

## Chapter 5

### Concluding Remarks and Recommendations

#### 5.1 Conclusions

The aim of this chapter is to provide overall conclusions, as well improvement suggestions intended to guide further research and, more importantly, enhance the implementation of activities at the ETSEQ. The concluding and final remarks given in subsections 3.4 and 4.5 will not be repeated here, but rather summarized or restated within wider context. The framework presented in the next subsection is a build up of the ETSEQ vision and provides all the necessary components to improve the competency based educational model currently developed.

The hypothesis of achieving enhanced technical knowledge through the application of social competencies has been documented and evaluated for validity. Current results provide evidence that the new competency based model of engineering education outperforms conventional approaches and is sustainable. Over a decade of research on the model initiated back in 1994 by some visionary professors [1,2] has provided tangible data to support the original hypothesis [3] (see Appendix A). It is a valid statement to confirm the sustainability of improvements [4,5], based on the long running nature of the project. The model's uniqueness is characterized by reconciliation of the classical dilemma of conveying necessary technical knowledge and adding supplementary social competencies. Typically, these two components are perceived as being mutually exclusive.

This research puts forward an assumption that not only reconciliation is possible, but also that there is additional productivity gain in enhancing technical competence through application of social competencies. The enhancement is particularly effective when it comes to long lasting sustainable results. Traditionally, students are exposed to a predetermined fixed amount of technical content, which for the sake of this discussion may be characterized as 100%. Unfortunately this amount of technical information can not be retained and overtime drops to numbers as low as 10%. If to the contrary, social competency building is integrated, the amount of technical knowledge may only be 80%, however has a much higher retention rate, typically circa 50% [6]. The supplementary information retention rate is considerable and has to be portrayed against the additional advantage of possessing superior social competencies, which complement superb technical knowledge retention. Preliminary observations clearly indicate that this new type of engineering students have an easy entry into today's highly competitive labor market, as they outperform graduates from other more conventional schools.

This research suggests full adoption of the social integration model by other schools, which would provide more talent to the job market, in addition to accelerating the necessary culture change in an academic organization, which is traditionally change adverse. To enhance the functionality of the social integration model, improvement suggestions are proposed in the following.

## **5.2 Recommendations for Future Research**

Some additional recommendations for future research are presented here, which are complementary to those already obtainable in Chapter 4 [7]. All along the length of this thesis work some individual recommendations were highlighted and it is now imperative to structure these recommendations in a manner which would allow future research to be performed in a more effective and efficient way. The best method of structuring recommendations is by using the Change Management framework developed by the Dow Chemical Company and which is presented here in section 2.4 (see Figure 2.2) [8]. In the following subsections, various components of this framework are discussed with specific reference to future improvements for this type of research.

### **5.2.1 Articulate Vision**

The vision of the school (see subsection 2.4.1) has been defined, but has not yet been clearly communicated and/or reiterated. Every major change is initiated by putting forward a compelling case for change, which is communicated to the organization in a very aggressive way. Very often the importance of vision communication is underestimated [9] and consequently the organization does not perceive the need for change. In this particular case, it were the professors, above all, who left the seminars with the impression that a transition to a more team based organization is more of an option as opposed to a clear mandate.

To improve the ETSEQ performance and the performance of respective management and government bodies, it should be clear that the change is a must and that there would be negative consequences [10] in case professors fail to adopt a different way of teaching and organizing education. In addition, it is proposed that at the beginning of each academic year all professors and faculty staff should be brought together for a one day learning event, at which point the vision would be revised, learning from past academic years reviewed and actions for improvement identified.

### **5.2.2 Establish Change Readiness**

It can be concluded that at the beginning of the project, readiness for change was only established to a moderate degree. One way to institute change readiness is to construct a more upfront communication and dialogue within the school and the students. In addition, one could consider conducting simple change readiness surveys [11], which would help diagnosing the perception of change in the organization. These surveys should be normally run on a six month basis to track relative progress.

