

# Elaboración de planes de entrenamiento cruzado a personal clave en proyectos: el caso de una empresa de ingeniería multidisciplinaria

## Development of cross-training plans for key personnel in projects: the case of a multidisciplinary engineering company

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### Abstract

*The research proposes a strategy to develop cross-training plans to be implemented in engineering companies that carry out multidisciplinary projects. Through empirical data collected by the application of the case method, the study performs an analysis to determine the activities and tasks that can be performed by specialists from different but complementary areas. The study is based on different existing theories, such as job rotation, project management maturity models, intellectual capital and motivational and leadership theories. As a result, each specialist obtains a holistic vision on the management of interdisciplinary projects, contributing to their development and improving the coordination of different areas. The application of these cross-training plans to key personnel in multidisciplinary projects benefits the interpersonal relationships among the project team and, consequently, collaborates in obtaining projects with better performance.*

*Keywords: Cross-training, holistic view, key personnel, interdisciplinary project, case study*

### Resumen

La investigación propone una estrategia para elaborar planes de entrenamiento cruzado para ser implementado en empresas de ingeniería que realizan proyectos multidisciplinarios. A través de datos empíricos recolectados mediante la aplicación del método del caso, el estudio efectúa un análisis para determinar las actividades y tareas que podrán realizar los especialistas de disciplinas diferentes pero complementarias. El estudio se apoya en diferentes teorías existentes, tales como la rotación de los puestos de trabajo, los modelos de madurez en la gestión de proyectos, el capital intelectual y las teorías motivacionales y de liderazgo. Como resultado, cada especialista obtiene una visión holística sobre el manejo de proyectos interdisciplinarios, aportando en su desarrollo y mejorando las coordinaciones de las diferentes áreas. La aplicación de estos planes de entrenamiento a personal clave en proyectos multidisciplinarios beneficia a las relaciones interpersonales dentro del equipo del proyecto, y en consecuencia, colabora en la obtención de proyectos con mejor desempeño.

**Palabras clave:** Entrenamiento cruzado, visión holística, personal clave, proyecto interdisciplinario, estudio de caso

## 1. Introduction

*In order to develop a multidisciplinary engineering project, it is essential that the key personnel of each project area works in a coordinated way, in order to comply with both the administrative and specialized technical aspects (Serer-Figueroa, 2010). Despite this evident premise, it has been often detected that each area works in an isolated form, thereby protecting their own work (Crowder et al., 2016; Housley, 2017). This conduct is evidenced by professionals tending to privilege more the success of the own area than the overall success of the project (Housley, 2017). A probable cause for this behavior is the ignorance and/or*

*prejudice of the project team regarding the fields of their peers, thereby entailing a clear trend to the isolation by area (Kline, 1995), whose consequence are problems in the overall performance of the project within the parent company and a biased vision of the project as a whole.*

*This study actually helps the organization to minimize the problem described above and proposes to apply a training strategy or cross-training to the organization's key personnel. In other words, for a specific project and a defined time frame, the idea is to assign one employee or a team to actively and integrally participate in areas that are not their specialty. As a result, it is expected that the organization can rely on professionals with global knowledge of the participating subject areas, where work teams can develop their activities in a coordinated, cohesive relationship and a good working environment, thus contributing to the project performance positively.*

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Specifically, this research aims at meeting the following objectives: (1) To prepare a plan for implementing cross-training to employees of a multidisciplinary engineering company; (2) to offer guidelines for selecting the key person or team that will participate in the cross-training; and (3) to propose a system to evaluate the project results once the cross-training has been implemented.

In order to achieve these goals, the study applies the Case Method (Yin, 2009), based on the empirical analysis of data obtained through interviews to the main stakeholders of the studied organization (multidisciplinary engineering company). The purpose is to get to know the activities of different areas, analyze the feasibility of doing the training, and compare the related theories. Subsequently, a cross-training plan is proposed to be implemented later on in the studied organization that develops multidisciplinary projects.

The following sections of this paper include the theoretical framework, the description of the methodology applied, the results and conclusions obtained in the study, including the limitations and future developments.

## 2. Theoretical framework

Job rotation has been analyzed from different perspectives (Eriksson & Ortega, 2006; Jeon et al., 2016; Kampkötter et al., 2016). For example, its impact on the personnel's learning, as well as the ability to provide information to the company regarding the skills of their employees (Lu & Yang, 2015). Chiavenato (2007, p. 402) describes job rotation as a "short-term education process, which is applied in a systematic and organized way, and where employees acquire knowledge, develop skills and competences based on defined objectives." On the other hand, for Bohlander et al. (2017, p. 288), cross-training is "closely related to the training of the team, where employees learn to do several tasks within the organization, different from their own." These authors indicate that part of the motivation to apply this type of training is the flexibility it offers to the organizations, which allows exchanging roles among the employees, something that would be impossible with highly specialized teams (Bohlander et al., 2017). In this sense, given the fact that engineering companies are characterized for having specialized areas, cross-training can break, to a certain point, the "ostracism" inherent to each area (Wang & Liu, 2013).

