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ORGANIZATIONAL MODELING IN THE MANAGEMENT OF PUBLIC WORKS CONTRACTS: A CASE STUDY AT THE FEDERAL UNIVERSITY OF CEARÁ

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ABSTRACT

There are many problems in the public administration in the contracting of works and services, such as: failure to comply with the object of the contract, delays in the delivery of the product and executed budgets higher than the estimates. The research aims to present an organizational model for the management of public works contracts, applied at the Federal University of Ceará. The article presents as a result the organizational submodels: business objectives and rules model, process model, actors' model, and resources developed under the light of the Enterprise Knowledge Development (EKD) methodology. The systemic view, provided by the submodels, allows the improvement of the processes and the clear identification on the management of contracts, indicating the opportunities of improvements. The study allows establishing strategies that help in the identification of the obstacles in the public contracting.

Keywords: Contracting of Works; EKD Methodology; Organizational Knowledge.

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1. INTRODUCTION

Public institutions, on many occasions, rely on hiring firms to perform works and services, and selecting a suitable contractor is one of the most critical factors for the success of the project. From the survey of the contracting needs, from the selection process of the contracted company, to the conclusion of the object of the contract, there is a contract management. In this way, contract management represents a series of procedures and activities with the purpose of transferring a good or service from one part to another, requiring, for its perfect execution, constant monitoring and evaluation.

Hiring in the public administration consists of a complex process that must follow the legal precepts, with the function of guaranteeing publicity, equality and isonomy to those interested in contracting with the public power (Freitas et Maldonado, 2013). Nevertheless, success in hiring depends on meeting a number of requirements, such as completion of each project within a predefined time frame, adequate cost and quality in the execution of the service and work. Although these three factors play important roles in construction projects, attention must be paid to the specific public needs, since the product generated must attend to society.

In the organizational context, companies increasingly adopt process mapping techniques to improve the flow of information and aspects related to the functional systems of the production chain. This allows the organizational knowledge that must be adapted to the constant changes caused by a dynamic and competitive market. As a result, an organization, whether public or private, needs to deepen knowledge about the business environment in which it is embedded. The organizational model deals with the representation of the structure, activities, processes, information, resources, objectives, and commercial and governmental restrictions (Pádua et al., 2004).

One of the techniques of organizational modeling is the Enterprise Knowledge Development (EKD) methodology, which, when addressed to the organization's objectives and formulated with simple language, improves communication between employees and an understanding of the needs of the organization. This methodology seeks to understand and document an organization from the development of six interdependent submodels (Gomes et al., 2017).

The improvement of processes or innovation depends on the identification of the most important processes as well as the performance indicators that are influenced when specific processes are executed (Han et al., 2009). As a result, the proposal of this work is to apply the EKD methodology to model the management of contracts for building works in the Pici Campus at the Federal University of Ceará (UFC). The main obstacles of the processes in the contracting of public works were investigated by means of the representation of the following submodels: objectives and business rules, processes, actors and resources, as well as to point the opportunities of improvements.

The work begins with the theoretical basis on bidding for the contracting of public works, and then the main concepts of the EKD methodology are presented. The third part of the article reports the methodology of the research and, finally, the submodels in the results and discussions are exposed. The article concludes with the main conclusions and recommendations of the research.

2. THEORETICAL REFERENCE

Contracting of public works

Public procurement should be directed to service providers that meet certain qualification criteria. The verification of the fulfillment of these criteria must be done individually for each process, and it is associated with the need to present the corresponding documents. The quality of execution of the engineering projects is intrinsically related to the contract elaborated. In each project, there must be an appropriate contract in place; otherwise, it may have negative consequences for all parties involved. Execution failures result in schedule delays, overspending, and performance and security issues.

Law No. 8,666 establishes that, except for the cases specified in the legislation, works must be contracted through the public bidding process, which guarantees equal conditions to all competitors, with clauses that establish payment obligations, maintaining the effective conditions of the proposal in accordance with the law. The contract notice will only allow the technical and economic qualification requirements indispensable to guarantee the fulfillment of these obligations. What must be fulfilled is the principle of advertising to guarantee the search for the best proposal in a bidding dispute (Torres, 2018).

The bidding process is divided into two phases: internal and external (Altounian, 2010). The first one begins with the request and opening of the process by the interested sector until the publication of the public notice, that is, the part developed by the administration itself. In this phase, there is the development of the basic project and preparation of the notice. When the bidding process is closed, the contract phase, in which the project will be executed, begins.

All public works must be bided from the complete project (basic and/or executive), with all its parts, drawings, speci-

Electronic Journal of Management & System
Volume 11, Number 4, 2018, pp. 509-518
DOI: 10.20985/1980-5160.2018.v13n4.1435

fications and other complements, approved by the competent authority. These documents should be made available to all those interested in participating in the bidding process. (Oliveira, 2010).

The Court of Auditors of the Union (*Tribunal de Contas da União* – TCU, 2014) notes that the internal phase of the procedure, related to public bids, should follow a sequence of preparatory acts, as indicated in Figure 1. It is observed that all phases, prior to the bidding process, are contemplated in the hiring process, this sequence of procedures corresponds to the administration of the contracts. The success of the project (enterprise to be carried out) depends on the strict monitoring of the contracting entity, in order to guarantee all the fulfillment of the requirements established in the bidding notice. Once the bidding phase has been completed with the selection of the best proposal, the contracting stage starts by means of the signature of the administrative contract.