As shown in Figure 5.1, there is a generic pattern, which is followed by individuals on the path to change [12]. It is of critical importance that the individuals affected by change move fast through the negative predisposition to change journey, as commitment to implement change only occurs when the individual is in the stage of testing.

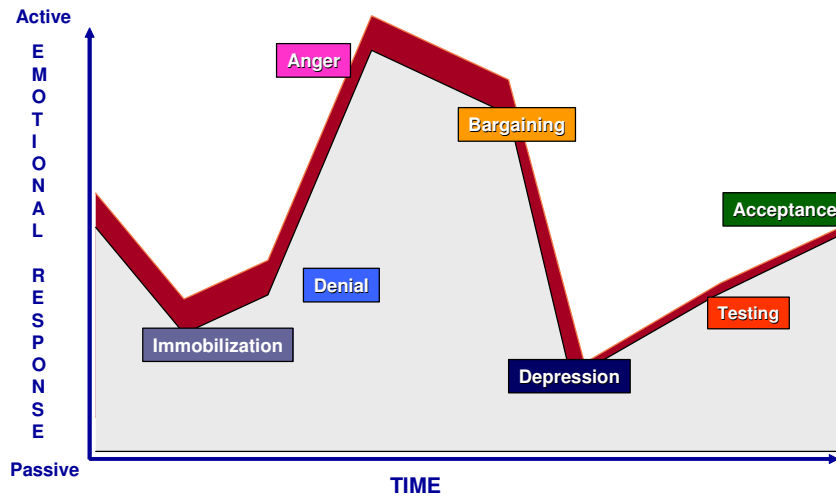


Figure 5.1. Illustration of negative predisposition to change

Only at the testing stage does the individual's energy focus on the task. Prior to that, when going through the change, the energy is focused on emotional survival. That is the reason why in general productivity and morale will typically drop or at least stagnate when going through major change, irrespective of the nature of the organization. Figure 5.2 illustrates the distribution of energy during change.

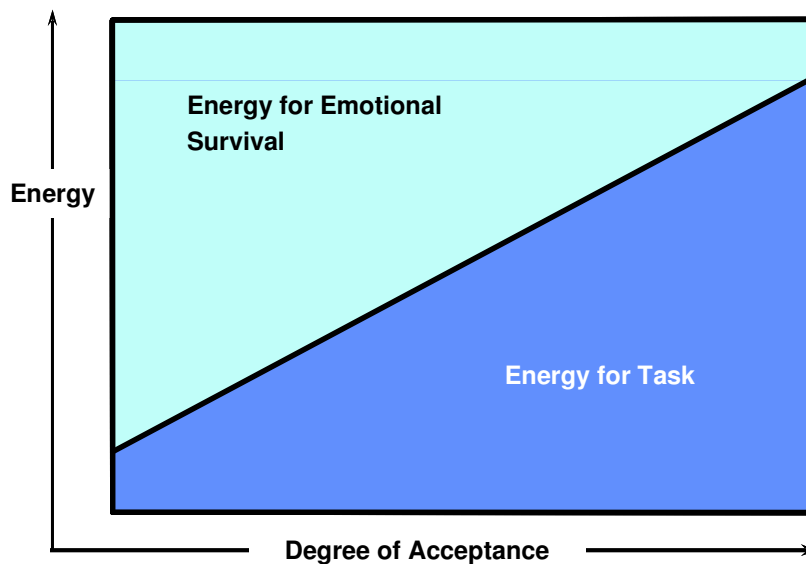


Figure 5.2. Distribution of energy during change

### **5.2.3 Develop Change Leadership**

This is probably one of the areas where this research project needs the largest improvement, if it has to be sustainable in the long term. Building the necessary capacity to lead the school through this particular change and future transformations is crucial for success. While some education took place at the beginning of this project, it became evident that it was not sufficient to make individuals capable of driving change. It is therefore proposed that all professors, if possible, should go through an educational step, at which point they would build and enhance their competencies on how to lead change. Because of the fruitful collaboration and partnership between the ETSEQ and The Dow Chemical Company, one could think of running a two day seminar called “Implementing Change Effectively” [8] for professors and faculty to build the competencies needed. That would in turn enhance the resilience of the school as such - a strategic asset in a growing competitive environment for attracting talented students and competent professors and researchers. This is the key objective of the ETSEQ. Within the school setting, professors act as role models and their behavior shapes that of team managers and their students. So, in case a professor is a luke warm supporter of the new educational model, he/she will project that same perspective on to the students. In fact, implanting ambiguity in the school will ultimately lead to some form of civil war, as supporters of project methodology will fight resisters [13]. That takes away precious energy needed for task completion and absorbs the energy needed for emotional survival as previously illustrated in this chapter.

