

Appendices

Appendix A.

Coaching Related Competencies

DEVELOPMENT OF COACHING COMPETENCIES IN STUDENTS THROUGH A PROJECT-BASED COOPERATIVE LEARNING APPROACH

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Abstract – First-year chemical engineering students carry out a horizontally integrated design project working in teams. The teams are each led by two fourth-year students, one taking on the role of team leader and the other of knowledge manager so that the project is also vertically integrated. Team leaders facilitate project and team management while knowledge managers facilitate the learning process of first-year students in such a way that both are essentially coaches. Fourth-year students experience alternatively both roles during the two semesters (15 weeks) of the academic year. These new roles require a new set of technical and social skills: Team management, facilitative leadership, and project management skills, which are formally introduced in the fourth-year Project Management course and put into practice in the Project Management in Practice course. The real challenge of the whole approach is ensuring that fourth-year students resist the temptation of reproducing the supervisory role of professors in the classical classroom environment, despite the pressure of achieving project objectives, the inexperience of first-year students who are not used to this approach, and the cultural inertia of the professors involved.

Index terms – Coaching skills, cooperative learning, project-based learning.

INTRODUCTION

Historically, engineering education has mainly focused on delivering scientific and technical information to students. However, in modern corporate environments, scientific and technical knowledge can only be applied effectively if it is combined with adequate social skills and management methodologies such as team and facilitative leadership skills and project management [1].

Social skills cannot be easily addressed after graduation by additional training [2]. They are best developed across a curriculum from the introductory to the professional levels in a stepwise fashion, with appropriate repetition and positive reinforcement. In this respect, industry has repeatedly and clearly demanded that the scope of undergraduate engineering education should be accordingly broadened [3]. The message is clear, start working the above skills as soon as possible.

Project-based learning [4] coupled with cooperative learning [5] enable engineering students to combine the building of knowledge with its application to real-life

problems while simultaneously developing the social skills needed in any challenging relational environment. In addition, one of the key elements for the success of any team endeavor is leadership. The challenge at hand is how to provide strong leadership to project teams formed by first-year students. The allocation of several professors to tutor each team is not practical given the constraints of limited faculty and budget. One alternative is to create and develop empowered student teams, ultimately capable of self-management; project teams formed by first-year students and led by senior undergraduate students who have fully experienced project-based and cooperative learning in their own education, and are equipped with team and facilitative leadership skills and project management know-how.

This paper describes how fourth-year chemical engineering students at the School of Chemical Engineering (ETSEQ) of the University Rovira i Virgili (Tarragona, Spain), develop and practice facilitative leadership skills and apply project management methods and tools through a learning approach that combines both project-based and cooperative learning.

THE PROJECT-BASED COOPERATIVE LEARNING APPROACH (PBCLA)

The PBCLA has been designed to facilitate the empowerment of teams formed by four or five first-year students and two fourth-year students to carry out a design project. The first pilot experience of the PBCLA at the ETSEQ was conducted during the Spring semester of the 1996-97 academic year. Then, 3 first-year and 2 fourth-year courses, 5 instructors and 23 teams of 56 students were involved. Currently, when the stationary state has been reached, all first-year courses, that is 12, 2 fourth-year courses, 24 instructors and 23 teams of 45 students are involved. Over 200 senior students have gone through the PBCLA experience during this period. The reason why to devise and implement the PBCLA, the description of the approach and its assessment during the first years of implementation are described in detail elsewhere [6]-[7].

In the last two years, the assessment of the PBCLA has been extended to include measurements of the development of skills by students. This is part of a doctorate project being carried out by one of the authors with the support of Dow Chemical Co. It is also worth to mention that in 2001, the ETSEQ was honored by the Catalan Government with the

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Jaume Vicens Vives accolade for the improvement in teaching achieved through the PBCLA.

Figure 1 illustrates the organizational environment in which the PBCLA is implemented and takes place. The design project starts the first week of classes and lasts for the two semesters of the academic year. Thus, first-year students begin team activities when they do not possess either the necessary technical abilities and knowledge or the appropriate team-based relational skills to carry out the project.

The scope of the design project has to be defined by each project team. On the one hand, the instructors (first and fourth year professors) that participate in the PBCLA select a chemical product or a process that will be the subject of study of the design project. For instance, sulfuric acid is the current 2001/02 subject while the thermal treatment of industrial wastes was selected for the 1998/99 academic year. On the other hand, each first-year instructor selects a set of instructional objectives from his/her course syllabus, which will not be covered in the regular class hours but rather achieved through the design project. The general instructional objective fixed by the school for the first-year students is that they begin the development of lifelong-learning skills within the team-based working environment of a professional chemical engineer.

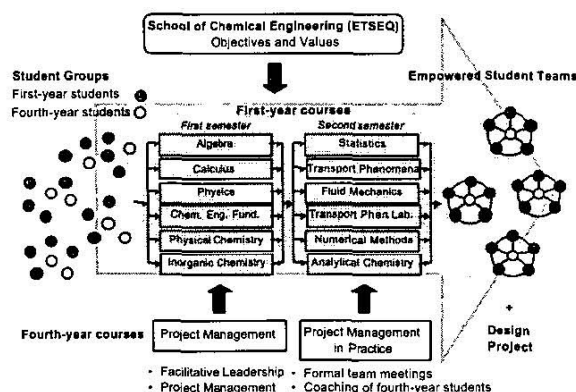


FIGURE 1
THE PROJECT-BASED COOPERATIVE LEARNING APPROACH AS DEPLOYED AT THE FIRST AND FOURTH ACADEMIC YEARS OF THE CHEMICAL ENGINEERING CURRICULUM AT THE ETSEQ.

Project teams are encouraged and guided to attain full empowerment to make decisions in all of the tasks that constitute the learning process [4]. This level of empowerment to project teams can only be granted by first-year instructors in view of the solid leadership that fourth-year students can provide. These students have accredited the knowledge needed to carry out the project activities and have already gone through the same experience a few years ago. In addition, they have been specifically trained in facilitative leadership skills and those needed to enhance

team performance [8]. However, they are now asked not to do the project activities again, that is, play the game, but rather to coach a group of first-year students through the different tasks involved in the learning process to achieve the project objectives. This new role requires that fourth-year students be equipped with facilitative leadership skills and project management know-how. This is the purpose of the Project Management (PM) course allocated in the fourth-year of the curriculum (see Figure 1).

Regarding time resources for the PBCLA, each first-year instructor dedicates between 20-50% of his/her class hours to the project so that the teams can attain their goals within the school schedule. This percentage is also the weight of the project in the first-year students' final grade in each course.

The Project Management in Practice (PMP) course provides the time needed for (i) formal team meetings (3 hours per week) wherein all team members, first and fourth-year students, are present, and (ii) plenary sessions (1 hour per week) between fourth-year students and the instructors of PMP and PM. The remaining time provided by the first-year instructors, which is not dedicated to formal team meetings, is used by first-year students to carry out project activities. Instructors are present in their class hours during these activities but they are no longer responsible for any of the tasks of the learning process. They act, like fourth-year students, as coaches of the project teams.

FOURTH-YEAR STUDENTS AS COACHES

Fourth-year students take on the roles of team leaders and knowledge managers in the project teams. Team leaders help first-year students develop team skills and practice project management methods and tools. Knowledge managers do the same with problem-solving and life-long learning skills. However, neither the team leader nor the knowledge manager works with first-year students on the learning activities that the project involves.

The specific responsibilities of teams leaders are:

- Develop and apply a method to establish the composition of project teams.
- Help the team to set its overall goal and specific objectives and develop an appropriate project plan.
- Manage the change that the PBCLA represents for first-year students.
- Help team members to clarify their roles, responsibilities, quality standards for their jobs, team norms and operational procedures.
- Manage the project and the formal team meetings.
- Facilitate the development of the team through the phases of formation, solidification and optimum team performance.
- Help the team to manage conflict.
- Develop communication and decision-making skills in team members.

- Facilitate the integration of new students into the team.
- Evaluate regularly and provide a final grade on the development of team skills and the quality of the job done by first-year students.

The responsibilities of the knowledge managers are:

- Establish a liaison with first-year instructors to clearly identify their needs and requirements on the project and to assure that the project scope is aligned with them.
- Identify first-year students' knowledge gaps.
- Devise learning activities to help first-year students to achieve by themselves the instructional objectives selected by the instructors.
- Assure that first-year students achieve the instructional objectives.
- Assist the team to connect with project stakeholders (other project teams, instructors, professionals from industry, School's authorities, etc.) to obtain the materials and knowledge necessary to solve the project, to cooperate, to arrange for training, to obtain resources, etc.
- Evaluate regularly and provide a final grade on the knowledge acquisition by first-year students.

Additionally, both roles share the following responsibilities:

- Help the team in the application of the evaluation procedure developed by first and fourth-year students and approved by the instructors participating in the project.
- Work with the professors of the PM and PMP courses to assure that the development process of the team is aligned to the School's objectives and values.

It should be noted that the roles of team leader and knowledge manager were both assumed by only one fourth-year student during the first years of application of the PBCLA [7]. The separation of roles resulted when an assessment of the approach revealed that the workload of fourth-year students was excessive. Currently, each fourth-year student alternatively assumes these roles during each semester.

The mission of the PM course is to provide the knowledge, methods, and tools on facilitative leadership and project management to fourth-year students so that they can perform effectively their coaching roles. Table I summarizes the syllabus of the PM course, which is imparted two hours per week during the whole academic year.