Eriksson & Ortega (2006) set out three theories concerning the reasons that motivate organizations to adopt a job rotation system. The first is the "employees' learning theory," which states that rotating employees accumulate more knowledge because they are exposed to a wide range of experiences. The following is the "entrepreneur's learning theory," where companies learn more from their own employees by observing how they perform different tasks. Finally, the "employees' motivation theory" argues that job rotation motivates employees and prevents the boredom produced by an endless repetition of the same tasks. Additionally, Chiavenato (2007) indicates that cross-training can change a worker's behavior in four ways: information transmission by acquiring new knowledge; development of skills directly related to the performance in a specific job;

development or change of attitudes to directly enhance the motivation due to the new knowledge; and the improvement of interpersonal relationships. Moreover, Robbins & Coulter (2010) indicate that the advantages of job rotation lie in reducing boredom and increasing the professionals' motivation. There are also indirect benefits for the organization because professionals with more skills and knowledge allow the management to have more flexibility for scheduling the jobs, adapting to changes, fostering innovation, and filling vacant positions. In this perspective, job rotation allows getting more familiar with different activities and tasks and increases the flexibility among work teams (areas) (Kampkötter et al., 2016). Furthermore, this strategy could entail some disadvantages by reducing the productivity due to the modifications in the work and the workforce, and some delays may occur given the distraction of having to train people in other subject areas (Eriksson & Ortega, 2006).

In order for a cross-training plan to succeed, the key personnel to be trained, together with the rest of the workforce, must necessarily be engaged and aligned under a favorable work environment (Jeon et al., 2016). Therefore, this research studies motivational and organizational leadership theories (Hersey et al., 1979; Locke, 1968; McClelland, 1965; Steers et al., 2004), which offer relevant concepts that are considered in the design and implementation of the cross-training plan.

Finally, for the proper implementation of cross-training, it is important to have a holistic view of the function of multidisciplinary engineering projects, regardless of the high level of specialization. This strategy has a positive motivational effect on the persons involved, provided that it goes hand in hand with the right leadership and relies on an organization that is concerned with advancing towards an optimal maturity level in project management. In this way, projects are bound to be developed in a more efficient and integrated manner.

## 3. Methodology

The applied technology includes three parts: the design of the strategy for the empirical study; the preparation, collection, and analysis of the evidence; and the analysis of the results and conclusion of the study. The empirical method used is the case method (Yin, 2009). This choice is justified because the research question is of the type how? Furthermore, the subject addressed is novel and pertinent for engineering companies, and the researcher has no control over the investigated element. Thus, according to Yin (2009), the present empirical research is carried out through an inductive case, since general hypothesis and proposals generated from different studied theories, especially cross-training, and motivational and leadership theories are subjected to fieldwork.

The central question of this research is: How to apply for a cross-training program among key employees of a multidisciplinary engineering company in order to achieve better results in the projects and be able to differentiate themselves from direct competitors?

This study is classified as a single, embedded case study, with different units of analysis: Project Managers, Area Managers, Engineers, and Design Engineers and HR Personnel. In the first place, the unit of analysis “project manager” is defined, since they hold a global view of the project, thereby combining managerial, business and technical elements. Moreover, this unit of analysis, together with area managers, are subjected to diagnosis to determine the maturity level of the organization in relation to the project management. Second, data about the technical knowledge and skills required by the person to be trained is collected from the unit of analysis “area managers.” In addition, this unit of analysis contributes to the identification and selection of the activities of each area, thereby delivering valuable material for drawing up the cross-training plan. As mentioned above, this unit also participates in the evaluation of the organization’s project management maturity level. Third, the unit of analysis “engineers and design engineers” confirms the data collected from the area managers and at the same time gives a view at the level of the project’s execution, in relation to the potential benefits and impacts of cross-training. This unit is the largest in terms of the number of employees involved, and it also contributes to information about the entry barriers. Finally, the survey is applied to the “HR personnel” with the aim of establishing their mechanisms to select and hire the professionals that belong to the organization.

The case used for the empirical study is an important Chilean engineering company, where data was collected through semi-structured surveys and interviews to key employees with different roles and specialties, who participate in multidisciplinary teams of several engineering projects, mainly in the conceptual design stage. The techniques used in this research for analyzing the evidence correspond to the formulation of an explanation and synthesis of crossed cases.

## 4. Analysis of results

The following results are derived from the surveys applied to different units of analysis, where all professionals belong to the studied engineering company and represent a typical engineering project work team. The following four factors were studied in the analysis:

- Organizational maturity in project management
- The organization’s resources and capacities and internal analysis
- The training team and the intangible assets of the organization
- The areas that are viable to transfer and the way area engineers are selected

The obtained results are synthesized in tables and charts, which, once they have been interpreted, are incorporated as evidence, which allows giving a structure to the cross-training plan.

Surveys are divided into two groups. The first group corresponds to project managers and area managers who go through a maturity analysis based on a summarized survey proposed by Kerzner (2011). The adoption of this instrument is based on the evidence indicating that, in organizations that are starting to implement project management standards systematically, it is not recommendable to apply complex methodologies regarding the language and number of questions as, for example, those used in the models OPM3 or CMMI (Kerzner, 2011; PMI, 2017). On the other hand, the second group of surveys comprises the two previous managers, in addition to the engineers and design engineers and HR personnel. All of them had to answer a questionnaire, which delivers results about the organization environment, management of the company’s intellectual capital, change management analysis and identification of multidisciplinary deliverables. All these information are inputs used for preparing the cross-training plan.

### 4.1 Report on the Field Work Results

#### 4.1.1 Results by Factors of Analysis

##### a) Maturity Level 1 - Common Language:

In order to evaluate, Kerzner (2011) establishes that every right answer has a score of ten points, and each wrong answer has a score equal to zero. The maximum score per each project management knowledge area is 100 and minimum 600 points are required for passing level 1.

