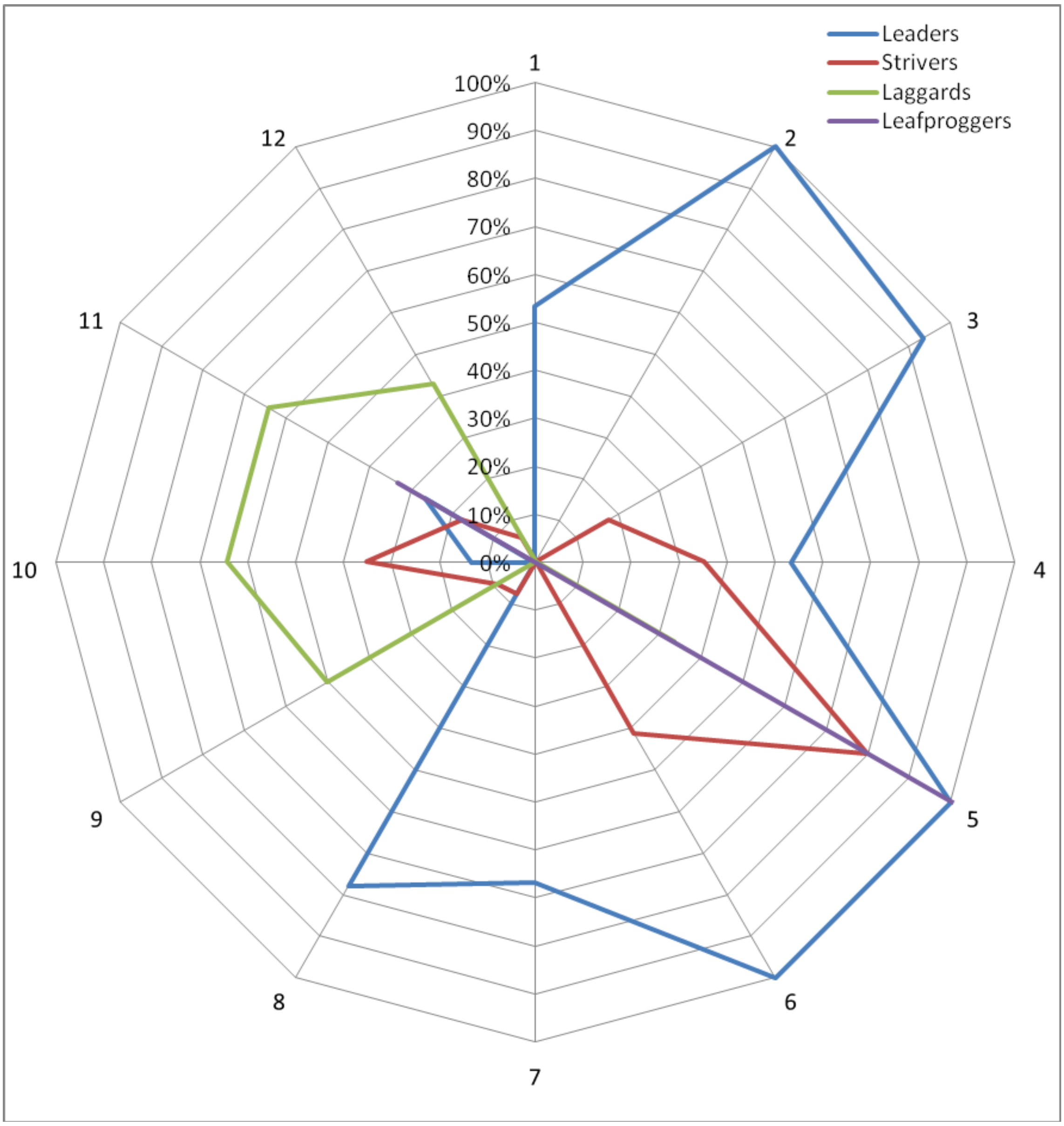
[369] Making it with the total number of countries would have only worked had we had clusters with the same number of countries. For instance, it would have been likely to happen that less leapfrogging countries were present in any category in relationship with the rest, as they are five times less numerous, despite the fact that they might have a relatively higher or lower weight would this be adjusted to the relative number.

[370] To be true, in one case.

It is important to note how broadband, even in digitally developed countries, is slightly above average, or rated "high", though below the total number of mobile phone subscribers, once again picturing the two different models of digital development between leaders and leapfroggers.



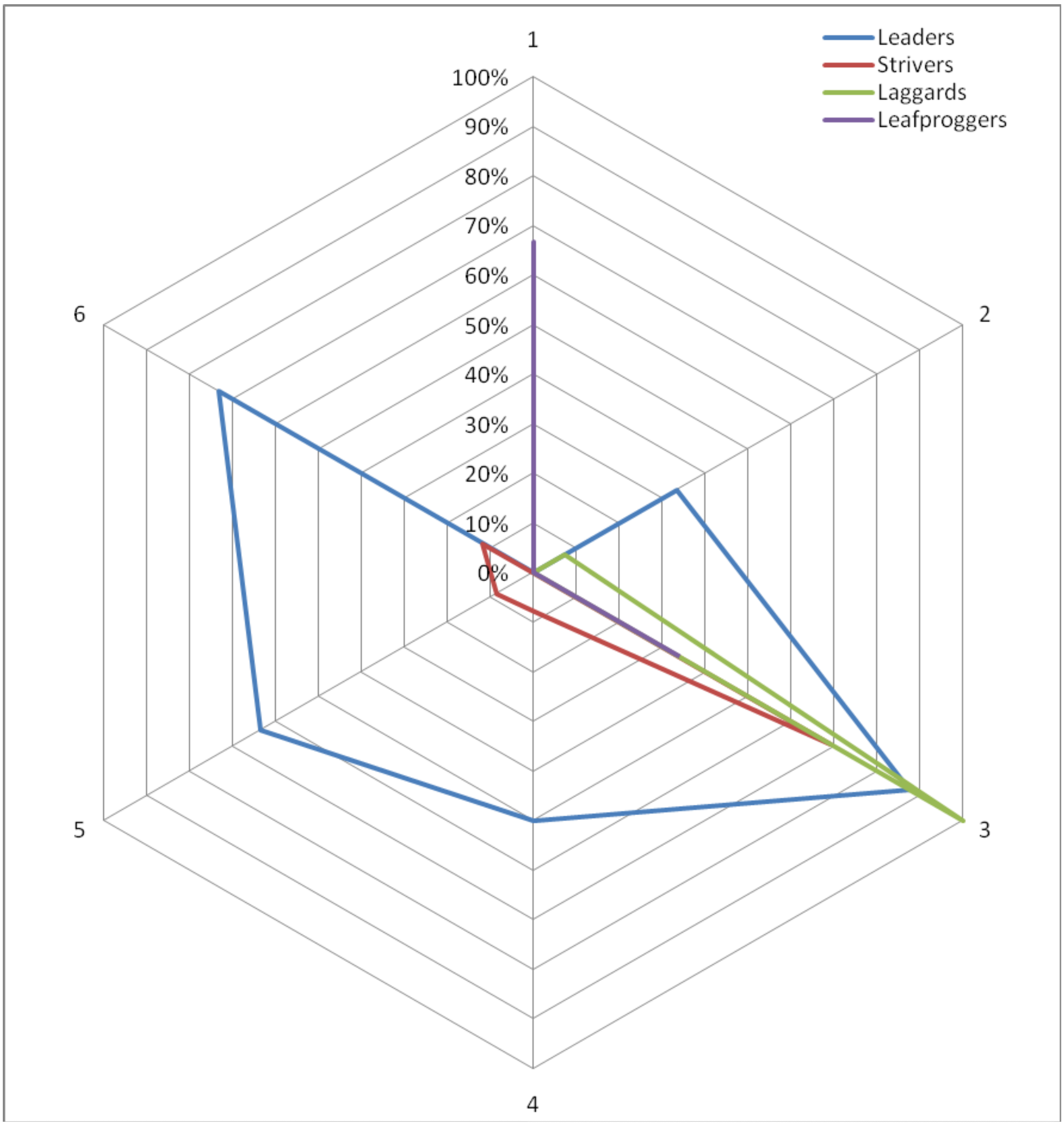
1 - Broadband subscribers (per 100 people)
2 - Personal computers (per 100 people)
3 - Telephone mainlines (per 100 people)
4 - Mobile phone subscribers (per 100 people)
5 - Population covered by mobile telephony (%)
6 - International Internet bandwidth (bits per person)
7 - Internet Hosts (per 10000 people)
8 - Internet subscribers (per 100 inhabitants)
9 - Residential monthly telephone subscription (US$)
10 - Price basket for Internet (US$ per month)
11 - Price basket for mobile (US$ per month)
12 - Price basket for residential fixed line (US$ per month)

Figure 207: % of countries scoring "high" in Infrastructures per digital development stage, WITSA country set

Concerning strivers, we can see that "old" technologies (e.g. telephone) are quite present (including newest ones as mobile telephony) but that Internet adoption lags behind in coverage and subscribers, which will surely replicate in lower users too.

12.3.2. The ICT Sector

Figure 208 shows an interesting picture: while digital leaders, in general, do better in the power of their ICT Sector in relationship with employment, international commerce and productivity, it is of high value seeing how leapfroggers are using the ICT Sector to pull from the rest of the economy, having a big weight in relationship to their GDP in two out of three cases.



1 - Telecommunications revenue (% GDP)
2 - High-technology exports (% of manufactured exports)
3 - Telephone subscribers per employee
4 - Telephone employees (per 100 people)
5 - Total full-time telecommunications staff (per 100 people)

Figure 208: % of countries scoring "high" in the ICT Sector per digital development stage, WITSA country set

Digital strivers, though still lagging behind, begin to have a shy presence of their ICT Sectors, but burdened – as it happens with laggards – with an insufficient allocation of resources to be able to respond to their markets' needs, as the number of telephone subscribers per employee might suggest. Indeed, this is a clear gate for foreign firms to penetrate the domestic ICT Sector, as it actually happens.

12.3.3. Digital Literacy

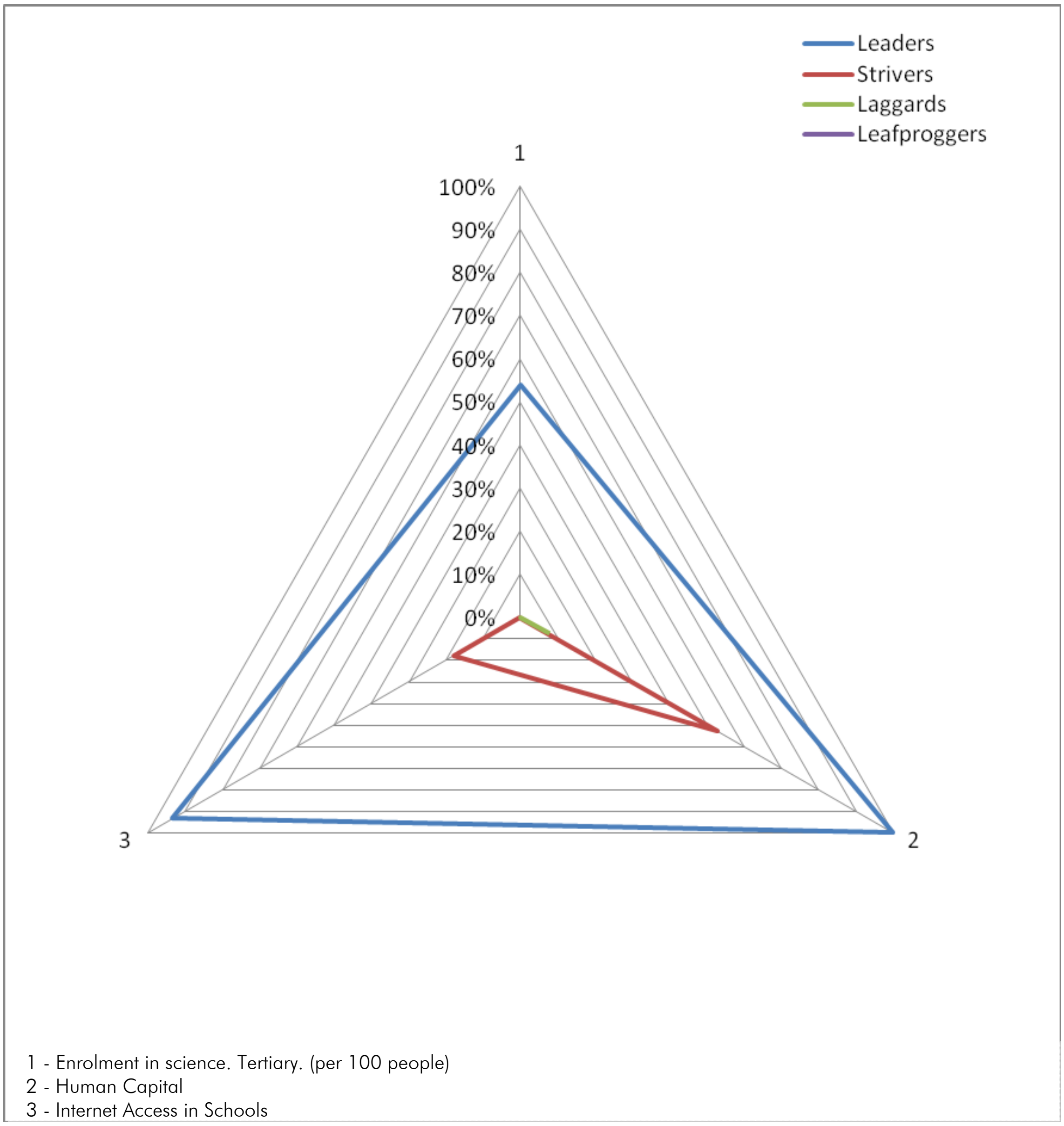


Figure 209: % of countries scoring "high" in Digital Literacy per digital development stage, WITSA country set

Taking into account that two out of three variables in this section actually belong to the real economy, it is not surprising to find the shape of Figure 209: the more developed countries are, the more likely to do well in human capital en tertiary enrolment in science (i.e. in education).

More interesting, on the other hand, it is to find how this same path, the path towards an educated and trained citizenry, is the one that these countries are taking in relationship to new literacies, better or worse measured by the penetration of the Internet in schools. Certainly, we can see how more developed countries and digital leaders – almost all of them, actually – bet for Internet in schools, while strivers shyly lag behind. No trace of laggards and leapfroggers here: the former ones are still struggling to achieve satisfactory levels of primary and secondary – not to speak of tertiary and higher – education; the latter, have their focus not in capacity building, but in setting up ICT "muscle" to compete overseas. It might well look that they are competing in quantity and prices, not in quality and innovation, a strategy that may pay high returns in the short run, leaving an uncertain long run.

12.3.4. The Policy and Regulatory Framework

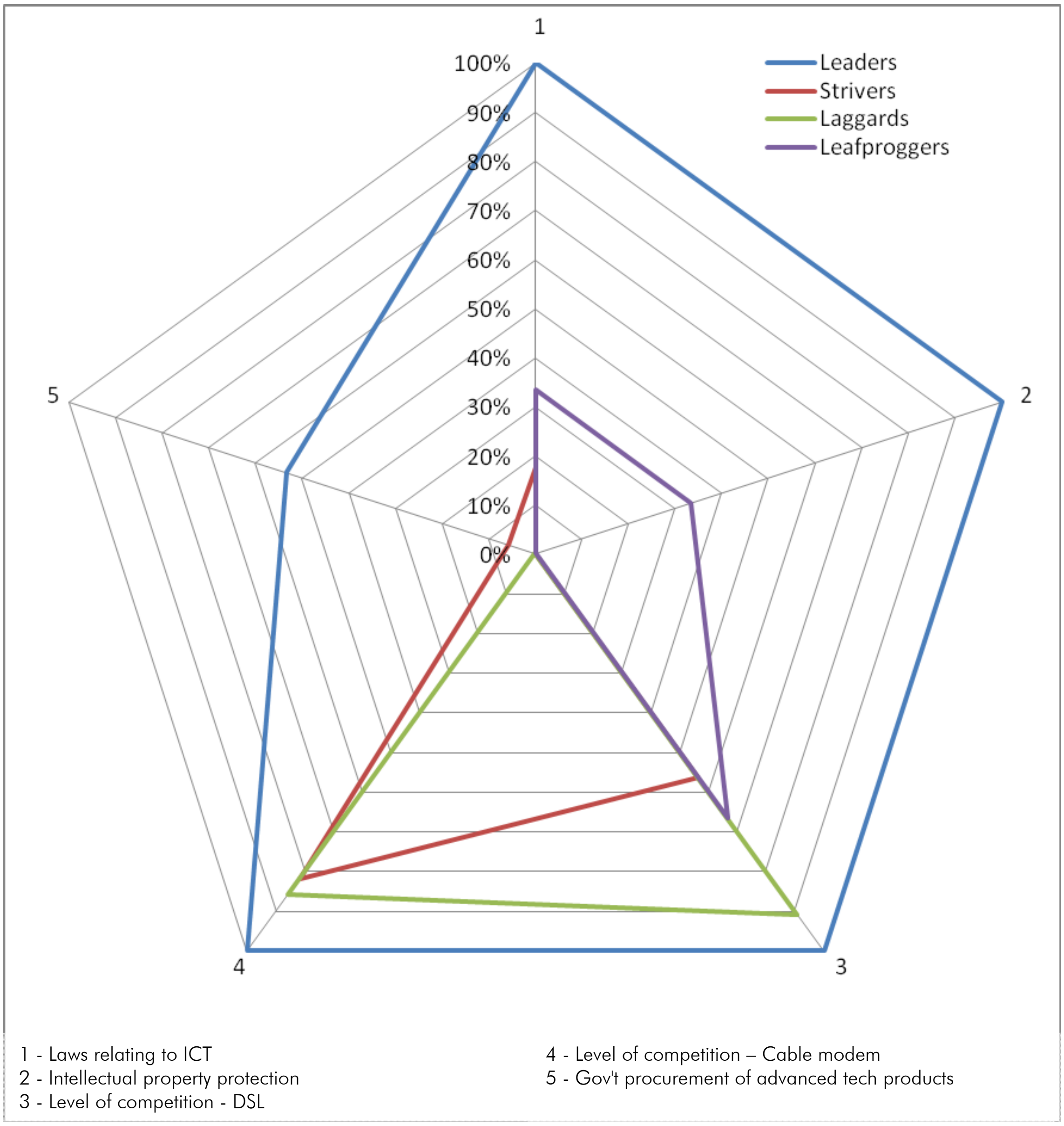


Figure 210: % of countries scoring "high" in the Policy and Regulatory Framework per digital development stage, WITSA country set

If we look just at digital leaders, Figure 210 confirms our previous statements in this chapter: while there is a huge consensus on the importance of the legal framework amongst digital leaders, there are two different ways at considering the direct intervention of governments in this field[371].

The interesting point in, Figure 210 is comparing the couple strivers/laggards with leapfroggers, as they depict two opposite models. Strivers and laggards are domestic oriented, as show their interest in developing a competitive market for the local provision of Internet services. On the contrary, leapfroggers look towards outside their countries, and are more concerned about – of course – the laws relating to ICT but also about intellectual property rights, and broadband, the carrier of their services towards their clients overseas. Cable has been leapfrogged, and the government has no weight as the policies are private sector oriented.

12.3.5. Usage

We already know that digital leaders are also the ones with most intensive usage – both in relative and absolute sense – of ICT related content and services. The fact that prices are low should not mislead us when looking at the total spending in ICTs in the retail sector or at the individual level. On the other hand, if we believe that a specific threshold of infrastructures has been achieved, we find it plausible that less expenditure is carried on in these late stages of investment in ICT capital.

This is just the opposite case of leapfroggers, which are doing just the contrary to quickly develop their ICT Sector and its power at the international level. This is linked, as Figure 211 shows, with somewhat high levels of technology absorption by firms.

Laggards are out of the equation, their focus being creating the infrastructures and the necessary legal framework to secure them and enable their proper functioning and application.

Digital strivers lie in between leaders and laggards: having their infrastructures a little bit more deployed, more or less appropriate legal frameworks, and combined with higher skills, they are at the doors of massive adoption of ICT services. This massive adoption seems to shyly rely on the web, both at the firm and government levels.

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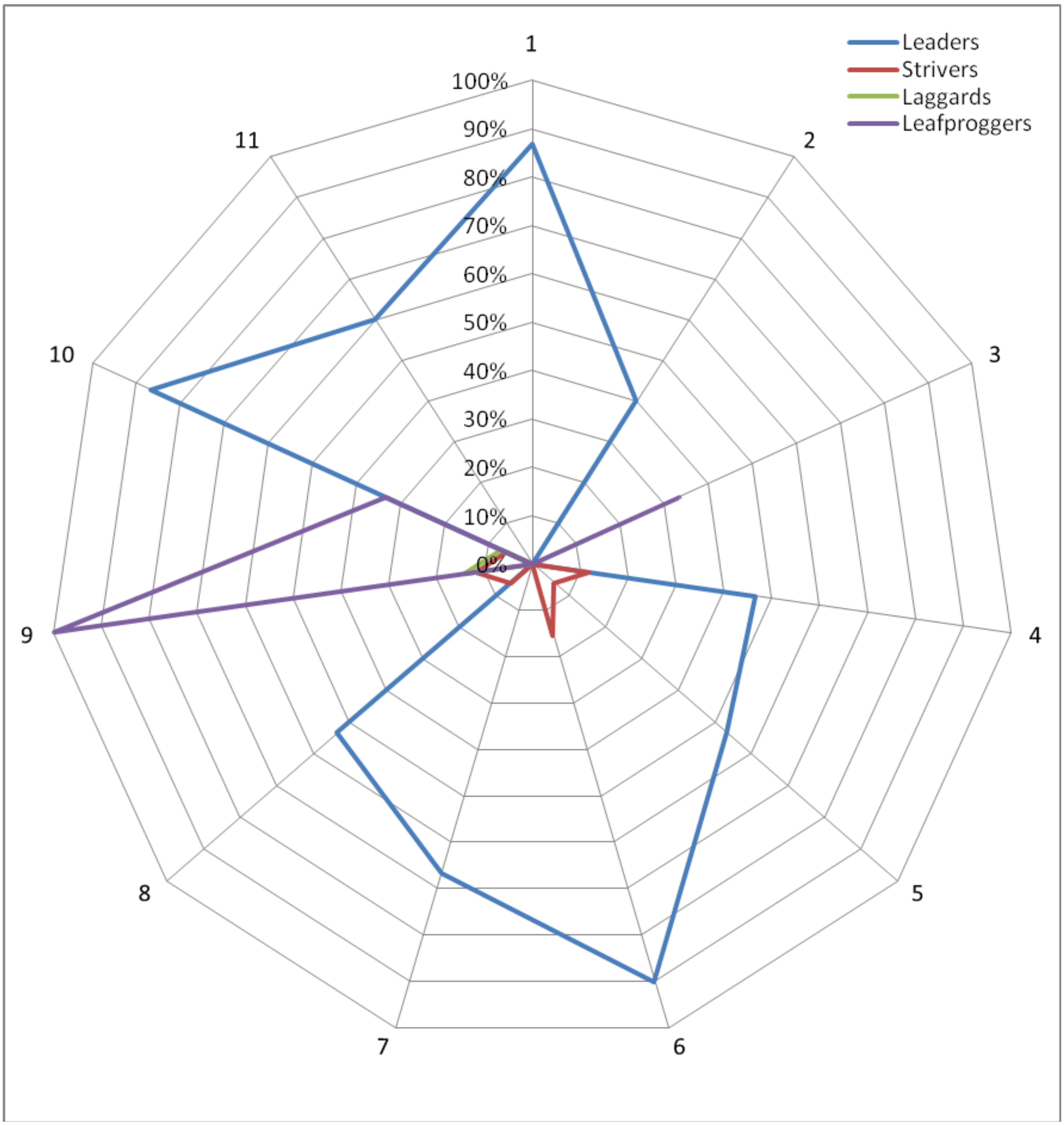
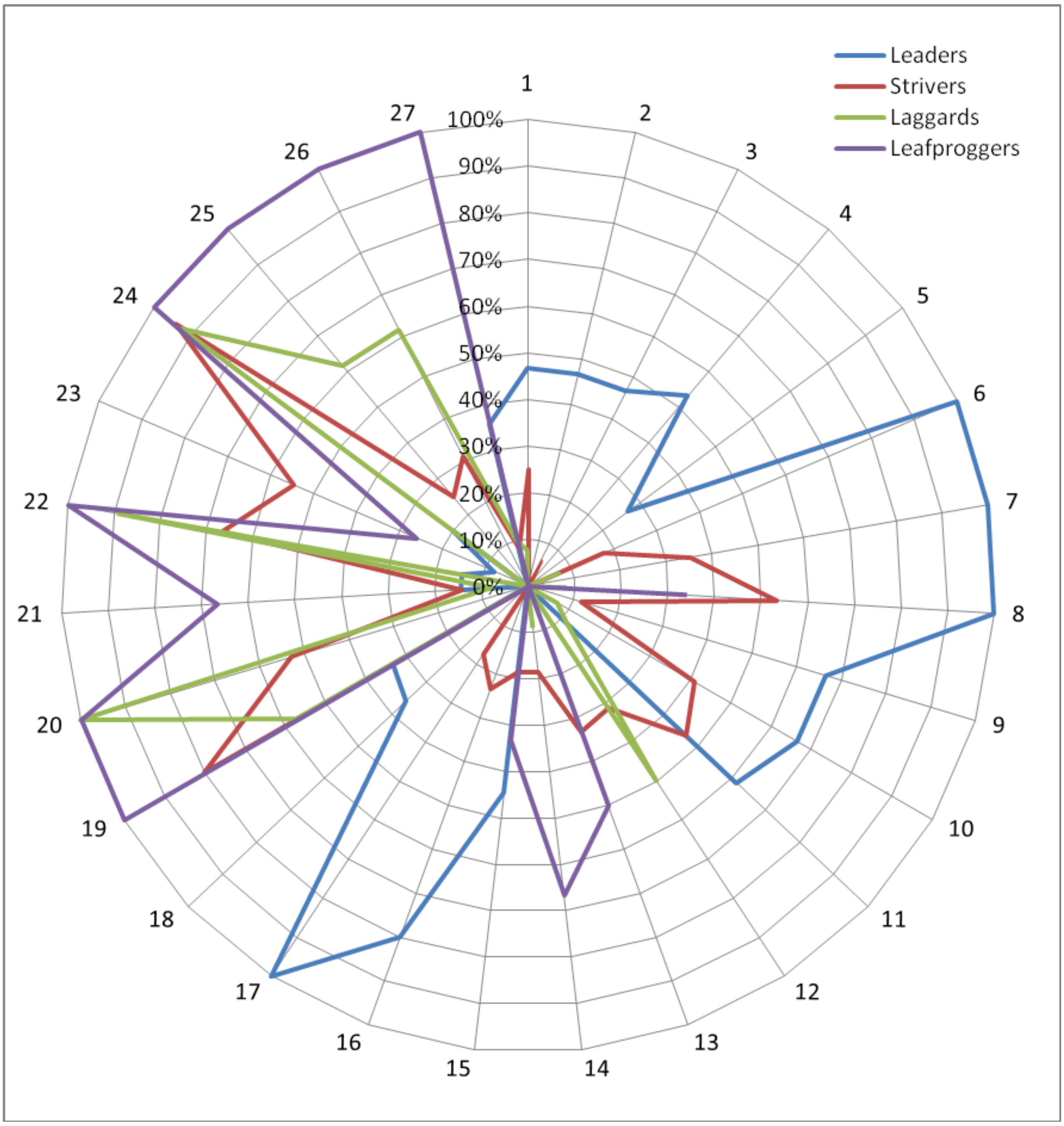
[371] Which correspond, without any doubt, to the neoliberal vs. Keynesian ways of understanding the economy as a whole.



1 - Secure Internet servers (per 1 million people)
2 - Total Domains (per 100 people)
3 - Total ICT Spending, Retail Trade (% of GDP)
4 - Web Measure
5 - Availability of government online services
6 - International outgoing telephone traffic (minutes) (per 100 people)
7 - Internet users (per 100 people)
8 - E-Participation
9 - Total ICT Spending, Consumer (% of GDP)
10 - Firm-level technology absorption
11 - Extent of business Internet use

Figure 211: % of countries scoring "high" in Usage per digital development stage, WITSA country set

12.3.6. Analogue Indicators



1 - GDP
2 - GDP Capita
3 - GDP per capita, PPP (current international $)
4 - GNI per capita, Atlas method (current US$)
5 - GNI per capita, PPP (current international $)
6 - HDI
7 - Life expectancy at birth, total (years)
8 - Improved water source (% of population with access)
9 - Health Public Expenditure (% of govt. expenditure)
10 - Health Public Expenditure (% of total Health expenditure)
11 - School enrollment, primary (% net)
12 - School enrollment, primary (% gross)
13 - Education Public Expenditure (% of govt. expenditure)
14 - Gross National Expenditure (% of GDP)
15 - General Govt. final consumption expenditure (% of GDP)
16 - Economic Incentive Regime
17 - Innovation
18 - Population in urban agglomerations > 1 million (% of total population)
19 - Inequality-10
20 - Mortality rate, infant (per 1,000 live births)
21 - Population growth (annual %)
22 - Interest payments (% of GDP)
23 - Present value of debt (% of GNI)
24 - GDP deflator (base year varies by country)
25 - Inflation, consumer prices (annual %)
26 - Inflation, GDP deflator (annual %)

Figure 212: % of countries scoring “high” in Analogue Indicators per digital development stage, WITSA country set

Besides the most evident aspects shown in Figure 212 that only strengthen the preconceptions about development (the rich get richer, etc.), it is worth noting how digital leaders strongly bet for a strong economic incentive regime and for innovation. It is very important to see – and in next chapters we will go back to this point – that beyond wealth (as measured in per capita income), education or health, this is the point that really makes a difference between digital leaders and the rest of countries. And, even more, it is an aspect that almost all countries share, despite their differences in income or how present their governments are to support a welfare state (e.g. health expenditure).

Though at a distance, it is also the path that digital strivers seem to be slowly adopting.

12.4. General observations

We want to end this chapter with a brief summary of the things we have been commenting so far:

- Developed – wealthy – countries are also the more digitally developed ones, leading the development of the Information Society internationally;
- The quantity of infrastructures is a basic aspect that presents a threshold which seems to be related with the behaviour of other characteristics, especially the weight of expenditure in ICTs;
- Quality (e.g. price) of such infrastructures seems also to be related to how developed the digital society is, and also impacts on the expenditure in ICTs by individuals at large;
- Human capital is also a tipping point between digitally developed and developing, being new literacies (e.g. Internet in schools) a path that digital leaders (and the ones that follow them more closely) have been paving for their citizenry;
- The legal framework, innovation, a proper economic environment are always present when the digital economy and the ICT sector are achieving successes, at all levels: at the adoption level, as an industry or at the international arena level;
- After the legal and economic framework, firms come to benefit from it and pull from the rest of the economy, usually leading adoption before governments and citizens;
- The intervention of the State, or the direct action of governments beyond just setting the rules of the game, is by no means a characteristic of digital development. In fact, both models (high and low intervention) are present at all stages of digital development;
- The difference between strivers and laggards is not (lack of) e-awareness, but human capital in general. And this comes from the initial supply of wealth;
- There are some countries – leapfroggers – that are strongly supportive towards developing an ICT Sector and investing in digital infrastructures with a clear focus on the international market. This is done despite their initial allocation of resources and the impact on their economies is, with our data, unclear.

13. Stages of digital development in the most developed economies: cluster analysis and characterization for the OECD countries

We here repeat the same steps performed in chapter 12, but for a narrower range of countries than those collected in the WITSA dataset: the OECD country dataset[372].

Our aim in zooming into the most developed counties is to see whether, when talking about digital development, the same conclusions that apply for the large set of countries apply too, though balanced, to a small richer sample, in a sort of fractal design. In other words, we wanted to check whether the behaviour of the most developed ones was any different from the whole set at large (i.e. WITSA) when taken aside, including the fact that there was more data for this set to perform a more accurate analysis.

It is our belief that reality does not necessarily follow this pattern. The deeper we get into our analysis, the more reasonable is to think that digital development is closely tied to the state of the real economy. So, we expect to find different explanations within richer countries than across a broader range of countries, as the variables that make them internally homogeneous and externally heterogeneous not only differ in their level but in their very nature.

13.1. Defining the stages of digital development through Cluster Analysis

From the initial set of 103 digital variables[373], we defined 5 clusters by using 17 variables – listed in Table 15 – that differ significantly ($p<0.001$) between clusters.

27 countries could be properly allocated amongst clusters according to their performance in the 17 variables we used. The country distribution is as follows:

1. United States
2. Australia, Canada, Denmark, Netherlands, Norway, Sweden, Switzerland, United Kingdom
3. Austria, Finland, France, Germany, Ireland, Japan, Rep. of Korea, New Zealand
4. Greece, Hungary, Italy, Poland, Spain
5. Czech Republic, Mexico, Portugal, Slovak Republic, Turkey

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[372] See Annex IV

[373] The 79 of our digital indicators full set plus the added 24 for the OECD countries. See previous note.

As we did in chapter 12, and before embarking upon the characterization exercise, we will comment on the composition of the clusters by looking at the countries that constitute them and the list of variables that contributed to creating them.

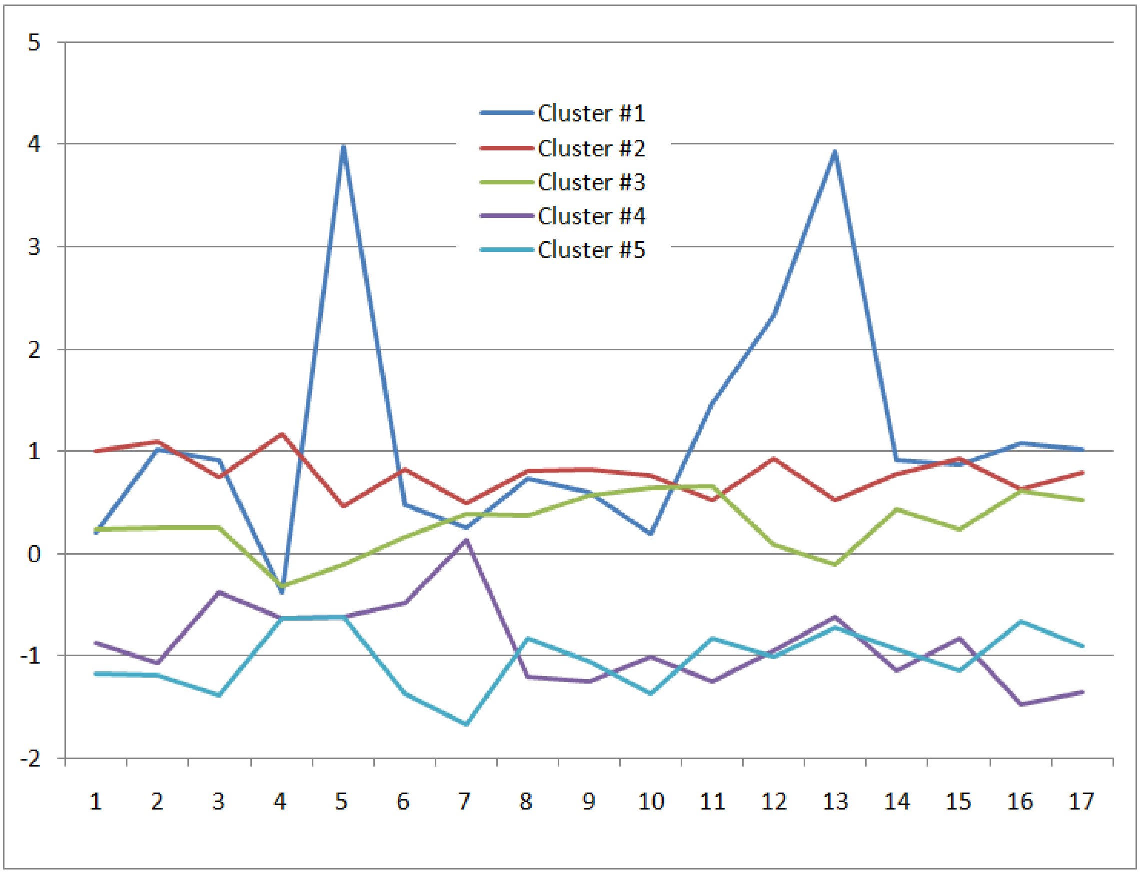
Unlike the case of the WITSA country set — where a sort of continuum can be drawn – in the case of OECD countries such a continuum is more difficult to find and a two layer snapshot of the stage of development instead presents itself. These results reinforce the idea that digital development does not follow a fractal-like pattern – that replicates itself with independence of the sample – but a simple, hierarchical one.

Cluster	1	2	3	4	5		
N =	1	8	8	5	5	F	Sig.
Broadband subscribers (per 100 people)	,20953	,99571	,23722	-,87218	-1,17893	13,543	,000
Personal computers (per 100 people)	1,01822	1,08541	,25735	-1,06313	-1,19419	43,533	,000
Telephone mainlines (per 100 people)	,91840	,74964	,24828	-,37928	-1,38870	8,245	,000
International Internet bandwidth (bits per person)	-,38300	1,16103	-,32347	-,62780	-,63569	8,463	,000
Internet Hosts (per 10000 people)	3,96762	,46810	-,11215	-,62234	-,61265	22,710	,000
GDP per Telecom Employee (US Dollars)	,47386	,81627	,16119	-,48033	-1,36759	9,077	,000
Human Capital	,25381	,49712	,38287	,13629	-1,67482	10,022	,000
Internet Access in Schools	,72439	,80600	,37168	-1,19879	-,83363	10,111	,000
Laws relating to ICT	,60258	,81661	,56778	-1,24891	-1,04845	22,005	,000
Intellectual property protection	,18858	,76578	,64024	-1,01655	-1,36649	29,039	,000
Gov't procurement of advanced tech products	1,47367	,52677	,65822	-1,25342	-,82564	13,890	,000
Secure Internet servers (per 1 million people)	2,31850	,92904	,08690	-,95593	-1,01621	26,467	,000
Total Domains (per 100 people)	3,92739	,51633	-,10154	-,61520	-,72482	26,811	,000
Availability of government online services	,91334	,78390	,43874	-1,13882	-,94009	11,478	,000
Internet users (per 100 people)	,86478	,93427	,22930	-,83230	-1,14481	11,419	,000
Firm-level technology absorption	1,07589	,62023	,60949	-1,46891	-,66764	16,544	,000
Extent of business Internet use	1,01266	,78650	,51833	-1,35495	-,89746	20,821	,000

Table 15: Results of k-means (quick cluster) analysis for the OECD country set (cluster centre values, F and significance)

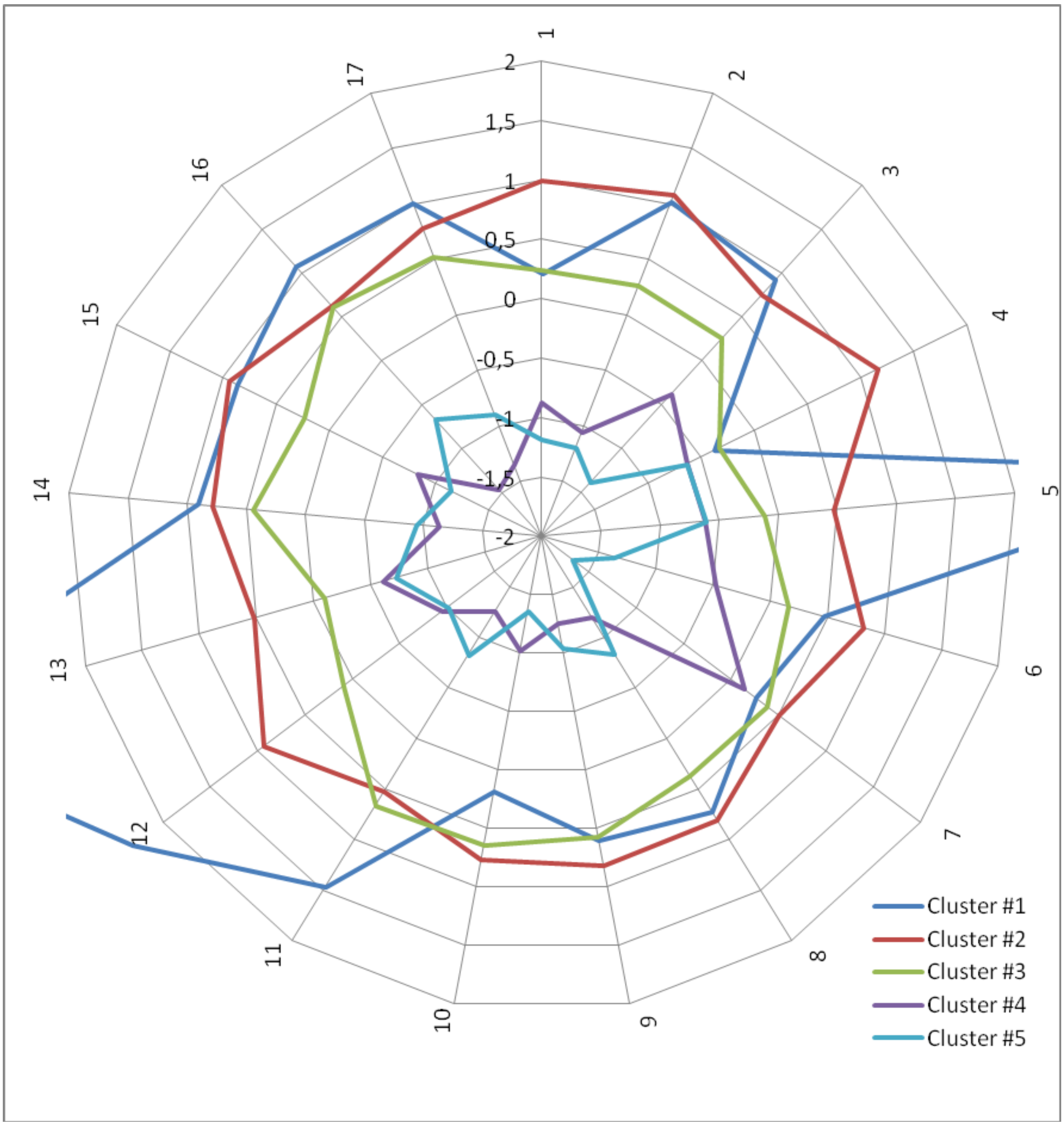
As we did in chapter 12, and before embarking upon the characterization exercise, we will comment on the composition of the clusters by looking at the countries that constitute them and the list of variables that contributed to creating them.

Unlike the case of the WITSA country set — where a sort of continuum can be drawn – in the case of OECD countries such a continuum is more difficult to find and a two layer snapshot of the stage of development instead presents itself. These results reinforce the idea that digital development does not follow a fractal-like pattern – that replicates itself with independence of the sample – but a simple, hierarchical one. Hence, Figure 205 and Figure 214 clearly show that we cannot speak of digital leaders, strivers and laggards when zooming in on the sample of OECD (i.e. developed) countries, but that we lost part of the model (the laggards and the leapfroggers) and we are just finding the same as before, but with more detail.



1 - Broadband subscribers (per 100 people)
2 - Personal computers (per 100 people)
3 - Telephone mainlines (per 100 people)
4 - International Internet bandwidth (bits per person)
5 - Internet Hosts (per 10000 people)
6 - GDP per Telecom Employee (US Dollars)
7 - Human Capital
8 - Internet Access in Schools
9 - Laws relating to ICT
10 - Intellectual property protection
11 - Gov't procurement of advanced tech products
12 - Secure Internet servers (per 1 million people)
13 - Total Domains (per 100 people)
14 - Availability of government online services
15 - Internet users (per 100 people)
16 - Firm-level technology absorption
17 - Extent of business Internet use

Figure 213: Cluster centre values for OECD countries (lines)



1 - Broadband subscribers (per 100 people)
2 - Personal computers (per 100 people)
3 - Telephone mainlines (per 100 people)
4 - International Internet bandwidth (bits per person)
5 - Internet Hosts (per 10000 people)
6 - GDP per Telecom Employee (US Dollars)
7 - Human Capital
8 - Internet Access in Schools
9 - Laws relating to ICT
10 - Intellectual property protection
11 - Gov't procurement of advanced tech products
12 - Secure Internet servers (per 1 million people)
13 - Total Domains (per 100 people)
14 - Availability of government online services
15 - Internet users (per 100 people)
16 - Firm-level technology absorption
17 - Extent of business Internet use

Figure 214: Cluster centre values for OECD countries (radial)

When zooming in, we find digital leaders split in three clusters (instead of the former two), which actually come from splitting in two our former cluster[374] of digital

[374] See previous chapter.

leaders[375]. Equally, digital strivers are here also split in two sub-layers, also with countries coming from the strivers' cluster in our WITSA countries dataset model[376].

As the OECD case is but a concrete case of the general model calculated with WITSA countries, after having characterized it we will not go further and will not calculate the determinants that cause a country to belong to one specific cluster: we are more interested in what makes a leader a leader, or a laggard a laggard, than what makes a striver a striver.

In line with Figure 214, and as we did in the previous chapter, we will label our clusters the following way:

1+2: Primary digital leaders
3: Secondary digital leaders
4: Primary digital strivers
5: Secondary digital strivers

which, combined again with our findings, results in the following classification of countries:

- Primary digital leaders: United States, Australia, Canada, Denmark, Netherlands, Norway, Sweden, Switzerland, United Kingdom
- Secondary digital leaders: Austria, Finland, France, Germany, Ireland, Japan, Rep. of Korea, New Zealand
- Primary digital strivers: Greece, Hungary, Italy, Poland, Spain
- Secondary digital strivers: Czech Republic, Mexico, Portugal, Slovak Republic, Turkey

In the next sections we will repeat our analysis in chapter 12 but focusing on the OECD country data set, which is to say that we will focus in the upper echelon of digital development.

13.2. Describing the stages of digital development through characterization: development stages

Before getting into detail with the analysis between countries and/or categories, we want to draw the attention of the reader to the fact that, sometimes, we will find statistical analysis that, when performed with different indicators that do actually measure the same thing[377], we end up with different results. This is due to different

[375] Plus the addition of Canada, Denmark and the Netherlands, that fell off the previous model due to lack of appropriate data.
[376] Plus the addition of Poland, the Czech and Slovak Republics and Turkey.
[377] For instance RE INF_S_01 - Broadband subscribers (per 100 people) and OECD04A1R - Broadband subscribers per 100 inhabitants in OECD countries

ways of measuring indicators according to the institutions gathering them, different years, or both reasons.

Even if, normally, results are different but similar in concept, we will find that, sometimes, exceptionally, results are not only different but they lead us to different final conclusions too.

13.2.1. Primary digital leaders

This group is characterized by having higher values than would be expected for most indicators, at both the digital and analogue levels. And it is worth noting too that, normally, most – if not all – countries in the group exhibit similar behaviour in relationship with these indicators.

In general, primary digital leaders show good expected performance at the infrastructure level, including hardware related issues such as those more related to the Internet. Though the number of countries that the analysis takes into account to calculate the percent of homes with a Personal Computer, it is important to note, nevertheless, that it is, by far, the variable that reports a higher value for the adjusted residuals, making the hypothesis of independence difficult to reject – a fact that is reinforced by a second indicator measuring the same variable: OECD's Households with access to a home computer, that includes, this time, 9 countries.

The ICT Sector variable is also a powerful one, but an interesting observation is to be made here: even if with low (0.10) significance, we can see that all countries have lower values than expected when measuring their expenditure in Research & Development in the manufacturing and the ICT industries as a percentage of business enterprise sector R&D expenditure.

This can have three possible interpretations, especially concerning the ICT industries. The first one is that the ICT sector has achieved a relative maturity that does not require such a high effort in R&D as it would in earlier stages of development of the sector. Second, and the one we are more comfortable with, is that the ICT sector is no exception when measuring R&D. In other words: it is the whole economy that is fully engaged in R&D practices, so that, as a share, the ICT sector – or the manufacturing sector more generally – does not especially stands out over other sectors. Which is good: the economy is not relying for innovation in just one sector, but the environment is so healthy that R&D is a common practice at the private sector level. And third, that it is not necessary to be a producer of ICT to be an advanced user of it, even finding advanced ICT manufacturing now heading towards lower wage economies – thus dragging out of the country too R&D in ICT industries.

Indicator	High	Lo.	% of cluster	Adjusted residuals	Sig. of Pearson Chi-Square	N (cluster)	N (sample)
Broadband subscribers (per 100 people)	7	2	77.8%	2.77	0.007	9	27
Broadband subscribers per 100 inhabitants in OECD countries	5	4	55.6%	2.48	0.055	9	27
Personal computers (per 100 people)	9	0	100.0%	2.82	0.000	9	27
Telephone mainlines (per 100 people)	9	0	100.0%	2.38	0.001	9	27
International Internet bandwidth (bits per person)	9	0	100.0%	1.75	0.011	9	27
Internet Hosts (per 10000 people)	8	1	88.9%	3.29	0.002	9	27
Internet subscribers (per 100 inhabitants)	7	0	100.0%	3.09	0.014	7	21
% of homes with a Personal Computer	5	0	100.0%	4.36	0.000	5	19
Price basket for mobile (US$ per month)	4	5	44.4%	2.45	0.091	9	27
Total communication access paths	6	3	66.7%	2.60	0.034	9	27
Standard analogue access lines	5	4	55.6%	2.95	0.028	9	27
Households with access to the Internet in selected OECD countries	5	4	55.6%	2.48	0.055	9	27
Households with access to a home computer	7	2	77.8%	3.10	0.006	9	27
Telephone employees (per 100 people)	4	1	80.0%	3.07	0.016	5	18
Total full-time telecommunications staff (per 100 people)	6	1	85.7%	2.70	0.017	7	23
GDP per Telecom Employee (US Dollars)	9	0	100.0%	3.05	0.003	9	27
Share of ICT-related occupations in the total economy in selected countries. broad definition	6	3	66.7%	3.03	0.021	9	23
R&D expenditure in manufacturing industries	0	8	0.0%	-1.70	0.066	8	18
R&D expenditure in selected ICT industries (manuf. & services)	0	8	0.0%	-1.70	0.066	8	18
Contributions of ICT investment to GDP growth	5	2	71.4%	3.30	0.012	7	18
Internet Access in Schools	9	0	100.0%	2.38	0.004	9	27
Laws relating to ICT	9	0	100.0%	2.38	0.000	9	27
Intellectual property protection	9	0	100.0%	2.82	0.000	9	27
Secure Internet servers (per 1 million people)	9	0	100.0%	3.29	0.000	9	27
Total Domains (per 100 people)	7	2	77.8%	3.46	0.004	9	27
Total ICT Spending. Government (% of GDP)	5	4	55.6%	3.50	0.007	9	27
Web Measure	7	2	77.8%	2.77	0.024	9	27
Availability of government online services	5	4	55.6%	2.09	0.062	9	27
International outgoing telephone traffic (minutes) (per 100 people)	8	0	100.0%	3.07	0.001	8	23
Internet users (per 100 people)	9	0	100.0%	3.81	0.000	9	27
Firm-level technology absorption	8	1	88.9%	2.72	0.001	9	27
Extent of business Internet use	8	1	88.9%	3.29	0.002	9	27
GDP Capita	7	2	77.8%	3.46	0.004	9	27
Urban Population (%)	7	2	77.8%	3.46	0.004	9	27

Economic Incentive Regime	9	0	100.0%	2.60	0.051	9	27
Innovation	9	0	100.0%	2.17	0.000	9	27
Education Public Expenditure (% of GDP)	3	5	37.5%	2.76	0.054	8	26
GDP per capita. PPP (current international $)	7	2	77.8%	3.46	0.004	9	27
GNI per capita. Atlas method (current US$)	7	2	77.8%	3.10	0.006	9	27
GNI per capita. PPP (current international $)	3	6	33.3%	2.60	0.080	9	27
Life expectancy at birth. total (years)	9	0	100.0%	1.96	0.001	9	27
Interest payments (% of GDP)	0	8	0.0%	-2.32	0.025	8	23
Total debt service (% of GNI)	0	3	0.0%	-2.24	0.025	3	5

LEGEND: High: # of countries with "high" (1) and "low" (0) values for the variables; % of countries in cluster with "high" value; adjusted residuals; significance of Pearson Chi-Square; N for cluster and whole sample.

Table 16: Crosstabs for clusters 1+2, OECD country set.

Strongly related with R&D and the power of infrastructures are the high stakes for investing in Internet access in schools, as a way to keep on investing in – in this case – human capital related with ICTs. Unlike what was found in chapter 12, this time human capital, in general, does not make a difference among digitally developed countries.

The same happens with the protection of this R&D – Intellectual Property Protection – and the legal framework of the afore-mentioned infrastructure – Laws relating to ICT – that also show higher values than expected, thus configuring a coherent set of results in relationship with the Information Society..

Usage is, as Table 17 shows, the less homogeneous part amongst countries, with results ranging from all countries[378] having higher values than expected with highest significance – Secure Internet Servers or Internet Users – to other indicators – ICT spending by the Government or e-Government – where the country set is almost split in two equal subsets.

Notwithstanding, if we look closely, we will see that usage is, in general, common ground and that it is only the usage made at the public sector that really differs. This could be in line with other of our findings that demonstrated the different intensities of the direct implication of governments in the promotion of the Information Society, despite their level of digital development.

This last aspect can also explain the only big difference in analogue indicators – Public Expenditure in Education – while other variables show similar behaviour. Besides the usual variables related to income, health and debt, we want to stress the

[378] 9 countries in total

relevance of the Economic Incentive Regime, Innovation and Urban Population as special characteristics of this primary digital leaders set of countries and, at another lower but still important level, how the private sector has broadly adopted ICTs.

13.2.2. Secondary digital leaders

Secondary digital leaders are characterized not by main, big infrastructures, planned to serve the industry or the ICT sector, though the penetration of personal computers and broadband makes them still have higher values in the field of infrastructure. We might argue that their infrastructure serves sufficiently the domestic demand but falls short at the international commerce level.

Just because of this – because of a lack of infrastructures – or because of the reasons mentioned in the previous section, expenditures in Research & Development have a strong presence in the share of total R&D expenditure in the business enterprise sector, though only for half of the countries, with the other half having lower values than expected[379].

What seems to be clear is that this group of countries is making an effort in catching up with the ICT factor, as show by the high values perceived at the level of contributions of ICTs in the added value and GDP growth. In other words, be it because of the weakness of the rest of the productive economy, or be it because there is an explicit effort in the ICT industry, higher values than expected in these issues show that this industry is actually shifting upwards the total performance of the economy.

Legal framework indicators also show a strong commitment towards properly regulating everything related with the Information Society, both specifically – Laws relating to ICT – or strongly related – Intellectual Property Rights.

Indicator	High	Lo.	% of cluster	Adjusted residuals	Sig. of Pearson Chi-Square	N (cluster)	N (sample)
Personal computers (per 100 people)	8	0	100.0%	2.59	0.000	8	27
Availability of Digital Subscriber Lines (DSL) in OECD countries	8	0	100.0%	1.80	0.047	8	27
R&D expenditure in manufacturing industries	3	3	50.0%	2.68	0.066	6	18
R&D expenditure in selected ICT industries (manuf. & services)	3	3	50.0%	2.68	0.066	6	18
Contribution of ICT-using services to value added per person engaged	0	7	0.0%	-1.72	0.022	7	19
Contributions of ICT investment to GDP growth	0	7	0.0%	-2.10	0.012	7	18
Laws relating to ICT	8	0	100.0%	2.19	0.000	8	27

379 And arguably having a behaviour much like the group of the top digital leaders instead.

Intellectual property protection	8	0	100.0%	2.59	0.000	8	27
Share of ICT value added in the business sector value added	3	4	42.9%	2.73	0.059	7	22
HDI	8	0	100.0%	2.19	0.001	8	27
Innovation	8	0	100.0%	1.99	0.000	8	27
GDP deflator (base year varies by country)	1	7	12.5%	-1.94	0.016	8	27
Life expectancy at birth. total (years)	8	0	100.0%	1.80	0.001	8	27
LEGEND: High: # of countries with "high" (1) and "low" (0) values for the variables; % of countries in cluster with "high" value; adjusted residuals; significance of Pearson Chi-Square; N for cluster and whole sample.							

Table 17: Crosstabs for cluster 3, OECD country set.

Last, analogue indicators do tell us that we are dealing with countries with a high level of development and welfare (HDI, life expectancy) but are not the main economic powers of the world (there is inflation and no special emphasis on the GDP or the GNI). Nevertheless, we find again a recurring variable: innovation, that shows significantly higher values than expected and for all the 8 countries of the group we have labelled as secondary digital leaders.

13.2.3. Primary digital strivers

The primary digital strivers – the more developed level among the digital strivers – is again characterized by an inner homogeneity and quite significant findings – though limited by the fact that the group is composed of just five countries[380].

Indicator	High	Low	% of cluster	Adjusted residuals	Sig. of Pearson Chi-Square	N (cluster)	N (sample)
Broadband subscribers (per 100 people)	0	5	0%	-2.05	0.007	5	27
Personal computers (per 100 people)	0	5	0%	-3.23	0.000	5	27
Internet Hosts (per 10000 people)	0	5	0%	-2.22	0.002	5	27
Internet subscribers (per 100 inhabitants)	1	4	20%	-1.66	0.014	5	21
Households with access to a home computer	0	5	0%	-1.90	0.006	5	27
Internet Access in Schools	1	4	20%	-2.73	0.004	5	27
Share of ICT-related occupations in the total economy in selected countries. broad definition	0	5	0%	-1.67	0.021	4	23
Laws relating to ICT	1	4	20%	-2.73	0.000	5	27
Intellectual property protection	0	5	0%	-3.23	0.000	5	27
Secure Internet servers (per 1 million people)	0	5	0%	-2.77	0.000	5	27
Total Domains (per 100 people)	0	5	0%	-1.75	0.004	5	27

[380] Which makes significance a delicate concept to deal with.

Web Measure	0	5	0%	-2.05	0.024	5	27
International outgoing telephone traffic (minutes) (per 100 people)	1	4	20%	-1.86	0.001	5	23
Internet users (per 100 people)	0	5	0%	-2.39	0.000	5	27
Firm-level technology absorption	0	5	0%	-2.57	0.001	5	27
Extent of business Internet use	0	5	0%	-2.22	0.002	5	27
GDP Capita	0	5	0%	-1.75	0.004	5	27
Urban Population (%)	0	5	0%	-1.75	0.004	5	27
GDP deflator (base year varies by country)	4	1	80%	1.98	0.016	5	27
GDP per capita. PPP (current international $)	0	5	0%	-1.75	0.004	5	27
GNI per capita. Atlas method (current US$)	0	5	0%	-1.90	0.006	5	27
Interest payments (% of GDP)	4	1	80%	2.72	0.025	3	23
Central government debt. total (% of GDP)	2	3	40%	2.81	0.048	4	23
LEGEND: High: # of countries with "high" (1) and "low" (0) values for the variables; % of countries in cluster with "high" value; adjusted residuals; significance of Pearson Chi-Square; N for cluster and whole sample.							

Table 18: Crosstabs for cluster 4, OECD country set.

Primary digital strivers somehow mirror the secondary digital leaders, as their domestic market infrastructures – including Internet Hosts – are the ones that score low in our model. Thus, we find an underdevelopment in the level of personal computers per capita or broadband adoption.

