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MAPPING PROJECT MANAGEMENT COMPETENCY AT AN ENGINEERING COMPANY

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To assure effectiveness in project management it is strategic to manage individual competence. This work proposes a competency map for the Scheduling and Financial Planning project support areas at an engineering company. The framework deveeloped encompasses the description of competences and performance criteria, assessment process and expected profiles according to professional categories. Moreover, a diagnosis of current proficiency levels was performed, identifying competency gaps. The research design merges qualitative and quantitative methods, including literature review, documentation analysis, behavioral events interviews, self-assessment survey and statistical analysis. The proposed map is an efficient visual managerial tool, replicable and insightful for managers.

Palavras-chaves: Competency management, Project management, Individual Competence

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1. Introduction

In order to design, develop and control efficient operational systems that rely heavily on professional services, it is strategic to manage individual competences. In the resource based view of strategy (BARNEY, 1991), the resources and competencies developed and controlled by the company are critical to competitive advantage. The core competences are the ultimate source of differentiation of enterprises (PRAHALAD & HAMEL, 1990), which are related to their capabilities, resources and competences. This study is focused on the construction and engineering industry, and more specifically in the project management field, which is frequently considered a core competence in this context.

IPMA (2006), PMI (2007) and AIPM (2008) propose project management competency frameworks. Despite these frameworks could be interesting starting points to build the competences dictionary of an organization, it is not sufficient to capture its peculiarities, and integrate with its career plan, identify gaps and plan development. This work proposes a method to develop a project management competency map. The field research was performed in the context a Brazilian engineering company founded in 1960.

This paper is structured as follow. The next sections present the theory that underpins the proposed framework. The research design and methods used are presented next. Finally the results and conclusions are presented.

2. Literature Review

The concept of individual competence used in this research is the capacity of mobilizing, integrating and transferring knowledge, skills and resources in order to reach or overcome expected performance, creating economic and social value to the organization and the individual, adapted from Ruas (2005) and Fleury & Fleury (2001). It means that competences are not only a stock of knowledge and skills associated with superior performance (common between American authors such as MCCLELAND, 1973; BOYALTZIS, 1982; SPENCER & SPENCER, 1993; MIRABLE, 1997), but also their application to deliver value (aligned with the French school represented by LE BOTERF, 1995, and ZARIFIAN, 1996, among others).

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In the specific context of project management, the International Project Management Association (IPMA, 2006) describes technical, contextual and behavioral competences. The Project Management Competency Development Framework (PMCDF) from the Project Management Institute (PMI, 2007) defines knowledge, performance and personal competences. The knowledge competences are described in PMBOK (2004). The performance and personal ones are constituted of units, for instance, "Planning the project", which are further divided in elements (e. g. "Approved project schedule"). The competence units are defined with verbs that imply action and delivery, and the elements include adjectives that relate to value aggregation (e.g. "approved"), which approximates this framework to the concept of competence chosen.

The AIPM (2008) defines performance competence in each project management knowledge area and introduces another important concept to this research: the differentiation of competences between professional levels (project practitioner, manager and director).

Various authors provide methods for competency management in specific contexts: (1) Rose et al. (2007), have identified project management competences in a software development company through semi-structured interviews and content analysis exploring behavior in actual project management situations; (2) Brill, Bishop and Walker (2006), have used the Delphi with experienced project managers to identify 117 competences in project management; (3) Dainty et al. (2005) have related project management competences to superior performance in the construction industry, applying variance analysis between two groups of project managers divided by an expert panel in superior and inferior performance (this study is a useful reference for identifying competences that differentiate professional functions, such as project analyst, coordinator or manager, and seniority levels, such as junior and senior, as will be seen further) and (4) Grant, Baumgardner and Shane (1997) that aggregate the analysis of relevance of competence considering specific conditions of the project (e.g. expertise of the team, complexity).