As Table 1 shows, project managers 2 and 3 are the only ones who obtain the minimum score needed to pass to the next level.



**Table 1.** Results by the unit of analysis of Maturity Level 1

Unit of Analysis	Score	Shortfall	Percentage	Result
Project manager n° 1	590	10	98%	FAILS
Project manager n° 2	640	-40	107%	PASSES
Project manager n° 3	610	-10	102%	PASSES
Area manager n° 1	390	210	65%	FAILS
Area manager n° 2	480	120	80%	FAILS

**a) Maturity Level 1 – Common Processes**

Table 2 shows the results obtained in Maturity Level 2 by the interviewed units of analysis. They indicate that the organization does not reach the minimum average score to pass to level 3 (singular

methodology). This level requires a minimum of (+6) and, in this case, none of the interviewees reached the level required in the lifecycle phases of the project; consequently, it was decided against the evaluation of the third maturity level.

**Table 2.** Results of Maturity Level 2

Average Scores													
Lifecycle Phases	-12	-10	-8	-6	-4	-2	0	+2	+4	+6	+8	+10	+12
Maturity						X							
Growth									X				
Line management								X					
Executive							X						
Embryonic								X					

**b) Summary of the result regarding the project management maturity in the organization**

- The organization has a basic level of project management.
- The organization gives more importance to scope management and cost management and, secondly, to the deadline management, thereby weakening the attention on the triple restriction (cost, deadline, and scope).
- The organization shows a low level of knowledge regarding communications management. It was detected that the internal coordination is more difficult in multidisciplinary teams.
- The quality, as a knowledge area, is present in project management and there are corporate policies within the organization.
- The HR management has purely administrative functions and has no influence whatsoever on the hiring management.

- There is no training program, which means a disadvantage in relation to their competitors.
- There is little interest in innovating in project development because they work with already known work standards, which entails rigidity in the engineering designs.
- Projects are aligned with the company's business strategy.
- The roles of the professionals who participate in the project are well defined.
- In general, work teams are maintained during the project; however, part of the team is dispersed as the project progresses.

**4.1.2 Results regarding the factors of analysis**

The evaluation starts by reviewing the more general aspects and then deals with more specific ones. In this sense, questionnaires are applied with the aim of assessing all the factors of analysis, except the maturity factor, which was addressed in the previous point.

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**a) General Questionnaire**

The survey has 22 questions, and the objective is to make an overall diagnosis of the organization in relation to the analysis factors corresponding to intellectual capital

management (Table 3), change management (Table 4) and multidisciplinary deliverables that are most appropriate for cross-training (Table 5).

**Table 3.** Questions of the General Questionnaire – Intellectual Capital Management**Intellectual capital management**

<b>Item</b>	<b>Questions</b>
Q1	How do you identify and define the critical knowledge of the professionals who are part of the project work team?
Q2	How do you identify the key knowledge for the projects' success?
Q3	What characteristics should the non-specialist have in order to absorb the knowledge from areas that are not the trainee's specialty?
Q4	Do you have a selection and hiring procedure that clearly indicates the skills and competences of the professional?
Q5	Do the specialists of each area know the global environment of a project? How do you measure this knowledge?
Q6	Do you have knowledge repositories (physical or virtual spaces where you can store the explicit knowledge of the individuals forming the organization) for their future access and use?
Q7	Do you form work teams in a collaborative environment where their knowledge is spread? Do you schedule meetings for exchanging knowledge and experience during the project development? Do you give or would give importance to this practice?
Q8	How do you share the lessons learned from previous projects?

**Table 4.** Questions of the General Questionnaire – Change Management**Change Management**

<b>Item</b>	<b>Questions</b>
Q1	How do you form work teams? Do you think this way is appropriate or do you propose a different modality?
Q2	What importance does the organization give to the work teams' leadership?
Q3	Are there any incentives at the beginning and/or end of the project?
Q4	How does your organization face changes?
Q5	Is the communication mechanism among different project areas efficient?
Q6	Is the project compliance delay quantified in terms of a lack of coordination among different areas?



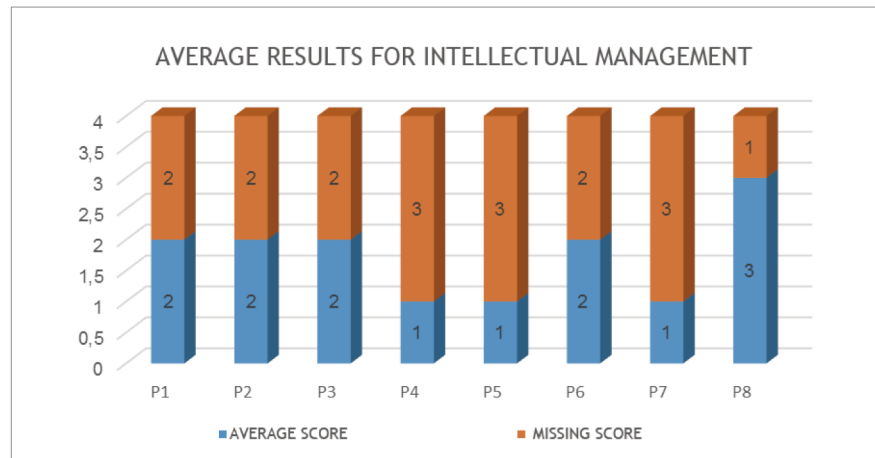
**Table 5.** Questions of the General Questionnaire – Multidisciplinary Deliverables

**Multidisciplinary Deliverables**

Item	Questions
Q1	How do you identify the activities, tasks and subjects needed in all areas that are easily understandable for a person that is not a specialist?
Q2	In your opinion, what are the fundamental and crucial activities and deliverables that a non-specialist should learn and whose knowledge could contribute to the project?
Q3	How important is it for you to rely on a work team who has a holistic approach to the project areas?
Q4	How are the project's activities and tasks carried out?
Q5	How is the interdisciplinary review process defined? Do you share it with the work team?
Q6	Do you consider the current interdisciplinary review efficient? Does it actually contribute to the project?
Q7	Do you have the time to train a non-specialist during the project development?
Q8	In what stage of the project do you consider most relevant to train a non-specialist in the tasks of other areas?