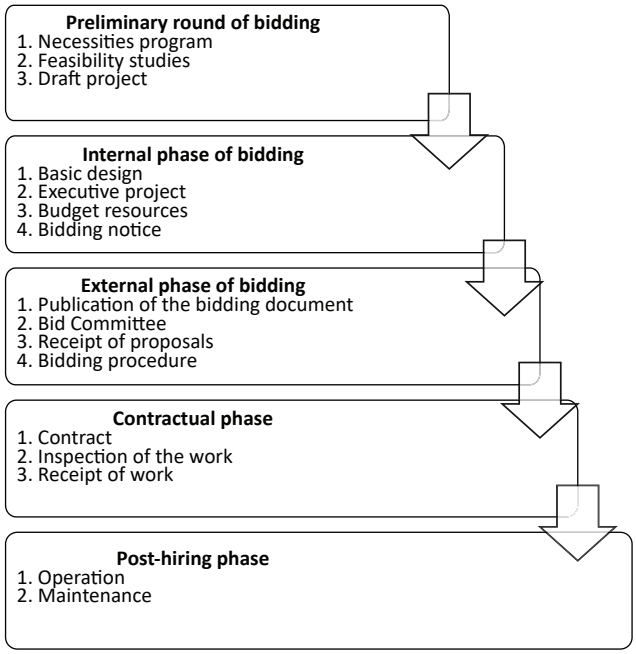

Figure 1. Flowchart of the process of contracting a public work
Source: Elaborated from TCU (2014).

The entire contract management process involves the participation of several actors, as well as requirements arising from the negotiation between the parties, the obligations that have been agreed upon and compliance with the conditions stipulated in the public notice. In contracting works and services it is important to establish a contracting policy directed to the interests and objectives of the contractor with the interests of the environment in which the project is involved, whether at the national or regional level (Limmer, 2013). Among the contract management studies, it is worth mentioning the analysis of the time estimate for public enterprises carried out in works tendered at the Federal University of Pará (Coutinho et al., 2012).

In general, it is observed that there is a need for tools that support the understanding of the processes of an organization. This situation is more evident when it comes to public administration, since it involves a large number of actors who need greater agility in the processes of contracting works and services. It should be noted that this theme still needs to be explored and depends on new management techniques for the improvement of services and organizational development.

Enterprise Knowledge Development (EKD)

It is understood as a model (tools, methodologies, modeling languages, and models) needed to design or redesign an entire organization. An organizational model has the purpose of allowing a common vision in the form of drawings of the events of an organization to the main actors of the entity (Vernadat, 2006).

Organizational modeling is a technique that describes the different aspects of an enterprise, which can be an organization or part of it, or even an activity that one wishes to study or describe. In this sense, EKD is an organizational modeling methodology that allows analyzing, developing and documenting a business by clearly describing its objectives and processes (Bubenko et al., 2001). EKD modeling can help in understanding the current state of business knowledge in various industries, as well as establishing a vision for the future and becoming a prerequisite for process validation and decision support (Abele et al., 2013; Romero et Noran, 2015).

The EKD is geared towards change management and when developed by Nuncan et Rolland (2003) it became known as EKD-CMM (*Enterprise Knowledge Development – Charge Management Method*). The EKD-CMM includes four phases: in the first phase, the current state of the company is modeled ("as is" model); in the second phase, the necessary changes in the company are defined; in the third phase, the model of the future state (model "to be") is elaborated; in the fourth phase, the existing context is identified during the implementation of the change.

Therefore, EKD helps to analyze, understand, develop, and document an organization and its components; it also helps in the understanding of social, organizational, technical, legal, and economic aspects; it solves problems and develops knowledge. This methodology considers a number of interrelated submodels, each focusing on the particular aspect of the domain problem (Stirna et al., 2007). This methodology does not require the use of software for

Electronic Journal of Management & System
Volume 11, Number 4, 2018, pp. 509-518
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the development of modeling, which facilitates the understanding of the submodels. In addition, it is not necessary to have technical knowledge on the subject to understand the models, which allows the modeling process to be carried out using blank paper, pencil and eraser (Guerrini et al., 2014).

The EKD modeling has the function of sharing the resources and competencies of the organization to increase the gains in competitive criteria. It provides an analytical view of the organization and its components in general (Neves et Guerrini, 2010). The perceived quality of a model is defined as the level at which the model has the following characteristics: ease of generation and understanding, and completeness and precision (Kock et al., 2009). Bubenko et al. (2001) clarifies that the EKD methodology is formed by a set of six submodels, each one having as a reference certain aspect of the organization and are all interconnected. The description of these six submodels is in sequence:

a) Objective Model (MO, acronym in Portuguese)

   MO provides a description of what and when the organization wants to achieve or avoid. The objective is to show points such as: the path that the organization must follow, the priorities of the established objectives and the relationship of the objectives with the problems, the threats and the opportunities. This submodel describes the company's essential targets, while defining the reason for the components of the other models. There is a relationship between the objectives, the problems, the threats and the opportunities that must be in agreement with the strategic planning of the organization.

b) Business Rules Model (MRN, acronym in Portuguese)