The low availability of human capital in ICT related issues – as stock, measured in the share of ICT-related occupations in the total economy, and as flow, proxied by internet access in Schools – is low (or lower than expected), even if the latter only applies to 3 out of the 5 countries.

Similarly, the legal framework also appears to be neglected or less developed than in other layers of digital development as we have been seeing in former examples.

Thus, it is not surprising that lower infrastructures, lower human capital and poorer legal framework are accompanied by much lower usage than expected, including usage properly said, and the supply of digital services and content. The number of users, the intensity of usage, how much (or how few) have firms adopted technology or use the Internet, the number of domains or lower the presence of the Government (Web Measure) and firms (proxied by Secure Internet Servers) are just aspects that confirm that the Information Society has still a long path ahead towards a full deployment.

Although without a proven relationship of causality between variables[381], we can see that these early stages of digital development are accompanied not by poor

381 Please see next chapter for a deeper analysis about this point.

economies but, certainly, neither by richest ones, as can be seen in their lower expected values for the GDP or GNI. Debt, interest rates and inflation do not contribute to have a healthier economy that could be leveraged to foster the Information Society. Last, but not least, urban concentration is also lower than expected for this group of countries.

13.2.4. Secondary digital strivers

If we said that primary digital strivers were the mirror of secondary digital leaders, then secondary digital strivers seem to be the mirror of primary digital leaders, at least at the infrastructures level. So, secondary digital strivers do not only have lower values for broadband subscribers or personal computers, but also for International Internet Bandwidth or Internet Hosts. This group is also a homogeneous one, and almost all countries score "low" (=0) for all these and other variables. Added to this, it is also true that the power of the statistical testing of the hypothesis of independence is more powerful if higher, for instance, than for top digital strivers. All combined makes of this the group of countries with lower expected values for all these variables and not only lower but more powerfully so.

ICT Sector variables show an ICT Sector that is very weak in human resources related indicators. There is a contradictory result in the "Contribution of ICT-using services to value added per person engaged" variable but, on the other hand, its power is at stake, as it only gathers two countries of the whole sample, which is by far too low a number for statistical purposes.

Indicator	High	Low	% of cluster	Adjusted residuals	Sig. of Pearson Chi-Square	N (cluster)	N (sample)
Broadband subscribers (per 100 people)	0	5	0%	-2.05	0.007	5	27
Personal computers (per 100 people)	0	5	0%	-3.23	0.000	5	27
Telephone mainlines (per 100 people)	0	5	0%	-3.82	0.001	5	27
International Internet bandwidth (bits per person)	2	3	40%	-2.65	0.011	5	27
Internet Hosts (per 10000 people)	0	5	0%	-2.22	0.002	5	27
Internet subscribers (per 100 inhabitants)	1	4	20%	-1.66	0.014	5	21
Total communication access paths	0	5	0%	-1.75	0.034	5	27
Availability of Digital Subscriber Lines (DSL) in OECD countries	2	3	40%	-2.25	0.047	5	27
Households with access to a home computer	0	5	0%	-1.90	0.006	5	27
Total full-time telecommunications staff (per 100 people)	0	5	0%	-2.22	0.017	5	23
GDP per Telecom Employee (US Dollars)	0	5	0%	-2.99	0.003	5	27
Contribution of ICT-using services to value added per person engaged	2	0	100%	2.90	0.022	1	19
Human Capital	3	2	60%	-3.08	0.023	5	27

Internet Access in Schools	2	3	40%	-1.65	0.004	5	27
Laws relating to ICT	1	4	20%	-2.73	0.000	5	27
Intellectual property protection	0	5	0%	-3.23	0.000	5	27
Secure Internet servers (per 1 million people)	0	5	0%	-2.77	0.000	5	27
Total Domains (per 100 people)	0	5	0%	-1.75	0.004	5	27
International outgoing telephone traffic (minutes) (per 100 people)	0	5	0%	-2.88	0.001	5	23
Internet users (per 100 people)	0	5	0%	-2.39	0.000	5	27
Firm-level technology absorption	0	5	0%	-2.57	0.001	5	27
Extent of business Internet use	0	5	0%	-2.22	0.002	5	27
GDP Capita	0	5	0%	-1.75	0.004	5	27
HDI	0	5	0%	-3.82	0.001	5	27
Urban Population (%)	0	5	0%	-1.75	0.004	5	27
Innovation	0	5	0%	-4.19	0.000	5	27
GDP deflator (base year varies by country)	4	1	80%	1.98	0.016	5	27
GDP per capita. PPP (current international $)	0	5	0%	-1.75	0.004	5	27
GNI per capita. Atlas method (current US$)	0	5	0%	-1.90	0.006	5	27
Life expectancy at birth. total (years)	1	4	20%	-3.44	0.001	5	27
School enrolment. primary (% gross)	2	3	40%	3.02	0.028	5	26
Mortality rate. infant (per 1.000 live births)	2	3	40%	3.08	0.023	5	27
Total debt service (% of GNI)	2	0	100%	2.24	0.025	5	5

LEGEND: High: # of countries with "high" (1) and "low" (0) values for the variables; % of countries in cluster with "high" value; adjusted residuals; significance of Pearson Chi-Square; N for cluster and whole sample.

Table 19: Crosstabs for cluster 5, OECD country set.

Human capital and Internet in Schools – that we grouped under Digital Literacy – is the only category that shows dissimilar behaviours amongst countries, what makes it difficult to state any general observation for the country set as a whole.

This does not happen neither with the legal framework nor with usage. In the first case, we find lower values than expected and with statistical significance.

In the second case, we find, again, the opposite as what we found with primary digital leaders, with lower scores for variables of usage including some strategic ones such as Secure Internet Servers, International Traffic or the level of Internet absorption by enterprises.

Last, concerning analogue indicators, is where we find, again, the relationship – though not yet causality – between digital and real economy development. This last tier of digital development – within the OECD countries – we have called secondary digital strivers is characterized by lower income and Human Development Index values than usual, along with higher child mortality and lower life expectancy at birth. Debt and inflation come again into the spotlight, as do lower values for innovation and concentration or urban settlements. For the first time here in this OECD country set we find higher values than expected for primary school enrolment, a characteristic we already found for digital laggards in our previous chapter that included the least digitally developed economies of our country set.

13.3. Describing the stages of digital development through characterization: categories

Again, and as we did in chapter 12 for the WITSA country set, we repeat here the characterization for the OECD country set, now category by category.

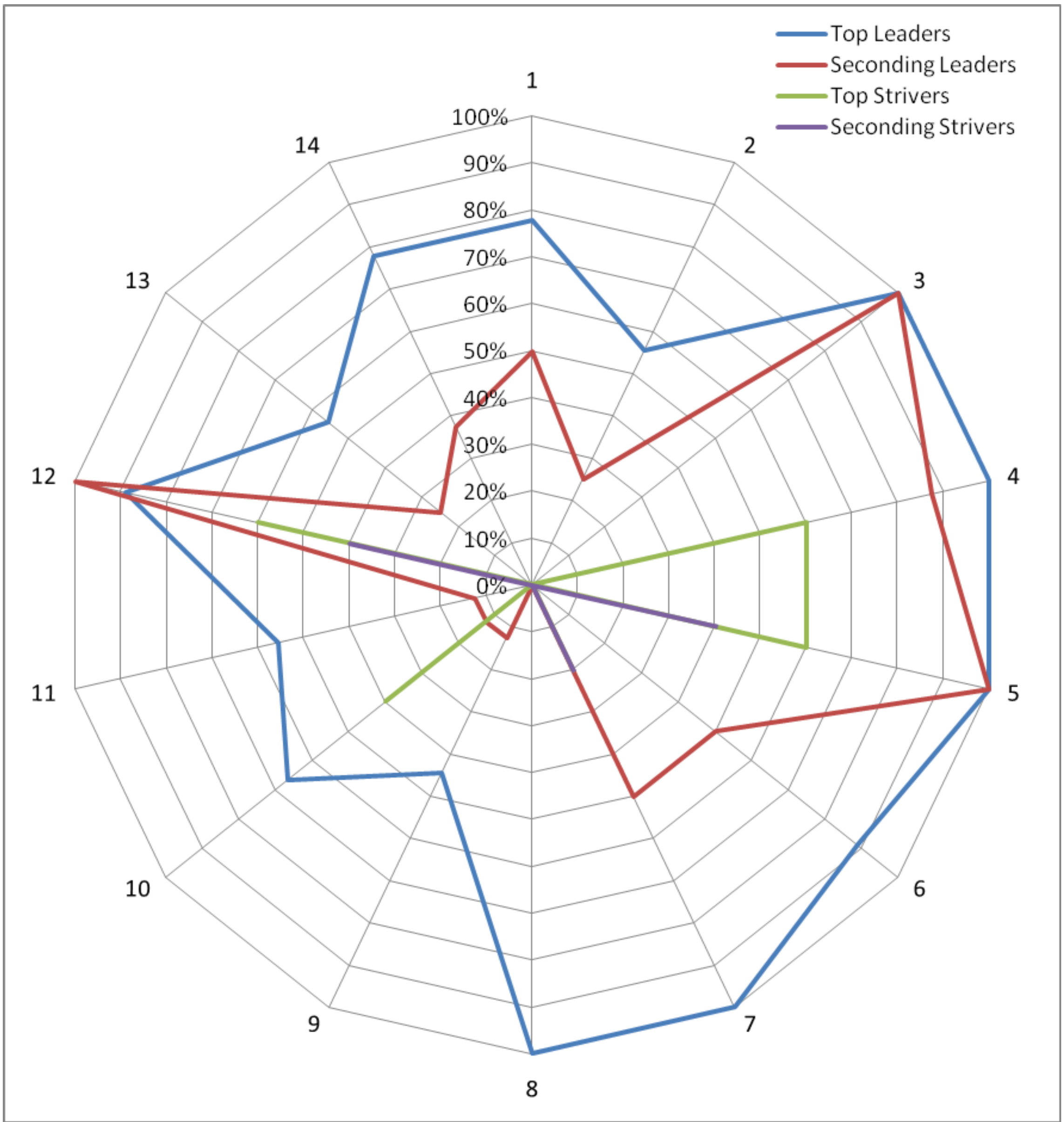
13.3.1. Infrastructures

Figure 207 clearly shows the big differences in Infrastructure between leaders – top and seconding – and strivers – top and seconding too. As in a gradation of adoption and installation, the percentage of countries that have high values for each variable decreases as we run down all the tiers of digital development.

It is worth noting how seconding leaders have similar levels of adoption in the main infrastructure variables (computers, telephone, bandwidth and DSL availability) but fall behind in the rest of strategic infrastructures like Internet hosts or broadband subscribers.

Digital strivers do not differ much from this pattern, though scoring lower than leaders. Indeed, their watermark is characterized thus by some isolated indicators where they actually have good scores.

An important conclusion, despite all differences, is the high stakes that most countries – digitally developed and developing – place on domestic and international broadband, valuable for both the domestic development and the international transactions and offshore services in a globalized economy.



1 - Broadband subscribers (per 100 people)
2 - Broadband subscribers per 100 inhabitants in OECD countries
3 - Personal computers (per 100 people)
4 - Telephone mainlines (per 100 people)
5 - International Internet bandwidth (bits per person)
6 - Internet Hosts (per 10000 people)
7 - Internet subscribers (per 100 inhabitants)
8 - % of homes with a Personal Computer
9 - Price basket for mobile (US$ per month)
10 - Total communication access paths
11 - Standard analogue access lines
12 - Availability of Digital Subscriber Lines (DSL) in OECD countries
13 - Households with access to the Internet in selected OECD countries

Figure 215: % of countries scoring "high" in Infrastructures per digital development stage, OECD country set

13.3.2. The ICT Sector

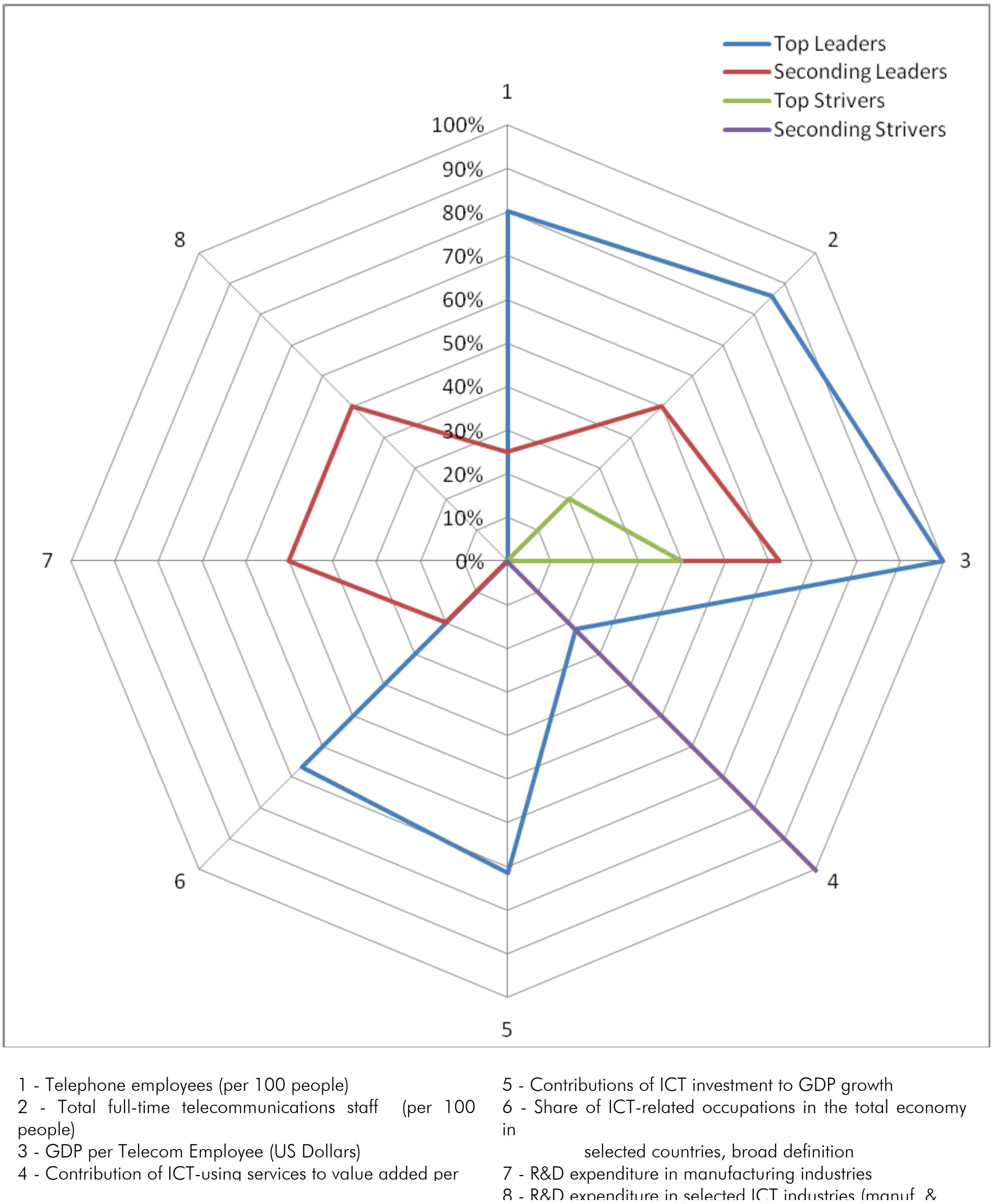


Figure 216: % of countries scoring "high" in the ICT Sector per digital development stage, OECD country set

The most interesting comparison that can be made regarding the ICT Sector – in our opinion – is that of the role of this industry in Research & Development in the business enterprise sector, as we have said before. Figure 216 shows it quite clearly:

while the difference between primary digital leaders and secondary digital leaders in the number of telephone employees, full-time telecom staff or GDP per telecom employee is just a matter of magnitude, the difference in investment, share of occupation and R&D related indicators is a matter of concept: while the most digitally developed ones have a positive impact in a healthy and powerful economy (GDP, occupation), lesser digitally developed (meaning seconding leaders) have a relative impact in a slower economy, being their contribution in relative terms more than in actual terms.

Right behind these first two groups of digital leaders, come primary digital strivers, with a very slightly share of their countries scoring high in the ICT Sector, leaving all of the secondary digital strivers out of the equation[382].

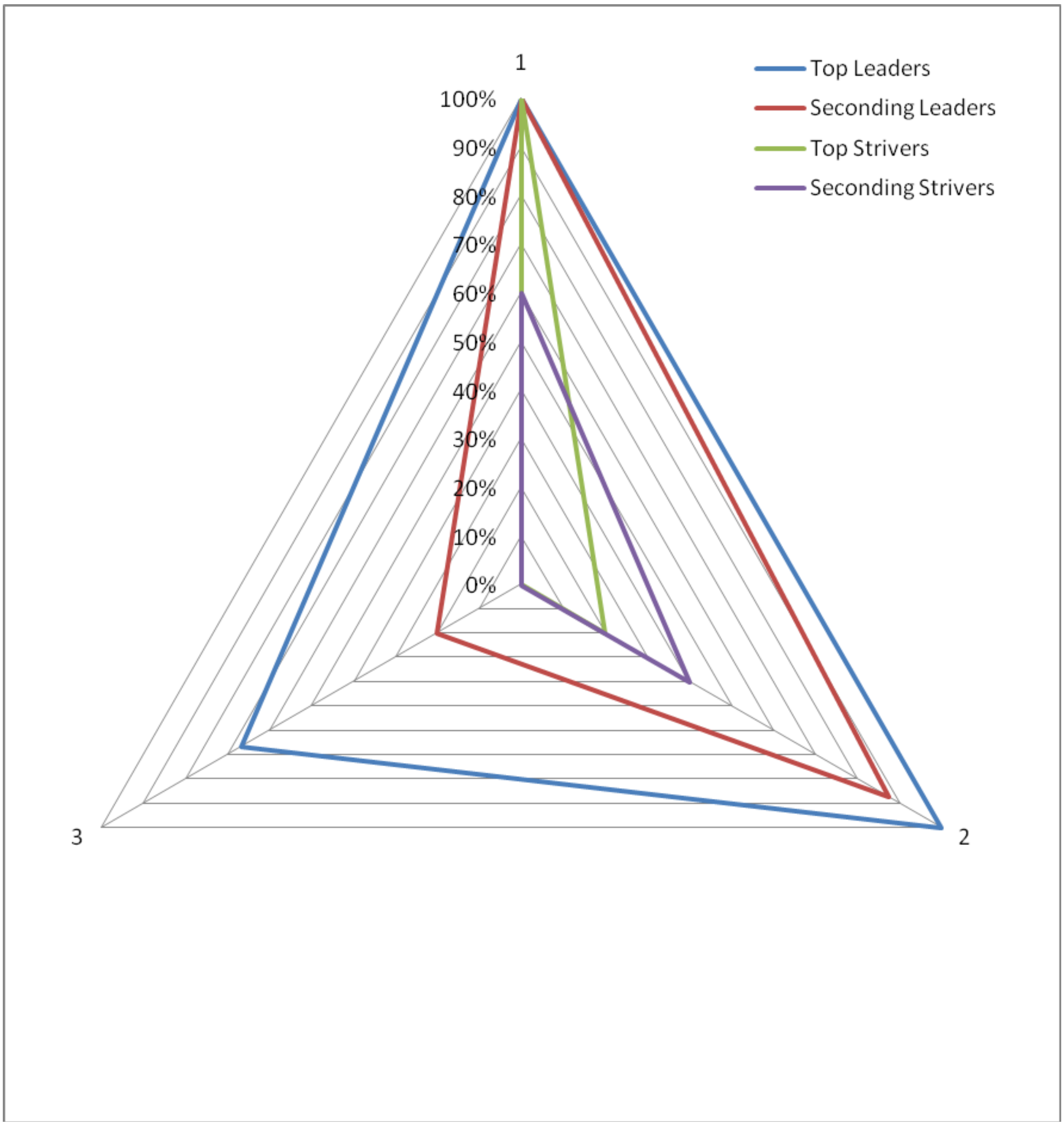
13.3.3. Digital Literacy

Plotting digital literacy shows again how digital development – at least in these developed stages as represented by OECD countries – is mostly a matter of degree. Despite some exceptions we have and will be pointing, the normal observation is seeing exactly the same behaviour amongst all countries of the set, just differenced by the degree of adoption – in this case, the proportion of countries in each stage of digital development – of a specific variable.

In this case, we see that while Human Capital scores high for all the three more developed tiers, while only half of the secondary digital strivers make it to figure as having a high level of Human Capital. This tells us that, in general, Human Capital is "abundant" amongst OECD countries and, in any case, does not make a big difference among them but only at the lowest level of development.

It is not this way with Internet Access in Schools, where the gradient is more manifest. Surprisingly, we find positions interchanged between top strivers and secondary strivers – interchanged as expected, of course. We can infer from this that there are countries that, even if having a lower stock of Human Capital, they are investing strongly in the making of it by means of ICTs being present at schools. Only the long run – in a one or two generation timespan – will tell, at the macro level, what the impact has been, but it would be interesting to test whether this is a way to leapfrog development by fostering the impact (quality, performance, etc.) of ICTs in education.

[382] As we have said before, we are not very comfortable in considering very seriously the 100% of seconding strivers countries scoring high in the Contribution of ICT-using services to value added per person engaged, as this value only gathers 2 countries out of 5, which already was a very weak result to rely upon.



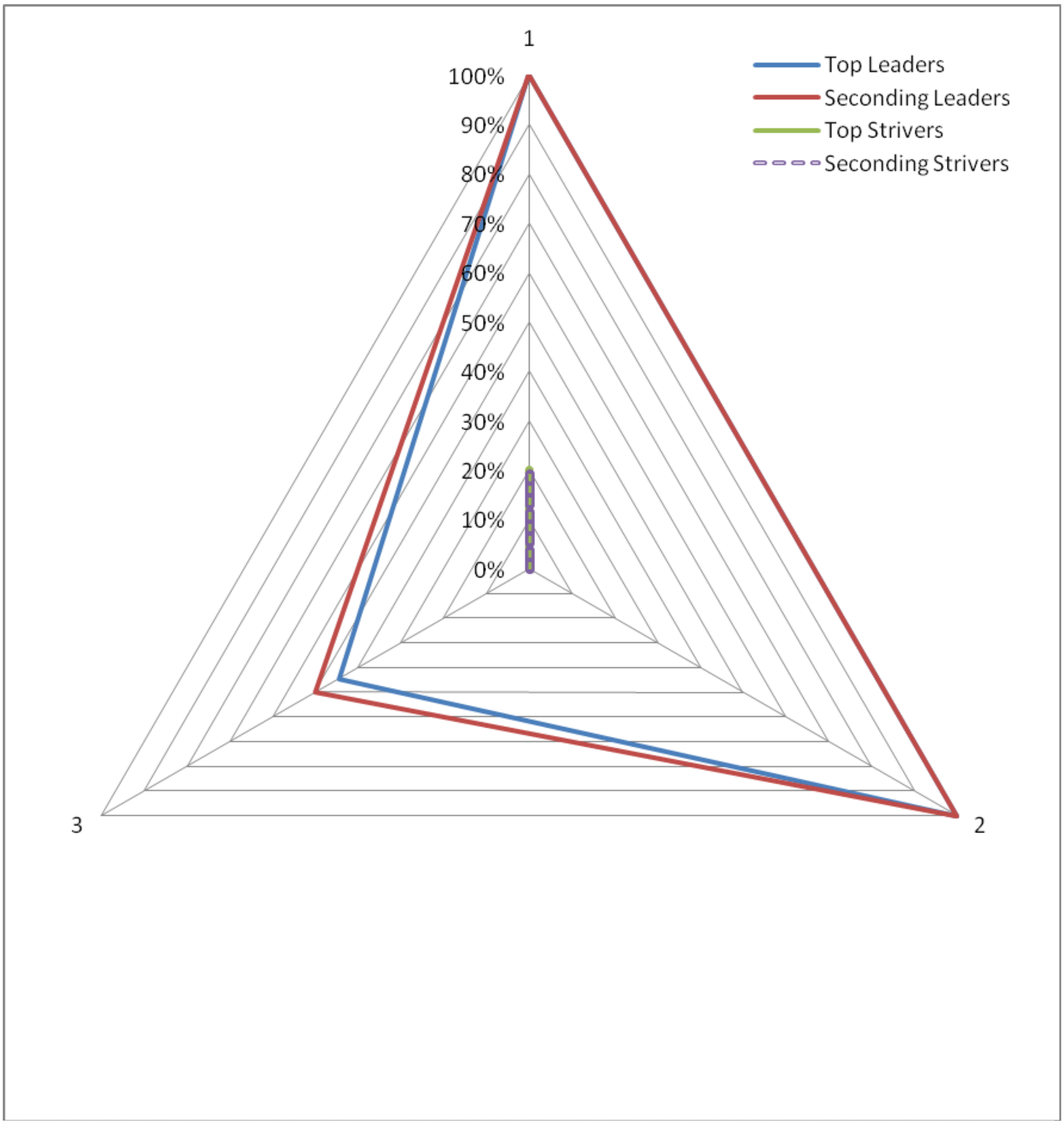
1 - Human Capital
2 - Internet Access in Schools
3 - Share of ICT-related occupations in the total economy in selected countries, broad definition

Figure 217: % of countries scoring "high" in Digital Literacy per digital development stage, OECD country set[383]

[383] We have also included here the variable "Share of ICT-related occupations in the total economy in selected countries, broad definition" that we have categorized within the ICT Sector, the reason being to make if possible to plot the chart, where a minimum of three variables were needed.

13.3.4. The Policy and Regulatory Framework

The category relating to the policy-making for the promotion of the Information Society is, probably, one of the clearest examples of the different behaviour between digital leaders – top and seconding – and digital strivers – top and seconding too –. And also about the direct involvement – or intervention – of governments in it beyond just helping to set up the proper environment.



1 - Laws relating to ICT
2 - Intellectual property protection
3 - Gov't procurement of advanced tech products

Figure 218: % of countries scoring "high" in the Policy and Regulatory Framework per digital development stage, OECD country set

We can easily see that 100% of the countries labelled as digital leaders strongly commit – or score high – in the creation of laws relating to ICTs and Intellectual property protection. By contrast, only 20% of digital strivers succeed in doing the latter, while we find no countries at all scoring high in setting up this proper framework for ICTs to develop (ICT sector regulation, digital content and services framing, etc.).

As noted above, the second derivative of Figure 218 is the direct – not just indirect – role of governments. As we have been saying in the previous chapters, two models seem to live together in successful initiatives to foster digital development: one with strong or direct government intervention – pictured in Figure 218 as the countries whose governments procure advanced tech products – and those without it. Interestingly enough, this is common in both sub-levels of highest digital development – or digital leaders – and is, by no means, a difference between one and the other sub-levels, as intuition might suggest[384].

Of course, strivers having not even barely succeeded in creating a proper ICT regulatory framework are neither directly involved in the promotion of the Information Society.

13.3.5. Usage

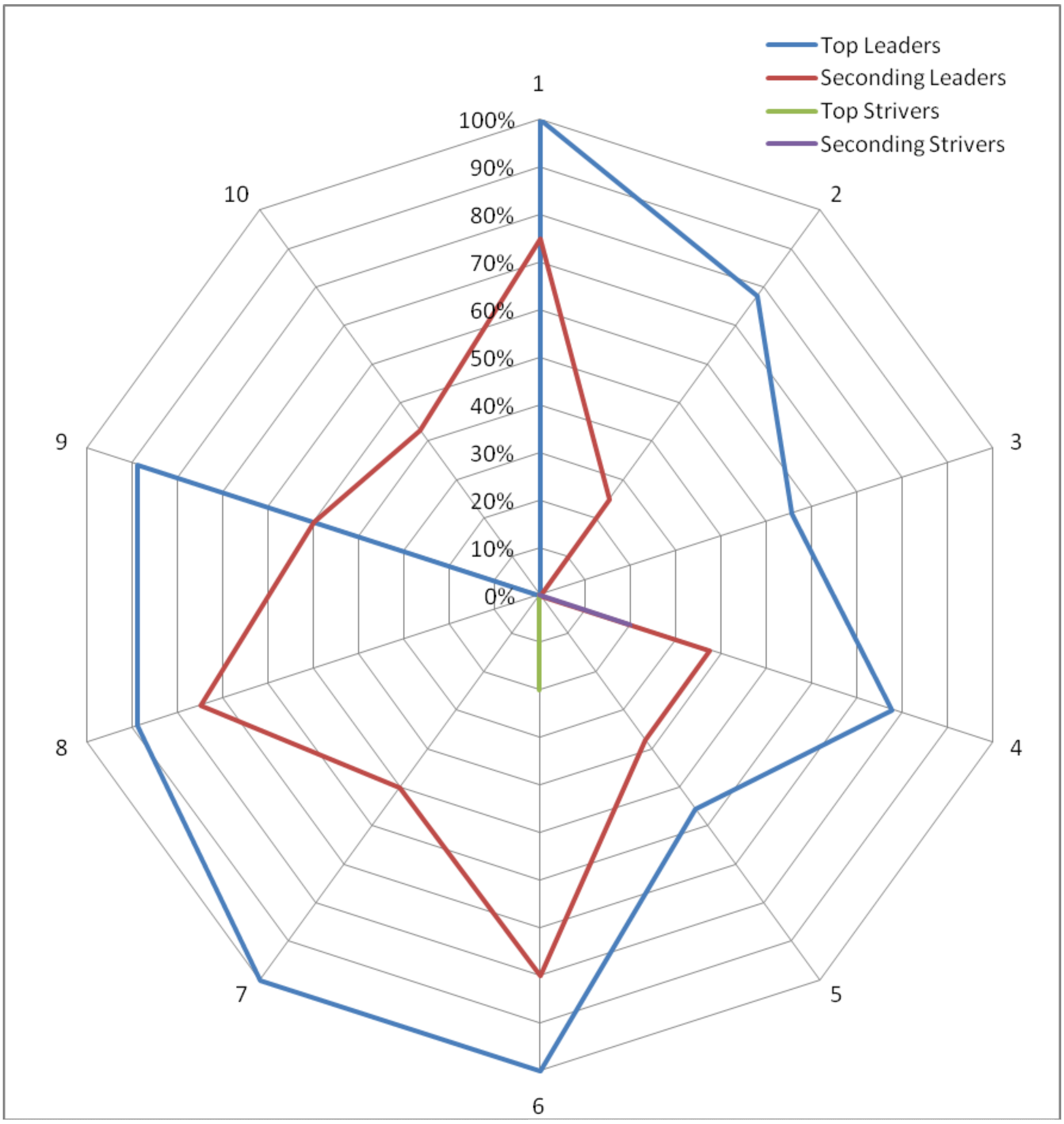
Concerning usage, the scheme we have been seeing so often repeat itself again: an equal model of digital development at two different stages, pictured by top and seconding leaders, and an almost symbolic digital development achievement as pictured by top and seconding strivers.

The most notable difference between top and seconding leaders is, notwithstanding, the level of adoption at the citizen and government level. Or, if seen from a supply point of view, what is the offer of digital content and services for the end user.

We can see by looking at Figure 219 that the whole picture is shifted towards the south-western part of the graphic, plus higher scores for the variable measuring Secure internet servers. This can be interpreted as a strong adoption by firms of both technology (Technology absorption) and its use (Business Internet use, Secure internet Servers). A second, and complementary interpretation, is that citizens are also intensively using the Internet.

At this stage, as we said, primary digital leaders only differ in the level of adoption – not the model – from secondary digital leaders.

[384] Being the successful one the one that fits one's own political beliefs, of course: no intervention and digital success for liberals, intervention and digital success for a more social democrat or Keynesian approach.



1 - Secure Internet servers (per 1 million people)
2 - Total Domains (per 100 people)
3 - Total ICT Spending, Government (% of GDP)
4 - Web Measure
5 - Availability of government online services
6 - International outgoing telephone traffic (minutes) (per 100 people)
7 - Internet users (per 100 people)
8 - Firm-level technology absorption
9 - Extent of business Internet use
10 - Share of ICT value added in the business sector value added

Figure 219: % of countries scoring "high" in Usage per digital development stage, OECD country set

The problem comes when we look at the north-eastern part of the figure. There, though top digital leaders also have a reduced presence, the lag between the aforementioned groups it not only a matter of degree, but of model: the number of domains, the expenditure in ICTs by governments and their presence (Web Measure) on the Net is almost inexistent at the aggregate, country level. Though we have been saying that we can predict digitally successful countries (in the sense that they score high in most indicators) in terms of their independence of the degree of direct intervention of the government in ICT matters, we seem to find some context about this in Figure 219.

Of course, direct intervention in the purest sense (as seen here in Total ICT spending by the government) is again at a 50-50 model, being coherent with our previous statements about this subject. But the fact that Web Measure almost reaches 80% of countries for the primary digital leaders means that, despite explicit direct intervention might not be closely related with success, government adoption is, as surely is the indirect impact of this government usage of ICTs.

What, indeed, does seem clear, is that top digital leaders not only perform well in the private sector adoption of ICTs (supply side), but are implicated too in how this adoption has its counterpart in the demand side: at the government level (as measured by the Web Presence), at the private sector level (measured by Secure Internet Servers) and in general (as measured by total domains).

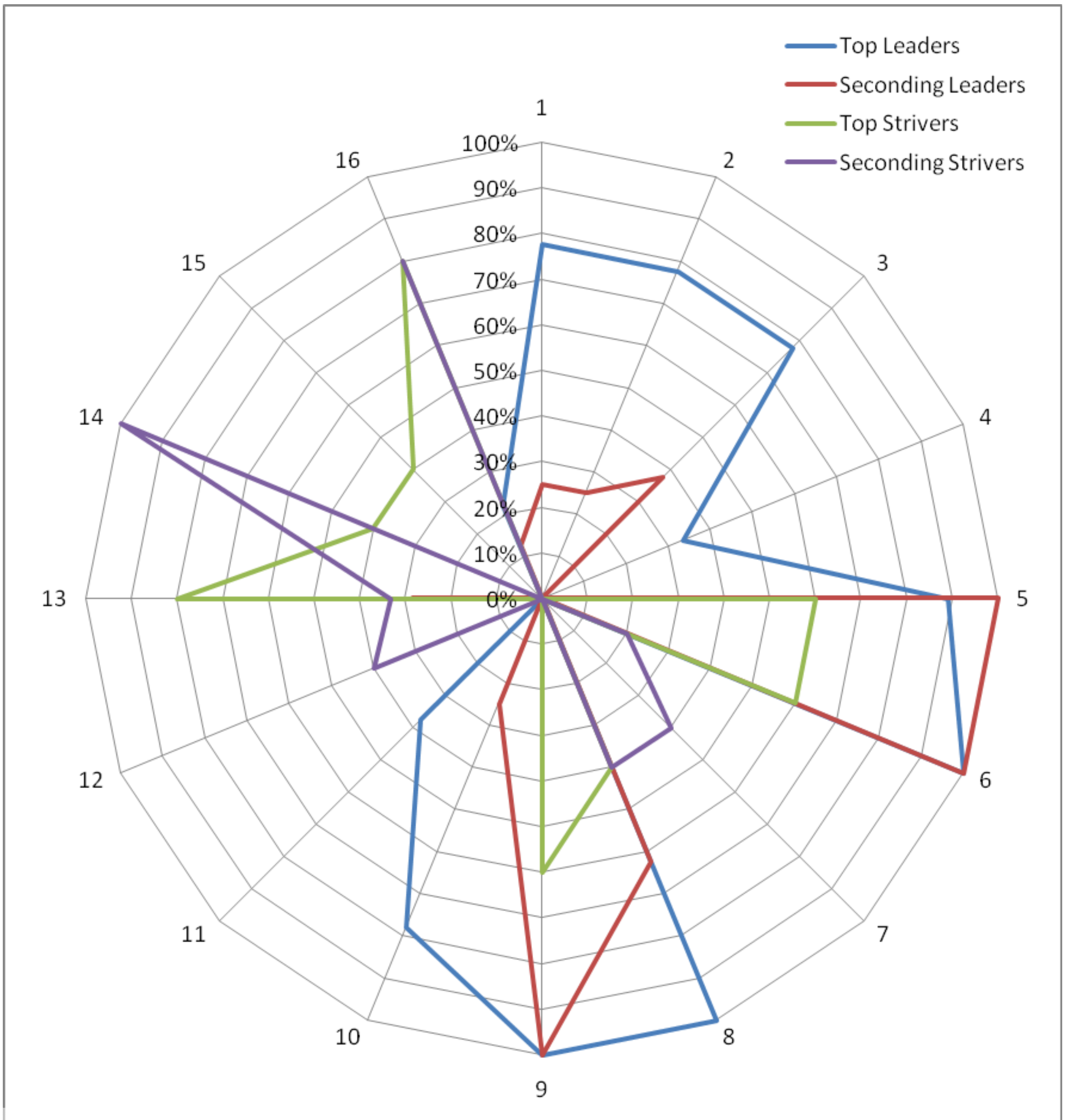
13.3.6. Analogue Indicators

If we focus on the real economy, we can highlight some interesting trends that, despite the messy aspect of Figure 220, can be clearly enough extracted.

The first and most evident one is the importance of income for the most digitally developed countries. This can be complemented, at the negative side of the economy, by also looking at interest payments, debt and inflation. A low level of digital development is accompanied – not caused, though – by a non-optimal situation of the real economy as measured with the usual indicators.

After these first evident and recurring facts, a second group of indicators come to reinforce the idea that real economy development is also characteristic of a broader definition of digital development: digital leaders and primary digital strivers have in common high Human Development Index values and high life expectancies at birth.

A third group of characteristics that accompany – though at different levels – digital development is Innovation, a proper Economic Incentive Regime and Urban Population. This is characteristic, as we have seen, not only in OECD countries but also in our previous analysis that took the WITSA countries.



1 - GDP Capita
2 - GDP per capita, PPP (current international $)
3 - GNI per capita, Atlas method (current US$)
4 - GNI per capita, PPP (current international $)
5 - HDI
6 - Life expectancy at birth, total (years)
7 - School enrollment, primary (% gross)
8 - Economic Incentive Regime
9 - Innovation
10 - Urban Population (%)
11 - Education Public Expenditure (% of GDP)
12 - Mortality rate, infant (per 1,000 live births)
13 - Interest payments (% of GDP)
14 - Total debt service (% of GNI)
15 - Central government debt, total (% of GDP)
16 - GDP deflator (base year varies by country)

Figure 220: % of countries scoring "high" in Analogue Indicators per digital development stage, OECD country set

13.4. General observations

Summing up, the main findings related to the characterization of the OECD countries as grouped in four tiers is:

- Infrastructure is adopted or installed gradually along all tiers, showing no evident change of pattern but just a different pace of adoption
- A significant step in the evolution of infrastructures is the increasing strategic importance of broadband, both at the domestic level as at an international level
- In most digitally developed economies, the ICT sector is important not only for their domestic economy, but as a strong industry with a presence abroad. This ICT sector grows naturally in a healthy economy where R&D is the norm and not the exception, as it happens with the second level of digital development.
- The same happens with Internet in schools, which we could consider the R&D part of education: digitally developed countries invest more in having new technologies present in schools, and this is a trend that repeats itself along stages of digital development
- Infrastructure, the ICT sector and digital literacy (in this case measured by Internet in Schools) flower in an economy that promotes an appropriate ICT regulation, including intellectual property protection.
- After an early adoption of technology by enterprises (supply side), there is an increasing importance of the demand side when speaking about Internet usage: a high level of secure servers, web presence or total domains is a characteristic of digital development, not only concerned with adoption but with end user usage
- If a healthy real economy development is characteristic of digital development, innovation, an efficient economic incentive regime and the level of urban population accompanies the highest levels of digital development.

14. Determinants of digital development: binary logistic regressions

We have far been able to elaborate four main stages of digital development by using cluster analysis. We have thus grouped countries[385] by the respective Euclidean distances amongst them, noting that some of them were nearer one another than with other groups of countries.

By taking a smaller set of countries[386], we have also been able to regroup them again in subsets – using, once again, cluster analysis – and have been successful in defining four new clusters.

We have labelled, according to our results[387], the clusters in the following way:

- Digital leaders
    - Primary digital leaders
    - Secondary digital leaders
- Digital strivers
    - Primary digital strivers
    - Secondary digital strivers
- Digital laggards
- Digital leapfroggers

and have listed and commented the main characteristics that describe them. Hence, the work set out in the previous two chapters is a purely descriptive one: what are the main characteristics that define the different stages of digital development, or what are the characteristics that countries near one another in the cluster analysis share in terms of digital development.

In this chapter our purpose is completely different: we want to find the causes, the determinants that help a country in reaching a specific stage of digital development. In this sense, we are not analyzing what are the factors that cause specific indicators to increase or decrease, but rather the causes that affect a country's performance as a whole.

In statistical terms, our dependent variable will be the level of digital development as calculated in our cluster analysis. Or, in other words, how to allocate countries between clusters.

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[385] Countries from the WITSA country set.
[386] Countries from the OECD country set.
[387] This labelling is, by no means, a way to name groups of countries, but groups of characteristics, as the different analyses include and exclude some countries, though the characteristics still apply.

At a qualitative level, we can report three conclusions from our characterization exercise:

- The first one is that digital leaders and digital strivers follow quite similar patterns of evolution, with the latter characterized by a lesser score in their respective indicators, or even a lack of (as measured by "low" or zero values) specific digital developments.
- The second conclusion is that laggards, while following a similar pattern as leaders or strivers, appear to be overwhelmed by the burden of economic underdevelopment, thus scoring high in some (economically and socially speaking) negative indicators that barely arise, if at all, when looking at digital leaders and strivers[388].
- Third, we have also seen that digital leapfroggers do not follow the same pattern, even with their differences, that digital leaders, strivers and laggards share, and that their behaviour is absolutely divergent from the other three groupings of countries.

That said, we decided to chose and analyze both ends of the more coherent path of digital development – digital leaders and digital laggards – and do not take into account neither digital strivers – because they are but a lesser degree of digital leaders – nor digital leapfroggers, because their behaviour is too exceptional[389].

14.1. Digital leaders

To calculate the determinants of the most digitally developed countries, we created a new variable ("is it a digital leader?", called ZCLUSTER54_CB[390]) and assigned a value of 1 to our digital leaders[391] ("yes"), and a zero ("no") to all the rest. Then, we calculated a binary logistic regression with this new variable as the dependent one.

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[388] For instance: infant mortality or debt interest payments.

[389] From a policy perspective, we could state that the digital leap-froggers are the most interesting because they suggest the policy steps that can be take to accelerate the process of digital development. The problem being that, even if appealing, they are statistically irrelevant or cannot provide solid significance for sound grounds. In our case, this cluster was made up of just three countries, which means that if anything came out of a regression with but three cases, it would be of no statistical value. This is, hence, the main reason why calculations are left for the other stages of digital development and leapfroggers have been left aside.

[390] The rationale behind the name ZCLUSTER54_CB being the following: Z for normalized, CLUSTER54 because it takes the variable for the five clusters and groups them into four (the USA merged into cluster 2), C standing for countries, and B as a "B version" which implies regrouping all clusters into digital leaders and rest of countries.

[391] See chapter 12

To build the binary logistic regressions, we chose as independent variables some of the most outstanding characteristics we already found in our characterization analysis.

These variables are the following (in parentheses, the source):

- Life expectancy at birth, total (years) (GEN30): the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life (World Bank, World Development Indicators).

- Inequality-20 (GEN05): ratio of the richest 20% to the poorest 20% (UNDP, Human Development Report[392]).

- Urban Population (%) (GEN07): urban population is the midyear population of areas defined as urban in each country and reported to the United Nations. This indicator measures the proportion between urban and the total population in percent (World Bank, World Development Indicators).

- Economic Incentive Regime (GEN08): The Economic Incentive and Institutional Regime is the simple average of the normalized scores on three key variables: Tariff & Nontariff Barriers, Regulatory Quality, and Rule of Law (World Bank, Knowledge Assessment Methodology).

    - Tariff & Nontariff Barriers: is a score assigned to each country based on the analysis of its tariff and non-tariff barriers to trade, such as import bans and quotas as well as strict labeling (sic) and licensing requirements (the score is based on the Heritage Foundation's Trade Freedom score and used the World Bank, Knowledge Assessment Methodology)

    - Regulatory Quality: measures the incidence of market-unfriendly policies such as price controls or inadequate bank supervision, as well as perceptions of the burdens imposed by excessive regulation in areas such as foreign trade and business development (World Bank, Governance Indicators / Knowledge Assessment Methodology).

    - Rule of Law: this indicator includes several indicators which measure the extent to which agents have confidence in and abide by the rules of society. These include perceptions of the incidence of both violent and non-violent crime, the effectiveness and predictability of the judiciary, and the enforceability of contracts (World Bank, Governance Indicators / Knowledge Assessment Methodology).

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[392] For this and next variables, please see Annex IV.

- Government prioritization of ICT (LEGAL_D_04): measures from 1 (strongly disagree) to 7 (strongly agree) the answer to the question "Information and communication technologies (computers Internet etc.) are an overall priority for the government" (World Economic Forum, Executive Opinion Survey / Global Information Technology Report).

These variables we have chosen can be reinterpreted as follows:

- A generic indicator that picks up the general state of health and personal welfare
- A way of measuring poverty and economic welfare
- How urbanized – and, hence, industrialized – is a specific country, including an indirect measure of knowledge, normally concentrated in cities
- How stable is the economy and how prepared is it for entrepreneurship to thrive
- What is the degree of involvement of governments in fostering the Information Society, as a priority

which is what we have been posing generally as more relevant and specifically differential in our characterization analysis.

With these variables we build the following binary logistic equation:

$$\text{logit}(\text{ZCLUSTER54\_CB}) = \beta_1 \cdot \text{GEN30} + \beta_2 \cdot \text{GEN05} + \beta_3 \cdot \text{GEN07} + \beta_4 \cdot \text{GEN08} + \beta_5 \cdot \text{LEGAL\_D\_04} + \varepsilon$$

The calculated values of the coefficients in the equation and the statistics of the regression can be found in Table 20.

The Chi-Square test confirms that the power of the effect of the independent variables taken jointly is statistically significant, and the Hosmer and Lemenshow test rejects the null hypothesis that there is no difference between the observed and predicted values of the dependent variable, thus confirming the goodness to fit of the overall model. Indeed, the model predicts a total of 95.7% of all cases (46 countries), 96.8% of digital leaders and 93.3% of the rest of countries. The high value of Nagelkerke's R-square implies quite a good degree in the explanatory power of the model too.

All the coefficients in the model fall within the range of 90% confidence intervals, some of them being very near to being included inside a 95% confidence interval.

Binary logistic regression with digital leaders (1 is a digital leader, 0 is not a digital leader) as the dependent variable.						
	B	S.E.	Wald	df	Sig.	Exp(B)
Life expectancy at birth, total (GEN30)	-.399	.208	3.664	1	.056	.671
Inequality-20 (GEN05)	-1.066	.578	3.403	1	.065	.344
Urban Population (%) (GEN07)	.138	.079	3.030	1	.082	1.148
Economic Incentive Regime (GEN08)	1.671	.877	3.628	1	.057	5.317
Government prioritization of ICT (LEGAL_D_04)	2.869	1.737	2.727	1	.099	17.611
N	46					
Correctly predicted cases	95.7%	96.8% (leaders)	93.3% (rest)			
-2 Log likelihood	15.970					
Cox & Snell R-square	.646					
Nagelkerke R-square	.862					
Chi-Square (sig)	47.799	(.000)				
Hosmer and Lemeshow Test Chi-Square (sig)	1.546	(.981)				

Table 20: Determinants of stage of digital development for most digitally developed countries (digital leaders).

Binary logistic regression with digital leaders (1 is a digital leader, 0 is not a digital leader) as the dependent variable.					
	Life expectancy at birth	Inequality-20	Urban Population	Economic Incentive Regime	Government prioritization of ICT
Life expectancy at birth	1,000	,529	-,745	-,879	-,871
Inequality-20	,529	1,000	-,553	-,560	-,561
Urban Population (%)	-,745	-,553	1,000	,591	,465
Economic Incentive Regime	-,879	-,560	,591	1,000	,668
Government prioritization of ICT	-,871	-,561	,465	,668	1,000

Table 21: Correlations of the determinants of stage of digital development for most digitally developed countries (digital leaders).

Regarding the signs and values of the coefficients, we find some expected though still interesting aspects to note, notably the first one, *Life expectancy at birth*, the only exception and most surprising one.

Life expectancy at birth, even if variations between countries are only small, has a negative impact in the probability that a country is a digital leader. Though the coefficient is quite small (-.399), which makes the odds ratio slightly approach to one (.671) and thus have a small impact in the overall model, the sign of the coefficient is surprising.

Though these countries generally have highest values of *life expectancy at birth*, there are indeed other countries, not categorized as digital leaders[393] that have higher values than some of them, and are all of them above the value of the country[394] with the lowest life expectancy at birth amongst digital leaders[395].

Thus said, we can infer three different interpretations to that unexpected negative relationship. First one could be that life expectancy has some sort of trade-off with the race towards digital development. In other words, we can infer that allocating resources (whatever they may be) to increase life expectancy, might reduce the probability (albeit very slightly) to become a digital leader. Strong – and cruel – as this statement might be, it nevertheless makes some sense when resources are scarce and there is rivalry in their application. An second alternative explanation might be that populations with higher life expectancy are those with older average populations and that being a digital leader is positively correlated with a more youthful population. A third possibility could simply be that this coefficient is gathering spurious relationships amongst variables.

The same sign – though opposite conclusions – come when looking at *Inequality*: the more unevenly distributed is wealth within a country, the less likely it is to be a digital leader. Again, the value of the coefficient is small (-1.066) – much smaller than for life expectancy – and has almost no effects when looking at the odds ratio (.344), but it does tell us something about the importance of redistributive policies, not for good-will, but for more pragmatic and economic reasons.

With a similar absolute value, though this time with positive sign, we find the coefficient for *Urban Population* (.138). This coefficient – though, again, very slightly – confirms some former findings by previous research[396] stating that the Information Society is likely to arise in cities, and that the hypotheses of a switch towards teleworking or telecommuting is not (yet) backed by evidence.

But the last two indicators are the ones that, because of their huge impact, really matter in this analysis.

During the last two chapters we have repeatedly mentioned how the economic framework and the role of governments in fostering ICTs always accompanied the best results when measuring digital development.

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[393] Italy, Spain, Greece, the United Arab Emirates, Portugal and Chile.
[394] The United States of America.
[395] We have performed this same analysis without taking into account the United States (by excluding it from the sample) and while the model loses explanatory power and the coefficients become, in general, less significant, the sign of the coefficient for Life expectancy at birth is still negative and just slightly smaller than in our model. This eliminates any doubt we had whether the United States might be the country that "breaks" the model. So, it is not.
[396] Please see the first part of this work and especially Castells (2002).

We here find that the *Economic Incentive Regim*e and the *Government prioritization of ICT* have a deep impact in determining whether a country has greater chance of becoming a digital leader, as both their respective coefficients have a positive sign, quite a high value and are both significant – though the latter less so than the former.

In term of the odds ratio, an increase in the *Economic Incentive Regime* is to have a positive impact in the probability of being a digital leader five times bigger than this increase. This impact is multiplied by seventeen (17.611) if the increase is to happen in the *Government prioritization of ICT*.[397]

The conclusions of these two findings are pretty straightforward. On the one hand, we find that an efficiently designed set of policies relating to Tariff & Nontariff Barriers, the Regulatory Quality of the market and finances, and the confidence of agents in the coherence of society (Rule of Law) is a powerful determinant that enables and fosters the development of the Information Society.

Moreover, not only a proper framework but an active prioritization of the Information Society from the Government side is even more important not only to develop it but to boost it. We have to keep in mind, notwithstanding, that prioritization is, by no means, a synonym for direct intervention, but a horizontal aspect that of course can operate through direct intervention, but is more likely to operate through establishing an enabling environment such as through effective regulation of the sector, availability of funding for investment, showcase projects for eGovernment, eEducation or eHealth , etc.

Summing up we can say that there is a weak – though statistically significant – relationship between life expectancy, inequality and urban population and the probability of being a highly digitally developed country. Life expectancy negatively determines digital development – most likely because digitally advanced populations are more youthful – and the other two positively, thus reinforcing previous research that place urban development as a determinant for the Information society, and social inequalities as a burden for development in general and digital development specifically.

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[397] In general, there is a generalized critique about how Government prioritization of ICT is measured (soft data based on surveys to experts) and what is the real value (or what their biases) of such indicators. Nevertheless, the coefficient is so huge that we find it also difficult to believe that it is only gathering biases inflected by subjective points of view – and in *all* countries –. On the other hand, personal interviews with Dennis McCauley (responsible for The Economist Intelligence Unit's e-Readiness Rankings) and Irene Mia (coeditor of the last four editions of the Global Information Technology Report) showed that, while the indicator was not bullet-proof, it was quite rigorously calculated and the possible biases addressed both in the design and later explotations of the collected data.

On the other hand, there is a strong (indeed strongest) positive relationship between the health of the economic environment and the role of governments in fostering the Information Society in order to achieve the highest level of digital development possible (in relationship with the rest of the World). This confirms the need to take action in promoting the use of ICTs and refutes the idea that digital development will simply happen of its own accord.

14.2. Digital laggards

The same exercise from the previous section is repeated here for the least developed countries[398] or digital laggards. As before, we create a new variable ("is it a digital laggard?", called ZCLUSTER54_CBL[399]) and assigned a value of 1 to our digital laggards[400] ("yes"), and a zero ("no") to all the rest. Again, we calculate a binary logistic regression taking this variable as the dependent one.

But, instead of repeating exactly the same exercise that we did with digital leaders, we chose instead to focus on the specificities of this group, as the characteristics of digital laggards were demonstrably different from those of digital leaders, in the sense that they not only lacked what others had, but the underlying concepts that defined them were, in some cases, just plain different.

So, we chose as independent variables not the same ones of our previous exercise, but the ones that better fit the characteristics of digital laggards. Namely:

- Inequality-10 (GEN06): is the ratio of richest 10% to poorest 10% (UNDP, Human Development Report).

- Health Public Expenditure (% of total Health expenditure) (GEN14): Public Health Expenditure is recurrent and capital spending in Health from central and local governments, external borrowing and grants (including donations from international agencies and nongovernmental organizations), and social (or compulsory) health insurance funds, here measured as percent of total Health Expenditure, which is the sum of public and private health expenditure and covers the provision of health services (preventive and curative), family planning and nutrition activities, and emergency aid for health but excludes provision of water and sanitation. (World Bank, World Development Indicators).

[398] Leaving aside the exceptional cases of digital leapfroggers
[399] The rationale behind the name ZCLUSTER54_CBL being the following: Z for normalized, CLUSTER54 because it takes the variable for the five clusters and groups them into four (the USA merged into cluster 2), C standing for countries, B as a "B version" which implies regrouping all clusters into digital leaders and rest of countries, and L as per "low".
[400] See chapter 12

- Population covered by mobile telephony (%) (INF_S_06): is the percentage of people within range of a mobile cellular signal regardless of whether they are subscribers. (World Bank, World Development Indicators).

- Importance of ICT to the government vision of the future (LEGAL_D_01): measures from 1 (strongly disagree) to 7 (strongly agree) the answer to the question "The government has a clear implementation plan for utilizing information and communication technologies for improving the country's overall competitiveness" (World Economic Forum, Executive Opinion Survey / Global Information Technology Report).

These variables we have chosen can be reinterpreted as follows:

- A way to measure poverty and economic welfare
- A generic indicator to pick up the concerns for and investment in health and personal welfare (improvement)
- The differential – and most mentioned – fact in infrastructures in developing countries: cellular phones.
- What is the degree of involvement of governments in fostering the Information Society, in its policy and applied strategy

With these variables we build the following binary logistic equation:

$$\begin{aligned}\text{logit(ZCLUSTER54\_CBL)} &= \beta_0 + \beta_1 \cdot \text{GEN06} + \beta_2 \cdot \text{GEN14} \\ &\quad + \beta_3 \cdot \text{INF\_S\_06} + \beta_4 \cdot \text{LEGAL\_D\_01} + \varepsilon\end{aligned}$$

being the results of the regression as pictured in Table 22.

The Chi-Square test confirms that the power of the effect of the independent variables taken jointly is statistically significant, and the Hosmer and Lemenshow test rejects the null hypothesis that there is no difference between the observed and predicted values of the dependent variable, thus confirming the goodness to fit of the overall model. Indeed, the model predicts a total of 94.6% of all cases (47 countries) – slightly less than the digital leaders model –, 96.4% of digital laggards and 88.9% of the rest of countries. The high value of Nagelkerke's R-square implies quite a good degree in the explanation power of the model too.

All the coefficients in the model fall within the range of 90% confidence intervals, and three of them are inside a 95% confidence interval.

The detailed analyses of the resulting coefficients and their respective signs do not offer any counterintuitive findings – as was the case with life expectancy in digital leaders – but they still provide some interesting reflections.

Binary logistic regression with digital laggards (1 is a digital laggard, 0 is not a digital laggard) as the dependent variable.						
	B	S.E.	Wald	df	Sig.	Exp(B)
Constant	38.214	16.958	5.078	1	.024	$3.945 \cdot 10^{16}$
Inequality-10 (GEN06)	-.235	.138	2.909	1	.088	.790
Health Public Expenditure (% of total Health expenditure) (GEN14)	-.176	.081	4.665	1	.031	.839
Population covered by mobile telephony (%) (INF_S_06)	-.100	.050	3.936	1	.047	.905
Importance of ICT to government vision of the future (LEGAL_D_01)	-4.304	2.239	3.696	1	.055	.014
N	47					
Correctly predicted cases	94.6%		96.4% (laggards)	88.9 % (rest)		
-2 Log likelihood	11.391					
Cox & Snell R-square	.551					
Nagelkerke R-square	.823					
Chi-Square (sig)	29.663	(.000)				
Hosmer and Lemeshow Test Chi-Square (sig)	3.684	(.815)				

Table 22: Determinants of stage of digital development for least digitally developed countries (digital laggards).

Binary logistic regression with digital laggards (1 is a digital laggard, 0 is not a digital laggard) as the dependent variable.					
	Constant	Inequality -10	Health Public Expenditure (% of total Health expenditure)	Population covered by mobile telephony (%)	Importance of ICT to government vision of the future
Constant	1,000	-,812	-,735	-,854	-,926
Inequality-10	-,812	1,000	,618	,645	,702
Health Public Expenditure (% of total Health expenditure)	-,735	,618	1,000	,571	,489
Population covered by mobile telephony (%)	-,854	,645	,571	1,000	,708
Importance of ICT to government vision of the future	-,926	,702	,489	,708	1,000

Table 23: Correlations of the determinants of stage of digital development for least digitally developed countries (digital laggards).

The first thing to note – and quite evident by its magnitude – is the value of the constant or intersect of the equation. Even if it is significant – and, indeed, the most significant of all coefficients – we cannot but believe that it still reflects many other different aspects not gathered in the equation. The fact that its odds ratio is very high can only mean that there are many missing variables that we failed to include in our model. This is by no means a surprise: we have stated from the very beginning of this work that the concept of access and the impact of this access (however they may be defined) are, on one hand, yet to be a matter of consensus and, on the other hand, issues whose complexity might be as wide as the target of our research: the society at large. The good news is that, even if the constant is gathering many variables not included in the model, it is doing it well in statistical terms, so that the model as a whole works and we can infer some statistically significant conclusions about the other variables, which are thus isolated from the "noise" of the excluded ones.