The organization's degree of compliance and knowledge about the factors of analysis in this study are evaluated with quantitative weighting, based on the given answers and through the expert judgment technique. The evaluation of each answer uses a scale of measurement

including the following: complies satisfactorily (4) expected/normal (3), partially (2) and does not comply or negative (1). The following Figure 1, Figure 2 and Figure 3 show the results for each group of questions.



**Figure 1.** Average Results – Intellectual Capital Management

The analysis of the results of the first group of questions shows a balance regarding knowledge management in the projects. On the other hand, the organization has a

deficit in relation to the specialists' hiring system. Finally, there is no clarity with regard to the management and systematization of the lessons learned.

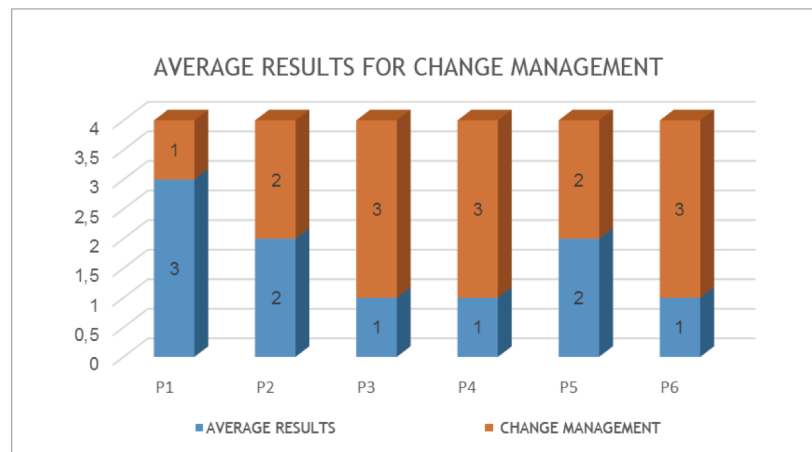


Figure 2. Average Results – Change Management

Based on the results of this group of questions, we can infer that the leadership and composition of the work teams are appropriate, as opposed to the

incentives and the way of dealing with the changes. There is no tracking of the flow of the projects and the reason for their delays.

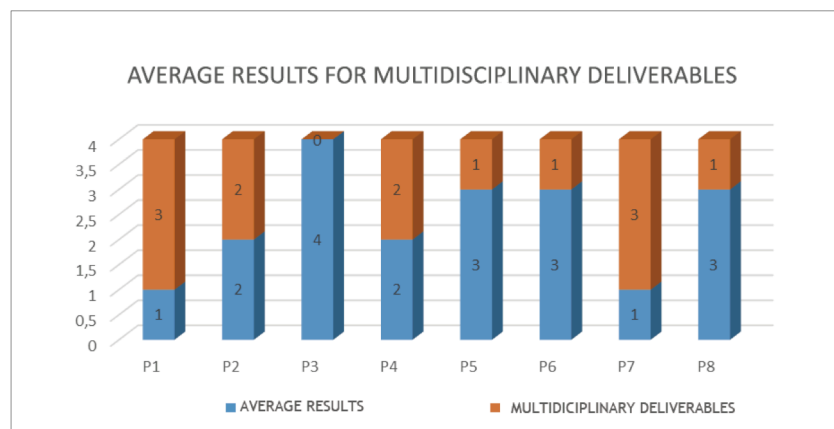


Figure 3. Average Results – Multidisciplinary Deliverables

The analysis of the last group of questions clearly points out the need to rely on professionals with a holistic approach to the projects, who can review and track the work teams. Furthermore, they consider relevant that training is done in the early stages of the engineering project.

related to adequate intellectual capital management, change management and multidisciplinary deliverables for cross-training. The evaluation of each answer is based on the following scale of measurement: completely agrees (5), agrees (4), acceptable (3), disagrees (2) and totally disagrees (1).