TABLE I
SYLLABUS OF THE PROJECT MANAGEMENT COURSE

<ul style="list-style-type: none"> - The project-based and cooperative learning approaches. - The coach role. - Change management. - Project management. - The Team Charter.

- Meeting management.
- Fostering participation.
- Effective decision-making.
- How to provide and receive effective feedback.
- Conflict management.
- Facilitation tools.

FOURTH-YEAR STUDENTS IN ACTION

The learning wheel shown in Figure 2 summarizes graphically the actions involved in the PBCLA. First-year students go through the four phases of the wheel - planning, executing, reviewing and acting - as many times as it is necessary to achieve the instructional objectives and project goals stated by first-year instructors and team leaders. Fourth-year students facilitate this cyclical journey while practicing the facilitative leadership skills and project management methods and tools learned during the training activities in team-skills provided by external resources [8], under the partnership with the Dow Chemical Co., and by the PM and PMP courses. Teams go to phase 5 when the project has to be closed out at the end of each semester. The role of fourth-year students is described next for every phase of the learning wheel in Figure 2.



FIGURE 2
THE LEARNING WHEEL AS EMBEDDED IN THE PBCLA.

1. PLANNING

During the planning phase, the team leader and the knowledge manager form and focus the team. This is achieved by following a prescribed set of steps leading to the production of a team charter [9], similar to the one included in Table II. First and fourth-year students work jointly to elaborate each of the sections of the team charter. The contribution of fourth-year students focuses more on the identification of Specific, Measurable, Attainable, Relevant and Time-limited (SMART) objectives (section 6 of the team charter), and on the corresponding learning activities to fulfill those objectives (section 7). Fourth-year students

adopt a directive leadership style (at least during the first semester) in these two items of the charter while a problem solving style is applied in the rest of the charter items.

The formulation of SMART objectives aligned to the project's overall goal requires a combined effort of analysis and synthesis. Figure 3 is part of a tree diagram (section 8 of the team charter) that could represent the scope of the design project for any team. The first level of deployment of the tree is generally formed by between 5-7 objectives. These objectives are selected because they pose real design problems for the sulfuric acid process (analysis) and their resolution requires the achievement of instructional objectives from different courses in a series of integrated activities (synthesis). In the example provided, instructional objectives from calculus, algebra and physics are applied to design a tank to store the raw material sulfur.

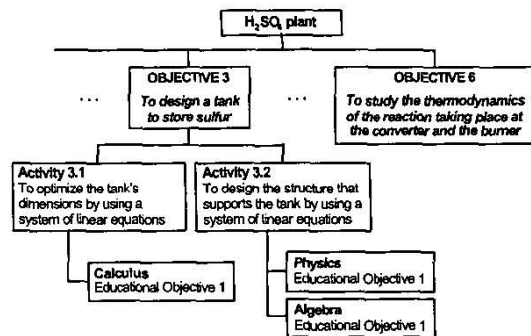


FIGURE 3
TREE DIAGRAM SHOWING PART OF THE SCOPE OF A PROJECT.

TABLE II
CONTENT OF THE TEAM CHARTER

1.	Roster
2.	Rules of the team
3.	Meeting logistics
4.	Team member knowledge and skills profile
5.	Team's overall goal, customers, stakeholders, and products
6.	SMART objectives
7.	Action plan
8.	Tree diagram
9.	Gantt diagram
10.	Stakeholder communication strategies
11.	Team contract

Fourth-year students are fully aware from their own experience that the planning phase has to be capitalized on to manage the big change that the PBCLA represents for most of the first-year students; they have been thrust into a project team which will be led by two fourth-year students acting only as coaches and all this within a student-centered environment where instructors will also serve as coaches, offering guidance and encouragement to teams. This sudden increase in responsibility generally creates stress in both fourth-year and first-year students. Fourth-year students are reminded that the PBCLA involves the following issues:

- Greater independence from instructors and consequently greater student accountability for their learning process.
- Greater initiative from students.
- Taking on unfamiliar tasks and roles and, consequently, higher risks.

Completion of section 5 of the team charter in Table II requires that the teams discuss thoroughly the rationale of the PBCLA. Debating about the needs of instructors, who are the clients of the project, and the needs of industry as a key stakeholder help first-year students to reflect on the very human "what's in it for me" and buy-in to the PBCLA. In general, the development of the whole team charter provides the structure that a new team needs to start working and helps to create a comfortable climate that reduces the anxiety feelings that inevitably arise in students.

The last basic task of the planning phase is that fourth-year students develop the evaluation process that will be applied to themselves and to first-year students in the PBCLA. Regarding fourth-year students, the grade obtained by applying the evaluation process is directly that of the PMP course and is used to determine the grade of the PM course. The evaluation process is the only decision that needs to be approved by all of the instructors participating in the project. Basically, the evaluation process has to be a 360 degree one, including self and peer evaluation.

2. EXECUTING

During the execution phase of the project, the knowledge manager, with the support of the team leader, designs in more or less detail the learning activities identified in section 7 of the team charter. These activities help fourth-year students to set-up clear directions and to clarify what is expected from first-year students. Knowledge managers and team leaders should do the activities before handing them out to first-year students. Thus, they can modulate the amount of work required in each activity by providing more or fewer data depending on the time available.

The knowledge manager and the team leader assign activities to first-year students by taking into account their knowledge and skill profiles (section 4 of the team charter) and the project progress (Gantt diagram). Generally each knowledge manager and team leader pair applies different approaches for assigning the activities. Some assign each activity to a pair of first-year students, one of them regarded as more "capable" than the other. Others assign each activity to a responsible member that must deliver the solved activity when it is due. In this case, the whole team has to define strategies to assure personal accountability of each team member for the work done by a single student. In any event, first-year students must carry out any activity outside the time allocated to formal team meetings, either at home or during the time shared by the different project courses.

3. REVIEWING AND 4. ACTING

The reviewing and acting phases of the learning wheel in Figure 2 take place at the formal team meetings. These are carefully planned and managed by the team leader. The main purpose of these meetings is to assess learning by first-year students and to ensure that all of them achieve all of the instructional objectives in time. This is a key responsibility of the knowledge manager. The presence of passengers in the project teams is not the problem since they are easily spotted. The challenge rather lies in the fact that when first-year students self-organize to carry out the learning activities they may specialize solely in the particular skill or set of skills (making calculations, building graphs, etc.) that they excel at or like them most, which generally coincide.

The approach followed by most knowledge managers to ensure that all first-year students master the instructional objectives is to ask some of them to facilitate learning to the rest of team members while knowledge managers help in the process by asking questions in greater depth. This questioning process enables knowledge managers to easily assess the degree of learning of each team member. Feedback from team leaders and knowledge managers highlights the fact that at the beginning of the project most first-year students panic when asked to present orally any material or to teach others even though they may actually master the topic. The development of both abilities is also a benefit of the PBCLA.

Team leaders and knowledge managers assess whether the objectives of any activity have been accomplished during the reviewing phase. An activity is considered as accomplished when the written resolution is correct, it has been drawn up according to the final report guidelines and all of the first-year students have achieved the instructional objectives involved. Once the activity is completed, the whole team reflects on how they have interacted to carry it out. This reflection is facilitated by both the team leader and the knowledge manager by using questionnaires that address different aspects related to the learning process, such as the design of the learning activity, the role of fourth-year students, the degree of participation of team members, etc.

The team proceeds again to the planning phase after the reviewing and acting phases are completed irrespectively of the evaluation of the activity; the team leader has to check the Gantt diagram to detect and analyze any time deviations from the plan, compute the actual number of hours invested in the learning activity, etc. Depending on the progress made on the project and the evaluation of the activity, the team leader has to decide whether or not to introduce changes into the plan, launch the next project activity/ies or continue working on the current activity if it has not yet been completed. In this case, the team will be spinning around the learning wheel until the activity is finalized. Depending on the complexity of the activity, the team can go around the wheel between 420 times. When all the activities of the

project have been accomplished, the team moves to the closing-out of the project.

5. CLOSING OUT

A closing-out phase is systematically managed by one team of fourth-year students at the end of each semester. The purpose of this phase goes beyond merely delivering a final report to first-year instructors. Its purpose is multifold:

1. Communicate the results achieved in the project.
2. Evaluate the performance of team members.
3. Reflect on how the team has accomplished the results: lessons learned and areas of improvement.
4. Provide positive reinforcement to students.

All project teams must deliver a final report and present and defend their results in a public poster session. During the five-hour long poster sessions, first-year students are interviewed individually by first-year instructors to assess the degree to which each student has achieved the instructional objectives. Thus, first-year instructors can grade individual team members and contrast their grades with those granted by team managers. The grade given by first-year instructors accounts for 30% of the project's grade while the remaining 70% is the responsibility of fourth-year students. In the event that the first-year-student grades given by instructors differ by more than 2 points from those given by fourth-year students, a joint meeting is called upon to solve the discrepancy. This poster session compels fourth-year students to put in place mechanisms to assure that the instructional objectives are really achieved by all first-year students and to be honest in their evaluations.