### **5.2.4 Build and Develop a Project Team to Manage New Model**

When managing change on a large scale it is imperative to have a mechanism in place, which will manage implementation. In present research, this role was assigned to a project team. However, the team charter was not clearly spelled out and the roles and responsibilities not clearly allocated. This represents yet another major area for improvement, as building and maintaining a project team infrastructure is one of the success ingredients. A typical project team for the school could be formed by two professors (one of which is project leader), five students (all from different integrated projects) and two staff members (PAS). Such a composition represents a cross section of the organization and therefore should integrate the needs and concerns of all different stakeholders.

Typically, a project team should receive sound education consisting of change management and team dynamic skills. Again, from a practical point of view, the proposal calls for that same change management seminar, as proposed for the professors [8], an introduction to group dynamics “Introduction to Teams and Groups©” [14], followed by the full series of models from “Enhancing Team Performance©” [15] over time. As the integrated project methodology along with the social competency building takes momentum at the ETSEQ, one should think of rotating project team members at the beginning of each academic year. In order to guarantee continuity, it is recommended that about 4 project team members, including the leader should stay the same while the others rotate. That way an additional benefit would be obtained in form of creating multipliers at university. The project team itself would be supported by various sub teams/networks, composed of different representatives from integrated projects

and faculty. While the project team should focus on implementation and management of milestones, the respective sub teams would provide content information for the different sub streams of the project. The template proposed in Figure 5.3 for management infrastructure calls for 4 sub streams: empowerment, communication, competency building, and culture. These components are directly derived from the vision and represent the major building blocks to work with.

The project team itself is typically connected to a sponsorship team, which provides the appropriate guidance, mission statement, resources, and balance of consequences. Sponsorship team members are generally selected from the highest level in the organization. In this case, members should be the ETSEQ director, the chairs of the departments involved, and the appropriate university vice president, with representatives of government and other faculties to allow leveraging within University Rovira i Virgili and other universities.