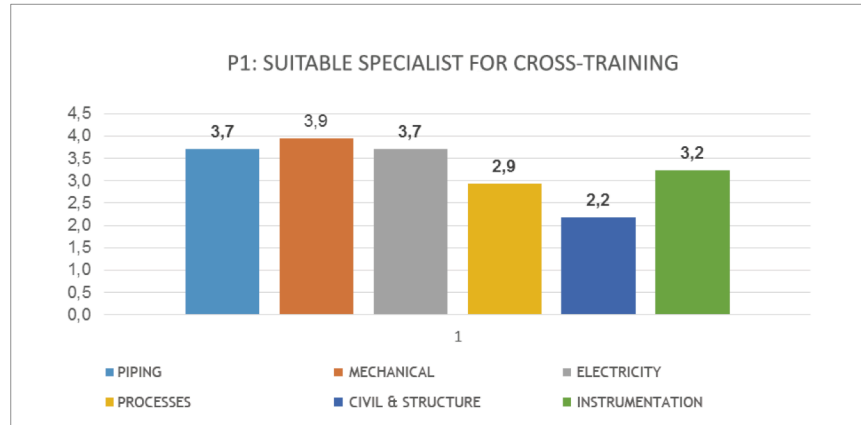
**b) Specific Surveys:**

This stage consists of surveys with factors of analysis

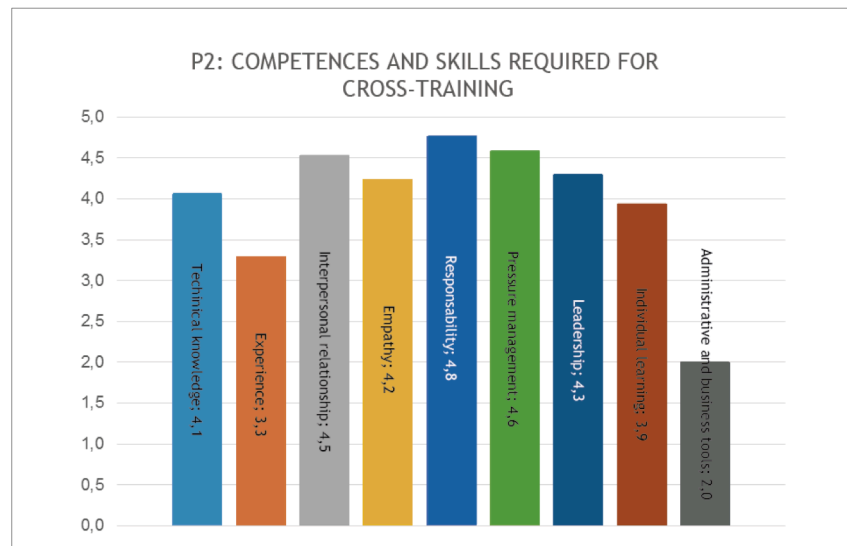
Figure 4 and Figure 5 show some of the results obtained.



**Factor of Analysis: Intellectual Capital Management**



**Figure 4.** Specialty of the training candidate



**Figure 5.** Competences and skills required by the candidate to be trained

**c) Summary of the results regarding the intellectual capital management**

- There is no explicit identification of the critical knowledge of the professionals assigned to the project; they are based on the specialty and experience.
- There is no formal policy concerning the competence development in project management.
- One of the strong points is the development of work teams, which are considered cohesive and have well-defined roles.
- The professional to be trained should have the following characteristics: minimum experience in engineering projects, strong technical education, able to work under pressure, proactive, excellent interpersonal relationships, responsibility and leadership.
- The team shows a low level of knowledge on the overall project, and it proportionally increases as the project magnitude increases.
- The criterion used for selecting the professionals of a project team is based on the availability of resources and not on the required skills. This adds a certain level of risk to project development.



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- *Tacit knowledge repositories are not evidenced. The available know-how of completed projects is used.*
- *It is inferred that the most recommended professional specialties for cross-training are Mechanical and Piping. The least recommended specialty is Civil & Structural.*
- *The organizations need to strengthen their human capital further and identify the key personnel and critical knowledge. The organization lacks a policy for retaining key employees.*
- *Cross-training is not in conflict with legal aspects.*
- *The experience of some professionals has a temporary competitive advantage. This experience should actually be taken into account by implementing a policy for promoting and retaining human talent, in order to reduce the gap detected in this analysis.*
- *The organization has financial and physical resources with competitive parity.*

**Factor of Analysis: Change Management**

The following Figure 6 and Figure 7 show a summary of the results:

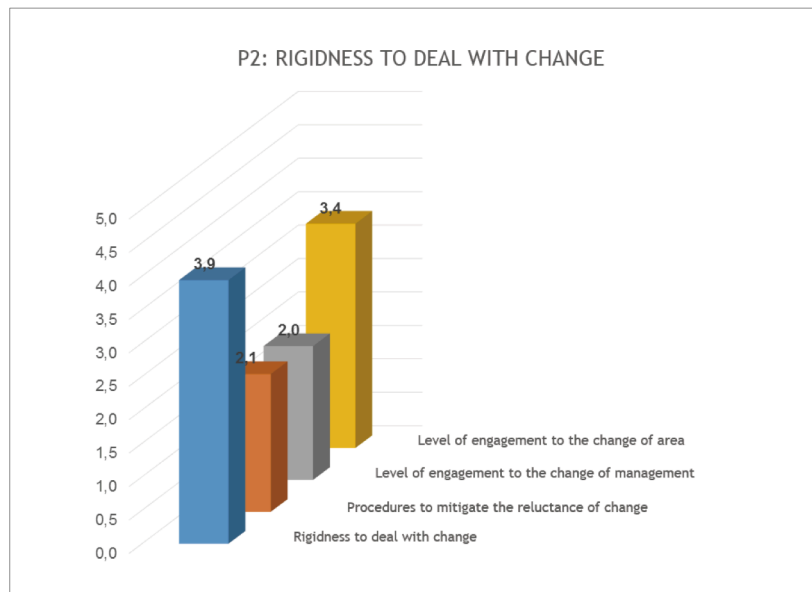


Figure 6. Attitude towards change

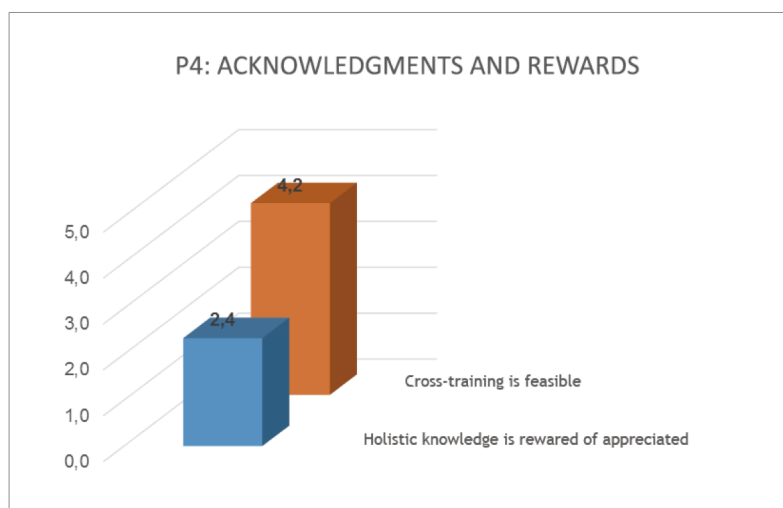


Figure 7. Regarding acknowledgments and rewards

**d) Summary of results regarding change management:**

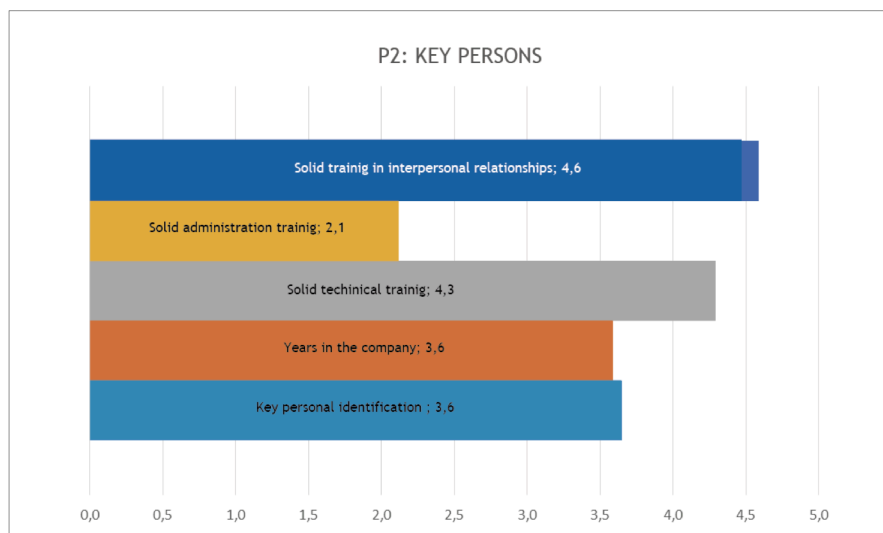
- The company's change management is associated with scope changes and how they affect the project development. Engineering companies work with methods that are sometimes difficult to change. Training is an opportunity to change that is welcomed and the organization is willing to make the necessary changes that contribute and offer competitive advantages to the business.
- There are no procedures for mitigating the reluctance to change. Further commitment from the organization's management is required.
- The organization does not provide any training regarding interpersonal skills such as leadership, teamwork, motivation; however, the importance of these skills for leading work teams is recognized.
- The organization privileges the hiring of human capital that fulfills a technical requirement and

whose salaries are within the project cost. Interpersonal skills are not considered a priority.

- There is no incentives policy associated with the successful participation and development of engineering projects. There is neither a retention policy for professionals.
- There are some communication tools. However, the interdisciplinary communication was shown to be deficient. This aspect should be improved, especially between senior management and middle management.
- Delays caused by interdisciplinary lack of coordination are not quantified.
- The department manager has more influence on the implementation of cross-training.

**Factor of Analysis: Multidisciplinary Deliverables**

Figure 8 and Figure 9 summarize the results of the factor of analysis of multidisciplinary deliverables.