   MRN is used to define and maintain business rules formulated according to the Objective Model. The rules can be understood as the operationalization or limit of the objectives. In addition, it is possible to narrow the traditional distance between the functional aspects of the systems and the organizational requirements, thus allowing complementing the specifications, pointing out strategies, alternatives, and objectives to be followed. This way of understanding the system domain makes the business actors understand what needs to be done to improve the quality of the system by reviewing current processes (Guerrini et al., 2014).

c) Concepts Model (MC, acronym in Portuguese)

   This submodel is used as a guide to definitions and concepts expressed in other models. As a result, it serves as a dictionary and in it the entities, the attributes and their relationships are represented. Its function is to define the MO expressions, such as the information content and the flow performed in the Business Process Model.

d) Business Process Model (MPN, acronym in Portuguese)

   MPN has the purpose of defining the organizational processes, how they interact and how information flows, as well as the way products generated are handled. A business process has information or admission inputs and produces information or output products. This submodel is similar to the traditional flowchart (Bubenko et al., 1998).

e) Model of Actors and Resources (MAR)

   In this type of submodel, the actors (employees) and the resources involved in the activity of the company are defined. It describes how different actors and resources relate to one another and how they relate to the components of the Objective Model and to components of the Business Process Model. MAR describes the existing or future business systems and helps clarifying who is or should be responsible for carrying out a process or task.

f) Model Requirements and Technical Components (MRCT, acronym in Portuguese)

   The MRCT is an initial attempt to define the entire structure and properties of the information system that will support business activities (Stirna et al., 2007). Attention in this submodel focuses on systems that support business objectives, processes and actors (Bubenko et al., 1998).

The six submodels of EKD, as defined, have an interrelationship represented by Figure 2. Each submodel represents a critical part of an organization. An integration between submodels is observed in order to capture all the elements of an organization and the interrelationship between them.

It is concluded that this methodology, through submodels, allows in a systematic and controlled way analyzing the organization. Consequently, the results of its application provide a clear vision in terms of how the organization works; the requirements and reasons for change; the alternatives that must be created to meet these requirements; and the criteria and arguments for developing these alternatives (Bubenko et al., 2001).

Electronic Journal of Management & System
Volume 11, Number 4, 2018, pp. 509-518
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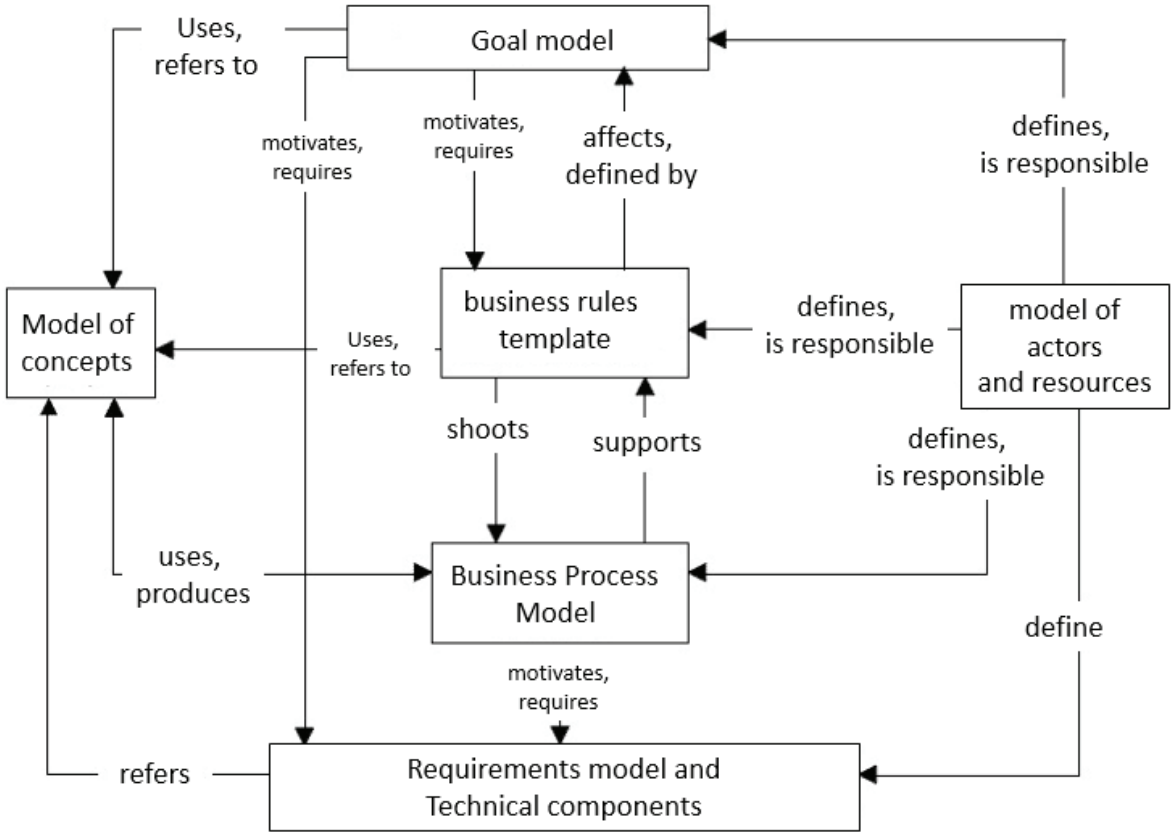

Figure 2. Representation of EKD submodels
Source: Elaborated from Bubenko *et al.* (2001).