Concerning the competency assessment, the IPMA (2008) considers the complexity in which the professional performs the competence to evaluate proficiency; PMI (2007) uses performance criteria (behavior indicators that specify how the competence is demonstrated in practice) and evidence (artifacts that prove the existence of the performance criteria). Campion et al. (2011) proposes multiple criteria to evaluate proficiency (stage of progression

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– beginner, master and expert; performance - marginal, good, excellent or even detailed descriptions of the competence for each proficiency level).

Edum-Fotwe and McCaffer (2000) have noticed a progressive scale of relevance considering academic graduation, formal training and professional experience as ways to develop project management competences. The present study, therefore, focus on linking actual professional experiences to competency development.

3. Research design

This study aims to explore the research questions presented in table 1.

Table 1 – Research questions.

Objective	Research questions
Definition	Which project management competences are required at this organization?
Assessment	What is the best method to measure proficiency in these competences?
Proficiency	Which competences differentiate each professional category?
Development	Which experiences provide competency development?

Source: Developed by the author.

The research design merges qualitative and quantitative methods, including literature review, job description analysis and eight behavioral event interviews with outstanding professionals to define the competency dictionary and map relationships between experiences and competences. A self-assessment and characterization of experiences were defined and applied to 73 professionals. Through Mood's median test and descriptive statistics, differentiating competences and experiences were identified. The expected proficiency was determined, allowing gap analysis. A sequence of development activities was suggested synthetisizing the results. Table 2 details the research methods.

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Table 2 – Research methods.

Objective	References	Data collection	Data Analysis
Definition	Rose et al. (2007), Dainty et al. (2005)	Archive analysis, interviews	Content analysis
Evaluation	PMI (2007) e AIPM (2008)	Focus Groups	Content analysis
Proficiency	Dainty et al. (2005)	Questionnary	Descriptive statistics, Mood's median test
Development	PMI (2007), Grant et al (1997), Rose et al. (2007)	Interviews, Questionnary	Causal map, Mood's median test

Source: Developed by the author.

4. Results

Triangulation of existing theoretical frameworks, interviews and job description was proven efficient to define organization-specific competences and performance criteria. For example, the competence "contributes to budget, resource planning and cash flow reviews and controls" was inspired by the competence element "Contribute to develop of the project budget" from AIPM (2008) and the excerpt of the job description of cost management analysts "supports the collection of costs data, budget and cash flow reviews". All performance criteria defined for each competence were supported by statements identified in the content analysis of the transcripted interviews, as exemplified in Table 3.

The interviewees and PMO feedback and reviews are important to ensure buy-in and connection with corporate strategy. The following types of changes were derived from this process:

a) Competence division. Example: separation between budget control and budget development because it is performed by two different teams.

b) Changes in competence description. Example: the substitution of the verb direct to orient project integration for scheduling managers, since the direction must be given by the project manager.

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c) Competence exclusion. Example: exclusion of competence related to administrative processes for cost management professionals, because although it is performed, it is not a desirable competence for strategic reasons.

d) Addition of performance criteria and competences. Example: inclusion of the competences related to Front End Loading for schedule management professionals, since it relates to an increasing demand from customers but not yet recognized by the current work force.

Table 3 – Example of competence and performance criteria.

1.1. Contributes to budget, resource planning and cash flow reviews and controls	
Performance Criteria	**Evidence from interviews**
1.1.1. Proactively interacts with other areas in order to obtain resource or cost estimates and receipt or payment dates.	*"In order to make a real good cash flow, you have to be able to interact with people from other disciplines."*

Source: Developed by the author.

