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PROBLEM-BASED LEARNING METHOD USE IN THE CIVIL CONSTRUCTION ORGANIZATIONAL ENVIRONMENT

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Abstract

The changes in the civil construction context, and consequently the production management of constructions, require a different profile engineer, which demands more refined skills from those professionals, such as innovation, focus on customer, production planning and control, quality management systems knowledge, sustainability and a hu-manist vision. The main objective of this paper is to show the efficiency of using the Prob-lem Based Learning methodology adapted to the organizational context. The research strategy adopted was the Research-Action, in which the research team aimed the im-provement of the way professionals understand and solve problems. The results involved the development of abilities related to the organizational context, as well as the individu-al, collective and organizational learning skills, highlighting problems and possible solu-tions for the company. Through increasing these skills, it was possible to stimulate a hu-manistic and sustainable vision, customer-focused, and a better quality management system. In addition, problems in this system were presented, which stated the necessity of creating an environment which enables the exchange of information among its sectors.

Keywords: Problem-Based Learning method; Learning Skills; Organizational management; Construction Environment

1. INTRODUCTION

The rising and constant changes in competitiveness at Civil Construction Industry, the velocity in which new technologies become available, the increase in quantity, speed and access to information mark a turbulent environment, which requires companies to have a great capacity of learning and adaptation that yields in continuous changes in the profile of civil engineers.

In this context, the emphasis in a wider work and academic background and the increase practical experience possibilities throughout higher education are evaluated as options to satisfy the demand of a multiprofessional profile and provide the personal maturity and the professional identity needed to act in situations of unpredictability, in which companies can be presented. In addition, the investment in developing abilities for management become indispensable for companies that intend to maintain their competitiveness in the current marketplace.

Therefore, this paper aims to show the efficiency in using the Problem-Based Learning (PBL) methodology in the civil construction organizational environment. The research was proposed and performed in a company which went through the process of reallocating the roles of its civil engineers that also managed the construction sites. The use of the suggested method was used in order to increment the development of the management skills of the workers.

Bomfim (2012) states that the development of managerial abilities in the companies allows the increment of the knowledge, the abilities and attitudes of the workers, factors that promote quality and productivity in the workplace. This study assists the comprehension of how much developing the managerial abilities are important in the civil construction, following the methodological strategy of the research-action.

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Brazilian Journal of Operations & Production Management
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2. LITERATURE RESEARCH

2.1 Problem-Based Learning in the Organizational Context

Kalatzis (2008) states that the Problem Based Learning (PBL) method was originated in the beginning of the 20th century. According to Schmidt (1993), in the 20s decade, the PBL was used as a case study method in Law programs at Harvard University, in the United States.

Barrows *et* Tamblyn (1976) define the PBL as the result of a workflow process oriented to the comprehension or solution of a problem. According to Schmidt (1993), the PBL is an approach to the learning and instruction processes, in which the students, in groups, deal with small problems, and supervised by a tutor.

In a broader way, Mamede *et al.,(*2001) conceptualize PBL as an educational strategy and a philosophy approach to the work background, which conceives a learning process in which self-directed students can build their knowledge actively. From problems and collaborative working, students learn in a contextual way, they set their own learning objectives and acquire a knowledge with a personal meaning following the inner disposal of each one.

Kalatziz (2008) says PBL, being an instructional model itself, presents definitions, attributes and objectives that make it a method. The same author states that PBL uses real-life problems to stimulate the development of critical thinking, problem-solving abilities and the learning of concepts presented in syllabus.

The PBL is a method that emphasizes the development of essential abilities such as the effective problem (BARROWS; TAMBLYN, 1976; WOODS, 1996; ENGEL, 1997) and the self-directed study. The approach centered on the student also increases the abilities of listening, summarize information and teach others. (BARROWS; TAMBLYN, 1976). Teaching classmates or workmates is an ability required by many professionals, jointly to the capacity of working as a part of the team. (BARROWS; TAMBLYN, 1976; WOODS, 1996).

The adapted model studied in this paper was developed by Neves (2006) in his Doctorate thesis, and states that the learning process initiates with the sharing of the individual knowledge. Later, this process becomes social, shared to the group, and generates both individual and collective learning. After the group comprehends and seeks the solution of the problem, the results are discussed one more time with the company staff, which motivates the final solution proposition to present rules and procedures that guarantee good conditions for the organizational learning process.