3. METHOD

The research adopts a qualitative-exploratory approach. It is qualitative because it has a concern regarding interpreting the studied environment and obtaining information on the perspective of the individuals involved in the research context (Martins, 2012). The classification of exploratory research is given as it is intended to understand and familiarize oneself with the problem, through observations, questionnaires and interviews with people who have practical experiences with the researched problem (Gil, 2010).

The strategy of this research, in turn, is characterized as a case study, because the researcher has low involvement with the individuals and with the organization researched, in order to interact during the visits in which the interviews are carried out, to make observations and consult the necessary documents (Martins, 2012). Case study is an investigation directed to the observation of a real world phenomenon, according to the context in which it is found, that is, it approaches a differentiated situation, presenting several variables and sources of evidence (Yin, 2015). The case study has the purpose of analyzing one or more objects (cases) with the use of multiple data collection instruments (Nakano, 2012).

In the present study, an applied methodology was used, since the practical application of the knowledge of the EKD for the solution of problems in the management of civil construction works contracts was sought. This type of research is directed to the immediate application of knowledge in a circumstantial reality, emphasizing the development of theories (Gil, 2010).

The study was carried out within the scope of the Federal University of Ceará, consisting of seven campuses that include 17 academic units, 2 hospitals, 17 libraries and 8 canteens. In Fortaleza, the UFC occupies an area of 233 hectares, divided into three campuses. This extensive university infrastructure means that it is necessary an efficient management and control of works for the improvement, expansion and maintenance of the buildings of the University.

The case study was conducted at the Infrastructure and Environmental Management Superintendence (*Superintendência de Infraestrutura e Gestão Ambiental* – UFC-INFRA), which is responsible for managing and controlling activities related to projects, works, maintenance, as well as the implementation of environmental management actions. The UFC-INFRA is comprised of project and works coordina-

Electronic Journal of Management & System
Volume 11, Number 4, 2018, pp. 509-518
DOI: 10.20985/1980-5160.2018.v13n4.1435

tion, the general activities department, and prefectures of university campuses. The research activities were carried out at the Campus do Pici and were directed to the activities developed at the Coordination of Works and Projects (*Coordenadoria de Obras e Projetos* – COP). This unit is responsible for planning, coordinating, bidding and managing activities related to UFC infrastructure projects and works. The need for improvement in contract management is evident. In 2016, for example, COP found 36 works contracts in progress.

The methodological procedure consisted of four stages. The first stage of the research is the definition of the theme, which, in this case, is modeling contract management in civil construction using EKD, a methodology that has great potential to aid contract management. The second stage consists of a review of the literature followed by data collection in which semi-structured interviews were carried out in the Coordination of Works and Projects. After the interviews, the MO, MRN and MPN submodels were elaborated, shown in the results of this article. From the development of organizational modeling, improvements were suggested through the validation of modeling. This validation occurred through the presentation and consolidation of the submodels by the superintendence of works and projects of the UFC.

4. RESULTS AND DISCUSSIONS

Organizational modeling of contract management resulted in the proposed submodels: Objective Model along with the UFC-INFRA Business Model (Figure 3); Model of Actors and Resources (Figure 4); Business Process Model (Figure 5).

According to MO and MRN, the main objective is to improve the physical infrastructure of UFC campuses for institutional activities. This objective (Objective 1) seeks to guarantee the quality of teaching, research and extension activities at the Federal University of Ceará. The main rule (Rule 1) that supports this objective is to enforce the guidelines of the institution's Institutional Development Plan (IDP). This plan is the instrument that guides the pedagogical actions, organizational structure and academic activities that the UFC has set for the horizon every five years. Thus, the improvement of university infrastructure must be in accordance with the organizational development plan.

It is noted that Objective 1 is supported by three objectives that deal with the coordination of architectural and engineering projects (Objective 1.1), for the monitoring of the bidding process (Objective 1.2) and for contract management (Objective 1.3). It should be emphasized that, since the University is subject to the conditions inherent in public administration, the requirements of Law 8.666 (Rule 3) must be guaranteed in the hiring process (Objective 1.1.2 and Objective 1.2.1).

One of the main difficulties in the management of public works is the delay of the bidding process. In many situations, there may be a long time between the construction of the project (where the budget is drawn up) and the beginning of the work. This delay results in the devaluation of prices already at the beginning of the work (Problem 3). Another issue raised by the interviewees is the abandonment of the contract by the hired contractors (Problem 1). Thus, unfinished ventures are perceived on campus awaiting a new bidding process. Problem 2 refers to the process of designing the projects, on many occasions, architectural projects, facilities, and structure. In these, specifications are missing, hindering the execution of the enterprise.

Opportunity 1 is related to the public financial incentive for projects that allow the expansion of education, research or extension. In recent years, there has been a federal funding incentive allowing for a significant increase in University campuses (Opportunity 1). It is noticeable the expansion of works directed to attend new courses of higher education, the construction of laboratories for research, among others. In addition, opportunities for building expansion can be generated by establishing partnerships with public or private institutions that seek to encourage academic research (Opportunity 2).