As in the case of digital leaders, inequality plays here also a role in digital development, but here with opposite sign[401] and with an absolute value smaller here, which means that the impact is quite small. The explanation behind this can be that digital laggards – or, in a broader sense, developing countries – might be more homogeneous in their poverty and inequality than digital leaders (or developed countries), then making the fact of inequality less relevant amongst them. Better said, inequality is, in general, a dire issue in developing countries, while in most developed countries inequality does not follow such a clear pattern. On the other hand, we are comparing these laggards also with digital strivers, which lie in between digital leaders and digital laggards in matters of inequality[402], thus decreasing too the importance of inequality in relationship with being a digital laggard. Concerning the sign (less inequality, more likely to be a laggard), the explanation could be that there is a need for a critical mass to trigger development. Indeed, this would explain the problem of the last mile in developing infrastructures, where service providers would install infrastructures if they would prove not being profitable.

Unlike the case of life expectancy for digital leaders, health does have a positive impact in digital development amongst digital laggards. Actually, the negative sign of the coefficient for Health Public Expenditure implies that increasing the public expenditures in Health (in % of total Health Expenditure) decreases the probability of being a digital laggard, hence, increases the probability of being more digitally developed. It is worth noting that it is not about increasing health expenditure as a whole, but the role of the government in doing so. This coincides with what we are seeing later in this section about the role of government in fostering ICTs and, in general, with the role of governments in lesser developed countries to lead economic and social changes.

Notwithstanding, we should not forget that the absolute value of the coefficient, and its related odds ratio value, are quite small. Thus, even if the coefficient is significant and explains a negative direction on how public expenditure in Health determines

[401] Note that the negative sign of this and the next variables has to be read as decreasing the probability of being a digital laggard, hence, the more inequality, the less underdeveloped, the more developed (this last transtlation is not accurate, so it should be read only as an explanatory clue).
[402] See Figure 206

being a digital laggard, it is no less true that the effect is not very big. Though not insignificant either, as an increase of 1 point in *Health Public Expenditure* would imply an decrease of 16% in the odds of being a digital laggard.

Similar to the previous case, but indeed little bit smaller in its effect, is the case of the percentage of population covered by mobile telephony, an ICT-specific variable. As would be expected, this variable has a negative coefficient, which means that increasing the percentage of mobile coverage decreases the probability of being a digital laggard. Despite the small effect at the odds ratio (an increase in 1 unit would imply a decrease of circa 10% in the probability of being a digital laggard), the finding is most powerful and much in line with other findings – an intuitions – about mobile telephony adoption in developing countries.

This confirms that developing countries have – for many and different reasons – heavily relied on mobile telephony and leveraged its high penetration to develop a model of Information Society that is different – at least in its initial steps – from most developed countries, that are more focused on the ICT Sector, including personal computers and broadband, as we saw in chapters 12 and 13 when we described the main characteristics of the digital leaders.

Last, but most interesting, is the *Importance of ICT to government vision* of the future. Slightly outside the 95% confidence interval – but still within the 10% one – we find that the role of the government in fostering the information Society has a huge impact on the probability of being or not a digital laggard. Thus, the greater the importance ascribed to ICT in the government vision, the less – much less – likely are those countries are to fall in the category of digital laggards.

Actually, there are two second derivatives to this statement, both in comparison with our findings in the analysis of digital leaders.

The first one is that, in both cases, the role of the government in fostering the Information Society is not only important but, by far, the most important factor that determines the probability of having more or less digital development. Of course we are not talking about what kind of measures or policies should the government be taking – more about this later – but rather about the fact that the role itself of the government is important in the sense that being aware of the digital revolution is crucial.

The second one is about the differences of the prior statement between digital leaders and digital laggards. If we go back to the definitions of these variables, digital leaders are determined by "Information and communication technologies (computers Internet etc.) [being] an overall priority for the government", while digital laggards are determined by "The government [not having] a clear implementation plan for utilizing information and communication technologies for improving the country's overall competitiveness". Subtle as the differences between the two concepts might be, we understand that the latter means a stronger degree of involvement of governments in the ICT strategy and policies. Not that it is asking for a higher degree of public intervention, but while the former can be read about awareness and prioritization, the latter can be read in terms of action, especially at a more micro (and less framework-oriented) level.

Concluding remarks

15. Conclusions

In the following pages it is our aim to summarize the preceding chapters, and to do so in order to answer our research questions and confirm (or refute) the hypotheses we stated in the Introduction and that guided our research.

In general, we can state that we can define access in a broader sense than just access to infrastructure, but including five large categories: Infrastructures, the ICT Sector, Digital Literacy, the Legal Framework and Usage (Digital Content and Services). This definition is backed by evidence as several statistically significant stages of digital development can be derived from them. From within these digital development stages, we can infer a continuous evolution with similar characteristics where stages – we identified three of them – only differ in the degree of development of the constituent variables while, on the other hand, there is a fourth group – leapfroggers – that show a quite different behaviour. This digital development is strongly determined by the role of governments in both setting an enabling economic environment and actively fostering the Information Society, among other issues like national income, inequality, health, urban population or mobile telephony.

15.1. Impact of ICTs and matters of access

In recent years, and most especially since the popularization of the Internet after the release of the graphical web browser during the early 1990s and with the increasing pervasiveness of mobile telephony, the debate over whether Information and Communication Technologies (ICTs) were causing a big impact in our lives has gained enormous momentum.

There is already a wide acknowledgement that there is an ongoing digital revolution, which might be considered as either a Third Industrial Revolution or the Third Revolution on its own, following the Agricultural Revolution of the Neolithic and the Industrial Revolution. Revolution or not – wide acknowledgement does not necessarily imply total consensus – evidence of a deep transformation due to the invasion of ICTs into all aspects of society and the economy is but increasing. This is characterized, for instance, in changes in how goods and services are produced, turning points in the international and national legal systems worldwide, redefinitions of how people socialize and understand their own identities, reconceptualizations of the provision of public goods (including intangible ones like culture or intellectual property), etc.

At the economic level we now have evidence of the positive impacts of ICTs on growth, the behaviour of markets, investment, efficiency, innovation, productivity, trade, employment and the demand-side of the economy, to name a few and at an aggregate level. Although not uniformly positive, there have been deep changes also in how the Economy at large works: production functions, competition, new niches and obsolete business models, transformations in employment and the job arena, or access to finance.

Outside of the economic sphere, we have seen and are witnessing changes in Education, in how people socialize and communicate, in broadcasting, in self-awareness and identity building, in health provision and the health system, of the ways in which citizens are empowered and participate, in Government, governance, politics and democracy, in Justice and Law; of the impact on the environment or on culture and daily life.

And although the debate is still open over whether these transformations will shift societies towards new stages of development and welfare, or whether they will be a matter of preserving or losing the present status against increasing competition, the prevailing sense is that there is no choice but to ride the wave of change.

This debate, though generalized (almost) all over the World, has been of especial relevance when framed in the reality of developing countries. A major summit (the World Summit on the Information Society) and dozens of other meetings and reports have been espousing the benefits of the digital revolution and warning of the costs of the digital divide, especially the latter.

But, if the consensus was not absolute, it is nevertheless quite broad in matters of acknowledging the impact of ICTs in development. Rather, the problem is that there are several ways to understand access to ICTs and, hence, what the digital divide is.

In this work we have presented a continuum of positions that grade from mere physical access to infrastructures until effective usage of digital content and services (which requires their existence), going through the capacity or digital competences required to transform physical access to infrastructures into effective usage.

We grouped then the multiple definitions of access or the digital divide into three main approaches:

- The Telecommunications Model, focused on the emitter and its ability to send a message out. This is a model based on technology and infrastructures as they are the carriers of the message;
- The Conduit and Literacy Models, which stress the capacity building aspects and the effective abilities to use both technology and its mediated commodities;
- The e-Readiness Model, similar to the Broadcasting Model of Communication Sciences, whose approach aims to be a more comprehensive one, focusing on the receiver and their ability to get a message. Thus, the notion of access trespasses the boundaries of infrastructures and competences, and is set at a higher level where the whole socioeconomic framework is taken into account.

If we are to promote the Information Society, we then demonstrated that both approaches – in fact, the Conduit and Literacy Models are somehow embedded into the e-Readiness Model – were insufficient and led to different problems. The Telecommunications Model proved incomplete as it did not include several issues that were clearly related with digital development, thus making it difficult to measure the effective impact of specific policies in the development of the Information Society. On the other hand, the e-Readiness Model carried some "analogue noise" that made it difficult to tell whether specific evolutions in ICTs – resulting from specific public policies – were having their desired impact on the real economy.

Actually, one of the main problems when defining access is that some of its components are kept out of the equation, meaning that they will neither be present in the solutions nor will be solutions to address them proposed for the same reason.

After an extensive analysis we propose that the components of access are as follows:

- The existence of infrastructure, in three main components: hardware, software and connectivity.
- The affordability of the afore mentioned infrastructure, in the sense of the relative (to the user and their income) affordability of use as well as management and maintenance.
- An ICT Sector – the industry – that creates or installs, maintains and manages infrastructures and enables content and services creation.
- Skilled workforce that forms part of the ICT Sector at all levels, from the mere running of infrastructures to Research and Development (R&D) and the fostering of innovation.
- Digital competences or the capability to effectively use infrastructures and benefit from content and services.
- A dynamic creation of digital competences, translated into the inclusion of digital literacy in the syllabuses of (formal and informal) educational and training systems.
- The setting up and constant updating of a legal framework – including regulatory agencies – that brings legal coverage to the infrastructure, the industry and the usage of digital tools, content and services.
- A commitment from governments and public institutions to foster the Information Society, meaning strategies and projects related with the legal framework, facilitation of supply-side activities and promotion of demand-side incentives.
- A supply of content and services that is locally (economically and culturally) relevant.
- Demand for and effective usage of digital content and services, with intensity and pervasiveness.

It is the lack of these components which causes the Digital Divide. But this may have different causes and manifestations, which may include income, geography, technology, skills and education, the social context, effective usage and information and content related issues, to mention only the socio-economic factors.

Given the importance of digital development and its impact, and having identified the components of access and the panoply of manifestations of the lack of it, we pose the following question: Is it worthwhile for governments to seek to foster digital development to accelerate the positive impacts of access to ICTs?

While the point of view of some authors is that public policies intended to achieve universal access are but a form of interventionism in the economy and, hence, a disruption of the invisible hand of the market, our findings show that public policies that foster the Information Society are indeed necessary, for several reasons:

- Starting points matter: the different manifestations of the digital divide show that it strikes unevenly and especially affects certain communities, depending on aspects not strictly related with the market (e.g. gender, race) or that the market is failing to address (e.g. the rural divide).
- Multiplier effects matter: the digital divide not only fails to correct but can actually exacerbate some other market failures. There is statistical evidence that level of income and inequality in the distribution of wealth are characteristic or can even determine access to digital development.
- Time matters: even though the market could (eventually) fix some issues, the time needed to reach the solution matters, especially for those on the wrong side of the digital divide. Evidence shows that shifts are happening at unprecedented speeds.
- The framework matters: most claims to public inaction are grounded on a partial view of the concept of access, mainly centred in infrastructure. But there is statistical evidence that the economic environment and the proactive participation of governments are causes that trigger digital development.

Everything said so far takes on a new meaning with the advent of the so called Web 2.0; the participatory or social web. Coinciding with a first phase of deployment of the Information Society (based around deploying infrastructures, the creation of a new industry and basic digital skills), the Web 2.0 represents a shift towards the demand side of the market. It implies that the end-user is making more intensive usage of ICTs and is directly participating in making of the digital economy. This blurs the separate concepts of sender and receiver; it also challenges the usual conceptions of digital skills and digital literacy; and exerts new pressures on the regulatory and legal framework, pushing it into unknown territories.

Emerging forms of usage, accompanied by new technologies and platforms, shift the focus from the supply-side to the demand-side, thus requiring approaches centred on pull policies rather than push ones.

With infrastructures out of the spotlight, the definitions of access and the digital divide require review, as does the way we understand and model the digital economy and the Information Society.

15.2. Measuring and modelling the digital economy

With the aim of exploring in detail the different concepts of access, the digital divide, e-readiness or, to some extent, even the definition of digital development itself and the Information Society, we analyzed some 55 models that depict the various understandings and approaches to these subjects.

First of all, one of the goals was merely descriptive: to take a snapshot of the evolution of explicit and implicit models and measuring tools that continue to evolve over time. This mapping exercise should lead us towards a higher goal, namely to explain what we understand by digital development – what are its characteristics – and, even more useful, what are the causes or determinants of such development.

But, to do so, it is necessary to reach agreement – even if only theoretical –on what is the target of our analysis.

The qualitative part of our research included four categories of models and measuring tools:

- Descriptive Models, which list approximations to the depiction of the Information Society without – normally – entering in its main components. In any case, they remained at the descriptive level and were never put into practice;
- Theoretical Models, where scientific-like reflections lead to theoretical models that have been, at least once, tested against reality with real data;
- Composite Indices, that have been built in order to respond to specific measurement needs but whose design clearly has a theoretical background – either explicit or implicit – which is normally translated into an index that allows ranking, or grouping, amongst countries;
- Sets of Indicators, normally built without an (evident) theoretical framework and that usually arise from measurement needs for practical issues – i.e. not policy making, but as mere "neutral" tools for third party uses.

This was done, mainly, to track all the shades of grey between the most theoretical approaches to the more practical and applied ones.

These models were analyzed in the light of our own understanding of digital development and according to the components we have listed above. These components were the result of an iterative comparison of the analyzed models plus the inclusion of other references from the scientific literature.

In general, we can state that the existing models have been shaped the way they are for two main reasons:

- Designs based on a specific and applied purpose that fits the general goals of the fostering organization, the best example being infrastructure-biased indices issued by telecoms organisations.
- Designs adapted to the availability of data, reverting to the use of proxies or soft data – in the best of cases – or the exclusion of variables – in the worst ones – potentially relevant to the subject to be measured.

But the devil is in the details.

These two different reasons have created, first of all, a great division amongst two main groupings of models:

- theoretical models – e.g. those of CSPP, Harvard, Bridges.org or SIBIS – that, due to lack of data, were never put into practice or applied just once and never repeated because of the costs of replication; and
- periodic indices – e.g. the DOI, the DAI or the IDI – and data sets that either fit the purposes of the promoters or fit the scarce availability of data.

In between, a third small group – e.g. the NRI, EIU's – have been struggling to bridge the previous groups, though they have (a) included data not strictly belonging to the digital economy (i.e. "analogue noise") and (b) included soft data that is susceptible to criticism because of its subjectivity or inaccuracy (especially in relationship with hard data).

The resulting work of these three main groupings has had some theoretical and practical implications.

First, attempts at policy evaluation have entered a vicious cycle, where what is not measured is not analyzed, and what cannot be analyzed is thus not measured. The final outcome is that, 35 year after the first publication of the ITU's *Yearbook of Statistics*, there still is a strong unbalance towards infrastructure indicators – and telecommunications in particular –versus other kinds of indicators.

This trend has indeed been reinforced by the fact that, in earlier times, the debate over access and the digital divide was concentrated in physically owning or accessing infrastructure.

And another fact that has yet strengthened the intensive usage of data about infrastructure is the relative ease with which they are measured: in comparison with other sources of data. Measurement of this kind of infrastructure – and, sometimes, also their use – is quite straightforward and, thanks to industry standards, relatively easy to compare and aggregate.

On the other hand, if the industry is keen to measure its penetration, performance or efficiency, it is necessary to consider other aspects of the digital economy that have attracted relatively less interest or have had a much lower return on the investment in acquiring data. This is the case, of course, of data about almost everything not directly related with infrastructures or specific usage.

Thus, we find that after measuring infrastructures, usage has been the next step in measuring policies – and, implicitly, in modelling the digital economy.

As we have already shown, these two main groups of indicators – infrastructure and usage – have the biggest share of all indicators analyzed in this work, relegating to a secondary level all other aspects of digital life, such as digital literacy, the legal and policy frameworks and the availability of digital content and online services.

In brief: while monitoring has generated a wide array of tools, explanation of the reality has not. While telecoms is the main source of data, especially for commercially-important data, socioeconomic related data has been kept out of the equation for too long. Though not forever, thankfully.

Though present since the mid 1990s, in more recent years – partly due to a more qualitative and diverse usage of the Internet and its applications – a growing interest has emerged to obtain data about what makes people use technology besides infrastructures, meaning (a) motivation and (b) the framework they are in.

This has reinforced the existing e-Readiness Models – such as those of the World Economic Forum, the Economist Intelligence Unit or the World Bank, to name but a few – and new strategies to “fill in the blanks” left by telecoms.

Unfortunately, and unlike the case of infrastructures, the remaining blanks are difficult to measure using hard data, resulting in two problems.

The first one, the impossibility – real or related to cost or other issues – of obtaining such data. The second one, the option for a second best solution based in gathering soft data coming from surveys whose quality is, by far and by construction, not comparable with hard data – despite the huge and worthy efforts to improve their explanatory power.

When data has been made available, an already existing problem has reappeared with more virulence: the cost of replicating surveys and, thus, the cost of maintaining time-series data so that not only static snapshots can be taken of the reality, but also its evolution over time.

Summing up:

Cause	Consequence
Novelty of the digital revolution	Focus on infrastructure
Relative ease of extracting data on infrastructures	Unbalance in favour of data on infrastructures
Higher commercial value in acquiring telecom data	Unbalance in favour of telecom data (little “social” data)
Cost of acquiring data and continual refinement of methodologies	Lack of time series
Cost of acquiring data	Lack of broad geographic series
Cost of acquiring data	Trade-off between periodicity and breadth of measurement
Relative higher cost of extracting “social” data	Unbalance in favour of data on infrastructures
Unbalance in favour of data on infrastructures	Reinforcement of unbalance in favour of data on infrastructures due to models adapted to poor data availability
Lower quality of soft data	Reinforcement of unbalance in favour of data on infrastructures due to lower validity of soft data

Table 24: Data gathering problems

At the qualitative level, these mainly quantitative issues have implied conceptual or theoretical biases that, in our consideration, are more serious than the mere lack of availability of data or its poor quality.

Adding to the already mentioned imbalance between infrastructures and usage data, and the rest of the data categories, there is also an imbalance in supply-side vs. demand-side indicators. Far from being yet another quantitative issue, its implications are crucial because policies depend on what is measured, in part because it is what gets the attention, and in part because it is what has been made available to evaluate impact.

The prevalence of supply-side indicators means, for instance, that we are giving priority to the existence of infrastructure but leaving aside whether it is affordable for the end user. Or that we are approximating usage by measuring Internet traffic or bandwidth use, which is only an imperfect reflection of what is really happening on the demand-side and, more important, does not explain why people are motivated to use the Internet or cellular phones.

We are not saying that *all* the focus should be put on demand, but that it should at least be *as* focused as the supply-side. And this is especially important when the supply potential is increasing – due to installation of infrastructure or creation of online services (e.g. e-Government) – and its utilization is still relatively low. Thus, demand-side measurement is required so as to understand the whole picture and be able to design appropriate policies.

The latter gains even more importance if we consider that failing to measure the reasons for usage may actually lead to some towards paths of exclusion. Not including in the model all the variables that matter will most probably cause not just a technical failure of that model, but an ethical failure of the institution fostering it: are policies promoting what really matters? Who are these governments serving?

Last, but not least, the imbalance between infrastructure + usage vs. other data categories leaves aside, once again everything in between what is to be used and the use of it, which we can call (as we did before) causes, or which we can call enablers.

Then, the unbalances and biases not only show failures under a merely quantitative point of view, but also on quality. By enablers, we understand the ICT Sector, skills and capacity building and the legal framework, including all side-effect issues such as affordability and effective usage or e-Awareness.

In our opinion, there is too little concern about the affordability of infrastructure relative to the view of residential users, for whom price is a primary issue. Added to this, their usage is not only a matter of physical access, supply of content and services, but capability – in a very broad sense – to use them. And capability is related with skills, but also with the permission to do so– again in a very broad sense –, which ranges from laws to policies to the socioeconomic environment.

At the macro level, forgetting the enablers also implies letting aside the possibilities of the (underrepresented in the indicators too) ICT Sector as a driver of development.

In other words, the actual landscape of the measurement of the digital economy is focused more in quantitative monitoring than on qualitative impact. And qualitative impact requires – as we will see later – better measuring tools so that appropriate decisions can be taken and their outcomes properly measured.

In our research, we have humbly provided a comprehensive approach, a 360º digital framework, based on our ten categories – mentioned above in this chapter as components of access – and that gathers, we believe, all the possible approaches and factors that compose the digital economy. In doing so, too, it is our purpose to propose a possible solution to the problems of both the Telecommunications Model and the Broadcasting/e-Readiness Model when applied to policy-making and decision-taking.

This aim of comprehensiveness serves the two purposes for which most measuring devices have been created, namely (1) to monitor what has been created (infrastructures, content usage, etc. and (2) to explain the reality (how, why, etc.). On the other hand, it avoids the common misuse of these tools, especially when using monitoring tools to infer explanatory statements (e.g. by using infrastructure-centred indices to rank countries according to their digital development).

Last, with this qualitative analysis and the 360° digital framework proposal we believe we have been able to answer the first and second sets of research questions we stated in the introduction, which also imply not refuting the first two hypotheses about the incompleteness of models and measuring devices and the possibility to be holistic in the approach despite certain unavailability of data.

In other words, we can so far state the following conclusions:

- Narrow institutional interests and a lack of appropriate data have led to a biased or fragmented models of digital development that make it both difficult to measure policies that foster the Information Society and measure the impact of such policies in digital development.

- The effect of these biased models is a fundamental distrust towards the design of policies that have not tried to fill the gaps with further data coming from other sources that made it possible to fill in conceptual voids or to include feedback about the impact of such policies.

- A 360° digital framework approach should include five categories and ten subcategories so that all factors of digital development are appropriately covered: Infrastructure – Availability and Affordability –, the ICT Sector – the Industry and the skilled Workforce –, Digital Literacy – the level of Digital Literacy and Digital Literacy Training –, the Policy and Regulatory Framework – Regulation and Policies – and Content and Services – Availability and Intensity of Usage –.

15.3. Characteristics and determinants of digital development and the role of the public sector

With this 360° digital framework as a working tool, we faced the challenge to (a) test it against reality and (b) define, characterize and find the determinants of the stages of digital development.

We found that we could draw four stages of digital development where 45 countries could be allocated by calculating their Euclidean – statistically significant – distances amongst themselves. The test was repeated to find four sub-stages within the most developed ones.

The stages of digital development we defined are as follows:

1. Digital leaders: they lead digital development by scoring higher than other countries in most categories and at a very advanced level. They can be subdivided between:
    a. Primary digital leaders; and
    b. Secondary digital leaders.
2. Digital strivers: they have established a framework for digital development but still have to strive to get higher scores in most categories. Again, it is possible to subdivide between:
    a. Primary digital strivers; and
    b. Secondary digital strivers.
3. Digital laggards: though they follow a similar path as leaders and strivers, they clearly lag behind other countries – especially digital leaders – and score lower in most or all categories.
4. Digital leapfroggers: do not appear to follow the same path between the three stages as other countries; instead, they intensively foster the Information Society in a context of low income and low development in general (in relation to other more developed countries), making it likely that they are achieving some sort of development leapfrogging.

As we have just stated, one of the most interesting things in this scheme is finding out that most countries – apart from leapfroggers – behave alike and follow the spectrum of digital development, with the differences arising mainly in the degree of development of their aggregated indicators.

This common pattern we are talking about can be described as follows, keeping in mind that – at this point dealing with cluster analysis and characterization – we are talking about characteristics and not reasons of causality – dealt with later on – and that there were no time-series in our analysis.

Economic development is the fundamental characteristic of digital development. In general, developed countries are digital leaders or figure in the upper tiers of digital strivers. All in all, most aspects we can find about digital development can be intuitively inferred from this last statement.

Thus, and entering the digital scenario, infrastructures – as in the real economy – play a major role in digital development. Its quality – pervasiveness, bandwidth, etc. – is linked to digital development and, indeed, seems to draw a sort of a threshold related with other digital characteristics, especially expenditure on ICTs. In this sense, below the threshold, expenditure is high so to achieve the essential infrastructure to run the Information Society. Above this threshold, expenditure in ICTs is lower in relative terms, and the emphasis can be placed on other issues like content and services. As said, and especially amongst digital leaders and strivers, infrastructures are installed gradually along tiers but following a very similar pattern. In this respect, investment in broadband is an increasingly strategic asset both to fuel the local market as for international relationships.

The existence of infrastructures – a quantitative indicator – also has a qualitative side: affordability. The cost of infrastructures – especially their use – seems also related with digital development and seriously drags on the further evolution of the digital economy and forces individuals and societies to increase their expenditure in ICTs, in a clear trade off with investment or consumption of other commodities, presumably reducing their welfare too.

A certain level of available infrastructure – above the threshold we mentioned before – coexists with more important roles of the ICT Sector in these economies. An ICT Sector with a twofold projection: the domestic economy and the international arena. As one of the most competitive sectors (especially at the international level), the strength of the ICT Sector is usually accompanied by high R&D levels, both in absolute terms and in relationship with other industries. When infrastructures are present and the ICT Sector is strong, R&D is the norm and is linked to the highest levels of digital development.

The ICT Sector is the most distinctive issue separating digital leaders, strivers and laggards – which follow the same pattern but at different speeds – from leapfroggers. The latter, are strongly supportive towards developing a domestic ICT Sector and putting huge effort in the investment related with digital infrastructures. Their target: the international export market. These approaches seem to be strategies on their own, regardless of the stage of development of their (analogue and digital) economies at large or the impact (beyond the direct one) on their economies and citizenry.

There are some countries – leapfroggers – that are strongly betting on the development of an ICT Sector and investing in digital infrastructures with a clear focus on the international market. This is done despite their initial allocation of resources and the impact on their economies is, at least with our data, unclear.

If we extend the concept of R&D to the human (capital) level, the presence of computers and Internet in schools is also related to digital development. Thus, the investment in human capital and improved digital literacy is also a tipping point of digital leaders and some digital strivers. This is, again, a pattern that repeats itself along the stages of digital development, fading out as we walk through the different stages. We find it characteristic that a main difference between digital leaders and strivers in opposition to digital laggards is, precisely, this support and engagement in digital competences in particular and human capital in general. Nevertheless, this is also common ground between developed and developing countries, so it can be read that, again, wealth or income, education and development are a triangle that replicates itself from the analogue to the digital world economy.

All the former aspects flower in the appropriate setting: the legal framework. ICT regulator frameworks, such as specific Telecom Acts, or intellectual property protection, go hand in hand with higher levels of installed infrastructures, ICT Sector evolution and stronger digital literacy and skills as proxied by Internet in schools. This is also related with a proper legal framework for the analogue economy, where innovation, an efficient economic incentive regime and the level of urban population seem a key to the development of the digital economy and the ICT sector at all levels.

This appropriate legal and economic framework allows the private sector to be early adopters – in relation to the public sector or households – and constitute, in most digitally developed economies, the main drivers of development at the content and services category, both in the supply-side and the demand-side. Though supply seems usually to come earlier than the demand-side within enterprises, it is quickly followed by (if we were able to speak of causality we would have said that it triggers) strong demand in the form of end user usage.

Last, and speaking of usage from the public sector, is it to note that both the two mainstream economic philosophies within capitalism – absolute laissez faire and mild Keynesianism – seem to be present (and compatible) with higher levels of digital development. Actually, if we stated that the role of the government in setting up the rules and guidelines of the digital economy was definitely tied to other digital development indicators, direct intervention – e.g. expenditure in ICTs – seem to have neither a positive nor a negative correspondence with digital development. Notwithstanding, it is also true that some of the triggered demand we talked of in the previous paragraph can also be related to the provision of public services online, as some variables (secure servers, domains) are not disaggregated per sector.

So, if these are the characteristics, what are the causes?

First of all, we have to take into account the caveat that just some coefficients fall within a 95% confidence level, being most of them close above this level, and a remaining few but within the 90% confidence level.

In digitally developed countries, causes that actually determine these economies to be labelled as digital leaders (or are at least closely associated with it) include life expectancy at birth, inequality (at 20%), urban population, the Economic Incentive Regime and Government prioritization of ICT.

Life expectancy at birth has a very small but negative impact on digital development. We can infer from the negative relationship between digital development and life expectancy (more life expectancy, less digital development) that this might be due either to the trade off between welfare (in a very broad sense) and the building of a new economy, or (more likely) to a positive relationship between a younger and more dynamic population and the building of a new Information Society.

Also related to human development and the welfare of the population, *Inequality* has a negative impact – though bigger than life expectancy at birth – in digital development. Thus, the greater the economic unbalances in the real economy the less likely this economy is to reach a higher stage of digital development. This is an interesting finding as it raises a cautionary remark that (digital) development goes hand in hand with a socially-balanced development strategy.

With an opposite sign, but with an impact as small as the case of life expectancy at birth, the *percent of urban population* also determines, in some degree, digital development. In this case, it does follow prior findings by other researchers that highlighted the importance to the development of the Information Society of clustering around cities as a focus of innovation.

Indeed, innovation and, more generally, the *economic incentive regime* plays a positive and more important role in the probability of reaching the stage of digital leader. We already mentioned when talking about the economic environment and R&D that the economic framework was a watermark of digital development. What we here find is that not only is it a watermark, but a cause in its full sense.

Moreover, the *Government prioritization of ICT* has the highest and most positive impact on digital development of all the determinants found in our model, multiplying by 18 the odds of an economy being allocated in the highest rank of digital development and three times stronger than the economic incentive regime. We have to be cautious, nevertheless, not to misunderstand prioritization with direct intervention, as the indicator measures the political and legal role of the government and not its direct participation in the economy.

Concerning less digitally developed economies, it is interesting to see that the causes of digital underdevelopment are similar (opposite) to those of development, with the inclusion of some particular aspects. So, we find that the determinants for not being digitally developed are Inequality (at 10%), Health Public Expenditure (% of total Health expenditure), Population covered by mobile telephony (%) and Importance of ICT to government vision of the future.

As we said, we find again *Inequality*, and again with a negative sign that has to be read carefully in this case. Regarding digital laggards, a negative coefficient in equality means that more inequality represents a lower probability of *not* being digitally developed, of being a digital laggard. In other words, higher inequality will decrease the probability of being a laggard. Though we can state that its power is lower than in the case of digital leaders, it is nevertheless surprising that more inequality would be "good" for digital development in its early stages. A possible explanation would be that of the last mile, where the deployment of infrastructures would never be completed if, at the margin, the cost of universal access overrides the profits achieved by the carriers. Or, what is the same, a critical mass or a minimum threshold or purchasing power is needed in early stages of digital development.

Slightly lower in power, the role of the Government in the provision of health services (*Public expenditure in Health as % of total Health Expenditure*) has also a negative impact on the probability of being a digital laggard. In this case, the finding follows intuition: the healthier the population – and the higher the commitment of the government to their welfare – the better for development.

The *percent of the population covered by mobile telephony* is another confirmation of intuition, and in two different ways. First of all, it statistically demonstrates that mobile telephony is a driver of digital development in lesser developed countries, which is something that researchers in the field have stated to exhaustion – and by focussing, in their methodologies, on those technologies that are less affordable or have lower penetration, many ICT4D projects are implicitly denying this fact. Second, this is an indicator that does not appear when analyzing digital leaders but only in the case of digital laggards, which sort of pictures the structural differences between both groupings of economies and reinforces the need for separate policy designs to foster the Information Society when addressing such different realities.

If mobile telephony represents the difference between digital leaders and laggards, the *Importance of ICT to government vision of the future* surely represents the similarity. Though slightly different to *Government prioritization of ICT* among digital leaders, the over-riding concept is whether governments care about fostering the Information Society. And if the case of digital leaders was clear, it is even more powerful in the case of developing countries; orders of magnitude more important. On the other hand, while the case of digital leaders and the *Government prioritization of ICT* was the answer to the question of whether "ICTs is an overall priority for the government", the case of digital laggards and the Importance of ICT to government vision of the future wants to answer the question of whether "the government has a clear implementation plan for utilizing ICTs for improving the country's overall competitiveness" which is, to our understanding, a stronger commitment of the government, where not only its overall priorities are questioned but also whether real policies and strategies have been planned.

Our main **conclusion** in this section is that:

- Governments' actions determine digital development. The probability of a country of reaching higher stages of digital development is highly increased by governments prioritizing ICTs, by assigning a high importance to ICT in their vision of the future, and by establishing an appropriate Economic Incentive Regime.

At this point, we believe we have been able to answer the remaining research questions and, with that, to accept our hypothesis about the importance of the Government in enabling and fostering the Information Society by active political engagement– though not necessarily through direct intervention – with the facilitation of analogue and digital economies.

Our **general conclusion** is, thus, that:

- Narrow institutional interests and a lack of data lead to fragmented models to measure digital development that distort policy design. A comprehensive framework that includes all the relevant categories (Infrastructure – Availability and Affordability –, the ICT Sector – the Industry and the skilled Workforce –, Digital Literacy – the level of Digital Literacy and Digital Literacy Training –, the Policy and Regulatory Framework – Regulation and Policies – and Content and Services – Availability and Intensity of Usage –) would improve such models. Within that framework, the adoption of public policies to foster the Information Society would lead to higher stages of digital development.

Which confirms our general hypothesis of this research.

15.4. Limitations of this research

All that has been said up to this point in this chapter – and, actually, in this work in general – should be taken with caution (as one should with any kind of analysis) due to some limitations of the research, mainly related with the quality of data.

We have already stated several times along the preceding pages that data are far from being perfect. In general terms, their main shortages can be summarized as:

- Lack of data for a broad range of economies;
- Lack of data along time (i.e. time series);
- Use soft data, with lower quality than hard data;
- Use of proxies instead of hard (or even soft) data in variables to represent indicators, proxies whose relationship with the represented variables is not demonstrated (e.g. education vs. digital literacy);
- Like of consistency of some data (e.g. series of data for a set of economies on an indicator and for a specific year might actually gather data from several years, due to lack of data, surveys collected or sent back when formal periods are over, etc.);
- Lack of unified, coherent, comparable large data sets collecting large amounts of indicators under the same methodology.

In specific issues, main shortages can be summarized as:

- Generalized lack of data about digital skills, both level and acquisition;
- Generalized lack of data about usage;
- Generalized lack of microdata about specific usage (including the reasons for not being a user);
- Generalized lack of hard data on policies and regulation;
- Some existing data practically unavailable due to costs of fees (despite them being gathered by public or public funded institutions).

Absolutely all these problems are present in the data sets we used to perform our analyses. On the other hand, we feel able to say that having been able to work with our model despite these issues is, to us, one of our more successful outcomes.

Of course, we are not trivializing the consequences of working with such data: although we believe that our findings and conclusions are quite robust, new and better data would likely make them teeter, especially when close to the boundaries of statistical significance or in coefficients near to zero (i.e. they might change sign easily).

Concerning tests of significance, we were careful enough to prune out of models any non-significant variables and set aside whole models whose explanatory power was not significant either. Notwithstanding, we are fully aware that we have been working with small samples (statistically speaking), which became even smaller when we focused in individual clusters or stages of digital development.

As has already been stated, this was one of the main reasons why the leapfroggers' stage – composed of just three economies – was not analyzed in a logistic regression or why some initially appealing economies to our study – like Iceland – were not included in the working database.

The approach to deal with aggregate data at the country level is also a dire limitation of the model. The reader will agree that countries or nations are constructs that represent the regions comprised within their boundaries in many aspects, but that necessarily blur the heterogeneity of their inner differences and hide the differences – sometimes huge ones – amongst their regions or lower levels of aggregation. Though this limitation is closely related with lack of data, we thought it was worth mentioning it in a separate way, as it is also a matter of scientific approach and methodological design to include these sensibilities in our models.

Last, but not least, one could argue that not only data but the whole model itself could be better designed. We are fully aware that we have tried to maintain a neutral, practical approach strictly focusing on the tools, and neither on the frameworks nor in the goals. But a theoretical approach could – and should – be added to that approach of ours. Our subject of research is closely related with institutional design and its impact in society, economic development theory and human development theory, or public policies design and assessment, to name a few. Matters of focus and length kept us aside from entering in deep with these disciplines. Nevertheless, we believe that some of these well established disciplines and their corresponding theories would have enriched our work.

On the other hand, we believe that not only is this a present problem, but a future one too: the ever-changing nature of technology puts at stake many theories and approximations within several months range (e.g. what is broadband, as defined by its lower capacity limit?). This would ask of models to be designed in dynamic terms and not statically. Following the example of broadband, to set aside quantitative considerations (e.g. raising the lower capacity limit to define broadband from 256 Kbit/s to 1 Mbit/s) and work in the field of "competences": e.g. "to be able to work comfortably online with any device and software". Of course, this adds a lot of subjectivity to the whole model, making us wonder whether the "solution" is worse than the problem. An approximation with structural equations with latent variables might be a better one. We deal with this proposal in next section.

15.5. Future lines of work

In our opinion, one of the most exciting and clear lines in which this research of ours should be expanded in the future is the refinement of the theoretical model or, so to speak, of the 360° digital framework. And, to do so in at least two ways.

A first way would be the strengthening of the theoretical corpus. In other words, one of the things that we have been doing in our research has been reviewing what had been done and put it all together. A (necessary) next step should be going one step beyond and building "new" theory from it by exploring all the relevant aspects of digital development still not covered in our work – and, maybe, not covered at all by people and institutions currently measuring and modelling digital development.

This enrichment of the theoretical corpus could also come from establishing relationships between our research and the field of e-Readiness and ICT4D and other disciplines like the afore-mentioned growth, human development, policies or institutional design. We nevertheless think that, given the topic of our research, there are two fields that naturally converge in our own field. The first one is what has been developed under the name of Knowledge Economy, which represents a "vertical" expansion of our work leading to explore the use of digital tools to the application of knowledge in all aspects of life – and, more precisely, in the production functions and growth. The second one is Network Theory – especially applied to policy-making – which represents a "horizontal" expansion of our work with the aim to gather all the collateral and synergic effects of networks, globalization, etc. in policy-making and the way Network Society works.

A second way would be to improve the fit and explanatory power of the applied model, especially in its predictive possibilities, further applications (micro and macro levels, by sector, by smaller geographical units – e.g. nationally or regionally –, etc.) and flexibility according to data availability and specificities of the target to be measured. In this respect, the inclusion of time-series data rather than simply "latest available" would be an important methodological improvement, especially with regard to the ways in which individual countries transition between the stages of digital development. In general, *any* improvement in data – in the lines we mentioned in the previous section – would most likely improve the fit of the model.

These two goals or lines of work seem to converge in what looks a natural evolution of our work: the application of structural equation modelling. We believe that this technique would both provide a better approximation to the theoretical issue and also increase the explanatory power of the statistical part when put into practice.

It would, most likely, also increase the number of variables that the model can work with. Let us remember that, although our model used more than 60 variables when explaining the characteristics of digital development, nevertheless this variety – and comprehensiveness – drastically dropped to just five when performing the logistic regressions.

Better modelling, along with better data – as we already explained in the previous section – should enable the model to evolve into yet another line of work: specific usage at the "really-micro" level, the one which deals with usage in a qualitative way and focusing on the *purposes* for which technology, digital content and services are used, and not in the mere *use* of them (e.g. use of e-mail for obtaining health information).

Thus, the combination of a broad, macro, generic work such as ours with usage-focused ones could provide valuable insight into the constraints and multipliers of a digital framework, while being enriched by the practical focus of other applied researches (e.g. following the previous example, enablers and motivations of usage of ICTs for health-related issues).

And, lastly, a third line of work, which we consciously abandoned in our research, but that would make perfect sense in the light of these considerations mentioned above: to investigate the causes of leapfrogging. Due to the heterogeneity of leapfroggers, and the fact that only three of them have been identified, this is, by far, the most challenging line to explore. On the other hand, it is nevertheless and most probably the most interesting one, at least in its implications for policy development. As we have been seeing, a minimum stage of socioeconomic development does not guarantee digital development, but does certainly make things easier (i.e. it is a necessary condition, but not a sufficient one). The Philosopher's Stone would hence be to find out how poorer countries, starting off from a position of disadvantage, could make it to higher stages of development and welfare.

All in all, this is what the whole thing was about.

Bibliography, Glossary and Annexes

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18. Annex I: categorization of the analyzed indicators

We here list our classification of the indicators contained in the analyzed models. What follows are not the original names of the indicators, but general concepts that may represent one or more than one of these indicators. For instance, *Mobile telephone users (% of population)*, *Proportion of population using mobile telephones* and *Penetration of mobile telephony* will go under the same concept.

Nevertheless, it is possbile that the reader might find redundant some of these concepts. We apologize for this inconvenience.

18.1. Infrastructures - Supply

Actual Digital Community Centre (DCC) usage percentage

Adjusted Business software and hardware spending per capita

Adjusted Government software and hardware spending per capita

Appropriateness of technology

Are cable network upgrades underway to permit the interactive applications necessary for electronic

commerce?

Availability of cellular phones

Availability of Digital Subscriber Lines (DSL) in OECD countries

Availability of wireline and wireless communication services, community access centres (free and paid), and

networked computers in businesses and homes

Average budget of a national RN

Basic rate ISDN subscribers

Broadband coverage in rural areas

Broadband Internet subscribers per 100 inhabitants

Broadband Penetration

Business

Business data access lines per 1,000

Cable modem Internet subscribers

Cable per household

Cable television subscribers per 1000 people

Communication channels and capacity

Computer Processing Power (% Worldwide MIPS)

Computers and the Internet: Employees - Summary of EU15 and EU25 aggregates

Computers and the Internet: Enterprises - Summary of EU15 and EU25 aggregates

Computers and the Internet: Households - Summary of EU15 and EU25 aggregates

Computers and the Internet: Individuals - Summary of EU15 and EU25 aggregates

Computers per 100 inhabitants

Connectivity Infrastructure of the Internet - Access Methods

Connectivity Infrastructure of the Internet - Domestic backbone

Connectivity Infrastructure of the Internet - International Links

Connectivity Infrastructure of the Internet - Internet Exchanges

Core usable backbone capacity on a national RN

Cost of PC relative to average individual income

Damage severity index

Degree of broadband extensiveness in the consumer market

Degree of broadband technologies take-up

Degree of multi-device users

Dial-up Internet subscribers

Digital Divide Index (DIDIX)

Digital lines/mainlines

Digital mobile cellular subscribers

Digital Opportunity Index

DSL Internet subscribers

Electricity

Employees - Availability of Computers

Employees - Devices to access the Internet

Employees - Type of connection to the Internet

Enterprise Access lines + DSL Lines per capita

Enterprises - Availability of Computers

Enterprises - Computers: Devices and communication systems

Enterprises - Type of connection to the Internet

Establishments with Remote Access

Faults per 100 mainlines

Fixed broadband Internet subscribers per 100 inhabitants

Fixed lines - capital city

Fixed lines - rest of the country (out of the capital city)

Fixed telephone lines per 100 inhabitants

Geographic Dispersion of the Internet

Geographic distribution of health institutions with computers, telephone and Internet connectivity

Government

Hardware (HW)

Hardware and Software

Health

Home

Household Internet access cost per month

Households - Availability of Computers

Households - Computers: Devices and communication systems

Households - Devices to access the Internet

Households - Type of connection to the Internet

Households with a PC

How high is the rate of packet loss?

How many dial-up attempts/connections fail because they are busy or interrupted?

How many ISDN or DSL subscribers are there per 1000 mainlines?

HW & OS Documentation

ICT that respondents have at home

Individuals - Place of computer use

Individuals - Place of internet use

Individuals accessing the Internet by primary access point, by age and gender

Information Infrastructure

International Internet bandwidth (Mbit/s)

International Internet bandwidth per inhabitant

Internet access awareness – utilisation of PIAPs

Internet access barriers index

Internet at home access divides

Internet Availability

Internet hosts (#)

Internet hosts per 1000

Internet subscribers per 100 inhabitants

Investment in Telecom as % of GDP

Is non-telephone or non-wireline access available to business users to enable Internet connection?

ISDN subscribers

ISDN voice channel equivalents

Leased line Internet subscribers

Level of Internet access (%)

Locally Tailored Software

Main (fixed) telephone lines in operation

Main fixed telephone lines per 100 population

Mobile broadband subscribers per 100 inhabitants

Mobile cellular subscribers per 100 inhabitants

Mobile cellular subscribers: prepaid subscribers

Mobile Internet subscribers

Mobile Phones per 1,000 People

Mobile telephone subscribers per 100 population

Mobile Wireless

Mobile/cell phones as percent of the population?

Multiple computer network presence within enterprises (Internet, Extranet, Intranet, EDI over IP)

Network Speed and Quality

Number of 3G subscribers per 100 inhabitants

Number of Internet exchange points

Number of Internet hosts as percentage of the population (including TLDs weighted by domain registrations)?

Number of Internet hosts under the domain of your country as a percentage of the population?

Number of Internet subscribers per 100 population

Number of localities with public Internet access centres (PIAC)

Number of localities with telephone service

Number of Personal Computers

Of the total number of residential lines, what percent represents additional (non-primary) lines?

Operating System (OS) Software

Other fixed broadband Internet subscribers

PC Ownership

Penetration of 3G handsets

Perceived barriers to buying/ordering over the Internet

Percent coverage of mobile cellular network (land area)

Percent of main (fixed) lines connected to digital exchanges

Percent of main (fixed) lines in urban areas

Percent of telephone faults cleared by next working day

Percentage of businesses with an intranet

Percentage of businesses with computers

Percentage of businesses with Internet access

Percentage of businesses with PCs

Percentage of employees using Computers

Percentage of employees using PCs

Percentage of employees using the Internet

Percentage of enterprises having access to the Internet

Percentage of enterprises using Extranet/Intranet

Percentage of enterprises with broadband access

Percentage of enterprises with Internet access having encountered security problems

Percentage of government employees with Internet access from the office

Percentage of government offices with Internet access

Percentage of government workers that use ICTs

Percentage of households equiped with home networking connections

Percentage of households or individuals connected in Objective 1 regions

Percentage of households with a telephone (Fixed, mobile, and fixed and mobile)

Percentage of households with access to the Internet broken down by device for accessing via PC, digital

TV, mobile device

Percentage of households with broadband access

Percentage of households with Internet access

Percentage of households with Internet access (from the home)

Percentage of individuals with access to the Internet broken down by place of access (home, workplace,

place of education, Internet cafe, PIAP etc)

Percentage of individuals with Internet access having encountered security problems

Percentage of localities with public Internet access centres (PIAC)

Percentage of localities with public Internet access centres (PIACs) by number of inhabitants (rural/urban)

Percentage of population covered by fixed networks

Percentage of population covered by mobile cellular telephony

Percentage of population with access to PIACs by type of PIAC (governmental/private)

Percentage of population with access to the Internet (by type of access, purpose and location of use)

Percentage of the population with access to a public Internet access centre (PIAC)

Perception regarding efficiency of the Internet – the time aspect

Perceptions regarding lack of ease of access regarding the Internet

Physical access to technology

Primary rate ISDN subscribers

Problems encountered by individuals when buying/ordering over the Internet

Proportion of businesses accessing the Internet by types of access (response categories)

Proportion of businesses with a Local Area Network (LAN)

Proportion of fixed broadband subscribers to total Internet subscribers

Proportion of households with a computer

Proportion of households with a fixed line telephone

Proportion of households with access to the Internet by type of access (response categories)

Proportion of households with Internet access at home

Proportion of individuals with use of a mobile telephone

Proportion of mobile broadband subscribers to total mobile subscribers

PSTN subscriptions per capita

Public telephones per 1,000 people

PWLAN locations

Quality of scientists' computer equipment

Ratio of availability of PCs to number of staff

Residential fixed line telephone monthly subscription costs

Residential phone lines

Security breaches occurred in the organisation

Security issues encountered

Share of at home Internet users according to type of bandwith

Share of establishments giving staff access to the Internet

Share of Households with Broadband

Software Share of IT Spending

Source of information on occurred breaches - loss of data

Source of Information on occurred breaches – notified by their own information security system

Speed & Availability - Commercial

Speed & Availability - Residential

Subscribers to speeds above 2 Mbit/s

Target population for DCC (Digital Community Centres) services

Technical Documentation

Technological Readiness

Telecom Network

Telecommunication services: Household share of main telephone lines

Telephone subscribers per employee

Telex subscriber lines

Tools for information security

Total (fixed) Internet subscribers

Total capacity of local public switching exchanges

Total Computer Hardware Spending

Total Computer Software Spending

Total congestion ratio on the RN

Total fixed broadband Internet subscribers

Total number of computers in Digital Community Centres (DCC)

Total number of Digital Community Centres (DCC)

Total number of mobile cellular subscribers to low and medium speed access to data communications

Total number of other public Internet access centres (PIAC)

Total number of public Internet access centres (PIAC)

Total number of sub-regional and regional backbones and exchange points to which the country has access

Total Telephones per 1,000 People

Transport Network

Ubiquity

User Manual

Waiting lines/mainlines

What is the average connection speed available to your business users?

What is the average connection speed available to your consumer users?

What is the highest connection speed available for wireless Internet access?

What is the highest connection speed supported by your infrastructure available to business users?

What is the highest connection speed supported by your infrastructure available to your consumer users?

What is the teledensity (number of telephone lines per 100 people) in your economy?

What percent of the area of your economy has access to digital wireless or other system such as Direct PC?

What percent of the population has a PC at home?

What percent of your economy has access to cable?

What percentage of the population currently has access to the Internet via the cable network?

What percentage of the population in your economy has digital wireless or Direct PC Internet Access?

What proportion of the population has access to PCs - through the home or from school or work?

Which users have dedicated or other high-speed (>1.5Mbps) digital access to the Internet?

WiFi hotspots

Wired/Fixed Wireless

Wireless Subscriber Share of Population

World Wide Web penetration ratio

18.2. Infrastructures - Demand

Affordability and reliability of network access, including the cost of service, downtime, and the prevalence

of sharing access among individuals

Affordability of technology and technology use

Broadband affordability

Broadband Internet connection charge

Broadband price (1Mbits/s-2Mbits/s)

Broadband price (2Mbits/s-8Mbits/s)

Business monthly telephone subscription

Business telephone connection charge

Business telephone monthly subscription costs

Cellular (100 min basket - US$) - Tariffs as percentage of GDP per capita (PPP US $)

Connection: fixed line - Tariffs as percentage of GDP per capita (PPP US $)

Content affordability

Cost of a local call

Dial-up Internet - price of per minute (off-peak) connection

Dial-up Internet - price of per minute (peak) connection

Dial-up Internet connection charge

Dial-up Internet monthly subscription

International telephone call prices

Internet access tariffs (20 hours per month), in US$, and as a percentage of per capita income

Internet Affordability

Internet cost as % of GDP

Internet cost for 20 hours

Internet ISP charges (US$) - Tariffs as percentage of GDP per capita (PPP US $)

Internet Total charges (US$) - Tariffs as percentage of GDP per capita (PPP US $)

Local 3 min call (US$) - Tariffs as percentage of GDP per capita (PPP US $)

Local fixed line call costs for three minutes

Local mobile call costs for three minutes

Logical layer (applications and software) affordability

Lowest cost of broadband

Mobile cellular - cheapest recharge card value

Mobile cellular - price of 3 minute local call (off-peak)

Mobile cellular - price of 3 minute local call (peak)

Mobile cellular - price of SMS

Mobile cellular connection charge

Mobile cellular monthly subscription

Mobile cellular tariffs (100 minutes of use per month), in US$, and as a percentage of per capita income

Mobile telephone subscription costs

Monthly broadband subscription charge

Monthly rental: fixed line - Tariffs as percentage of GDP per capita (PPP US $)

Perception regarding affordability of the Internet

Physical layer (infrastructure) affordability

Price Basket for Internet (US$ per month)

Price basket for mobile telephone service ($ a month)

Price basket for residential fixed line ($ a month)

Price indicators based on monthly usage baskets

Price of a 3-minute fixed telephone local call (off-peak rate)

Price of a 3-minute fixed telephone local call (peak rate)

Price of call to United States ($ for 3 minutes)

Price/speed

Prices of telecommunication

Residential telephone connection charges

Residential telephone monthly subscription

What is the current year to year growth rate in number of Internet users in your economy?

What is the price level and structure charged to connecting to the Internet via leased line? a. What is the

standard list or retail price for a 2 km 2Mbps leased line?

What is the pricing structure charged to connect to the Internet on a dial-up basis: a. For dial-up

telecommunications services purchased by consumer/residential customers?

What is the pricing structure charged to connect to the Internet on a dial-up basis: b. For dial-up telecommunications services purchased by business customers?

What is the pricing structure charged to connect to the Internet on a dial-up basis: c. For charges levied by Internet Service Providers?

18.3. ICT Sector - Supply

Ability of the financial system to support electronic transactions

Bill Service

Capacity of Innovation

Commercial Models

Competitiveness of broadband technologies

Computer, communications and other services import

Contributions of ICT investment to GDP growth

Fixed telephone service investment

Foreign investment (in telecoms)

Foreign technology licensing

High-Tech Exports

How many licensees are there in your economy in the a. Cellular network?

How many licensees are there in your economy in the b. PCS network?

How many licensees are there in your economy in the c. Packet data network?

ICT Employment Opportunities

ICT goods exports as percentage of total exports

ICT goods imports as percentage of total imports

ICT imports and exports as percentage of total imports and exports

ICT patents as a percentage of national total (EPO) in selected countries

Information technology expenditure in millions of euro and as a percentage of GDP

Is access provided to elements of the system in an unbundled fashion (i.e. without being tied to purchase of other services from the network provider)?

Market shares in telecommunication

Mobile communication investment

Mobile telecommunication services revenue in total for OECD

Number of ISPs

Openness to financial and personal participation by foreign investors in ICT businesses

Other telecommunication revenues

Percentage of agricultural population and extension workers involved in the exploitation and deployment of ICTs to the sector

Percentage of enterprises having taken ICT precautions

Percentage of enterprises that have installed security devices on their PCs and updated them within the last three months

Percentage of ICT investments and expenditures (as a percentage vis-à-vis GDP and general Government expenditures)

Percentage of individuals having taken ICT security precautions within the last three months

Percentage of individuals that have installed security devices on their PCs and updated them within the last three months

R&D expenditure in selected ICT industries

Revenue from fixed telephone calls

Revenue from fixed telephone connection charges

Revenue from fixed telephone service

Revenue from fixed telephone subscription charges

Revenue from international calls

Revenue from leased lines

Revenue from local calls

Revenue from mobile communications

Revenue from national long distance calls

Sector expenditure (% of GDP)

Service and Support

Share of countries in ICT patents at the EPO

Share of ICT value added in the business sector value added

Sponsorship of science and technology parks as hubs of innovation and support for new enterprises

Technology Achievement Index

Telecommunication infrastructure investment in total for OECD

Telecommunication services revenue in total for OECD

Telecommunication services: Investment

Telecommunication services: Operators and service providers

Telecommunications investment (% of revenue)

Telecommunications revenue (% of GDP)

Top 50 telecommunications firms and IT firms

Total annual investment in telecom

Total Communications Spending

Total Computer Services Spending

Total revenue from all telecommunication services

Trade in ICT goods

Value added in the ICT sector (as a percentage of total value added)

Venture capital availability

What is the availability for end user organizations of skilled IT support in the form of service provider
businesses and contractors?

What is the average capacity of access for most ISPs?

What is the capacity of access services available to most users in your economy?

What types of services are available to large business users to access the Internet?

18.4. ICT Sector - Demand

Developing the ICT Workforce

Female mobile telecommunication staff

Female professional mobile telecommunication staff

Female professional telecommunication staff

Female telecommunication staff

Intermediary

Jobs for which access to the Internet is of high importance

Management Training

Mobile telecommunication staff

Number of professionals - Tertiary students in science, math and engineering

Persons employed with ICT specialist skills

Production Training

Proportion of total business sector workforce involved in the ICT sector

Share of ICT-related occupations in the total economy in selected countries, broad definition

Share of ICT-related occupations in the total economy in selected countries, narrow definition

Telecommunication services: Employment - Full time equivalent

Telecommunication services: Employment - number

Telecommunication services: Turnover

Total full-time telecommunication staff

18.5. Digital Literacy - Supply

Assessment of the level of e-commerce awareness/network literacy: What is the proportion of people who
access the web who are not students, academics or active in the Information Technology (IT)/Communications area:

Autonomy of use

Awareness of security features of Websites

Citizen perception of the safety of on-line government services

Computer skills of scientists

Computer use amongst citizens

Culture of local creativity and information sharing within the society

Deficiencies in basic ICT skills in establishments

Digital literacy (COQS-Index)

Effects of security concerns on e-Commerce

Employees - Level of Internet access

Enterprises - Level of Internet access

e-Skilled

European Computer Driving Licences

Have you ever used a computer?

Households - Level of Internet access

How long have you been using computers?

How often do you use a computer at these places? - Home

How often do you use a computer at these places? - Other

How often do you use a computer at these places? - School

How often do you use computers for the following reasons? - Browsing Internet

How often do you use computers for the following reasons? - Download Music

How often do you use computers for the following reasons? - Download Software

How often do you use computers for the following reasons? - Educational Software

How often do you use computers for the following reasons? - E-Mail or Chat Rooms

How often do you use computers for the following reasons? - Graphics Programs

How often do you use computers for the following reasons? - Internet Collaborate

How often do you use computers for the following reasons? - Play Games

How often do you use computers for the following reasons? - Use Spreadsheets

How often do you use computers for the following reasons? - Write Documents

How often do you use computers for the following reasons? - Writing Programs

How well can you do each of these tasks on a computer? - Attach e-mail

How well can you do each of these tasks on a computer? - Chat

How well can you do each of these tasks on a computer? - Database

How well can you do each of these tasks on a computer? - Download files

How well can you do each of these tasks on a computer? - Download music

How well can you do each of these tasks on a computer? - Edit photos

How well can you do each of these tasks on a computer? - E-mails

How well can you do each of these tasks on a computer? - Move files

How well can you do each of these tasks on a computer? - Multi-media

How well can you do each of these tasks on a computer? - Music CD

How well can you do each of these tasks on a computer? - Presentation

How well can you do each of these tasks on a computer? - Search Internet

How well can you do each of these tasks on a computer? - Spreadsheet

How well can you do each of these tasks on a computer? - Virus

How well can you do each of these tasks on a computer? - Web Page

How well can you do each of these tasks on a computer? - Word Processor

Human capacity and training

ICT Education

ICT user experience in the labour force

Individuals' level of computer skills

Individuals' level of Internet skills

Internet skills of scientists

Internet/web literacy

On-line content creation potential

Perceived lack of skills as a potential barrier to Internet use

Perceived lack of usefulness of the Internet as a barrier to access

Percentage of ICT-qualified teachers in primary and secondary schools (of the total number of teachers)

Percentage of persons employed using computers connected to the Internet in their normal work routine

Persons employed with ICT user skills

Psychosocial barriers to Internet use

Relevance of web security features in e-Commerce

Share of home-based teleworkers

Share of jobs which are perceived feasible for telework

Share of population who feel very confident in communicating over the Internet

Share of population who feel very confident in identifying the source of information on the Internet

Share of population who feel very confident in obtaining and installing computer software

Share of population who feel very confident in using an Internet search engine

Skills and efficiency of the workforce, and strength of efforts to retain skilled managers and technologists

Spread of e-Lancing

Technical skills of workforce

Trust in technology

Users' skills

18.6. Digital Literacy - Demand

Computers altogether

Computers instruction

Computers with web

Do schools and educational institutions have access to the most recent technology and technological
applications?