The use of the PBL method adapted to the organizational context is justified by the will of the company to invest in the qualification of their engineers that manage construction sites in the context of their own workplace, sharing experiences among each other, in a way they can discuss the means of performing activities. Thus, they are able to identify the concepts studied and relate then to the company's reality.

The model is divided in five stages: Problematization, Action, Solution Discussion, Solution Presentation Planning and Consolidation. The process begins with the detailed analysis of the context, in which the problem is defined and initial solution propositions are set. In the following stage, individually, the solution is applied into action, and the reflection about the results occurs. Next, the results are presented and discussed among the group members. If there is an agreement, the group writes a document, procedures or a new practice and defines how the solution is going to be presented to the company. If there is no agreement, the solution propositions are discussed. When this stage is completed, it is performed an evaluation of the cycle. In the last stage, the results are presented and the final solution proposition is discussed with the company. Finally, a new problem is defined and then, a new cycle begins. The Fig.1 shows the adapted model's structure.

3. RESEARCH METHODOLOGY

The strategy of Research-Action was used as it was developed with the interest in changing and participation of everyone involved. Thiollent (2007) states that for a research to be marked as Research-Action it is essential the implementation of an action by the people involved in the problem. Additionally, it is necessary the action not to be trivial, which means an action that needs to be investigated scientifically, in order to be elaborated and performed. In the Research-Action, the researchers fill an active role of adjusting the problems found, in the accompaniment and in the evaluation of the actions generated from the problems.

The research process was performed in a participative way which involved the researcher and the engineers of the site. Facing the context of a problem, the engineers developed an action, which was followed by a reflection and the planning of new actions for the next cycle. The research assumed the role of an enabler who provided orientations about the didactic resources aiming for the theoretical restructuration and the seeking for knowledge by the engineers that participated in this research through their own initiative.

The researcher was also responsible for organizing the group dynamics and the meeting topics. Besides, throughout the meetings, he presented a questioning attitude, asking constantly the engineers about the reasons for the problems listed in each cycle.

According to Silva *et* Menezes (2005), in the perspective of how it approaches the problem, this research is

Brazilian Journal of Operations & Production Management
Volume 13, Número 1, 2016, pp. 78-85
DOI: 10.14488/BJOPM.2016.v13.n1.a9

characterized as qualitative as it considers that information can be qualified, which means that opinions can be classified and analyzed by using resources and techniques. From the point of view of its objectives, the research is considered as descriptive since it aims to describe the characteristics of a phenomenon and it uses techniques and data collection through systemic observation. Regarding to its technical procedures, the research is classified as Research-Action as it was elaborated with the participation and compromise of changing of every part involved in this study.