Poster sessions are an excellent opportunity to provide positive reinforcement to students and keep momentum. The experience shows that most first-year students can manage successfully the questioning by instructors and, in some cases, much to the surprise of fourth-year students. When first-year students have to explain (verbalize) what they have done and, more importantly, how it was done, they gain a deeper understanding of the material and lots of positive reinforcement is generated. In addition to this, the final poster session that is held at the end of the second semester is split into two consecutive mornings. The second one is open to everybody from university, industry, and society in general (parents, spouses, friends, etc.). These stakeholders also discuss with students the results of their projects and how they have organized themselves to obtain those results. Finally, fourth-year students deliver symbolic, tangible objects with the ETSEQ logo printed on them to everybody attending the poster session to extend the lifespan of the experience by creating memories.

All project teams have also to report the results accomplished in the project and how these have been achieved during each semester. This closing-out written document reports the performance of team members in the project, evaluates all feedback received from instructors and

stakeholders (including the grades obtained), captures all lessons learned and makes recommendations to the instructors of the PMP course for improvements of the PBCLA. After the action involved in the other four phases of the learning wheel, it is essential to force this reflection in teams. This is particularly important at the end of the first semester since teams can identify and develop ideas of improvement and apply them during the second semester.

In addition to the closing-out report, the team leader and knowledge manager deliver an oral presentation of the report to the instructors of the PMP course. The session, which is open to other fourth-year students and faculty, is an opportunity for the instructors to discuss the self and peer evaluation of fourth-year students, give feedback on technical and process related aspects of the project, assess their oral and communication skills, and provide recognition and positive reinforcement to them. This recognition is essential to call for the extra effort required from fourth-year students for making the PBCLA a success.

CHANGE MANAGEMENT IS KEY

One of the most critical items in the implementation of the PBCLA is the role of first-year instructors. As explained earlier, the instructors of the PM and PMP courses coach fourth-year students and these, in turn, do the same with first-year students. However, the latter rely strongly on their instructors at the beginning of the academic year. First-year students are very sensitive to the words, body language and actions of their instructors. It is thus important that they refrain from conveying any premature evaluation or perception on the PBCLA or its implementation since it may weaken the trustworthiness of first-year students in fourth-year students, making the task of the latter even more challenging.

At the heart of the PBCLA is the concept of the empowerment of students. Students should assume responsibility for their own learning, create their own job profiles and gain the appropriate self-discipline and self-criticism to complete a complex task. In this environment, instructors can no longer assume a command-and-control role. Like fourth-year students, professors should take on a coach role. Figure 4 summarizes the fundamental role changes that instructors must assume in the PBCLA.

The understanding and assumption by instructors of their role change, together with the concomitant training, are essential for the success of the PBCLA. The ETSEQ has organized external non-compulsory training in team skills, cooperative learning and other effective teaching methods since 1996. In addition, the ETSEQ has intensified its partnership with the Dow Chemical Company to obtain expertise in coaching and change management skills, particularly in faculty management education. These are essential to involve faculty in effective teaching and to deploy the PBCLA across the engineering curriculum [6].

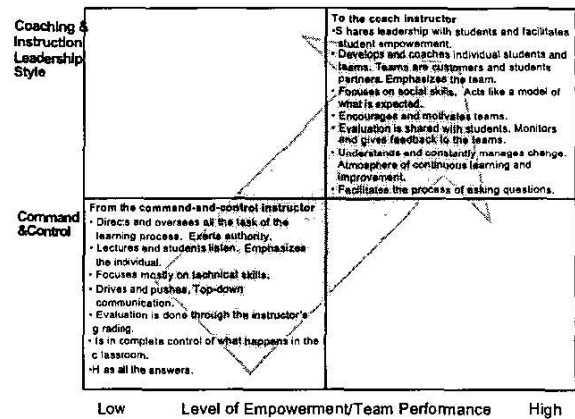


FIGURE 4
CHANGES IN THE ROLE OF INSTRUCTORS IN THE PBCLA

ACKNOWLEDGMENT

To the University Rovira i Virgili for its continuous support to innovate in undergraduate education. To Dow Chemical Co., in particular to Mr. Lluís Vernis, for their sharing of coaching and change management expertise. Finally, to the Cahners TRACOM Group for their permission to use the Enhancing Team Performance materials.

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Appendix B.
Original Survey Forms

B1. Original Survey Forms

In the following the original survey forms are presented. The surveys carry a header for the DNI number, which is the individual identification of the students, so it is assured that the relevant surveyed population participated, but also that confidentiality is assured as the author of this thesis work had no access in any form to that DNI number. The table B1 shows the sequence of the surveys and the respective target population.

<u>Survey No.</u>	<u>Description</u>
1	Baseline assessment for team members
2	Team members after receiving the intervention
3	Team members three months after the intervention
4	Team members six & nine months after the intervention
5a	Team Leader & Knowledge Manager baseline assessment
5b	Team Leader & Knowledge Manager 3 months after the intervention
5c	Team Leader 6 & 9 months after the intervention
5d	Knowledge Manager 6 & 9 months after the intervention

Table B1. Survey sequence

B.1.1. Survey 1: Baseline Assessment for Team Members

- How much experience do you have with “working in a team”?
(definition of working in a team: “A team that, within a given set of boundaries, is authorized, capable and willing to manage its own activities with interdependence to produce an agreed upon set of target outcomes”).

none	almost none	a little bit	some	a lot

If some or a lot, from where: _____

- A) Provided, you had experience with working in teams, in which areas did you find the greatest difficulties

Please rank the 3 most important ! (1=most important)

Purpose & Objectives of Team (the reason why the team exists)	
Capabilities of Team (the ability to build on the differences in skills, knowledge, experiences & individual differences)	
Dealing with Change (the ability to handle changes and respond to them)	
Team Rules & Norms (the adherence of the individual to the defined group behaviors)	
Communication (the ability to communicate and interact effectively amongst each other)	
Handling Conflict / Conflict Resolution (the ability to solve conflicts constructively)	
Recognition & Reward (the way in which achievements are recognized and celebrated)	
Team Operating Procedures (the extent to which a team is using methods and tools to improve its performance)	
Integrating New Team Members (the ability to handle changes in team membership)	
Evaluation of Team Performance (the extent to which the team is assessing its own overall performance)	
Evaluation of Team Members Performance (the extent to which each member is assessing its own performance and that of others)	

2 B) In case you have not worked in teams, where would you anticipate the greatest difficulties?

Please rank the 3 most important! (1=most important)

Purpose & Objectives of Team (the reason why the team exists)	
Capabilities of Team (the ability to build on the differences in skills, knowledge, experiences & individual differences)	
Dealing with Change (the ability to handle changes and respond to them)	
Team Rules & Norms (the adherence of the individual to the defined group behaviors)	
Communication (the ability to communicate and interact effectively amongst each other)	
Handling Conflict / Conflict Resolution (the ability to solve conflicts constructively)	
Recognition & Reward (the way in which achievements are recognized and celebrated)	
Team Operating Procedures (the extent to which a team is using methods and tools to improve its performance)	

Integrating New Team Members (the ability to handle changes in team membership)	
Evaluation of Team Performance (the extent to which the team is assessing its own overall performance)	
Evaluation of Team Members Performance (the extent to which each member is assessing its own performance and that of others)	

3. Assuming that you want to improve your skills for working in a team, which training/learning method would you prefer?

Please mark your preferred method

Lecturing	
Interactive Workshop	
Case Studies	
Special Task Assignment with Coach Support	
Experiential Learning within your Team	
Self-study through reading, etc.	

4. Demographics

When you entered this university, was Chemical Engineering your first option / choice?

Yes	No

Male	Female

17- 20	21-25	26-30	over 31

5. Please list a maximum of three hobbies (activities) that you practice:

6. Please list three non-professional activities that you don't like or hate:

7. Please indicate the background of your education.

8. Please indicate any previous working experience.

B.1.2. Survey 2: Team Members after Receiving the Intervention

1. Do you perceive this teamwork intervention helpful?

not at all	a little bit	somewhat	rather	very much

2. Which module did you find most valuable?

Rank the 3 most important! (1=most important)

Common Purpose	
Team Capabilities	
Change	
Team Norms	
Communication / Conflict	
Recognition / Reward	
Team Operating Procedures	
New Member Integration	
Evaluation	

Please explain why: _____

3. How would you rate the effectiveness of the delivery?

bad	low	acceptable	High	very high

4. Comments / Suggestions about the delivery _____

5. List at most five activities of any kind that you carried out prior to university without a conscious or explicit plan for expected tangible results (no clear purpose):

6. List at most five activities of any kind that you carried out prior to university with a conscious or explicit plan for expected tangible results (clear purpose):

7. List at most three activities of any kind that you participated in their conception, design, planning and implementation prior to university:

8. In the activities listed in items 6 and 7 above did you (alone or with others) evaluate the results attained?

not at all	a little bit	somewhat	rather	very much

9. Do you usually assume responsibility for your own good or bad results prior to university?

fully assume	mostly assume	partly assume	some blame to others	blame others

10. Did you like to interact with others or alone prior to university?

always with others	mostly with others	sometimes with others	more on my own	always alone

11. Are you presently economically independent from your parents?

not at all	a little bit	partly	very much	completely

12. Demographics (gender and age)

Male	Female	17-20	21-25	26-30	Over 31

B.1.3. Survey 3: Team Members Three Months after the Intervention

1. Which module out of the enhancing team performance training has helped you most in your work so far?

Rank the 3 most important! (1=most important)

Common Purpose	
Team Capabilities	
Change	
Team Norms	
Communication / Conflict	
Recognition / Reward	
Team Operating Procedures	
New Member Integration	
Evaluation	

Please explain your ranking: _____

2. Could you give two specific examples on how the most important ranked item from above has helped you so far in the project?

