

Defining Knowledge Management Strategy Using APO Assessment Tool: A Case in the Construction Industry

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Abstract

This article proposes a methodology to define the basis of a knowledge management strategy, applying tools to identify the characteristics of the company, ending with the APO evaluation tool for knowledge management; this is an initial step for the development of a strategy in this discipline within a company of electrical installations in the construction industry. This process consists of three key stages for its execution; starting with a process of observation through direct exploration; then the application of surveys to project participants; finally, an APO maturity assessment tool was used in knowledge management matters, with the objective of placing the organization at a stage of maturity in the discipline under study, as well as identifying areas of opportunity and strengths. These study instruments made it possible to know the state of the organization in terms of knowledge management, identifying enablers, barriers, areas of opportunity and good practices that favor the establishment of the discipline under study as an organizational asset.

Keywords: *knowledge management, site monitoring, information, knowledge, observation, survey, APO maturity assessment.*

1. INTRODUCTION

The globalization of markets highlights knowledge as the basic value for the success of companies; in the modern world it represents the synthesis of information, professional and practical knowledge, and research that includes experiences with a practical value (Hebibi et al., 2019). The recent and explosive development in science and technology makes knowledge an essential element in any organization; it is a reservoir of intelligence with the capacity to generate business development (Mohajan, 2016).

In the current era of knowledge, the ability to manage it is a crucial aspect for business success because this element is considered an intellectual asset that has relevant characteristics very different from other goods: it is not reduced when consumed, the transfer does not diminish it, it is easily created, its reuse is difficult, and most of this asset is in tacit form and requires prior processing; this makes it a relevant subject of study for organization (Mohapatra et al., 2016). There are multiple categories to characterize knowledge, among which tacit and explicit knowledge stand out; the former is of a private and personal nature for a subject, difficult to externalize and share; the latter is of a public nature, has been expressed and shared, has been codified and possesses structure (Caddy, 2012).

Finding the way to exploit the knowledge also allows its refinement, which improves the experiences obtained, having a relevant impact on efficiency and short-term success through its reuse (Kim, 2020). The appropriate knowledge management strategy allows to achieve an objective application of knowledge,

enhancing this asset as a value-creating element, even boosting other departments of the organizations such as administrative processes and technological systems (Ode & Ayavoo, 2020).

Regarding the construction environment, one of the most important skills that an organization must have is customer service and operational techniques that allow engineers to deliver their work in accordance with the objectives set at the beginning (Yap & Chow, 2020). This knowledge must address the threat of the current complexity of this industry, with reduced profit margins and limited innovation and continuous improvement capabilities (Leeds, 2020).

The purpose of this article is to propose a methodology to identify the initial state of an organization, applying the APO evaluation tool for knowledge management, to define the basis for a strategy in this discipline. The compilation of relevant literature, as well as the development and proposal of the methodology, seek to raise awareness of the importance of carrying out activities aimed at identifying and defining the relevant elements of the organization as a starting point before defining a strategy to manage its knowledge.

This article begins with the section on the problem, a space for the general description of the organizational environment as well as the current situation to be addressed in the development of this work plan; the following section is the theoretical framework and related studies, a space where relevant information on the subject of study is shared, as well as experiences where other authors developed similar projects that serve as parallels for the current project; then there is the methodology section, where the different activities to be carried out with this work are identified, as well as a precise outline of the particular requirements for its execution and possible future replication. Finally, there is the implementation section, where the results obtained through the action proposed in the previous stage are shared, which will be the trigger for subsequent actions in the definition of the knowledge management strategy.

2. PROBLEM

This project represents a case study that was developed in an electrical installation company located in northwestern Mexico. It is a family company that collaborates with a group of workers from different areas of professional and technical knowledge; and that with a great diversity of labor skills make up its local and mining operative force.

This company has demonstrated effective and sustainable results throughout its years of operation, having an unstructured but reliable working system until today; but it cannot be neglected that in the practice of contemporary industries, many projects fail in the search for efficient performance due to the lack of effective coordination, a problem that could be addressed from effective communication and stored experience, but many companies have conflicts to deal with the last point, they do not know how to identify what knowledge they should capture (Yap & Skitmore, 2020). This non-formalized work system is a barrier for the organization to establish a system of exploitation and competitive advantage, that values its intellectual assets and is reflected in the improvements of its collaborators and its procedures.

