The Adaptation and Application of an ICT-Supported Collaboration Model: A Case Study in a Public Sector Construction Project Department

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ABSTRACT

A construction project in the public sector has additional complexity due to the number of disciplines and stakeholders with individual interests and different ways of expressing and interpreting information. The approach of collaboration helps to define common goals and commitment between the parties, and the Information and Communication Technology (ICT) acts as the support structure for relationships due to its characteristics to support communication, graphical representations and project developments. This paper aims to apply a collaboration model supported by ICT in a building and infrastructure design process related to the public sector, listing the reasons why the parties collaborate and cooperate, the necessary structure and the ICT aspects that can provide support. The research method is exploratory in a case study fashion which consisted of a theoretical research to define the initial collaboration model framework adaptation and the field study to validate it. The case study was developed in a City Hall in the South of Brazil. The results present opportunities for reflection about the collaborative management of public projects and confirm that organizational and behavioral aspects are relevant to better understand the improvements generated by ICT use by public building design teams.

INTRODUCTION

This paper aims to explore how Information and Communication Technology (ICT) can support collaboration in construction project process. From a collaboration model introduced by Castilho Jr. (2005) and a case study in a City Hall building and infrastructure design department, it is assumed that an adapted model, based on the academic literature of Construction concepts, can bring clarity to the discussions and interpretations on ICT and collaboration issues during a public building design development process.

It is presented the applied research method, the collaboration model adaptation and the main results when relationships between departments of the municipality are organized and displayed in the structure of the proposed model.

RESEARCH METHOD

The data modeling represents elements, attributes, and significant relationships of the actual situation graphically. When the recreation of a context is based on qualitative data collected from perceptions, abstractions and analysis of a researcher, then the method could be the Case Modeling (Pozzobon and Freitas 1998).

The resulting model is a simplified and intelligible representation of the specific reality in order to make it more describable qualitatively. The model has structure to its own extension and generalization, becoming a suggestive and speculative instrument, i.e., it leads to predictions about the study field (Sayão 2001).

According to Oliveira et al. (2009) the procedure of building a model involves three distinct phases of successive actions: a proposed model (literature), the design of a field research work (here as a case study), and the completion of the field research work.

Reference model. The reference model for this study was the one proposed by Castilho Jr. (2005) that makes use of themes such as Strategic Management and Organizational Theory to analyze the interorganizational collaboration supported by ICT in three dimensions: strategic drivers that define why organizations must collaborate; structural constraints that define factors that enable the creation and maintenance of collaboration; and, ICT aspects to define how technology affects collaboration. Thus, the dimensions and their subdivisions in ‘macroconcepts’ form the reference model grouped in three levels according to their focus: efficiency, effectiveness and innovation (Figure 1).

Adapted model. The original collaborative model was adapted for this study based on a review for collaboration and ICT application in construction projects. The resulting review collected thirty eight references that were organized in three different tables that together represent the conceptual framework and theoretical basis for the model definition (Nascimento et al. 2013). The key concepts are grouped into three macroconcepts for each dimension of the model in the same way the reference model of Castilho Jr (2005) is presented.

Field Research. The field research was developed as a study case conducted in a city of the metropolitan area of Curitiba in the South of Brazil (São José dos Pinhais). The research focuses on the building design development process for construction and urban renovation projects demanded to the related department at that municipality. The studied department is responsible for the preparation and development of public building and urban designs and other details of construction projects for the city development. The process involves the building design and analysis of a construction

project, the required supporting documentation and the preparation of bidding documents.

The relevance of this department for the study of ICT-supported collaboration is justified by the restructuring completion of its internal management and the Building Information Modeling (BIM) deployment for building architectural design projects which occurred between the years 2010 and 2011. The restructuring sought to improve the project development productivity, reduce waste and increase collaboration among agents. It was analyzed the scenario before and after the event, the reasons for each change, the results and impressions according to the affected professionals, as well as the yearnings for future improvements. The constitution of the department, its internal processes and the restructuring process are presented in the previous work of Nascimento et al. (2012).