Table 4 presents the Competency Dictionary for the Schedule Management area (without the performance criteria), grouped in four categories, according to existing literature (project management processes, personal and contextual – PMI, 2007; IPMA, 2008) and specific requirements from the type of organization under study (technical, in terms of engineering and construction, and company strategy).
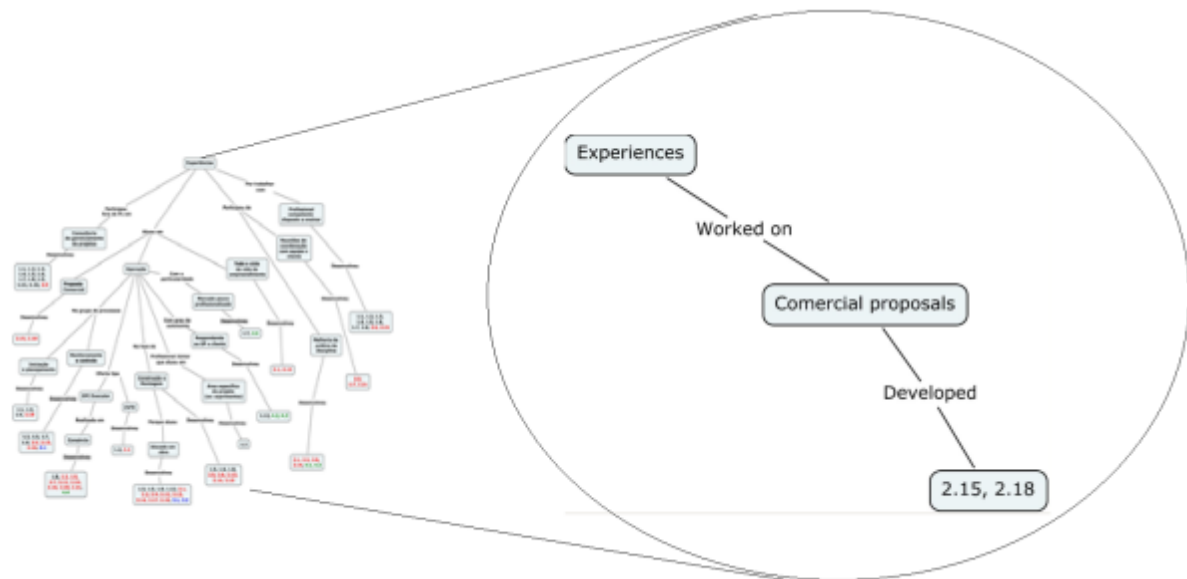
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Table 4 – Schedule Management competences.

Group	Competences
Project management processes	1.1. Contribute to WBS development.1.2. Develop project schedule. 1.3. Contribute to schedule control. 1.4. Apply and adequate tools and techniques. 1.5. Interpret and predict deviations and act to reduce impacts. 1.6. Support scope control. 1.7. Manage information and report status. 1.8. Contribute to risk management. 1.9. Guide scope delivery. 1.10. Enable FEL™ deliveries. 1.11. Audit schedule management. 1.12. Take responsibility for schedule management
Personal	2.1. Holistic vision. 2.2. Team work. 2.3. Conceptual thinking. 2.4. Analytical thinking. 2.5. Negotiation. 2.6. Leadership. 2.7. Emotional intelligence. 2.8. Entrepreneurship. 2.9. Team building. 2.10. Technology domain. 2.11. Delegation. 2.12. Learning ability. 2.13. Communication. 2.14. Systemic vision. 2.15. Tolerance for uncertainty. 2.16. Attention to details. 2.17. Critical analysis. 2.18. Agility. 2.19. Flexibility. 2.20. Resilience. 2.21. Diplomacy.
Technical	3.1. Acquire technical vision and facilitate interaction. 3.2. Understand technical abilities to improve management
Context and strategy	4.1. Promote continuous improvement. 4.2. Align project and company objectives. 4.3. Establish trust with client. 4.4. Establish strategies for multiple *stakeholders*.

Source: Developed by the author.

Relationships between experiences and competences were identified in the behavioral event interviews. The interviewees were encouraged to specify which competences were developed in each activity experienced in the organization. The results are summarized in causal maps (Figure 1).

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Figure 1 – Relationships between experiences and competences.

Source: Developed by the author.

The proposed map is an efficient visual managerial tool, replicable and insightful for managers. It indicates the most relevant experiences to improve proficiency related to critical competences. Figure 1, for instance, illustrates a connection between participation in commercial proposals and the development of agility (competence 2.18) and ability to deal with uncertainties (competence 2.15), due to the aggressive schedules to deliver the proposal and the lack of reliable data that characterizes this activity.