3. In which area do you feel a need to get additional help?

Please explain why.

Please indicate potential solutions.

4. What issues do you think are still not covered?

5. List two activities that you carried out alone (not related to team activities) at the ETSEQ during the past 3 months with a conscious or explicit plan for expected tangible results (clear purpose):

6. In the two activities that you listed above in item 5, have you qualitatively or quantitatively evaluated the results attained?

not at all	a little bit	somewhat	rather	very much

7. List a maximum of five activities that you carried out at the ETSEQ as a team member during the past 3 months with a conscious or explicit plan for expected tangible results (clear purpose):

8. In the activities that you listed above in item 7, has your team qualitatively or quantitatively evaluated the results attained?

Not at all	a little bit	somewhat	rather	very much

9. After 3 months at the ETSEQ, do you consider that your attitude with respect to assuming responsibility for the results obtained by yourself has changed with respect to prior to university?

not at all	a little bit	somewhat	rather	very much

10. Do you now establish and follow a plan to overcome any of the difficulties concerning learning or team work organization that you (or your team) have identified?

not at all	a little bit	somewhat	rather	very much

11. How many hours per week do you meet with the team leader regarding your project (first and fourth – year students' project)?

1 h	2 h	3 h	4 h	5 h or more

If your answer is 5 hours or more, then please specify.

12. How many hours per week do you meet with the knowledge leader? regarding your project (first and fourth – year students' project)?

1 h	2 h	3 h	4 h	5 h or more

13. How many hours per week do you meet with only your peers regarding your project (first and fourth – year students' project)?

1 h	2 h	3 h	4 h	5 h or more

14. What percentage of the total time allocated to team meetings is dedicate to discuss with your peers on the average ?

0 %	25 %	50%	75 %	100 %

15. What percentage of the total time allocated to team meetings is dedicated to discuss scientific or technical matters on the average?

0 %	25 %	50%	75 %	100 %

16. What percentage of the total time allocated to team meetings is dedicated to discuss organizational matters on the average?

0 %	25 %	50%	75 %	100 %

17. How would you characterize your attitude during team meetings, as mostly listening or mostly talking?

mostly listen				mostly talking

23. How responsible are you for the work assigned to you by the team (concerning first and fourth year students' project) ?

not at all	a little bit	somewhat	rather	very much

24. How many times have you failed to attend team meetings during the past 3 months (concerning first and fourth year students' project) ?

never	once	twice	3 to 5 times	6 or more

25. How many times have you failed with team project deadlines in the work assigned to you during the past 3 months (concerning first and fourth year students' project)?

never	once	twice	3 to 5 times	6 or more

26. How many times have your peers helped you understand a technical issue or scientific question through face-to-face discussions so far (concerning first and fourth year students' project)?

never	once	twice	3 to 5 times	6 or more

27. How many times have you helped your peers understand a technical issue or scientific question through face-to-face discussions so far (concerning first and fourth year students' project)?

never	once	twice	3 to 5 times	6 or more

28. Have you learned something from your peers through the reasoning, methods and skills that they applied to deal with the project (concerning first and fourth year students' project)?

no	a little bit	somewhat	rather	very much

29. How much have you learned from the discussions and interaction with the knowledge manager of your team (concerning first and fourth year students' project)?

Nothing		somewhat		a lot

30. How many times have you consulted the team members and knowledge leader of other teams during the past 3 months (concerning first and fourth year students' project)?

Never	once	twice	3 to 5 times	6 or more

31. How many times have you shifted roles with your peers during the past 3 months (concerning first and fourth year students' project)?

Never	once	twice	3 to 5 times	6 or more

32. How many times have you qualitatively or quantitatively evaluated your own work (self-evaluation) during the past 3 months (concerning first and fourth year students' project)?

Never	once	twice	3 to 5 times	6 or more

33. How many times have you qualitatively or quantitatively evaluated the work of the other team members during the past 3 months (concerning first and fourth year students' project)?

Never	once	twice	3 to 5 times	6 or more

34. How many times have you qualitatively or quantitatively evaluated the team leader during the past 3 months (concerning first and fourth year students' project)?

Never	once	twice	3 to 5 times	6 or more

35. How many times have you qualitatively or quantitatively evaluated the knowledge manager during the past 3 months (concerning first and fourth year students' project)?

Never	once	twice	3 to 5 times	6 or more

36. How many times has the team evaluated the deviations of the work done (attained objectives) with respect to the planned one (concerning first and fourth year students' project)?

Never	once	twice	3 to 5 times	6 or more

37. How many times have you been requested to learn the work done by a peer and checked on it (concerning first and fourth year students' project)?

Never	once	twice	3 to 5 times	6 or more

38. Do you perceive the team work in the project as an "all float or all sink"-situation (concerning first and fourth year students' project)?

"all sink"				"all float"

39. Comments / Suggestions _____

40. Demographics (gender and age)

Male	Female	17-20	21-25	26-30	Over 31

B.1.4. Survey 4: Team Members 6 and 9 Months after the Intervention

1. Which module out of the enhancing team performance training has helped you most in your work so far?

Rank the 3 most important! (1=most important)

Common Purpose	
Team Capabilities	
Change	
Team Norms	
Communication / Conflict	
Recognition / Reward	
Team Operating Procedures	
New Member Integration	
Evaluation	

Please explain why: _____

2. Could you give two specific examples on how the most important ranked item from above has helped you so far in the project?

3. In which area do you feel a need to get additional help?

Please explain why.

Please indicate potential solutions.

4. What issues do you think are still not covered?

5. List two activities that you carried out alone (not related to team activities) at the ETSEQ during the past 3 months with a conscious or explicit plan for expected tangible results (clear purpose):

6. In the two activities that you listed above in item 5 have you qualitatively or quantitatively evaluated the results attained?

not at all	a little bit	somewhat	rather	very much

7. List a maximum of 5 activities that you carried out at the ETSEQ as a team member during the past 3 months with a conscious or explicit plan for expected tangible results (clear purpose):

8. In the activities that you listed above in item 7, has your team qualitatively or quantitatively evaluated the results obtained?

not at all	a little bit	somewhat	rather	very much

9. After 3 or 9 months at the ETSEQ do you consider that your attitude with respect to assuming responsibility for the results obtained by yourself has changed with respect to prior to University?

not at all	a little bit	somewhat	rather	very much

10. Do you now establish and follow a plan to overcome any of the difficulties concerning learning or team work organization that you (or your team) have identified?

not at all	a little bit	somewhat	rather	very much

11. How many hours per week do you now meet with the team leader?

1 h	2 h	3 h	4 h	5 h or more

12. How many hours per week do you now meet with the knowledge manager?

1 h	2 h	3 h	4 h	5 h or more

13. How many hours per week do you now meet with only your peers?

1 h	2 h	3 h	4 h	5 h or more

14. What percentage of the total time allocated to team meetings is dedicated to discuss with your peers on the average?

0 %	25 %	50 %	75 %	100 %

15. What percentage of the total time allocated to team meetings is dedicated to discuss scientific or technical matters on the average?

0 %	25 %	50 %	75 %	100 %

16. What percentage of the total time allocated to team meetings is dedicated to discuss organizational matters on the average?

0 %	25 %	50 %	75 %	100 %

17. How would you characterize your attitude during team meetings, as mostly listening or mostly talking?

mostly listening				mostly talking

18. How much have you contributed so far to establish the purpose (objectives) of your team?

not at all	a little bit	somewhat	rather	very much

19. How much is now your contribution to the planning and realization of the project by your team?

not at all	a little bit	somewhat	rather	very much

20. How often does your team now evaluate its own activities to identify the causes for success or failure (strive for improvement)?

never		once a month		weekly

21. Please list the most relevant activities carried out in team meetings with the team leader during the past three months and the time (%) dedicated to each of them?

	%
	%
	%
	%
	%
	%
	%
	%
	%

Comments: _____

22. Please list the most relevant activities carried out in team meetings with the knowledge manager during the past three months and the time (%) assigned to each of them?

	%
	%
	%
	%

Comments: _____

23. How responsible are you now for the work assigned to you by the team so far (concerning the first and fourth year students' project)?

not at all	a little bit	somewhat	rather	very much

24. How many times have you failed to attend team meetings during the past 3 months (concerning the first and fourth year students' project)?

never	once	twice	3 to 5 times	6 or more

25. How many times have you failed with team project deadlines in the work assigned to you during the past 3 months (concerning the first and fourth year students' project)?

never	once	twice	3 to 5 times	6 or more

26. How many times have your peers helped you understand a technical issue or scientific question through face-to-face discussions during the past 3 months (concerning the first and fourth year students' project)?

never	once	twice	3 to 5 times	6 or more

27. How many times have you helped your peers understand a technical issue or scientific question through face-to-face discussions during the past 3 months (concerning the first and fourth year students' project)?

never	once	twice	3 to 5 times	6 or more

28. How much have you learned from your peers through the reasoning, methods and skills that they applied to deal with the project so far (concerning the first and fourth year students' project)?

nothing	a little bit	somewhat	quite a lot	a lot

29. How much have you learned from the discussions and interaction with the knowledge manager of your team so far (concerning the first and fourth year students' project)?

nothing	a little bit	somewhat	quite a lot	a lot

30. How many times have you consulted the team members and knowledge manager of other teams during the past 3 months (concerning the first and fourth year students' project)?

never	once	twice	3 to 5 times	6 or more

31. How many times have you shifted roles with your peers during the past 3 months (concerning the first and fourth year students' project)?