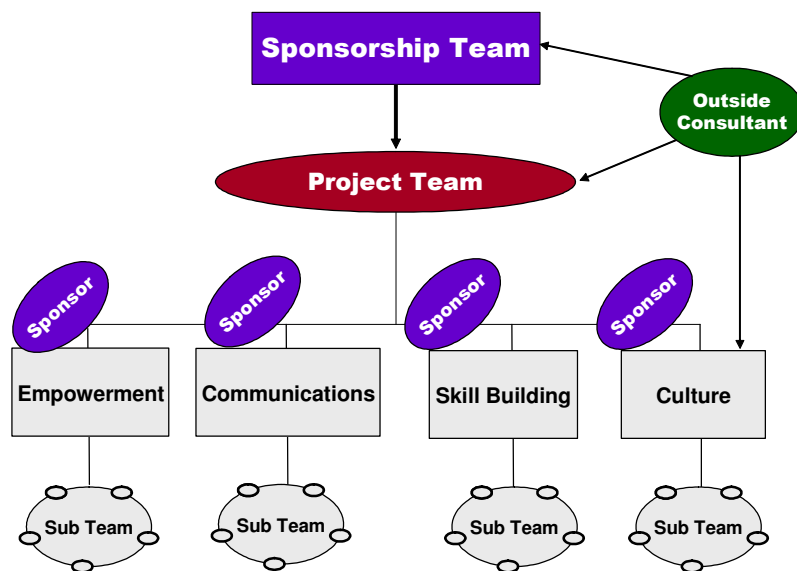


Figure 5.3. Project management infrastructure

### 5.2.5 Identify and Manage Expectations of Stakeholders

The prime stakeholders of this research are the various constituencies of the university. Provided that recommendations made so far in this chapter are all followed, this particular topic would be addressed practically. One could think of some other stakeholders outside of the university, in particular governmental agencies like the Ministry of Education of Catalonia, chemical manufacturers, and other universities/faculties who might be interested in learning from this project. Typical tools to track the positioning and relative movement of stakeholders are surveys, interviews, and focus groups. In this particular case, it is proposed to simply communicate more effectively with the various stakeholders, but other than that no additional measures are currently needed.

### **5.2.6 Design and Execute Communication Strategies**

It is a today's societal paradox that despite all the information floating around, communication suffers rather often than not. It is quite a challenge to select appropriate information out of the wealth of knowledge available and appropriately communicate it to the recipients. That is the reason why one of the sub streams of the project team is communication. The task here would be to do a better job in selecting message, messenger, and media [16]. As efforts have been made throughout this research to keep the various stakeholders informed, it is recognized that additional structured efforts are needed to communicate appropriately. Given the assumption that the project team and the leadership would have received appropriate change management education, this area for improvement could be considered covered.

### **5.2.7 Design Jobs**

As the subject of this research is an academic organization rather than a business organization, it would be more appropriate to call this area "design roles". This signifies that roles and functionalities are different before and after vision implementation. For example, before the vision implementation takes place, professors could be perceived as some form of hierarchy with the students behaving like subordinates and reporting to the professors.

The new competency based educational model is a client and service one, whereby professors represent service providers to the clients, equals students, to perform optimally. That calls for a change of roles and functionality towards a facilitation scheme, which leads towards implementation. Again, the project team with the mandate of defining empowerment would be responsible to put forward role descriptions for the new model and consequently an implementation scenario of how current incumbents would shift towards the new role descriptions and perform according to these expectations.

### **5.2.8 Develop Performance Measures**

While a vision statement and a qualitative description of its components are available, there is a lack of quantitative performance indicators at the ETSEQ. Additionally, each objective should have a timeline and defined quantities for improvement. For example, in the chemical engineering department vision, the empowerment principles are put forward as follows: empowerment principles are applied by students, faculty members, and PAS. Effort has to be invested in order to translate these principles into compelling objectives. That should include an operational definition of what empowerment principles mean, a deadline to complete the implementation of these principles, and finally an objective way on how to measure progress. In the absence of well defined performance measures no real progress is possible [17]. Even worse, the progress made becomes the subject of interpretations and this, in turn, can ultimately fuel the 'civil war' between supporters and resistors of the change, as mentioned in subsection 5.2.3. Creative communication is required when dealing with performance measures and agreeing upon corrective measures.

## Concluding Remarks and Recommendations

When setting up the measures in more detail for the organization, a number of principles and considerations have to be adhered to. First, there has to be a hierarchy of measures [18]. The following Figure 5.4 captures the concept of this hierarchy.