Working in operations that include the entire project life cycle (engineering, procurement, construction and assembling) contributes to the following competences: the development of personal competences (adaptability, emotional intelligence), project management processes (risk management) and contextual competences (strategy to deal with diverse of practices among stakeholders). All these competences were associated with the complexity level of this kind of operation, particularly when there are various partners with different organizational cultures.

For junior analysts, one critical experience is to acquire autonomy either in operations with a simpler scope or being responsible for a well defined part of the scope in complex projects, such as engineering and procurement control. Participating in improvement of project

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management practices is a way to develop personal competences (innovation, systemic approach) and contextual and strategy ones (strategic alignment, practice improvement).

One difference between schedule management and cost management competences is that the experience "on site", following the everyday business, is far more relevant to development of competences in the first case.

An assessment method was conceived using performance criteria in the past tense and a semantic scale (turned in metric) based on performed autonomy. Example:

Did you actively interact with technical project areas to estimate resources and costs?

- No (0)

- Yes, under supervision (1)

- Yes, with autonomy (3)

- Oriented execution (9)

A self-assessment was applied to the population (89% response rate), divided in six categories (intern, assistant, junior analyst, analyst, coordinator and manager), and their experiences were classified.

The current proficiency chart (excerpt in Figure 2) was developed using descriptive analysis (average).
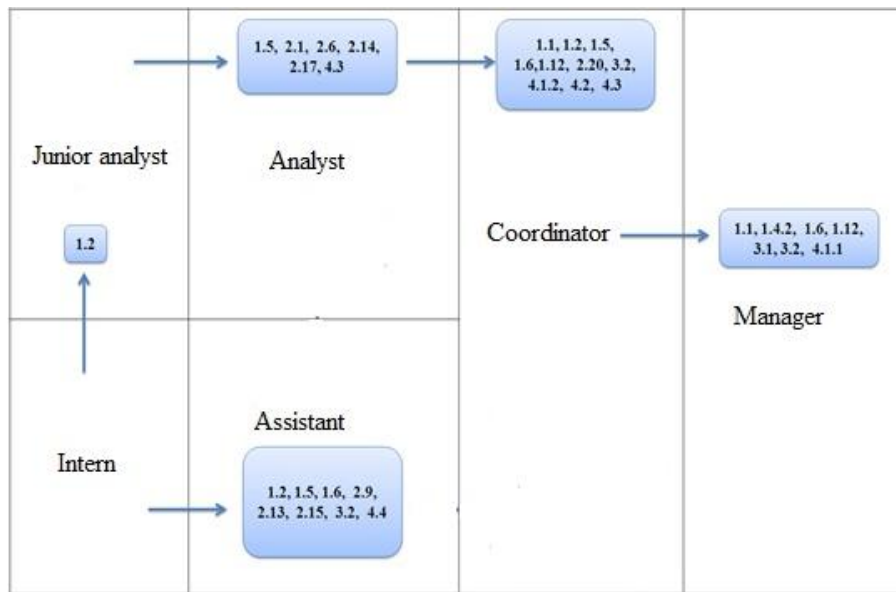
Figure 2 – Proficiency chart (excerpt).
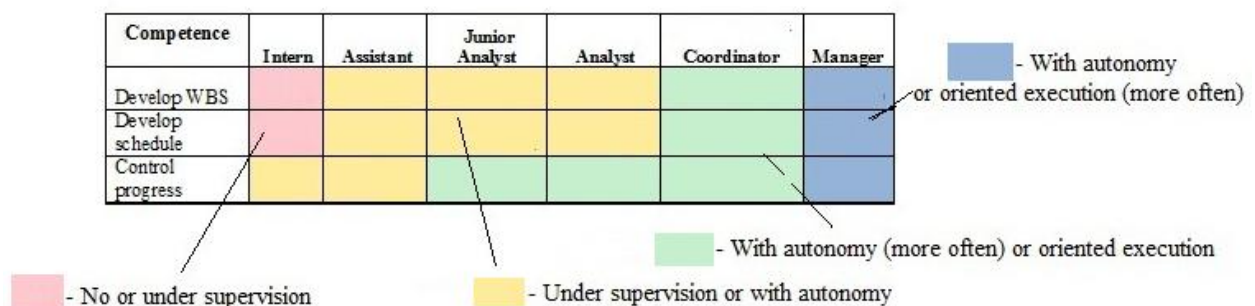
Source: Developed by the author.