Enhancing Education with ICTs

Enrolled Student to PC ratio (in primary, secondary schools and tertiary education)

Enrolled student to PC ratio in primary and secondary schools

Establishments providing e-learning

Establishments providing ICT training

Establishments supporting ICT-related self-learning of their staff

Establishments using an Intranet for staff training

Gross enrolment ratio at tertiary level in science, mathematics and engineering

Higher Ed

ICT training qualifications

Intensity of ICT-related training

Internet access in schools

Is the education system being reviewed to take advantage of the most recent technology and technological
applications?

Is there close cooperation in your country between educational institutions and businesses to develop up-to-
date curricula?

Is your economy taking initiatives to increase access of schools to the Internet?

Is your economy taking initiatives to integrate the Internet and e-commerce in its education and training
policy?

K-12

Lack of adequate supply as obstacle to participation in ICT training

Major Internet-using Sectors of the Economy - Academic

Most recent training course on computer use

Participation in ICT-related self-learning

Participation in ICT-related training

Participation of the unemployed in ICT-related training

Penetration of ICT in schools and ability of educators to use and teach in accordance with the technologies

Percentage of primary and secondary schools with Internet access for students for study purposes

Percentage of students enrolled in tertiary education in an ICT field or an ICT-dominated field (of the total
number of students), by gender

Percentage of students enrolled in tertiary education with Internet access for students for study purposes

Percentage of tertiary education institutions with e-learning courses (of the total number of tertiary education
institutions)

Proportion of computers connected to web

Proportion of ICT-qualified teachers in primary and secondary schools

Proportion of schools with a radio used for educational purposes (by ISCED level 1 to 3)

Proportion of schools with a telephone communication facility (by ISCED level 1 to 3)

Proportion of schools with a TV used for educational purposes (by ISCED level 1 to 3)

Proportion of schools with Internet access, by type (by ISCED level 1 to 3)

Proportion of students enrolled by gender at the tertiary level in ICT-related fields (for ISCED levels 5 and

6)

Proportion of students who have access to the Internet at school (by ISCED level 1 to 3)

Quality of and participation levels in the education system, with an emphasis on efforts to create and
support a knowledge-based society

Ratio of computers for instruction to school size

Ratio of computers to school size

Schools with broadband access

Schools' Access to ICTs

Shortage audio-visual

Shortage computer software

Shortage computers

Shortage Internet

Student-to-computer ratio (by ISCED level 1 to 3)

Use of e-learning tools for work-related learning

Use of the Internet for learning

User Training

Way of obtaining e-skills

What percent of schools have some computer/IT education as part of the curricula?

What proportion of schools have access to the Internet?

What proportion of the people who access the web in your economy are NOT men between 10 and 35?

Workforce

18.7. Legal Framework - Supply

Are bloggers, other ICT users, websites or service providers subject to extra-legal intimidation, physical
violence, or cyber attacks by state authorities or any other actor?

Are individuals prosecuted or sanctioned by other legal means for posting or accessing information on the
internet or disseminating information via other ICTs, particularly on political and social issues?

Are there economic constraints that negatively impact users' ability to publish content online or online
media outlets' ability to remain financially sustainable?

Are there laws which call for criminal penalties or civil liability for online and ICT activities?

Are there legal, regulatory, or economic obstacles that prevent the existence of diverse business entities
providing access to digital technologies?

Barriers to information security

Barriers to on-line purchasing

Barriers to on-line selling

Concerns regarding on-line privacy

Concerns regarding on-line security

Conflict/Security Filtering

Consistency

Consumer Confidence

Content

Converged Regulator

Copyright

Countering spam legislation and responsible countering spam authority

Countries with a separate regulator

Dispute resolution decisions

Do foreign exchange restrictions prevent or restrict consumer purchases from international web sites?

Do government regulations restrict electronic settlement of e-commerce transactions or the use of electronic
payment technologies?

Do infrastructural limitations restrict access to internet and other ICTs?

Do online journalists, commentators, and ordinary users practice self-censorship?

Does e-commerce result in a reduction of physical inspection by Customs?

Does the government block access to digital media or particular Web 2.0 applications permanently or
during specific events?

Does the government place restrictions on anonymous communication or require user registration?

Does your economy allow foreign providers to participate in the market of wireless communication
services?

Electronic authentication

Electronic ID

Existence of effective competition among communication and information services providers

Existence of national ICT legislations and regulatory frameworks and their effective implementation.

Existence of national or sectoral ICT policies and strategies and their implementation status

Extent of efforts to protect electronic privacy

Freedom on the Internet

Has your economy acceded to the WTO Information Technology Agreement to enable optimal market
conditions and prices for terminal equipment?

Has your economy already started to license radio spectrum for voice, data and video network access as an
alternative to the wireline "local loop" or "last mile"?

How is the market for basic telecommunications infrastructure regulated?

How many spectrum bands are being used for Internet access?

How restricted is the market for ISPs in your economy? a. From the ISP perspective:

How restricted is the market for ISPs in your economy? b. From the customer perspective

How would the market for basic telecommunications infrastructure be best characterized?

How would you describe the market for Internet Service Providers (ISPs) in your economy?

Incumbent telco privatised

Independent institution regulating ICT sector

Interconnection agreements and prices: Are interconnection agreements made public?

Interconnection agreements and prices: Are interconnection prices made public?

Internet Tools Filtering

IP Telephony: Are individual users allowed to make voice over IP phone calls?

IP Telephony: Does your country have policies or regulations in place that deal with Voice over IP

Is access to the internet and other ICTs prohibitively expensive or beyond reach of certain segments of the
population?

Is licensed spectrum used for Internet access in your economy?

Is the technology infrastructure of commercial financial institutions capable of supporting online authorization and settlement of e-commerce transactions?

Is your economy open to foreign investment in wireless telecommunications?

Laws and Regulations by region

Laws relating to ICT

Legal and regulatory framework

Legal Framework

Level of competition: Cable Modem

Level of competition: Cable television

Level of competition: Cable TV

Level of competition: Data

Level of competition: Domestic fixed long distance

Level of competition: DSL

Level of competition: Fixed satellite

Level of competition: Fixed telecom local

Level of competition: Fixed telecom national

Level of competition: Fixed Wireless Broadband

Level of competition: GMPCS

Level of competition: IMT 2000

Level of competition: International Gateways

Level of competition: International long distance service

Level of competition: Internet Services

Level of competition: Leased lines

Level of competition: Local Services

Level of competition: Mobile satellite

Level of competition: Mobile telephone service

Level of competition: Paging

Level of competition: VSAT

Level of competition: Wireless local loop

Liability

Licensing agreements

Number of countries with which there is a roaming agreement

Organizational Infrastructure of the Internet

Patent Applications Granted by USPTO

Political Filtering

Presence of information security policies

Privacy

Publishing Laws

Quality of Competion in the ISP sector

Reference Interconnection Offers (RIOs): Do you require any operators to publish Reference Interconnection
Offer (RIO)?

Regulation of fixed telephony

Reliability of electrical supply for business-critical computer operations; and the ease of importing and
exporting goods and of transporting them within a country

Reporting of on-line violations

Sector Structure - Private Sector Participation

Security

Security and Encryption

Social Filtering

Spectrum information

Standards

Status of the main fixed-line operators

Strength and effectiveness of the legal framework to address and prosecute computer crimes, authorize
digital signatures, and enable public key infrastructures

Strength of legal protections and progress in protecting intellectual property rights, especially for software

Tariffs on electronic commerce

Telecom Market Regulation

Telecommunications Regulation

Threats to on-line security – computer hackers

To what extent are individuals able to use the internet and other ICT technologies as sources of information
and tools for mobilization, particularly regarding political and social issues?

To what extent are providers of access to digital technologies required to aid the government in controlling
and monitoring the access of their users?

To what extent are sources of information that are robust and reflect a diversity of viewpoints readily available to citizens, despite government efforts to limit access to certain content?

To what extent do ISPs enjoy equal access to network facilities, at the same rates, terms and conditions as
those utilized by telecommunication companies themselves, for the provision of their own competing ISP
services?

To what extent do national regulatory bodies overseeing digital technology operate in a free, fair, and
independent manner?

To what extent does the constitution or other laws contain provisions designed to protect freedom of expression, including on the internet, and are they enforced?

To what extent does the state censor internet and other ICT content, particularly on political and social
issues?

To what extent is censorship of internet and ICT content transparent, proportional to the stated aims, and
accompanied by an independent appeals process?

To what extent is the content of online sources of information determined or subtly manipulated by the
government or a particular partisan interest?

To what extent is there state surveillance of internet and ICT activities without judicial or other independent oversight, including systematic retention of user traffic data?

To which extent is the interoperability of networks enabling user choice?

Traditional legal framework

Transparency

Voice over IP Allowed

VSAT

What is your economy's policy with regard to standards?

Wireless Local Loop

WTO Telecoms Agreement

XDSL

18.8. Legal Framework - Demand

Any initiatives underway or planned to address retraining or social implications of the Internet on the
workplace (this includes the positive effects of telecommuting, more flexibility and new entrepreneurship as
well as issues of job dislocation)?

Are any studies or agencies gauging the effects of e-commerce on employment - both job creation and
dislocation?

Does your economy support the development of adaptive technologies for electronic commerce, to alleviate
the isolation and increase the independence of people with physical or cognitive disabilities?

Existence of official ICT policy and related strategies in one or more sectors

Explicit Objective

Funding

Government ICT Vision

Government prioritisation of ICT

Government privatisation of ICT

Government procurement of Advanced Technology

Government success in ICT promotion

ICT Trade Policy

Is there a targeted public budget (Universal Service plan) that helps the needy pay for local phone calls,
without creating market distortions?

Is your economy promoting industry self-regulation to address e-commerce policy issues?

Is your economy taking initiatives to raise awareness and disseminate best e-commerce practice among
Small and Medium Enterprises (SMEs)?

Key Linkage

Leadership

Level of effort to promote access for all citizens

National ICT strategy

Number of active or completed Government-sponsored initiatives in ICT with national scope

Participation

Policy

Political will and public support

Priority given by government to promoting the development of an e-society on a national level

Quality of partnerships between industry leaders and government to improve E-Readiness

Support/Suppression/Apathy

To which extent does the government adopt international principles that facilitate the development of
global services, and ensure a level playing field for all providers?

Universal Access

Universal Access Strategy

What is the extent of independent sources of advice to users and consumers?

18.9. Content and Services - Supply

Adherence to the website accessibility guidelines

Adjusted computer services spending by Government per capita

Are there any Secure Electronic Transaction (SET) and/or Secure electronic Commerce Environment (SECE) services offered or undergoing tests?

Availability of e-Government services

Availability of on-line government services for businesses

Availability of online services

B2B Electronic Commerce

B2C Electronic Commerce

BEGIX Index (Balanced e-Government Index)

Business

Business awareness of availability of on-line government services

Contribution of ICT-using services to value added per person engaged e-Business Development

eCommerce Spending Share of GDP

E-commerce

E-Consultation

Effect of telework on work performance

E-Government

E-government availability (supply side)

E-government readiness index

E-government Web Measure Index

E-Information

Employees - Remote working

Enterprises - Internet activities

Enterprises - Remote working

Enterprises practising telework

Enterprises purchasing via Internet and/or networks other than Internet

Enterprises selling via Internet and/or networks other than Internet

Establishments advertising vacancies on the Internet

Extent of demonstrated progress on e-government, including efforts to automate governmental processes,
offer services to business and citizens electronically, and create national portals

Externally Adapted Information

Externally Produced Information

Government

Government Access Penetration

Government online procurement

Health

Higher Ed

Home

How many Internet sites have secure socket layer (SSL) with third party certification (indicator of electronic
commerce)? Secure web servers per 100000 inhabitants:

How often are local websites and/or addresses inaccessible?

ICT Expenditure ($ per capita)

ICT Expenditure as % of GDP

Individuals using the Internet by activity

Internet Banking

Is local content widely available?

Is there a paperless customs environment, in which all documents are transmitted in the form of e-certified
images?

IT Services Spending Share of GDP

K-12

Language

Locally Adapted Information

Locally Developed Information

Locally Relevant Content

Major Internet-using Sectors of the Economy - Commercial

Major Internet-using Sectors of the Economy - Public

Number of Arabized software applications written locally

Number of local web sites and databases with agricultural information and content

On-line availability of government services for citizens

Online Commerce

Online public services for businesses

Online public services for citizens

People and Organizations Online

Percentage of businesses receiving orders over Internet

Percentage of businesses receiving orders over the Internet

Percentage of businesses with a web site

Percentage of enterprises having received orders on-line over the last calendar year

Percentage of enterprises having website/homepage

Percentage of enterprises' total turnover from e-commerce over the last calendar year

Percentage of enterprises with persons employed working part of their time away from enterprise premises
and accessing enterprise's IT systems from there

Percentage of entreprises having received on-line payments for Internet sales over the last calendar year

Percentage of government agencies with online (interactive) services

Percentage of government offices and agencies with a web site

Percentage of health institutions using ICTs (by type of health institution: private clinic, government, university hospital or pharmacy)

Percentage of health professionals using ICTs for medical purposes

Percentage of individuals having ordered/bought goods or services for private use over the Internet in the
last three months

Percentage of individuals having used the Internet in relation to training and educational purposes

Percentage of local web sites and databases with medical information

Percentage of networks and web sites which are attacked, and nature of attacks

Percentage of online government services (of a total number of services)

Percentage of population (aged 16 and over) using Internet to seek health information whether for
themselves or others

Percentage of software developed in local language

Percentage of web sites developed in local languages

Prevalence of evaluation of website accessibility

Priority levels regarding corporate websites accessibility

Proportion of businesses with an extranet

Purpose of student/teacher use (as a percentage for email, research, employment opportunities and software
applications)

Purpose of use

Purpose of use (as a percentage for email, research, database work, geomatics and software applications)

Secure Internet servers (per million people, Dec. 2007)

Secure servers per capita

Secure servers/Internet hosts

Share of businesses participating in e-marketplaces

Share of businesses procuring on-line

Share of businesses selling on-line

Share of establishments involved in "All round e-Commerce"

Size of digital journal collections

Staff providing electronic library services

Telecom Services Spending per Capita

Total Domains

Total ICT Spending, Communications

Total ICT Spending, Construction

Total ICT Spending, Educational Services

Total ICT Spending, Energy and Utilities

Total ICT Spending, Financial Services

Total ICT Spending, Government

Total ICT Spending, Healthcare

Total ICT Spending, Hospitality, Hotels and Leisure

Total ICT Spending, Manufacturing

Total ICT Spending, Natural Resources

Total ICT Spending, Professional Services

Total ICT Spending, Retail Trade

Total ICT Spending, Transportation

Total ICT Spending, Wholesale and Distribution

Total Information and Communications Technology Spending

Value of orders received over the Internet (as a percentage of the total value of orders)

Value of orders received over the Internet (as a percentage of total value of orders)

Volume of governmental information available online (in megabytes)

Volume of local data available online (number of web pages)

Web Measure

Web sites per capita

Website accessibility scale

Website adaptability potential for people with special needs

Working papers available via the Internet

18.10. Content and Services - Demand

Adjusted computer services spending by Business

Attitude towards on-line public services

Attitudes of businesses towards on-line government services

Broadband users

Business preference for using on-line government services

Business use of on-line government services

Businesses' sales to businesses

Businesses' sales to consumers

Citizen experience of using on-line government services

Citizen preference for on-line government services

Citizens access to and use of the Internet

Citizens' awareness of availability of on-line government services

Computer-mediated social communication for R&D purposes

Consumer

Downloads (games, music, films)

Downloads (software)

eBanking

E-Decision-Making

Effect of telework on work location

Effect of telework on working hours

eGovernment by individuals

eGovernment take-up by businesses

E-government usage by enterprises (demand side)

E-government usage by individuals (demand side) total and by gender

eInvoicing

Enterprises using e-Government services

E-participation index

Estimated Internet users

Extent of Business internet use

Female home internet users

Female Internet users as percent of female population

Firm-level technology absorption

Fixed call volume /main line subscribers

Fixed call volume per capita

For which purposes does the business community in your economy use the Internet?

Frequency

Frequency of individual access to the Internet in the last 12 months (response categories)

How does the government use Internet technologies?

Hypothetical removal of Internet access – impact regarding a sense of inclusion

ICT pervasiveness

ICT use and government efficiency

ICTs in Everyday Life

ICTs in the Workplace

Incoming international minutes to mobile network

Incoming Internet Traffic

Incoming telephone traffic

Individuals - Computer use

Individuals - Frequency of computer use

Individuals - Internet activities

Individuals - Internet use

Influence of the Internet on choosing R&D problems

Innovation

Integration into daily routines

International incoming and outgoing fixed telephone traffic (minutes)

International incoming and outgoing total telephone traffic (minutes)

International incoming fixed telephone traffic (minutes)

International incoming total telephone traffic (minutes)

International outgoing fixed telephone traffic (minutes per person)

International outgoing fixed telephone traffic (minutes)

International outgoing total telephone traffic (minutes)

International voice traffic (minutes per person)

Internet Buying as percentage of businesses with 10 or more employees

Internet Dial-up traffic (minutes)

Internet dropouts - Internet home access chum

Internet penetration by size class, 2006. Percentage of businesses with ten or more employees using the
Internet

Internet purchases by individuals

Internet selling and purchasing by industry, 2005

Internet usage for on-line banking

Internet use amongst citizens

Internet users

Internet users (per 1000 people)

Local fixed telephone traffic (minutes)

Major Internet-using Sectors of the Economy - Health

MMS sent

Mobile call volume / Mobile subscribers

Mobile call volume per capita

Mobile data revenues

Mobile e-mail composite (Business users)

Mobile enterprise messaging B2B ARPU

Mobile internet composite (Private users)

National (fixed) trunk telephone traffic (minutes)

National outgoing fixed to mobile traffic (minutes)

On-line communication by the general public with one's own doctor/ clinic

Online purchases

Online User

Outgoing Internet Traffic

Outgoing mobile minutes to fixed networks

Outgoing national mobile minutes

Outgoing telephone traffic

Outgoing/originating mobile minutes to international

Outgoing/originating mobile minutes to other mobile networks

Outgoing/originating mobile minutes to same mobile network

Percent female Internet users

Percentage of businesses placing orders over the Internet

Percentage of businesses with an intranet

Percentage of computer users

Percentage of enterprises having purchased on-line over the last calendar year

Percentage of enterprises using e-learning applications for training and education of employees

Percentage of enterprises using the Internet for interacting with public authorities broken down by purpose

Percentage of heavy intensity Internet users

Percentage of individuals regularly using the Internet

Percentage of individuals using the Internet for interacting with public authorities broken down by purpose
(purposes: obtaining information, obtaining forms, returning filled in forms)

Percentage of individuals using the Internet for specific purposes in the previous three months

Percentage of internet users at home

Population using e-Government services

Proportion of businesses using the Internet by type of activity (response categories)

Proportion of individuals that used the Internet

PSTN, Mobile and VoIP minutes per capita

Purpose

Ratio of corporate data revenue to switched access revenue

Revenue from data services

Revenue from fixed value-added telecommunication services

Revenue from Internet services

Roaming minutes (outside home network)

Roaming minutes by foreign subscribers

Scientists’ access to on-line information sources

Self assessed impacts of on-line purchases

Self-assessed impacts of on-line sales

Share of IP and Ethernet in corporate data revenue

Share of mobile teleworkers

Share of self-employed teleworkers in SOHOs

Share of workforce practising tele-cooperation

SMS Messages per User per Month

SMS sent

Sophistication of Use of the Internet - Individual Use

Sophistication of Use of the Internet - Organizational Use

Supporting existing social contacts via using e-Mail

Take-up by speeds

Telecommunication services: Access to networks (1000)

Telecommunication services: Access to networks (per 100 inhabitants)

Telecommunication services: International calls

Telecommunication services: International receipts and payments

Telecommunication services: SMS (Short message service)

Telecommunication services: Traffic

Telework-enabled labour force participation

Text and multimedia messaging revenues

The type of use of the Internet becomes more sophisticated as consumers grow more confident in electronic
commerce. For which purpose is the Internet used by individual users in your economy?

Time online

Total ICT Spending, Consumer

Typology of usage of ICTs in the agricultural sector (as a percentage for R&D, business, weather and
prices)

Usage of collaboration applications

Usage of Internet-based data collection and data analysis methods

Usage of mobile phones for e-Commerce

Usage of on-line Government Services by citizens

Usage of on-line information sources

Usage of the Internet by the general public to consult with a medical professional/service other than one's
usual doctor

Usage of the Internet by the general public to purchase medications

Usage of the Internet by the general public to search for health-related information

Use of the Internet for job seeking

Users accessing the Internet from different locations

Users according to on-line tenure

Value of purchases and sales by Internet and/or networks other than Internet

What is the estimated number of people who access the Internet per account?

What percent of businesses uses the Internet in your economy?

18.11. Nondigital

8th Grade Achievement in Mathematics

8th Grade Achievement in Science

Adequate Regulations & Supervision Financial Institutions

Adult literacy rates

Age

Aircraft departures thousands

Annual GDP Growth (%)

Are financial institutions allowed to issue credit cards to consumers?

Are there financial limits imposed by government on credit card usage?

Availability of Scientists and Engineers

Availability of specialised training services

Average area covered by a permanent post office (km2)

Average Years of Schooling

Basic Education

Brain Drain

Burden of Government Regulation

Buyer Sophistication

Child Mortality

Citation index

Civil Liberties Score

CO2 Emissions

Combined gross enrolment ratio for primary, secondary and tertiary schools

Company spending on R&D

Composite ICRG Risk Rating

Composite Risk Rating

Control of Corruption

Corruption perception

Corruption Score

Cost to Enforce a Contract (% of Debt)

Cost to Register a Business as % of GNI Per Capita

Daily Newspapers per 1,000 People

Dealing with licenses

Direct to Home satellite antenna subscribers

Does customs operate 24 hours a day, seven days a week?

Does export require physical inspection or declaration?

Does your country have regulatory barriers that restrict the free movement of workers, by setting country-specific requirements and avoiding mutual recognition?

Does your country have regulatory barriers to the free provision of services across borders?

Domestic Credit to Private Sector as % of GDP

Education

Educational level

Effectiveness of Law making bodies

Efficiency of Legal Framework

Electric power transmission and distribution losses

Electricity production

Employment in Industry (%)

Employment in Services (%)

Energy use per capita average annual % growth

English Language

Entrepreneurship

Estimated earned income, female (PPP US$)

Estimated earned income, male (PPP US$)

Ethnic Diversity

Exports of Goods and Services as % of GDP

Extent and Effect of Taxation

Extent of staff Training

Females in Labor Force (% of total labour force)

Financial Market Sophistication

Flexibility of People to Adapt to New Challenges

Foreign Direct Investment Inflows as % of GDP

Foreign Direct Investment Outflows as % of GDP

Foreign investment policy

Foreign trade and exchange regimes

Freedom of press

GDP (current US$ bill)

GDP per Capita (in/nal current $ PPP)

GDP per capita rank (PPP US$)

Gender

Gender Development Index

General Taxation Principles

Geographic Dispersion

GINI Index

GNI per capita, World Bank Atlas method ($)

Government Effectiveness

Gross Capital Formation as % of GDP

Gross enrolment ratios

Has a deminimis level been established?

Have the International Express Carriers Conference Guidelines on handling procedures been adopted and implemented?

Homes passed by multi-channel television

Human Development Index

Human Development Index rank

Identifying Needs

If export requires a declaration, will EDI suffice?

Inflation Rate-CPI in %

Innovation: Patents

Innovation: R&D Spending

Innovation: Trademarks

Intellectual Property protection

Intensity of Local Competition

Interest Rate Spread

International Cost of Living based on $100 US

Involvement in international R&D collaborations

Judicial Independence

Labour Market

Life Expectancy at birth

Loan Market

Local Capacity

Local Competition

Local economic environment

Local Mobilisation

Local supplier quality

Logarithm of electricity consumption per capita

Macroeconomic environment

Manufactures Trade as % of GDP

Market opportunities

MGMT Education Available in first-class Business

Military Expenditure (% of GDP)

National Culture is Open to Foreign Influence

Number of days to enforce a contract

Number of procedures to enforce a contract

Number of procedures to start a business

Number of radio sets

Number of television sets

Number of terrestrial multi-channel television subscribers

Overall political environment

Ownership

Patents Granted by USPTO / Mil. People

Percentage of coauthored scientific articles

Percentage of households with electricity

Percentage of Population 65 Years or Older

Policy toward private enterprise

Population with access to electricity

Postal Service

Poverty Index

Poverty Index rank

Primary education

Property Rights

Proportion of households with a radio

Proportion of households with a television

Proportion of schools with electricity (by ISCED level 1 to 3)33

Protected Areas as % of Surface

Public health expenditure as % of GDP

Public Security

Public Spending on Education as % of GDP

Publications in scientific journals per capita

Pupils per teacher

Purchasing Power

Quality of educational system

Quality of management schools

Quality of math and science education

Quality of public schools

Quality of scientific research institution

Race Diversity

Radio sets per 100 inhabitants

Rail lines total route-km Rail density (km/1,000 km2)

Regulatory Framework

Religiosity

Researchers in R&D

Researchers in R&D / Mil. People

Royalty and License Fees Payments (US$ mil.)

Royalty and License Fees Payments (US$/pop.)

Royalty and License Fees Receipts (US$ mil.)

Royalty and License Fees Receipts (US$/pop.)

Rule of Law

School Enrollment, Secondary, Female (% gross)

School Enrollment, Tertiary, Female (% gross)

Schools

Science and Engineering Enrolment Ratio (%)

Science Enrolment Ratio (%)

Scientific and Technical Journal Articles

Scientific and Technical Journal Articles / Mil. People

Seats in Parliament Held by Women (as % of total)

Secondary education

Secondary gross enrolment ratio

Self Esteem

Social Power

Socio-cultural factors

Socio-Economic Status

Soundness of Banks

State of Cluster Development

Tariff & Nontariff Barriers

Television sets per 100 inhabitants

Tertiary education

Tertiary enrolment

Tertiary gross enrolment ratio

Time required to start a business

To what extent are shipments pre-cleared through EDI, so that shipments are either released or their status
is notified at least two hours before arrival?

Total Employment

Total Expenditure for R&D as % of GNI

Total number of households

Total number of multi-channel television subscribers

Total Population

Total resident population

Total road network km Road density (km/1,000 km2)

Total Royalty Payments and receipts(US$/pop.)

Total Royalty Payments and receipts(US$mil.)

Trade as % of GDP

Transparency and predictability of regulatory implementation, openness of government, rule of law, and
general business risk (e.g., political stability, financial soundness)

Triad patent families per capita

TVs as percent of the population?

Unemployment Rate (% of labour force)

University Education Meets the Needs of Economy

University/Industry Collaboration

Urban Population

US utility patents

Value Chain Presence

Voice and Accountability

Well Educated People Do not Emigrate Abroad

Which description most adequately reflects your distribution environment? (Non-IT Services and Distribution Channels)

Young Population

19. Annex II: Evolution of the UN System related indices

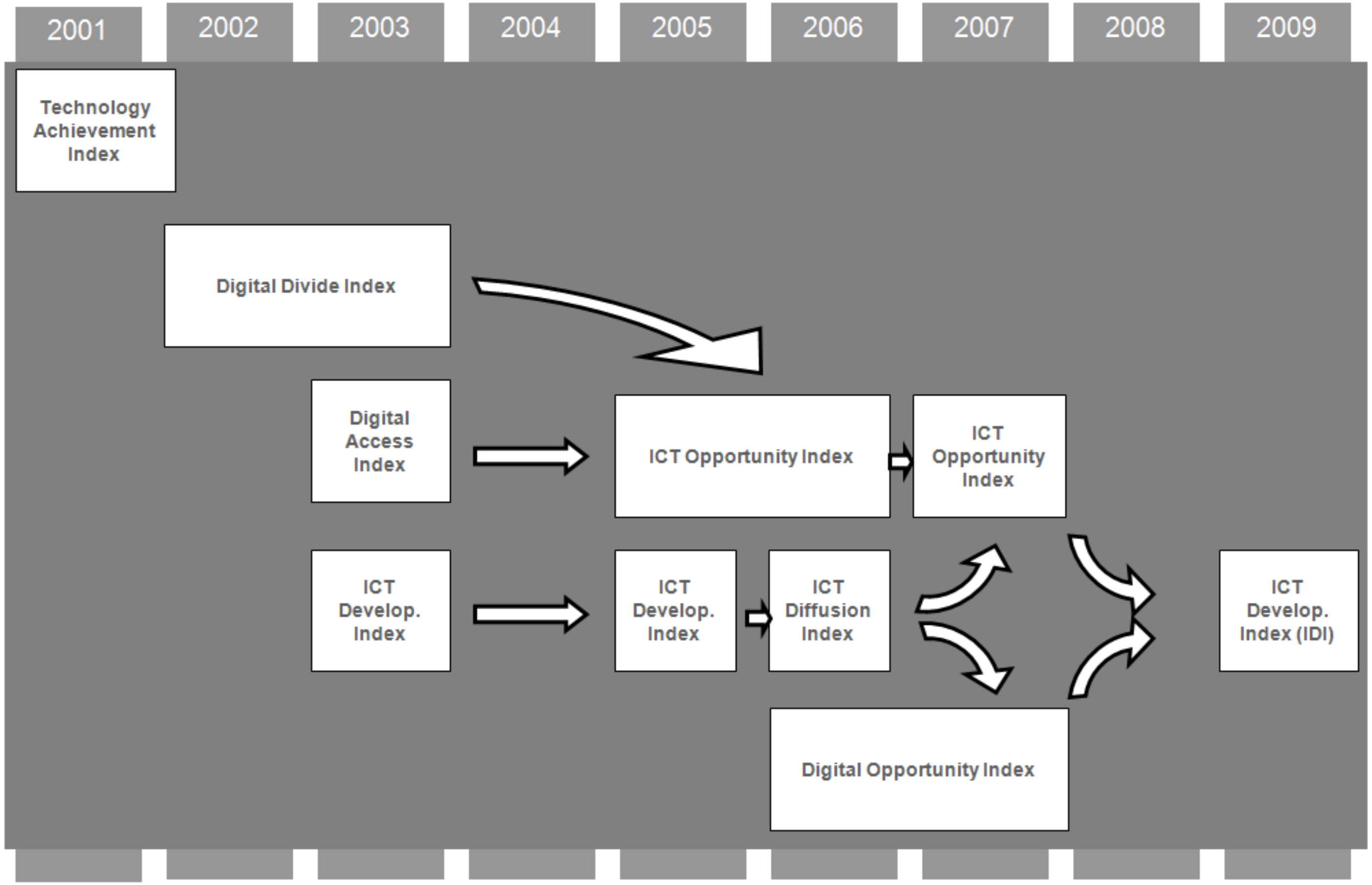

Figure 221: Evolution of the UN System related indices[403]

[403] Please refer to Chapter 7. Dates refer to when the indices were published (year), though work on them might come from earlier years. Note too that though the Digital Divide Index was developed by Orbicom, it was foundamental for later developments of UN indices, thus why its inclusion here.

20. Annex III: Comparison between the Networked Readiness Index (WEF) and the e-Readiness Rankings (EIU)

We stated in section 7.11 about the Networked Readiness Index and the e-Readiness Rankings that "despite their differences, at the aggregate level they are almost the same thing".

We have taken data from 2008 for the NRI and the EIU[404], both the final scores of the indices and the rankings.

Table 25 shows the results of the correlation analysis between the four variables: the NRI Index, the NRI Rank, the EIU Index and the EIU Rank. The numbers clearly show a strongest correlation and at the maximum level of signification.

		NRI Index	NRI Rank	EIU Index	EIU Rank
NRI Index	Pearson Correlation	1			
	Sig. (2-tailed)				
NRI Rank	Pearson Correlation	-,979(**)	1		
	Sig. (2-tailed)	,000			
EIU-Index	Pearson Correlation	,936(**)	-,917(**)	1	
	Sig. (2-tailed)	,000	,000		
EIU Rank	Pearson Correlation	-,935(**)	, 922(**)	-,993(**)	1
	Sig. (2-tailed)	,000	,000	,000	

** Correlation is significant at the 0.01 level (2-tailed).

Table 25: Correlations between the NRI and the EIU (scores and rankings)

As we said, nevertheless, this is at the aggregate level. As Figure 222 and Figure 223 visually show how, taken individually, at the country level, differences matter, with countries having their raking varied even by orders of magnitude[405].

Of course, we agree that "the strong correlations can therefore not just be interpreted as proof of the validity of the bureaucratic quality indicators. All sets of indicators [can] share similar problems and deficiencies" (Van de Walle, 2005).

[404] Dutta et al. (2008) and Economist Intelligence Unit (2008), respectively.

[405] The higher amount of countries analyzed by the NRI makes this changes in order of magnitude (and not by mere units) possible.

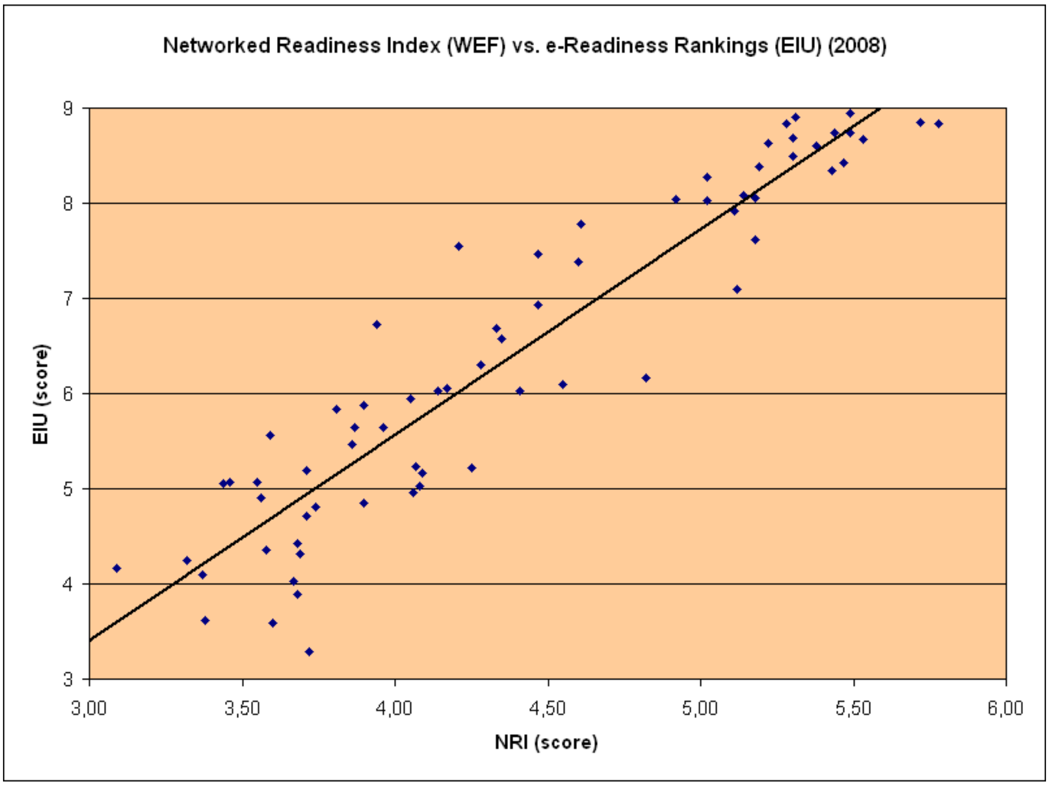

Figure 222: Relationship between the NRI and the EIU (scores)

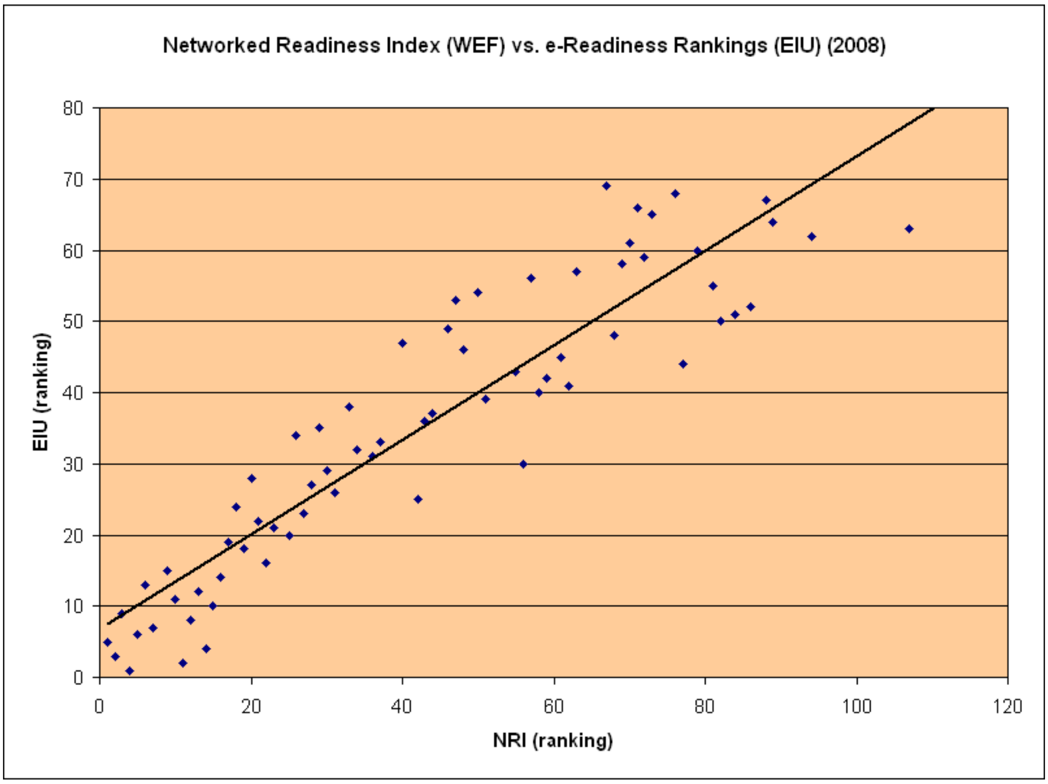

Figure 223: Relationship between the NRI and the EIU (rankings)

These differences are, of course, due to the different methodologies followed to choose the indicators and calculate them. We can see in their compositions that while the EIU is more business centred, the WEF puts more weight on governments and final users. We wonder whehter the reasons for these two slightly different approaches can be explained because of the EIU being designed in a more anglosaxon environment – traditionally more prone towards economic liberalism and the power of markets – and the NRI being born on a (european) continental framework, where the State has had, usually, a higher degree of presence in everyday life.

Countries 2008	NRI (score)	NRI (index)	EIU (score)	EIU (index)
Albania	3.06	108		
Algeria	3.38	88	3.61	67
Angola				
Argentina	3.59	77	5.56	44
Armenia	3.10	106		
Australia	5.28	14	8.83	4
Austria	5.22	15	8.63	10
Azerbaijan	3.72	67	3.29	69
Bahrain	4.13	45		
Bangladesh	2.65	124		
Barbados	4.26	38		
Belgium	4.92	25	8.04	20
Benin	3.01	113		
Bermuda			8.22	17
Bolivia	3.05	111		
Bosnia and Herzegovina	3.22	95		
Botswana	3.59	78		
Brazil	3.87	59	5.65	42
Bulgaria	3.71	68	5.19	48
Burkina Faso	3.12	103		
Burundi	2.46	126		
Cambodia	2.96	115		
Cameroon	2.89	118		
Canada	5.30	13	8.49	12
Chad	2.40	127		
Chile	4.35	34	6.57	32
China	3.90	57	4.85	56
Colombia	3.71	69	4.71	58
Costa Rica	3.87	60		
Croatia	4.06	49		
Cyprus	4.23	41		
Czech Republic	4.33	36	6.68	31
Denmark	5.78	1	8.83	5
Dominican Republic	3.66	75		
Ecuador	3.09	107	4.17	63
Egypt	3.74	63	4.81	57

El Salvador	3.72	66		
Estonia	5.12	20	7.10	28
Ethiopia	2.77	123		
Finland	5.47	6	8.42	13
France	5.11	21	7.92	22
Gambia	3.17	101		
Georgia	3.34	91		
Germany	5.19	16	8.39	14
Ghana				
Greece	3.94	56	6.72	30
Guatemala	3.58	80		
Guyana	3.16	102		
Haiti				
Honduras	3.35	90		
Hong Kong	5.31	11	8.91	2
Hungary	4.28	37	6.30	33
Iceland	5.44	8		
India	4.06	50	4.96	54
Indonesia	3.60	76	3.59	68
Iran			3.18	70
Iraq				
Ireland	5.02	23	8.03	21
Israel	5.18	18	7.61	24
Italy	4.21	42	7.55	25
Jamaica	4.09	46	5.17	49
Japan	5.14	19	8.08	18
Jordan	4.08	47	5.03	53
Kazakhstan	3.68	71	3.89	66
Kenya	3.34	92		
Kuwait	4.01	52		
Kyrgyz Republic	2.99	114		
Latvia	4.14	44	6.03	37
Lesotho	2.79	122		
Libya	3.10	105		
Lithuania	4.41	33	6.03	38
Luxembourg	4.94	24		
Macedonia. FYR	3.49	83		
Madagascar	3.12	104		
Malawi				
Malaysia	4.82	26	6.16	34
Mali	3.17	99		
Malta	4.61	27	7.78	23
Mauritania	3.21	97		
Mauritius	3.96	54		
Mexico	3.90	58	5.88	40
Moldova	3.21	96		
Mongolia	3.43	87		
Morocco	3.67	74		
Mozambique	2.82	121		
Namibia	3.33	93		

Nepal	2.88	119		
Netherlands	5.44	7	8.74	7
New Zealand	5.02	22	8.28	16
Nicaragua	2.95	116		
Nigeria	3.32	94	4.25	62
Norway	5.38	10	8.60	11
Oman	3.97	53		
Pakistan	3.37	89	4.10	64
Panama	3.74	64		
Paraguay	2.87	120		
Peru	3.46	84	5.07	51
Philippines	3.56	81	4.90	55
Poland	3.81	62	5.83	41
Portugal	4.60	28	7.38	27
Puerto Rico	4.25	39		
Qatar	4.42	32		
Romania	3.86	61	5.46	45
Russian Federation	3.68	72	4.42	59
Saudi Arabia	4.07	48	5.23	46
Senegal	3.46	85		
Serbia and Montenegro				
Singapore	5.49	5	8.74	6
Slovak Republic	4.17	43	6.06	36
Slovenia	4.47	30	6.93	29
South Africa	4.05	51	5.95	39
South Korea	5.43	9	8.34	15
Spain	4.47	31	7.46	26
Sri Lanka	3.58	79	4.35	60
Suriname	2.91	117		
Sweden	5.72	2	8.85	3
Switzerland	5.53	3	8.67	9
Syria	3.06	110		
Taiwan	5.18	17	8.05	19
Tajikistan	3.18	98		
Tanzania	3.17	100		
Thailand	4.25	40	5.22	47
Trinidad and Tobago	3.55	82	5.07	50
Tunisia	4.33	35		
Turkey	3.96	55	5.64	43
Uganda	3.06	109		
Ukraine	3.69	70	4.31	61
United Arab Emirates	4.55	29	6.09	35
United Kingdom	5.30	12	8.68	8
United States	5.49	4	8.95	1
Uruguay	3.72	65		
Venezuela	3.44	86	5.06	52
Vietnam	3.67	73	4.03	65
Zambia	3.02	112		
Zimbabwe	2.50	125		

Table 26: NRI and EIU scores and rankings

21. Annex IV: List of indicators and sources of data

21.1. Digital Indicators – Full Set

Cat.	Indicator	Source	Code in this work
Infrastructures - Supply	Broadband subscribers (per 100 people)	World Bank - World Development Indicators	INF_S_01
	Personal computers (per 100 people)	World Bank - World Development Indicators	INF_S_02
	Telephone mainlines (per 100 people)	World Bank - World Development Indicators	INF_S_03
	Telephone subscribers (per 100 people)	World Bank - World Development Indicators	INF_S_04
	Mobile phone subscribers (per 100 people)	World Bank - World Development Indicators	INF_S_05
	Population covered by mobile telephony (%)	World Bank - World Development Indicators	INF_S_06
	International Internet bandwidth (bits per person)	World Bank - World Development Indicators	INF_S_07
	Telephone faults (per 100 mainlines)	World Bank - World Development Indicators	INF_S_08
	Internet Hosts (per 10000 people)	ITU - World Telecommunication Indicators	INF_S_09
	Internet subscribers (per 100 inhabitants)	ITU - World Telecommunication Indicators	INF_S_10
	% of homes with Internet	ITU - World Telecommunication Indicators	INF_S_11
	% of homes with a Personal Computer	ITU - World Telecommunication Indicators	INF_S_12
Infrastructures - Demand	Residential monthly telephone subscription (US$)	ITU - World Telecommunication Indicators	INF_D_01
	Residential telephone connection charge (US$)	ITU - World Telecommunication Indicators	INF_D_02
	Cellular - cost of 3 minute local call (off-peak) (US$)	ITU - World Telecommunication Indicators	INF_D_03
	Cellular - cost of 3 minute local call (peak) (US$)	ITU - World Telecommunication Indicators	INF_D_04
	Cost of a local 3 minute call (off-peak rate) (US$)	ITU - World Telecommunication Indicators	INF_D_05
	Cost of a local 3 minute call (peak rate) (US$)	ITU - World Telecommunication Indicators	INF_D_06
	Price basket for Internet (US$ per month)	World Bank - World Development Indicators	INF_D_07
	Price basket for mobile (US$ per month)	World Bank - World Development Indicators	INF_D_08
	Price basket for residential fixed line (US$ per month)	World Bank - World Development Indicators	INF_D_09
	Telephone average cost of call to US (US$ per three minutes)	World Bank - World Development Indicators	INF_D_10
ICT Sector -	Telecommunications revenue (% GDP)	World Bank - World Development Indicators	ICTSECTOR_S_01
	Computer, communications and other services exports (% of commercial service exports)	World Bank - World Development Indicators	ICTSECTOR_S_02
	Computer, communications and other services imports (% of	World Bank - World Development Indicators	ICTSECTOR_S_03

	commercial service imports)		
	High-technology exports (% of manufactured exports)	World Bank - World Development Indicators	ICTSECTOR_S_04
	High-technology exports (current US$)	World Bank - World Development Indicators	ICTSECTOR_S_05
	Telecommunications investment (% of revenue)	World Bank - World Development Indicators	ICTSECTOR_S_06
	Number of ISPs	CIA Factbook	ICTSECTOR_S_07
ICT Sector - Demand	Telephone subscribers per employee	World Bank - World Development Indicators	ICTSECTOR_D_01
	Telephone employees (per 100 people)	World Bank - World Development Indicators	ICTSECTOR_D_02
	Mobile communications staff (per 100 people)	ITU - World Telecommunication Indicators	ICTSECTOR_D_03
	Total full-time telecommunications staff (per 100 people)	ITU - World Telecommunication Indicators	ICTSECTOR_D_04
	GDP per Telecom Employee (US Dollars)	WITSA Digital Planet	ICTSECTOR_D_06
Digital Literacy - Supply	LiveJournal users (per 100 people)	Nationmaster.com	DIGLIT_S_01
	FaceBook users (per 100 people)	FaceBook	DIGLIT_S_02
	Enrolment in science. Tertiary. (per 100 people)	UNESCO Stats	DIGLIT_S_03
	Enrolment in engineering, manufacturing and construction. Tertiary. (per 100 people)	UNESCO Stats	DIGLIT_S_04
	Enrolment in all programmes. Tertiary. (per 100 people)	UNESCO Stats	DIGLIT_S_05
	Gross enrolment ratio. All levels combined (except pre-primary). (per 100 people)	UNESCO Stats	DIGLIT_S_06
	Human Capital	UN e-Government Readiness Survey	DIGLIT_S_07
Di git -	Total ICT Spending, Educational Services (%GDP)	WITSA Digital Planet	DIGLIT_D_01
	Internet Access in Schools	WEF Executive Opinion Survey	DIGLIT_D_02
Legal Framework - Supply	Laws relating to ICT	WEF Executive Opinion Survey	LEGAL_S_01
	Intellectual property protection	WEF Executive Opinion Survey	LEGAL_S_02
	Level of competition - Local services	ITU World Telecommunication Regulatory Database	LEGAL_S_03
	Level of competition - Wireless local loop	ITU World Telecommunication Regulatory Database	LEGAL_S_04
	Level of competition – Data	ITU World Telecommunication Regulatory Database	LEGAL_S_05
	Level of competition - DSL	ITU World Telecommunication Regulatory Database	LEGAL_S_06
	Level of competition - Cable modem	ITU World Telecommunication Regulatory Database	LEGAL_S_07
	Level of competition - VSAT	ITU World Telecommunication Regulatory Database	LEGAL_S_08
	Level of competition - Leased lines	ITU World Telecommunication Regulatory Database	LEGAL_S_09
	Level of competition - Fixed Wireless Broadband	ITU World Telecommunication Regulatory Database	LEGAL_S_10
	Level of competition - Mobile	ITU World Telecommunication Regulatory Database	LEGAL_S_11
	Level of competition - Fixed sat	ITU World Telecommunication Regulatory Database	LEGAL_S_12
	Level of competition - Mobile sat	ITU World Telecommunication Regulatory Database	LEGAL_S_13
	Level of competition - Internet services	ITU World Telecommunication Regulatory Database	LEGAL_S_14

Legal Framew	Importance of ICT to government vision of the future	WEF Executive Opinion Survey	LEGAL_D_01
	Government success in ICT promotion	WEF Executive Opinion Survey	LEGAL_D_02
	Gov't procurement of advanced tech products	WEF Executive Opinion Survey	LEGAL_D_03
	Government prioritization of ICT	WEF Executive Opinion Survey	LEGAL_D_04
Use - Supply	Secure Internet servers (per 1 million people)	World Bank - World Development Indicators	USE_S_01
	Total Domains (per 100 people)	Webhosting.info	USE_S_02
	Total ICT Spending, Government (% of GDP)	WITSA Digital Planet	USE_S_03
	Total ICT Spending, Retail Trade (% of GDP)	WITSA Digital Planet	USE_S_04
	Web Measure	UN e-Government Readiness Survey	USE_S_05
	Availability of government online services	WEF Executive Opinion Survey	USE_S_06
Use – Demand	International incoming telephone traffic (calls) (per 100 people)	ITU - World Telecommunication Indicators	USE_D_01
	International incoming telephone traffic (minutes) (per 100 people)	ITU - World Telecommunication Indicators	USE_D_02
	International outgoing telephone traffic (calls) (per 100 people)	ITU - World Telecommunication Indicators	USE_D_03
	International outgoing telephone traffic (minutes) (per 100 people)	ITU - World Telecommunication Indicators	USE_D_04
	Total national telephone traffic (calls) (per 100 people)	ITU - World Telecommunication Indicators	USE_D_05
	Total national telephone traffic (minutes) (per 100 people)	ITU - World Telecommunication Indicators	USE_D_06
	Internet users (per 100 people)	World Bank - World Development Indicators	USE_D_07
	E-Participation	UN e-Government Readiness Survey	USE_D_08
	Total ICT Spending, Consumer (% of GDP)	WITSA Digital Planet	USE_D_09
	Firm-level technology absorption	WEF Executive Opinion Survey	USE_D_10
	Extent of business Internet use	WEF Executive Opinion Survey	USE_D_11
	ICT use and government efficiency	WEF Executive Opinion Survey	USE_D_12

Table 27: Digital Indicators for the full set of countries

21.2. Digital Indicators – OECD Set

Cat.	Indicator	Source	Code in this work
OECD Key ICT Indicators	Total communication access paths	OECD Key ICT Indicators	OECD01A1
	Standard analogue access lines	OECD Key ICT Indicators	OECD01A2
	Mobile subscribers	OECD Key ICT Indicators	OECD02A1
	Subscribers using pre-paid cards	OECD Key ICT Indicators	OECD02A2
	Broadband subscribers per 100 inhabitants in OECD countries	OECD Key ICT Indicators	OECD04A1
	Availability of Digital Subscriber Lines (DSL) in OECD countries	OECD Key ICT Indicators	OECD04B1
	Households with access to the Internet in selected OECD countries	OECD Key ICT Indicators	OECD06A1
	Households with access to a home computer	OECD Key ICT Indicators	OECD06B1
	Internet penetration by size class, 2006. Percentage of businesses with ten or more employees using the Internet (10-49)	OECD Key ICT Indicators	OECD07A1
	Internet penetration by size class, 2006. Percentage of businesses with ten or more employees using the Internet (50-249)	OECD Key ICT Indicators	OECD07A2
	Internet penetration by size class, 2006. Percentage of businesses with ten or more employees using the Internet (250-)	OECD Key ICT Indicators	OECD07A3
	Share of ICT-related occupations in the total economy in selected countries, narrow definition	OECD Key ICT Indicators	OECD08A1
	Share of ICT-related occupations in the total economy in selected countries, broad definition	OECD Key ICT Indicators	OECD08B1
	Share of ICT value added in the business sector value added	OECD Key ICT Indicators	OECD10A1
	R&D expenditure in manufacturing industries	OECD Key ICT Indicators	OECD10B1
	R&D expenditure in services industries	OECD Key ICT Indicators	OECD10B2
	R&D expenditure in selected ICT industries (manuf. & services)	OECD Key ICT Indicators	OECD10B3
	Share of ICT employment in business sector employment	OECD Key ICT Indicators	OECD10C1
	ICT-related patents as a percentage of national total (PCT filings)	OECD Key ICT Indicators	OECD11A1
	Share of countries in ICT-related patents filed under the PCT	OECD Key ICT Indicators	OECD11B1
	Trade in ICT goods (USD millions) (exports)	OECD Key ICT Indicators	OECD12A1
	Trade in ICT goods (USD millions) (imports)	OECD Key ICT Indicators	OECD12A2
	Contribution of ICT-using services to value added per person engaged	OECD Key ICT Indicators	OECD14A1
	Contributions of ICT investment to GDP growth	OECD Key ICT Indicators	OECD15A1

Table 28: Digital Indicators for the OECD countries

21.3. Analogue Indicators

Cat.	Indicator	Source	Code in this work
Analogue indicators	Population	World Bank - World Development Indicators	GEN01
	GDP	World Bank - World Development Indicators	GEN02
	GDP Capita	World Bank - World Development Indicators	GEN03
	HDI	UNDP - Human Development Report	GEN04
	Inequality-20	UNDP - Human Development Report	GEN05
	Inequality-10	UNDP - Human Development Report	GEN06
	Urban Population (%)	World Bank - World Development Indicators	GEN07
	Economic Incentive Regime	World Bank - KAM	GEN08
	Innovation	World Bank - KAM	GEN09
	KEI Variation	World Bank - KAM	GEN10
	Gross National Expenditure (% of GDP)	World Bank - World Development Indicators	GEN11
	General Govt. final consumption expenditure (% of GDP)	World Bank - World Development Indicators	GEN12
	Health Public Expenditure (% of govt. expenditure)	World Bank - World Development Indicators	GEN13
	Health Public Expenditure (% of total Health expenditure)	World Bank - World Development Indicators	GEN14
	Total Employment (x1000)	World Bank - World Development Indicators	GEN15t
	Education Public Expenditure (% of GDP)	World Bank - World Development Indicators	GEN16
	Education Public Expenditure (% of govt. expenditure)	World Bank - World Development Indicators	GEN17
	Population growth (annual %)	World Bank - World Development Indicators	GEN19
	Population in urban agglomerations > 1 million (% of total population)	World Bank - World Development Indicators	GEN20
	External debt, total (% of GNI)	World Bank - World Development Indicators	GEN21
	GDP (current US$)	World Bank - World Development Indicators	GEN22
	GDP deflator (base year varies by country)	World Bank - World Development Indicators	GEN23
	GDP growth (annual %)	World Bank - World Development Indicators	GEN24
	GDP per capita, PPP (current international $)	World Bank - World Development Indicators	GEN25
	GDP per capita growth (annual %)	World Bank - World Development Indicators	GEN26
	GNI (current US$)	World Bank - World Development Indicators	GEN27
	GNI per capita, Atlas method (current US$)	World Bank - World Development Indicators	GEN28
	GNI per capita, PPP (current international $)	World Bank - World Development Indicators	GEN29
	Life expectancy at birth, total (years)	World Bank - World Development Indicators	GEN30
	School enrolment, primary (% net)	World Bank - World Development Indicators	GEN31

	School enrolment, primary (% gross)	World Bank - World Development Indicators	GEN32
	Surface area (sq. km)	World Bank - World Development Indicators	GEN33
	Mortality rate, infant (per 1,000 live births)	World Bank - World Development Indicators	GEN34
	Improved water source (% of population with access)	World Bank - World Development Indicators	GEN35
	Gross capital formation (% of GDP)	World Bank - World Development Indicators	GEN36
	Exports of goods and services (% of GDP)	World Bank - World Development Indicators	GEN37
	Exports of goods and services (annual % growth)	World Bank - World Development Indicators	GEN38
	Gross domestic savings (% of GDP)	World Bank - World Development Indicators	GEN39
	Gross savings (% of GDP)	World Bank - World Development Indicators	GEN40
	Interest payments (% of GDP)	World Bank - World Development Indicators	GEN41
	Interest payments (current LCU)	World Bank - World Development Indicators	GEN41B
	Total debt service (% of exports of goods, services and income)	World Bank - World Development Indicators	GEN42
	Total debt service (% of GNI)	World Bank - World Development Indicators	GEN43
	Total debt service (TDS, current US$)	World Bank - World Development Indicators	GEN44
	Present value of debt (% of exports of goods and services)	World Bank - World Development Indicators	GEN45
	Present value of debt (% of GNI)	World Bank - World Development Indicators	GEN46
	Inflation, consumer prices (annual %)	World Bank - World Development Indicators	GEN47
	Inflation, GDP deflator (annual %)	World Bank - World Development Indicators	GEN48
	Central government debt, total (% of GDP)	World Bank - World Development Indicators	GEN49
	General government final consumption expenditure (% of GDP)	World Bank - World Development Indicators	GEN50
	Tax revenue (% of GDP)	World Bank - World Development Indicators	GEN51
	External balance on goods and services (% of GDP)	World Bank - World Development Indicators	GEN52
	Imports of goods and services (% of GDP)	World Bank - World Development Indicators	GEN53