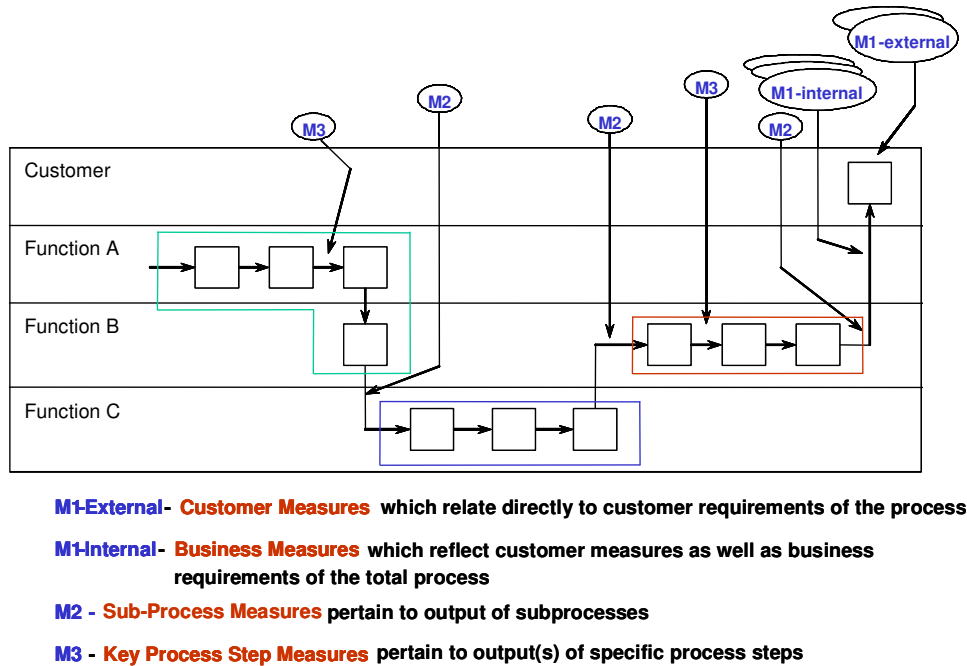


Figure 5.4. Hierarchy of measures

While this concept is primarily applied in the business world, it is nonetheless generically applicable and would serve the ETSEQ very well. In more practical terms, customer measures would be, for example, survey indicators which give supporting evidence that “we will be a center of reference in the field of Chemical Engineering in Europe with a priority hold into the Mediterranean area”. Or in other words, there have to be measures (like a survey on the attractiveness of the school in Tarragona or its perceived value by students, professors and researchers), which indicate the progress towards the accomplishment of the vision. Next internal measures should be defined, like ratings, grades, drop-out rates, etc., per faculty to reflect a unit performance. Finally, measures could be introduced on the next level below where you could compare and analyze classes within an academic year. This would be followed by student performance data.

Once the hierarchy of measures or indicators has been established, a good performance tracking mechanism has to be put in place. Typically, a grid of measures or dashboard would be used in industry. Such a grid reflects the organizational alignment, needed to show the correlation between efforts and results. In order to engage the organization, these measures are normally discussed and reviewed with the members of the organization. This allows for the teams and individuals at a working level to clearly see their contributions and impact of their activities. In more practical terms, the sponsorship team would propose the critical customer and external measures. The project team in turn would then propose the organizational measures (one level below) and, together with the sub teams, draft team and individual indicators. This way there is clear alignment between the hierarchy of measures and the change management

infrastructure, as illustrated earlier in this chapter. Figure 5.5 provides an example on how such a performance grid could be established at the ETSEQ.

| Organizational Level | Cost                       | Satisfaction                                    | Time  | Volume                                       | Defect                            |
|----------------------|----------------------------|---|---|--|-----------------------------------|
| Client               | University budget          | Industry response                               | Time span between application and job offer | Number of students applying                  | Post evaluation of engineer hires |
| Organization         | Department budget          | Perception survey of university                 | Deviation from min. possible study period   | Drop out rate                                | Professor & student feedback      |
| Team                 | Cost of integrated project | Comparative survey of different faculties teams | Completion of integrated project            | Number of active teams                       | Marks for integrated project      |
| Individual           | Cost per student           | Student survey                                  | Time required to study                      | Number of students participating in projects | Student marks                     |

Figure 5.5. Performance grid for the ETSEQ

As indicated in chapter 4, one could think about additional measures to prove the hypothesis that social competencies enhance technical learning, as well as give evidence on the improvement results obtained by the social competency building. For example, it is industry standard to assess the level of empowerment. Likewise, an empowerment assessment could be applied to the teams working on integrated project during the final stages of education (4<sup>th</sup> and 5<sup>th</sup> years) [19]. This empowerment assessment will be beneficial, since it would facilitate the identification of future improvement opportunities and consequently allow for higher levels of empowerment. This measure would fit well in the category of team level of the performance grid. The collective view on the empowerment assessments for all teams working on integrated project would represent a measure for the organizational level. Parallel to these empowerment assessments the diagnosis tool provided by the vendor of “Enhancing Team Performance©” could also be used to validate the results of the empowerment assessment. When it comes to organizational level and customer level the EFQM model [20] and its subsequent assessment would represent another measure. While this evaluation requires competencies and effort, it provides an excellent organizational diagnosis. In addition, it would be useful to compare it with assessment already conducted at the ETSEQ back in 1998 [21].