Never	once	twice	3 to 5 times	6 or more

32. How many times have you qualitatively or quantitatively evaluated your own work (self-evaluation) during the past 3 months (concerning the first and fourth year students' project)?

never	once	twice	3 to 5 times	6 or more

33. How many times have you qualitatively or quantitatively evaluated the work of the other team members during the past 3 months (concerning the first and fourth year students' project)?

never	once	twice	3 to 5 times	6 or more

34. How many times have you qualitatively or quantitatively evaluated the team leader during the past 3 months (concerning the first and fourth year students' project)?

never	once	twice	3 to 5 times	6 or more

35. How many times have you qualitatively or quantitatively evaluated the knowledge manager during the past 3 months (concerning the first and fourth year students' project)?

never	once	twice	3 to 5 times	6 or more

36. How many times has the team evaluated the deviations of the work done (attained objectives) with the respect to the planned one during the past 3 months (concerning the first and fourth year students' project)?

never	once	twice	3 to 5 times	6 or more

37. How many times have you been asked to learn the work done by a peer and checked about it during the past 3 months (concerning the first and fourth year students' project)?

never	once	twice	3 to 5 times	6 or more

38. Do you perceive the team work in the project as an "all sink or all float"-situation?

"all sink"				"all float"

39. Comments / Suggestions _____

40. Demographics (gender and age)

Male	Female	17-20	21-25	26-30	Over 31

41. Demographics (choice of school) : When you entered this University, was Chemical Engineering your first choice?

Yes	No

If no, what was your first choice? _____

B.1.5. Survey 5a : Team Leader and Knowledge Manager Baseline Assessment

1. How much experience do you have with “working in a team”?
(definition of working in a team: „A team that, within a given set of boundaries, is authorized, capable and willing to manage its own activities with interdependence to produce an agreed upon set of target outcomes”).

none	almost none	a little bit	some	a lot

If some or a lot, from where: _____

2. In which areas did you experience or do you anticipate the greatest difficulties when working in teams?

Please rank the 3 most important! (1=most important)

Purpose & Objectives of Team (the reason why the team exists)	
Capabilities of Team (the ability to build on the differences in skills, knowledge, experiences & individual differences)	
Dealing with Change (the ability to handle changes and respond to them)	
Team Rules & Norms (the adherence of the individual to the defined group behaviors)	
Communication (the ability to communicate and interact effectively amongst each other)	
Handling Conflict / Conflict Resolution (the ability to solve conflicts constructively)	
Recognition & Reward (the way in which achievements are recognized and celebrated)	
Team Operating Procedures (the extent to which a team is using methods and tools to improve its performance)	
Integrating New Team Members (the ability to handle changes in team membership)	
Evaluation of Team Performance (the extent to which the team is assessing its own overall performance)	
Evaluation of Team Members Performance (the extent to which each member is assessing its own performance and that of others)	

3. Assuming that you want to improve your skills for working in and leading a team, which training/learning method would you prefer?

Please mark your preferred method

Lecturing	
Interactive Workshop	
Case Studies	
Special Task Assignment with Coach Support	
Experiential Learning within your Team	
Self-study through reading, etc.	

4. How do you classify yourself with respect to the following characteristics?

analytic :

not at all		somewhat		Extremely

creative :

not at all		somewhat		Extremely

controlling :

not at all		somewhat		Extremely

visionary :

not at all		Somewhat		extremely

leading by examples :

not at all		Somewhat		extremely

opportunistic :

not at all		Somewhat		extremely

hierarchy driven :

not at all		Somewhat		extremely

informal :

not at all		Somewhat		extremely

independent :

not at all		Somewhat		extremely

risk taking :

not at all		Somewhat		extremely

5. How would you like your role to be?

commanding :

not at all		Somewhat		extremely

uniform :

not at all		Somewhat		extremely

inspirational :

not at all		Somewhat		extremely

methodical :

not at all		Somewhat		extremely

people oriented :

not at all		Somewhat		extremely

performance driven :

not at all		Somewhat		extremely

rewards driven :

not at all		Somewhat		extremely

6. Please list three hobbies:

7. Please list the three things of any kind that you dislike the most:

8. Demographics

Team Leader Knowledge manager

Male	Female

17- 20	21-25	26-30	over 31

B.1.6. Survey 5b: Team Leader and Knowledge Manager 3 Months after the Intervention

1. Which module out of the enhancing team performance training has helped you most in your work so far?

Rank the 3 most important! (1=most important)

Common Purpose	
Team Capabilities	
Change	
Team Norms	
Communication / Conflict	
Recognition / Reward	
Team Operating Procedures	
New Member Integration	
Evaluation	

Please explain why.

2. Can you give a specific example on how the most important ranked item from above has helped you?

3. In your role as team leader or knowledge manager where did you experience the greatest difficulties when working with your team?

Please rank the 3 most important ! (1=most important)

Purpose & Objectives of Team	
Capabilities of Team	
Dealing with Change	
Team Rules & Norms	
Communication	
Handling Conflict / Conflict Resolution	

Recognition & Reward	
Team Operating Procedures	
Integrating New Team Members	
Evaluation of Team Performance	

Please explain why.

4. In which area do you feel a need to get additional help? What issues do you think are still not covered?

Please explain.

Please indicate potential solutions.

5. How would you describe your role with the team ?

commanding :

not at all		somewhat		extremely

uniform :

not at all		somewhat		extremely

inspirational :

not at all		somewhat		extremely

methodical :

not at all		somewhat		extremely

people oriented :

not at all		somewhat		extremely

performance driven :

not at all		somewhat		extremely

rewards driven :

not at all		somewhat		extremely

6. How would you characterize your attitude during team meetings, as mostly listening or mostly talking?

mostly listen				mostly talking

7. How much have you contributed so far to establish objectives in your team?

not at all	a little bit	somewhat	rather	very much

8. How much have you contributed so far to the planning of your team?

not at all	a little bit	somewhat	rather	very much

9. How often does your team evaluate its own activities to identify the causes for success or failure (strive for improvement)?

never		once a month		weekly

10. Please list the most relevant activities carried out in team meetings by you during the past three months and the time (%) dedicated to each of them?

	%
	%
	%
	%
	%
	%
	%
	%

Comments: _____

11. Demographics

Team leader

Knowledge manager

Male	Female

17- 20	21-25	26-30	over 31

B.1.7. Survey 5c: Team Leader 6 and 9 Months after the Intervention

Which module out of the enhancing team performance training has helped you most in your work so far?

Rank the 3 most important! (1=most important)

Common Purpose	
Team Capabilities	
Change	
Team Norms	
Communication / Conflict	
Recognition / Reward	
Team Operating Procedures	
New Member Integration	
Evaluation	

And please explain why.

Can you give a specific example on how the most important ranked item from above has helped you?

In your role as team leader, in which area did you experience the greatest difficulties when working with your team?

Please rank the 3 most important! (1=most important)

Purpose & Objectives of Team	
Capabilities of Team	
Dealing with Change	
Team Rules & Norms	
Communication	
Handling Conflict / Conflict Resolution	
Recognition & Reward	
Team Operating Procedures	
Integrating New Team Members	
Evaluation of Team Performance	

And please explain why.

Could you have solved your project work without the Enhancing Team Performance Intervention?

not at all	a little bit	somewhat	rather	very much

How much has this intervention helped you in your role as team leader to solve your project task?

Not at all	a little bit	somewhat	rather	very much

How much has this intervention increased your productivity / effectiveness in your role as team leader?

0 %	25 %	50 %	75 %	100 %

In which area do you feel a need to get additional help? What issues do you think are still not covered?

Please explain.

Please indicate potential solutions.

Assuming that you want to improve your skills for working in and leading a team, which training/learning method would you prefer?

Please mark your preferred method

Lecturing	
Interactive Workshop	
Case Studies	
Special Task Assignment with Coach Support	
Experiential Learning within your Team	
Self-study through reading, etc.	

9. How would you describe your role with the team?

commanding :

not at all		somewhat		extremely

uniform :

not at all		somewhat		extremely

inspirational :

not at all		somewhat		extremely

methodical :

not at all		somewhat		extremely

people oriented :

not at all		somewhat		extremely

performance driven :

not at all		somewhat		extremely

rewards driven :

not at all		somewhat		extremely

10. How would you characterize your attitude during team meetings now, as mostly listening or mostly talking?

mostly listen				mostly talking

11. How much have you contributed so far to establish objectives in your team?

not at all	a little bit	somewhat	rather	very much

12. How much have you contributed to the planning of your team now?

not at all	a little bit	somewhat	rather	very much

13. How often does your team evaluate its own activities now to identify the causes for success or failure (strive for improvement)?

never		once a month		weekly

14. Please list the most relevant activities carried out in team meetings by you during the past three months and the time (%) dedicated to each of them?