Site monitoring is possibly the priority process of this organization, it is the guarantee of its survival; and it is this activity in the industry that serves as a means of acquiring economic gains, thus becoming the basis of the economy of the company at issue, being also a space of important flow of relevant and intensive intellectual capital to manage. In this industry, it is normal that such work monitoring is performed in highly disorganized environments, with little control and registration of activities, which ends up impacting on the deficient control of information in multiple aspects of the projects (Zepeda, 2021). Knowledge derived from individual and collective experience can be used through institutionalization or integration into work systems, procedures, structures, or strategies of the organization, being an important source of renewal and innovation (Herbst, 2017). In this work, they

interact with different professionals and workers, with important flows of information and with the requirement of different degrees of knowledge for the execution and closing of the different projects. Comments from the CEO indicate that the company needs a strategy that allows it to have intellectual tools that favor quick and accurate decision making in the different projects. The knowledge of each project allows highlighting and taking advantage of the general and particular competencies of the organization's members and processes, thus making it possible to obtain better results that materialize in individual and collective performance, as well as impacting on quality and the elimination of errors (Mittal et al., 2019). Companies require an adequate justification that fits their possibilities and needs, so it is important that knowledge management initiatives and strategies are directly linked to the business strategy (Ahmed & Elhag, 2017), without neglecting the operational work in the field and leveraging the organization's resources.

This project will have a major impact on the actions of engineers and procurement personnel, being the main ones in charge of monitoring multiple aspects related to the site works; being also the main holders of higher knowledge of the activities in the field, together with greater responsibility and access to relevant information of each installation performed.

3. THEORETICAL FRAMEWORK AND RELATED STUDIES

Knowledge management as part of organizational strategy is not really a novel practice, at least it was not a consciously performed practice; the course of history demonstrates it in diverse examples such as the relationship between artisans-apprentices, military development, business families, among others; and thanks to the fact that economics has advanced to the establishment of new operational bases, such as intellectual assets, it has prompted management processes to become involved with this discipline (Hansen et al., 1999).

These strategies require identifying how to apply knowledge successfully, finding the right way to adjust to the needs of the organization, always considering the objective of meeting a business need and adding value to operations (Greiner et al., 2007). In the construction industry, an inherent business necessity is the timely and functional delivery of a facility, so each system installed on site must be in harmony with the quality, delivery and functionality of the other facilities (Chiu & Lai, 2017), resulting in as a vital factor that the strategies in the discipline of knowledge management are structured based on the different processes, enablers and practices that drive the company's operational performance (Shahzad et al., 2016). Two types of highlighted strategies are identified in the literature: codification and personalization, which should be used to enhance communication and collaboration with the appropriate support from management (Shehata, 2015).

Greiner et al. (2007) mentioned that organizations that need to improve the efficiency of their processes obtain better results with a codification knowledge management strategy, such as construction companies; on the contrary, when seeking to generate innovation in products and processes, they suggest the use of a personalization strategy. Managers are free to choose to implement either one type of strategy or both, and when both profiles are put into action through a properly conceptualized strategy, the benefits can be greater (Payal et al., 2019). Table 1 summarizes the two main types of strategy and their objectives:

Table 1. Main types of knowledge management strategies and objectives (Greiner et al., 2007)

<i>Strategy</i>	<i>Aim</i>	<i>Approach</i>	<i>Problems</i>	<i>Type of Knowledge</i>
Personalization, networking, and dialogue	Innovation, creativity, and knowledge creation	Persons	New problems, unstructured, non-repetitive	Tacit knowledge

Codification, collecting, storing, and disseminating explicit knowledge	Efficiency, externalization, and reuse of knowledge	Processes	Repetitive activities and similar processes	Explicit knowledge
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Direct observation provides unique information about how the person interacts with the different processes, events, norms and contexts in which he operates; but the researcher must be cautious and avoid bias in his observation, because other methods such as surveys are limited to what the respondent wishes to express; being open to the general understanding of the diverse experiences of the community is necessary (Fix et al., 2022). The collection of observed information can be done with different levels of participation; it can be anonymous, without revealing the identity of the researcher; it can be invisible, observing without being observed; or without influence, with no operational impact on the area being studied (Nunes & Arruda Filho, 2018). It is difficult to find specific templates to carry out the observation function, but the author Merriam in a 1988 publication presented a very useful list that contemplates general factors of probable application in any context; among these factors are the physical environment, roles of the participants, activities, among other not very perceptible elements (Rogers et al., 2021).

Social research is well suited to the use of surveys, being this tool appropriate to obtain and describe data, in accordance with the characteristics of the individuals in the study environment (Bamber & Elezi, 2020), as well as relevant information regarding their interactions, experiences and motivations (Nixon et al., 2022). In these exercises it is possible to focus on a specific current time and work environment, selecting relevant sources of information and knowledge, which were initially possible to identify thanks to other information gathering tools (Hirt et al., 2022). It is possible that effective results are not always found when using the survey tool, because the response rates are often below the expected, making it necessary to use mixed methods of surveys by different means of interaction (Guinalú & Díaz de Rada, 2020).