Table 29: Analogue Indicators for the full set of countries

21.4. Countries – Full Set

Afghanistan	Brunei Darussalam	Dominican Republic	Guyana	Lebanon	Namibia	Saint Helena	Tanzania
Albania	Bulgaria	Ecuador	Haiti	Lesotho	Nauru	Saint Pierre and Miquelon	Thailand
Algeria	Burkina Faso	Egypt, Arab Rep.	Heard Island and McDonald Islands	Liberia	Nepal	Samoa	Timor-Leste
American Samoa	Burundi	El Salvador	Holy See	Libya	Netherlands	San Marino	Togo
Andorra	Cambodia	Equatorial Guinea	Honduras	Liechtenstein	Netherlands Antilles	Sao Tome and Principe	Tokelau
Angola	Cameroon	Eritrea	Hong Kong, China	Lithuania	New Caledonia	Saudi Arabia	Tonga
Anguilla	Canada	Estonia	Hungary	Luxembourg	New Zealand	Senegal	Trinidad and Tobago
Antigua and Barbuda	Cape Verde	Ethiopia	Iceland	Macao, China	Nicaragua	Serbia	Tunisia
Argentina	Cayman Islands	Faeroe Islands	India	Macau	Niger	Seychelles	Turkey
Armenia	Central African Republic	Falkland Islands (Islas Malvinas)	Indonesia	Macedonia, FYR	Nigeria	Sierra Leone	Turkmenistan
Aruba	Chad	Faroe Islands	Iran, Islamic Rep.	Madagascar	Niue	Singapore	Tuvalu
Australia	Channel Islands	Fiji	Iraq	Malawi	Norfolk Island	Slovak Republic	Uganda
Austria	Chile	Finland	Ireland	Malaysia	Northern Mariana Islands	Slovenia	Ukraine
Azerbaijan	China	France	Isle of Man	Maldives	Norway	Solomon Islands	United Arab Emirates
Bahamas, The	Chinese Taipei	French Guiana	Israel	Mali	Oman	Somalia	United Kingdom
Bahrain	Christmas Island	French Polynesia	Italy	Malta	Pakistan	South Africa	United States
Bangladesh	Cocos (Keeling) Islands	Gabon	Jamaica	Marshall Islands	Palau	Spain	Uruguay
Barbados	Colombia	Gambia, The	Jan Mayen	Martinique	Panama	Sri Lanka	Uzbekistan
Belarus	Comoros	Georgia	Japan	Mauritania	Papua New Guinea	St. Kitts and Nevis	Vanuatu
Belgium	Congo, Dem. Rep.	Germany	Jersey	Mauritius	Paraguay	St. Lucia	Venezuela, RB

Belize	Congo, Rep.	Ghana	Johnston Atoll	Mayotte	Peru	St. Vincent and the Grenadines	Vietnam
Benin	Cook Islands	Gibraltar	Jordan	Mexico	Philippines	Sudan	Virgin Islands (U.S.)
Bermuda	Costa Rica	Greece	Kazakhstan	Micronesia, Fed. Sts.	Pitcairn Islands	Suriname	Wallis and Futuna
Bhutan	Cote d'Ivoire	Greenland	Kenya	Moldova	Poland	Svalbard	West Bank and Gaza
Bolivia	Croatia	Grenada	Kiribati	Monaco	Portugal	Swaziland	Western Sahara
Bosnia and Herzegovina	Cuba	Guadeloupe	Korea, Dem. Rep.	Mongolia	Puerto Rico	Sweden	Yemen, Rep.
Botswana	Cyprus	Guam	Korea, Rep.	Montenegro	Qatar	Switzerland	Yugoslavia
Bouvet Island	Czech Republic	Guatemala	Kuwait	Montserrat	Reunion	Syrian Arab Republic	Zambia
Brazil	Denmark	Guernsey	Kyrgyz Republic	Morocco	Romania	Taiwan	Zimbabwe
British Indian Ocean Territory	Djibouti	Guinea	Lao PDR	Mozambique	Russian Federation	Tajikistan	
British Virgin Islands	Dominica	Guinea-Bissau	Latvia	Myanmar	Rwanda	Turks and Caicos Islands	

Table 30: List of all countries

21.5. Countries – Simplified Set (WITSA countries)

Algeria	Canada	Finland	Ireland	Mexico	Poland	Spain	United States
Argentina	Chile	France	Israel	Morocco	Portugal	Sri Lanka	Uruguay
Australia	China	Germany	Italy	Netherlands	Romania	Sweden	Venezuela, RB
Austria	Chinese Taipei	Greece	Jamaica	New Zealand	Russian Federation	Switzerland	Vietnam
Bangladesh	Colombia	Honduras	Japan	Nigeria	Saudi Arabia	Thailand	Zimbabwe
Belgium	Costa Rica	Hong Kong, China	Jordan	Norway	Senegal	Tunisia	
Bolivia	Czech Republic	Hungary	Kenya	Pakistan	Singapore	Turkey	
Brazil	Denmark	India	Korea, Rep.	Panama	Slovak Republic	Ukraine	
Bulgaria	Ecuador	Indonesia	Kuwait	Peru	Slovenia	United Arab Emirates	
Cameroon	Egypt, Arab Rep.	Iran, Islamic Rep.	Malaysia	Philippines	South Africa	United Kingdom	

Table 31: List countries in the simplified set (WITSA countries)

21.6. Countries – OECD Set

Australia	Czech Republic	Germany	Italy	Netherlands	Portugal	Switzerland	
Austria	Denmark	Greece	Japan	New Zealand	Slovak Republic	Turkey	
Belgium	Finland	Hungary	Korea, Rep.	Norway	Spain	United Kingdom	
Canada	France	Ireland	Mexico	Poland	Sweden	United States	

Table 32: List countries in the OECD set

22. Annex V: Frequencies of the variables

22.1. Digital Indicators – Full Set: Frequencies

Variables	N Valid	N Missing	Mean	Median	Mode [406]	Std. Deviation	Var.	Min.	Max.	Percentile 25	Percentile 50	Percentile 75
INF_S_01 - Broadband subscribers (per 100 people)	70	5	9.03	3.94	0.00	9.92	98.51	0.00	31.79	0.61	3.94	17.37
INF_S_02 - Personal computers (per 100 people)	74	1	27.19	13.45	0.52	29.23	854.57	0.52	122.10	4.55	13.45	50.89
INF_S_03 - Telephone mainlines (per 100 people)	74	1	27.78	26.09	0.56	19.01	361.23	0.56	67.27	11.13	26.09	42.82
INF_S_04 - Telephone subscribers (per 100 people)	45	30	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01
INF_S_05 - Mobile phone subscribers (per 100 people)	74	1	72.94	79.02	6.29	34.42	1184.93	6.29	136.45	46.06	79.02	102.90
INF_S_06 - Population covered by mobile telephony (%)	56	19	92.26	99.00	99.00	14.97	224.15	30.92	100.00	91.25	99.00	99.48
INF_S_07 - International Internet bandwidth (bits per person)	73	2	3038.31	560.19	1.06	5881.67	34593996.25	1.06	34796.12	70.71	560.19	2844.15
INF_S_08 - Telephone faults (per 100 mainlines)	40	35	11.84	6.20	0.00	23.29	542.66	0.00	145.40	2.60	6.20	12.12
INF_S_09 - Internet Hosts (per 10000 people)	74	1	476.74	59.62	0.00	1001.56	1003116.45	0.00	6645.16	5.40	59.62	395.10
INF_S_10 - Internet subscribers (per 100 inhabitants)	49	26	0.13	0.07	0.00	0.14	0.02	0.00	0.52	0.02	0.07	0.20
INF_S_11 - % of homes with Internet	4	71	47.10	56.50	0.40	32.33	1045.51	0.40	75.00	14.30	56.50	70.50

[406] When multiple modes exist, the smallest value has been chosen

INF_S_12 - % of homes with a Personal Computer	25	50	42.75	46.00	46.00	21.85	477.55	6.07	79.00	26.00	46.00	61.30
INF_D_01 - Residential monthly telephone subscription (US$)	46	29	9.57	6.45	0.86	7.03	49.36	0.86	29.85	4.19	6.45	14.61
INF_D_02 - Residential telephone connection charge (US$)	45	30	73.38	56.79	0.00	50.76	2576.35	0.00	195.18	39.23	56.79	111.94
INF_D_03 - Cellular - cost of 3 minute local call (off-peak) (US$)	14	61	0.45	0.45	0.12	0.29	0.09	0.12	0.97	0.16	0.45	0.71
INF_D_04 - Cellular - cost of 3 minute local call (peak) (US$)	15	60	0.78	0.62	0.12	0.66	0.44	0.12	2.56	0.24	0.62	1.22
INF_D_05 - Cost of a local 3 minute call (off-peak rate) (US$)	0	75										
INF_D_06 - Cost of a local 3 minute call (peak rate) (US$)	46	29	0.13	0.09	0.00	0.17	0.03	0.00	0.99	0.03	0.09	0.17
INF_D_07 - Price basket for Internet (US$ per month)	74	1	14.61	12.05	1.27	9.38	87.95	1.27	38.51	7.19	12.05	22.24
INF_D_08 - Price basket for mobile (US$ per month)	74	1	12.42	10.43	6.88	10.29	105.90	1.17	74.98	5.73	10.43	17.04
INF_D_09 - Price basket for residential fixed line (US$ per month)	56	19	15.83	11.66	2.07	10.44	108.97	2.07	39.51	7.34	11.66	26.07
INF_D_10 - Telephone average cost of call to US (US$ per three minutes)	53	22	1.19	1.02	0.32	0.67	0.45	0.32	3.00	0.71	1.02	1.66
ICTSECTOR_S_01 - Telecommunications revenue (% GDP)	71	4	3.75	3.56	1.42	1.40	1.95	1.42	9.14	2.85	3.56	4.43
ICTSECTOR_S_02 - Computer, communications and other services exports (% of commercial service exports)	65	10	34.59	31.10	6.23	19.95	397.82	6.23	100.00	18.85	31.10	46.82
ICTSECTOR_S_03 - Computer, communications and other	65	10	32.95	31.35	1.62	14.51	210.51	1.62	70.53	22.62	31.35	41.78

services imports (% of commercial service imports)												
ICTSECTOR_S_04 - High-technology exports (% of manufactured exports)	68	7	13.67	8.63	0.11	14.19	201.44	0.11	67.64	4.11	8.63	19.47
ICTSECTOR_S_05 - High-technology exports (current US$)	69	6	24681498461.54	2196436826.00	262997.00	51515405856.03	2653837040511260000000.00	262997.00	2710000000000.00	227596878.50	2196436826.00	23845318150.50
ICTSECTOR_S_06 - Telecommunications investment (% of revenue)	53	22	30.36	16.68	3.81	46.23	2136.89	3.81	267.54	12.44	16.68	27.81
ICTSECTOR_S_07 - Number of ISPs	67	8	0.37	0.11	0.00	0.68	0.46	0.00	2.94	0.04	0.11	0.32
ICTSECTOR_D_01 - Telephone subscribers per employee	45	30	718.11	656.42	187.44	364.09	132564.00	187.44	1849.56	447.08	656.42	885.87
ICTSECTOR_D_02 - Telephone employees (per 100 people)	45	30	0.16	0.13	0.02	0.11	0.01	0.02	0.44	0.06	0.13	0.24
ICTSECTOR_D_03 - Mobile communications staff (per 100 people)	28	47	0.03	0.03	0.00	0.03	0.00	0.00	0.12	0.01	0.03	0.05
ICTSECTOR_D_04 - Total full-time telecommunications staff (per 100 people)	50	25	0.16	0.14	0.01	0.11	0.01	0.01	0.42	0.05	0.14	0.24
ICTSECTOR_D_06 - GDP per Telecom Employee (US Dollars)	75	0	42549.83	21630.31	69.98	42980.45	1847318659.74	69.98	203400.21	9293.54	21630.31	70575.26
DIGLIT_S_01 - LiveJournal users (per 100 people)	58	17	0.12	0.00	0.00	0.75	0.57	0.00	5.75	0.00	0.00	0.01
DIGLIT_S_02 - FaceBook users (per 100 people)	33	42	3.69	1.30	0.01	6.35	40.30	0.01	29.16	0.17	1.30	4.38
DIGLIT_S_03 - Enrolment in science. Tertiary. (per 100 people)	42	33	0.34	0.32	0.02	0.16	0.03	0.02	0.80	0.23	0.32	0.45
DIGLIT_S_04 - Enrolment in engineering, manufacturing and	43	32	0.57	0.46	0.02	0.39	0.15	0.02	2.02	0.36	0.46	0.74

construction. Tertiary. (per 100 people)											
DIGLIT_S_05 - Enrolment in all programmes. Tertiary. (per 100 people)	54	21	3.64	3.56	0.51	1.48	2.18	0.51	6.68	2.85	3.56	4.56
DIGLIT_S_06 - Gross enrolment ratio. All levels combined (except pre-primary). (per 100 people)	53	22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DIGLIT_S_07 - Human Capital	73	2	0.86	0.89	0.99	0.13	0.02	0.39	0.99	0.81	0.89	0.96
DIGLIT_D_01 - Total ICT Spending, Educational Services (%GDP)	75	0	0.00	0.00	0.00	0.01	0.00	0.00	0.05	0.00	0.00	0.00
DIGLIT_D_02 - Internet Access in Schools	73	2	4.17	3.82	3.16	1.28	1.63	1.77	6.35	3.18	3.82	5.24
LEGAL_S_01 - Laws relating to ICT	73	2	4.22	4.01	3.21	1.01	1.01	2.21	6.01	3.38	4.01	5.24
LEGAL_S_02 - Intellectual property protection	73	2	4.22	3.93	3.48	1.23	1.52	1.96	6.48	3.30	3.93	5.44
LEGAL_S_03 - Level of competition - Local services	70	5	3.37	4.00	4.00	1.11	1.22	1.00	4.00	3.00	4.00	4.00
LEGAL_S_04 - Level of competition - Wireless local loop	65	10	3.42	4.00	4.00	1.04	1.09	1.00	4.00	3.00	4.00	4.00
LEGAL_S_05 - Level of competition - Data	70	5	3.84	4.00	4.00	0.47	0.22	1.00	4.00	4.00	4.00	4.00
LEGAL_S_06 - Level of competition - DSL	63	12	3.62	4.00	4.00	0.85	0.72	1.00	4.00	4.00	4.00	4.00
LEGAL_S_07 - Level of competition - Cable modem	48	27	3.79	4.00	4.00	0.65	0.42	1.00	4.00	4.00	4.00	4.00
LEGAL_S_08 - Level of competition - VSAT	66	9	3.79	4.00	4.00	0.60	0.35	1.00	4.00	4.00	4.00	4.00
LEGAL_S_09 - Level of competition - Leased lines	67	8	3.37	4.00	4.00	1.15	1.33	1.00	4.00	3.00	4.00	4.00
LEGAL_S_10 - Level of	51	24	3.51	4.00	4.00	0.92	0.85	1.00	4.00	3.00	4.00	4.00

competition - Fixed Wireless Broadband												
LEGAL_S_11 - Level of competition - Mobile	72	3	3.61	4.00	4.00	0.70	0.49	1.00	4.00	3.00	4.00	4.00
LEGAL_S_12 - Level of competition - Fixed sat	59	16	3.56	4.00	4.00	0.95	0.91	1.00	4.00	4.00	4.00	4.00
LEGAL_S_13 - Level of competition - Mobile sat	55	20	3.49	4.00	4.00	0.98	0.96	1.00	4.00	3.00	4.00	4.00
LEGAL_S_14 - Level of competition - Internet services	69	6	3.90	4.00	4.00	0.30	0.09	3.00	4.00	4.00	4.00	4.00
LEGAL_D_01 - Importance of ICT to government vision of the future	73	2	4.14	4.18	3.73	0.83	0.69	1.97	6.28	3.58	4.18	4.65
LEGAL_D_02 - Government success in ICT promotion	73	2	4.30	4.37	4.07	0.74	0.55	2.63	6.04	3.76	4.37	4.82
LEGAL_D_03 - Gov't procurement of advanced tech products	73	2	3.86	3.79	3.61	0.63	0.40	2.41	5.53	3.43	3.79	4.29
LEGAL_D_04 - Government prioritization of ICT	73	2	4.70	4.79	3.90	0.74	0.54	2.86	6.33	4.21	4.79	5.20
USE_S_01 - Secure Internet servers (per 1 million people)	74	1	126.43	22.84	0.02	204.20	41696.23	0.02	868.01	2.57	22.84	154.83
USE_S_02 - Total Domains (per 100 people)	74	1	2.00	0.32	0.00	4.29	18.38	0.00	25.25	0.08	0.32	1.87
USE_S_03 - Total ICT Spending, Government (% of GDP)	74	1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
USE_S_04 - Total ICT Spending, Retail Trade (% of GDP)	74	1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
USE_S_05 - Web Measure	73	2	0.53	0.54	0.41	0.20	0.04	0.09	1.00	0.41	0.54	0.66
USE_S_06 - Availability of government online services	73	2	4.13	3.99	3.15	1.14	1.29	1.51	6.31	3.23	3.99	5.18
USE_D_01 - International incoming telephone traffic (calls) (per 100 people)	0	75										

USE_D_02 - International incoming telephone traffic (minutes) (per 100 people)	29	46	6051.78	4482.55	0.01	5605.26	31418938.29	0.01	21229.19	2156.94	4482.55	8158.97
USE_D_03 - International outgoing telephone traffic (calls) (per 100 people)	0	75										
USE_D_04 - International outgoing telephone traffic (minutes) (per 100 people)	49	26	8115.58	2474.08	0.00	11888.11	141327092.11	0.00	66117.52	903.59	2474.08	12500.10
USE_D_05 - Total national telephone traffic (calls) (per 100 people)	0	75										
USE_D_06 - Total national telephone traffic (minutes) (per 100 people)	1	74	507901.54	507901.54	507901.54			507901.54	507901.54	507901.54	507901.54	507901.54
USE_D_07 - Internet users (per 100 people)	74	1	31.05	24.80	0.29	23.37	546.07	0.29	89.01	11.52	24.80	47.40
USE_D_08 - E-Participation	73	2	0.32	0.25	0.07	0.26	0.07	0.00	1.00	0.11	0.25	0.47
USE_D_09 - Total ICT Spending, Consumer (% of GDP)	75	0	0.02	0.02	0.01	0.01	0.00	0.01	0.07	0.02	0.02	0.03
USE_D_10 - Firm-level technology absorption	73	2	5.05	5.04	4.18	0.72	0.51	3.20	6.29	4.45	5.04	5.59
USE_D_11 - Extent of business Internet use	73	2	4.38	4.18	4.17	0.91	0.84	2.23	6.12	3.76	4.18	5.14
USE_D_12 - ICT use and government efficiency	73	2	4.49	4.37	5.64	0.82	0.68	2.01	6.14	4.00	4.37	5.18

Table 33: Digital Indicators for the full set of countries: Frequencies

22.2. Digital Indicators – OECD Set

Variables	N Valid	N Missing	Mean	Median	Mode	Std. Deviation	Var.	Min.	Max.	Percentile 25	Percentile 50	Percentile 75
OECD01A1 - Total communication access paths	28	47	144.46	151.50	153.00	27.09	733.74	65.00	178.00	130.50	151.50	164.50
OECD01A2 - Standard analogue access lines	28	47	36.29	38.00	28.00	11.87	140.95	0.00	58.00	28.00	38.00	44.00
OECD02A1 - Mobile subscribers	28	47	91.21	97.00	102.00	18.63	346.92	45.00	122.00	77.50	97.00	102.75
OECD02A2 - Subscribers using pre-paid cards	28	47	45.93	47.00	42.00	29.07	845.18	0.00	111.00	20.50	47.00	72.25
OECD04A1 - Broadband subscribers per 100 inhabitants in OECD countries	28	47	21.01	22.70	23.30	8.88	78.80	4.30	35.10	14.45	22.70	29.38
OECD04B1 - Availability of Digital Subscriber Lines (DSL) in OECD countries	28	47	82.69	90.50	84.00	23.19	537.64	9.00	100.00	84.00	90.50	95.53
OECD06A1 - Households with access to the Internet in selected OECD countries	28	47	56.00	60.95	7.70	20.73	429.80	7.70	94.10	41.60	60.95	70.08
OECD06B1 - Households with access to a home computer	28	47	64.10	68.95	75.40	18.57	345.00	12.20	86.30	53.55	68.95	78.30
OECD07A1 - Internet penetration by size class, 2006. Percentage of businesses with ten or more employees using the Internet (10-49)	24	51	94.33	94.35	93.70	3.37	11.35	84.50	98.80	93.53	94.35	96.48
OECD07A2 - Internet penetration by size class, 2006. Percentage of businesses with ten or more employees using the Internet (50-249)	26	49	98.41	98.90	98.90	2.09	4.37	88.80	99.90	98.33	98.90	99.23
OECD07A3 - Internet	26	49	99.20	99.50	100.00	1.07	1.14	94.90	100.00	99.08	99.50	99.85

penetration by size class, 2006. Percentage of businesses with ten or more employees using the Internet (250-)											
OECD08A1 - Share of ICT-related occupations in the total economy in selected countries, narrow definition	24	51	3.42	3.16	2.77	0.92	0.85	1.71	5.21	2.77	3.16	4.18
OECD08B1 - Share of ICT-related occupations in the total economy in selected countries, broad definition	24	51	21.05	21.26	11.79	3.78	14.29	11.79	28.02	19.36	21.26	23.33
OECD10A1 - Share of ICT value added in the business sector value added	23	52	8.65	7.90	5.00	2.44	5.97	5.00	14.78	7.07	7.90	10.67
OECD10B1 - R&D expenditure in manufacturing industries	19	56	22.56	19.08	5.85	13.96	194.85	5.85	53.11	11.40	19.08	29.47
OECD10B2 - R&D expenditure in services industries	19	56	10.25	9.58	1.70	6.49	42.17	1.70	27.52	5.13	9.58	14.04
OECD10B3 - R&D expenditure in selected ICT industries (manuf. & services)	19	56	32.81	30.62	12.09	15.47	239.39	12.09	70.23	22.40	30.62	36.28
OECD10C1 - Share of ICT employment in business sector employment	23	52	5.74	5.59	2.59	1.71	2.94	2.59	9.80	4.85	5.59	6.33
OECD11A1 - ICT-related patents as a percentage of national total (PCT filings)	25	50	22.41	20.26	10.59	9.91	98.25	10.59	45.05	13.16	20.26	30.21
OECD11B1 - Share of countries in ICT-related patents filed under the PCT	28	47	3.22	0.54	0.02	7.21	51.92	0.01	33.63	0.06	0.54	2.98
OECD12A1 - Trade in ICT goods (USD millions) (exports)	28	47	65.56	14.34	1.67	136.19	18548.69	1.67	585.00	5.02	14.34	54.65
OECD12A2 - Trade in ICT	28	47	31.37	14.30	2.38	46.30	2143.64	2.38	234.85	7.34	14.30	42.38

goods (USD millions) (imports)												
OECD14A1 - Contribution of ICT-using services to value added per person engaged	22	53	0.45	0.37	0.56	0.39	0.15	-0.17	1.29	0.18	0.37	0.60
OECD15A1 - Contributions of ICT investment to GDP growth	19	56	0.55	0.52	0.35	0.15	0.02	0.35	0.92	0.41	0.52	0.64

Table 34: Digital Indicators for the OECD countries: Frequencies

22.3. Analogue Indicators: Frequencies

Variables	N Valid	N Missing	Mean	Median	Mode	Std. Deviation	Var.	Min.	Max.	Percentile 25	Percentile 50	Percentile 75
GEN_01 Population	73	2	76231944.14	21590400.00	2006800.00	200642469.97	40257400757032300.00	2006800.00	1311797692.00	7591900.00	21590400.00	62350275.00
GEN_02 GDP	71	4	654609867491.16	181862000000.00	9185730560.00	1699189421214.31	288724468916662000000000.00	9185730560.00	13163900000000.00	61897428992.00	181862000000.00	394033000000.00
GEN_03 GDP Capita	71	4	17384.41	11984.53	1154.84	13728.65	188475718.45	1154.84	50077.99	6212.19	11984.53	31947.16
GEN_04 HDI	74	1	0.81	0.81	0.73	0.14	0.02	0.43	0.97	0.74	0.81	0.94
GEN_05 Inequality-20	71	4	9.03	7.00	4.90	6.43	41.38	3.40	42.30	4.90	7.00	9.80
GEN_06 Inequality-10	71	4	18.52	12.30	6.90	22.26	495.38	4.50	168.10	7.80	12.30	17.80
GEN_07 Urban Population (%)	74	1	66.64	67.76	67.76	19.65	386.26	15.10	100.00	56.11	67.76	81.04
GEN_08 Economic Incentive Regime	74	1	5.93	6.34	5.39	2.76	7.64	0.29	9.71	3.77	6.34	8.45
GEN_09 Innovation	74	1	6.31	6.33	5.65	2.35	5.51	1.68	9.89	4.07	6.33	8.64

GEN_10 KEI Variation	74	1	-0.23	-1.00	-2.00	7.37	54.37	-21.00	18.00	-3.25	-1.00	4.00
GEN_11 Gross National Expenditure (% of GDP)	63	12	99.45	100.45	68.34	11.59	134.35	68.34	137.44	93.49	100.45	105.40
GEN_12 General Govt. final consumption expenditure (% of GDP)	62	13	15.66	14.52	11.34	5.37	28.79	5.54	26.90	11.34	14.52	19.36
GEN_13 Health Public Expenditure (% of govt. expenditure)	73	2	10.91	11.00	3.50	4.76	22.70	0.70	21.00	7.15	11.00	14.30
GEN_14 Health Public Expenditure (% of total Health expenditure)	73	2	58.00	60.60	71.40	18.48	341.46	17.50	88.60	44.20	60.60	74.85
GEN_15_t - Total Employment (x1000)	75	0	32600.99	7220.96	554.78	102127.81	10430089718.32	554.78	780602.60	2650.86	7220.96	22949.32
GEN_16 Education Public Expenditure (% of GDP)	60	15	4.84	4.73	1.27	1.47	2.17	1.27	8.42	3.77	4.73	5.92
GEN_17 Education Public Expenditure (% of govt. expenditure)	50	25	15.63	13.52	8.48	5.96	35.50	8.48	29.81	11.05	13.52	18.50
GEN19 - Population growth (annual %)	73	2	1.08	1.03	-0.87	0.92	0.84	-0.87	4.17	0.42	1.03	1.65
GEN20 - Population in urban agglomerations > 1 million (% of total population)	66	9	27.23	23.41	4.40	18.97	359.79	4.40	103.34	14.03	23.41	36.08
GEN21 - External debt, total (% of GNI)	43	32	37.46	33.85	5.20	20.25	410.07	5.20	102.73	24.75	33.85	49.01
GEN22 - GDP (current US$)	73	2	716142808611.07	180713914368.00	10739448832.00	1775978585720.25	3154099936936880000000000.00	10739448832.00	13811200294912.00	74103545856.00	180713914368.00	446501486592.00
GEN23 - GDP deflator (base year varies by country)	72	3	2411.08	136.38	92.06	18489.15	341848689.16	92.06	157091.16	116.49	136.38	201.36

GEN24 - GDP growth (annual %)	72	3	5.30	5.28	1.30	2.44	5.94	1.30	11.90	3.29	5.28	6.87
GEN25 - GDP per capita, PPP (current international $)	72	3	18888.07	13012.03	1242.18	14693.66	215903611.17	1242.18	53332.47	6574.11	13012.03	33349.01
GEN26 - GDP per capita growth (annual %)	72	3	4.17	3.97	0.76	2.42	5.86	0.76	11.21	2.12	3.97	5.44
GEN27 - GNI (current US$)	72	3	724049438414.22	197000000000.00	1490000000.00	1791517270871.40	3209534131830520000000000.00	9962247168.00	1380000000000.00	72290957312.00	1970000000.00	4552500000.00
GEN28 - GNI per capita, Atlas method (current US$)	71	4	17088.87	7320.00	470.00	18477.86	341431310.14	470.00	76450.00	2850.00	7320.00	32470.00
GEN29 - GNI per capita, PPP (current international $)	71	4	18277.89	12580.00	1340.00	14361.33	206247896.90	1340.00	53320.00	5990.00	12580.00	33340.00
GEN30 - Life expectancy at birth, total (years)	73	2	73.59	74.83	46.78	7.48	55.90	46.78	82.32	71.07	74.83	79.36
GEN31 - School enrolment, primary (% net)	60	15	92.94	95.30	63.42	7.65	58.50	63.42	99.88	90.43	95.30	97.90
GEN32 - School enrolment, primary (% gross)	67	8	104.64	104.32	79.84	8.52	72.67	79.84	136.87	98.88	104.32	109.93
GEN33 - Surface area (sq. km)	73	2	1354469.99	323800.00	699.00	2953324.71	8722126858902.07	699.00	17098240.00	86325.00	323800.00	962610.00
GEN34 - Mortality rate, infant (per 1,000 live births)	72	3	19.08	11.04	2.31	21.52	462.97	2.31	98.60	4.19	11.04	23.41
GEN35 - Improved water source (% of population with access)	61	14	92.97	97.00	100.00	10.41	108.40	47.00	100.00	89.50	97.00	100.00
GEN36 - Gross capital formation (% of GDP)	63	12	24.26	22.56	13.48	5.73	32.81	13.48	44.40	20.85	22.56	27.04
GEN37 - Exports of goods and services (% of GDP)	65	10	48.43	39.36	12.85	37.06	1373.16	12.85	230.91	27.61	39.36	57.72
GEN38 - Exports of goods	58	17	8.05	7.41	-12.11	5.83	34.01	-12.11	27.02	5.36	7.41	11.65

and services (annual % growth)											
GEN39 - Gross domestic savings (% of GDP)	63	12	24.13	23.28	-8.75	11.41	130.22	-8.75	59.11	17.43	23.28	29.05
GEN40 - Gross savings (% of GDP)	57	18	23.97	23.15	10.23	7.87	61.94	10.23	53.80	19.07	23.15	28.15
GEN41 - Interest payments (% of GDP)	56	19	186.49	0.02	0.00	1384.00	1915457.51	0.00	10358.26	0.02	0.02	0.05
GEN41B - Interest payments (current LCU)	51	24	995262279779.09	26741000000.00	13000000.00	4389658741796.27	19269103869428400000000000.00	13000000.00	29643700000000.00	4147660000.00	26741000000.00	112766608000.00
GEN42 - Total debt service (% of exports of goods, services and income)	37	38	17.12	13.31	2.49	15.23	231.92	2.49	87.76	7.20	13.31	22.07
GEN43 - Total debt service (% of GNI)	43	32	7.10	5.43	1.04	6.45	41.65	1.04	30.29	2.79	5.43	8.85
GEN44 - Total debt service (TDS, current US$)	43	32	12059458046.51	5472200000.00	202197000.00	15782172547.51	249076970319289000000.00	202197000.00	62144534000.00	957927000.00	5472200000.00	14685762000.00
GEN45 - Present value of debt (% of exports of goods and services)	43	32	89.84	87.00	10.15	50.93	2593.80	10.15	230.16	48.48	87.00	123.04
GEN46 - Present value of debt (% of GNI)	43	32	39.69	34.43	3.86	23.53	553.68	3.86	99.55	22.43	34.43	57.92
GEN47 - Inflation, consumer prices (annual %)	72	3	4.98	3.62	0.06	3.92	15.39	0.06	18.70	2.18	3.62	7.47
GEN48 - Inflation, GDP deflator (annual %)	71	4	5.09	3.78	-3.83	4.44	19.68	-3.83	21.51	2.37	3.78	7.78
GEN49 - Central government debt, total (% of GDP)	33	42	57.05	49.00	21.99	26.36	694.85	21.99	140.09	40.85	49.00	70.12
GEN50 - General government final consumption expenditure	70	5	15.11	14.21	5.00	5.48	30.00	5.00	28.05	10.99	14.21	18.62

(% of GDP)												
GEN51 - Tax revenue (% of GDP)	60	15	18.46	17.26	0.82	6.91	47.81	0.82	34.18	13.90	17.26	22.82
GEN52 - External balance on goods and services (% of GDP)	65	10	0.16	-0.82	-35.13	11.63	135.16	-35.13	40.22	-6.05	-0.82	5.60
GEN53 - Imports of goods and services (% of GDP)	65	10	48.27	38.91	10.67	34.50	1190.52	10.67	202.05	28.62	38.91	61.06

Table 35: Analogue Indicators for the full set of countries: Frequencies

23. Annex VI: Correlation Tables

23.1. Digital Indicators – Full Set

	INF_S_01	INF_S_02	INF_S_03	INF_S_04	INF_S_05	INF_S_06	INF_S_07	INF_S_08	INF_S_09	INF_S_10	INF_S_11	INF_S_12	INF_D_01	INF_D_02	INF_D_03	INF_D_04	INF_D_06	INF_D_07	INF_D_08	INF_D_09	INF_D_10	ICTSECTOR_S_01	ICTSECTOR_S_02	ICTSECTOR_S_03	ICTSECTOR_S_04
INF_S_01	1.000	0.889	0.862	0.086	0.632	0.443	0.693	-0.125	0.615	0.886	0.982	0.918	0.683	0.113	-0.149	0.009	-0.037	0.345	0.163	0.696	-0.441	-0.258	0.354	0.360	0.329
INF_S_02	0.889	1.000	0.829	0.107	0.585	0.400	0.620	-0.207	0.632	0.812	0.938	0.931	0.738	0.093	0.006	0.142	-0.061	0.245	0.177	0.693	-0.511	-0.290	0.384	0.369	0.385
INF_S_03	0.862	0.829	1.000	0.080	0.694	0.501	0.555	-0.261	0.521	0.780	0.979	0.794	0.736	0.041	-0.141	0.047	0.191	0.227	0.217	0.703	-0.547	-0.294	0.212	0.331	0.321
INF_S_04	0.086	0.107	0.080	1.000	0.399	0.258	0.206	-0.209	-0.081	0.033	1.000	0.291	0.065	0.065	-0.239	-0.184	0.059	0.194	0.195	0.082	-0.215	0.250	0.080	-0.194	0.014
INF_S_05	0.632	0.585	0.694	0.399	1.000	0.549	0.464	-0.270	0.303	0.599	0.935	0.659	0.573	0.059	-0.115	0.078	0.215	0.267	0.275	0.633	-0.549	-0.023	0.117	0.303	0.189
INF_S_06	0.443	0.400	0.501	0.258	0.549	1.000	0.279	0.148	0.218	0.367	0.766	0.442	0.499	0.135	0.172	0.255	0.198	0.174	0.232	0.446	-0.136	0.207	-0.068	-0.041	0.121
INF_S_07	0.693	0.620	0.555	0.206	0.464	0.279	1.000	-0.144	0.503	0.796	0.850	0.745	0.556	0.193	-0.142	-0.069	-0.011	0.222	0.025	0.471	-0.367	-0.201	0.211	0.265	0.198
INF_S_08	-0.125	-0.207	-0.261	-0.209	-0.270	0.148	-0.144	1.000	-0.039	-0.220	-1.000	-0.503	0.088	-0.007	0.507	0.576	0.111	0.002	0.013	-0.033	0.580	0.147	-0.254	-0.157	-0.147
INF_S_09	0.615	0.632	0.521	-0.081	0.303	0.218	0.503	-0.039	1.000	0.790	0.844	0.755	0.637	0.091	0.520	0.618	-0.060	0.136	0.050	0.473	-0.300	-0.230	0.229	0.203	0.288
INF_S_10	0.886	0.812	0.780	0.033	0.599	0.367	0.796	-0.220	0.790	1.000	0.941	0.858	0.754	0.272	0.096	0.259	-0.007	0.234	0.131	0.585	-0.528	-0.349	0.355	0.520	0.394
INF_S_11	0.982	0.938	0.979	1.000	0.935	0.766	0.850	-1.000	0.844	0.941	1.000	0.997	0.839	0.977	.(a)	.(a)	-0.236	-0.520	-0.540	-1.000	-0.938	-0.915	0.582	0.077	0.515
INF_S_12	0.918	0.931	0.794	0.291	0.659	0.442	0.745	-0.503	0.755	0.858	0.997	1.000	0.672	0.685	-1.000	1.000	0.017	0.399	0.086	0.739	-0.591	-0.666	0.649	0.426	0.541
INF_D_01	0.683	0.738	0.736	0.065	0.573	0.499	0.556	0.088	0.637	0.754	0.839	0.672	1.000	0.334	0.086	0.211	0.154	0.316	0.294	0.911	-0.505	-0.308	0.239	0.431	0.447
INF_D_02	0.113	0.093	0.041	0.065	0.059	0.135	0.193	-0.007	0.091	0.272	0.977	0.685	0.334	1.000	0.364	0.182	0.016	0.326	0.184	0.364	0.142	-0.259	0.217	0.070	0.108
INF_D_03	-0.149	0.006	-0.141	-0.239	-0.115	0.172	-0.142	0.507	0.520	0.096	.(a)	-1.000	0.086	0.364	1.000	0.936	0.082	0.053	0.672	0.569	-0.252	-0.015	-0.083	0.295	-0.409
INF_D_04	0.009	0.142	0.047	-0.184	0.078	0.255	-0.069	0.576	0.618	0.259	.(a)	1.000	0.211	0.182	0.936	1.000	0.000	-0.003	0.640	0.712	-0.225	-0.031	-0.182	0.181	-0.269
INF_D_06	-0.037	-0.061	0.191	0.059	0.215	0.198	-0.011	0.111	-0.060	-0.007	-0.236	0.017	0.154	0.016	0.082	0.000	1.000	-0.029	0.093	0.219	-0.060	-0.047	-0.093	0.042	-0.087
INF_D_07	0.345	0.245	0.227	0.194	0.267	0.174	0.222	0.002	0.136	0.234	-0.520	0.399	0.316	0.326	0.053	-0.003	-0.029	1.000	0.244	0.468	-0.221	-0.006	-0.015	0.051	0.003
INF_D_08	0.163	0.177	0.217	0.195	0.275	0.232	0.025	0.013	0.050	0.131	-0.540	0.086	0.294	0.184	0.672	0.640	0.093	0.244	1.000	0.646	-0.330	0.024	0.042	-0.078	-0.035
INF_D_09	0.696	0.693	0.703	0.082	0.633	0.446	0.471	-0.033	0.473	0.585	-1.000	0.739	0.911	0.364	0.569	0.712	0.219	0.468	0.646	1.000	-0.340	-0.186	0.211	0.391	0.231
INF_D_10	-0.441	-0.511	-0.547	-0.215	-0.549	-0.136	-0.367	0.580	-0.300	-0.528	-0.938	-0.591	-0.505	0.142	-0.252	-0.225	-0.060	-0.221	-0.330	-0.340	1.000	0.021	-0.090	-0.315	-0.183
ICTSECTOR_S_01	-0.258	-0.290	-0.294	0.250	-0.023	0.207	-0.201	0.147	-0.230	-0.349	-0.915	-0.666	-0.308	-0.259	-0.015	-0.031	-0.047	-0.006	0.024	-0.186	0.021	1.000	-0.440	-0.282	-0.254
ICTSECTOR_S_02	0.354	0.384	0.212	0.080	0.117	-0.068	0.211	-0.254	0.229	0.355	0.582	0.649	0.239	0.217	-0.083	-0.182	-0.093	-0.015	0.042	0.211	-0.090	-0.440	1.000	0.676	0.224

ICTSECTOR_S_03	0.360	0.369	0.331	-0.194	0.303	-0.041	0.265	-0.157	0.203	0.520	0.077	0.426	0.431	0.070	0.295	0.181	0.042	0.051	-0.078	0.391	-0.315	-0.282	0.676	1.000	0.174
ICTSECTOR_S_04	0.329	0.385	0.321	0.014	0.189	0.121	0.198	-0.147	0.288	0.394	0.515	0.541	0.447	0.108	-0.409	-0.269	-0.087	0.003	-0.035	0.231	-0.183	-0.254	0.224	0.174	1.000
ICTSECTOR_S_05	0.330	0.362	0.402	-0.357	0.100	0.174	0.121	-0.075	0.428	0.304	0.271	0.396	0.466	0.025	-0.234	-0.138	-0.138	0.007	0.008	0.279	0.076	-0.182	0.251	0.142	0.529
ICTSECTOR_S_06	-0.273	-0.280	-0.361	-0.259	-0.334	-0.257	-0.145	0.287	-0.167	-0.171	0.843	-0.074	-0.271	-0.104	-0.344	-0.451	-0.075	-0.186	-0.103	-0.228	0.175	0.021	0.139	0.037	0.424
ICTSECTOR_S_07	0.309	0.364	0.406	-0.124	0.294	0.224	0.214	-0.033	0.433	0.237	0.297	0.170	0.346	0.105	0.456	0.174	-0.073	0.099	0.064	0.297	-0.275	0.027	-0.072	0.028	0.022
ICTSECTOR_D_01	-0.116	-0.076	-0.048	-0.136	0.046	-0.253	-0.175	-0.280	-0.149	-0.058	1.000	-0.062	-0.075	0.062	0.388	0.324	0.075	-0.115	-0.040	0.083	-0.224	0.035	0.152	0.266	0.169
ICTSECTOR_D_02	0.669	0.687	0.732	0.261	0.716	0.463	0.565	-0.127	0.534	0.638	-1.000	0.717	0.611	0.148	-0.367	-0.215	0.178	0.268	0.257	0.575	-0.303	-0.194	0.242	0.090	0.269
ICTSECTOR_D_03	0.373	0.479	0.484	0.424	0.659	0.410	0.371	0.148	0.348	0.596	.(a)	0.443	0.557	0.288	-0.004	0.042	0.067	0.205	0.628	0.652	-0.501	-0.210	0.291	-0.011	0.377
ICTSECTOR_D_04	0.697	0.693	0.759	0.350	0.720	0.509	0.496	-0.184	0.527	0.636	0.994	0.661	0.738	0.254	0.087	0.164	0.065	0.289	0.268	0.720	-0.447	-0.301	0.358	0.270	0.143
ICTSECTOR_D_06	0.724	0.726	0.726	0.282	0.618	0.407	0.535	-0.146	0.525	0.706	0.996	0.843	0.706	0.255	0.175	0.285	0.129	0.330	0.594	0.861	-0.485	-0.382	0.404	0.257	0.289
DIGLIT_S_01	0.058	0.074	0.103	-0.211	0.061	0.071	-0.041	-0.001	-0.015	0.065	0.193	-0.029	0.007	0.095	0.555	0.363	0.023	0.068	-0.024	0.096	-0.129	-0.039	-0.047	0.122	-0.079
DIGLIT_S_02	-0.105	-0.069	-0.061	-0.312	-0.154	-0.042	-0.063	0.070	-0.042	0.015	1.000	-0.097	-0.070	-0.014	0.587	0.555	-0.035	-0.045	0.152	0.054	0.208	-0.075	-0.305	-0.199	-0.105
DIGLIT_S_03	0.404	0.464	0.487	0.199	0.369	0.421	0.164	-0.102	0.327	0.302	0.642	0.629	0.537	0.176	0.228	0.509	0.057	0.257	-0.005	0.372	-0.040	-0.212	0.170	0.147	0.394
DIGLIT_S_04	0.298	0.078	0.272	0.217	0.280	0.356	-0.119	0.509	-0.048	0.016	0.862	0.033	-0.154	-0.026	-0.417	-0.267	0.103	0.151	-0.180	-0.048	-0.116	0.141	0.137	0.114	0.162
DIGLIT_S_05	0.406	0.334	0.483	-0.008	0.481	0.392	0.114	0.246	0.327	0.313	0.893	0.386	0.303	0.107	-0.031	0.214	0.279	0.250	-0.127	0.412	-0.160	0.053	-0.047	0.165	0.103
DIGLIT_S_06	0.157	0.207	0.197	0.841	0.300	0.229	0.158	-0.144	0.086	0.233	0.634	0.230	0.306	0.157	0.285	0.508	-0.036	0.280	0.276	0.279	-0.289	-0.077	0.057	0.002	-0.077
DIGLIT_S_07	0.628	0.586	0.747	0.079	0.688	0.569	0.352	-0.202	0.389	0.532	0.968	0.689	0.569	0.115	-0.084	0.105	0.142	0.155	0.256	0.598	-0.380	-0.194	-0.010	0.212	0.285
DIGLIT_D_01	-0.092	-0.073	-0.152	-0.098	-0.223	0.102	-0.052	-0.007	-0.048	-0.129	-0.958	-0.200	-0.183	-0.116	0.062	-0.045	-0.029	-0.153	-0.112	-0.137	0.118	0.082	-0.081	0.026	-0.108
DIGLIT_D_02	0.864	0.826	0.812	0.284	0.708	0.419	0.572	-0.302	0.561	0.780	0.996	0.837	0.687	0.111	-0.210	0.020	-0.050	0.203	0.136	0.583	-0.544	-0.271	0.293	0.387	0.442
LEGAL_S_01	0.825	0.793	0.783	0.112	0.632	0.392	0.562	-0.155	0.537	0.764	0.997	0.892	0.681	0.077	-0.124	0.106	-0.080	0.208	0.088	0.629	-0.591	-0.273	0.259	0.393	0.470
LEGAL_S_02	0.832	0.812	0.780	0.190	0.597	0.356	0.584	-0.190	0.551	0.813	0.994	0.878	0.713	0.104	0.115	0.298	-0.011	0.264	0.187	0.709	-0.556	-0.255	0.269	0.372	0.402
LEGAL_S_03	0.357	0.222	0.265	-0.069	0.255	0.099	0.241	0.125	0.231	0.307	.(a)	0.583	0.435	0.125	0.050	0.114	0.214	0.180	0.004	0.418	-0.258	-0.057	0.185	0.332	0.176
LEGAL_S_04	0.391	0.329	0.283	-0.068	0.258	0.104	0.209	0.125	0.225	0.330	-0.204	0.424	0.392	0.125	0.460	0.375	0.060	0.036	0.191	0.328	-0.120	0.001	0.239	0.289	0.148
LEGAL_S_05	0.246	0.148	0.071	-0.264	0.160	0.112	0.144	0.109	0.155	0.219	.(a)	.(a)	0.225	-0.007	0.444	0.353	0.117	0.165	0.050	0.241	-0.188	0.144	-0.029	0.148	-0.178
LEGAL_S_06	0.349	0.288	0.277	-0.036	0.274	0.134	0.214	-0.482	0.201	0.288	.(a)	0.285	0.256	0.057	0.439	0.341	0.111	0.031	0.159	0.214	-0.188	-0.058	0.309	0.327	0.029
LEGAL_S_07	0.301	0.243	0.286	-0.047	0.147	0.097	0.183	0.133	0.171	0.199	.(a)	.(a)	0.455	-0.062	0.513	0.389	0.006	0.015	0.181	0.110	-0.090	-0.165	0.153	0.216	0.108
LEGAL_S_08	0.297	0.152	0.166	-0.418	0.161	0.116	0.150	0.118	0.162	0.150	.(a)	.(a)	0.240	-0.052	0.257	0.230	0.154	0.019	-0.313	0.195	-0.134	0.118	-0.059	0.271	-0.070
LEGAL_S_09	0.353	0.172	0.243	-0.158	0.254	0.060	0.213	0.092	0.219	0.256	-0.204	0.277	0.355	0.021	0.439	0.341	0.180	0.008	-0.001	0.324	-0.042	-0.027	0.070	0.266	0.159
LEGAL_S_10	0.318	0.253	0.200	-0.311	0.143	0.020	0.131	0.149	0.195	0.253	-0.697	0.282	0.275	-0.022	0.462	0.335	0.160	0.085	-0.141	0.345	-0.065	0.082	0.130	0.381	0.017
LEGAL_S_11	0.219	0.211	0.115	-0.245	0.114	0.109	0.075	0.002	0.151	0.153	-0.575	0.336	0.188	-0.045	0.444	0.353	0.026	0.056	-0.241	0.137	-0.308	-0.065	0.093	0.255	-0.026
LEGAL_S_12	0.402	0.317	0.327	-0.137	0.422	0.511	0.239	0.210	0.237	0.297	.(a)	.(a)	0.453	-0.131	0.666	0.489	0.223	0.121	0.015	0.373	-0.389	0.140	-0.050	0.338	-0.120
LEGAL_S_13	0.395	0.320	0.250	-0.154	0.287	0.428	0.232	0.231	0.247	0.259	.(a)	0.117	0.402	0.002	0.666	0.489	0.079	0.088	-0.055	0.303	-0.278	0.061	0.092	0.317	-0.051
LEGAL_S_14	0.262	0.155	0.140	-0.346	0.146	0.087	0.148	0.091	0.159	0.197	.(a)	.(a)	0.233	-0.143	0.339	0.274	0.069	0.226	-0.052	0.228	-0.142	0.199	-0.103	0.154	-0.003

LEGAL_D_01	0.481	0.439	0.410	0.241	0.383	0.127	0.365	-0.064	0.305	0.472	0.641	0.595	0.358	0.031	-0.417	-0.255	-0.133	0.140	-0.084	0.251	-0.265	-0.129	0.215	0.262	0.399
LEGAL_D_02	0.454	0.455	0.364	0.231	0.297	0.086	0.367	-0.048	0.325	0.469	0.366	0.618	0.304	-0.043	-0.314	-0.274	-0.169	0.044	-0.092	0.188	-0.277	-0.074	0.288	0.289	0.383
LEGAL_D_03	0.614	0.634	0.554	0.129	0.433	0.215	0.402	-0.003	0.444	0.617	0.904	0.723	0.442	-0.032	-0.358	-0.197	-0.154	0.069	-0.029	0.298	-0.297	-0.154	0.317	0.364	0.489
LEGAL_D_04	0.526	0.506	0.450	0.267	0.386	0.113	0.429	-0.132	0.375	0.531	0.840	0.634	0.369	0.054	-0.347	-0.191	-0.164	0.119	-0.086	0.266	-0.367	-0.099	0.268	0.235	0.377
USE_S_01	0.769	0.825	0.738	0.016	0.412	0.294	0.638	-0.099	0.815	0.806	0.979	0.836	0.757	0.128	0.375	0.464	-0.055	0.203	0.112	0.674	-0.363	-0.279	0.263	0.250	0.340
USE_S_02	0.578	0.581	0.584	-0.009	0.359	0.216	0.472	-0.072	0.627	0.647	0.751	0.760	0.467	-0.098	-0.164	-0.062	-0.153	0.028	-0.026	0.341	-0.429	-0.170	0.140	0.035	0.180
USE_S_03	0.124	0.180	0.078	0.182	-0.047	0.166	0.103	0.017	0.332	0.006	-0.923	-0.348	0.207	-0.151	0.105	-0.010	-0.023	-0.039	0.075	0.060	-0.015	0.309	0.018	-0.092	0.003
USE_S_04	0.128	0.074	0.041	-0.024	0.025	0.023	0.145	0.181	0.132	0.044	-0.448	-0.295	0.089	-0.077	0.336	0.329	0.029	0.139	-0.111	0.115	-0.104	0.265	-0.235	-0.162	-0.106
USE_S_05	0.743	0.700	0.705	0.033	0.556	0.374	0.531	-0.209	0.605	0.660	0.987	0.793	0.622	0.254	-0.359	-0.136	-0.045	0.242	0.127	0.629	-0.452	-0.210	0.176	0.249	0.400
USE_S_06	0.736	0.710	0.707	0.064	0.575	0.289	0.549	-0.140	0.517	0.703	0.999	0.777	0.672	0.044	-0.117	0.075	-0.039	0.251	0.054	0.578	-0.529	-0.290	0.172	0.367	0.455
USE_D_02	0.488	0.456	0.467	0.186	0.470	0.253	0.616	-0.267	0.268	0.818	1.000	0.785	0.429	-0.131	0.557	0.785	-0.242	0.400	0.195	0.410	-0.274	-0.188	-0.233	0.130	-0.153
USE_D_04	0.407	0.518	0.518	0.469	0.473	0.212	0.300	-0.169	0.240	0.471	0.993	0.662	0.349	-0.005	0.219	0.231	0.060	0.026	0.185	0.461	-0.205	-0.340	0.430	0.352	0.211
USE_D_07	0.873	0.822	0.809	0.129	0.632	0.462	0.623	-0.179	0.641	0.811	0.860	0.915	0.670	-0.017	0.068	0.279	-0.069	0.280	0.234	0.685	-0.522	-0.274	0.235	0.349	0.309
USE_D_08	0.626	0.583	0.571	-0.125	0.272	0.266	0.422	-0.124	0.573	0.571	0.899	0.646	0.430	0.104	-0.245	-0.018	-0.095	0.126	0.021	0.411	-0.249	-0.081	0.075	0.088	0.363
USE_D_09	-0.402	-0.412	-0.456	0.086	-0.223	-0.052	-0.330	0.218	-0.294	-0.480	-0.979	-0.655	-0.427	-0.147	0.105	0.003	-0.050	-0.031	-0.066	-0.342	0.263	0.715	-0.330	-0.346	-0.218
USE_D_10	0.670	0.717	0.588	0.264	0.466	0.314	0.469	-0.081	0.495	0.622	0.990	0.765	0.588	0.108	-0.070	0.099	-0.072	0.199	0.122	0.523	-0.344	-0.235	0.369	0.315	0.458
USE_D_11	0.820	0.829	0.758	0.086	0.566	0.357	0.566	-0.157	0.572	0.782	0.963	0.832	0.661	0.174	-0.133	0.044	-0.100	0.263	0.123	0.600	-0.493	-0.259	0.358	0.407	0.421
USE_D_12	0.627	0.590	0.595	0.122	0.541	0.203	0.473	-0.083	0.411	0.654	0.880	0.644	0.571	-0.001	-0.307	-0.151	-0.055	0.235	0.019	0.444	-0.491	-0.251	0.173	0.306	0.404

Colours highlight significance for correlations: orange. confidence at 99%; pale orange. confidence at 95%. .(a) stands for data not available.

Table 36: Digital Indicators for the Full Set of countries: Pearson correlations.