	%
	%
	%
	%
	%
	%
	%
	%
	%

Comments: _____

15. Please list the names of your clients:

16. Please list the names of your sponsors:

17. Do you know the requirements of your clients?

not at all	a little bit	somewhat	rather	very much

18. How many times have you used the Memory Jogger: The Team pocket guide?

never	sometimes	often	very often	Always

19. How many times have you used the Memory Jogger: The Project management pocket guide?

never	sometimes	often	very often	Always

20. Did a Change in your leadership style occur since the beginning of the project ? (A change from “Leader directed” to “Shared Leadership”)

Yes: (Please explain)

No: (Please explain)

21. When did the Change in your leadership style from “Leader directed” to “Shared Leadership” occur since the beginning of the project?

not yet	1 month	2 months	3 months	4 months	6 months	8 months

22. Can you recall “Surprises”, when working with your team?

Positive: _____

Negative: _____

23. Demographics

Male	Female

17- 20	21-25	26-30	over 31

B.1.8. Survey 5d: Knowledge Manager, 6 and 9 Months after the Intervention

1. Which module out of the enhancing team performance training has helped you most in your work so far?

Rank the 3 most important! (1=most important)

Common Purpose	
Team Capabilities	
Change	
Team Norms	
Communication / Conflict	
Recognition / Reward	
Team Operating Procedures	
New Member Integration	
Evaluation	

And please explain why.

2. Can you give a specific example on how the most important ranked item from above has helped you?

3. In your role as knowledge manager, in which area did you experience the greatest difficulties when working with your team?

Please rank the 3 most important! (1=most important)

Purpose & Objectives of Team	
Capabilities of Team	
Dealing with Change	
Team Rules & Norms	
Communication	
Handling Conflict / Conflict Resolution	
Recognition & Reward	
Team Operating Procedures	
Integrating New Team Members	
Evaluation of Team Performance	

And please explain why.

4. Could you have solved your project work without the Enhancing Team Performance Intervention?

not at all	a little bit	somewhat	rather	very much

5. How much has this intervention helped you in your role as knowledge manager to solve your tasks?

not at all	a little bit	somewhat	rather	very much

6. How much has this intervention increased your productivity / effectiveness in your role as knowledge manager?

0 %	25 %	50 %	75 %	100 %

7. In which area do you feel a need to get additional help? What issues do you think are still not covered?

Please explain.

Please indicate potential solutions.

8. Assuming that you want to improve your skills for working in a team, which training/learning method would you prefer?

Please mark your preferred method

Lecturing	
Interactive Workshop	
Case Studies	
Special Task Assignment with Coach Support	
Experiential Learning within your Team	
Self-study through reading, etc.	

9. What would you describe your role with the team?

commanding :

not at all		somewhat		extremely

uniform :

not at all		somewhat		extremely

inspirational :

not at all		somewhat		extremely

methodical :

not at all		somewhat		extremely

people oriented :

not at all		somewhat		extremely

performance driven :

not at all		somewhat		extremely

rewards driven :

not at all		somewhat		extremely

10. How would you characterize your attitude during team meetings now, as mostly listening or mostly talking?

mostly listen		somewhat		mostly talking

11. How much have you contributed so far to establish objectives in your team?

not at all	a little bit	somewhat	rather	very much

12. How much have you contributed to the planning of your team?

not at all	a little bit	somewhat	rather	very much

13. How often does your team evaluate its own activities now to identify the causes for success or failure (strive for improvement)?

Never		once a month		weekly

14. In case there are deviations between your evaluation of a team member's performance and his/her self-evaluation, what do you do? (provided you do evaluations)

15. Does your team discuss openly the results of all evaluations of team members, including tests, exams, laboratory reports, etc.?

Never	seldom	sometimes	often	always

16. Please list the most relevant activities carried out in team meetings by you during the past three months and the time (%) dedicated to each of them?

	%
	%
	%
	%
	%
	%
	%
	%

Comments: _____

17. Please list the names of your clients:

18. Please list the names of your sponsors:

19. Do you know the requirements of your clients?

not at all	a little bit	somewhat	rather	very much

20. How many times have you used the Memory Jogger: The Team pocket guide?

Never	sometimes	often	very often	always

21. How many times have you used the Memory Jogger: The Project management pocket guide?

Never	sometimes	often	very often	always

22. Did a Change in your leadership style occur since the beginning of the project? (A change from "Leader directed" to "Shared Leadership")

Yes: (Please explain)

No: (Please explain)

23. When did the Change in your team style from "Leader directed" to "Shared Leadership" occur since the beginning of the project?

not yet	1 month	2 months	3 months	4 months	6 months	8 months

24. Can you recall "Surprises", when working with your team?

Positive:

Negative:

25. When revisiting the first year subjects, have you realized that there were things you did not learn? Could you list some of them?

26. By defining a plan for the first year students to learn, did you yourself learn things from the first year subjects? Could you list some of them?

27. Could you briefly list (describe) the methods that you use to manage the knowledge and the learning within your team?

28. Are you now able to identify where first year students have more difficulties in learning?

No	a little bit	somewhat	rather well	very much

29. Could you comment on these difficulties and make suggestions?

30. Demographics

Male	Female

17- 20	21-25	26-30	over 31

Appendix C.
Improved Survey Forms

C.1 Introduction to Improved Survey Forms

Here a short recommendation list for future work is presented. The subsequent improvement opportunities can be summarized in 4 bullet categories:

1. Number of questions
2. Consistency of questions
3. Type of questions
4. Evaluation form of questions

Numerous feedback from the students and the evaluation personnel has amounted to questions being too many. Particularly the 40 question survey forms of 6 and 9 months into the research are considered overwhelming. For that reason, it is recommended to reduce the number of questions in future surveys. In the improved survey forms, a number of approximately 30 questions maximum is proposed.

Furthermore the survey process can be enhanced by introducing more consistent and streamlined questions: such as questions aiming at the same objective should not be phrased differently (e.g. question number 3 in the 3 month survey and question number 4 in the 9 month survey). It is also helpful to have equivalent questions targeting the same objective to have consistent numbering of questions. The above principle applies to question 4 in the 3 month survey and question 5 in the 9 month survey. Another example is question number 9 in the 3 month survey and question number 11 in the 9 month survey. Enhanced transparency and consistency will help improving survey feedback, and simplify evaluation work.

Concerning the type of questions, multiple choice is always the preferred way of asking the participants. The number of responses as well as the students' feedback clearly indicates that open ended questions should be avoided, if at all included. Very few participants use the feedback mechanism of open ended questions and the comments section. Therefore, the improved survey form has no open ended questions, other than the possibility to provide comments at the end of the survey.

When it comes to the fashion of evaluating the questions, there are primarily two options to provide pictorial representation of the survey results. First option is the display using a pie chart; the other option is using a bar chart. When confronted with these two options, the bar chart version presents a better way of conveying results, particularly when comparing the two academic years against one another, as selected in chapter 3.

C.1.1. Improved Survey Forms. Team Members 3 Months after the Intervention

1. Which module out of the enhancing team performance training has helped you most in your work so far?
 - a. Common purpose
 - b. Team capabilities
 - c. Change

- d. Team norms
 - e. Communication/conflict
 - f. Recognition/Reward
 - g. Operating procedures
 - h. New member integration
 - i. Evaluation
2. In which area do you feel a need to get additional help?
- a. Common purpose
 - b. Team capabilities
 - c. Change
 - d. Team norms
 - e. Communication/conflict
 - f. Recognition/Reward
 - g. Operating procedures
 - h. New member integration
 - i. Evaluation
3. Please list one activity which you carried out at the ETSEQ as a team member during the past 3 months with a conscious or explicit plan for expected tangible results (clear purpose)?
-
4. In the activity listed above in item 3, how often has your team qualitatively or quantitatively evaluated the results?
- a. not at all
 - b. very little
 - c. occasionally
 - d. frequently
 - e. always
5. How much has your attitude with respect to assuming responsibility for the results obtained by you or your team changed so far?
- a. not at all
 - b. very little
 - c. a lot
 - d. completely
6. Do you now establish and follow a plan to overcome any of the difficulties concerning learning or teamwork organization that you (or your team) have identified?
- a. never
 - b. sometimes
 - c. always
7. How many hours per week do you meet with the team leader regarding your project?
- a. 1 hour
 - b. 2 hours
 - c. 3 hours

- d. 4 hours
 - e. 5 or more hours
8. How many hours per week do you meet with your knowledge leader?
- a. 1 hour
 - b. 2 hours
 - c. 3 hours
 - d. 4 hours
 - e. 5 or more hours
9. How many hours per week do you meet with only your peers?
- a. 1 hour
 - b. 2 hours
 - c. 3 hours
 - d. 4 hours
 - e. 5 or more hours
10. What percentage of the total time allocated to team meetings is dedicated to discussions among your peers?
- a. 100%
 - b. 75%
 - c. 50%
 - d. 25%
 - e. less than 25%
11. What percentage of the total time allocated to team meetings is dedicated to discuss scientific or technical matters?
- a. 100%
 - b. 75%
 - c. 50%
 - d. 25%
 - e. less than 25%
12. What percentage of the total time allocated to team meetings is dedicated to discuss organizational matters?
- a. 100%
 - b. 75%
 - c. 50%
 - d. 25%
 - e. less than 25%
13. How would you characterize your attitude during team meetings, as mostly listening or mostly talking?
- a. mostly talking
 - b. mostly listening
 - c. equally talking and listening
 - d. somewhat talking
 - e. somewhat listening
14. How much have you contributed so far to establish the purpose (objectives) of your team?