Applying Mood's median test was fundamental for career advancement trajectory, indicating competences that differentiate professional categories (p-value<0.05), resulting in seniority competence maps, as shown in Figure 3.

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Figure 3 – Differenciating competences for each professional category.
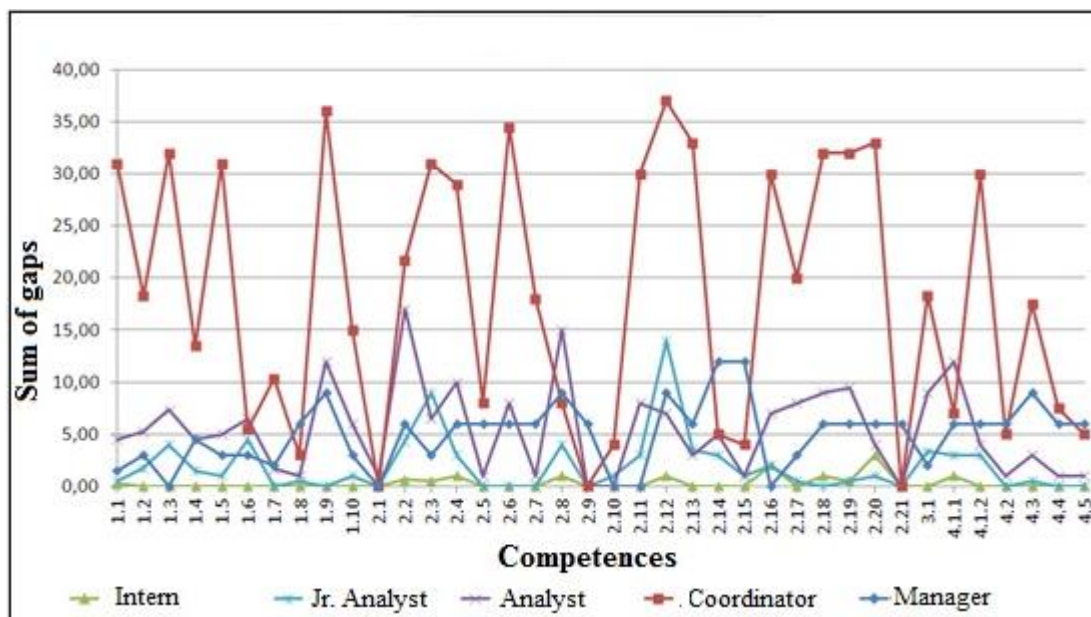

Source: Developed by the author.

Figure 3 illustrates that in the transition between junior analyst and analyst there is an evolution in interpreting deviations and trends (competence code 1.5), holistic vision (2.1), systemic vision (2.14), leadership (2.6), critical analysis (2.17) and establish trust with client (4.3), which is coherent, because analysts typically have more activities in the front line with the clients than juniors, with ability to analyze more variables at the same time due to cumulated experience. In the transition to senior analyst, context and strategy (4.1.1, 4.2, 4.3) and better understanding of interdependence between technical disciplines (3.2) are major competence differentiators, along with scope management (1.2, 1.6), deviation and trend analysis with autonomy (1.5) and responsibility for project time management (1.12).