The nature of the different projects makes them temporary in nature, and it is necessary to identify the knowledge acquired during this period of work to store it as an intellectual asset and improve it with the passing of the projects; but it is also very important to know that there is no official recipe to generate knowledge management initiatives, being necessary to evaluate the maturity in the discipline to know from where to start the work (Pereira et al., 2021). According to Dalkir (2017) and Qodarsih et al. (2020), traditionally, knowledge management maturity models contain four to six steps, and many of these proposals are based on “Capability Maturity Model” (CMM), designed by Paulk et al. (1995).

Hsieh et al. (2009) developed the model KNM (Knowledge Navigator Model) taking as an analogy a path to navigate for the implementation of knowledge management, formalizing the method with an evaluation and calculation framework for its application, consisting of five phases: the first is the chaotic knowledge phase, followed by conscious knowledge, then the knowledge management phase, then the advanced knowledge management phase, culminating with the integrated knowledge management phase. Time after this initial version, Hsieh et al. (2020) considered that the three initial objectives, namely culture, knowledge management processes and information technology, were limited with the demands of modern industry a decade later, so they proposed the KNM 2.0 model, contemplating important elements to support the maturity assessment, these being: assessing the readiness of service-oriented knowledge economies, big data, smart factories and strategic knowledge management performance. Bougoulia & Glykas (2022) propose a comprehensive management assessment framework based on the guidelines established by ISO 30401; a proposal generated from an intensive literature review where they identified enablers and critical success factors, determining ten components for each of these elements respectively,

calling their framework GQC (Glykas Quality Compass). APO (Asian Productivity Organization) proposes its own maturity evaluation method (APO, 2020), formulating a questionnaire that allows organizations to perform an initial assessment in the discipline, in order to promote precise initiatives and strategies based on the strengths and weaknesses identified in their collaborators and their operative environment, using seven different categories (leadership, processes, people, technologies, knowledge processes, learning and innovation, and knowledge management outcomes), each with six questions respectively, making a total of forty-two questions for a possible total of two hundred and ten points, which in the final aggregate will determine what stage the organization is currently at in knowledge management discipline maturity.

In a construction company, Zepeda (2021) carried out a project that began with a stage of analysis of the company's operations, separating activities, functions and personnel needs; a compilation obtained through different observation and interview processes, with questioning focused on detailing the organizational environment before executing the project.

Ahmed & Elhag (2017) proposed an action plan for the determination of appropriate knowledge management initiatives and strategies that fit the particular characteristics of an organization; these authors begin with a process of identifying relevant goals and initiatives that are part of the business philosophy in order to enhance them with the future strategy.

Nourbakhsh et al. (2018) used the APO knowledge management assessment tool in a banking company. In this project they focused their main questioning on the current state of organizational readiness for knowledge management in the different branches, along with a key emphasis on enablers, knowledge processes and finally on knowledge outcomes and achievements, all these fundamental pillars for utilization of this tool.

4. METHODOLOGY

The methodology section shows step by step the activities to be carried out to achieve the identification stage that is intended with this development; these actions were defined based on the research performed in the field of knowledge management. These initiatives are aimed at taking advantage of the intellectual assets generated and discovered in the organization throughout its years of operation, but as the authors Hansen et al. (1999) point out that organizations are not always aware of the intellectual capital value they possess, and as a first enabler of this discipline, actions aimed at extracting valuable knowledge and information from the company are proposed in multiple categories.

This methodology is intended to identify and take advantage of the different communication channels that favor collaboration and knowledge sharing (Marouf, 2016), with the purpose of promoting the reuse of knowledge for its exploitation and improvement, which can be reflected in intellectual and operational benefits for the organization (Kim, 2020).

It is proposed to start with visits to the institution to carry out non-invasive observations of the different activities intended for work monitoring; workers should be aware of this intervention in a cordial and calm environment, knowing the purpose of the observer (Arzate, 2019). This dynamic helps to understand the context and allows acquiring tacit and explicit knowledge for the researcher, thanks to the possibility of observation in the field and in key documents (Jia et al., 2021).

The application of surveys to the participants of a study allows to extract valuable knowledge from experienced people who know the work environment, highlighting with this virtues and defects; surveys work as a descriptive exercise that allows to know the perceptions of those involved for the benefit of future interpretations for the project (Carrillo-Villafaña, 2015).

In order to follow up on the problem raised in this study, it is necessary to share a questionnaire with those involved where they can clearly express their perception of knowledge management, even without being extensively trained in the subject (Qodarsih et al., 2020). For this purpose, we propose the application of the APO knowledge management assessment tool, an instrument recommended by the association of the same name to initiate the development of any initiative in this area, as in this case; from this tool it is possible to identify the strengths and virtues of the different relevant categories, and based on the gaps identified in knowledge, future efforts can be focused (APO, 2020).