- a. none
 - b. very little
 - c. some
 - d. a lot
15. How much do you contribute to the planning of the project by your team?
- a. not at all
 - b. very little
 - c. some
 - d. a lot
16. How often does your team evaluate its own activities to identify the causes for success or failure (strive for improvement)?
- a. never
 - b. weekly
 - c. biweekly
 - d. monthly
17. Which of the activities carried out by the team leader do you feel is most relevant to team meetings?
- a. evaluating work
 - b. clarifying project expectations
 - c. resolving conflicts
 - d. setting the agenda
 - e. coaching team members
 - f. contributing to the content of the project work
18. Which of the activities carried out by the knowledge manager do you feel is most relevant to team meetings?
- a. evaluating work
 - b. clarifying project expectations
 - c. resolving conflicts
 - d. setting the agenda
 - e. coaching team members
 - f. contributing to the content of the project work assigning work
19. How accountable are you for the work assigned to you by the team?
- a. very little
 - b. some
 - c. a lot
 - d. completely
20. How many times have you failed to attend team meetings during the past 3 months?
- a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6 times
 - e. never

21. How many times have you failed with team project deadlines in the work assigned to you during the past 3 months?
 - a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6 times
 - e. never

22. How many times have your peers helped you understand a technical issue or scientific question through face-to-face discussions?
 - a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6
 - e. never

23. How many times have you helped your peers understand a technical issue or scientific question through face-to-face discussions?
 - a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6
 - e. never

24. How much have you learned from your peers through the reasoning, methods, and skills?
 - a. nothing
 - b. minimal
 - c. some
 - d. a lot

25. How much have you learned from the discussions and interactions with the knowledge manager?
 - a. nothing
 - b. minimal
 - c. some
 - d. a lot

26. How many times have you consulted the team members and the knowledge leader of other teams during the past 3 months?
 - a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6
 - e. never

27. How many times have you shifted roles with your peers during the past 3 months?
 - a. once
 - b. twice
 - c. 3 to 5 times

- d. more than 6
 - e. never
28. How many times have you qualitatively or quantitatively evaluated your own work (self-evaluation)?
- a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6
 - e. never
29. How many times have you qualitatively or quantitatively evaluated the work of other team members?
- a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6
 - e. never
30. How many times have you qualitatively or quantitatively evaluated the team leader?
- a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6
 - e. never
31. How many times have you qualitatively or quantitatively evaluated the knowledge manager?
- a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6
 - e. never
32. How many times has the team evaluated the deviations of the work completed with respect to the work that was planned?
- a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6
 - e. never
33. How many times have you been requested to learn work done by a peer and checked on it?
- a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6
 - e. never

34. Do you perceive the teamwork in the project – as an “all float or all sink” situation?
- all float
 - all sink
 - neutral

35. Comments/Suggestions:

Demographics (gender & age)

Male	Female	17-20	21-25	26-30	31 or Over

C.1.2. Improved Survey Forms. Team Members 9 Months after the Intervention

- Which module out of the enhancing team performance training has helped you most in your work so far?
 - Common purpose
 - Team capabilities
 - Change
 - Team norms
 - Communication/conflict
 - Recognition/reward
 - Operating procedures
 - New member integration
 - Evaluation
- In which area do you feel a need to get additional help?
 - Common purpose
 - Team capabilities
 - Change
 - Team norms
 - Communication/conflict
 - Recognition/reward
 - Operating procedures
 - New member integration
 - Evaluation
- Please list one activity which you carried out at the ETSEQ as a team member during the past 3 months with a conscious or explicit plan for expected tangible results (clear purpose)?

- In the activity listed above in item 3, how often has your team qualitatively or quantitatively evaluated the results?
 - not at all
 - very little
 - occasionally
 - frequently
 - always

5. How much has your attitude with respect to assuming responsibility for the results obtained by you or your team changed so far?
 - a. not at all
 - b. very little
 - c. a lot
 - d. completely

6. Do you now establish and follow a plan to overcome any of the difficulties concerning learning or teamwork organization that you (or your team) have identified?
 - a. never
 - b. sometimes
 - c. always

7. How many hours per week do you meet with the team leader regarding your project?
 - a. 1 hour
 - b. 2 hours
 - c. 3 hours
 - d. 4 hours
 - e. 5 or more hours

8. How many hours per week do you meet with your knowledge leader?
 - a. 1 hour
 - b. 2 hours
 - c. 3 hours
 - d. 4 hours
 - e. 5 or more hours

9. How many hours per week do you meet with only your peers?
 - a. 1 hour
 - b. 2 hours
 - c. 3 hours
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10. What percentage of the total time allocated to team meetings is dedicated to discussions among your peers?
 - a. 100%
 - b. 75%
 - c. 50%
 - d. 25%
 - e. less than 25%

11. What percentage of the total time allocated to team meetings is dedicated to discuss scientific or technical matters?
 - a. 100%
 - b. 75%
 - c. 50%
 - d. 25%

- e. less than 25%
12. What percentage of the total time allocated to team meetings is dedicated to discuss organizational matters?
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 - e. less than 25%
 13. How would you characterize your attitude during team meetings, as mostly listening or mostly talking?
 - a. mostly talking
 - b. mostly listening
 - c. equally talking and listening
 - d. somewhat talking
 - e. somewhat listening
 14. How much have you contributed so far to establish the purpose (objectives) of your team?
 - a. none
 - b. very little
 - c. some
 - d. a lot
 15. How much do you contribute to the planning of the project by your team?
 - a. not at all
 - b. very little
 - c. some
 - d. a lot
 16. How often does your team evaluate its own activities to identify the causes for success or failure (strive for improvement)?
 - a. never
 - b. weekly
 - c. biweekly
 - d. monthly
 17. Which of the activities carried out by the team leader do you feel is most relevant to team meetings?
 - a. evaluating work
 - b. clarifying project expectations
 - c. resolving conflicts
 - d. setting the agenda
 - e. coaching team members
 - f. contributing to the content of the project work
 18. Which of the activities carried out by the knowledge manager do you feel is most relevant to team meetings?
 - a. evaluating work

- b. clarifying project expectations
 - c. resolving conflicts
 - d. setting the agenda
 - e. coaching team members
 - f. contributing to the content of the project work
19. How accountable are you for the work assigned to you by the team?
- a. very little
 - b. some
 - c. a lot
 - d. completely
20. How many times have you failed to attend team meetings during the past 3 months?
- a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6 times
 - e. never
21. How many times have you failed with team project deadlines in the work assigned to you during the past 3 months?
- a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6 times
 - e. never
22. How many times have your peers helped you understand a technical issue or scientific question through face-to-face discussions?
- a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6
 - e. never
23. How many times have you helped your peers understand a technical issue or scientific question through face-to-face discussions?
- a. once
 - b. twice
 - c. 3 to 5 times
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 - b. minimal
 - c. some
 - d. a lot

25. How much have you learned from the discussions and interactions with the knowledge manager?
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 - b. minimal
 - c. some
 - d. a lot

26. How many times have you consulted the team members and the knowledge leader of other teams during the past 3 months?
 - a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6
 - e. never

27. How many times have you shifted roles with your peers during the past 3 months?
 - a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6
 - e. never

28. How many times have you qualitatively or quantitatively evaluated your own work (self-evaluation)?
 - a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6
 - e. never

29. How many times have you qualitatively or quantitatively evaluated the work of other team members?
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 - b. twice
 - c. 3 to 5 times
 - d. more than 6
 - e. never

30. How many times have you qualitatively or quantitatively evaluated the team leader?
 - a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6
 - e. never

31. How many times have you qualitatively or quantitatively evaluated the knowledge manager?
 - a. once
 - b. twice

- c. 3 to 5 times
 - d. more than 6
 - e. never
32. How many times has the team evaluated the deviations of the work completed with respect to the work that was planned?
- a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6
 - e. never
33. How many times have you been requested to learn work done by a peer and checked on it?
- a. once
 - b. twice
 - c. 3 to 5 times
 - d. more than 6
 - e. never
34. Do you perceive the teamwork in the project – as an “all float or all sink” situation?
- a. all float
 - b. all sink
 - c. neutral
35. How beneficial has the Enhancing Team Performance Intervention been in helping you solve your work project so far?
- a. very beneficial
 - b. beneficial
 - c. neutral
 - d. not beneficial
36. How much has this intervention increased your productivity/effectiveness so far?
- a. not at all
 - b. moderately
 - c. significantly
 - d. extremely
37. What is the weight of the participation of the team members in the decision making process compared to that of the two leaders?
- a. 100%
 - b. 75%
 - c. 50%
 - d. 25%
 - e. less than 25%
38. Comments/Suggestions:

39. Demographics (gender & age)

Male	Female	17-20	21-25	26-30	31 or Over

Appendix D.

International Journal of Engineering Education: Reviewer's Comments

INTERNATIONAL JOURNAL OF ENGINEERING EDUCATION
REFeree'S REVIEW FORM

Reviewer's reference : IJEE Review Witt-4-05C

Date: 4-18-05

- 1.1 **TOPIC AREA:** Curriculum development, social, business and teamwork skills
- 1.2 **TITLE OF REVIEWED PAPER:** A Competency-Based Educational Model in Chemical Engineering Schools
- 1.3 **AUTHOR(S):** Hans-Jorg Witt, Joan R. Alabart, Frances Giralt, Joan Herrero, Lluís Vernis, Magda Medir

- 2.1 **CONTENT (e.g.: Clarity of objective; basis of theory; conclusions drawn; understanding of subject, contribution to engineering education.)**

Comments: The authors have done a nice job in presenting their innovative curriculum development. They have a thorough presentation of the objectives and appear to have a good understanding of the subject matter. The paper is universal in its contribution to engineering education and their work can apply to other engineering disciplines besides chemical engineering.