An analogous Mood's median test was applied to identify differentiating experiences, by comparison of the profiency demonstrated by the group who has had a certain experience (such as working in the construction site or working in a consortium with outside partners) and the group who did not, for each competence identified. If the p-value was below 0.05, then the group who had that experience was significantly more proficient in that particular

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competence. This test was useful to back the analysis presented in Figure 1. For instance, it was confirmed that working in commercial proposals is related to the development of agility (2.18) and leading with uncertainties (2.15), but also adding develop project schedule (1.2), conceptual thinking (2.3), negotiation (2.5), among others, as competences better developed by professionals that have lived this particular experience.

The expected profiles were defined, allowing gap analysis to orientate competency development investments. For instance, Figure 4 illustrates one of these gap analysis, developed by summing the difference between the expected profiency and the actual one for each competence and for each professional category, and it strongly indicates the need to focus efforts to reduce the competence gap of coordinators.

Figure 4 – Sum of gaps by category.

Source: Developed by the author.

Another use is comparing individual performance with expected proficiency for the current category and the following one (Figure 5). For examplo, the intern 1 is proficient for his category, but compared to what is expected from a junior analyst, he must improve the following competences: develop project schedule under supervision (1.2), contribute to schedule control (1.3), manage information and report status (1.7) with autonomy, interpersonal relationship (2.2) and agility (2.18). Following the analysis relating experiences and competences, it may be interesting to allocate this professional as responsible for a

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specific area in a project (related to competences 1.2, 1.3, 1.7) and engaging him in planning processes in a guided way (1.2, 2.18).

Figure 5 – Proficiency of intern 1 x expected proficiency (junior analysts).
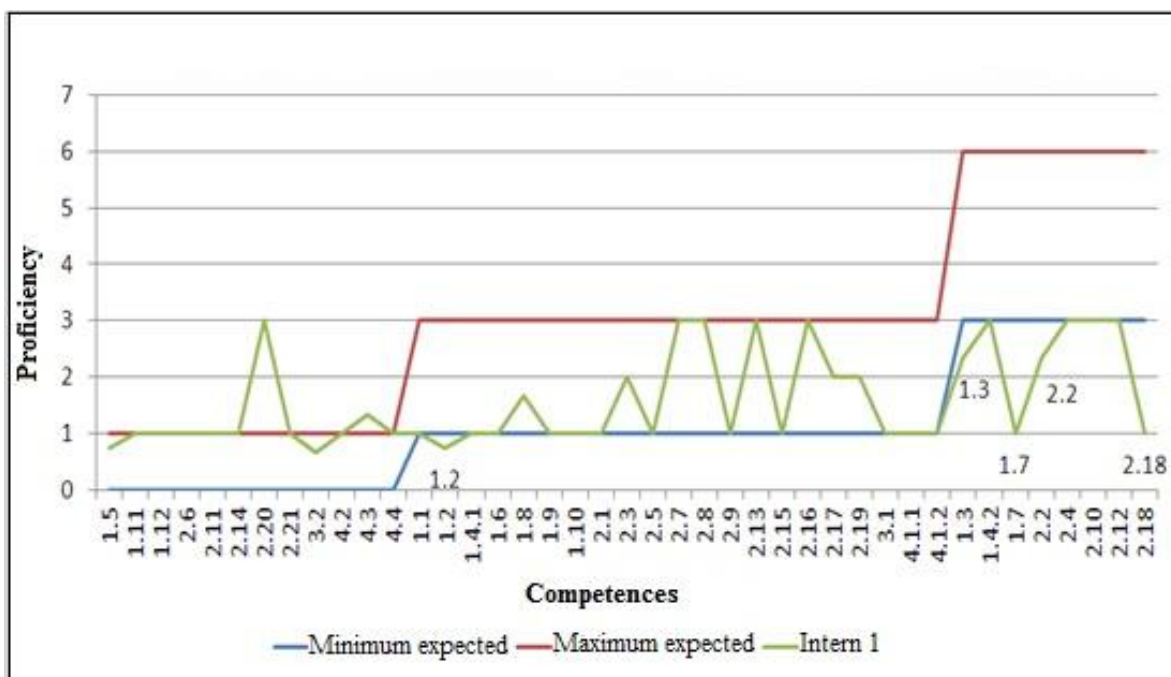
Source: Developed by the author.