	ICTSECTOR_S_05	ICTSECTOR_S_06	ICTSECTOR_S_07	ICTSECTOR_D_01	ICTSECTOR_D_02	ICTSECTOR_D_03	ICTSECTOR_D_04	ICTSECTOR_D_06	DIGLIT_S_01	DIGLIT_S_02	DIGLIT_S_03	DIGLIT_S_04	DIGLIT_S_05	DIGLIT_S_06	DIGLIT_S_07	DIGLIT_D_01	DIGLIT_D_02	LEGAL_S_01	LEGAL_S_02	LEGAL_S_03	LEGAL_S_04	LEGAL_S_05	LEGAL_S_06	LEGAL_S_07	LEGAL_S_08
INF_S_01	0.330	-0.273	0.309	-0.116	0.669	0.373	0.697	0.724	0.058	-0.105	0.404	0.298	0.406	0.157	0.628	-0.092	0.864	0.825	0.832	0.357	0.391	0.246	0.349	0.301	0.297
INF_S_02	0.362	-0.280	0.364	-0.076	0.687	0.479	0.693	0.726	0.074	-0.069	0.464	0.078	0.334	0.207	0.586	-0.073	0.826	0.793	0.812	0.222	0.329	0.148	0.288	0.243	0.152
INF_S_03	0.402	-0.361	0.406	-0.048	0.732	0.484	0.759	0.726	0.103	-0.061	0.487	0.272	0.483	0.197	0.747	-0.152	0.812	0.783	0.780	0.265	0.283	0.071	0.277	0.286	0.166
INF_S_04	-0.357	-0.259	-0.124	-0.136	0.261	0.424	0.350	0.282	-0.211	-0.312	0.199	0.217	-0.008	0.841	0.079	-0.098	0.284	0.112	0.190	-0.069	-0.068	-0.264	-0.036	-0.047	-0.418
INF_S_05	0.100	-0.334	0.294	0.046	0.716	0.659	0.720	0.618	0.061	-0.154	0.369	0.280	0.481	0.300	0.688	-0.223	0.708	0.632	0.597	0.255	0.258	0.160	0.274	0.147	0.161
INF_S_06	0.174	-0.257	0.224	-0.253	0.463	0.410	0.509	0.407	0.071	-0.042	0.421	0.356	0.392	0.229	0.569	0.102	0.419	0.392	0.356	0.099	0.104	0.112	0.134	0.097	0.116
INF_S_07	0.121	-0.145	0.214	-0.175	0.565	0.371	0.496	0.535	-0.041	-0.063	0.164	-0.119	0.114	0.158	0.352	-0.052	0.572	0.562	0.584	0.241	0.209	0.144	0.214	0.183	0.150
INF_S_08	-0.075	0.287	-0.033	-0.280	-0.127	0.148	-0.184	-0.146	-0.001	0.070	-0.102	0.509	0.246	-0.144	-0.202	-0.007	-0.302	-0.155	-0.190	0.125	0.125	0.109	-0.482	0.133	0.118
INF_S_09	0.428	-0.167	0.433	-0.149	0.534	0.348	0.527	0.525	-0.015	-0.042	0.327	-0.048	0.327	0.086	0.389	-0.048	0.561	0.537	0.551	0.231	0.225	0.155	0.201	0.171	0.162
INF_S_10	0.304	-0.171	0.237	-0.058	0.638	0.596	0.636	0.706	0.065	0.015	0.302	0.016	0.313	0.233	0.532	-0.129	0.780	0.764	0.813	0.307	0.330	0.219	0.288	0.199	0.150
INF_S_11	0.271	0.843	0.297	1.000	-1.000	.(a)	0.994	0.996	0.193	1.000	0.642	0.862	0.893	0.634	0.968	-0.958	0.996	0.997	0.994	.(a)	-0.204	.(a)	.(a)	.(a)	.(a)
INF_S_12	0.396	-0.074	0.170	-0.062	0.717	0.443	0.661	0.843	-0.029	-0.097	0.629	0.033	0.386	0.230	0.689	-0.200	0.837	0.892	0.878	0.583	0.424	.(a)	0.285	.(a)	.(a)
INF_D_01	0.466	-0.271	0.346	-0.075	0.611	0.557	0.738	0.706	0.007	-0.070	0.537	-0.154	0.303	0.306	0.569	-0.183	0.687	0.681	0.713	0.435	0.392	0.225	0.256	0.455	0.240
INF_D_02	0.025	-0.104	0.105	0.062	0.148	0.288	0.254	0.255	0.095	-0.014	0.176	-0.026	0.107	0.157	0.115	-0.116	0.111	0.077	0.104	0.125	0.125	-0.007	0.057	-0.062	-0.052
INF_D_03	-0.234	-0.344	0.456	0.388	-0.367	-0.004	0.087	0.175	0.555	0.587	0.228	-0.417	-0.031	0.285	-0.084	0.062	-0.210	-0.124	0.115	0.050	0.460	0.444	0.439	0.513	0.257
INF_D_04	-0.138	-0.451	0.174	0.324	-0.215	0.042	0.164	0.285	0.363	0.555	0.509	-0.267	0.214	0.508	0.105	-0.045	0.020	0.106	0.298	0.114	0.375	0.353	0.341	0.389	0.230
INF_D_06	-0.138	-0.075	-0.073	0.075	0.178	0.067	0.065	0.129	0.023	-0.035	0.057	0.103	0.279	-0.036	0.142	-0.029	-0.050	-0.080	-0.011	0.214	0.060	0.117	0.111	0.006	0.154
INF_D_07	0.007	-0.186	0.099	-0.115	0.268	0.205	0.289	0.330	0.068	-0.045	0.257	0.151	0.250	0.280	0.155	-0.153	0.203	0.208	0.264	0.180	0.036	0.165	0.031	0.015	0.019
INF_D_08	0.008	-0.103	0.064	-0.040	0.257	0.628	0.268	0.594	-0.024	0.152	-0.005	-0.180	-0.127	0.276	0.256	-0.112	0.136	0.088	0.187	0.004	0.191	0.050	0.159	0.181	-0.313
INF_D_09	0.279	-0.228	0.297	0.083	0.575	0.652	0.720	0.861	0.096	0.054	0.372	-0.048	0.412	0.279	0.598	-0.137	0.583	0.629	0.709	0.418	0.328	0.241	0.214	0.110	0.195
INF_D_10	0.076	0.175	-0.275	-0.224	-0.303	-0.501	-0.447	-0.485	-0.129	0.208	-0.040	-0.116	-0.160	-0.289	-0.380	0.118	-0.544	-0.591	-0.556	-0.258	-0.120	-0.188	-0.188	-0.090	-0.134
ICTSECTOR_S_01	-0.182	0.021	0.027	0.035	-0.194	-0.210	-0.301	-0.382	-0.039	-0.075	-0.212	0.141	0.053	-0.077	-0.194	0.082	-0.271	-0.273	-0.255	-0.057	0.001	0.144	-0.058	-0.165	0.118
ICTSECTOR_S_02	0.251	0.139	-0.072	0.152	0.242	0.291	0.358	0.404	-0.047	-0.305	0.170	0.137	-0.047	0.057	-0.010	-0.081	0.293	0.259	0.269	0.185	0.239	-0.029	0.309	0.153	-0.059
ICTSECTOR_S_03	0.142	0.037	0.028	0.266	0.090	-0.011	0.270	0.257	0.122	-0.199	0.147	0.114	0.165	0.002	0.212	0.026	0.387	0.393	0.372	0.332	0.289	0.148	0.327	0.216	0.271
ICTSECTOR_S_04	0.529	0.424	0.022	0.169	0.269	0.377	0.143	0.289	-0.079	-0.105	0.394	0.162	0.103	-0.077	0.285	-0.108	0.442	0.470	0.402	0.176	0.148	-0.178	0.029	0.108	-0.070
ICTSECTOR_S_05	1.000	-0.045	0.122	0.171	0.070	0.410	0.128	0.270	-0.071	-0.143	0.216	0.006	-0.001	-0.291	0.213	-0.055	0.369	0.382	0.364	0.183	0.144	-0.048	0.077	0.162	0.141
ICTSECTOR_S_06	-0.045	1.000	-0.121	-0.246	-0.252	-0.214	-0.342	-0.240	-0.110	-0.208	-0.331	0.039	-0.189	-0.118	-0.266	-0.072	-0.302	-0.204	-0.300	0.013	-0.213	-0.156	-0.216	-0.411	-0.122
ICTSECTOR_S_07	0.122	-0.121	1.000	-0.267	0.577	0.422	0.381	0.220	0.048	0.280	0.252	0.026	0.284	0.075	0.330	-0.051	0.349	0.294	0.223	0.155	0.138	0.040	0.158	0.157	0.141
ICTSECTOR_D_01	0.171	-0.246	-0.267	1.000	-0.485	-0.240	-0.382	-0.151	0.027	0.087	-0.382	-0.036	-0.194	-0.369	-0.034	-0.139	0.035	0.049	0.036	0.112	0.028	0.102	-0.001	-0.160	0.176

ICTSECTOR_D_02	0.070	-0.252	0.577	-0.485	1.000	0.766	0.945	0.699	-0.010	-0.025	0.562	0.334	0.503	0.477	0.628	-0.195	0.697	0.640	0.585	0.218	0.197	0.026	0.297	0.265	-0.028
ICTSECTOR_D_03	0.410	-0.214	0.422	-0.240	0.766	1.000	0.666	0.837	-0.139	-0.220	0.374	0.216	-0.081	0.585	0.493	-0.215	0.607	0.291	0.400	0.062	0.466	0.064	0.391	0.465	-0.207
ICTSECTOR_D_04	0.128	-0.342	0.381	-0.382	0.945	0.666	1.000	0.748	-0.141	-0.143	0.565	0.526	0.609	0.497	0.638	-0.163	0.704	0.673	0.638	0.273	0.253	0.033	0.273	0.278	0.016
ICTSECTOR_D_06	0.270	-0.240	0.220	-0.151	0.699	0.837	0.748	1.000	-0.006	-0.070	0.453	0.015	0.198	0.348	0.550	-0.119	0.663	0.619	0.709	0.195	0.324	0.078	0.293	0.207	-0.124
DIGLIT_S_01	-0.071	-0.110	0.048	0.027	-0.010	-0.139	-0.141	-0.006	1.000	0.937	-0.009	0.137	0.208	0.635	0.115	-0.068	0.136	0.081	0.039	0.066	0.087	0.052	0.069	0.065	0.055
DIGLIT_S_02	-0.143	-0.208	0.280	0.087	-0.025	-0.220	-0.143	-0.070	0.937	1.000	-0.090	-0.287	-0.266	-0.365	-0.053	-0.083	-0.123	-0.144	0.007	-0.437	-0.042	0.008	-0.033	0.220	-0.120
DIGLIT_S_03	0.216	-0.331	0.252	-0.382	0.562	0.374	0.565	0.453	-0.009	-0.090	1.000	0.339	0.685	0.296	0.527	0.005	0.569	0.554	0.521	0.115	0.114	-0.007	0.054	0.177	0.252
DIGLIT_S_04	0.006	0.039	0.026	-0.036	0.334	0.216	0.526	0.015	0.137	-0.287	0.339	1.000	0.683	0.138	0.436	0.089	0.292	0.234	0.052	0.088	0.151	-0.084	0.148	0.110	0.193
DIGLIT_S_05	-0.001	-0.189	0.284	-0.194	0.503	-0.081	0.609	0.198	0.208	-0.266	0.685	0.683	1.000	0.227	0.722	0.113	0.398	0.319	0.184	0.223	0.213	0.234	0.264	0.210	0.361
DIGLIT_S_06	-0.291	-0.118	0.075	-0.369	0.477	0.585	0.497	0.348	0.635	-0.365	0.296	0.138	0.227	1.000	0.309	-0.078	0.293	0.225	0.261	-0.066	-0.103	-0.081	-0.069	0.072	-0.246
DIGLIT_S_07	0.213	-0.266	0.330	-0.034	0.628	0.493	0.638	0.550	0.115	-0.053	0.527	0.436	0.722	0.309	1.000	-0.093	0.619	0.575	0.507	0.165	0.193	0.098	0.182	0.270	0.130
DIGLIT_D_01	-0.055	-0.072	-0.051	-0.139	-0.195	-0.215	-0.163	-0.119	-0.068	-0.083	0.005	0.089	0.113	-0.078	-0.093	1.000	-0.184	-0.179	-0.119	0.071	0.196	0.052	0.054	0.003	0.069
DIGLIT_D_02	0.369	-0.302	0.349	0.035	0.697	0.607	0.704	0.663	0.136	-0.123	0.569	0.292	0.398	0.293	0.619	-0.184	1.000	0.915	0.870	0.303	0.289	0.103	0.277	0.232	0.209
LEGAL_S_01	0.382	-0.204	0.294	0.049	0.640	0.291	0.673	0.619	0.081	-0.144	0.554	0.234	0.319	0.225	0.575	-0.179	0.915	1.000	0.914	0.356	0.188	0.079	0.133	0.039	0.216
LEGAL_S_02	0.364	-0.300	0.223	0.036	0.585	0.400	0.638	0.709	0.039	0.007	0.521	0.052	0.184	0.261	0.507	-0.119	0.870	0.914	1.000	0.295	0.201	0.123	0.112	0.076	0.118
LEGAL_S_03	0.183	0.013	0.155	0.112	0.218	0.062	0.273	0.195	0.066	-0.437	0.115	0.088	0.223	-0.066	0.165	0.071	0.303	0.356	0.295	1.000	0.615	0.477	0.534	0.337	0.470
LEGAL_S_04	0.144	-0.213	0.138	0.028	0.197	0.466	0.253	0.324	0.087	-0.042	0.114	0.151	0.213	-0.103	0.193	0.196	0.289	0.188	0.201	0.615	1.000	0.443	0.630	0.671	0.479
LEGAL_S_05	-0.048	-0.156	0.040	0.102	0.026	0.064	0.033	0.078	0.052	0.008	-0.007	-0.084	0.234	-0.081	0.098	0.052	0.103	0.079	0.123	0.477	0.443	1.000	0.525	0.294	0.730
LEGAL_S_06	0.077	-0.216	0.158	-0.001	0.297	0.391	0.273	0.293	0.069	-0.033	0.054	0.148	0.264	-0.069	0.182	0.054	0.277	0.133	0.112	0.534	0.630	0.525	1.000	0.623	0.515
LEGAL_S_07	0.162	-0.411	0.157	-0.160	0.265	0.465	0.278	0.207	0.065	0.220	0.177	0.110	0.210	0.072	0.270	0.003	0.232	0.039	0.076	0.337	0.671	0.294	0.623	1.000	0.455
LEGAL_S_08	0.141	-0.122	0.141	0.176	-0.028	-0.207	0.016	-0.124	0.055	-0.120	0.252	0.193	0.361	-0.246	0.130	0.069	0.209	0.216	0.118	0.470	0.479	0.730	0.515	0.455	1.000
LEGAL_S_09	0.140	-0.224	0.157	0.131	0.133	-0.020	0.165	0.144	0.083	0.113	-0.030	0.027	0.116	-0.260	0.166	0.081	0.273	0.253	0.210	0.704	0.778	0.494	0.708	0.631	0.598
LEGAL_S_10	0.225	-0.096	0.165	0.019	0.044	-0.047	0.008	0.021	0.088	-0.345	0.105	0.087	0.263	-0.075	0.129	0.208	0.128	0.098	0.171	0.848	0.861	0.615	0.568	0.591	0.616
LEGAL_S_11	0.080	-0.067	0.014	0.248	-0.085	-0.161	-0.015	-0.065	0.086	0.026	0.253	0.109	0.237	-0.183	0.088	0.062	0.157	0.167	0.121	0.469	0.498	0.598	0.451	0.309	0.689
LEGAL_S_12	-0.163	-0.049	0.203	-0.090	0.211	-0.201	0.227	0.155	0.083	0.080	0.166	0.032	0.252	0.018	0.295	0.228	0.355	0.413	0.384	0.484	0.465	0.616	0.514	0.452	0.641
LEGAL_S_13	-0.099	-0.028	0.132	-0.069	0.154	-0.317	0.189	0.100	0.100	0.082	0.200	-0.101	0.200	0.075	0.119	0.238	0.251	0.297	0.319	0.517	0.589	0.604	0.559	0.750	0.611
LEGAL_S_14	0.126	-0.224	0.157	0.115	0.025	-0.025	0.034	-0.014	0.056	0.065	-0.131	-0.073	0.162	-0.178	0.177	0.058	0.082	0.094	0.080	0.533	0.433	0.805	0.494	0.371	0.708
LEGAL_D_01	0.316	-0.125	-0.016	0.222	0.298	0.128	0.371	0.318	0.047	-0.159	0.343	0.223	0.115	0.166	0.128	-0.307	0.689	0.734	0.674	0.173	0.074	-0.013	-0.001	-0.008	0.139
LEGAL_D_02	0.322	-0.087	-0.005	0.182	0.243	0.112	0.305	0.314	-0.007	-0.014	0.255	0.127	-0.019	0.077	0.014	-0.220	0.642	0.679	0.670	0.086	0.087	-0.036	-0.018	0.012	0.074
LEGAL_D_03	0.493	-0.145	0.138	0.126	0.411	0.281	0.488	0.431	-0.069	-0.063	0.443	0.254	0.178	0.002	0.242	-0.237	0.773	0.800	0.769	0.137	0.101	-0.051	-0.006	0.058	0.099
LEGAL_D_04	0.311	-0.176	0.079	0.163	0.353	0.197	0.381	0.366	-0.030	-0.144	0.277	0.150	0.103	0.125	0.107	-0.251	0.699	0.737	0.712	0.135	0.097	0.000	0.025	-0.023	0.080
USE_S_01	0.395	-0.207	0.500	-0.176	0.673	0.402	0.628	0.677	-0.004	0.053	0.517	-0.099	0.324	0.198	0.487	-0.065	0.705	0.706	0.752	0.288	0.259	0.161	0.250	0.218	0.163
USE_S_02	0.333	-0.154	0.627	-0.191	0.552	0.345	0.540	0.433	-0.011	0.194	0.314	-0.135	0.156	0.035	0.405	-0.051	0.531	0.512	0.505	0.242	0.215	0.131	0.216	0.189	0.145

USE_S_03	0.208	-0.147	0.104	-0.040	0.084	0.094	0.020	0.108	-0.113	-0.180	-0.019	-0.264	-0.168	-0.041	-0.226	0.251	0.144	0.116	0.224	0.021	0.135	0.081	0.095	0.058	0.059
USE_S_04	-0.069	-0.132	0.132	-0.125	-0.031	-0.268	-0.072	-0.035	0.013	0.049	0.105	-0.400	0.007	-0.059	-0.286	0.362	-0.002	0.056	0.142	0.122	0.044	0.205	-0.028	-0.060	0.145
USE_S_05	0.366	-0.267	0.324	0.045	0.517	0.399	0.607	0.577	-0.021	-0.282	0.377	0.210	0.414	0.142	0.635	-0.259	0.720	0.745	0.657	0.350	0.323	0.217	0.296	0.164	0.254
USE_S_06	0.359	-0.229	0.235	0.139	0.528	0.192	0.564	0.546	0.044	-0.166	0.579	0.208	0.364	0.224	0.560	-0.257	0.819	0.888	0.784	0.250	0.127	0.106	0.107	0.060	0.261
USE_D_02	-0.117	-0.151	0.069	-0.199	0.487	0.147	0.296	0.509	-0.031	-0.223	0.601	-0.226	0.258	0.702	0.402	-0.158	0.443	0.539	0.557	0.151	0.231	0.096	0.181	0.094	0.032
USE_D_04	0.137	-0.181	0.153	-0.218	0.549	0.665	0.518	0.571	-0.042	-0.165	0.410	-0.268	0.046	0.411	0.235	-0.104	0.512	0.491	0.565	0.037	0.066	-0.141	0.035	-0.104	-0.238
USE_D_07	0.304	-0.325	0.408	-0.025	0.711	0.539	0.668	0.719	0.168	-0.094	0.485	0.189	0.442	0.289	0.639	-0.108	0.837	0.786	0.781	0.379	0.359	0.138	0.310	0.276	0.156
USE_D_08	0.426	-0.217	0.311	0.050	0.401	0.108	0.337	0.393	-0.048	0.021	0.417	0.202	0.378	-0.037	0.463	-0.134	0.546	0.570	0.526	0.304	0.334	0.158	0.246	0.209	0.205
USE_D_09	-0.157	0.044	-0.107	0.048	-0.307	-0.249	-0.376	-0.451	-0.060	-0.115	-0.285	-0.001	-0.167	-0.088	-0.466	-0.111	-0.411	-0.383	-0.337	-0.160	-0.093	0.061	-0.154	-0.241	0.096
USE_D_10	0.388	-0.157	0.144	0.168	0.425	0.401	0.503	0.587	-0.046	-0.014	0.484	0.106	0.129	0.164	0.285	-0.235	0.821	0.830	0.827	0.271	0.196	0.069	0.114	0.034	0.051
USE_D_11	0.417	-0.233	0.337	0.140	0.558	0.338	0.639	0.624	0.035	-0.184	0.565	0.260	0.374	0.172	0.561	-0.200	0.886	0.900	0.843	0.296	0.219	0.161	0.189	0.149	0.238
USE_D_12	0.300	-0.166	0.059	0.222	0.402	0.158	0.458	0.473	-0.001	-0.198	0.447	0.219	0.243	0.159	0.383	-0.352	0.736	0.804	0.710	0.202	0.133	0.107	0.065	0.031	0.235

Colours highlight significance for correlations: orange. confidence at 99%; pale orange. confidence at 95%. .(a) stands for data not available.

Table 36: Digital Indicators for the Full Set of countries: Pearson correlations (continued).

	LEGAL_S_09	LEGAL_S_10	LEGAL_S_11	LEGAL_S_12	LEGAL_S_13	LEGAL_S_14	LEGAL_D_01	LEGAL_D_02	LEGAL_D_03	LEGAL_D_04	USE_S_01	USE_S_02	USE_S_03	USE_S_04	USE_S_05	USE_S_06	USE_D_02	USE_D_04	USE_D_07	USE_D_08	USE_D_09	USE_D_10	USE_D_11	USE_D_12
INF_S_01	0.353	0.318	0.219	0.402	0.395	0.262	0.481	0.454	0.614	0.526	0.769	0.578	0.124	0.128	0.743	0.736	0.488	0.407	0.873	0.626	-0.402	0.670	0.820	0.627
INF_S_02	0.172	0.253	0.211	0.317	0.320	0.155	0.439	0.455	0.634	0.506	0.825	0.581	0.180	0.074	0.700	0.710	0.456	0.518	0.822	0.583	-0.412	0.717	0.829	0.590
INF_S_03	0.243	0.200	0.115	0.327	0.250	0.140	0.410	0.364	0.554	0.450	0.738	0.584	0.078	0.041	0.705	0.707	0.467	0.518	0.809	0.571	-0.456	0.588	0.758	0.595
INF_S_04	-0.158	-0.311	-0.245	-0.137	-0.154	-0.346	0.241	0.231	0.129	0.267	0.016	-0.009	0.182	-0.024	0.033	0.064	0.186	0.469	0.129	-0.125	0.086	0.264	0.086	0.122
INF_S_05	0.254	0.143	0.114	0.422	0.287	0.146	0.383	0.297	0.433	0.386	0.412	0.359	-0.047	0.025	0.556	0.575	0.470	0.473	0.632	0.272	-0.223	0.466	0.566	0.541
INF_S_06	0.060	0.020	0.109	0.511	0.428	0.087	0.127	0.086	0.215	0.113	0.294	0.216	0.166	0.023	0.374	0.289	0.253	0.212	0.462	0.266	-0.052	0.314	0.357	0.203
INF_S_07	0.213	0.131	0.075	0.239	0.232	0.148	0.365	0.367	0.402	0.429	0.638	0.472	0.103	0.145	0.531	0.549	0.616	0.300	0.623	0.422	-0.330	0.469	0.566	0.473
INF_S_08	0.092	0.149	0.002	0.210	0.231	0.091	-0.064	-0.048	-0.003	-0.132	-0.099	-0.072	0.017	0.181	-0.209	-0.140	-0.267	-0.169	-0.179	-0.124	0.218	-0.081	-0.157	-0.083
INF_S_09	0.219	0.195	0.151	0.237	0.247	0.159	0.305	0.325	0.444	0.375	0.815	0.627	0.332	0.132	0.605	0.517	0.268	0.240	0.641	0.573	-0.294	0.495	0.572	0.411
INF_S_10	0.256	0.253	0.153	0.297	0.259	0.197	0.472	0.469	0.617	0.531	0.806	0.647	0.006	0.044	0.660	0.703	0.818	0.471	0.811	0.571	-0.480	0.622	0.782	0.654
INF_S_11	-0.204	-0.697	-0.575	.(a)	.(a)	.(a)	0.641	0.366	0.904	0.840	0.979	0.751	-0.923	-0.448	0.987	0.999	1.000	0.993	0.860	0.899	-0.979	0.990	0.963	0.880
INF_S_12	0.277	0.282	0.336	.(a)	0.117	.(a)	0.595	0.618	0.723	0.634	0.836	0.760	-0.348	-0.295	0.793	0.777	0.785	0.662	0.915	0.646	-0.655	0.765	0.832	0.644
INF_D_01	0.355	0.275	0.188	0.453	0.402	0.233	0.358	0.304	0.442	0.369	0.757	0.467	0.207	0.089	0.622	0.672	0.429	0.349	0.670	0.430	-0.427	0.588	0.661	0.571
INF_D_02	0.021	-0.022	-0.045	-0.131	0.002	-0.143	0.031	-0.043	-0.032	0.054	0.128	-0.098	-0.151	-0.077	0.254	0.044	-0.131	-0.005	-0.017	0.104	-0.147	0.108	0.174	-0.001

INF_D_03	0.439	0.462	0.444	0.666	0.666	0.339	-0.417	-0.314	-0.358	-0.347	0.375	-0.164	0.105	0.336	-0.359	-0.117	0.557	0.219	0.068	-0.245	0.105	-0.070	-0.133	-0.307
INF_D_04	0.341	0.335	0.353	0.489	0.489	0.274	-0.255	-0.274	-0.197	-0.191	0.464	-0.062	-0.010	0.329	-0.136	0.075	0.785	0.231	0.279	-0.018	0.003	0.099	0.044	-0.151
INF_D_06	0.180	0.160	0.026	0.223	0.079	0.069	-0.133	-0.169	-0.154	-0.164	-0.055	-0.153	-0.023	0.029	-0.045	-0.039	-0.242	0.060	-0.069	-0.095	-0.050	-0.072	-0.100	-0.055
INF_D_07	0.008	0.085	0.056	0.121	0.088	0.226	0.140	0.044	0.069	0.119	0.203	0.028	-0.039	0.139	0.242	0.251	0.400	0.026	0.280	0.126	-0.031	0.199	0.263	0.235
INF_D_08	-0.001	-0.141	-0.241	0.015	-0.055	-0.052	-0.084	-0.092	-0.029	-0.086	0.112	-0.026	0.075	-0.111	0.127	0.054	0.195	0.185	0.234	0.021	-0.066	0.122	0.123	0.019
INF_D_09	0.324	0.345	0.137	0.373	0.303	0.228	0.251	0.188	0.298	0.266	0.674	0.341	0.060	0.115	0.629	0.578	0.410	0.461	0.685	0.411	-0.342	0.523	0.600	0.444
INF_D_10	-0.042	-0.065	-0.308	-0.389	-0.278	-0.142	-0.265	-0.277	-0.297	-0.367	-0.363	-0.429	-0.015	-0.104	-0.452	-0.529	-0.274	-0.205	-0.522	-0.249	0.263	-0.344	-0.493	-0.491
ICTSECTOR_S_01	-0.027	0.082	-0.065	0.140	0.061	0.199	-0.129	-0.074	-0.154	-0.099	-0.279	-0.170	0.309	0.265	-0.210	-0.290	-0.188	-0.340	-0.274	-0.081	0.715	-0.235	-0.259	-0.251
ICTSECTOR_S_02	0.070	0.130	0.093	-0.050	0.092	-0.103	0.215	0.288	0.317	0.268	0.263	0.140	0.018	-0.235	0.176	0.172	-0.233	0.430	0.235	0.075	-0.330	0.369	0.358	0.173
ICTSECTOR_S_03	0.266	0.381	0.255	0.338	0.317	0.154	0.262	0.289	0.364	0.235	0.250	0.035	-0.092	-0.162	0.249	0.367	0.130	0.352	0.349	0.088	-0.346	0.315	0.407	0.306
ICTSECTOR_S_04	0.159	0.017	-0.026	-0.120	-0.051	-0.003	0.399	0.383	0.489	0.377	0.340	0.180	0.003	-0.106	0.400	0.455	-0.153	0.211	0.309	0.363	-0.218	0.458	0.421	0.404
ICTSECTOR_S_05	0.140	0.225	0.080	-0.163	-0.099	0.126	0.316	0.322	0.493	0.311	0.395	0.333	0.208	-0.069	0.366	0.359	-0.117	0.137	0.304	0.426	-0.157	0.388	0.417	0.300
ICTSECTOR_S_06	-0.224	-0.096	-0.067	-0.049	-0.028	-0.224	-0.125	-0.087	-0.145	-0.176	-0.207	-0.154	-0.147	-0.132	-0.267	-0.229	-0.151	-0.181	-0.325	-0.217	0.044	-0.157	-0.233	-0.166
ICTSECTOR_S_07	0.157	0.165	0.014	0.203	0.132	0.157	-0.016	-0.005	0.138	0.079	0.500	0.627	0.104	0.132	0.324	0.235	0.069	0.153	0.408	0.311	-0.107	0.144	0.337	0.059
ICTSECTOR_D_01	0.131	0.019	0.248	-0.090	-0.069	0.115	0.222	0.182	0.126	0.163	-0.176	-0.191	-0.040	-0.125	0.045	0.139	-0.199	-0.218	-0.025	0.050	0.048	0.168	0.140	0.222
ICTSECTOR_D_02	0.133	0.044	-0.085	0.211	0.154	0.025	0.298	0.243	0.411	0.353	0.673	0.552	0.084	-0.031	0.517	0.528	0.487	0.549	0.711	0.401	-0.307	0.425	0.558	0.402
ICTSECTOR_D_03	-0.020	-0.047	-0.161	-0.201	-0.317	-0.025	0.128	0.112	0.281	0.197	0.402	0.345	0.094	-0.268	0.399	0.192	0.147	0.665	0.539	0.108	-0.249	0.401	0.338	0.158
ICTSECTOR_D_04	0.165	0.008	-0.015	0.227	0.189	0.034	0.371	0.305	0.488	0.381	0.628	0.540	0.020	-0.072	0.607	0.564	0.296	0.518	0.668	0.337	-0.376	0.503	0.639	0.458
ICTSECTOR_D_06	0.144	0.021	-0.065	0.155	0.100	-0.014	0.318	0.314	0.431	0.366	0.677	0.433	0.108	-0.035	0.577	0.546	0.509	0.571	0.719	0.393	-0.451	0.587	0.624	0.473
DIGLIT_S_01	0.083	0.088	0.086	0.083	0.100	0.056	0.047	-0.007	-0.069	-0.030	-0.004	-0.011	-0.113	0.013	-0.021	0.044	-0.031	-0.042	0.168	-0.048	-0.060	-0.046	0.035	-0.001
DIGLIT_S_02	0.113	-0.345	0.026	0.080	0.082	0.065	-0.159	-0.014	-0.063	-0.144	0.053	0.194	-0.180	0.049	-0.282	-0.166	-0.223	-0.165	-0.094	0.021	-0.115	-0.014	-0.184	-0.198
DIGLIT_S_03	-0.030	0.105	0.253	0.166	0.200	-0.131	0.343	0.255	0.443	0.277	0.517	0.314	-0.019	0.105	0.377	0.579	0.601	0.410	0.485	0.417	-0.285	0.484	0.565	0.447
DIGLIT_S_04	0.027	0.087	0.109	0.032	-0.101	-0.073	0.223	0.127	0.254	0.150	-0.099	-0.135	-0.264	-0.400	0.210	0.208	-0.226	-0.268	0.189	0.202	-0.001	0.106	0.260	0.219
DIGLIT_S_05	0.116	0.263	0.237	0.252	0.200	0.162	0.115	-0.019	0.178	0.103	0.324	0.156	-0.168	0.007	0.414	0.364	0.258	0.046	0.442	0.378	-0.167	0.129	0.374	0.243
DIGLIT_S_06	-0.260	-0.075	-0.183	0.018	0.075	-0.178	0.166	0.077	0.002	0.125	0.198	0.035	-0.041	-0.059	0.142	0.224	0.702	0.411	0.289	-0.037	-0.088	0.164	0.172	0.159
DIGLIT_S_07	0.166	0.129	0.088	0.295	0.119	0.177	0.128	0.014	0.242	0.107	0.487	0.405	-0.226	-0.286	0.635	0.560	0.402	0.235	0.639	0.463	-0.466	0.285	0.561	0.383
DIGLIT_D_01	0.081	0.208	0.062	0.228	0.238	0.058	-0.307	-0.220	-0.237	-0.251	-0.065	-0.051	0.251	0.362	-0.259	-0.257	-0.158	-0.104	-0.108	-0.134	-0.111	-0.235	-0.200	-0.352
DIGLIT_D_02	0.273	0.128	0.157	0.355	0.251	0.082	0.689	0.642	0.773	0.699	0.705	0.531	0.144	-0.002	0.720	0.819	0.443	0.512	0.837	0.546	-0.411	0.821	0.886	0.736
LEGAL_S_01	0.253	0.098	0.167	0.413	0.297	0.094	0.734	0.679	0.800	0.737	0.706	0.512	0.116	0.056	0.745	0.888	0.539	0.491	0.786	0.570	-0.383	0.830	0.900	0.804
LEGAL_S_02	0.210	0.171	0.121	0.384	0.319	0.080	0.674	0.670	0.769	0.712	0.752	0.505	0.224	0.142	0.657	0.784	0.557	0.565	0.781	0.526	-0.337	0.827	0.843	0.710
LEGAL_S_03	0.704	0.848	0.469	0.484	0.517	0.533	0.173	0.086	0.137	0.135	0.288	0.242	0.021	0.122	0.350	0.250	0.151	0.037	0.379	0.304	-0.160	0.271	0.296	0.202
LEGAL_S_04	0.778	0.861	0.498	0.465	0.589	0.433	0.074	0.087	0.101	0.097	0.259	0.215	0.135	0.044	0.323	0.127	0.231	0.066	0.359	0.334	-0.093	0.196	0.219	0.133
LEGAL_S_05	0.494	0.615	0.598	0.616	0.604	0.805	-0.013	-0.036	-0.051	0.000	0.161	0.131	0.081	0.205	0.217	0.106	0.096	-0.141	0.138	0.158	0.061	0.069	0.161	0.107

LEGAL_S_06	0.708	0.568	0.451	0.514	0.559	0.494	-0.001	-0.018	-0.006	0.025	0.250	0.216	0.095	-0.028	0.296	0.107	0.181	0.035	0.310	0.246	-0.154	0.114	0.189	0.065
LEGAL_S_07	0.631	0.591	0.309	0.452	0.750	0.371	-0.008	0.012	0.058	-0.023	0.218	0.189	0.058	-0.060	0.164	0.060	0.094	-0.104	0.276	0.209	-0.241	0.034	0.149	0.031
LEGAL_S_08	0.598	0.616	0.689	0.641	0.611	0.708	0.139	0.074	0.099	0.080	0.163	0.145	0.059	0.145	0.254	0.261	0.032	-0.238	0.156	0.205	0.096	0.051	0.238	0.235
LEGAL_S_09	1.000	0.665	0.391	0.613	0.563	0.605	0.133	0.102	0.105	0.095	0.240	0.220	0.026	0.140	0.305	0.178	0.058	-0.082	0.341	0.289	-0.049	0.187	0.190	0.163
LEGAL_S_10	0.665	1.000	0.658	0.691	0.831	0.594	-0.026	-0.035	0.028	-0.023	0.234	0.197	0.114	0.204	0.309	0.091	0.127	-0.049	0.272	0.267	0.068	0.023	0.188	0.016
LEGAL_S_11	0.391	0.658	1.000	0.470	0.518	0.562	0.094	0.098	0.103	0.072	0.181	0.166	0.007	0.015	0.190	0.195	0.042	-0.073	0.206	0.197	-0.186	0.075	0.161	0.200
LEGAL_S_12	0.613	0.691	0.470	1.000	0.893	0.454	0.193	0.215	0.235	0.167	0.278	0.220	0.071	0.198	0.313	0.346	0.322	0.037	0.377	0.176	-0.029	0.299	0.368	0.286
LEGAL_S_13	0.563	0.831	0.518	0.893	1.000	0.432	0.108	0.150	0.180	0.116	0.298	0.240	0.142	0.312	0.287	0.186	0.263	0.031	0.326	0.200	0.077	0.241	0.287	0.161
LEGAL_S_14	0.605	0.594	0.562	0.454	0.432	1.000	-0.076	-0.121	-0.097	-0.079	0.170	0.150	-0.019	0.132	0.288	0.111	0.042	-0.477	0.151	0.244	0.065	-0.002	0.135	0.050
LEGAL_D_01	0.133	-0.026	0.094	0.193	0.108	-0.076	1.000	0.941	0.850	0.930	0.368	0.284	0.217	-0.036	0.483	0.736	0.363	0.459	0.454	0.405	-0.123	0.749	0.600	0.842
LEGAL_D_02	0.102	-0.035	0.098	0.215	0.150	-0.121	0.941	1.000	0.889	0.938	0.374	0.286	0.328	-0.009	0.398	0.644	0.261	0.484	0.415	0.388	-0.089	0.776	0.576	0.763
LEGAL_D_03	0.105	0.028	0.103	0.235	0.180	-0.097	0.850	0.889	1.000	0.849	0.517	0.394	0.269	-0.022	0.515	0.721	0.224	0.497	0.554	0.482	-0.175	0.844	0.748	0.737
LEGAL_D_04	0.095	-0.023	0.072	0.167	0.116	-0.079	0.930	0.938	0.849	1.000	0.455	0.318	0.268	0.044	0.502	0.681	0.366	0.501	0.495	0.436	-0.124	0.780	0.639	0.777
USE_S_01	0.240	0.234	0.181	0.278	0.298	0.170	0.368	0.374	0.517	0.455	1.000	0.690	0.266	0.202	0.645	0.662	0.477	0.474	0.766	0.607	-0.383	0.632	0.734	0.495
USE_S_02	0.220	0.197	0.166	0.220	0.240	0.150	0.284	0.286	0.394	0.318	0.690	1.000	0.263	0.291	0.579	0.500	0.269	0.317	0.570	0.591	-0.291	0.431	0.513	0.406
USE_S_03	0.026	0.114	0.007	0.071	0.142	-0.019	0.217	0.328	0.269	0.268	0.266	0.263	1.000	0.382	0.106	0.096	-0.139	0.255	0.090	0.156	0.393	0.297	0.190	0.164
USE_S_04	0.140	0.204	0.015	0.198	0.312	0.132	-0.036	-0.009	-0.022	0.044	0.202	0.291	0.382	1.000	-0.083	-0.038	0.022	-0.023	0.047	-0.058	0.326	0.107	0.095	-0.024
USE_S_05	0.305	0.309	0.190	0.313	0.287	0.288	0.483	0.398	0.515	0.502	0.645	0.579	0.106	-0.083	1.000	0.757	0.392	0.390	0.724	0.779	-0.256	0.599	0.765	0.659
USE_S_06	0.178	0.091	0.195	0.346	0.186	0.111	0.736	0.644	0.721	0.681	0.662	0.500	0.096	-0.038	0.757	1.000	0.585	0.483	0.706	0.611	-0.369	0.716	0.822	0.899
USE_D_02	0.058	0.127	0.042	0.322	0.263	0.042	0.363	0.261	0.224	0.366	0.477	0.269	-0.139	0.022	0.392	0.585	1.000	0.760	0.621	0.439	-0.288	0.265	0.402	0.544
USE_D_04	-0.082	-0.049	-0.073	0.037	0.031	-0.477	0.459	0.484	0.497	0.501	0.474	0.317	0.255	-0.023	0.390	0.483	0.760	1.000	0.452	0.213	-0.246	0.498	0.404	0.489
USE_D_07	0.341	0.272	0.206	0.377	0.326	0.151	0.454	0.415	0.554	0.495	0.766	0.570	0.090	0.047	0.724	0.706	0.621	0.452	1.000	0.594	-0.421	0.651	0.778	0.588
USE_D_08	0.289	0.267	0.197	0.176	0.200	0.244	0.405	0.388	0.482	0.436	0.607	0.591	0.156	-0.058	0.779	0.611	0.439	0.213	0.594	1.000	-0.167	0.484	0.595	0.508
USE_D_09	-0.049	0.068	-0.186	-0.029	0.077	0.065	-0.123	-0.089	-0.175	-0.124	-0.383	-0.291	0.393	0.326	-0.256	-0.369	-0.288	-0.246	-0.421	-0.167	1.000	-0.252	-0.317	-0.260
USE_D_10	0.187	0.023	0.075	0.299	0.241	-0.002	0.749	0.776	0.844	0.780	0.632	0.431	0.297	0.107	0.599	0.716	0.265	0.498	0.651	0.484	-0.252	1.000	0.847	0.698
USE_D_11	0.190	0.188	0.161	0.368	0.287	0.135	0.600	0.576	0.748	0.639	0.734	0.513	0.190	0.095	0.765	0.822	0.402	0.404	0.778	0.595	-0.317	0.847	1.000	0.701
USE_D_12	0.163	0.016	0.200	0.286	0.161	0.050	0.842	0.763	0.737	0.777	0.495	0.406	0.164	-0.024	0.659	0.899	0.544	0.489	0.588	0.508	-0.260	0.698	0.701	1.000

Colours highlight significance for correlations: orange. confidence at 99%; pale orange. confidence at 95%. .(a) stands for data not available.

Table 36: Digital Indicators for the Full Set of countries: Pearson correlations (continued).

23.2. Digital Indicators – OECD Set

	OECD01A1	OECD01A2	OECD02A1	OECD02A2	OECD04A1	OECD04B1	OECD06A1	OECD06B1	OECD07A1	OECD07A2	OECD07A3	OECD08A1	OECD08B1	OECD10A1	OECD10B1	OECD10B2	OECD10B3	OECD10C1	OECD11A1	OECD11B1	OECD12A1	OECD12A2	OECD14A1	OECD15A1
OECD01A1	1,0000	0.570	0.825	0.307	0.683	0.501	0.621	0.660	0.236	0.656	0.615	0.418	0.625	0.289	0.051	0.128	0.100	0.333	0.334	-0.096	0.110	-0.129	-0.478	-0.078
OECD01A2	0.570	1,0000	0.157	0.015	0.546	0.272	0.438	0.466	-0.030	0.318	0.457	0.190	0.310	0.238	0.205	0.146	0.246	0.307	0.384	0.077	0.193	0.044	-0.283	0.448
OECD02A1	0.825	0.157	1,0000	0.612	0.237	0.293	0.224	0.273	-0.078	0.470	0.403	0.082	0.338	0.136	-0.172	0.118	-0.106	0.091	0.014	-0.250	0.166	-0.266	-0.300	-0.316
OECD02A2	0.307	0.015	0.612	1,0000	-0.261	-0.028	-0.310	-0.271	-0.478	-0.074	-0.023	-0.359	-0.102	-0.246	-0.379	0.005	-0.340	-0.299	-0.408	-0.400	0.170	-0.265	-0.039	-0.320
OECD04A1	0.683	0.546	0.237	-0.261	1,0000	0.687	0.905	0.867	0.555	0.506	0.422	0.681	0.755	0.476	0.380	0.083	0.378	0.586	0.655	0.176	-0.189	0.167	-0.414	0.351
OECD04B1	0.501	0.272	0.293	-0.028	0.687	1,0000	0.735	0.756	0.249	0.370	0.367	0.500	0.711	0.414	0.279	-0.154	0.187	0.464	0.382	0.141	-0.391	0.149	-0.490	0.179
OECD06A1	0.621	0.438	0.224	-0.310	0.905	0.735	1,0000	0.955	0.557	0.584	0.475	0.697	0.776	0.533	0.486	0.039	0.455	0.551	0.650	0.204	-0.101	0.177	-0.289	0.405
OECD06B1	0.660	0.466	0.273	-0.271	0.867	0.756	0.955	1,0000	0.534	0.626	0.518	0.647	0.783	0.430	0.385	0.000	0.348	0.552	0.604	0.208	-0.080	0.133	-0.423	0.327
OECD07A1	0.236	-0.030	-0.078	-0.478	0.555	0.249	0.557	0.534	1,0000	0.711	0.279	0.476	0.348	0.112	0.475	0.045	0.439	0.389	0.465	0.198	-0.123	0.086	-0.413	0.068
OECD07A2	0.656	0.318	0.470	-0.074	0.506	0.370	0.584	0.626	0.711	1,0000	0.890	0.221	0.219	0.349	0.162	-0.031	0.133	0.329	0.341	0.111	-0.068	-0.052	-0.537	0.000
OECD07A3	0.615	0.457	0.403	-0.023	0.422	0.367	0.475	0.518	0.279	0.890	1,0000	-0.072	-0.207	0.266	0.337	-0.145	0.244	0.187	0.338	0.197	-0.032	0.017	-0.402	-0.159
OECD08A1	0.418	0.190	0.082	-0.359	0.681	0.500	0.697	0.647	0.476	0.221	-0.072	1,0000	0.626	0.268	0.117	-0.072	0.068	0.411	0.398	0.090	-0.276	0.031	-0.010	0.528
OECD08B1	0.625	0.310	0.338	-0.102	0.755	0.711	0.776	0.783	0.348	0.219	-0.207	0.626	1,0000	0.532	0.159	0.089	0.172	0.624	0.377	0.049	-0.304	0.098	-0.260	0.295
OECD10A1	0.289	0.238	0.136	-0.246	0.476	0.414	0.533	0.430	0.112	0.349	0.266	0.268	0.532	1,0000	0.816	0.169	0.822	0.737	0.598	0.020	-0.202	-0.013	-0.131	0.071
OECD10B1	0.051	0.205	-0.172	-0.379	0.380	0.279	0.486	0.385	0.475	0.162	0.337	0.117	0.159	0.816	1,0000	0.013	0.908	0.727	0.757	0.164	0.330	0.086	0.008	-0.320
OECD10B2	0.128	0.146	0.118	0.005	0.083	-0.154	0.039	0.000	0.045	-0.031	-0.145	-0.072	0.089	0.169	0.013	1,0000	0.432	0.116	-0.108	-0.219	-0.334	-0.176	0.454	0.215
OECD10B3	0.100	0.246	-0.106	-0.340	0.378	0.187	0.455	0.348	0.439	0.133	0.244	0.068	0.172	0.822	0.908	0.432	1,0000	0.718	0.638	0.056	0.158	0.004	0.216	-0.172
OECD10C1	0.333	0.307	0.091	-0.299	0.586	0.464	0.551	0.552	0.389	0.329	0.187	0.411	0.624	0.737	0.727	0.116	0.718	1,0000	0.589	0.049	-0.331	-0.034	-0.372	0.029
OECD11A1	0.334	0.384	0.014	-0.408	0.655	0.382	0.650	0.604	0.465	0.341	0.338	0.398	0.377	0.598	0.757	-0.108	0.638	0.589	1,0000	0.412	0.073	0.366	-0.054	0.092
OECD11B1	-0.096	0.077	-0.250	-0.400	0.176	0.141	0.204	0.208	0.198	0.111	0.197	0.090	0.049	0.020	0.164	-0.219	0.056	0.049	0.412	1,0000	0.132	0.927	0.293	0.309
OECD12A1	0.110	0.193	0.166	0.170	-0.189	-0.391	-0.101	-0.080	-0.123	-0.068	-0.032	-0.276	-0.304	-0.202	0.330	-0.334	0.158	-0.331	0.073	0.132	1,0000	0.079	0.038	-0.125
OECD12A2	-0.129	0.044	-0.266	-0.265	0.167	0.149	0.177	0.133	0.086	-0.052	0.017	0.031	0.098	-0.013	0.086	-0.176	0.004	-0.034	0.366	0.927	0.079	1,0000	0.332	0.278
OECD14A1	-0.478	-0.283	-0.300	-0.039	-0.414	-0.490	-0.289	-0.423	-0.413	-0.537	-0.402	-0.010	-0.260	-0.131	0.008	0.454	0.216	-0.372	-0.054	0.293	0.038	0.332	1,0000	0.531
OECD15A1	-0.078	0.448	-0.316	-0.320	0.351	0.179	0.405	0.327	0.068	0.000	-0.159	0.528	0.295	0.071	-0.320	0.215	-0.172	0.029	0.092	0.309	-0.125	0.278	0.531	1,0000

Colours highlight significance for correlations: orange, confidence at 99%; pale orange, confidence at 95%. .(a) stands for data not available.

Table 37: Digital Indicators for the OECD countries: Pearson correlations.

23.3. Analogue Indicators

	GEN01	GEN02	GEN03	GEN04	GEN05	GEN06	GEN07	GEN08	GEN09	GEN10	GEN11	GEN12	GEN13	GEN14	GEN15t	GEN16	GEN17	GEN19	GEN20	GEN21	GEN22	GEN23	GEN24	GEN25	GEN26	GEN27
GEN01	1.000	0.285	-0.202	-0.161	-0.008	-0.039	-0.299	-0.194	-0.173	0.304	-0.058	-0.147	-0.418	-0.330	0.973	-0.174	-0.086	-0.040	-0.137	-0.336	0.316	-0.044	0.353	-0.207	0.370	0.315
GEN02	0.285	1.000	0.358	0.252	-0.086	-0.079	0.142	0.230	0.303	-0.019	-0.108	0.283	-0.122	0.058	0.299	0.028	-0.154	-0.159	0.124	-0.349	0.999	-0.047	-0.237	0.349	-0.174	0.999
GEN03	-0.202	0.358	1.000	0.756	-0.350	-0.275	0.580	0.832	0.895	-0.127	-0.384	0.538	0.526	0.586	-0.158	0.405	-0.321	-0.143	0.426	0.374	0.354	-0.067	-0.469	0.998	-0.409	0.355
GEN04	-0.161	0.252	0.756	1.000	-0.319	-0.252	0.593	0.682	0.750	-0.044	-0.242	0.446	0.405	0.502	-0.090	0.187	-0.418	-0.301	0.267	0.360	0.248	0.031	-0.347	0.746	-0.224	0.251
GEN05	-0.008	-0.086	-0.350	-0.319	1.000	0.955	0.106	-0.372	-0.340	-0.394	-0.143	-0.193	-0.019	-0.141	0.006	-0.231	0.213	0.243	0.230	-0.032	-0.086	0.025	0.242	-0.344	0.146	-0.088
GEN06	-0.039	-0.079	-0.275	-0.252	0.955	1.000	0.104	-0.314	-0.287	-0.394	-0.159	-0.133	0.029	-0.057	-0.028	-0.227	0.156	0.201	0.182	0.022	-0.080	-0.001	0.157	-0.272	0.078	-0.081
GEN07	-0.299	0.142	0.580	0.593	0.106	0.104	1.000	0.501	0.582	-0.255	-0.377	0.409	0.369	0.432	-0.254	0.110	-0.069	0.007	0.570	0.213	0.127	0.158	-0.233	0.578	-0.226	0.130
GEN08	-0.194	0.230	0.832	0.682	-0.372	-0.314	0.501	1.000	0.867	0.017	-0.089	0.523	0.544	0.631	-0.144	0.350	-0.236	-0.203	0.280	0.491	0.222	0.016	-0.404	0.815	-0.322	0.226
GEN09	-0.173	0.303	0.895	0.750	-0.340	-0.287	0.582	0.867	1.000	-0.153	-0.222	0.612	0.565	0.608	-0.114	0.388	-0.347	-0.318	0.292	0.404	0.304	-0.062	-0.399	0.870	-0.277	0.306
GEN10	0.304	-0.019	-0.127	-0.044	-0.394	-0.394	-0.255	0.017	-0.153	1.000	0.052	0.000	-0.268	-0.085	0.304	0.096	0.078	0.057	-0.223	-0.211	-0.008	-0.012	0.070	-0.109	0.050	-0.007
GEN11	-0.058	-0.108	-0.384	-0.242	-0.143	-0.159	-0.377	-0.089	-0.222	0.052	1.000	-0.024	0.061	-0.108	-0.062	-0.222	-0.227	-0.085	-0.342	0.321	-0.110	0.011	-0.058	-0.395	-0.023	-0.109
GEN12	-0.147	0.283	0.538	0.446	-0.193	-0.133	0.409	0.523	0.612	0.000	-0.024	1.000	0.430	0.658	-0.116	0.639	-0.270	-0.226	-0.122	0.066	0.273	-0.114	-0.429	0.519	-0.332	0.274
GEN13	-0.418	-0.122	0.526	0.405	-0.019	0.029	0.369	0.544	0.565	-0.268	0.061	0.430	1.000	0.742	-0.371	0.171	-0.233	-0.256	0.068	0.208	-0.118	-0.024	-0.352	0.491	-0.252	-0.118
GEN14	-0.330	0.058	0.586	0.502	-0.141	-0.057	0.432	0.631	0.608	-0.085	-0.108	0.658	0.742	1.000	-0.267	0.309	-0.300	-0.311	0.038	0.299	0.049	-0.099	-0.364	0.585	-0.235	0.055
GEN15t	0.973	0.299	-0.158	-0.090	0.006	-0.028	-0.254	-0.144	-0.114	0.304	-0.062	-0.116	-0.371	-0.267	1.000	-0.167	-0.094	-0.078	-0.115	-0.294	0.332	-0.038	0.351	-0.162	0.381	0.331
GEN16	-0.174	0.028	0.405	0.187	-0.231	-0.227	0.110	0.350	0.388	0.096	-0.222	0.639	0.171	0.309	-0.167	1.000	0.120	-0.091	-0.145	0.044	0.043	-0.205	-0.483	0.272	-0.434	0.030
GEN17	-0.086	-0.154	-0.321	-0.418	0.213	0.156	-0.069	-0.236	-0.347	0.078	-0.227	-0.270	-0.233	-0.300	-0.094	0.120	1.000	0.436	0.110	-0.467	-0.166	-0.037	0.117	-0.212	-0.075	-0.160
GEN19	-0.040	-0.159	-0.143	-0.301	0.243	0.201	0.007	-0.203	-0.318	0.057	-0.085	-0.226	-0.256	-0.311	-0.078	-0.091	0.436	1.000	0.286	-0.329	-0.174	-0.121	0.187	-0.070	-0.221	-0.171
GEN20	-0.137	0.124	0.426	0.267	0.230	0.182	0.570	0.280	0.292	-0.223	-0.342	-0.122	0.068	0.038	-0.115	-0.145	0.110	0.286	1.000	0.102	0.092	0.078	0.051	0.439	-0.056	0.094
GEN21	-0.336	-0.349	0.374	0.360	-0.032	0.022	0.213	0.491	0.404	-0.211	0.321	0.066	0.208	0.299	-0.294	0.044	-0.467	-0.329	0.102	1.000	-0.338	0.108	-0.161	0.347	-0.027	-0.338
GEN22	0.316	0.999	0.354	0.248	-0.086	-0.080	0.127	0.222	0.304	-0.008	-0.110	0.273	-0.118	0.049	0.332	0.043	-0.166	-0.174	0.092	-0.338	1.000	-0.049	-0.229	0.325	-0.160	1.000
GEN23	-0.044	-0.047	-0.067	0.031	0.025	-0.001	0.158	0.016	-0.062	-0.012	0.011	-0.114	-0.024	-0.099	-0.038	-0.205	-0.037	-0.121	0.078	0.108	-0.049	1.000	0.104	-0.066	0.153	-0.049
GEN24	0.353	-0.237	-0.469	-0.347	0.242	0.157	-0.233	-0.404	-0.399	0.070	-0.058	-0.429	-0.352	-0.364	0.351	-0.483	0.117	0.187	0.051	-0.161	-0.229	0.104	1.000	-0.384	0.915	-0.228
GEN25	-0.207	0.349	0.998	0.746	-0.344	-0.272	0.578	0.815	0.870	-0.109	-0.395	0.519	0.491	0.585	-0.162	0.272	-0.212	-0.070	0.439	0.347	0.325	-0.066	-0.384	1.000	-0.372	0.347
GEN26	0.370	-0.174	-0.409	-0.224	0.146	0.078	-0.226	-0.322	-0.277	0.050	-0.023	-0.332	-0.252	-0.235	0.381	-0.434	-0.075	-0.221	-0.056	-0.027	-0.160	0.153	0.915	-0.372	1.000	-0.161
GEN27	0.315	0.999	0.355	0.251	-0.088	-0.081	0.130	0.226	0.306	-0.007	-0.109	0.274	-0.118	0.055	0.331	0.030	-0.160	-0.171	0.094	-0.338	1.000	-0.049	-0.228	0.347	-0.161	1.000
GEN28	-0.170	0.327	0.953	0.702	-0.370	-0.284	0.482	0.784	0.841	-0.089	-0.300	0.580	0.544	0.579	-0.134	0.461	-0.322	-0.154	0.238	0.343	0.325	-0.074	-0.519	0.945	-0.453	0.327
GEN29	-0.198	0.356	0.996	0.756	-0.347	-0.274	0.585	0.829	0.893	-0.125	-0.390	0.524	0.523	0.580	-0.154	0.400	-0.308	-0.144	0.438	0.328	0.352	-0.065	-0.451	0.998	-0.390	0.354
GEN30	-0.180	0.197	0.707	0.660	-0.221	-0.169	0.548	0.706	0.706	-0.232	-0.112	0.333	0.503	0.583	-0.102	0.162	-0.212	-0.205	0.352	0.407	0.187	0.033	-0.257	0.705	-0.177	0.193
GEN31	-0.161	0.096	0.421	0.713	0.042	0.048	0.419	0.396	0.491	-0.267	-0.121	0.279	0.540	0.466	-0.069	0.167	-0.279	-0.441	0.083	0.268	0.108	0.115	-0.210	0.382	-0.038	0.106

GEN32	0.158	-0.061	-0.257	-0.057	0.474	0.362	0.030	-0.281	-0.235	-0.103	-0.087	-0.091	0.051	-0.089	0.157	-0.124	0.043	-0.021	0.050	-0.201	-0.048	0.152	0.201	-0.254	0.198	-0.050
GEN33	0.423	0.416	0.031	-0.029	0.093	0.053	0.075	-0.148	0.054	0.207	-0.213	0.014	-0.170	-0.097	0.445	-0.111	-0.021	-0.142	0.078	-0.317	0.437	-0.047	0.135	0.006	0.193	0.431
GEN34	0.206	-0.176	-0.641	-0.687	0.214	0.186	-0.516	-0.688	-0.722	0.208	0.107	-0.386	-0.499	-0.622	0.106	-0.191	0.261	0.381	-0.270	-0.452	-0.171	-0.044	0.180	-0.638	0.028	-0.175
GEN35	-0.136	0.171	0.584	0.623	-0.161	-0.122	0.561	0.669	0.696	-0.287	-0.034	0.422	0.445	0.481	-0.071	0.091	-0.230	-0.365	0.313	0.434	0.167	0.086	-0.201	0.587	-0.063	0.173
GEN36	0.537	0.069	-0.249	-0.254	-0.211	-0.251	-0.404	-0.240	-0.208	0.276	0.254	-0.187	-0.270	-0.257	0.544	-0.065	0.240	-0.058	-0.150	-0.199	0.099	-0.144	0.358	-0.244	0.363	0.096
GEN37	-0.153	-0.166	0.419	0.277	-0.090	-0.090	0.324	0.420	0.353	-0.022	-0.364	-0.052	-0.030	0.077	-0.117	0.128	0.220	0.194	0.555	0.439	-0.174	-0.068	0.090	0.443	0.014	-0.171
GEN38	0.260	0.154	-0.015	-0.114	-0.212	-0.166	-0.217	0.137	0.093	0.136	-0.037	-0.051	-0.144	0.061	0.301	-0.093	-0.124	-0.270	-0.122	0.092	0.164	0.182	0.342	-0.008	0.423	0.166
GEN39	0.353	0.198	0.346	0.254	-0.028	-0.043	0.256	0.141	0.172	0.161	-0.846	-0.027	-0.145	0.129	0.335	0.151	0.235	0.069	0.367	-0.330	0.168	-0.089	0.186	0.362	0.184	0.167
GEN40	0.573	0.172	-0.085	-0.096	0.011	0.007	-0.135	-0.285	-0.158	0.149	-0.496	-0.271	-0.432	-0.319	0.592	-0.016	0.399	0.069	0.012	-0.435	0.193	-0.151	0.331	-0.084	0.301	0.194
GEN41	-0.045	-0.051	-0.145	-0.126	0.722	0.885	-0.014	-0.188	-0.210	-0.213	-0.142	-0.047	0.028	0.012	-0.041	-0.205	-0.009	0.113	0.043	0.077	-0.053	-0.012	-0.039	-0.146	-0.085	-0.053
GEN41B	0.030	-0.037	-0.165	-0.293	0.339	0.247	0.035	-0.254	-0.191	-0.187	-0.013	-0.064	0.120	0.116	0.030	-0.066	-0.056	0.018	0.122	-0.192	-0.038	-0.032	0.216	-0.164	0.196	-0.038
GEN42	-0.200	-0.079	0.380	0.386	0.082	0.032	0.530	0.269	0.224	-0.071	-0.125	-0.048	0.209	0.190	-0.194	-0.232	-0.329	-0.288	0.448	0.272	-0.073	0.784	-0.043	0.404	0.074	-0.077
GEN43	-0.252	-0.187	0.510	0.433	0.015	-0.004	0.467	0.456	0.414	-0.216	-0.089	-0.042	0.233	0.372	-0.225	-0.090	-0.378	-0.366	0.255	0.594	-0.187	0.562	-0.141	0.504	0.005	-0.189
GEN44	0.256	0.617	0.418	0.337	0.019	-0.033	0.314	0.169	0.446	0.201	-0.274	0.181	0.046	0.188	0.258	-0.006	-0.041	-0.316	0.140	-0.102	0.617	-0.061	-0.065	0.433	0.059	0.609
GEN45	-0.167	-0.071	0.273	0.228	0.054	0.018	0.373	0.239	0.308	-0.179	0.099	0.055	0.147	0.167	-0.162	-0.263	-0.560	-0.315	0.395	0.533	-0.055	0.289	0.021	0.287	0.135	-0.058
GEN46	-0.307	-0.270	0.477	0.411	-0.118	-0.111	0.337	0.526	0.521	-0.253	0.225	0.115	0.170	0.336	-0.262	-0.006	-0.495	-0.424	0.164	0.932	-0.258	0.170	-0.059	0.461	0.102	-0.259
GEN47	0.047	-0.183	-0.522	-0.482	0.200	0.203	-0.317	-0.567	-0.473	0.010	0.176	-0.374	-0.289	-0.302	0.017	-0.248	0.114	0.005	-0.131	0.044	-0.181	0.100	0.413	-0.516	0.407	-0.183
GEN48	0.029	-0.188	-0.542	-0.402	0.157	0.139	-0.286	-0.584	-0.463	0.026	0.145	-0.339	-0.336	-0.326	0.013	-0.199	0.090	-0.075	-0.176	0.026	-0.183	0.098	0.420	-0.530	0.444	-0.185
GEN49	-0.008	-0.071	-0.292	-0.253	0.233	0.184	-0.190	-0.451	-0.322	-0.144	0.467	-0.186	-0.353	-0.316	-0.023	-0.156	-0.426	-0.152	0.016	0.519	-0.071	0.089	-0.145	-0.306	-0.095	-0.071
GEN50	-0.106	0.160	0.505	0.472	-0.201	-0.154	0.335	0.448	0.557	0.103	-0.049	0.918	0.289	0.507	-0.077	0.550	-0.380	-0.241	-0.054	-0.024	0.172	-0.092	-0.441	0.445	-0.342	0.170
GEN51	-0.355	-0.161	0.287	0.299	-0.119	-0.102	0.245	0.327	0.383	-0.109	0.145	0.673	0.331	0.357	-0.299	0.546	-0.007	-0.126	-0.124	0.275	-0.143	0.013	-0.523	0.273	-0.489	-0.144
GEN52	0.063	0.145	0.448	0.320	0.109	0.119	0.444	0.189	0.242	-0.010	-0.978	0.061	-0.038	0.219	0.054	0.156	0.123	0.118	0.437	-0.279	0.105	-0.014	0.017	0.461	-0.001	0.105
GEN53	-0.184	-0.223	0.314	0.190	-0.128	-0.131	0.199	0.388	0.297	-0.020	-0.092	-0.075	-0.017	-0.005	-0.144	0.081	0.196	0.169	0.464	0.518	-0.222	-0.069	0.091	0.337	0.015	-0.219

Colours highlight significance for correlations: orange. confidence at 99%; pale orange. confidence at 95%. .(a) stands for data not available.

Table 38: Analogue Indicators: Pearson correlations.