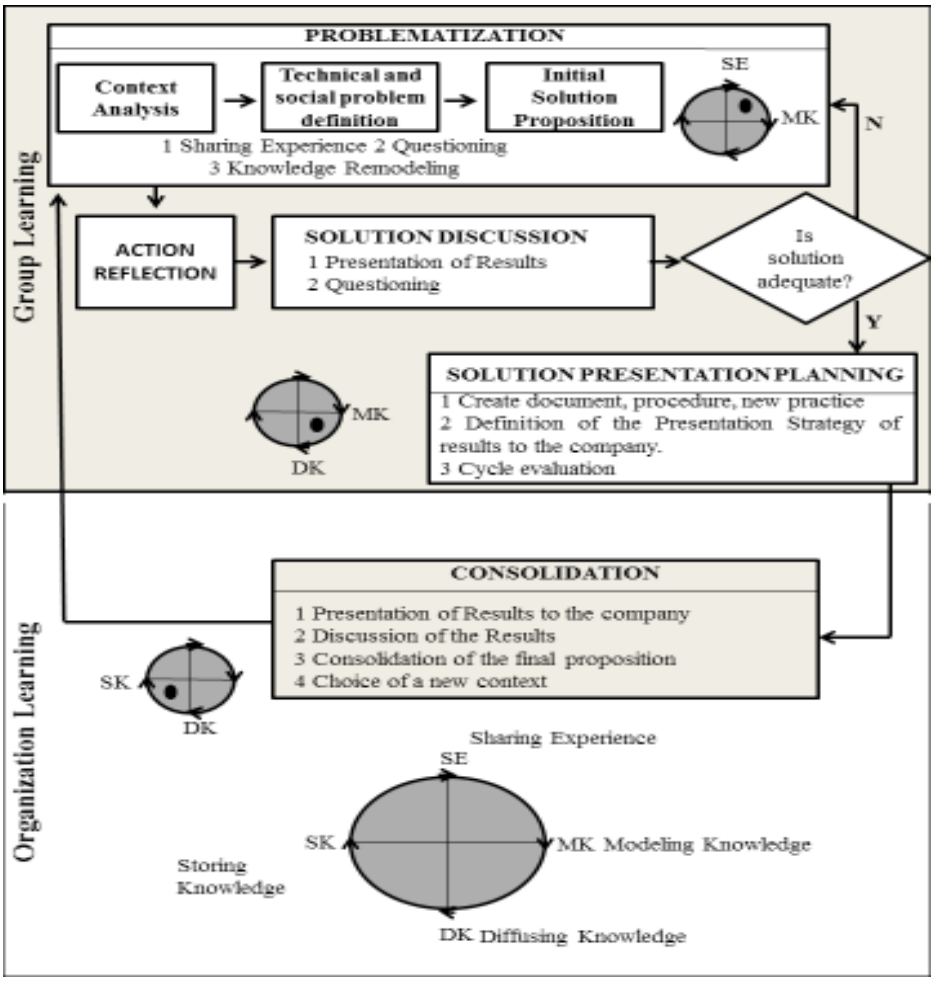

Figure 1. Capacitation Model

Source: Compiled from Neves (2006)

The empirical research was performed through observing the PBL method implementation as an assistance to the development of the demanded abilities by the company. It can be affirmed that each cycled corresponded to a learning stage of the researcher, which began with the research's issue. According to the results, the researcher performed reflections on the individual learning and the necessary abilities to the engineers. Those reflections occurred between cycles, with the analysis of the meetings notes (transcription of the meetings), in which the following were analyzed: the frequency of the group members, the increase in the meeting participation (exposing opinions), the commitment to the activities that were defined by the group, and the members' perception to the objectives of the company.

Brazilian Journal of Operations & Production Management
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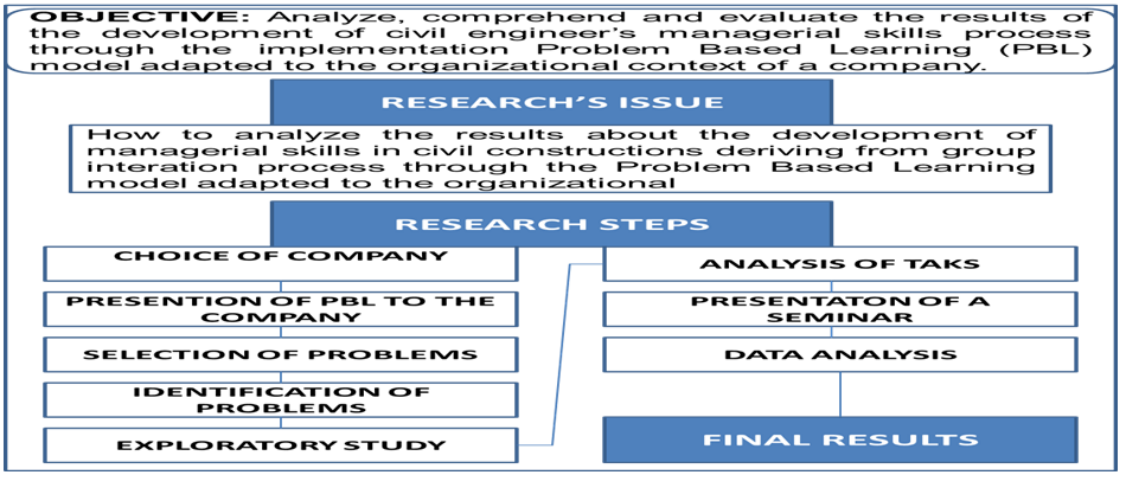

Figure 2. Research outline

Source: The Author(s) own.

After the implementation period of the PBL method in company, the data treatment was performed. This analysis sought to fundament itself in the researcher's observations during the meetings, considering learning aspects and organizational management according to the reports from the engineers.