As a synthesis, a sequence of development activities was conceived (Figure 6), triangulating the Competence Dictionary, relationships between experiences and competences and the expected profile for project schedule management professionals. For project management processes competences, the following logic was applied:

− Competence performed under supervision: e-learning, coaching and oriented on-the-job training are more appropriate.

− Competence performed with autonomy: simulation of a situation close to the real one and on-the-job training with autonomy are more appropriate.

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– Competence performed orientating execution: preparation of simulations (in order to develop the competence of sharing knowledge and experiences to others), giving coaching and on-the-job training as team leader.

Figure 6 – Excerpt of the sequence of development activities (analyst category).
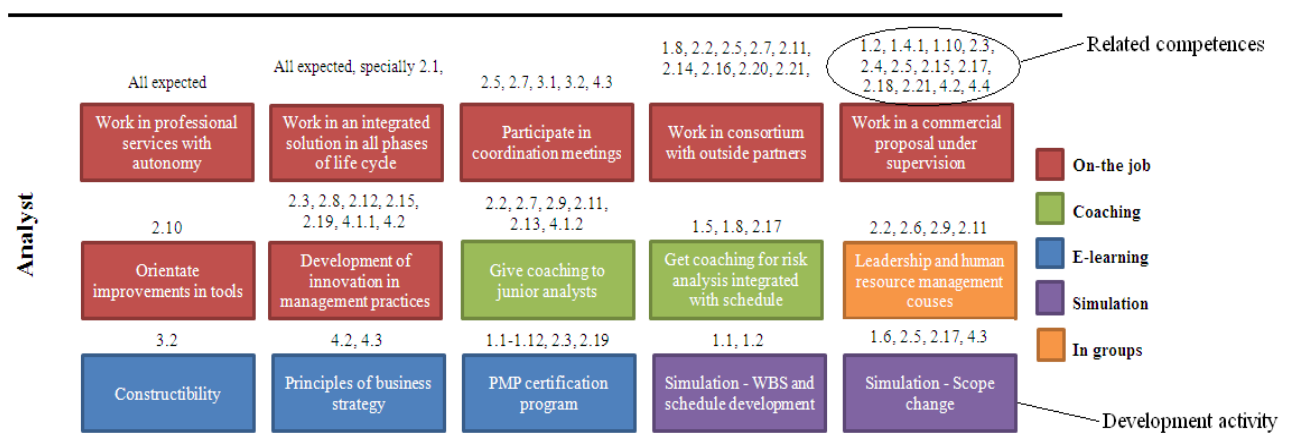
Source: Developed by the author.

5. Final considerations

The concept of individual competence was widely accepted in the case study, till then a poorly understood term for most of project management professionals in the Organization. The frameworks from international institutes of project management (PMI, 2007; IPMA, 2006 e AIPM, 2008) combined with qualitative research approaches (Rose et al, 2007; Dainty et al, 2005) have provided a solid structural, conceptual and methodological basis for the development of the project management competency map for a particular organization.

In an era of human capital as strategic asset, a method to identify relevant competences in project management, measure team performance and clarify their way to professional success

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is valuable to optimize resources and guarantee project excellence. The operations manager that aims to improve quality and efficiency in projects and professional services must manage the most important resource of this type of production system: people and their respective competences. The proposed competence map is an efficient visual managerial tool, replicable and insightful for managers.

The iterative process to validate the Competency Dictionary with the coordinators of the project management disciplines was also fundamental for the engagement of stakeholders and acceptance of the proposed competency framework.

The main question that requires further investigation is the relationship between competences and the specific project context in which they are performed, adding a "complexity factor" in the analysis of proficiency. To address this issue, there is a challenge to measure project complexity and successfully operationalize its assessment.

Some aspects of the research design could limit the generalization of the findings. First, it embraced an engineering and construction projects, and new studies should be conducted for other types of projects and sectors. Second, the focus is on a specific organization, and its characteristics conditioned the findings.

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