The studied design and project development process involves other agents in the context of the specific City Hall organization. The building design and construction projects could be demanded by at least three other departments of the municipality: the human and community development promotion, social welfare, and sport and recreation departments. They are responsible for the initial definition of needs and requirements conducting to new construction or renovation projects. Other analyzed agents are responsible for the investment and feasibility analysis as the mayor´s office, and several other departments as the urbanism, tax and incoming, purchasing and bidding, and material resources and procurement, as well as the construction and road works departments.

COLLABORATION DRIVERS

All departments believed that investment in collaboration should be variable according to the project - despite claiming the need for good relations existence throughout the term - and that the political importance of the project directly influences the level of cooperation. The concern not to lose the individuality was constant, even if the collaboration did not lead directly to the loss. All interviewed respondents were concerned to maintain power and autonomy of decision in their specialties and individual responsibilities.

As indicated in the model it was observed that the departments invest in collaboration to achieve efficiency issues of their individual activities with emphasis on improving coordination and information alignment. Although it was noted with the model a few opportunities are exploited to achieve complementarity and value creation collectively.

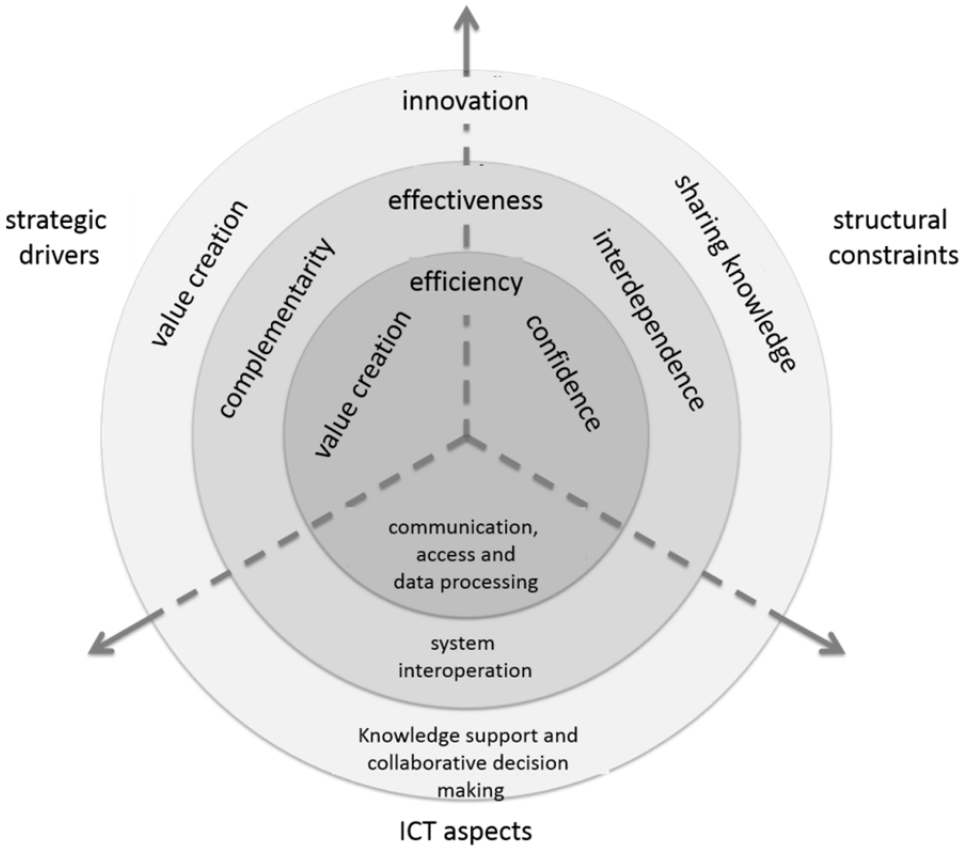


Figure 1. Model of interorganizational collaboration supported by ICT (Castilho Jr. 2005)

CONSTRAINTS FOR COLLABORATION

The municipality governance determined an interdependent environment that generated opportunities and structures for the development of collaborative relationships. Despite of this, the departments continued in believing the autonomy could only be achieved by working apart. Although the use of constraints in favor of the collectiveness, they kept the desire to be able to replicate the collaborative structure within their own department or to restrict the entry of partners.