The actors and resources needed to achieve the established objectives are represented in Figure 4. The MAR shows all those who participate in all the processes of the Coordination of Works of the Federal University of Ceará. In this illustration, it is possible to analyze the organizational and individual units that operate in the UFC project and contract management process. It is noted that, in order to guarantee Objective 1, the University depends on a specialized technical staff, such as engineers and architects who act as inspectors and designers, among other employees of the Superintendency. This representation also shows that the coordination of projects and works has two directors: the director of the division of works responsible for Objective 1.2 and the director of studies and projects, responsible for leading Objective 1.1. Figure 4 shows the organizational units external to the UFC. These are companies contracted through the bidding process for the execution of works (Organizational Unit 3) or for the elaboration of projects (Organizational Unit 4).

Once the MO and the MR were elaborated, the Business Processes (MPN) submodels were developed, according to the example of Figure 5. The developed MPN consists of the process of contracting works of low complexity and is linked to Objective 1. The MPN begins with the request of projects and works to the Pro-Rectory of Planning and Administration (PROPLAD). This procedure occurs from the evaluation

Electronic Journal of Management & System
Volume 11, Number 4, 2018, pp. 509-518
DOI: 10.20985/1980-5160.2018.v13n4.1435

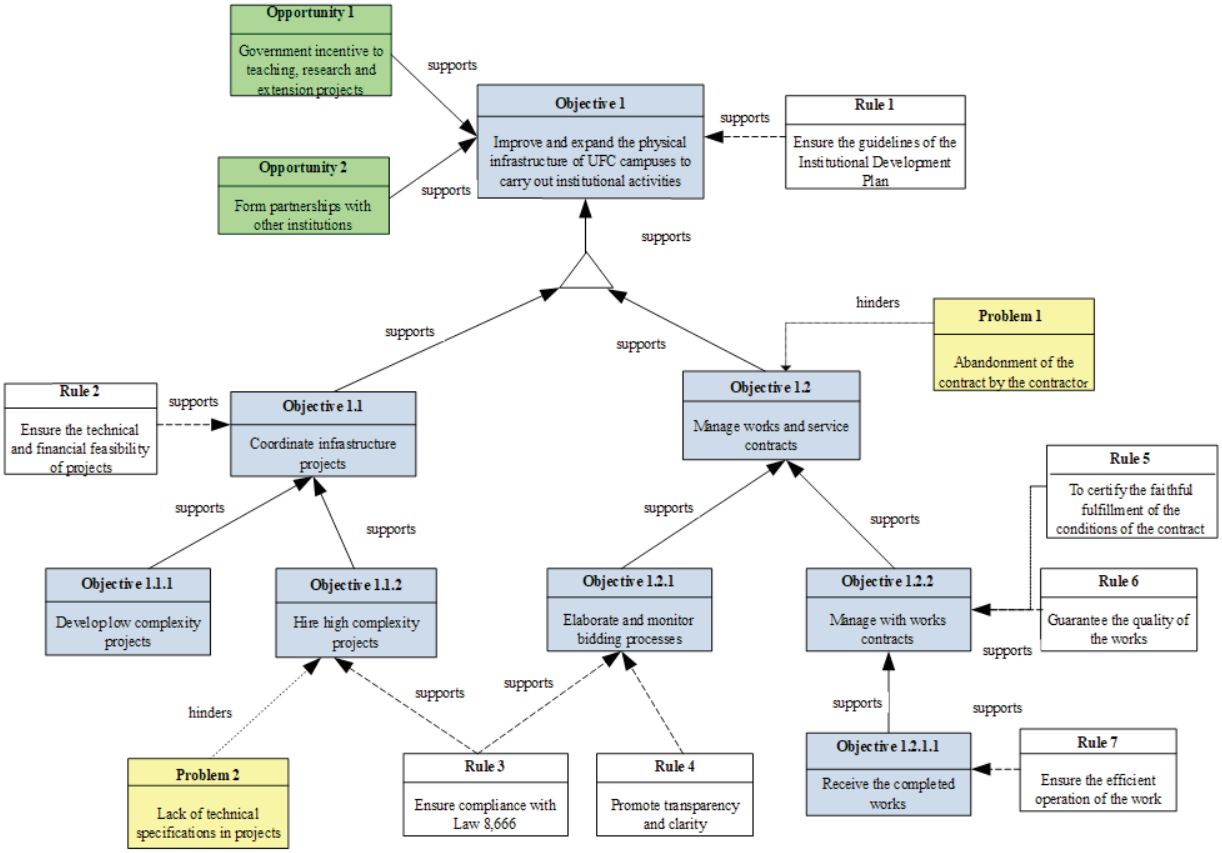

Figure 3. Business Objectives and Rules Submodel
Source: The authors themselves.

of the need for a work, followed by feasibility and priority setting of the demands, and, if approved, the Definitive Receipt Term of the Work (*Termo de Recebimento Definitivo da Obra* – TRDO) is delivered. PROPLAD receives the process from the academic units, which carry out the request through the necessities program, whose function is to detail the object and justification of the demand. In addition, the process must contain a letter of maximum authority of the requesting unit, stating to be aware of the demand.

After evaluating the necessity, feasibility and priority of the applications (Process 1), if the request is not approved, PROPLAD informs the applicant and file the documentation related to the request. In case the demand is considered viable, it is referred to UFC-INFRA. UFC-INFRA, in turn, analyzes the demand and directs the process to the Coordination of Projects and Works (*Coordenadoria de Projetos e Obras* – CPO), which verifies whether the request is feasible. If the claim is not considered viable, the request is filed for control and history.