**Figure 8.** Characteristics of key persons

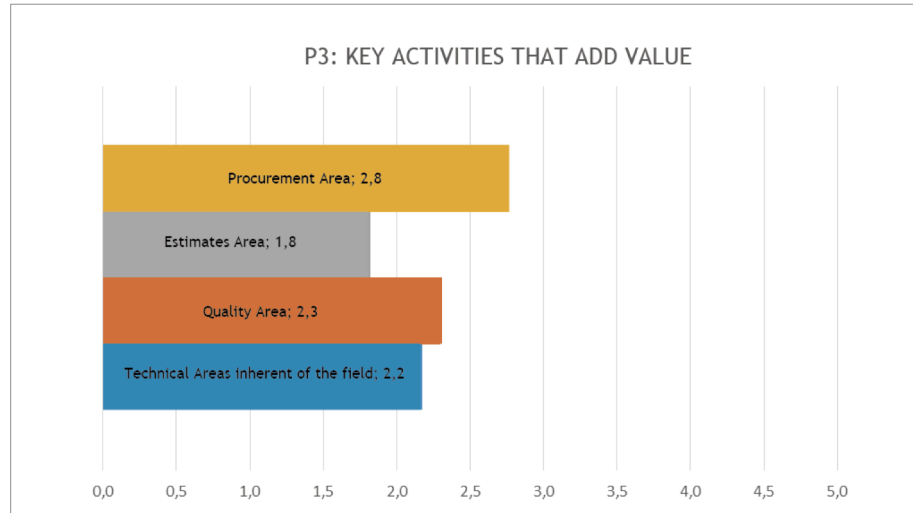


Figure 9. Activities that add value

e) **Summary of results regarding multidisciplinary deliverables:**

- There is a lack of tools that allow identifying the deliverables that can be transferred to non-specialists. Expert judgment is proposed to evaluate and define the new activities and deliverables within the cross-training plan.
- Project managers, area managers and specialists of each area are most fitted to identify specific activities, tasks and deliverables. Tools such as expert judgment, brainstorm and interdisciplinary technical meetings are recommended.
- It is necessary to have a perfect knowledge of the processes included in an engineering project, so that cross-training can be successful.
- The different areas work isolated, which fosters lack of communication and, consequently, a negative impact on the project performance.
- Completed projects are used as knowledge repositories. The lessons learned are not much reviewed.
- Prior to the training, a basic introduction is needed, which addresses the engineering processes and the terminology used in the projects.
- In order to guarantee the success of cross-training, you must rely on the board of directors' consent and the collaboration of the project team.
- Cross-training should be implemented in the detail-engineering or basic-engineering stages of the project.

- The activities contributing to differentiation from the competition should be strengthened by investing in advanced human capital. Cross-training can contribute to improve the project results and give added value to the business.

## 5. Preparation of the cross-training plan

The objective of this document is to provide a guide with specific recommendations for implementing a cross-training plan aimed at an engineering project team. It is necessary to determine the project's deliverables, activities and difficulties faced by each area, with the purpose of achieving better internal coordination and favorably impact the project results.

The importance of this document lies in the provision of a set of lessons learned collected from the persons involved in the case study, as well as the documentation derived from the projects that the organization has developed during the last years.

### 5.1 Cross-training Plan

The diagram in Figure 10 shows how the cross-training plan is created and implemented in a multidisciplinary engineering company, in accordance with the PMI® guide of knowledge (PMI, 2017). Additionally, the flowchart in Figure 11 shows the stages and interactions that should be met to implement the cross-training program.



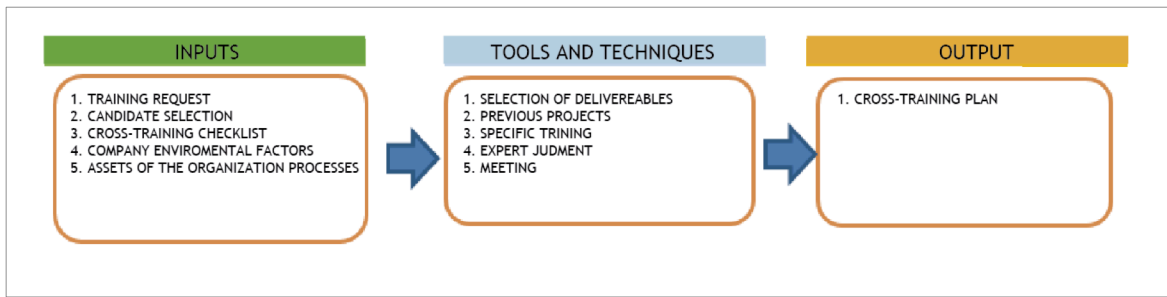


Figure 10. Cross-training plan generation

### 5.2 Cross-training plan structure

The flowchart below establishes the structure, activities and minimum descriptions that should be contained in the “Cross-training Plan” document, which must be

delivered to the HR department of the organization, so that it is incorporated into the company’s training processes, with the aim of implementing it, prior consent from the project management.