The data analysis process began with the reading of the meeting notes. Periods from those notes, interviews with members and documents from company such as organogram, procedures and indicators were used in order to intersect the evidences. The group meeting story was told in a sequential and chronological way, presenting factors that were considered important by the research with the objective of analyzing the organizational learning process, the development of the managerial ability and aspects of the company's organizational management.

In order to facilitate the data analysis, the following constructs were defined: analysis of the organizational context; analysis of the individual learning, analysis of the collective learning, analysis of the organizational learning; and analysis of the company's management system. These definitions were basedin the literature review and the source of evidences were the meeting notes, the interviews with directors, employees and the engineers (managers of the sites), the in loco observation, the researcher's personal notes and the analysis of company's internal documents.

The evidences were elaborated during the process of transcription the meetings and the reading of them, and aimed to identify expressions and words used by the engineers as they spoke in the meeting. This was important since it was an assistance to the researcher in the analysis of the interviews.

4. RESULTS ANALYSIS

Initially, the problems listed for each topic werelisted, which represented their priority of attention according to the company's interests. It was observed that a major part of the problems listed in all topics were related directly to the planning and control of the construction sites.

In order to identify the managerial abilities, the personal characteristics and specific work abilities were considered, as well as additional information collected in the interviews to engineers and their employees. The Fig. 3 presents the mean of the results for the engineers that managed the construction sites. It can be seen that the managers (ME) view their own expertise differently from the opinions of their team (OTHERS), which was more critical over the abilities of the engineers (Table 1).

It observes that the great divergences in the results are presented in the abilities Leadership, Teamwork, Decision Making, and Critical Analysis; hence they need more attention in their development process. Throughout the exploratory study through the researcher's in loco perception in the meetings, it was identified that engineers presented high technical capacity, however the difficulties in managing people were evident.

During the development of the cycles, the difficulties of implementing the PBL method in company were noticeable. The group was not able to break the resistance in bearing the responsibilities over the presented problems, which compromised the group's process of making an action in the learning process and, consequently, in the development of the managerial abilities.

Brazilian Journal of Operations & Production Management
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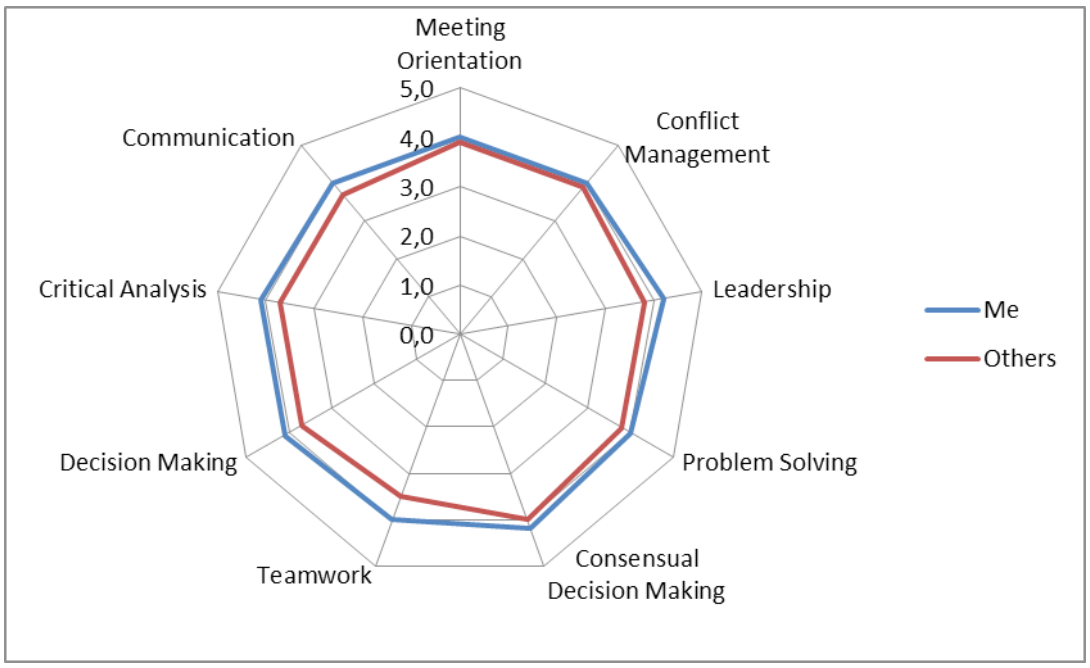

Figure 3. Chart of evaluation of the management abilities (mean)

Source: The Author(s) own.