Only within the relationship with the department responsible for the construction monitoring and control there were a separation of responsibilities and well defined steps, resulting in few structural constraints for collaboration. The work with these other public servants during the design phase was interdependent and had longer duration and shared responsibilities, which made the collaborative structures used for monitoring and decision making.

In addition, the internal divisions of the design department formed a proactive environment for collaboration. The promoted internal restructuring transformed the organization structure in a more favorable relationship environment, resulting in generation and continuous knowledge sharing and a joint and self-controlled way.

Therefore, the relations within and among the other requesting departments reached all the model dimensions regarding the determining factors for collaboration, while the confidence between the control and monitoring department permitted high level of trust. Moreover, being a specific relationship based on formal documents, the structures that used the collaboration were marked by informality.

ICT ASPECTS

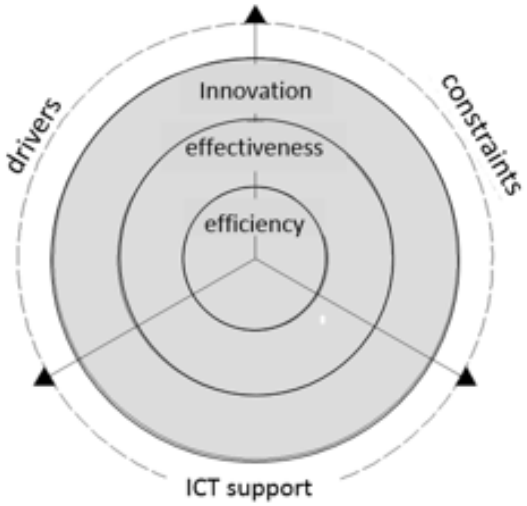
There were institutional and behavioral restrictions that prevented the seamless flow of information throughout the bidding project process. Institutional impediments arised because the technology adoption and handling capability of each department were different. The design department possessed computational capacity and superior skills related to the others.

Behavioral impediments existed due to work habits. The need to create their own copies of the documents and discuss the project using printed formats, resulted in information fragmentation and did not ensure complete understanding of those involved professionals. Therefore, the technological process capability was limited as a whole. It was below the potential induced by the studied department and prevented the maintenance of information integration.

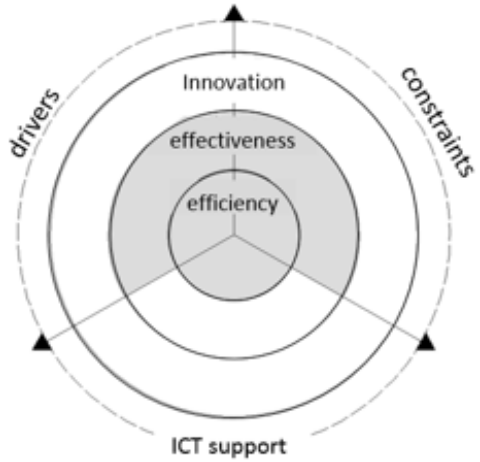
Gradually the formal communication was gaining over informality due to the email characteristic of history maintenance helping build relationships and have a security paper between departments. The personal and telephone communication had the importance of addressing urgent requests directly related to the fact that the agents felt greater confidence in personal contact.