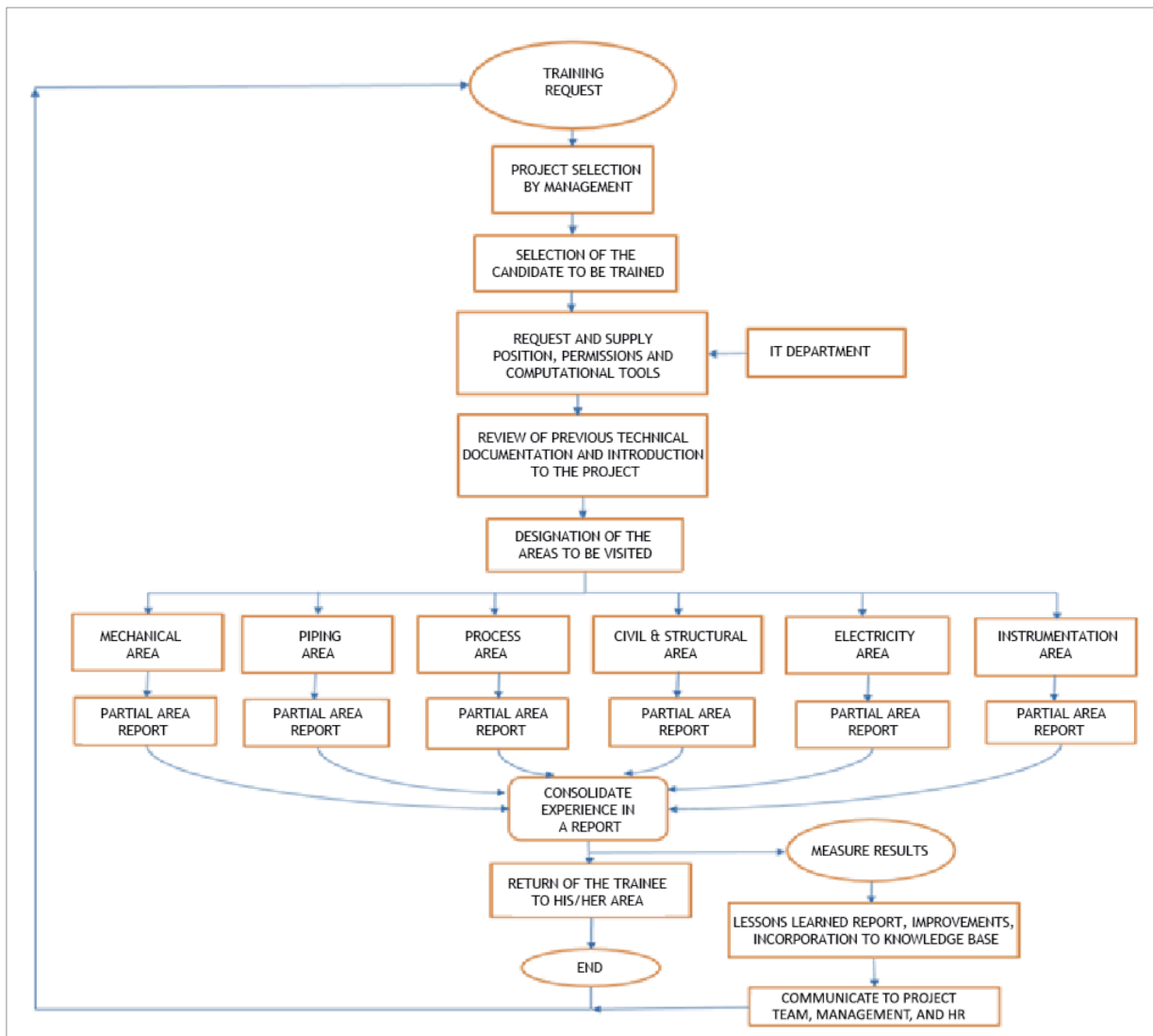


Figure 11. Implementation flowchart of the cross-training plan

- a) **Scope:** Identify key technical competences and interpersonal skills to select the candidate to be trained. Indicate the deliverables of all areas that the trained professional will prepare. Propose quantitative tools to measure the impact of the cross-training implementation. Provide a plan that will serve as a guide to incorporate new competences and skills for future professionals in the hiring process of the organization.
- b) **Definitions:** A glossary of terms is provided to understand some of the concepts in this plan.
- c) **Roles:** Definitions of different roles existing in a multidisciplinary engineering company: project managers, project engineer, area managers, engineers, design engineers, human resources personnel, etc.
- d) **Organigram:** A typical organization chart of a multidisciplinary engineering project is shown. Herein, it is possible to appreciate the main positions and roles that participate in the cross-training.
- e) **Flowchart of a typical project:** An explanatory diagram is shown, with the aim of getting acquainted with the processes of an engineering project.
- f) **Characteristic of the trainee:** Propose a guide for selecting the professional that will take part in the cross-training.
- g) **Recommended deliverables:** Based on the case study, the different units of analysis proposed different deliverables that the trainee will do prior introduction.
- h) **Minimum conditions to implement the plan:** In order to successfully implement the cross-training plan, a series of conditions should be met, where the HR department has to provide all the permissions and conditions that are needed for proper training. The project manager is responsible for supervising their compliance.
- i) **Training record (knowledge base):** It is necessary to have records that capture the experience of the trained professional once the cross-training is completed.
- Once the training process is over, the trainee has to make a final report that consolidates the training experience in each visited area, and subsequently coordinate a talk with the team members who participated in the project, with the purpose of evaluating and exchanging views, ideas, improvements, experiences, recommendations, comments, and any other elements contributing to enhance this process.
- j) **Evaluation:** This item indicates that, once the professional's training has been completed, the

assigned area management shall make an evaluation, considering technical criteria and interpersonal skills.

- k) **Project performance reports:** Additionally, an evaluation, tracking and control of the performance indicators should be made, based on the project's initial planning and the formal modifications during its development.
- l) **Measurement proposed for the training:** Some indicators are indicated for measuring the project performance once the cross-training has been implemented.

## 6. Conclusions

Based on a case study, the research prepares a cross-training plan for organizations working with projects where professional teams of different areas must coordinate and closely collaborate with each other in order to comply with the project scope. Specifically, the activities and tasks that are the basis to start the cross-training must be selected and proposed by a professional team with broad experience in projects; thus, the proposed deliverables will have strong technical support that will guarantee that the key personnel can start developing the deliverables that are alien to their specialty.

This plan does not only help to implement a cross-training within interdisciplinary engineering companies by fostering job rotation but also provides a tool to select the key employees within the organization, as well as guidelines for hiring new professionals. Additionally, the cross-training plan proposes measures to evaluate the project results following the implementation. These evaluation tools can be improved once the cross-training plan is initiated. Thus, the training process will help to increase the productivity of the organization and the project, although the non-specialized key personnel will actively contribute by generating deliverables with a wider and holistic approach.

Despite the fact that this study has limitations in relation to the amount of collected data (a single organization where field data was collected), the proposal shows that the initiative is positive, considering all the theoretical aspects indicated in the study and how favorable its implementation can be for the organization, especially in terms of teamwork, working environment and holistic approach to the projects to be developed. The challenge for the future, once the cross-training has been implemented, will be to measure the results quantitatively, analyze them and evaluate the training plan, with the aim of introducing the necessary improvements. Moreover, it seems advisable to study the feasibility of implementing this model in other similar organizations that work under a multidisciplinary approach to develop engineering projects.



## 7. Referencias

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