Table 1. Evaluation of the management abilities (mean)

Abilities	Me	Others
Meeting Orientation	4,0	3,9
Conflict Management	4,0	3,9
Leadership	4,2	3,8
Problem Solving	4,0	3,8
Consensual Decision Making	4,2	4,0
Teamwork	4,0	3,5
Decision Making	4,1	3,7
Critical Analysis	4,1	3,7
Communication	4,0	3,7

Source: The Author(s) own.

4.1. Cycle #1 – Construction Sites Planning and Control

In this cycle, six meetings were executed weekly. At first, current problems were discussed in the construction sites and the possible solutions for them. In the first meeting, nine engineers participated and the group's contract was defined, in which was stated the meeting rules, absence tolerance, the commitment and confidentiality of the information.

Later, the listed problems related to the planning process were approached by questions made to the engineers about their reasons of those problems.

The engineers spoke about the lack of meeting with the sites' administration in order to define the execution strategies of the services. The researcher observed that only four engineers presented a more active attitude as he expressed his understanding and opinion about the topic discussed. According to the answers, the research asked for a flowchart of the planning system for the next meeting, aiming to identify who are the people involved and the components of this process in the company. Thus, the meeting ended with the responsibilities set for each one for the next session and the definitions of data, place, and time of it. It was also decided that a reference term about planning would be sent to the engineers so they could read it and assist them as a theoretical basis about this topic.

In the second meeting, nine engineers participated and it began by presenting the flowchart of the company's main current planning stages. At this moment, the researcher

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could identify and analyze all the stages and members involved in the planning process and he asked to the engineers: "In your opinion, what are the relevant indicators in a planning system?"; "Why do you think the planning is not going well?"

In a general way, the engineers alleged they believe the planning should be presented in a more objective manner.

"[...] Some tools that don't increase value to the process must be eliminated from the planning [...] there is a large variety of indicators today that has no use for many services [...]." (Engineer 1).

It was identified certain discomfort by the engineers on the tools used in the planning process. Most of the did not know how to transform the indicators into relevant information for a better management.

Next, the researcher asked for whom had read the reference term about planning that was provided in the first meeting.

"[...] I didn't find the time to do the reading" (Engineer 1).

"[...] I started reading it, but it's large, it has many pages [...]." (Engineer 3).

"[...] The term should be more objective, it's too 'academic'." (Engineer 7).

At this moment, it was clear that the engineers were still not familiar with the PBL implementation methodology. The conference ended with the definition of time, date and place of the next session as well as the topics that would be discussed. It was also decided that the reference term would be presented by the group's coordinator.

The third meeting was attended by only five engineers, i.e. only 50% of all group members, which showed certain disinterest/resistance in the PBL program. The conference began with the presentation of the reference term by the group's coordinator, who discussed concepts, definitions and tools for long term (strategic level), medium term (tactical level) and short term (operational level) planning.

At the end of the presentation, the coordinator asked the group how to introduce the reference term into the current flowchart of the company. Then, it was initiated a discussion about the relevant tools and indicators for the company's planning process. Some practices were cited such as service order programming (SO), Service Execution Planning (SEP), evaluation indicators of constructors and the introduction of the commitment meeting practice.

This meeting ended by defining the date, time and place of the next session and the group took the responsibility of search and bring schedule models to be used in the commitment meeting practice.

The fourth meeting was attended by eight engineers. The group coordinator initiated this session by asking why planning is important and if the group was in the percentage categories of engineers that believe or do not believe in planning.

"[...] It is important to give us a horizon [...] without planning, we would not be able to know if we're late or not site's course." (Engineer 4).

Schedule models were also presented by the group and it was decided the creation of a procedure to attend the planning's needs expressed by each participant, in order to minimize the difficulties in following the company's current planning. The conference ended by defining the data, place and time of the next session as well as the member's deliberation for the next meeting. The researcher and the coordinator were in charge of sending a procedure model for planning and the group should search and define the better practices to be inserted in the procedure.

The fifth meeting was attended by nine engineers and aimed the elaboration of the planning procedure, with the participation of all members jointly. The coordinator began by asking if someone read the procedure sent and if there was any insertion/modification in it.

"[...] I did some observations and took notes, but I haven't modified anything. I brought it here so we can do it along our own procedure" (Engineer 1).