### 5.2.9 Develop Competencies

Besides Develop Change Leadership this is probably the second biggest area of improvement. In subsection 5.2.3 the education of professors was discussed in detail. In this particular subsection emphasis is put on education of the remaining stakeholder, which is crucial in order to make the changes sustainable. Figure 5.6 shows the correlation between the level of competencies and empowerment. Research supports unanimously this correlation, whereby the competency



building has to be initiated first before the behavior changes become visible [22, 23].

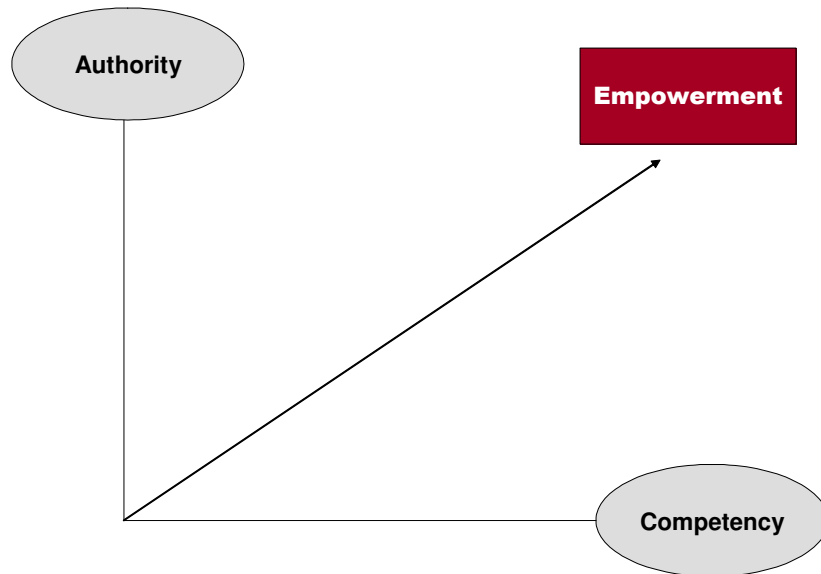


Figure 5.6. Relationship between competency and empowerment

While Figure 5.6 represents the conceptual correlation, it is worth to have a further look into the competency building process. It is important to notice that in order to accomplish the vision of a technical and social competent engineer, a large part of the education has to be focused on developing methods and social competencies. Figure 5.7, which is an upgrade of Figure 2.1, reveals the education that would enable students to become “global engineers”.