	GEN29	GEN30	GEN31	GEN32	GEN33	GEN34	GEN35	GEN36	GEN37	GEN38	GEN39	GEN40	GEN41	GEN41B	GEN42	GEN43	GEN44	GEN45	GEN46	GEN47	GEN48	GEN49	GEN50	GEN51	GEN52
GEN01	-0.198	-0.180	-0.161	0.158	0.423	0.206	-0.136	0.537	-0.153	0.260	0.353	0.573	-0.045	0.030	-0.200	-0.252	0.256	-0.167	-0.307	0.047	0.029	-0.008	-0.106	-0.355	0.063
GEN02	0.356	0.197	0.096	-0.061	0.416	-0.176	0.171	0.069	-0.166	0.154	0.198	0.172	-0.051	-0.037	-0.079	-0.187	0.617	-0.071	-0.270	-0.183	-0.188	-0.071	0.160	-0.161	0.145
GEN03	0.996	0.707	0.421	-0.257	0.031	-0.641	0.584	-0.249	0.419	-0.015	0.346	-0.085	-0.145	-0.165	0.380	0.510	0.418	0.273	0.477	-0.522	-0.542	-0.292	0.505	0.287	0.448
GEN04	0.756	0.660	0.713	-0.057	-0.029	-0.687	0.623	-0.254	0.277	-0.114	0.254	-0.096	-0.126	-0.293	0.386	0.433	0.337	0.228	0.411	-0.482	-0.402	-0.253	0.472	0.299	0.320
GEN05	-0.347	-0.221	0.042	0.474	0.093	0.214	-0.161	-0.211	-0.090	-0.212	-0.028	0.011	0.722	0.339	0.082	0.015	0.019	0.054	-0.118	0.200	0.157	0.233	-0.201	-0.119	0.109
GEN06	-0.274	-0.169	0.048	0.362	0.053	0.186	-0.122	-0.251	-0.090	-0.166	-0.043	0.007	0.885	0.247	0.032	-0.004	-0.033	0.018	-0.111	0.203	0.139	0.184	-0.154	-0.102	0.119
GEN07	0.585	0.548	0.419	0.030	0.075	-0.516	0.561	-0.404	0.324	-0.217	0.256	-0.135	-0.014	0.035	0.530	0.467	0.314	0.373	0.337	-0.317	-0.286	-0.190	0.335	0.245	0.444
GEN08	0.829	0.706	0.396	-0.281	-0.148	-0.688	0.669	-0.240	0.420	0.137	0.141	-0.285	-0.188	-0.254	0.269	0.456	0.169	0.239	0.526	-0.567	-0.584	-0.451	0.448	0.327	0.189
GEN09	0.893	0.706	0.491	-0.235	0.054	-0.722	0.696	-0.208	0.353	0.093	0.172	-0.158	-0.210	-0.191	0.224	0.414	0.446	0.308	0.521	-0.473	-0.463	-0.322	0.557	0.383	0.242
GEN10	-0.125	-0.232	-0.267	-0.103	0.207	0.208	-0.287	0.276	-0.022	0.136	0.161	0.149	-0.213	-0.187	-0.071	-0.216	0.201	-0.179	-0.253	0.010	0.026	-0.144	0.103	-0.109	-0.010
GEN11	-0.390	-0.112	-0.121	-0.087	-0.213	0.107	-0.034	0.254	-0.364	-0.037	-0.846	-0.496	-0.142	-0.013	-0.125	-0.089	-0.274	0.099	0.225	0.176	0.145	0.467	-0.049	0.145	-0.978
GEN12	0.524	0.333	0.279	-0.091	0.014	-0.386	0.422	-0.187	-0.052	-0.051	-0.027	-0.271	-0.047	-0.064	-0.048	-0.042	0.181	0.055	0.115	-0.374	-0.339	-0.186	0.918	0.673	0.061
GEN13	0.523	0.503	0.540	0.051	-0.170	-0.499	0.445	-0.270	-0.030	-0.144	-0.145	-0.432	0.028	0.120	0.209	0.233	0.046	0.147	0.170	-0.289	-0.336	-0.353	0.289	0.331	-0.038
GEN14	0.580	0.583	0.466	-0.089	-0.097	-0.622	0.481	-0.257	0.077	0.061	0.129	-0.319	0.012	0.116	0.190	0.372	0.188	0.167	0.336	-0.302	-0.326	-0.316	0.507	0.357	0.219
GEN15t	-0.154	-0.102	-0.069	0.157	0.445	0.106	-0.071	0.544	-0.117	0.301	0.335	0.592	-0.041	0.030	-0.194	-0.225	0.258	-0.162	-0.262	0.017	0.013	-0.023	-0.077	-0.299	0.054
GEN16	0.400	0.162	0.167	-0.124	-0.111	-0.191	0.091	-0.065	0.128	-0.093	0.151	-0.016	-0.205	-0.066	-0.232	-0.090	-0.006	-0.263	-0.006	-0.248	-0.199	-0.156	0.550	0.546	0.156
GEN17	-0.308	-0.212	-0.279	0.043	-0.021	0.261	-0.230	0.240	0.220	-0.124	0.235	0.399	-0.009	-0.056	-0.329	-0.378	-0.041	-0.560	-0.495	0.114	0.090	-0.426	-0.380	-0.007	0.123
GEN19	-0.144	-0.205	-0.441	-0.021	-0.142	0.381	-0.365	-0.058	0.194	-0.270	0.069	0.069	0.113	0.018	-0.288	-0.366	-0.316	-0.315	-0.424	0.005	-0.075	-0.152	-0.241	-0.126	0.118
GEN20	0.438	0.352	0.083	0.050	0.078	-0.270	0.313	-0.150	0.555	-0.122	0.367	0.012	0.043	0.122	0.448	0.255	0.140	0.395	0.164	-0.131	-0.176	0.016	-0.054	-0.124	0.437
GEN21	0.328	0.407	0.268	-0.201	-0.317	-0.452	0.434	-0.199	0.439	0.092	-0.330	-0.435	0.077	-0.192	0.272	0.594	-0.102	0.533	0.932	0.044	0.026	0.519	-0.024	0.275	-0.279
GEN22	0.352	0.187	0.108	-0.048	0.437	-0.171	0.167	0.099	-0.174	0.164	0.168	0.193	-0.053	-0.038	-0.073	-0.187	0.617	-0.055	-0.258	-0.181	-0.183	-0.071	0.172	-0.143	0.105
GEN23	-0.065	0.033	0.115	0.152	-0.047	-0.044	0.086	-0.144	-0.068	0.182	-0.089	-0.151	-0.012	-0.032	0.784	0.562	-0.061	0.289	0.170	0.100	0.098	0.089	-0.092	0.013	-0.014
GEN24	-0.451	-0.257	-0.210	0.201	0.135	0.180	-0.201	0.358	0.090	0.342	0.186	0.331	-0.039	0.216	-0.043	-0.141	-0.065	0.021	-0.059	0.413	0.420	-0.145	-0.441	-0.523	0.017
GEN25	0.998	0.705	0.382	-0.254	0.006	-0.638	0.587	-0.244	0.443	-0.008	0.362	-0.084	-0.146	-0.164	0.404	0.504	0.433	0.287	0.461	-0.516	-0.530	-0.306	0.445	0.273	0.461
GEN26	-0.390	-0.177	-0.038	0.198	0.193	0.028	-0.063	0.363	0.014	0.423	0.184	0.301	-0.085	0.196	0.074	0.005	0.059	0.135	0.102	0.407	0.444	-0.095	-0.342	-0.489	-0.001
GEN27	0.354	0.193	0.106	-0.050	0.431	-0.175	0.173	0.096	-0.171	0.166	0.167	0.194	-0.053	-0.038	-0.077	-0.189	0.609	-0.058	-0.259	-0.183	-0.185	-0.071	0.170	-0.144	0.105
GEN28	0.951	0.641	0.352	-0.268	-0.013	-0.551	0.495	-0.272	0.235	-0.043	0.246	-0.081	-0.126	-0.167	0.430	0.516	0.508	0.299	0.446	-0.519	-0.542	-0.301	0.532	0.335	0.367
GEN29	1.000	0.707	0.415	-0.265	0.016	-0.640	0.584	-0.248	0.443	-0.008	0.355	-0.070	-0.144	-0.164	0.397	0.484	0.440	0.282	0.446	-0.522	-0.530	-0.300	0.483	0.265	0.457
GEN30	0.707	1.000	0.715	0.011	-0.076	-0.912	0.803	-0.053	0.297	0.158	0.251	0.051	-0.187	-0.067	0.289	0.377	0.176	0.378	0.500	-0.354	-0.404	-0.160	0.306	0.150	0.201
GEN31	0.415	0.715	1.000	0.459	-0.019	-0.803	0.684	-0.159	0.072	0.158	0.126	0.009	0.031	-0.122	0.249	0.312	0.209	0.224	0.316	-0.304	-0.259	-0.025	0.312	0.362	0.093
GEN32	-0.265	0.011	0.459	1.000	0.146	-0.082	-0.038	0.000	-0.271	-0.098	0.033	0.079	0.083	0.302	0.258	0.053	0.199	0.117	-0.153	0.061	0.079	0.042	0.012	-0.132	0.014

GEN33	0.016	-0.076	-0.019	0.146	1.000	-0.013	0.041	0.223	-0.212	0.005	0.260	0.315	-0.015	-0.012	-0.020	-0.158	0.629	0.003	-0.236	0.040	0.092	-0.212	0.133	-0.172	0.141
GEN34	-0.640	-0.912	-0.803	-0.082	-0.013	1.000	-0.838	0.013	-0.333	-0.238	-0.266	0.007	0.246	0.040	-0.290	-0.401	-0.253	-0.351	-0.558	0.282	0.288	0.203	-0.367	-0.186	-0.192
GEN35	0.584	0.803	0.684	-0.038	0.041	-0.838	1.000	-0.066	0.269	0.117	0.211	-0.040	-0.140	-0.105	0.243	0.349	0.226	0.348	0.512	-0.276	-0.271	-0.306	0.332	0.206	0.118
GEN36	-0.248	-0.053	-0.159	0.000	0.223	0.013	-0.066	1.000	-0.008	0.249	0.204	0.491	-0.265	0.126	-0.348	-0.321	-0.052	-0.325	-0.161	0.263	0.134	0.040	-0.194	-0.212	-0.291
GEN37	0.443	0.297	0.072	-0.271	-0.212	-0.333	0.269	-0.008	1.000	0.150	0.389	0.231	-0.049	-0.148	-0.171	0.266	-0.181	-0.304	0.399	-0.241	-0.227	-0.151	-0.102	0.010	0.369
GEN38	-0.008	0.158	0.158	-0.098	0.005	-0.238	0.117	0.249	0.150	1.000	0.160	0.236	-0.075	-0.206	-0.010	0.066	-0.024	0.050	0.158	0.158	0.052	-0.265	-0.093	-0.233	0.010
GEN39	0.355	0.251	0.126	0.033	0.260	-0.266	0.211	0.204	0.389	0.160	1.000	0.747	-0.067	0.066	-0.019	-0.053	0.305	-0.173	-0.236	-0.168	-0.177	-0.484	-0.020	-0.382	0.877
GEN40	-0.070	0.051	0.009	0.079	0.315	0.007	-0.040	0.491	0.231	0.236	0.747	1.000	0.015	0.386	-0.335	-0.366	0.090	-0.377	-0.419	0.077	-0.035	-0.309	-0.197	-0.454	0.468
GEN41	-0.144	-0.187	0.031	0.083	-0.015	0.246	-0.140	-0.265	-0.049	-0.075	-0.067	0.015	1.000	-0.034	-0.089	-0.090	-0.153	-0.176	-0.171	0.136	0.066	0.087	-0.069	-0.029	0.064
GEN41B	-0.164	-0.067	-0.122	0.302	-0.012	0.040	-0.105	0.126	-0.148	-0.206	0.066	0.386	-0.034	1.000	0.162	-0.030	-0.021	0.180	-0.147	0.088	0.001	0.081	-0.132	-0.179	0.005
GEN42	0.397	0.289	0.249	0.258	-0.020	-0.290	0.243	-0.348	-0.171	-0.010	-0.019	-0.335	-0.089	0.162	1.000	0.782	0.279	0.648	0.400	-0.059	0.000	-0.031	0.038	0.109	0.166
GEN43	0.484	0.377	0.312	0.053	-0.158	-0.401	0.349	-0.321	0.266	0.066	-0.053	-0.366	-0.090	-0.030	0.782	1.000	0.157	0.421	0.653	-0.136	-0.104	0.072	-0.106	0.317	0.127
GEN44	0.440	0.176	0.209	0.199	0.629	-0.253	0.226	-0.052	-0.181	-0.024	0.305	0.090	-0.153	-0.021	0.279	0.157	1.000	0.257	-0.002	-0.150	-0.053	-0.343	0.285	-0.056	0.333
GEN45	0.282	0.378	0.224	0.117	0.003	-0.351	0.348	-0.325	-0.304	0.050	-0.173	-0.377	-0.176	0.180	0.648	0.421	0.257	1.000	0.656	0.081	0.207	0.370	0.117	-0.034	-0.031
GEN46	0.446	0.500	0.316	-0.153	-0.236	-0.558	0.512	-0.161	0.399	0.158	-0.236	-0.419	-0.171	-0.147	0.400	0.653	-0.002	0.656	1.000	0.028	0.075	0.559	0.013	0.294	-0.190
GEN47	-0.522	-0.354	-0.304	0.061	0.040	0.282	-0.276	0.263	-0.241	0.158	-0.168	0.077	0.136	0.088	-0.059	-0.136	-0.150	0.081	0.028	1.000	0.846	0.433	-0.328	-0.270	-0.217
GEN48	-0.530	-0.404	-0.259	0.079	0.092	0.288	-0.271	0.134	-0.227	0.052	-0.177	-0.035	0.066	0.001	0.000	-0.104	-0.053	0.207	0.075	0.846	1.000	0.506	-0.320	-0.234	-0.210
GEN49	-0.300	-0.160	-0.025	0.042	-0.212	0.203	-0.306	0.040	-0.151	-0.265	-0.484	-0.309	0.087	0.081	-0.031	0.072	-0.343	0.370	0.559	0.433	0.506	1.000	-0.053	0.141	-0.476
GEN50	0.483	0.306	0.312	0.012	0.133	-0.367	0.332	-0.194	-0.102	-0.093	-0.020	-0.197	-0.069	-0.132	0.038	-0.106	0.285	0.117	0.013	-0.328	-0.320	-0.053	1.000	0.545	0.066
GEN51	0.265	0.150	0.362	-0.132	-0.172	-0.186	0.206	-0.212	0.010	-0.233	-0.382	-0.454	-0.029	-0.179	0.109	0.317	-0.056	-0.034	0.294	-0.270	-0.234	0.141	0.545	1.000	-0.281
GEN52	0.457	0.201	0.093	0.014	0.141	-0.192	0.118	-0.291	0.369	0.010	0.877	0.468	0.064	0.005	0.166	0.127	0.333	-0.031	-0.190	-0.217	-0.210	-0.476	0.066	-0.281	1.000
GEN53	0.338	0.252	0.039	-0.281	-0.275	-0.281	0.251	0.089	0.950	0.150	0.125	0.090	-0.077	-0.162	-0.228	0.187	-0.307	-0.263	0.444	-0.186	-0.180	0.058	-0.132	0.121	0.059

Colours highlight significance for correlations: orange. confidence at 99%; pale orange. confidence at 95%. .(a) stands for data not available.

Table 38: Analogue Indicators: Pearson correlations (continued).

23.4. Analogue vs. Digital (Full Set) Indicators

	INF_S_01	INF_S_02	INF_S_03	INF_S_04	INF_S_05	INF_S_06	INF_S_07	INF_S_08	INF_S_09	INF_S_10	INF_S_11	INF_S_12	INF_D_01	INF_D_02	INF_D_03	INF_D_04	INF_D_06	INF_D_07	INF_D_08	INF_D_09	INF_D_10	ICTSECTOR_S_01	ICTSECTOR_S_02	ICTSECTOR_S_03	ICTSECTOR_S_04
GEN01	-0.153	-0.158	-0.123	-0.365	-0.308	-0.360	-0.140	-0.025	-0.005	-0.161	-0.217	-0.044	0.027	-0.006	-0.299	-0.251	-0.149	-0.159	-0.237	-0.192	0.340	-0.208	0.240	0.053	0.090
GEN02	0.263	0.336	0.359	-0.354	0.090	0.127	0.051	-0.040	0.697	0.257	0.346	0.397	0.388	-0.057	-0.056	-0.015	-0.092	0.014	0.018	0.274	-0.001	-0.160	0.174	0.078	0.219
GEN03	0.882	0.858	0.889	0.116	0.732	0.477	0.595	-0.244	0.640	0.867	0.970	0.875	0.844	0.126	-0.013	0.138	0.140	0.302	0.370	0.766	-0.553	-0.357	0.341	0.412	0.355
GEN04	0.679	0.633	0.726	0.101	0.750	0.515	0.414	-0.355	0.433	0.643	0.957	0.761	0.628	0.133	0.264	0.357	0.204	0.247	0.355	0.661	-0.492	-0.253	0.121	0.266	0.213
GEN05	-0.411	-0.328	-0.358	0.042	-0.313	-0.121	-0.242	0.022	-0.210	-0.369	-0.600	-0.623	-0.319	-0.192	-0.085	-0.168	-0.037	-0.044	-0.076	-0.267	0.193	0.226	-0.351	-0.379	-0.113
GEN06	-0.317	-0.258	-0.282	0.123	-0.257	-0.124	-0.182	0.004	-0.159	-0.291	-0.306	-0.559	-0.253	-0.144	-0.085	-0.158	-0.038	-0.024	-0.084	-0.204	0.167	0.205	-0.295	-0.316	-0.123
GEN07	0.479	0.535	0.560	0.316	0.632	0.554	0.349	-0.363	0.295	0.498	0.927	0.499	0.395	-0.094	0.016	0.124	0.042	0.220	0.325	0.398	-0.541	-0.058	0.059	0.034	0.196
GEN08	0.766	0.750	0.789	0.362	0.755	0.575	0.518	-0.232	0.510	0.725	0.985	0.751	0.768	0.143	-0.060	0.140	0.035	0.301	0.292	0.761	-0.577	-0.145	0.193	0.291	0.388
GEN09	0.866	0.841	0.889	0.134	0.792	0.515	0.547	-0.235	0.560	0.816	0.985	0.892	0.759	0.083	-0.091	0.116	0.152	0.293	0.202	0.765	-0.555	-0.224	0.202	0.381	0.388
GEN10	-0.028	-0.049	-0.060	-0.153	-0.154	0.053	-0.002	0.095	-0.067	0.073	0.172	0.114	0.078	0.169	0.039	-0.075	-0.188	-0.242	-0.025	-0.141	0.417	-0.084	0.330	0.235	-0.053
GEN11	-0.208	-0.288	-0.198	0.150	-0.137	0.038	-0.126	0.127	-0.251	-0.416	-0.778	-0.663	-0.176	-0.105	-0.056	-0.109	0.035	0.075	0.061	-0.108	0.146	0.549	-0.449	-0.433	-0.320
GEN12	0.566	0.599	0.528	0.166	0.607	0.385	0.462	0.137	0.514	0.551	0.974	0.681	0.561	0.085	0.155	0.220	0.070	0.277	0.362	0.660	-0.370	0.048	0.334	0.511	-0.018
GEN13	0.510	0.462	0.577	0.197	0.442	0.362	0.285	-0.192	0.103	0.343	0.889	0.411	0.339	0.125	0.227	0.335	0.161	0.277	0.251	0.666	-0.445	-0.068	-0.043	0.119	0.052
GEN14	0.525	0.497	0.587	0.361	0.652	0.449	0.374	-0.144	0.230	0.390	0.933	0.589	0.431	0.281	0.139	0.335	-0.030	0.263	0.306	0.688	-0.298	-0.153	0.180	0.279	0.071
GEN15t	-0.110	-0.121	-0.058	-0.307	-0.249	-0.315	-0.112	-0.085	0.014	-0.133	-0.032	0.094	0.173	-0.020	-0.301	-0.245	-0.154	-0.134	-0.178	-0.160	0.361	-0.176	0.169	0.039	0.129
GEN16	0.464	0.407	0.314	0.025	0.240	0.300	0.393	0.464	0.341	0.478	0.084	0.539	0.513	0.138	0.419	0.557	-0.024	0.163	-0.011	0.421	-0.132	0.026	0.108	0.282	0.104
GEN17	-0.304	-0.258	-0.340	0.123	-0.300	-0.178	-0.186	0.032	-0.194	-0.350	-0.898	-0.163	-0.325	-0.213	-0.137	-0.205	-0.202	-0.233	-0.313	-0.346	0.179	0.087	-0.088	-0.189	0.207
GEN19	-0.256	-0.108	-0.339	0.226	-0.299	-0.153	-0.148	0.108	-0.140	0.011	-0.485	-0.133	-0.281	-0.057	-0.053	-0.169	-0.125	0.017	-0.014	-0.242	0.183	0.079	0.092	-0.097	0.168
GEN20	0.245	0.347	0.290	0.246	0.300	0.242	0.147	-0.225	0.157	0.214	0.312	-0.004	0.087	-0.081	-0.427	-0.368	-0.098	0.085	0.192	0.023	-0.202	-0.033	0.012	-0.195	0.146
GEN21	0.439	0.189	0.306	0.549	0.574	0.412	0.457	-0.065	0.463	0.125	.(a)	0.424	0.453	-0.003	-0.293	-0.281	0.156	0.113	0.097	0.159	-0.235	0.240	-0.289	-0.081	-0.016
GEN22	0.264	0.332	0.363	-0.358	0.077	0.118	0.054	-0.036	0.686	0.239	0.338	0.381	0.393	-0.059	-0.065	-0.023	-0.086	0.015	-0.014	0.278	0.002	-0.166	0.171	0.093	0.222
GEN23	-0.080	-0.061	0.005	-0.153	-0.015	-0.167	-0.056	-0.101	-0.021	-0.345	0.692	-0.228	-0.084	-0.073	-0.312	-0.278	-0.036	0.112	0.069	-0.074	-0.138	0.010	-0.140	-0.110	-0.096
GEN24	-0.459	-0.401	-0.414	0.049	-0.360	-0.139	-0.369	0.127	-0.375	-0.380	0.110	-0.416	-0.499	-0.049	-0.666	-0.575	0.019	-0.271	-0.403	-0.574	0.424	0.004	-0.129	-0.285	-0.081
GEN25	0.835	0.822	0.860	0.224	0.749	0.479	0.554	-0.265	0.594	0.814	0.974	0.859	0.751	0.081	-0.040	0.118	0.164	0.258	0.323	0.726	-0.491	-0.370	0.335	0.407	0.362
GEN26	-0.370	-0.358	-0.283	-0.034	-0.247	-0.074	-0.312	0.071	-0.319	-0.391	0.427	-0.367	-0.384	-0.004	-0.607	-0.489	0.067	-0.271	-0.316	-0.514	0.344	-0.020	-0.157	-0.267	-0.143
GEN27	0.266	0.334	0.366	-0.360	0.087	0.123	0.055	-0.040	0.685	0.239	0.335	0.381	0.392	-0.063	-0.065	-0.021	-0.083	0.009	-0.015	0.279	0.009	-0.170	0.173	0.093	0.224
GEN28	0.898	0.841	0.849	0.127	0.645	0.429	0.661	-0.203	0.653	0.876	0.992	0.874	0.856	0.164	0.119	0.250	0.139	0.330	0.409	0.834	-0.488	-0.372	0.349	0.390	0.316
GEN29	0.890	0.860	0.889	0.123	0.731	0.476	0.588	-0.252	0.634	0.878	0.982	0.877	0.823	0.073	-0.045	0.114	0.136	0.278	0.367	0.741	-0.554	-0.357	0.336	0.393	0.358
GEN30	0.627	0.627	0.739	0.261	0.654	0.517	0.368	-0.638	0.354	0.673	0.871	0.815	0.536	0.071	-0.296	-0.052	0.118	0.212	0.203	0.485	-0.414	-0.258	0.046	0.107	0.301

GEN31	0.336	0.331	0.458	-0.083	0.417	0.524	0.149	-0.430	0.180	0.275	0.878	0.463	0.277	0.089	0.268	0.379	0.146	0.174	0.079	0.270	-0.249	-0.230	-0.192	-0.051	0.180
GEN32	-0.229	-0.192	-0.171	-0.240	-0.285	-0.038	-0.242	0.046	-0.171	-0.277	-0.683	-0.420	-0.112	0.127	0.139	0.078	0.007	-0.092	0.039	-0.225	0.216	-0.151	-0.142	-0.138	-0.015
GEN33	-0.044	0.051	0.090	-0.454	-0.142	-0.038	-0.062	-0.038	0.234	-0.007	0.142	0.179	0.222	-0.026	-0.113	-0.186	-0.038	-0.131	-0.127	0.045	0.370	-0.186	0.118	0.068	0.017
GEN34	-0.552	-0.543	-0.705	-0.228	-0.708	-0.596	-0.307	0.623	-0.321	-0.580	-0.969	-0.732	-0.490	-0.173	0.153	-0.063	-0.120	-0.139	-0.191	-0.475	0.361	0.168	0.015	-0.121	-0.320
GEN35	0.495	0.489	0.654	0.228	0.694	0.457	0.310	-0.706	0.316	0.565	0.963	0.634	0.454	-0.007	-0.501	-0.329	0.104	0.043	0.128	0.436	-0.571	-0.135	-0.112	0.027	0.341
GEN36	-0.218	-0.271	-0.110	-0.215	-0.245	-0.238	-0.153	-0.161	-0.217	-0.272	-0.752	-0.421	-0.264	-0.043	-0.374	-0.364	0.070	-0.060	-0.253	-0.334	0.236	0.072	-0.045	0.033	-0.119
GEN37	0.299	0.327	0.269	0.472	0.376	0.198	0.251	-0.189	0.141	0.445	0.283	0.104	0.208	-0.187	-0.445	-0.401	-0.257	-0.083	-0.081	-0.096	-0.240	0.007	0.135	0.109	0.382
GEN38	0.111	0.058	0.132	0.149	0.041	0.298	0.024	0.111	-0.025	0.001	0.355	0.135	0.062	0.324	-0.542	-0.395	-0.066	0.068	-0.216	-0.097	0.246	-0.106	0.243	-0.019	0.162
GEN39	0.120	0.196	0.194	0.023	0.125	-0.021	0.065	-0.207	0.150	0.266	-0.222	0.453	0.196	0.220	-0.133	-0.079	-0.054	-0.065	0.218	0.012	-0.030	-0.536	0.455	0.256	0.285
GEN40	-0.010	-0.006	-0.060	-0.215	-0.267	-0.281	0.022	-0.261	-0.002	-0.004	-0.680	0.133	-0.118	0.058	-0.310	-0.262	-0.178	-0.224	-0.477	-0.388	0.244	-0.375	0.349	0.106	0.304
GEN41	-0.145	-0.123	-0.163	0.154	-0.203	0.060	-0.086	-0.012	-0.068	-0.153	-0.827	-0.257	-0.154	-0.123	-0.334	-0.313	-0.047	-0.047	-0.091	-0.124	-0.170	0.197	-0.174	-0.160	-0.099
GEN41B	-0.090	-0.130	-0.076	-0.213	-0.153	-0.146	-0.117	0.391	-0.113	-0.173	0.420	-0.337	-0.232	0.086	-0.412	-0.301	-0.132	-0.075	-0.070	-0.295	-0.120	0.141	-0.064	-0.062	-0.059
GEN42	0.309	0.269	0.436	0.010	0.325	0.226	-0.009	-0.224	0.682	0.125	.(a)	0.246	0.215	-0.021	0.623	0.562	0.258	0.186	0.435	0.216	-0.357	-0.052	-0.088	0.071	-0.132
GEN43	0.443	0.247	0.395	0.365	0.522	0.222	0.109	-0.190	0.707	0.278	.(a)	0.357	0.429	0.112	0.259	0.269	0.137	0.284	0.318	0.328	-0.342	0.058	-0.149	0.082	0.018
GEN44	0.392	0.285	0.406	-0.420	0.262	0.135	-0.106	-0.239	0.356	0.283	.(a)	0.250	0.520	0.089	0.069	0.046	0.289	-0.136	0.191	0.369	0.035	-0.282	0.196	0.291	0.189
GEN45	0.350	0.125	0.312	-0.101	0.408	0.293	0.227	0.015	0.428	-0.047	.(a)	-0.141	0.296	-0.049	-0.106	-0.136	0.409	-0.008	0.292	0.130	-0.158	-0.121	-0.126	-0.032	-0.154
GEN46	0.467	0.284	0.409	0.471	0.691	0.431	0.494	-0.108	0.470	0.229	.(a)	0.521	0.486	-0.062	-0.389	-0.374	0.177	0.115	0.157	0.176	-0.318	0.135	-0.301	-0.048	0.026
GEN47	-0.516	-0.521	-0.404	-0.171	-0.411	-0.131	-0.292	0.275	-0.323	-0.508	0.139	-0.637	-0.443	0.147	-0.464	-0.447	-0.028	-0.288	-0.317	-0.501	0.311	0.077	-0.238	-0.317	-0.298
GEN48	-0.565	-0.555	-0.436	-0.330	-0.326	-0.151	-0.314	0.373	-0.327	-0.458	-0.147	-0.515	-0.583	-0.118	-0.339	-0.275	0.099	-0.373	-0.386	-0.585	0.420	0.159	-0.285	-0.294	-0.328
GEN49	-0.353	-0.435	-0.242	-0.007	-0.049	0.109	-0.157	0.147	-0.289	-0.337	-0.435	-0.290	-0.364	-0.306	-0.545	-0.454	0.195	0.046	-0.079	-0.336	0.147	0.249	-0.290	-0.215	-0.501
GEN50	0.540	0.536	0.470	-0.083	0.498	0.337	0.453	0.097	0.362	0.541	0.841	0.721	0.532	0.192	0.271	0.250	0.084	0.245	0.222	0.601	-0.306	-0.015	0.353	0.519	-0.021
GEN51	0.301	0.269	0.199	0.067	0.456	0.204	0.392	0.009	0.179	0.334	0.893	0.486	0.272	-0.001	0.537	0.605	0.055	0.377	-0.058	0.463	-0.186	0.265	-0.194	0.208	-0.083
GEN52	0.205	0.301	0.212	0.121	0.218	0.042	0.124	-0.139	0.237	0.374	0.812	0.623	0.215	0.199	0.070	0.124	-0.069	-0.042	0.314	0.169	-0.158	-0.576	0.456	0.242	0.331
GEN53	0.255	0.250	0.218	0.434	0.330	0.202	0.227	-0.169	0.071	0.342	0.058	-0.120	0.129	-0.274	-0.477	-0.446	-0.260	-0.075	-0.192	-0.156	-0.213	0.182	-0.008	0.036	0.310

Colours highlight significance for correlations: orange. confidence at 99%; pale orange. confidence at 95%. .(a) stands for data not available.

Table 39: Analogue vs. Digital (Full Set) Indicators: Correlations.: Pearson correlations

	ICTSECTOR_S_05	ICTSECTOR_S_06	ICTSECTOR_S_07	ICTSECTOR_D_01	ICTSECTOR_D_02	ICTSECTOR_D_03	ICTSECTOR_D_04	ICTSECTOR_D_06	DIGLIT_S_01	DIGLIT_S_02	DIGLIT_S_03	DIGLIT_S_04	DIGLIT_S_05	DIGLIT_S_06	DIGLIT_S_07	DIGLIT_D_01	DIGLIT_D_02	LEGAL_S_01	LEGAL_S_02	LEGAL_S_03	LEGAL_S_04	LEGAL_S_05	LEGAL_S_06	LEGAL_S_07	LEGAL_S_08
GEN01	0.501	0.093	-0.081	0.186	-0.151	0.053	-0.171	-0.191	-0.108	0.032	-0.085	-0.125	-0.318	-0.264	-0.208	-0.041	-0.082	-0.043	-0.126	0.027	0.001	-0.122	-0.050	0.059	0.082
GEN02	0.710	-0.134	0.327	0.036	0.243	0.395	0.262	0.297	-0.063	0.108	0.169	-0.081	0.143	-0.262	0.203	0.054	0.263	0.274	0.262	0.154	0.138	0.057	0.119	0.099	0.112
GEN03	0.342	-0.367	0.368	-0.090	0.772	0.792	0.804	0.945	0.074	-0.099	0.483	0.086	0.420	0.285	0.683	-0.002	0.825	0.809	0.835	0.393	0.358	0.213	0.346	0.251	0.242
GEN04	0.293	-0.393	0.251	0.080	0.611	0.619	0.620	0.663	0.123	0.207	0.530	0.149	0.458	0.322	0.747	-0.259	0.701	0.598	0.636	0.194	0.394	0.318	0.399	0.348	0.247
GEN05	-0.110	-0.001	-0.204	0.057	-0.351	-0.498	-0.393	-0.366	-0.108	-0.109	-0.222	-0.137	-0.175	-0.086	-0.080	0.054	-0.452	-0.355	-0.389	-0.281	-0.405	-0.078	-0.359	-0.326	-0.316
GEN06	-0.114	-0.055	-0.154	0.043	-0.276	-0.431	-0.293	-0.281	-0.079	-0.114	-0.214	-0.092	-0.103	-0.060	-0.031	0.016	-0.389	-0.337	-0.361	-0.276	-0.351	-0.046	-0.286	-0.260	-0.310
GEN07	0.115	-0.237	0.272	-0.060	0.591	0.504	0.516	0.531	-0.115	-0.033	0.405	0.049	0.312	0.216	0.602	-0.186	0.517	0.459	0.440	0.081	0.072	0.096	0.170	0.068	-0.026
GEN08	0.262	-0.340	0.368	0.009	0.698	0.565	0.811	0.712	0.111	-0.072	0.465	0.076	0.305	0.385	0.662	-0.237	0.861	0.845	0.838	0.243	0.188	0.077	0.154	0.093	0.128
GEN09	0.345	-0.408	0.369	0.027	0.719	0.514	0.768	0.715	0.117	-0.079	0.509	0.226	0.550	0.277	0.788	-0.106	0.872	0.855	0.837	0.330	0.267	0.154	0.236	0.146	0.203
GEN10	0.148	0.048	-0.032	0.159	-0.144	-0.048	0.052	-0.030	0.062	0.342	-0.111	-0.152	-0.303	-0.102	-0.263	-0.162	0.063	0.023	0.040	-0.168	-0.026	-0.114	-0.086	0.028	-0.017
GEN11	-0.251	-0.073	0.128	-0.203	-0.091	-0.014	-0.137	-0.316	0.019	0.142	-0.206	-0.057	-0.143	-0.030	-0.226	0.383	-0.281	-0.280	-0.196	-0.121	0.030	-0.044	-0.065	0.097	-0.012
GEN12	0.099	-0.223	0.267	0.019	0.468	0.518	0.626	0.622	0.094	-0.184	0.347	0.129	0.328	0.195	0.479	0.291	0.486	0.495	0.534	0.194	0.273	0.121	0.163	0.140	0.141
GEN13	-0.142	-0.344	0.182	0.013	0.313	-0.038	0.392	0.436	0.076	0.158	0.191	0.086	0.280	0.253	0.581	-0.041	0.377	0.416	0.469	0.056	0.054	0.015	0.098	0.070	-0.011
GEN14	0.018	-0.361	0.216	0.050	0.511	0.448	0.651	0.587	0.099	-0.061	0.317	0.208	0.372	0.292	0.645	-0.084	0.530	0.466	0.476	0.095	0.126	-0.031	0.179	0.213	-0.103
GEN15t	0.583	0.024	-0.059	0.184	-0.134	0.097	-0.137	-0.158	-0.092	0.069	-0.010	-0.085	-0.260	-0.228	-0.127	-0.037	-0.034	-0.017	-0.095	0.025	0.014	-0.133	-0.045	0.098	0.101
GEN16	0.065	-0.178	-0.006	-0.042	0.113	0.088	0.310	0.348	0.100	-0.066	0.451	0.141	0.297	0.182	0.216	0.300	0.418	0.461	0.486	0.159	0.205	0.113	-0.018	0.180	0.179
GEN17	-0.167	0.038	-0.246	0.150	-0.346	-0.418	-0.340	-0.312	-0.074	0.080	-0.039	-0.104	-0.238	-0.171	-0.438	0.147	-0.166	-0.112	-0.168	-0.269	-0.190	-0.452	-0.360	-0.364	-0.238
GEN19	-0.068	0.252	-0.205	-0.161	-0.281	-0.028	-0.303	-0.031	-0.082	0.024	0.068	-0.328	-0.347	0.083	-0.450	-0.037	-0.212	-0.157	-0.083	-0.100	-0.038	-0.078	-0.064	-0.059	-0.212
GEN20	0.125	-0.205	0.155	-0.042	0.309	0.457	0.134	0.305	0.016	0.010	0.120	0.103	0.034	0.274	0.251	-0.046	0.317	0.265	0.259	-0.114	-0.034	-0.039	-0.007	-0.050	-0.213
GEN21	-0.214	-0.196	0.379	-0.261	0.518	0.685	0.411	0.226	-0.106	-0.108	0.214	0.192	0.376	0.552	0.409	0.049	0.384	0.140	0.149	-0.066	-0.038	0.086	0.090	0.303	0.250
GEN22	0.726	-0.130	0.321	0.050	0.217	0.261	0.243	0.247	-0.064	0.137	0.178	-0.082	0.146	-0.278	0.207	0.057	0.258	0.276	0.259	0.159	0.137	0.069	0.125	0.111	0.125
GEN23	-0.062	0.196	0.008	0.048	-0.297	-0.421	-0.325	-0.068	-0.042	-0.066	-0.182	-0.113	-0.029	0.292	0.065	-0.012	-0.090	-0.114	-0.037	-0.276	-0.295	0.037	-0.394	-0.056	0.039
GEN24	-0.045	0.268	-0.169	-0.216	-0.177	-0.299	-0.220	-0.523	0.034	-0.223	-0.086	0.159	-0.059	0.102	-0.210	-0.230	-0.318	-0.326	-0.465	-0.189	-0.297	-0.254	-0.277	-0.093	-0.155
GEN25	0.340	-0.370	0.316	-0.103	0.760	0.791	0.795	0.913	0.076	-0.130	0.477	0.095	0.423	0.299	0.642	-0.011	0.813	0.793	0.814	0.357	0.317	0.138	0.308	0.191	0.163
GEN26	-0.020	0.166	-0.085	-0.165	-0.067	-0.184	-0.103	-0.477	0.069	-0.215	-0.108	0.273	0.042	0.090	-0.025	-0.232	-0.238	-0.276	-0.440	-0.167	-0.281	-0.224	-0.251	-0.061	-0.087
GEN27	0.729	-0.134	0.316	0.050	0.223	0.261	0.247	0.249	-0.065	0.124	0.175	-0.083	0.143	-0.278	0.205	0.060	0.263	0.280	0.264	0.158	0.136	0.061	0.122	0.104	0.120
GEN28	0.305	-0.317	0.278	-0.103	0.728	0.710	0.759	0.982	0.034	-0.089	0.435	0.019	0.327	0.276	0.606	0.038	0.778	0.787	0.836	0.372	0.341	0.213	0.332	0.243	0.232
GEN29	0.346	-0.362	0.336	-0.084	0.759	0.772	0.796	0.937	0.081	-0.104	0.455	0.087	0.404	0.283	0.678	-0.021	0.828	0.811	0.833	0.379	0.345	0.206	0.345	0.256	0.233

GEN30	0.246	-0.507	0.232	-0.049	0.572	0.469	0.600	0.574	0.064	-0.287	0.489	0.272	0.446	0.309	0.681	-0.048	0.707	0.609	0.577	0.195	0.259	0.016	0.380	0.348	0.137
GEN31	0.200	-0.483	0.106	0.167	0.207	0.095	0.333	0.234	0.061	0.137	0.477	0.216	0.441	0.174	0.722	-0.095	0.346	0.341	0.348	0.029	0.092	0.300	0.162	0.617	0.263
GEN32	-0.019	0.009	-0.170	0.186	-0.287	-0.252	-0.278	-0.271	-0.057	-0.018	-0.022	0.063	-0.186	-0.080	0.135	-0.039	-0.290	-0.182	-0.217	-0.150	-0.115	-0.090	-0.255	0.015	-0.049
GEN33	0.298	-0.054	0.410	0.000	0.150	0.070	0.078	-0.046	-0.045	0.328	0.169	-0.104	0.166	-0.276	0.099	-0.065	0.005	-0.031	-0.098	-0.010	0.072	0.028	0.054	0.069	0.107
GEN34	-0.236	0.508	-0.255	-0.050	-0.583	-0.479	-0.617	-0.495	-0.089	0.230	-0.517	-0.407	-0.652	-0.300	-0.806	0.056	-0.684	-0.572	-0.506	-0.160	-0.215	-0.033	-0.320	-0.282	-0.156
GEN35	0.188	-0.520	0.271	0.092	0.555	0.585	0.604	0.470	-0.156	-0.161	0.499	0.472	0.626	0.339	0.659	-0.044	0.653	0.567	0.531	0.148	0.143	0.104	0.259	0.163	0.216
GEN36	0.169	-0.136	0.181	0.110	-0.025	-0.194	-0.103	-0.323	0.189	-0.079	-0.020	0.314	-0.058	-0.046	-0.255	0.051	-0.044	-0.068	-0.181	0.097	0.058	-0.291	0.034	0.132	0.034
GEN37	0.196	-0.124	0.107	-0.081	0.332	0.506	0.377	0.188	0.057	-0.211	0.020	-0.041	0.000	0.326	0.228	-0.178	0.467	0.383	0.354	0.117	0.105	-0.025	0.113	0.099	-0.012
GEN38	0.395	-0.042	0.112	-0.053	0.181	0.386	0.271	-0.072	0.114	-0.480	0.390	0.341	0.235	0.221	0.065	-0.085	0.107	0.041	-0.089	0.119	-0.212	-0.165	-0.120	-0.044	0.082
GEN39	0.382	-0.189	-0.047	0.162	0.190	0.634	0.269	0.376	0.059	-0.120	0.200	0.215	-0.086	0.174	0.156	-0.378	0.350	0.250	0.191	0.054	0.086	-0.150	0.101	0.016	-0.221
GEN40	0.429	0.102	-0.164	0.185	-0.054	-0.148	-0.186	-0.141	-0.209	-0.299	0.190	0.139	-0.173	-0.227	-0.203	-0.120	0.118	0.033	-0.064	0.012	0.098	-0.157	0.136	0.070	0.048
GEN41	-0.070	-0.097	-0.065	0.073	-0.229	-0.516	-0.196	-0.124	-0.024	-0.079	-0.053	0.122	0.030	0.474	-0.021	-0.060	-0.259	-0.287	-0.255	-0.305	-0.346	0.047	-0.366	0.050	0.056
GEN41B	-0.015	0.075	-0.094	0.090	-0.255	-0.085	-0.203	-0.171	-0.039	-0.128	-0.205	0.356	-0.018	-0.167	-0.039	0.059	-0.098	-0.024	-0.099	0.069	0.030	0.014	-0.006	0.062	-0.187
GEN42	-0.200	0.007	0.042	0.287	0.124	0.204	0.300	0.441	0.390	0.079	0.100	0.434	0.190	0.621	0.400	-0.032	0.082	-0.040	0.046	-0.105	-0.195	0.215	-0.137	0.275	0.163
GEN43	-0.139	-0.033	0.157	-0.037	0.442	0.545	0.447	0.497	-0.094	-0.150	0.170	0.173	0.334	0.703	0.456	-0.107	0.326	0.117	0.229	0.006	-0.198	0.177	-0.093	0.161	0.096
GEN44	0.229	-0.125	-0.167	0.359	0.099	-0.088	0.228	0.389	0.084	0.309	0.222	0.115	0.263	-0.342	0.347	-0.107	0.276	0.191	-0.017	0.124	0.125	0.160	0.172	0.168	0.240
GEN45	-0.230	-0.142	0.163	-0.001	0.180	0.158	0.170	0.226	-0.013	-0.001	-0.121	0.137	0.229	0.242	0.349	0.033	0.118	0.036	-0.100	0.047	-0.070	0.196	0.091	0.344	0.327
GEN46	-0.185	-0.117	0.404	-0.201	0.608	0.728	0.446	0.310	-0.152	-0.137	0.234	0.274	0.469	0.603	0.515	-0.078	0.478	0.258	0.175	0.072	-0.084	0.075	0.097	0.331	0.244
GEN47	-0.251	0.112	-0.081	-0.187	-0.320	-0.254	-0.363	-0.453	-0.059	-0.112	-0.208	0.226	0.038	-0.112	-0.288	-0.020	-0.548	-0.514	-0.599	-0.339	-0.308	-0.310	-0.278	-0.246	-0.237
GEN48	-0.261	0.133	-0.171	-0.234	-0.307	-0.511	-0.455	-0.535	-0.037	-0.029	-0.270	0.211	0.065	-0.210	-0.231	-0.038	-0.558	-0.552	-0.612	-0.326	-0.273	-0.183	-0.244	-0.169	-0.205
GEN49	-0.160	0.428	-0.271	0.086	-0.383	-0.247	-0.361	-0.242	-0.311	-0.231	-0.407	0.103	-0.033	-0.100	-0.165	-0.130	-0.533	-0.440	-0.395	-0.170	-0.116	-0.130	-0.106	-0.285	-0.291
GEN50	0.129	-0.189	0.193	0.163	0.230	0.224	0.447	0.500	0.084	-0.152	0.381	0.146	0.337	0.131	0.455	0.304	0.460	0.478	0.509	0.228	0.348	0.260	0.226	0.127	0.248
GEN51	-0.241	-0.139	0.112	0.119	0.193	-0.225	0.134	0.168	0.067	0.218	0.231	-0.204	0.283	0.261	0.276	0.342	0.240	0.323	0.360	0.147	-0.009	0.244	0.009	-0.130	0.241
GEN52	0.278	-0.044	-0.133	0.107	0.198	0.526	0.269	0.507	-0.025	-0.094	0.197	0.031	-0.035	0.178	0.251	-0.400	0.320	0.245	0.221	0.013	0.029	-0.021	0.083	-0.075	-0.241
GEN53	0.127	-0.120	0.170	-0.123	0.262	0.164	0.192	0.031	0.070	-0.199	-0.033	-0.051	0.012	0.269	0.145	-0.056	0.394	0.329	0.306	0.122	0.105	-0.018	0.095	0.130	0.082

Colours highlight significance for correlations: orange. confidence at 99%; pale orange. confidence at 95%. .(a) stands for data not available.

Table 39: Analogue vs. Digital (Full Set) Indicators: Correlations.: Pearson correlations (continued).

	LEGAL_ S_09	LEGAL_ S_10	LEGAL_ S_11	LEGAL_ S_12	LEGAL_ S_13	LEGAL_ S_14	LEGAL_ D_01	LEGAL_ D_02	LEGAL_ D_03	LEGAL_ D_04	USE_S_ 01	USE_S_ 02	USE_S_ 03	USE_S_ 04	USE_S_ 05	USE_S_ 06	USE_D_ 02	USE_D_ 04	USE_D_ 07	USE_D_ 08	USE_D_ 09	USE_D_ 10	USE_D_ 11	USE_D_ 12
GEN01	-0.040	0.094	-0.003	-0.406	-0.346	0.055	0.067	0.067	0.023	0.010	-0.083	-0.023	0.033	-0.199	-0.031	-0.027	-0.245	-0.132	-0.192	0.061	-0.071	0.037	-0.025	0.011
GEN02	0.123	0.138	0.138	0.054	0.072	0.098	0.125	0.163	0.301	0.181	0.505	0.552	0.373	0.085	0.381	0.250	-0.039	0.172	0.325	0.424	-0.183	0.299	0.353	0.203
GEN03	0.334	0.291	0.202	0.401	0.328	0.228	0.469	0.412	0.574	0.496	0.794	0.619	0.073	0.064	0.723	0.752	0.459	0.789	0.846	0.543	-0.533	0.658	0.771	0.642
GEN04	0.305	0.275	0.226	0.448	0.355	0.246	0.327	0.264	0.401	0.313	0.517	0.385	-0.040	-0.120	0.599	0.588	0.468	0.402	0.665	0.425	-0.360	0.473	0.589	0.508
GEN05	-0.438	-0.334	-0.108	-0.391	-0.443	-0.043	-0.317	-0.383	-0.392	-0.365	-0.276	-0.150	0.047	-0.104	-0.160	-0.112	-0.066	-0.342	-0.377	-0.050	0.164	-0.435	-0.330	-0.168
GEN06	-0.393	-0.324	-0.042	-0.415	-0.440	-0.011	-0.314	-0.382	-0.393	-0.345	-0.209	-0.124	0.047	-0.118	-0.094	-0.094	-0.062	-0.264	-0.296	-0.005	0.105	-0.427	-0.298	-0.157
GEN07	-0.036	-0.098	0.111	0.338	0.168	0.069	0.184	0.159	0.294	0.216	0.408	0.390	0.033	-0.188	0.504	0.533	0.512	0.364	0.514	0.437	-0.274	0.328	0.461	0.409
GEN08	0.295	0.060	0.035	0.404	0.256	0.154	0.557	0.477	0.589	0.548	0.668	0.499	0.131	0.131	0.702	0.730	0.397	0.474	0.752	0.422	-0.300	0.707	0.779	0.655
GEN09	0.278	0.220	0.149	0.386	0.263	0.228	0.469	0.402	0.589	0.499	0.719	0.503	0.038	0.066	0.752	0.775	0.470	0.474	0.829	0.549	-0.418	0.672	0.831	0.643
GEN10	0.005	-0.186	-0.048	-0.038	0.035	-0.226	0.258	0.353	0.266	0.244	-0.053	-0.071	0.116	-0.073	-0.156	-0.081	-0.164	0.108	-0.050	-0.131	0.013	0.180	0.010	0.063
GEN11	0.112	0.003	-0.250	0.086	0.150	0.047	-0.207	-0.155	-0.297	-0.140	-0.247	-0.189	0.389	0.415	-0.203	-0.420	-0.057	-0.255	-0.249	-0.161	0.586	-0.230	-0.272	-0.302
GEN12	0.111	0.255	0.070	0.299	0.237	0.178	0.215	0.245	0.347	0.267	0.527	0.108	0.206	-0.080	0.515	0.381	0.564	0.680	0.554	0.367	-0.121	0.368	0.538	0.312
GEN13	0.138	-0.004	-0.063	0.205	0.128	0.132	0.040	-0.029	0.071	0.094	0.397	0.197	-0.187	0.022	0.392	0.337	0.259	0.203	0.489	0.276	-0.195	0.195	0.385	0.204
GEN14	0.126	-0.065	-0.137	0.108	0.053	0.007	0.153	0.069	0.206	0.168	0.410	0.270	-0.145	-0.115	0.459	0.365	0.337	0.340	0.583	0.221	-0.354	0.319	0.467	0.256
GEN15t	-0.006	0.172	-0.003	-0.352	-0.318	0.089	0.084	0.071	0.062	0.010	-0.054	-0.004	0.038	-0.213	0.007	0.012	-0.190	-0.117	-0.148	0.102	-0.064	0.045	-0.004	0.033
GEN16	0.107	0.152	0.077	0.336	0.303	0.086	0.399	0.419	0.500	0.358	0.399	0.138	0.175	0.099	0.278	0.405	0.496	-0.065	0.383	0.361	-0.125	0.459	0.432	0.339
GEN17	-0.133	-0.270	-0.158	-0.272	-0.274	-0.368	0.257	0.322	0.173	0.192	-0.231	0.007	0.180	-0.025	-0.176	0.022	-0.286	0.116	-0.260	0.011	0.382	0.051	-0.194	0.079
GEN19	-0.120	-0.099	-0.107	-0.107	-0.018	-0.205	0.178	0.220	0.079	0.122	-0.091	-0.099	0.208	0.009	-0.169	-0.047	-0.122	0.247	-0.278	-0.031	0.189	0.071	-0.175	0.061
GEN20	-0.176	-0.170	-0.043	-0.006	-0.036	-0.133	0.304	0.249	0.279	0.266	0.226	0.469	0.062	0.001	0.273	0.387	0.227	0.210	0.267	0.365	-0.187	0.271	0.259	0.349
GEN21	0.131	-0.047	0.000	0.324	0.281	0.116	-0.061	-0.148	-0.093	-0.070	0.380	0.419	0.082	0.129	0.173	0.149	0.353	0.440	0.426	-0.104	0.127	-0.027	0.185	0.041
GEN22	0.130	0.144	0.145	0.061	0.079	0.117	0.115	0.152	0.295	0.168	0.500	0.549	0.353	0.088	0.373	0.250	-0.036	0.069	0.316	0.423	-0.193	0.288	0.356	0.201
GEN23	-0.269	-0.285	0.064	0.057	0.068	0.037	-0.106	-0.067	-0.108	-0.051	-0.061	-0.048	-0.046	-0.049	-0.026	-0.027	-0.142	-0.232	-0.048	-0.127	0.032	-0.160	-0.086	-0.007
GEN24	-0.363	-0.166	-0.123	-0.367	-0.301	-0.224	-0.163	-0.193	-0.194	-0.226	-0.439	-0.259	-0.179	-0.222	-0.311	-0.288	-0.419	-0.130	-0.463	-0.273	0.128	-0.258	-0.309	-0.260
GEN25	0.304	0.235	0.159	0.357	0.291	0.099	0.503	0.442	0.585	0.517	0.740	0.579	0.096	0.047	0.713	0.748	0.432	0.723	0.818	0.506	-0.494	0.660	0.732	0.657
GEN26	-0.325	-0.145	-0.099	-0.343	-0.307	-0.142	-0.259	-0.300	-0.239	-0.294	-0.404	-0.220	-0.266	-0.234	-0.256	-0.288	-0.361	-0.269	-0.355	-0.269	0.044	-0.291	-0.242	-0.307
GEN27	0.129	0.142	0.141	0.057	0.076	0.110	0.129	0.165	0.304	0.181	0.500	0.547	0.364	0.086	0.381	0.255	-0.038	0.151	0.321	0.423	-0.189	0.297	0.357	0.210
GEN28	0.330	0.262	0.190	0.363	0.323	0.219	0.443	0.413	0.545	0.489	0.831	0.550	0.133	0.073	0.713	0.718	0.493	0.814	0.837	0.531	-0.506	0.669	0.762	0.619
GEN29	0.327	0.274	0.198	0.393	0.329	0.224	0.475	0.421	0.586	0.502	0.781	0.620	0.089	0.071	0.716	0.745	0.432	0.781	0.844	0.539	-0.532	0.665	0.769	0.642
GEN30	0.317	0.053	0.088	0.328	0.206	0.084	0.375	0.265	0.392	0.354	0.495	0.371	0.035	-0.121	0.601	0.592	0.504	0.501	0.664	0.408	-0.403	0.450	0.575	0.537

GEN31	0.122	0.123	0.172	0.250	0.231	0.321	0.059	-0.057	0.081	0.036	0.240	0.083	-0.236	-0.285	0.409	0.377	0.462	-0.012	0.380	0.302	-0.248	0.095	0.302	0.251
GEN32	-0.160	-0.051	-0.043	-0.079	-0.028	-0.054	-0.194	-0.254	-0.244	-0.295	-0.232	-0.224	-0.169	-0.439	-0.086	-0.007	0.008	-0.200	-0.269	-0.005	-0.014	-0.328	-0.193	-0.053
GEN33	-0.097	0.141	0.128	-0.190	-0.171	0.110	-0.090	-0.059	0.000	-0.080	0.189	0.240	0.099	-0.133	0.068	0.047	-0.063	0.012	0.026	0.198	-0.189	-0.050	0.075	0.000
GEN34	-0.276	-0.043	-0.044	-0.296	-0.154	-0.111	-0.295	-0.173	-0.351	-0.273	-0.412	-0.327	0.036	0.190	-0.576	-0.535	-0.378	-0.374	-0.607	-0.362	0.334	-0.387	-0.554	-0.447
GEN35	0.167	0.029	0.136	0.253	0.139	0.256	0.307	0.234	0.334	0.382	0.392	0.308	0.026	-0.132	0.628	0.513	0.320	0.359	0.550	0.411	-0.275	0.393	0.515	0.460
GEN36	0.092	0.058	-0.152	-0.205	-0.197	-0.122	0.159	0.118	0.063	0.096	-0.252	-0.142	0.098	-0.074	-0.228	-0.109	-0.010	-0.298	-0.125	-0.028	0.166	-0.018	-0.133	-0.068
GEN37	0.109	0.023	-0.096	0.049	-0.010	0.016	0.450	0.388	0.458	0.406	0.195	0.467	-0.005	0.053	0.164	0.360	0.076	0.334	0.293	0.154	-0.119	0.366	0.307	0.346
GEN38	-0.086	-0.084	-0.056	-0.405	-0.263	0.074	0.074	-0.039	0.061	0.064	0.011	-0.013	-0.169	-0.073	0.105	-0.039	-0.286	-0.114	0.038	-0.049	-0.051	0.067	0.096	-0.035
GEN39	-0.058	-0.175	-0.066	-0.288	-0.352	-0.204	0.265	0.214	0.328	0.188	0.126	0.118	-0.224	-0.440	0.124	0.300	0.076	0.333	0.252	0.114	-0.483	0.324	0.251	0.245
GEN40	-0.043	-0.031	0.046	-0.479	-0.425	-0.121	0.206	0.198	0.224	0.178	-0.048	0.106	0.000	-0.322	-0.031	0.124	-0.093	-0.079	-0.011	0.127	-0.163	0.165	0.069	0.153
GEN41	-0.297	0.074	0.073	-0.359	-0.349	0.046	-0.241	-0.278	-0.324	-0.238	-0.089	-0.073	0.106	-0.085	-0.017	-0.082	-0.082	-0.129	-0.155	0.045	0.049	-0.361	-0.233	-0.124
GEN41B	-0.072	-0.123	0.082	-0.123	-0.120	-0.010	0.029	0.008	0.016	0.007	-0.146	-0.105	-0.048	-0.224	0.010	-0.045	-0.114	-0.166	-0.080	0.117	0.035	-0.126	-0.056	-0.035
GEN42	-0.051	-0.113	0.252	0.403	0.359	0.151	-0.224	-0.208	-0.211	-0.234	0.326	0.215	-0.116	-0.101	0.160	0.166	-0.096	-0.102	0.224	-0.065	-0.172	-0.163	0.052	0.080
GEN43	-0.039	-0.106	0.062	0.324	0.265	0.171	-0.083	-0.172	-0.129	-0.137	0.515	0.373	-0.128	-0.088	0.193	0.215	0.032	0.164	0.293	-0.160	-0.125	-0.082	0.107	0.098
GEN44	0.197	-0.046	0.165	0.099	0.070	0.214	-0.031	-0.121	-0.043	-0.160	0.122	0.150	-0.192	-0.208	0.346	0.295	0.013	-0.108	0.153	0.325	-0.309	0.050	0.349	0.198
GEN45	0.221	-0.004	0.272	0.415	0.414	0.213	-0.293	-0.336	-0.264	-0.319	0.220	0.287	-0.084	0.056	0.252	0.162	0.131	0.048	0.265	-0.062	-0.119	-0.152	0.160	0.038
GEN46	0.172	-0.031	0.089	0.432	0.376	0.131	-0.039	-0.138	-0.028	-0.083	0.442	0.485	-0.044	0.022	0.224	0.241	0.390	0.506	0.529	-0.122	-0.023	0.057	0.278	0.111
GEN47	-0.395	-0.278	-0.254	-0.354	-0.292	-0.369	-0.401	-0.376	-0.432	-0.313	-0.412	-0.294	-0.131	0.040	-0.398	-0.420	-0.289	-0.412	-0.487	-0.297	0.149	-0.469	-0.467	-0.444
GEN48	-0.269	-0.151	-0.194	-0.242	-0.221	-0.235	-0.455	-0.399	-0.409	-0.424	-0.468	-0.310	-0.213	0.004	-0.429	-0.463	-0.256	-0.480	-0.499	-0.294	0.189	-0.517	-0.515	-0.468
GEN49	-0.155	-0.025	-0.161	0.133	-0.066	-0.137	-0.191	-0.187	-0.452	-0.200	-0.464	-0.333	-0.021	0.201	-0.371	-0.367	0.351	-0.217	-0.248	-0.291	0.110	-0.508	-0.482	-0.132
GEN50	0.176	0.344	0.163	0.376	0.330	0.173	0.214	0.240	0.333	0.258	0.405	0.135	0.194	-0.010	0.485	0.404	0.569	0.128	0.520	0.334	-0.133	0.372	0.542	0.345
GEN51	0.144	0.104	0.172	0.420	0.308	0.310	0.290	0.248	0.167	0.284	0.274	0.137	-0.052	0.158	0.261	0.350	0.766	0.096	0.336	0.224	0.016	0.189	0.202	0.300
GEN52	-0.121	-0.181	0.008	-0.198	-0.256	-0.159	0.157	0.129	0.265	0.118	0.229	0.172	-0.290	-0.409	0.201	0.332	0.071	0.458	0.281	0.114	-0.559	0.296	0.274	0.248
GEN53	0.166	0.101	-0.107	0.133	0.093	0.079	0.430	0.374	0.402	0.397	0.133	0.444	0.093	0.195	0.097	0.275	0.030	0.053	0.220	0.121	0.060	0.293	0.238	0.288

Colours highlight significance for correlations: orange. confidence at 99%; pale orange. confidence at 95%. .(a) stands for data not available.