- 2.2 **DEGREE OF NOVELTY OR ORIGINALITY (e.g.: presence of new ideas; innovative contribution; bulk of the material has not been published elsewhere.)**

Comments: The authors have integrated the business skills into chemical engineering in a unique way. There have been other papers published on various facets of the subject, but the authors work is a unique integration of those and has industry input and applicability.

- 2.3 **STRUCTURE OF PAPER (e.g.: general layout; use and number of figures/diagrams, etc.)**

Comments: The paper is well organized. Figures and tables are proper to the discussion, although in some cases too detailed. The main concern is the overall paper length and extensive detail in tables that support the figures.

- 2.4 **QUALITY OF TEXT (e.g.: Clarity of expression; consistency; readability; number of quotations and references)**

Comments: The paper is quite clear and easy to follow. The authors have a significant reference listing although some references in the area of teamwork, communication skills and project-based learning could be included, see below:

Newell, J. A., A. J. Marchese, R. P. Ramachandran, B. Sukumaran, and R. Harvey, "Multi-Disciplinary Design and Communication: a Pedagogical Vision," *International Journal of Engineering Education* 15 (5), 376 (1999).

Farrell, S., R. P. Hesketh, J. A. Newell, and M. J. Savelski, C. S. Slater, "A Model

score	Out of
18	20
9	10
6	10
7	10

for Synergistic Interaction between Industry and Universities with a Focus on Undergraduate Education,” in *Engineering Education and Research - 2003: A Chronicle of Worldwide Innovations*, (2005).

2.5 REVIEWER’S GENERAL OPINION AND COMMENTS (e.g.: correctness of the text; applicability of the items included; quality of the paper; scope covered.)

Comments: The paper is of high quality and has extensive detail in the background and concepts of the curriculum development. The authors make a controversial statement in section 1.b. on page 4, “technical and natural selection played a major role in the evolution of the genus homo over the past 2,500,000 years.” I would put any anthropology and evolution theory in the appropriate journals and not in this one. The term “social competencies” might be better stated as “business or management skills.” Another term used is “soft skills.” The authors may want to consider consolidating some parts of the paper that could be referenced to a web site at their school.

43	50
TOTAL	83 100

2.6 RECOMMENDATIONS

Accept

Accept with modifications

Reject

REVIEWER’S FAMILIARITY WITH THE AREA DISCUSSED IN THE PAPER:

FAMILIAR: REASONABLY FAMILIAR: X COMMENT:

Appendix E.

Details of Some Interventions and Additional Short Courses/Seminars

E.1 Communication and Human Interaction

In chapter 1 the importance of communicating effectively has been highlighted. It is fair to say that there are a lot of learning resources available on the market which are offering solutions to this skill deficit. However, there is only a limited number of resources which are robust enough to pertain in different cultures and parts of the world. In addition, a lot of them are either too theoretical and conceptual and lack a skill building piece or are ill designed the other way round. Based on this dilemma it is proposed to use a specifically designed intervention to account for the appropriate skill building in this area. The proposal calls for a one day workshop with two components. The first component would talk about the principles and dynamics of communication [1]. This conceptual part would be followed by a practical life skill building. The best way to do so, is by using the principle of experiential learning [2], which is commercially available by the Galli Business Theatre [3]. This company offers a unique approach by using classical theatre principles applied to today's business environment. Preliminary contacts with this company have already been established and they graciously offered to sponsor such a prototype. With the valid assumption that this prototype will be successful, a similar agreement to the one with the "Enhancing Team Performance©" supplier could be envisioned in order to support the large scale building of Communication and Human Interaction competency. Attached is a first pass of an outline of the workshop's agenda.

Workshop Agenda

08:30 hrs	Welcome and Learning Objectives
08:45 hrs	Introduction of Participants
09:30 hrs	Principles of Communication Part I
10:30 hrs	Break
10:45 hrs	Communication Theatre
11:30 hrs	Principles of Communication Part II
12:15 hrs	Lunch
13:15 hrs	Feedback Theatre
14:00 hrs	Debrief & Reflection
14:30 hrs	Break
14:45 hrs	Principles of Communication Part III
15:30 hrs	Communication Group Exercise
16:00 hrs	Human Dynamics
17:00 hrs	Evaluation and Discussion
18:00 hrs	End of Workshop

E.2. Cultural Background and Diversity

The examples quoted in chapter 1 (Market for Pre-Prepared Lettuce and BMW 3-Series) clearly stress the importance of cultural diversity [4]. The ability to interact with all types of cultures in a global village environment is a strategic asset. The need for this competency has caused a nearly mushrooming effect of learning resources to cope with demand. The author of this research investigated the supplier market for this competency and is now proposing to set off with a course called Managing across Cultures© by Trompenaars Hampden-Turner [5]. One of

the founders of this company, Fons Trompenaars is well renowned and has built his research on the époque making work of Hofstede [6]. The extensive and profound research is reflected in the quality of the course. Managing across Cultures© is extensively used by the Dow Chemical Company and has yielded a significantly better understanding of cultural differences. Because of the excellent working relationship between the Dow Chemical Company and Fons Trompenaars, the author of this work was able to get the commitment from the latter supplier to provide the Managing across Cultures© course with a licensing agreement similar to the one of the “Enhancing Team Performance©” course. The references point to the full course material. For the sake of illustration a short description of the course is following. First the participants have to fill out a survey. The results are then correlated to a comprehensive data base and plotted against their cultural behaviors in relation to individualist/collectivist society and other major cultural patterns. In the class the participants learn and understand how other cultures relate to these behaviors and to what extent a conflict may be provoked by different societal norms and values. The comprehension of the sources of potential conflicts leads to more empathy, understanding, forgiveness and ability to reconcile differences. The total time commitment for a participant is approximately 3 days, whereby 2 days are spent in the classroom and the remaining day is split up between pre work and follow up work.

E.3. Facilitative Leadership

In today’s environment, organizations are trying to reduce hierarchal layers and move towards flat and lean structures [7]. This calls for a very different leadership style. Irrespective of whether one comes from a business or a non profit organization, the leadership style of tomorrow is increasingly based on coaching, facilitation, mentoring, etc., rather than on leading by power of authority [8]. The following graph sums up the needs of tomorrow’s leadership.

Forms of Leadership

- ◆ Leadership by Structure
 - Company policies, set of objectives, controlling, principles of management, structure and organization of operations, job descriptions, assessment and performance measurement systems, etc.
- ◆ Leadership by Interaction
 - Interpersonal relationships, delegation, motivation, information flow, communication, support, etc.
- ◆ Leadership by Symbols
 - Cultural norms and values, written and unwritten rules and customs, company culture, status symbols, rituals at particular events, etc.

Figure E.3. Forms of Leadership

This role scenario requires the current and future leaders to adapt their leadership style and display a significant amount of versatility, irrespective of their power and authority. This is particularly difficult in case the leader does not possess a lot of hierarchical power, as is the case for the team managers of the integrated project. As they have very little balance of consequences to direct towards undesired behavior of a team member, they need facilitative leadership and conflict resolution skills. For the latter, the skill set needed goes beyond the teaching which occurs in the Communication and Conflict module of Enhancing Team Performance©. As a solution for closing this skill gap, the course Human Interaction© by Witt & Partner [9] is proposed. This is a 3 day course which focuses primarily on skill building comprised of training on general theory of facilitation supplemented by tools and techniques [10, 11]. The participants have to design a case study and are video taped while presenting their case. The course instructor of this course injects disruptive behavior to push the participants out of their comfort zone with the aim of exploring different behavior patterns. During the feedback session of the video replay, the participants have an opportunity of analyzing their reaction and judging which of the behavior traits are effective/ineffective when facilitating the case. Participants learn the prime task of facilitation, which is balancing the triangle of content, group and individual.

The target audience for this course would be primarily team managers and professors.

E.4. Organizational Development and Performance

Along with the changes in business and society, the perception of organizations changes as well. Traditionally organizations have been perceived from a deterministic perspective based on Taylorism [12]. However, there is a growing appreciation of organizations as much more complex socio-technical systems [13,14]. Based on system thinking [15], organizations can be characterized as an equivalent to a living organism or as communication nodes, producing a desired result [16, 17]. That in turn calls for the global engineer of tomorrow to be equipped with basic understanding of organizational design, of aligning the employees within that organization and of synchronizing the whole system for an optimal level of performance. Currently not a lot of learning resources exist to cover this need in a comprehensive fashion. For that reason only preliminary thoughts and concepts exist on how to build this skill. The first part of a proposal is looking into a self-learning case study, whereby over the course of a semester, a small task force of students would have to solve a case study which is centered on the three components (Organizational Design, Strategy Alignment, Organizational Development and Performance). Considerable research and work in this area is needed to pull such a case study together along with necessary education and skill building.

E.5 References for Appendix E

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- [4] Rosenzweig, P.M.: Managing the New Global Workforce: Fostering Diversity, Forging Consistency, *European Management Journal*, **1998**
- [5] Trompenaars, F; Hampden-Turner, W.: *Managing Across Cultures*, United Nations/Intercultural Management Publishers, **1997**
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