From this initial stage in the development of the strategy in this matter, it is necessary to visualize the elimination of barriers and the promotion of the enablers, with an adequate accompaniment that favors the exchange, as well as a future follow-up and progressive training for the members involved (Ozumba & Shakantu, 2018)(Liu & Ren, 2019).

This whole process will uncover the interactions, resources and elements that are important for the execution of the site works. These characteristics will serve to formulate the future strategy to exploit the intellectual resources of the organization and improve operational efficiency.

Figure 1 contains the methodology to be followed for these activities, with these proposed actions the dynamics to identify and define the initial status in terms of knowledge management to move forward with the creation of a strategy is completed:

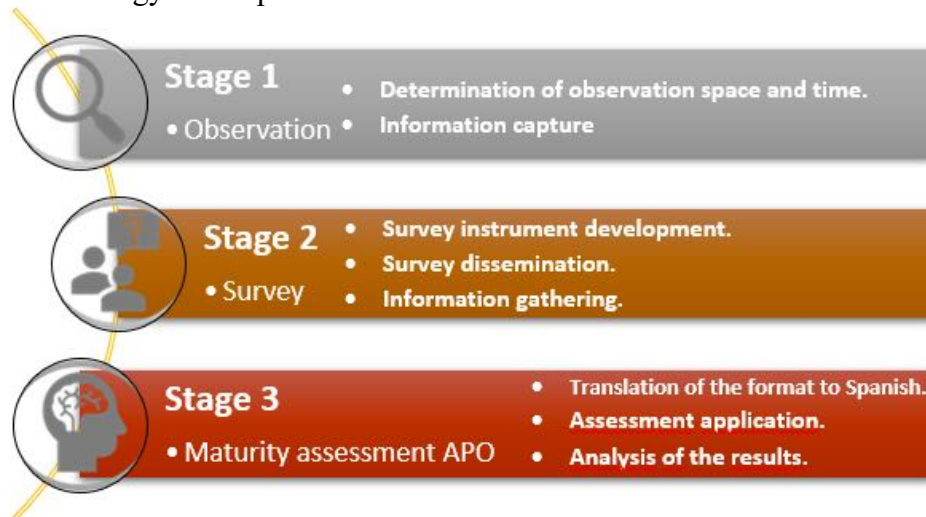


Figure 1. Proposed methodology

In the first stage it is necessary to initially establish a work system to carry out the observation, it is required to define time, form and objectives to capture, seeking that the identification of information and knowledge is valuable for the purposes of the project; it is necessary to respect the time and privacy of the participants. The format determined in this phase will be personalized according to the type of project; this capture process is not absolute; it changes according to the research approach.

The second stage requires the development of an instrument to obtain knowledge. It is proposed to generate a survey with key questions to be disseminated among the participants. The dissemination of this survey should be carried out using the different means available to the organization and within the reach of the collaborators. The contribution of each participant allows enriching the previous activity, gathering and consolidating the information and knowledge of the organization to support the knowledge management strategy contemplated in the future. This dynamic allows the identification of the work environment from the perspective of the experienced worker.

The third stage consists of using the APO knowledge management assessment tool, a questionnaire structured by seven different categories, which should be distributed to the members of the organization Perez-Soltero et al. (2023), "Defining Knowledge Management Strategy Using APO Assessment Tool: A Case in the Construction Industry", *IUP Journal of Knowledge Management*, Vol. 21, No. 2, pp. 5-26.

(the authors recommend surveying over 70% of employees, but depending on the size of the company, this may vary). It is necessary to consider the adaptation of the original method to the work characteristics of the participants, considering the nature of their operations (surveying office personnel are not the same as surveying fieldworkers). This dynamic allows to identify areas of improvement and strengths, specifically and between categories, ending with the analysis of the results obtained, which allows to proceed with the determination of the foundations and goals for the knowledge management strategy, as well as the identification of the state of maturity in the discipline.

5. IMPLEMENTATION

For the first stage, it was established by the project leaders that the observations would be free with respect to the time and space of observation. A logbook was generated to conduct these observations, supported by the work guidelines previously identified by the authors and based on the experiences observed in the participants, as well as the contributions of the project leaders. Observation is focused here on site work activities, office work and documentation, all in keeping with the central objective of monitoring the work in terms of knowledge management. Figure 2 shows the logbook format used, generated based on an adaptation made by Rogers et al. (2021), with the freedom granted by the activity of direct observation as Arzate, (2019), highlighting general observations and comments, with the purpose of capturing the information obtained through the observation.