For the beginning of the bidding process (Process 4), the objects must be properly characterized with precision (basic project). These processes should be based on previous studies demonstrating their technical and financial feasibility, the origin of the resources and the adequate deadlines for the execution of the works. In the process of qualification (Process 6), during the bidding phase, the economic-financial conditions, the fiscal legal regularity situation and the technical capacity of the companies to execute the bidding scope are determined.

In tendering processes, according to Law 8.666/93, there must be compliance with the constitutional principle of isonomy for the selection of the most advantageous proposal for the administration and promotion of sustainable national development (Rule 3). The forms of evaluation of the proposals can be by judgment of lower price, better technique or even by better technique and price.

In drafting the contracts, the clauses must contain a clear and objective language, both as regards the technical aspects of the services to be performed, as well as economic, financial and legal aspects. The duties and rights of the parties should be clearly established, especially as regards expenditure, quality, time and security (Rule 4). It is possible that, during the process, there will be the modification of the contract for the following reasons: need to change the basic project; need for changes to ensure better technical

Electronic Journal of Management & System
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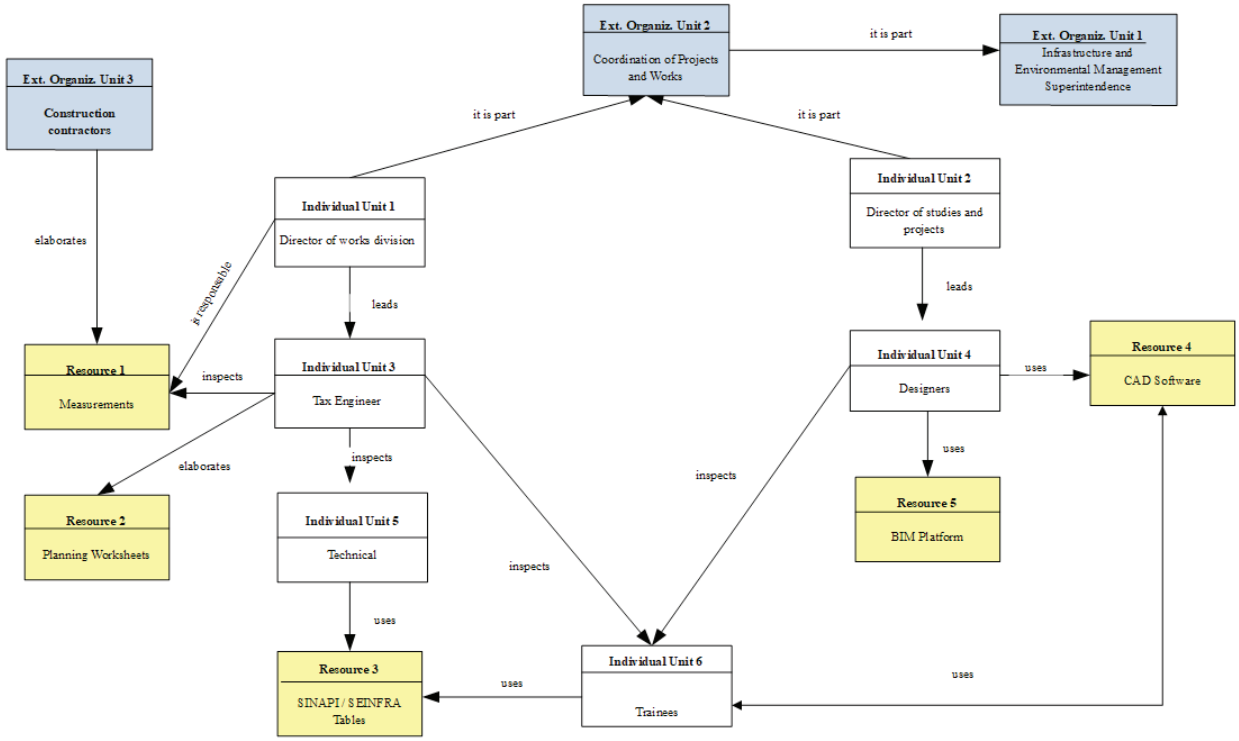

Figure 4. Actors and Resources Submodel

Source: The authors themselves.

SINAPI – Sistema Nacional de Pesquisa de Custos e Índices da Construção Civil (*National System of Research of Costs and Indices of the Civil Construction*); SEINFRA – Secretaria da Infraestrutura (*Infrastructure Secretariat*)

adequacy; change of technology; and quantitative changes (Problem 2). To this end, the Coordination of Works and Projects (Organizational Unit 2) shall promote the contractual amendment through an additive term. For the elaboration of the executive projects, these projects must contain a set of necessary and sufficient elements to the complete execution of the work.

Subsequently, the bidding of the work contemplates all elements of the object (projects, budget, memorials, and measurement standards) that must be well defined, and the bidding must clearly represent the intended aspects with the hiring, obeying Law 8,666/93.

After contracting and signing the service order (Sector Information 10), the contracted company (Organizational Unit 3), which will execute the work, must request the connection of basic services (water, electricity, etc.). The Works Division (*Divisão de Obras* – DO) issues a decree defining the contract auditor (Individual Unit 3) and starts supervising the execution of the work. All occurrences identified by the supervisor are recorded in the construction diary and communicated to the company by means of a notice, which has a period of five working days to present a defense and take action.