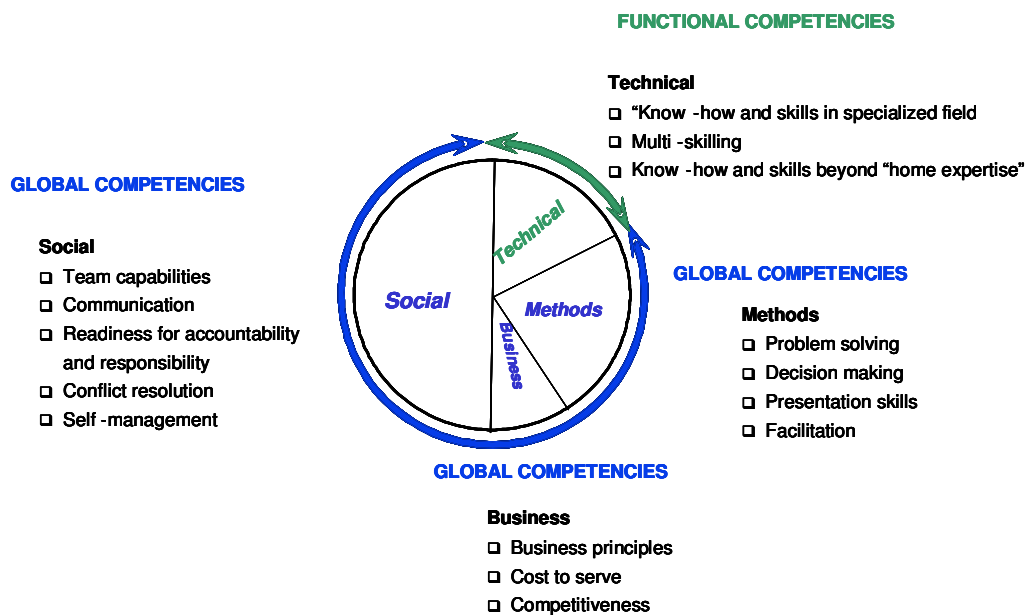


Figure 5.7. Components of competency building for a global engineer

Based on the above arguments social competencies are critical, as they allow better learning and consequently increase the ability to absorb and retain

technical competencies and knowledge. All the survey feedback obtained from students (team managers and team members), which has been reported in chapter 3, calls for more ongoing education. They are clearly demanding continuous support and coaching in order to make the learning and the behavior changes sustainable. Based on that feedback, the interventions given in Figure 4.1 and Table 4.2 as part of the proposed educational model could be complemented with other interventions in form of short courses and seminars to further enhance teamwork capability. A brief description of some of these complementary training alternatives is given below. Appendix E also includes a more detailed description of some of these proposed interventions.

One of the challenges when starting re-skilling of an organization is to find a learning resource which, while being sophisticated enough to cover the concepts and implementation, is also simple and compelling enough to be understood by the total population affected. Even though “Enhancing Team Performance©” is a great learning resource, it takes considerable effort to educate the whole organization. In addition it is a modular process and thus requires some time to convey the learning. As an improvement for future resources, it is proposed to have an alternative base education in form of “Introduction to Teams and Groups©” [14]. This is a course of approximately 6 hours, which conveys all the basic principles of teams and groups. It also allows immediate application of the learning as it contains exercises, tools and surveys, which are carried out during the course. This learning resource has been developed by The Dow Chemical Company under the leadership of the author of this research. It is proposed that the entire school population is educated with this material. This would build an appropriate foundation on which the external and more complete intervention “Enhancing Team Performance©” could be built. As “Introduction to Teams and Groups©” is only a 6 hour course, large amounts of participants could be taken through it in a relatively short period of time. This course was successfully prototyped at the ETSEQ as part of the courses for Multi-Disciplinary Seminars.

Another improvement opportunity is the provision of on-going coaching and consulting. Research unanimously supports the need for this component of learning [24-26]. It is common that groups and organizations after having received education, struggle with implementation. That is why it is crucial to have coaches and consultants available for help to overcome all kinds of barriers during implementation. The surveys feedback regarding improvement opportunities is clearly pointing in this direction. It is proposed that professors, team leaders and knowledge managers undergo a seminar on coaching. Because of the relationship with The Dow Chemical Company, it is possible to come to an agreement with the company Development Dimensions International Inc. (DDI). This relationship could be shaped in similar form to the partnership with The TRACOM Group for “Enhancing Team Performance©”. The vendor DDI has a great learning resource on the market in form of the product “Enhancing Coach Performance©” [27]. Similar to “Enhancing Team Performance©”, it is designed in modular form and helps coaches to fulfill their role and consequently support team performance. Under the assumption that the target population is educated in this way, it is to be expected that the implementation of the new educational model is considerably enhanced. Preliminary discussions between the author of this research and DDI have already taken place, so that “Enhancing Coach Performance©” education could start relatively soon.

In addition to the coaching support described above, it is proposed to have an external consultant available on a periodic basis. This individual would provide the coaching of the coaches in all aspects of leadership, change management and group dynamics. It is also critical that the consultant delivers the necessary tough messages to the senior level of the school and university. The advantage of being an outsider is providing a fresh pair of eyes, as well as being impartial and bringing a component of objectiveness and mediation to the party. It is proposed to set up an official agreement between this consultant and the university, so both parties could agree on their expectations. Besides consulting, this person is also to stimulate dynamics between the various constituencies of the project infrastructure.