LOGBOOK FOR OBSERVATIONS

Date: ___/___/___

Place: _____

Session time: _____

Type of work:

Office

Documents

Site work action

Description (place, working staff, priority actions, interactions, materials, resources).

Strengths and areas of opportunity in knowledge management matter (enablers, barriers, initiatives, proposals, data, tools).

Figure 2. Adapted logbook format for observations

This activity made it possible to get to know the work environment, the participants in positions relevant to site monitoring, the personnel in their charge, the resources they manage, the resources they request, some operational activities, various relevant documents, work progress documents, estimates, among other operational and sensitive information within the organization; likewise, this dynamic provided knowledge in the discipline of study. Appendix I describes in greater detail the findings obtained through this activity, identifying the strengths and areas of opportunity in the different workspaces observed. In the second stage, a survey was conducted with six strategically defined participants, based on their direct participation in site monitoring. The purpose of the activity was to learn from the participants their

direct perception of the flow of information and knowledge, as well as particular characteristics of their work that could benefit the performance of the project (Appendix 2).

The steps for the application began with the generation of the survey, focusing the content of the questions around the discipline of study, objectively seeking to obtain information using the Google Forms platform, in this way it was easily obtained access to those involved without aggressively invading their workspaces, this along with a previous quick introduction so that they could feel involved in the project from an early stage.

Figure 3 summarizes the information obtained with this dynamic, which made it possible to actively involve workers in the formulation of the strategy, an effect that will be reflected in the next phase.

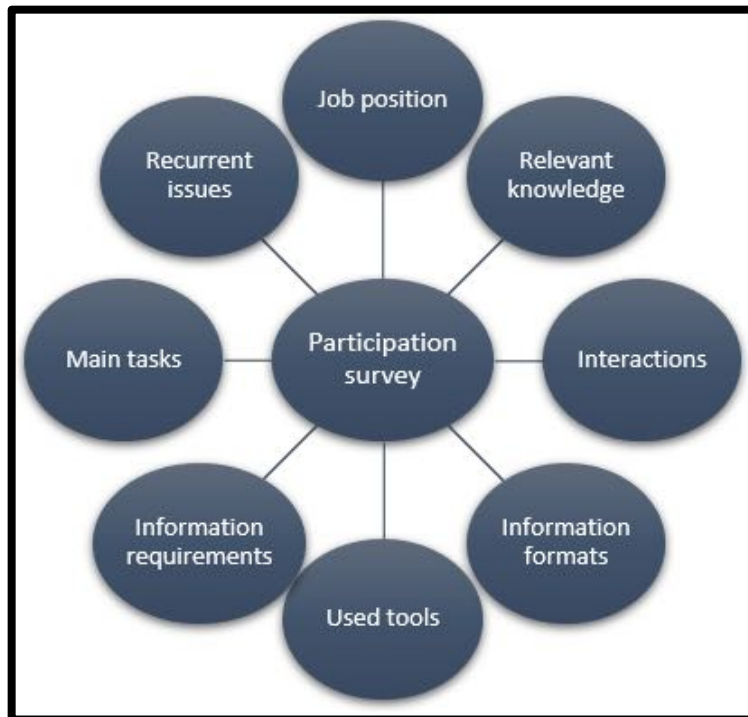


Figure 3. Information obtained from participation surveys

The knowledge and information gathered in this activity is not definitive; it will be subjected to a process of analysis in favor of improving it and creating a working system that contemplates knowledge management. This material continues to contribute knowledge for the formulation of the future strategy, thus consolidating the fundamentals of the current state with two different perspectives, in first person and from the contribution of the collaborators. Appendix 3 presents a summary of each category identified from the responses obtained.

In the third stage, seven workers were evaluated with the APO knowledge management maturity evaluation, all of them outside administrative functions; not all the people considered in this evaluation were part of the previous activity, due to the role they play in the organization, following the recommendation mentioned by the authors of the method to survey 70% of workers, and who have an accumulated experience of more than 6 months.

The questionnaire was adapted with the support of a spreadsheet in a Microsoft Excel file; subsequently, the evaluation was administered in person and remotely, depending on the possibilities of attendance. This stage did not include intensive training in the subject matter, but simply shared information on some key terms so that they could respond more clearly.

Figure 4 contains the overall results obtained by categories, these values were generated from the average obtained from all the evaluations, providing a quantitative perspective for the analysis of results.