The meeting advanced with the process of elaboration of the procedure, in which the group members presented their suggestions and understandings about each item to be included, modified or excluded from the procedure. The researcher noticed that some engineers did not opine in the generation of the document. The procedure intended to establish the planning stages and the control of the construction site's physical advance. The meeting ended with the procedure written and formatted, however it was necessary to attach tools that would follow what was described in the procedure. This was a task to be presented in the next session. Each engineer was in charge of bringing tools that attended to the necessity of what was in the procedure.

Finally, the sixth meeting was attended by eight engineers. The group coordinator was absent, and then the meeting was conducted by the researcher. This session aimed to complete the planning procedure by attaching tools that would attend the defined guidelines. This meeting began with the group questioning about the advance of the program, its real objectives and where it would like to reach through its implementation in the company.

"[...] I confess that I didn't identify the company in the procedure we wrote in the last meeting" (Engineer 6).

Brazilian Journal of Operations & Production Management
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"[...] I think you must agree that we're already in the sixth meeting and still couldn't leave one point, the planning. [...] We need to see a goal that we still don't have today." (Engineer 1).

It was possible to notice that the group still had not understood the real meaning of the PBL program implementation. The company's high administration, when asked, would have informed that the objective would be the raise of the site's physical advance from 1.5% to 3% per month, which caused certain misunderstanding about what was being done related to objectives defined by the company's administration.

"[...] We are waiting for something that isn't coming. It starts to discourage, and frustrate, as we have no expectation of an immediate feedback." (Engineer 3).

"[...] If this objective was set in the first meeting, which was to increase the productivity, I think that the production/execution item would never be sixth in priority. Certainly, it would have to be among the first three. [...]." (Engineer 1).

The meeting finished with the definition of a new set of topics to be analyzed, which were: Projects, HR & Supplies, Production/Execution, Costs and safety. It was defined that planning was a topic related to all the others, then, the next meeting would discuss about Projects. The procedure that was being elaborated about planning was not completed.

5. CONCLUSION

It was observed that, in practice, the technical abilities assumed a secondary position as regards the management of construction sites' functions, which go through the financial control of the materials supply, mobilization and demobilization of work force and the accompaniment of the release of resources with the financial agent, which reinforces the role of the engineer-manager of construction sites as not a planner, centralizing the control and the seek for results in a short-term period.

The group presented issues in acting towards to the problems. Those issues were always in other sectors of the company. The managers had a duty to admit their responsibilities for the problems (afraid of showing weaknesses), what strained the decision making and, consequently, compromised the development process of the managerial skills and the group learning process. They had difficulties in evolving the self-knowledge, reflecting on their actions and experience.

The analysis of the research's results and the company's organizational aspects identified that the managerial activities are affected since managers should worry about the process of solving the problems, and not the results. They must see the problem as a part of the solution. It can be noticed that the PBL method increased the abilities regarding the Teamwork, Leadership, Communication, Problem Solving, Conflict Management, information dissemination and systemic thought.

The company must create an environment that enables the exchange of information among its sectors, aiming the engagement of the people involved. It is also necessary to be certified that every member is aware about the purpose of their work and how it contributes to the organization to achieve their goals. Recognize and appreciate the work performed by the collaborators is also valid. It is highlighted that clear feedbacks provide the development of a good work, however to do this, people need clear and in time information. It is not necessary only to evaluate the behavior or the results is necessary, but also to make people notice their importance to the company's success.

Some organizational problems related to the managerial activities were identified such as: the lack of standardization in the management process, flaws in the information system (Construction Site x HR x Supplies), lack of organizational memory and absence of a clearer organizational policy, which raises difficulties in the decision making process of the engineers in accordance to the company's goals.

Regarding to the model, it is important to state that the discussed problem has to be aligned to the company's objectives and to the interests of the group (collective); preferably real and happening at the moment (related to the daily routine); and associated to the managerial process; relevant to the professional exercise. In addition, the decision about the set of actions to be performed for the solution and implementation must be the responsibility of the production manager; and also consider the human, social and technical aspects. Then, the problem stimulates the individual, group and organizational learning. It is necessary that all group members understand the need of changes and improvements.

The information system optimization (systemic thought), the generation of an organizational memory and the qualification of engineers to better use of the planning system correspond to significant and primary improvements to the company.

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