Table 39: Analogue vs. Digital (Full Set) Indicators: Correlations.: Pearson correlations (continued).

23.5. Analogue vs. Digital (OECD Set) Indicators

	OECD01A1	OECD01A2	OECD02A1	OECD02A2	OECD04A1	OECD04B1	OECD06A1	OECD06B1	OECD07A1	OECD07A2	OECD07A3	OECD08A1	OECD08B1	OECD10A1	OECD10B1	OECD10B2	OECD10B3	OECD10C1	OECD11A1	OECD11B1	OECD12A1	OECD12A2	OECD14A1	OECD15A1
GEN01	-0.369	-0.036	-0.442	-0.315	-0.086	-0.064	-0.100	-0.135	-0.104	-0.369	-0.214	-0.110	-0.125	-0.139	0.028	-0.215	-0.065	-0.125	0.158	0.898	0.074	0.922	0.401	0.282
GEN02	-0.125	0.078	-0.248	-0.301	0.105	0.090	0.102	0.083	0.012	0.067	0.160	0.020	0.012	-0.061	0.029	-0.130	-0.029	-0.040	0.281	0.955	0.108	0.962	0.347	0.322
GEN03	0.653	0.476	0.326	-0.098	0.739	0.457	0.678	0.719	0.449	0.496	0.388	0.489	0.537	0.117	0.125	0.480	0.315	0.359	0.470	0.326	0.030	0.302	-0.083	0.355
GEN04	0.698	0.253	0.645	0.140	0.521	0.560	0.521	0.579	0.326	0.411	0.367	0.212	0.484	0.219	0.041	0.151	0.100	0.308	0.270	0.206	0.130	0.149	-0.210	0.043
GEN05	-0.531	-0.104	-0.436	0.183	-0.470	-0.396	-0.549	-0.630	-0.300	-0.710	-0.494	-0.487	-0.548	-0.395	-0.232	0.242	-0.108	-0.511	-0.289	0.058	0.116	0.224	0.647	0.267
GEN06	-0.494	-0.101	-0.408	0.184	-0.424	-0.351	-0.500	-0.588	-0.246	-0.696	-0.496	-0.441	-0.469	-0.383	-0.242	0.268	-0.105	-0.502	-0.266	0.067	0.106	0.246	0.655	0.311
GEN07	0.246	0.467	-0.070	-0.052	0.554	0.415	0.470	0.406	0.261	0.049	-0.019	0.345	0.520	-0.060	-0.349	-0.016	-0.322	-0.013	0.038	0.107	-0.039	0.229	-0.077	0.634
GEN08	0.562	0.310	0.359	-0.020	0.578	0.440	0.513	0.591	0.209	0.512	0.410	0.631	0.653	0.164	-0.109	0.435	0.084	0.347	0.323	0.091	-0.195	0.062	-0.151	0.333
GEN09	0.738	0.619	0.331	-0.174	0.891	0.673	0.854	0.894	0.450	0.588	0.536	0.629	0.760	0.482	0.473	0.180	0.502	0.660	0.628	0.303	-0.025	0.251	-0.365	0.389
GEN10	-0.291	-0.096	-0.312	-0.083	-0.064	-0.209	-0.138	-0.175	-0.059	0.000	-0.091	0.070	-0.034	0.178	-0.107	0.007	-0.094	0.405	-0.137	-0.205	-0.499	-0.189	-0.135	0.247
GEN11	-0.376	-0.086	-0.212	0.172	-0.661	-0.529	-0.652	-0.651	-0.378	-0.173	0.053	-0.759	-0.619	-0.280	-0.209	-0.106	-0.246	-0.599	-0.424	-0.213	0.299	-0.083	0.146	-0.154
GEN12	0.621	0.410	0.453	0.048	0.668	0.617	0.577	0.624	0.526	0.523	0.465	0.610	0.559	0.129	-0.056	0.073	-0.032	0.424	0.469	0.210	-0.273	0.082	-0.498	0.638
GEN13	0.293	0.200	0.195	0.198	0.157	0.191	0.151	0.270	0.199	0.199	0.236	0.088	0.133	-0.166	-0.112	0.221	-0.008	0.014	-0.162	-0.493	-0.112	-0.558	-0.371	-0.288
GEN14	0.398	0.133	0.408	0.140	0.251	0.420	0.231	0.334	0.024	0.447	0.288	0.192	0.475	0.190	-0.240	0.079	-0.183	0.419	-0.033	-0.240	-0.386	-0.338	-0.513	-0.117
GEN15t	-0.311	-0.003	-0.406	-0.335	-0.029	-0.006	-0.029	-0.057	-0.079	-0.308	-0.153	-0.055	-0.075	-0.118	0.044	-0.199	-0.044	-0.113	0.207	0.931	0.089	0.944	0.403	0.302
GEN16	0.374	0.313	0.172	-0.109	0.560	0.411	0.451	0.410	0.165	0.006	-0.129	0.581	0.602	0.198	-0.038	0.228	0.062	0.419	0.108	-0.138	-0.108	-0.126	-0.067	0.264
GEN17	-0.500	-0.153	-0.613	-0.281	-0.021	0.027	-0.040	-0.202	0.208	-0.723	-0.703	0.480	0.413	0.020	0.257	0.522	0.438	0.003	-0.106	-0.034	-0.221	0.079	0.583	0.648
GEN19	0.03	0.283	-0.016	0.173	-0.010	-0.067	-0.089	-0.117	0.146	-0.060	-0.020	-0.041	-0.055	-0.014	-0.021	0.788	0.312	0.054	-0.181	-0.167	-0.065	-0.108	0.211	0.261
GEN20	-0.179	0.324	-0.367	-0.419	0.020	-0.102	0.106	0.065	0.015	-0.118	0.033	-0.016	-0.234	-0.029	0.271	0.242	0.339	-0.229	0.239	0.341	0.136	0.249	0.627	0.516
GEN21	0.857	0.249	0.827	0.351	0.906	0.137	0.393	0.426	-0.658	0.406	0.272	0.025	0.626	1.000	.(a)	.(a)	.(a)	1.000	0.618	0.790	-0.279	-0.410	.(a)	.(a)
GEN22	-0.123	0.078	-0.244	-0.289	0.102	0.085	0.096	0.075	0.006	0.082	0.170	0.007	0.010	-0.062	0.019	-0.133	-0.038	-0.042	0.274	0.948	0.104	0.964	0.334	0.312
GEN23	-0.640	-0.307	-0.506	-0.015	-0.495	-0.661	-0.628	-0.723	-0.530	-0.948	-0.857	-0.415	-0.532	-0.325	-0.375	0.623	-0.077	-0.294	-0.320	-0.140	-0.096	-0.083	0.433	0.061
GEN24	-0.348	-0.534	-0.119	-0.228	-0.371	-0.263	-0.145	-0.200	0.289	0.132	-0.006	-0.017	-0.238	0.269	0.033	0.261	0.140	0.049	-0.060	-0.262	-0.052	-0.285	0.142	0.015
GEN25	0.637	0.432	0.329	-0.106	0.719	0.422	0.657	0.691	0.466	0.497	0.382	0.477	0.496	0.135	0.150	0.480	0.337	0.365	0.464	0.326	0.023	0.293	-0.100	0.270
GEN26	-0.345	-0.604	-0.110	-0.275	-0.353	-0.231	-0.111	-0.154	0.230	0.146	0.000	-0.003	-0.211	0.310	0.040	-0.107	-0.009	0.024	0.026	-0.198	-0.029	-0.239	0.019	-0.183
GEN27	-0.121	0.079	-0.244	-0.292	0.105	0.088	0.099	0.079	0.013	0.083	0.171	0.009	0.012	-0.062	0.021	-0.139	-0.039	-0.040	0.277	0.951	0.105	0.964	0.330	0.309
GEN28	0.669	0.448	0.320	-0.109	0.796	0.473	0.684	0.719	0.477	0.406	0.296	0.552	0.600	0.154	0.110	0.416	0.274	0.452	0.417	0.192	-0.059	0.157	-0.220	0.251
GEN29	0.645	0.434	0.307	-0.143	0.762	0.439	0.682	0.716	0.519	0.496	0.385	0.536	0.518	0.104	0.125	0.348	0.259	0.347	0.476	0.345	0.027	0.308	-0.164	0.290
GEN30	0.718	0.649	0.385	0.047	0.639	0.542	0.607	0.704	0.421	0.483	0.581	0.383	0.384	-0.051	0.195	-0.020	0.168	0.174	0.396	0.158	0.144	0.075	-0.551	-0.033

GEN31	0.23	0.170	0.265	0.151	0.032	0.147	0.107	0.181	0.220	0.063	0.096	-0.171	0.011	-0.357	-0.148	-0.325	-0.276	-0.325	0.137	-0.099	0.291	-0.107	-0.294	-0.528
GEN32	-0.077	-0.033	-0.025	0.281	-0.115	0.164	-0.128	-0.123	-0.097	-0.373	-0.151	-0.308	-0.150	-0.360	-0.020	0.098	0.023	-0.544	-0.014	-0.122	-0.001	0.034	0.241	-0.329
GEN33	-0.221	0.295	-0.479	-0.335	0.085	-0.070	0.080	0.042	0.004	-0.018	0.044	0.182	-0.075	-0.169	-0.047	0.170	0.029	-0.116	0.180	0.468	-0.026	0.512	0.491	0.593
GEN34	-0.787	-0.392	-0.647	-0.070	-0.553	-0.565	-0.628	-0.716	-0.245	-0.928	-0.842	-0.427	-0.534	-0.298	-0.155	0.172	-0.067	-0.282	-0.339	-0.092	-0.074	0.019	0.483	0.446
GEN35	0.775	0.360	0.630	-0.023	0.568	0.458	0.661	0.725	0.419	0.945	0.788	0.475	0.642	0.373	-0.070	-0.049	-0.100	0.346	0.344	0.021	0.059	-0.090	-0.579	-0.188
GEN36	-0.202	-0.173	-0.097	-0.264	-0.261	-0.239	-0.170	-0.220	0.075	-0.003	0.008	-0.100	-0.373	-0.115	-0.099	0.376	0.038	-0.387	-0.322	-0.391	0.168	-0.377	0.138	0.177
GEN37	-0.018	-0.457	0.086	-0.125	0.160	0.295	0.258	0.258	0.178	0.069	-0.161	0.364	0.330	0.229	0.096	-0.311	-0.018	0.266	0.094	-0.098	-0.277	-0.107	-0.280	0.022
GEN38	-0.071	-0.310	0.057	-0.252	-0.094	0.122	0.117	0.076	0.058	0.207	0.207	0.145	0.123	0.419	0.212	-0.371	0.079	0.200	0.202	0.269	-0.112	0.136	-0.191	-0.289
GEN39	0.204	-0.145	0.131	-0.392	0.468	0.333	0.530	0.492	0.445	0.196	-0.080	0.729	0.410	0.257	0.170	0.272	0.276	0.408	0.207	-0.047	-0.232	-0.189	-0.140	0.188
GEN40	0.22	0.116	0.004	-0.393	0.623	0.456	0.647	0.567	0.684	0.163	0.102	0.640	0.495	0.344	0.615	-0.125	0.581	0.532	0.537	0.250	-0.176	0.167	-0.312	0.077
GEN41	-0.019	-0.132	0.250	0.455	-0.423	-0.367	-0.543	-0.522	-0.507	-0.486	-0.324	-0.620	-0.256	-0.272	-0.200	-0.481	-0.359	-0.273	-0.334	-0.053	0.214	-0.018	-0.136	-0.352
GEN41B	-0.066	0.058	-0.189	-0.328	0.195	0.138	0.364	0.172	0.075	0.133	0.158	-0.137	0.078	0.476	0.458	-0.145	0.349	0.054	0.183	0.060	0.027	0.075	0.053	0.362
GEN42	0.67	0.802	0.640	0.475	0.582	-0.378	0.118	0.071	-1.000	0.628	0.471	-0.525	-0.092	1.000	.(a)	.(a)	.(a)	1.000	0.710	0.567	-0.667	-0.755	.(a)	.(a)
GEN43	0.776	0.439	0.728	0.606	0.931	0.413	0.374	0.463	-0.862	0.190	0.121	0.064	0.730	1.000	.(a)	.(a)	.(a)	1.000	0.488	0.937	0.035	-0.092	.(a)	.(a)
GEN44	-0.588	0.679	-0.683	0.671	-0.369	-0.161	-0.764	-0.674	-0.862	-0.777	-0.605	-0.861	-0.416	-1.000	.(a)	.(a)	.(a)	-1.000	-0.959	0.105	0.677	0.759	.(a)	.(a)
GEN45	0.171	0.566	0.071	0.394	0.125	-0.694	-0.459	-0.487	-0.989	0.383	0.387	-0.972	-0.674	1.000	.(a)	.(a)	.(a)	1.000	0.501	0.291	-0.412	-0.378	.(a)	.(a)
GEN46	0.844	0.196	0.818	0.267	0.856	0.025	0.365	0.379	-0.578	0.463	0.315	-0.027	0.536	1.000	.(a)	.(a)	.(a)	1.000	0.649	0.714	-0.376	-0.501	.(a)	.(a)
GEN47	-0.448	-0.228	-0.197	0.202	-0.534	-0.547	-0.568	-0.640	-0.683	-0.355	-0.372	-0.560	-0.352	0.271	0.093	0.506	0.296	-0.037	-0.296	-0.187	-0.062	-0.084	0.444	0.025
GEN48	-0.233	-0.198	0.021	0.242	-0.432	-0.434	-0.495	-0.536	-0.352	-0.187	-0.178	-0.500	-0.347	0.035	-0.190	-0.037	-0.187	-0.037	-0.333	-0.130	0.025	-0.074	0.138	0.014
GEN49	0.076	0.000	0.244	0.465	-0.286	-0.290	-0.376	-0.331	-0.336	-0.252	-0.109	-0.496	-0.298	-0.297	-0.009	-0.553	-0.242	-0.316	-0.184	-0.071	0.326	-0.032	-0.237	-0.467
GEN50	0.611	0.364	0.461	0.103	0.572	0.525	0.515	0.541	0.388	0.542	0.434	0.310	0.485	0.173	-0.032	0.028	-0.022	0.422	0.424	-0.035	-0.209	-0.045	-0.470	0.099
GEN51	0.381	0.249	0.367	0.318	0.238	0.241	0.198	0.233	-0.007	-0.102	-0.259	-0.084	0.387	0.160	-0.044	0.443	0.137	0.270	-0.024	-0.319	0.108	-0.305	0.042	0.162
GEN52	0.316	-0.040	0.184	-0.225	0.607	0.463	0.615	0.606	0.382	0.191	-0.082	0.740	0.587	0.312	0.238	0.015	0.251	0.615	0.410	0.184	-0.324	0.037	-0.216	0.041
GEN53	-0.117	-0.497	0.039	-0.070	-0.009	0.186	0.098	0.102	0.078	0.018	-0.152	0.177	0.186	0.153	0.027	-0.349	-0.102	0.092	-0.021	-0.165	-0.209	-0.130	-0.237	0.012

Colours highlight significance for correlations: orange, confidence at 99%; pale orange, confidence at 95%. .(a) stands for data not available.

Table 40: Analogue vs. Digital (OECD Set) Indicators: Pearson correlations.

24. Annex VII: Variables used in the statistics

24.1. Factor analysis

24.1.1. Infrastructures

Group 1:

INF_S_01R INF_S_02R INF_S_03R INF_S_05R
INF_S_06R
INF_S_07R INF_S_08R INF_S_09R INF_S_10R
INF_S_12R

Group 2:

INF_S_01R INF_S_02R INF_S_05R INF_S_06R
INF_S_07R
INF_S_08R INF_S_09R INF_S_12R

Group 3:

INF_S_01R INF_S_02R INF_S_05R INF_S_06R
INF_S_07R
INF_S_09R INF_S_12R

24.1.2. Digital Indicators

Group 1:

INF_S_01R INF_S_02R INF_S_03R
INF_S_05R
INF_S_07R INF_S_09R INF_D_07R
INF_D_08R
INF_D_09R INF_D_10R ICTSECTOR_S_01R
ICTSECTOR_S_02R ICTSECTOR_S_03R ICTSECTOR_S_04R
ICTSECTOR_S_07R ICTSECTOR_D_05R ICTSECTOR_D_06R
DIGLIT_S_07R DIGLIT_D_01R DIGLIT_D_02R
LEGAL_S_01R LEGAL_S_02R LEGAL_S_03R
LEGAL_S_04R
LEGAL_S_05R LEGAL_S_06R LEGAL_S_11R
LEGAL_S_14R

LEGAL_D_01R LEGAL_D_02R LEGAL_D_03R
LEGAL_D_04R
USE_S_01R USE_S_02R USE_S_03R
USE_S_04R
USE_S_05R USE_S_06R USE_D_07R
USE_D_08R
USE_D_09R USE_D_10R USE_D_11R
USE_D_12R

Group 2:

INF_S_01R INF_S_02R INF_S_03R
INF_S_05R
INF_S_07R INF_S_09R INF_D_07R
INF_D_08R
INF_D_09R INF_D_10R ICTSECTOR_S_01R
ICTSECTOR_S_02R ICTSECTOR_S_03R ICTSECTOR_S_04R
ICTSECTOR_S_07R ICTSECTOR_D_05R ICTSECTOR_D_06R
DIGLIT_S_07R DIGLIT_D_01R DIGLIT_D_02R
LEGAL_S_01R
LEGAL_S_02R LEGAL_S_03R LEGAL_S_04R
LEGAL_S_05R
LEGAL_S_06R LEGAL_S_11R LEGAL_S_14R
LEGAL_D_01R
LEGAL_D_02R LEGAL_D_03R LEGAL_D_04R
USE_S_01R
USE_S_02R USE_S_03R USE_S_05R
USE_S_06R
USE_D_07R USE_D_08R USE_D_09R
USE_D_10R
USE_D_11R USE_D_12R

Group 3:

INF_S_01R INF_S_02R INF_S_03R
INF_S_05R
INF_S_07R INF_S_09R INF_D_07R
INF_D_08R
INF_D_09R INF_D_10R ICTSECTOR_S_01R
ICTSECTOR_S_02R ICTSECTOR_S_03R ICTSECTOR_S_04R
ICTSECTOR_S_07R ICTSECTOR_D_05R ICTSECTOR_D_06R
DIGLIT_S_07R DIGLIT_D_01R DIGLIT_D_02R
LEGAL_S_01R
LEGAL_S_02R LEGAL_S_03R LEGAL_S_04R
LEGAL_S_05R

LEGAL_S_06R	LEGAL_S_11R	LEGAL_S_14R
	LEGAL_D_01R	
LEGAL_D_02R	LEGAL_D_03R	LEGAL_D_04R
	USE_S_01R	
USE_S_02R	USE_S_03R	USE_S_05R
	USE_S_06R	
USE_D_07R	USE_D_08R	USE_D_09R
	USE_D_10R	
USE_D_11R	USE_D_12R	

24.2. Cluster analysis

24.2.1. Indicators – Core Set 1

Used in Cluster analysis (2, 3 and 4 clusters) for the WITSA set.

ZINF_S_01	ZINF_S_02	ZINF_S_03	ZINF_S_05
ZINF_S_07	ZINF_S_09	ZINF_D_09	
	ZICTSECTOR_S_03		
ZICTSECTOR_D_06	ZDIGLIT_S_07	ZDIGLIT_D_02	
	ZLEGAL_S_01		
ZLEGAL_S_02	ZLEGAL_D_03	ZUSE_S_01	ZUSE_S_02
ZUSE_S_06	ZUSE_D_07	ZUSE_D_09	ZUSE_D_10
ZUSE_D_11	ZUSE_D_12		

24.2.2. Indicators – Core Set 2

Used in Cluster analysis (5 clusters) for the WITSA set.

ZINF_S_01	ZINF_S_02	ZINF_S_03	ZINF_S_05
ZINF_S_07	ZINF_S_09	ZINF_D_09	
	ZICTSECTOR_S_01		
ZICTSECTOR_D_06	ZDIGLIT_S_07	ZDIGLIT_D_02	
	ZLEGAL_S_01		
ZLEGAL_S_02	ZLEGAL_D_03	ZUSE_S_01	ZUSE_S_02
ZUSE_S_06	ZUSE_D_07	ZUSE_D_09	ZUSE_D_10
ZUSE_D_11	ZUSE_D_12		

24.2.3. Indicators – Simplified Core Set

Tried – but desestimated - in Cluster analysis (2, 3, 4 and 5 clusters) for the WITSA set.

INF_S_01	INF_D_09	ICTSECTOR_S_01
	ICTSECTOR_D_06	
DIGLIT_S_07	DIGLIT_D_02	LEGAL_S_01
	LEGAL_D_03	
USE_S_06	USE_D_07	

24.2.4. Indicators – OECD Core Set 1

Used in Cluster analysis (2 clusters) for the OECD set.

ZINF_S_01	ZINF_S_02	ZINF_S_03	ZINF_S_07
ZINF_S_09	ZICTSECTOR_S_01	ZICTSECTOR_D_06	
	ZDIGLIT_S_07		
ZDIGLIT_D_02	ZLEGAL_S_01	ZLEGAL_S_02	
	ZLEGAL_D_03		
ZUSE_S_01	ZUSE_S_02	ZUSE_S_06	ZUSE_D_07
ZUSE_D_10	ZUSE_D_11		

24.2.5. Indicators – OECD Core Set 2

Used in Cluster analysis (3, 4 and 5 clusters) for the OECD set.

ZINF_S_01	ZINF_S_02	ZINF_S_03	ZINF_S_07
ZINF_S_09	ZICTSECTOR_D_06	ZDIGLIT_S_07	
	ZDIGLIT_D_02		
ZLEGAL_S_01	ZLEGAL_S_02	ZLEGAL_D_03	ZUSE_S_01
ZUSE_S_02	ZUSE_S_06	ZUSE_D_07	ZUSE_D_10
ZUSE_D_11			

24.2.6. Indicators – OECD Core Set 3

Used in Cluster analysis (3 clusters) for the OECD set (alternate calculation).

ZINF_S_01	ZINF_S_02	ZINF_S_07	ZINF_D_09
ZICTSECTOR_S_01	ZICTSECTOR_D_06	ZDIGLIT_D_02	
	ZLEGAL_S_01		
ZLEGAL_S_02	ZLEGAL_D_03	ZUSE_S_01	ZUSE_S_06
ZUSE_D_07	ZUSE_D_09	ZUSE_D_10	ZUSE_D_11

24.2.7. Indicators – OECD Core Set 4

Used in Cluster analysis (4 clusters) for the OECD set (alternate calculation).

ZINF_S_01 ZINF_S_02 ZINF_S_07 ZINF_S_09
ZINF_D_09 ZICTSECTOR_S_01 ZICTSECTOR_D_06
ZDIGLIT_D_02
ZLEGAL_S_01 ZLEGAL_S_02 ZLEGAL_D_03 ZUSE_S_01
ZUSE_S_02 ZUSE_S_06 ZUSE_D_07 ZUSE_D_09
ZUSE_D_10 ZUSE_D_11

24.2.8. Indicators – OECD Core Set 5

Used in Cluster analysis (5 clusters) for the OECD set (alternate calculation).

ZINF_S_01 ZINF_S_02 ZINF_S_05 ZINF_S_07
ZINF_S_09 ZINF_D_09 ZICTSECTOR_S_01
ZICTSECTOR_D_06
ZDIGLIT_D_02 ZLEGAL_S_01 ZLEGAL_S_02
ZLEGAL_D_03
ZUSE_S_01 ZUSE_S_02 ZUSE_S_06 ZUSE_D_07
ZUSE_D_09 ZUSE_D_10 ZUSE_D_11

25. Annex VIII: Cluster Analyses

This annex lists the statistical results of all the cluster analyses performed. Note that countries appear in the cluster that was automatically assigned by the statistical output. In *any* case the number of the cluster relates in *any* way to the stage of digital development.

25.1. Full set of countries

25.1.1. Full set of countries: 2 clusters

Cluster	Country	Distance to the core
1	Argentina	2.26405
1	Bolivia	4.49363
1	Brazil	2.14814
1	Bulgaria	2.96066
1	Chile	2.94278
1	Ecuador	3.31829
1	Egypt, Arab Rep.	2.21286
1	Greece	3.29907
1	Hungary	3.08290
1	India	3.38276
1	Indonesia	3.05928
1	Italy	4.23467
1	Jamaica	3.14560
1	Jordan	3.25339
1	Malaysia	4.23739
1	Mexico	1.87121
1	Pakistan	3.79991
1	Panama	1.73837
1	Peru	2.45675
1	Philippines	1.93116
1	Portugal	4.03648
1	Romania	1.67156
1	Saudi Arabia	3.09850
1	South Africa	2.81753
1	Spain	3.67311
1	Sri Lanka	2.16100
1	Thailand	2.14888
1	Tunisia	3.24369
1	Uruguay	1.60880
2	Australia	2.48033
2	Austria	1.81361
2	Finland	1.85664
2	France	2.44878
2	Germany	2.06484
2	Ireland	3.55783
2	Japan	2.78155
2	Korea, Rep.	4.03485
2	New Zealand	2.73177
2	Norway	2.72732
2	Singapore	3.38564
2	Sweden	2.69050
2	Switzerland	1.98733
2	United Kingdom	2.01199
2	United States	6.94347

Table 41: Countries per cluster and distances to the core –
Full set, 2 clusters

25.1.2. Full set of countries: 3 clusters

Cluster	Country	Distance to the core
1	United States	0.00000
2	Australia	3.20226
2	Austria	1.70810
2	Finland	2.21237
2	France	1.72931
2	Germany	2.08642
2	Ireland	3.16281
2	Italy	4.32223
2	Japan	2.56449
2	Korea, Rep.	3.70241
2	Malaysia	4.56823
2	New Zealand	2.74102
2	Norway	3.26262
2	Portugal	3.26386
2	Singapore	3.31758
2	Spain	3.13125
2	Sweden	3.32083
2	Switzerland	2.66234
2	United Kingdom	2.44905
3	Argentina	2.06692
3	Bolivia	4.09541
3	Brazil	2.40229
3	Bulgaria	2.92952
3	Chile	3.27913
3	Ecuador	2.92152
3	Egypt, Arab Rep.	1.82088
3	Greece	3.46671
3	Hungary	3.47744
3	India	3.30712
3	Indonesia	2.73726
3	Jamaica	3.23490
3	Jordan	3.17986
3	Mexico	1.81713
3	Pakistan	3.53170
3	Panama	1.53564
3	Peru	2.23888
3	Philippines	1.56445
3	Romania	1.72245
3	Saudi Arabia	3.27788
3	South Africa	2.86535
3	Sri Lanka	1.77581
3	Thailand	2.34081
3	Tunisia	3.38561
3	Uruguay	1.61327

Table 42: Countries per cluster and distances to the core – Full set, 3 clusters

25.1.3. Full set of countries: 4 clusters

Cluster	Country	Distance to the core
1	Brazil	1.90979
1	Chile	2.21695
1	Hungary	2.50498
1	India	3.53285
1	Italy	3.61018
1	Jamaica	3.29517
1	Malaysia	2.94777
1	Portugal	2.80612
1	Saudi Arabia	2.85540
1	South Africa	3.15518
1	Spain	2.76863
1	Thailand	1.84448
1	Tunisia	2.90624
2	United States	0.00000
3	Australia	2.78265
3	Austria	1.67446
3	Finland	1.92092
3	France	2.17336
3	Germany	1.93799
3	Ireland	3.38637
3	Japan	2.68422
3	Korea, Rep.	3.83841
3	New Zealand	2.84394
3	Norway	2.82450
3	Singapore	3.31085
3	Sweden	2.67056
3	Switzerland	1.95825
3	United Kingdom	1.96556
4	Argentina	1.62542
4	Bolivia	3.28182
4	Bulgaria	2.72990
4	Ecuador	2.09429
4	Egypt, Arab Rep.	1.81507
4	Greece	3.39410
4	Indonesia	2.62835
4	Jordan	3.31719
4	Mexico	1.78079
4	Pakistan	3.61439
4	Panama	1.68403
4	Peru	1.96514
4	Philippines	1.37833
4	Romania	1.90786
4	Sri Lanka	1.65596
4	Uruguay	1.51207

Table 43: Countries per cluster and distances to the core – Full set, 4 clusters

25.1.4. Full set of countries: 5 clusters

Cluster	Country	Distance to the core
1	United States	0.00000
2	Brazil	1.89589
2	Bulgaria	3.52262
2	Chile	2.29201
2	Greece	2.95215
2	Hungary	1.84258
2	Italy	3.23727
2	Jamaica	3.18747
2	Mexico	1.82970
2	Panama	2.10944
2	Portugal	3.06564
2	Romania	2.12178
2	Saudi Arabia	1.92086
2	Spain	2.55783
2	Thailand	2.27072
2	Tunisia	3.16802
2	Uruguay	1.85954
2	United Arab Emirates	3.19078
3	Australia	2.54023
3	Austria	1.41879
3	Finland	1.87608
3	France	2.23463
3	Germany	1.92612
3	Ireland	2.74540
3	Japan	2.71719
3	Korea, Rep.	4.04103
3	New Zealand	2.79813
3	Norway	2.91569
3	Singapore	3.30911
3	Sweden	2.58870
3	Switzerland	1.95568
3	United Kingdom	1.96221
4	Argentina	2.43645
4	Bolivia	3.25945
4	Ecuador	2.15405
4	Egypt, Arab Rep.	1.69220
4	India	3.62529
4	Indonesia	1.97222
4	Pakistan	2.78588
4	Peru	2.15880
4	Philippines	1.81391
4	Sri Lanka	1.61230
4	Algeria	2.26628
4	Cameroon	2.44971
4	Vietnam	2.02224
4	Zimbabwe	3.56816
5	Jordan	1.78255
5	South Africa	2.14364
5	Senegal	2.97439

Table 44: Countries per cluster and distances to the core – Full set, 5 clusters

25.2. OECD set of countries

25.2.1. OECD set of countries: 2 clusters

Cluster	Country	Distance to the core
1	Australia	1.99084
1	Austria	1.90474
1	Canada	2.06689
1	Denmark	4.02903
1	Finland	2.18853
1	France	2.57352
1	Germany	2.30492
1	Ireland	3.14150
1	Japan	2.92298
1	Korea, Rep.	4.19188
1	New Zealand	2.98220
1	Norway	3.16357
1	Sweden	2.27960
1	Switzerland	2.21933
1	United Kingdom	1.63185
1	United States	5.52911
2	Czech Republic	2.21038
2	Greece	3.10557
2	Hungary	1.65813
2	Italy	2.49658
2	Mexico	2.93175
2	Poland	1.84057
2	Portugal	2.96623
2	Slovak Republic	1.82922
2	Spain	2.58515
2	Turkey	3.59352

Table 45: Countries per cluster and distances to the core – OECD set, 2 clusters

25.2.2. OECD set of countries: 3 clusters

Cluster	Country	Distance to the core
1	Czech Republic	2.19781
1	Greece	3.08086
1	Hungary	1.40717
1	Italy	2.34651
1	Mexico	2.80631
1	Poland	1.83978
1	Portugal	2.58212
1	Slovak Republic	1.81752
1	Spain	2.48535
1	Turkey	3.44001
2	Australia	1.99461
2	Austria	1.66199
2	Canada	2.10450

2	Denmark	3.93116
2	Finland	2.12370
2	France	2.31260
2	Germany	2.36189
2	Ireland	3.04888
2	Japan	2.75735
2	Korea, Rep.	3.43336
2	Netherlands	2.82140
2	New Zealand	2.82645
2	Norway	2.46504
2	Sweden	2.16974
2	Switzerland	2.14113
2	United Kingdom	1.36466
3	United States	0.00000

Table 46: Countries per cluster and distances to the core – OECD set, 3 clusters

25.2.3. OECD set of countries: 3 clusters (alt.)

Cluster	Country	Distance to the core
1	Australia	1.81940
1	Austria	1.36881
1	Finland	1.49914
1	France	2.24448
1	Germany	1.91486
1	Ireland	3.05846
1	Norway	3.26072
1	Sweden	2.32502
1	Switzerland	1.70889
1	United Kingdom	1.69200
1	United States	2.39869
2	Greece	2.41997
2	Hungary	1.60542
2	Italy	2.12205
2	Mexico	2.62412
2	Portugal	2.96137
2	Spain	1.66475
3	Japan	1.82919
3	Korea, Rep.	3.31185
3	New Zealand	2.60735
1	Australia	1.81940
1	Austria	1.36881
1	Finland	1.49914
1	France	2.24448
1	Germany	1.91486
1	Ireland	3.05846
1	Norway	3.26072
1	Sweden	2.32502
1	Switzerland	1.70889
1	United Kingdom	1.69200
1	United States	2.39869

2	Greece	2.41997
2	Hungary	1.60542
2	Italy	2.12205
2	Mexico	2.62412
2	Portugal	2.96137
2	Spain	1.66475
3	Japan	1.82919
3	Korea, Rep.	3.31185
3	New Zealand	2.60735
1	Australia	1.81940
1	Austria	1.36881
1	Finland	1.49914
1	France	2.24448

Table 47: Countries per cluster and distances to the core – OECD set, 3 clusters (alt.)

25.2.4. OECD set of countries: 4 clusters

Cluster	Country	Distance to the core
1	Australia	2.15067
1	Austria	1.53890
1	Canada	2.16794
1	Finland	2.15457
1	France	1.98143
1	Germany	2.18211
1	Ireland	2.74556
1	Japan	2.48710
1	Korea, Rep.	3.34848
1	New Zealand	2.55533
1	Norway	2.66387
1	Switzerland	2.34698
1	United Kingdom	1.54832
2	United States	0.00000
3	Denmark	1.90095
3	Netherlands	1.75248
3	Sweden	1.65631
4	Czech Republic	2.19781
4	Greece	3.08086
4	Hungary	1.40717
4	Italy	2.34651
4	Mexico	2.80631
4	Poland	1.83978
4	Portugal	2.58212
4	Slovak Republic	1.81752
4	Spain	2.48535
4	Turkey	3.44001

Table 48: Countries per cluster and distances to the core – OECD set, 4 clusters

25.2.5. OECD set of countries: 4 clusters (alt.)

Cluster	Country	Distance to the core
1	United States	0.00000
2	Japan	2.38196
2	Korea, Rep.	2.38196
3	Australia	2.23391
3	Austria	1.47157
3	Finland	1.80136
3	France	2.25018
3	Germany	2.02088
3	Ireland	3.04207
3	New Zealand	3.20944
3	Norway	3.41574
3	Sweden	2.56265
3	Switzerland	1.87742
3	United Kingdom	1.70197
4	Greece	2.42462
4	Hungary	1.61350
4	Italy	2.12695
4	Mexico	2.63379
4	Portugal	2.96668
4	Spain	1.70547

Table 49: Countries per cluster and distances to the core – OECD set, 4 clusters (alt.)

25.2.6. OECD set of countries: 5 clusters

Cluster	Country	Distance to the core
1	Denmark	1.90095
1	Netherlands	1.75248
1	Sweden	1.65631
2	Greece	2.60382
2	Hungary	1.45081
2	Italy	1.72350
2	Poland	2.21275
2	Portugal	2.57396
2	Spain	1.66200
3	Australia	2.15067
3	Austria	1.53890
3	Canada	2.16794
3	Finland	2.15457
3	France	1.98143
3	Germany	2.18211
3	Ireland	2.74556
3	Japan	2.48710
3	Korea, Rep.	3.34848
3	New Zealand	2.55533
3	Norway	2.66387
3	Switzerland	2.34698
3	United Kingdom	1.54832

4	Czech Republic	2.42186
4	Mexico	2.05064
4	Slovak Republic	1.57693
4	Turkey	2.16413
5	United States	0.00000

Table 50: Countries per cluster and distances to the core – OECD set, 5 clusters

25.2.7. OECD set of countries: 5 clusters (alt.)

Cluster	Country	Distance to the core
1	Greece	1.82368
1	Mexico	1.82368
2	Japan	2.38397
2	Korea, Rep.	2.38397
3	Australia	2.47531
3	Austria	1.50227
3	Finland	1.75285
3	France	2.47917
3	Germany	2.06795
3	Ireland	3.07376
3	Norway	3.25907
3	Sweden	2.41119
3	Switzerland	1.85892
3	United Kingdom	1.90573
4	United States	0.00000
5	Hungary	2.00029
5	Italy	2.91566
5	New Zealand	3.57834
5	Portugal	2.18292
5	Spain	1.04969

Table 51: Countries per cluster and distances to the core – OECD set, 5 clusters (alt.)

26. Annex IX: Characterizations

26.1. WITSA set of countries

Indicator	N of Valid Cases	Sig. of Pearson Chi-Square	Leaders	Strivers	Laggards	Hoppers	Leaders	Strivers	Laggards	Hoppers	Leaders	Strivers	Laggards	Hoppers
			High				Low				Adjusted residuals			
			3	2	4	5	3	2	4	5	3	2	4	5
Broadband subscribers (per 100 people)	49	0.000	8	0	0	0	7	17	14	3	4.66	-2.25	-1.96	-0.79
Personal computers (per 100 people)	49	0.000	15	0	0	0	0	17	14	3	7.00	-3.39	-2.94	-1.19
Telephone mainlines (per 100 people)	49	0.000	14	3	0	0	1	14	14	3	5.73	-1.83	-3.23	-1.30
Mobile phone subscribers (per 100 people)	49	0.009	8	6	0	0	7	11	14	3	2.55	0.76	-2.80	-1.13
Population covered by mobile telephony (%)	39	0.003	13	12	3	2	0	3	6	0	2.42	0.36	-3.54	0.80
International Internet bandwidth (bits per person)	49	0.000	15	7	0	0	0	10	14	3	5.15	-0.38	-4.00	-1.61
Internet Hosts (per 10000 people)	49	0.000	10	0	0	0	5	17	14	3	5.34	-2.58	-2.24	-0.91
Internet subscribers (per 100 inhabitants)	32	0.000	7	1	0	0	2	12	8	2	4.31	-1.87	-1.89	-0.84
Residential monthly telephone subscription (US$)	31	0.027	0	1	5	0	8	10	5	2	-1.61	-1.07	2.98	-0.72
Price basket for Internet (US$ per month)	49	0.018	2	6	9	0	13	11	5	3	-2.09	0.06	2.75	-1.30
Price basket for mobile (US$ per month)	49	0.046	4	3	9	1	11	14	5	2	-0.78	-1.83	2.75	-0.05
Price basket for residential fixed line (US$ per month)	49	0.004	0	1	6	0	15	16	8	3	-1.90	-1.23	3.61	-0.73
Telephone average cost of call to US (US$ per three minutes)	36	0.051	6	4	0	0	6	8	9	3	2.10	0.53	-2.15	-1.12
Telecommunications revenue (% GDP)	49	0.000	0	0	0	2	15	17	14	1	-0.96	-1.05	-0.91	5.65
High-technology exports (% of manufactured exports)	48	0.029	5	0	1	0	10	16	13	3	2.94	-1.85	-0.72	-0.68
Telephone subscribers per employee	32	0.079	7	9	8	1	1	4	0	2	0.74	-1.01	1.73	-1.97

Telephone employees (per 100 people)	32	0.020	4	1	0	0	4	12	8	3	3.09	-1.02	-1.41	-0.78
Total full-time telecommunications staff (per 100 people)	36	0.001	7	1	0	0	4	11	10	3	3.96	-1.42	-1.99	-0.97
GDP per Telecom Employee (US Dollars)	49	0.000	11	2	0	0	4	15	14	3	4.93	-1.71	-2.66	-1.07
Enrolment in science. Tertiary. (per 100 people)	29	0.010	7	0	0	0	6	10	4	2	3.37	-2.20	-1.22	-0.83
Human Capital	49	0.000	15	9	1	0	0	8	13	3	4.56	0.20	-3.89	-1.82
Internet Access in Schools	49	0.000	14	3	0	0	1	14	14	3	5.73	-1.83	-3.23	-1.30
Laws relating to ICT	49	0.000	15	3	0	1	0	14	14	2	5.84	-2.21	-3.52	-0.20
Intellectual property protection	49	0.000	15	0	0	1	0	17	14	2	6.68	-3.55	-3.08	0.03
Level of competition - DSL	45	0.014	15	9	10	2	0	7	1	1	2.37	-2.96	1.04	-0.60
Level of competition – Cable modem	34	0.019	15	9	6	0	0	2	1	1	1.89	-0.80	-0.23	-2.78
Gov't procurement of advanced tech products	49	0.000	8	1	0	0	7	16	14	3	4.20	-1.65	-2.10	-0.85
Secure Internet servers (per 1 million people)	49	0.000	13	0	0	0	2	17	14	3	6.33	-3.07	-2.66	-1.07
Total Domains (per 100 people)	49	0.001	6	0	0	0	9	17	14	3	3.94	-1.91	-1.65	-0.67
Total ICT Spending. Retail Trade (% of GDP)	48	0.002	0	0	0	1	15	17	13	2	-0.68	-0.75	-0.62	3.91
Web Measure	49	0.006	7	2	0	0	8	15	14	3	3.40	-0.87	-2.10	-0.85
Availability of government online services	49	0.000	8	1	0	0	7	16	14	3	4.20	-1.65	-2.10	-0.85
International outgoing telephone traffic (minutes) (per 100 people)	31	0.000	9	2	0	0	1	11	6	2	4.38	-1.99	-2.02	-1.08
Internet users (per 100 people)	49	0.000	10	0	0	0	5	17	14	3	5.34	-2.58	-2.24	-0.91
E-Participation	49	0.000	8	1	0	0	7	16	14	3	4.20	-1.65	-2.10	-0.85
Total ICT Spending. Consumer (% of GDP)	49	0.000	0	2	2	3	15	15	12	0	-1.90	-0.37	0.00	4.38
Firm-level technology absorption	49	0.000	13	1	1	1	2	16	13	2	5.36	-2.91	-2.41	0.03
Extent of business Internet use	49	0.000	9	0	0	0	6	17	14	3	5.00	-2.42	-2.10	-0.85
GDP	47	0.081	7	4	1	0	8	12	12	3	2.28	-0.06	-1.73	-1.05
GDP Capita	47	0.001	7	0	0	0	8	16	13	3	4.19	-2.06	-1.77	-0.75
HDI	49	0.000	15	3	1	0	0	14	13	3	5.84	-2.21	-2.87	-1.42
Inequality-10	47	0.030	5	12	8	3	10	3	6	0	-2.51	1.95	-0.22	1.47
Economic Incentive Regime	49	0.000	12	4	0	0	3	13	14	3	4.69	-0.99	-3.08	-1.24
Innovation	49	0.000	15	3	0	0	0	14	14	3	6.10	-2.02	-3.37	-1.36

Gross National Expenditure (% of GDP)	40	0.037	0	3	1	2	9	13	11	1	-1.43	0.54	-0.77	2.61
General Govt. final consumption expenditure (% of GDP)	40	0.082	4	3	0	1	5	13	12	2	2.08	-0.16	-2.07	0.60
Health Public Expenditure (% of govt. expenditure)	49	0.000	10	2	0	0	5	15	14	3	4.56	-1.51	-2.52	-1.02
Health Public Expenditure (% of total Health expenditure)	49	0.005	10	7	1	0	5	10	13	3	2.89	0.47	-2.72	-1.36
Education Public Expenditure (% of govt. expenditure)	33	0.065	0	5	0	1	11	10	5	1	-1.91	2.06	-1.14	1.20
Population growth (annual %)	44	0.090	2	2	1	2	12	12	12	1	-0.20	-0.20	-0.96	2.49
Population in urban agglomerations > 1 million (% of total population)	44	0.007	5	0	0	0	9	15	12	3	3.48	-1.71	-1.45	-0.64
GDP deflator (base year varies by country)	48	0.000	3	16	12	3	12	1	1	0	-5.22	2.63	1.99	1.15
GDP per capita. PPP (current international $)	48	0.002	7	1	0	0	8	16	13	3	3.76	-1.48	-1.89	-0.80
GNI per capita. Atlas method (current US$)	47	0.000	8	0	0	0	7	16	13	3	4.54	-2.23	-1.92	-0.81
GNI per capita. PPP (current international $)	47	0.025	4	0	0	0	11	16	13	3	3.05	-1.50	-1.29	-0.55
Life expectancy at birth. total (years)	48	0.000	15	6	0	0	0	11	13	3	5.30	-0.87	-3.72	-1.58
School enrolment. primary (% net)	39	0.066	8	7	1	0	5	8	8	2	1.84	0.57	-2.08	-1.21
School enrolment. primary (% gross)	44	0.022	0	5	6	0	14	11	6	2	-2.62	0.72	2.35	-0.84
Mortality rate. infant (per 1.000 live births)	48	0.000	0	9	13	3	15	8	0	0	-4.87	0.09	4.05	1.72
Improved water source (% of population with access)	43	0.000	12	8	1	1	0	7	12	2	3.99	0.21	-3.75	-0.64
Interest payments (% of GDP)	37	0.001	2	8	8	2	12	4	1	0	-3.79	1.07	2.41	1.34
Present value of debt (% of GNI)	27	0.018	1	6	0	7	12	5	3	20	-2.08	2.81	-1.09	0.00
Inflation. consumer prices (annual %)	47	0.000	0	4	8	3	15	12	5	0	-3.21	-0.73	2.69	2.61
Inflation. GDP deflator (annual %)	46	0.001	0	5	8	3	14	11	5	0	-3.28	-0.37	2.39	2.45
Tax revenue (% of GDP)	38	0.017	5	1	1	2	9	11	9	0	1.33	-1.51	-1.19	2.61

Number of valid cases; significance of Pearson Chi-Square; high: # of countries with “high” (1) and “low” (0) values for the variables; adjusted residuals. Colours highlight values for adjusted residuals: orange and yellow, values above 1.96 and 1.645 (confidence 95% and 90%) respectively; blue and pale blue values below above 1.645 and 1.96 (confidence 90% and 95%).

Table 52: Crosstabs for clusters, WITSA country set.

26.2. OECD set of countries

Indicator	N of Valid Cases	Sig. of Pearson Chi-Square	Leaders	Strivers	Laggards	Hoppers	Leaders	Strivers	Laggards	Hoppers	Leaders	Strivers	Laggards	Hoppers
			High				Low				Adjusted residuals			
			3	2	4	5	3	2	4	5	3	2	4	5
Broadband subscribers (per 100 people)	49	0,000	8	0	0	0	7	17	14	3	4,66	-2,25	-1,96	-0,79
Personal computers (per 100 people)	49	0,000	15	0	0	0	0	17	14	3	7,00	-3,39	-2,94	-1,19
Telephone mainlines (per 100 people)	49	0,000	14	3	0	0	1	14	14	3	5,73	-1,83	-3,23	-1,30
Mobile phone subscribers (per 100 people)	49	0,009	8	6	0	0	7	11	14	3	2,55	0,76	-2,80	-1,13
Population covered by mobile telephony (%)	39	0,003	13	12	3	2	0	3	6	0	2,42	0,36	-3,54	0,80
International Internet bandwidth (bits per person)	49	0,000	15	7	0	0	0	10	14	3	5,15	-0,38	-4,00	-1,61
Internet Hosts (per 10000 people)	49	0,000	10	0	0	0	5	17	14	3	5,34	-2,58	-2,24	-0,91
Internet subscribers (per 100 inhabitants)	32	0,000	7	1	0	0	2	12	8	2	4,31	-1,87	-1,89	-0,84
Residential monthly telephone subscription (US$)	31	0,027	0	1	5	0	8	10	5	2	-1,61	-1,07	2,98	-0,72
Price basket for Internet (US$ per month)	49	0,018	2	6	9	0	13	11	5	3	-2,09	0,06	2,75	-1,30
Price basket for mobile (US$ per month)	49	0,046	4	3	9	1	11	14	5	2	-0,78	-1,83	2,75	-0,05
Price basket for residential fixed line (US$ per month)	49	0,004	0	1	6	0	15	16	8	3	-1,90	-1,23	3,61	-0,73
Telephone average cost of call to US (US$ per three minutes)	36	0,051	6	4	0	0	6	8	9	3	2,10	0,53	-2,15	-1,12
Telecommunications revenue (% GDP)	49	0,000	0	0	0	2	15	17	14	1	-0,96	-1,05	-0,91	5,65
High-technology exports (% of manufactured exports)	48	0,029	5	0	1	0	10	16	13	3	2,94	-1,85	-0,72	-0,68
Telephone subscribers per employee	32	0,079	7	9	8	1	1	4	0	2	0,74	-1,01	1,73	-1,97
Telephone employees (per 100 people)	32	0,020	4	1	0	0	4	12	8	3	3,09	-1,02	-1,41	-0,78
Total full-time telecommunications staff (per 100 people)	36	0,001	7	1	0	0	4	11	10	3	3,96	-1,42	-1,99	-0,97
GDP per Telecom Employee (US Dollars)	49	0,000	11	2	0	0	4	15	14	3	4,93	-1,71	-2,66	-1,07
Enrolment in science. Tertiary. (per 100 people)	29	0,010	7	0	0	0	6	10	4	2	3,37	-2,20	-1,22	-0,83

Human Capital	49	0,000	15	9	1	0	0	8	13	3	4,56	0,20	-3,89	-1,82
Internet Access in Schools	49	0,000	14	3	0	0	1	14	14	3	5,73	-1,83	-3,23	-1,30
Laws relating to ICT	49	0,000	15	3	0	1	0	14	14	2	5,84	-2,21	-3,52	-0,20
Intellectual property protection	49	0,000	15	0	0	1	0	17	14	2	6,68	-3,55	-3,08	0,03
Level of competition - DSL	45	0,014	15	9	10	2	0	7	1	1	2,37	-2,96	1,04	-0,60
Level of competition – Cable modem	34	0,019	15	9	6	0	0	2	1	1	1,89	-0,80	-0,23	-2,78
Gov't procurement of advanced tech products	49	0,000	8	1	0	0	7	16	14	3	4,20	-1,65	-2,10	-0,85
Secure Internet servers (per 1 million people)	49	0,000	13	0	0	0	2	17	14	3	6,33	-3,07	-2,66	-1,07
Total Domains (per 100 people)	49	0,001	6	0	0	0	9	17	14	3	3,94	-1,91	-1,65	-0,67
Total ICT Spending, Retail Trade (% of GDP)	48	0,002	0	0	0	1	15	17	13	2	-0,68	-0,75	-0,62	3,91
Web Measure	49	0,006	7	2	0	0	8	15	14	3	3,40	-0,87	-2,10	-0,85
Availability of government online services	49	0,000	8	1	0	0	7	16	14	3	4,20	-1,65	-2,10	-0,85
International outgoing telephone traffic (minutes) (per 100 people)	31	0,000	9	2	0	0	1	11	6	2	4,38	-1,99	-2,02	-1,08
Internet users (per 100 people)	49	0,000	10	0	0	0	5	17	14	3	5,34	-2,58	-2,24	-0,91
E-Participation	49	0,000	8	1	0	0	7	16	14	3	4,20	-1,65	-2,10	-0,85
Total ICT Spending, Consumer (% of GDP)	49	0,000	0	2	2	3	15	15	12	0	-1,90	-0,37	0,00	4,38
Firm-level technology absorption	49	0,000	13	1	1	1	2	16	13	2	5,36	-2,91	-2,41	0,03
Extent of business Internet use	49	0,000	9	0	0	0	6	17	14	3	5,00	-2,42	-2,10	-0,85
GDP	47	0,081	7	4	1	0	8	12	12	3	2,28	-0,06	-1,73	-1,05
GDP Capita	47	0,001	7	0	0	0	8	16	13	3	4,19	-2,06	-1,77	-0,75
HDI	49	0,000	15	3	1	0	0	14	13	3	5,84	-2,21	-2,87	-1,42
Inequality-10	47	0,030	5	12	8	3	10	3	6	0	-2,51	1,95	-0,22	1,47
Economic Incentive Regime	49	0,000	12	4	0	0	3	13	14	3	4,69	-0,99	-3,08	-1,24
Innovation	49	0,000	15	3	0	0	0	14	14	3	6,10	-2,02	-3,37	-1,36
Gross National Expenditure (% of GDP)	40	0,037	0	3	1	2	9	13	11	1	-1,43	0,54	-0,77	2,61
General Govt. final consumption expenditure (% of GDP)	40	0,082	4	3	0	1	5	13	12	2	2,08	-0,16	-2,07	0,60
Health Public Expenditure (% of govt. expenditure)	49	0,000	10	2	0	0	5	15	14	3	4,56	-1,51	-2,52	-1,02
Health Public Expenditure (% of total Health expenditure)	49	0,005	10	7	1	0	5	10	13	3	2,89	0,47	-2,72	-1,36

Education Public Expenditure (% of govt. expenditure)	33	0,065	0	5	0	1	11	10	5	1	-1,91	2,06	-1,14	1,20
Population growth (annual %)	44	0,090	2	2	1	2	12	12	12	1	-0,20	-0,20	-0,96	2,49
Population in urban agglomerations > 1 million (% of total population)	44	0,007	5	0	0	0	9	15	12	3	3,48	-1,71	-1,45	-0,64
GDP deflator (base year varies by country)	48	0,000	3	16	12	3	12	1	1	0	-5,22	2,63	1,99	1,15
GDP per capita, PPP (current international $)	48	0,002	7	1	0	0	8	16	13	3	3,76	-1,48	-1,89	-0,80
GNI per capita, Atlas method (current US$)	47	0,000	8	0	0	0	7	16	13	3	4,54	-2,23	-1,92	-0,81
GNI per capita, PPP (current international $)	47	0,025	4	0	0	0	11	16	13	3	3,05	-1,50	-1,29	-0,55
Life expectancy at birth, total (years)	48	0,000	15	6	0	0	0	11	13	3	5,30	-0,87	-3,72	-1,58
School enrolment, primary (% net)	39	0,066	8	7	1	0	5	8	8	2	1,84	0,57	-2,08	-1,21
School enrolment, primary (% gross)	44	0,022	0	5	6	0	14	11	6	2	-2,62	0,72	2,35	-0,84
Mortality rate, infant (per 1,000 live births)	48	0,000	0	9	13	3	15	8	0	0	-4,87	0,09	4,05	1,72
Improved water source (% of population with access)	43	0,000	12	8	1	1	0	7	12	2	3,99	0,21	-3,75	-0,64
Interest payments (% of GDP)	37	0,001	2	8	8	2	12	4	1	0	-3,79	1,07	2,41	1,34
Present value of debt (% of GNI)	27	0,018	1	6	0	7	12	5	3	20	-2,08	2,81	-1,09	0,00
Inflation, consumer prices (annual %)	47	0,000	0	4	8	3	15	12	5	0	-3,21	-0,73	2,69	2,61
Inflation, GDP deflator (annual %)	46	0,001	0	5	8	3	14	11	5	0	-3,28	-0,37	2,39	2,45
Tax revenue (% of GDP)	38	0,017	5	1	1	2	9	11	9	0	1,33	-1,51	-1,19	2,61

Number of valid cases; significance of Pearson Chi-Square; high: # of countries with “high” (1) and “low” (0) values for the variables; adjusted residuals. Colours highlight values for adjusted residuals: orange and yellow, values above 1.96 and 1.645 (confidence 95% and 90%) respectively; blue and pale blue values below above 1.645 and 1.96 (confidence 90% and 95%).

Table 53: Crosstabs for clusters, OECD country set.

Afterword

They say doing a PhD – including writing the dissertation – is a huge individual intellectual effort. It is true. Definitely.

But, I'd dare say, it does not compare with the tremendous personal effort of learning about oneself. Such a big project is not (only) an intellectual exploration, but a journey to the boundaries of one's capabilities: to guess what they are and map where they are placed.

Fortunately, there are plenty of companions that join the trip along the way. I'm humbly thankful to all of them, for they also endured part of the effort and got little in exchange.

Unlike what is often heard about PhDs, this work of mine has neither been the beginning nor will it be an arriving point. The past, present and – hopefully – future ramblings about e-Readiness, ICT4D, the Digital Divide and the Information Society in general can be found in my personal research portal: ICTlogy.net

I hope you enjoyed the reading as much as I enjoyed the writing.

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To contact the author:
http://ismael.ictlogy.net/

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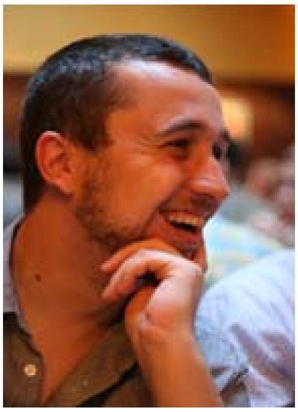
See also the author's blog on the Information Society, the Digital Divide and ICT4D:
http:// ictlogy.net/



Ismael Peña-López is Lecturer at the School of Law and Political Science, Universitat Oberta de Catalunya (UOC). He holds a Bachelor in Economics. Master en ecoaudit and environmental planning. Specialist postdegre in Knowledge Management. M.Phil. in Political Science.

His main field of interest is twofold. On one hand — and due to a personal philosophy of life — the aspects related with Information and Communication Technologies for Development (ICT4D): e-Readiness, the Digital Divide, ICTs in cooperation for development, nonprofit technology, online volunteering, e-Inclusion.

On the other hand — and due to a professional engagement in the field — the aspects related with e-Learning and empowerment: digital capacity building and literacy, e-Portfolios, Open Access, Open Science, Access to Knowledge. When both ends meet, the conjunction is perfect.

Founding member and director for five years of UOC's cooperation for development programme, mainly about e-learning for development. He is editor of ICTlogy.