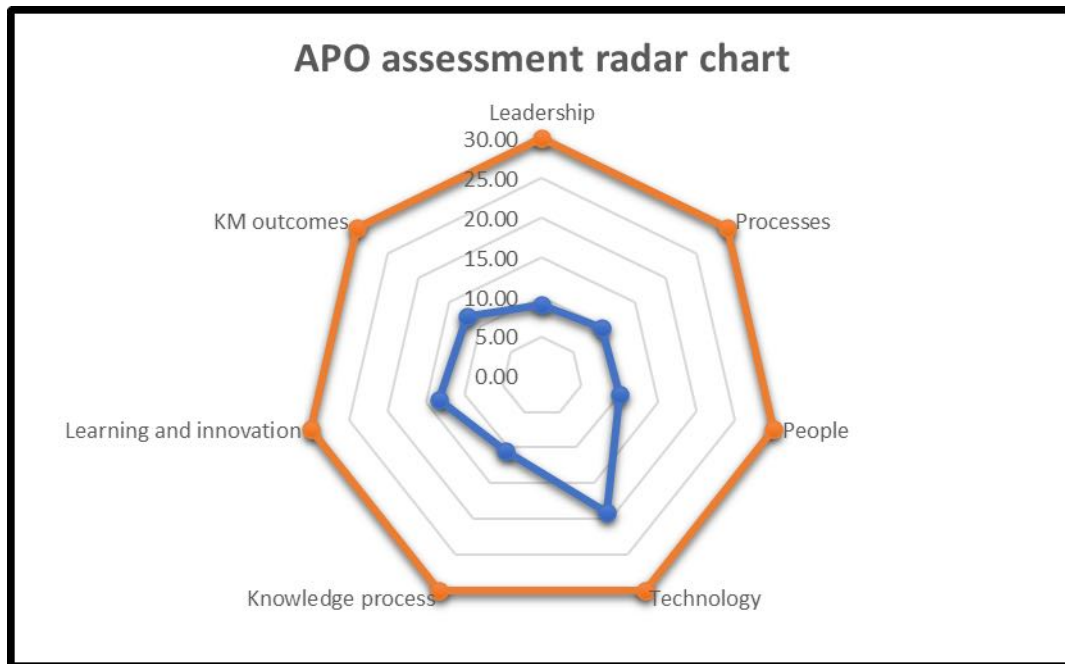


Figure 4. APO assessment results.

Table 2 indicates the status of each category. The values obtained indicate that 6 out of 7 categories are below the average possible value, with only the technology category standing out as being above the middle of the scale.

Table 2. Overall results by category and reliability analysis of the assessment

<i>Category</i>	<i>Overall results</i>	<i>Cronbach's alpha</i>
Leadership	9.00	0.80
Processes	9.71	0.88
People	10.14	0.82
Technology	19.00	0.71
Knowledge process	10.43	0.80
Learning an innovation	13.29	0.84
KM outcomes	12.14	0.93

Table 2 contains the Cronbach's Alpha values for the purpose of validating the applied questionnaire, thus determining the reliability of the measurement instrument, indicating consistency for this repetitive process. All values are in acceptable reliability ranges.

The determination of each category is not definitive, since it may be that workers evaluate a category with high values because they truly consider it to be well worked in their company, but this does not inhibit the option of improving by taking advantage of the multiple opportunities available.

From the average obtained in the whole maturity assessment, 83 out of 210, it is possible to identify in which step or level the organization is. Figure 5 presents 5 possible maturity levels, each one with a different representation of what knowledge management is for the company.

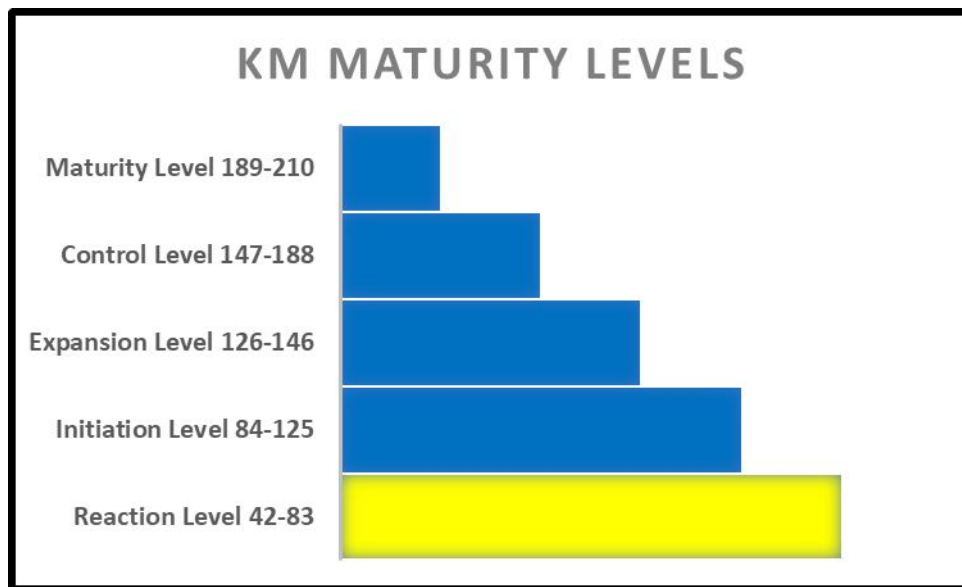


Figure 5. APO KM maturity levels (APO, 2020)