### **5.2.10 Align Culture, Structure and Rewards**

As discussed earlier in this research work, implementation of the educational model along with building social competencies represents a significant culture change. This philosophy is dominated by two schools of thought. One states that tools and techniques should be used to initiate the necessary culture change. The other favors the concept of “change the culture indirectly by changing the way you do things” [28]. The author of this research is a disciple of the latter school of thought. Therefore it is not recommended to introduce additional activities, but rather rigorously implement the other recommendations. As these recommendations originate at the top of the organization, a significant behavior change of professors would in turn drive significant behavior change of team managers, resulting in behavior change across the university.

When it comes to structural changes, there is no apparent need to change anything in the organizational structure or set up of the university or school. Typically when large scale reengineering projects are executed, a change in organizational structure is involved. Nonetheless, it is believed that the educational model can be successfully implemented even within the current organizational set up. This judgment is of critical importance due to the fact that structural changes in an academic organization require time consuming state approval procedure, which would slow down the speed of change. Hence it is desirable to implement the changes within the current structural set up.

Rewards represents most likely the third biggest area of emphasis. It is an accepted principle in behavioral science [24] that the reward of the desired behavior has a dramatic impact on changing behavior. The change of behavior in an academic organization is particularly complex, as there is very little direct, immediate and personal incentive to change. This assumption applies to the students and professors alike. In case of students it is not immediately obvious why they should change their behavioral pattern, when it is a valid option to maintain the status quo. Only the success of the integrated project could serve as a first tangible incentive towards improved team dynamics and consequently, more productive team behavior. Therefore, it is highly recommended that the integrated project marks should carry more weight when allocated against the total subject composition. This would not only elevate the image of the integrated project, but would also make the behavior change more desirable.

In case of professors the situation is ever more complex. The latter are by definition “funcionarios”, thus their recognition structure is rigid and state determined. A reward for this target group would have to appeal primarily to their intrinsic motivation [29]. This could take the form of student/dean feedback and personal growth and development. Preliminary attempts to initiate the student feedback to professors have been undertaken, however not in any structured form. Therefore, additional work is necessary to design – for the student and professor use – a transparent recognition scheme, which clearly links desired behavior changes and reward.

### **5.2.11 Develop Human Resource Policies**

When business organizations undergo massive changes, they develop a high activity level at aligning and designing human resource policies. With the assumption that a reengineering effort will dramatically impact employee and career development, a revisit of human resource policies is necessary. In case of academic organization one has to look into this arena as well. Potential improvement opportunities lie in the answers to the following questions:

- How do you assign topics to professors?
- Do you introduce rotational assignments?
- Do you require social competency building and personal development for professors as condition for employment?
- Do you make participation in development activities a mandatory requirement for university members?

These and other questions should trigger a university revisit of human resource policies. A cohesive system of employee development and reward policies should be designed in conjunction with the findings of the previous Align Culture, Structure and Rewards sub chapter.

Further research and effort in the reward policy area is needed to complete the support system for the implementation.

### **5.2.12 Implement Change/Measure Results/Reward Teams and Individuals/Maintain and Improve**

The prime objective of this section is to implement the vision and the objectives and to assure sustainability. If all along the change process the suggestions for improvement would have been implemented, it is fair to assume that by now the change is systemic and sustainable. This also implies the engagement of the total organization affected and an intense dialogue and communication throughout the implementation process. Therefore, the task at hand calls for implementation discipline with performance tracking, analyzing deviations, capturing learning and continuous improvement program. Ideally, there is an infrastructure in place to perform these tasks. This infrastructure could be represented in form of the project team, as proposed in subsection 5.2.4, or any variation of that proposal. It is mandatory that performance tracking is an integral part of the duties of university management, so that response to any deviation occurs in a timely fashion. Based on current experience, when change management is adopted, performance tracking becomes an integral part of operating. Gradually the

management of these changes has to become a daily activity and no longer carry the notion of being on top of the normal work flow.

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