Regarding the measurement and request for payments (Process 11), the contractor must send the complete documentation (budget worksheet, photographic report, calculation reports) to the supervisor and there should be no criteria different from those stipulated by the contract that are not approved by the inspection 5).

After completion of the work, the company responsible sends an official letter to the supervisor (informing the completion of the works). The works division director (Individual Unit 1) appoints a commission that will be responsible for the visit to the work (Process 12). In case of pending work (Process 13), this commission will be responsible for preparing the report of pending, and the term of inspection. After making the adjustments, the commission prepares the final receipt and sends a letter to the accounting and finance department (*Departamento de Contabilidade e Finanças* – DCF) requesting the release of the contractual guarantee (Sector Information 13).

The organizational modeling allowed a systemic view of the entire work management of the UFC. Some suggestions for improvements were identified after the process analysis and are presented below.

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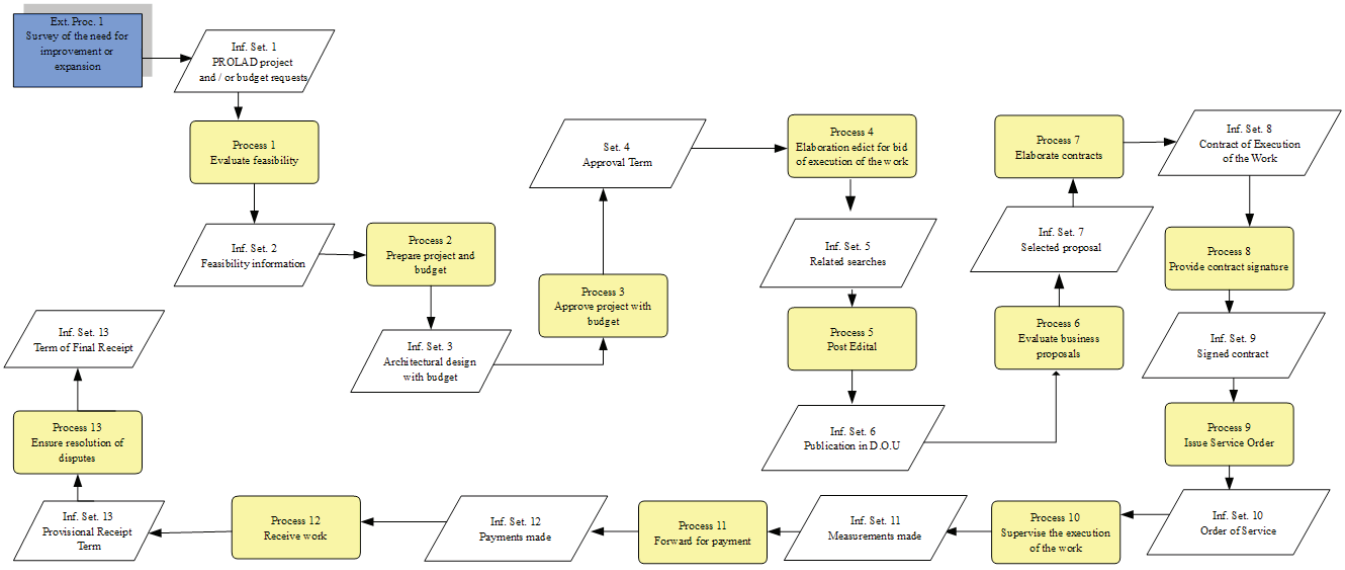

Figure 5. Process of contracting works

Source: The authors themselves.

D.O.U. - Official Diary of the Union - Sector Information 6.

Legend: Inf. Set – Sector Information; D. O. U: Official Diary of the Union (Diário Oficial da União, in Portuguese)

In the process of preparing projects and budgets, it is suggested to include checking with the applicant and/or user so that the final work can meet all the requirements.

It is suggested that all services are monitored with the help of information technology. The companies contracted should be concerned with the best use of resources and use techniques of planning and control of production to ensure compliance with the pre-established deadline.

As for the bidding process, attention must be paid to the inadequacy of prices in the physical and financial schedule of the proposals, which may cause the construction company to be disinterested in completing the work.

Another concern is the observation of proposals with very low values, as they may compromise the quality of the product. It is recommended to opt for the modality of technical bidding and price.

For the process of monitoring and supervising the execution of the work, the difficulty of using contractual additives, such as the increase of the initially planned quantities or technical specifications, should be highlighted in order to contemplate possible project changes.

5. CONCLUSIONS

Hiring public works is, by definition, complex and its success depends on many varied and interconnected parts. Contract managers must be prepared and processes must be well-defined for the purpose of meeting short deadlines, tight budgets and ensuring minimal quality. In this sense, the understanding of the interaction between the organizational units, the knowledge about the objectives that govern an organization and the analysis of the processes can be decisive factors for the improvement of the management of contracts in public institutions.

The contract management process in civil construction using process modeling is less widespread, requiring greater attention from the managers of institutions and researchers of the subject, in order to generate knowledge that can be added to the results acquired in this work. Organizational modeling has brought important contributions to the systemic view of project management. The systemic view for this area makes it possible to see the process of product development (public works) as a whole, rather than in partitioned stages (bidding, contract elaboration, and execution of the work) separated by each specialist sector.