The organization is in the reaction level, which means that they do not really know what knowledge management is, they are unaware of the opportunity for improvement that it represents for productivity and competitiveness. For further specification of the findings obtained by category, please refer to Appendix 4, where the strengths and areas of opportunity identified by this method are highlighted.

6. CONCLUSION

The proposed methodology allowed to know the key elements for the future development of a knowledge management strategy from the point of view of this discipline of study, as well as the operational part of the company, specifically related to the site monitoring and to those who are mainly involved in this work. This work consisted of three stages; starting with a process of direct observation to analyze in first person the activities and interactions that surround the execution of the tasks of several workdays; then the participants were surveyed to learn about various operational aspects from the perspective of the workers themselves and in attachment to issues relevant to the discipline of knowledge management, being them the most knowledgeable of their jobs; and concluded with the application of the evaluation tool for the preparation of knowledge management APO, identifying the characteristics of the organization based on a quantitative criterion and with a perspective of the discipline of study, discovering the bases for the knowledge management strategy with the support of the contributions of the creators of the APO method. This series of applied exercises will allow, thanks to their respective results, to synthesize information related to the company with greater objectivity to determine the strategy adjusted to their needs, seeking that the valuable human capital they have can be integrated with the appropriate use of different technologies, can be adjusted to the operational processes without setbacks and that they can properly structure their information management system; subsequently the integration of the discipline of knowledge management to the philosophy and methods of the company can be achieved.

We now have sufficient tools to identify the situation of the company in this case study, with its strengths and weaknesses that can be used as enablers and barriers to be overcome respectively, taking advantage of the available capital to favor the intellectual assets, and therefore improve operational performance in the years to come thanks to the exploitation of this asset that does not end.

Among future works, it is proposed to advance the strategy formally contemplated for the organization, being this effort also a space for improvement, which will allow to opt for better tools and solid foundations of the selected strategy in the subject of study according to the characteristics of the institution. It will also be possible to replicate this methodology in other organizations, even if they are not precisely from the construction sector, always considering that there is no uniform method to identify factors and develop a knowledge management strategy; these analyses should always be generated from personalized observation, in adjustment to the needs of the specific organization.

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Appendix 1. Summary of the direct observation activity.

<i>Type of work</i>	<i>Description</i>	<i>Strengths (KM)</i>	<i>Opportunity areas (KM)</i>
Office	<ul style="list-style-type: none"> • Interaction with various members of the organization (accounting, drivers, director, procurement, engineers, customers, among others) • Desk for personal use • Familiar with electronic devices and vehicles (cellphone, computer, car, camera) • Indefinite hours (there are no rules for being in the office) 	<ul style="list-style-type: none"> • Constant exchange of knowledge and information • Trust among collaborators • Closeness between workers • Reduced work area. • Communication • Information sessions (non-standardized) • Rest periods and dialogue not established but identified • Time for reflection and review in an informal way 	<ul style="list-style-type: none"> • Non-work distractions • Lack of an organized system for storing information • Lack of awareness regarding the use of intellectual capital • Irregular analysis periods, interrupted by various occasional problems (sometimes tasks without a defined responsible person) • Multiple projects monitored at the same time, without structure
Documents	<ul style="list-style-type: none"> • Work estimates to report progress and invoicing • Purchase orders • Regulatory employee and personal documents • Official CFE documentation • Responsible for multiples documents as contractors • Reports on the usage of machinery and equipment • Construction budgets • Personal and external CAD type software files 	<ul style="list-style-type: none"> • Purchase orders monitored by another person • Basic and sufficient knowledge of Excel • Effective distribution of responsible persons for the documentation • Tacit experience accumulated with respect to the documents • Modifications to documents allowed due to error or changes (not recommended action) 	<ul style="list-style-type: none"> • There is no official storage space for documentation • Lack of an explicit method for learning the proper use of documentation • Non-standardized formats for similar works (for example, estimates for different works) • Non-existing formats with possibility of being enabled
Site work action	<ul style="list-style-type: none"> • Supervision of all workers • Vehicles enter and leave the site work according to their order. • Record the progress of the site work 	<ul style="list-style-type: none"> • Current members experienced in field actions • Trust and communication with employees 	<ul style="list-style-type: none"> • Lack of a training system established for field knowledge of the work site • No official registry of vehicles and tools