ANALYSIS

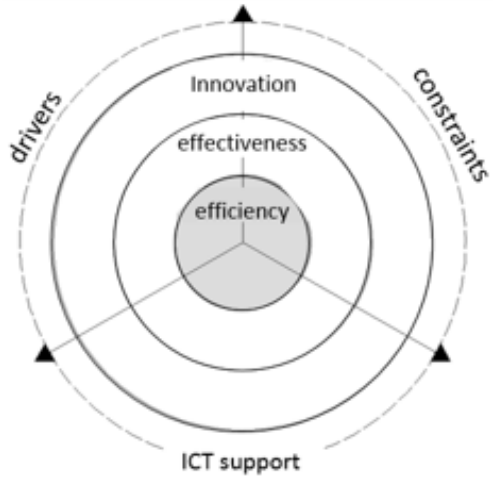
The collaborative relationship within the design department reached the level of innovation in the three macro concepts of the collaboration model (Figure 2). Relations between the internal divisions of the department were close and interdependent, guided by the intention to maximize and maintain the value generated by their activities. The internal agents used different collaborative structures such as trust and responsibility, which prevent the management and control processes to be completely regulated by contracts and regulations. The use of ICT was intense and the tools expertise generates innovation and knowledge sharing, which is clear from the establishment of standard models for design and dissemination of the information modeling (BIM) as a means of project value development.



building design department



building/infrastructure request*



construction monitoring and control

Figure 2. An illustrative representation of each dimension and each environment examined

The other departments that demand construction projects are motivated and interdependent to the design department. They seek effectiveness in the collaborative relationships. Confidence in long-term and interdependence are highlighted as determinants for collaboration between all of the departments. They are motivated by the sharing of resources (project information) and design and construction skills. However, the use of ICT to support the relationships is focused on communication, information flow and documents, because at the time of the research the other departments at the municipality lack of resources and skills to match the higher level of technology of the design department.

Finally, the collaboration between the construction control and monitoring staff and the design department is only concerned about issues facing the relationship efficiency. The interactions are specific and based on documents. These parties create only few opportunities for informal and interdependent characteristics that lead to collaborative relationship activities. Informal situations such as discussing projects between the design team and the construction works department have collaborative features, but not enough to change the context as a whole.

CONCLUSIONS

The research had as main objective the adaptation and application of an ICT-supported collaboration model for design and construction project process in a public agency (municipality). Therefore, with the detailed case study description presented, it is assumed that the overall objective was achieved. Taking into account the limits of a single developed case study, the specific goal of identifying the requirements and opportunities for collaboration among the department offices in the municipality government was also achieved.

The model classifies human characteristics raised in field research as motivation drivers (or motivators) and constraint factors. These two kinds of factors proved crucial to analyze the potential installed capacity, implementation of collaborative practices and agent desires to pursue an approach of this kind. The ICT-supported model is not vital for collaboration studies as analyzed. Although it addresses the tool capabilities according to the actual needs, ambitions and conditions set forth by the motivation drivers and constraint factors. In other words, the ICT-supported model tries to suggest features that should be meet in ICT environments according to needs and requirements.

The applied model could be used as an analysis tool. The promoted discussion that it supports serves to help decision making and strategic planning on intra- and inter-organizational collaboration in long or short term projects. In temporary projects such as construction enterprises, companies or professionals can use the discussion offered by the model to identify the impacts of taking on a project with different agents from a survey of their own motivators, constraints and how they can seek support in ICT.

The ICT-supported collaboration model can also be used for collaborative public management environments to clarify and expose motivators and constraints

and support to developing global strategic plans that meet particular goals of agents and sensitize them with commitment and collaboration with the collectiveness.

ACKNOWLEDGEMENTS

The authors thank to the City of São José dos Pinhais, specially the Director of the Building Design Department, Mr. Ayres Filho. It also mandatory to give thanks to Prof. Dr. Castilho Jr, who contributed with essential discussions regarding the application of the collaborative model.

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