Once the submodels were developed, through the EKD methodology, it was possible to analyze, understand and give more clarity and knowledge to those involved in the contracting of projects and works regarding rules, organizational processes and actors with their respective responsibilities for performing tasks. The modeling allowed establishing opportunities for improvement and to know the obstacles present in the process of contract management at the Federal University of Ceará.

Electronic Journal of Management & System
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It should be emphasized that in the article the main submodels developed were presented; however, for a better understanding of the interaction of all components offered by the methodology, it is recommended to use the Concepts Model to guarantee clarity in the terms and requirements related to the Laws governing the Public Administration.

REFERENCES

Abele, L.; Hansen, T.; Kleinsteuber, M. (2013), "A knowledge engineering methodology for resource monitoring in the industrial domain", IFAC Proceedings Volumes, Vol. 46, No. 9, pp. 307-312.

Altounian, C. S. (2010), Obras Públicas – Licitação, Contratação, Fiscalização e Utilização, 2 ed., Fórum, Belo Horizonte.

Bubenko, J.; Persson, A.; Stirna, J. (2001), User guide of the knowledge management approach using enterprise knowledge patterns, Stockholm: IST Programme Project Hypermedia and Pattern Based Knowledge Management for Smart Organizations.

Bubenko, J.; Stirna, J.; Brash, D. (1998), EKD user guide, Royal Institute of Technology, Stockholm.

Coutinho, L. S. A. L. et al. (2012), "Modelagem do tempo de execução de obras civis: estudo de caso na Universidade Federal do Pará", Ambiente Construído, Vol. 12, No. 1, pp. 243-256.

Freitas, M.; Maldonado, J. M. S. V. (2013), "O pregão eletrônico e as contratações dos serviços contínuos", Revista Administração Pública, Vol. 47, No. 5, pp. 1265-1281.

Gil, A. C. (2010), Como elaborar projetos de pesquisa, 5 ed., Atlas, São Paulo.

Gomes, L. P. C.; Marques, D. M. N.; Guerrini, F. M. (2017), "Programa seis sigma auto-organizado: modelo da situação atual e necessidades de mudanças", Gestão & Produção, Vol. 24, pp. 95-107.

Guerrini, F. M.; Escrivão Filho, E.; Cazarini, E. W.; Pádua, S. I. D. (2014), Modelagem da organização: uma visão integrada, Bookman, São Paulo.

Han, K. H.; Kang, J. G.; Song, M. (2009), "Two-stage process analysis using the process-based performance measurement framework and business process simulation", Expert Systems with Applications, Vol. 36, No. 3, pp. 7080-7086.

Kock, N.; Verville, J.; Danesh-Pajou, A.; DeLuca, D. (2009), "Communication flow orientation in business process modeling and its effect on redesign success: results from a field study", Decision Support Systems, Vol. 46, No. 2, pp. 562-575.

Limmer, C. V. (2013), Planejamento, orçamentação e controle de projetos e obras, LTC, Rio de Janeiro.

Martins, R. A. (2012), "Abordagens quantitativa e qualitativa", em: Metodologia de pesquisa em engenharia de produção e gestão de operações, Elsevier, Rio de Janeiro, pp. 47-63.

Nakano, N. D. (2012), "Métodos de pesquisa adotados na engenharia de produção e gestão de operações", em: Metodologia de pesquisa em engenharia de produção e gestão de operações, Elsevier, Rio de Janeiro, pp. 65-74.

Neves, F. V. F.; Guerrini, F. M. (2010), "Modelo de requisitos e componentes técnicos para a formação e gerência de redes de cooperação entre empresas da construção civil", Gestão & Produção, Vol. 17, No. 1, pp. 195-206.

Nuncan, S.; Rolland, C. A. (2003), "A multi-method for defining the organizational change", Information and Software Tecnology, Vol. 45, No. 2, pp. 61-82.

Oliveira, P. J. (2010), Obras Públicas – Tirando suas dúvidas, Fórum, Belo Horizonte.

Pádua, S. I. D.; Cazarini, E. W.; Inamusu, R. Y. (2004), "Modelagem organizacional: captura dos requisitos organizacionais no desenvolvimento do sistema de informação", Gestão & Produção, Vol. 11, No. 2, pp. 197-209.

Romero, D.; Noran, O. (2015), "Green Virtual Enterprises and their Breeding Environments: Engineering their Sustainability as Systems of Systems for the Circular Economy", IFAC-PapersOnLine, Vol. 48, No. 3, pp. 2258-2265.

Stirna, J.; Persson, A.; Sandkuhl, K. (2007), Participative Enterprise Modelling: Experiences and Recommendations, Trondheim, CAiSE.

Tribunal de Contas da União - TCU (2014), Obras públicas: recomendações básicas para a contratação e fiscalização de obras de edificações públicas, 4 ed., TCU, Brasília.

Torres, R. C. L. (2018), Leis de licitações públicas comentadas, 9 ed., Juspodivm, Rio de Janeiro.

Vernadat, F. B. (2006), Interoperable Enterprise Systems: architectures and methods, Saint-Etienne: Information Control Problems in Manufacturing (INCOM).

Yin, R. K. (2015), *Estudo de caso: planejamento e métodos,* Bookman, São Paulo.

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