	<ul style="list-style-type: none"> • Continuous communication with leaders • Cell phone use • Meetings with customers • Link with the office for the purchase of materials 	<ul style="list-style-type: none"> • Established relationships with external engineers and managers • Established relationships with vendors and suppliers • Knowledge of personnel in field 	<ul style="list-style-type: none"> • No official record of the performance of the entire team • Staff attendance reports on physical sheet • Platforms of basic use for the exchange of documentation with external personnel
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Appendix 2. Questionnaire

1. Participant's name:
2. Job – functions:
3. Main tasks:
4. Technological tools used (devices and/or softwares):
5. In what format do you write, share, or request information?
6. Briefly explain how you share information through the different media.
7. In your opinion, what would be the most important knowledge of your position?
8. This project is just getting started. Do you have any suggestions for improving the processes you use to monitor construction sites?
9. What recurring problems do you encounter in information and knowledge management?
10. Which personnel do you interact with? Identify them by position and department.
11. What information do you need to capture and use within site monitoring?

Appendix 3. Summary by categories of the participation survey.

<i>Categories</i>	<i>Description of responses</i>
Job positions	<ul style="list-style-type: none"> • Site supervising engineer • Purchasing and materials logistics • General manager • Formalities for CFE
Used tools	<ul style="list-style-type: none"> • Excel • AutoCAD • Cell phone (various common applications) • Computer • Google tools • Opus • Microsoft Teams

Main tasks	<ul style="list-style-type: none"> • Budgets creations • Development of electrical drawings • Site work estimations • General supervision • Quoting and purchasing • Logistics • Formalities for CFE • Management processes • Cost control
Relevant knowledge	<ul style="list-style-type: none"> • Sum of experiences in electrical matters • Knowledge of site management • Diverse technical knowledge (cell phones, computers, etc.) • Knowledge of materials • Contracts in execution • Field and digital site development • Harmonious interaction with personnel • Administrative processes
Information formats	<ul style="list-style-type: none"> • email • Handwritten report • Calls • Text message (WhatsApp) • Excel files • AutoCAD files • Word files • Application for personal use
Information requirements	<ul style="list-style-type: none"> • Work progress • Worked hours • Quantity of installed materials • Machine-hours • Photographic evidence • Material supply invoices • Support for administrative management
Interactions	<ul style="list-style-type: none"> • With the general manager • Resident engineers of the company's own and outside the company • Other supervisors • Accounting • Crew foreman • Electrical officers and assistants • Payroll clerk • Personnel processing clerk
Recurrent issues	<ul style="list-style-type: none"> • Lack of information capture at different stages of the projects • Incomplete drawings supplied by third parties • Inadequate tracking of material purchased – material collected • Lack of digital tools • Ineffective communication with new personnel • Lack of comprehensive knowledge system that brings together the different areas of the construction execution process • Modifications to the Project and work program • Rework due to simple and avoidable causes

Appendix 4. Category classification with their strengths and areas of opportunity

<i>Categories</i>	<i>Strengths</i>	<i>Areas of opportunity</i>
Leadership	<ul style="list-style-type: none"> • Management cooperation on the need and potential usefulness of the strategy 	<ul style="list-style-type: none"> • Establishment of strategic vision for KM • Generation of knowledge management initiatives
Processes	<ul style="list-style-type: none"> • Strategically established job positions 	<ul style="list-style-type: none"> • Key processes to promote excellence in performance • Systems work innovation
People	<ul style="list-style-type: none"> • Collaboration among participants • Exchange of corrective knowledge 	<ul style="list-style-type: none"> • Training/induction programs
Technology	<ul style="list-style-type: none"> • Use of electronic devices • Technology within everyone’s reach 	<ul style="list-style-type: none"> • Formal establishment of the technological structure • Current tools exploitation • Digital upgrades • Knowledge management integration
Knowledge process	<ul style="list-style-type: none"> • Basic notions of knowledge processes • Identification of knowledge holders • Retention of personnel with relevant knowledge 	<ul style="list-style-type: none"> • Project documentation • Leveraging lessons learned/best practices • Benchmarking.
Learning and innovation	<ul style="list-style-type: none"> • Management openness to innovation. 	<ul style="list-style-type: none"> • Risk assumption • Multifunctional analysis teams • Exchange of ideas • Encourage collaboration
KM outcomes	<ul style="list-style-type: none"> • Customer satisfaction • Knowledge integrated in processes 	<ul style="list-style-type: none"> • Knowledge management practices • Various performance indicators