An Integrated Collaboration Model of Public Services in Construction Supervision

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Abstract—Nowadays, construction project is an important factor in driving China’s economy. Construction supervision, however, is facing the problem of isolated processes, which may increase the workload and the risk of making mistakes. This phenomenon is often seen in public service network and is worth studying. To deal with this problem, an integrated collaboration model for public service network in construction supervision is needed. In this paper, the framework of the model and its three sub-models is introduced. Process model organizes isolated processes to treat them as a whole. Organization model helps with collaborative supervision in related agencies. Data model makes it possible to exchange information seamlessly. With the help of them, collaborative supervision can be realized and the supervision network will be more effective.

Keywords: public service network; collaborative supervision; supervision network

I. INTRODUCTION

The construction projects have a great influence on national economy and tend to play a more and more important part in the national investment. As a result, government supervision is a significant way to avoid potential risks of the projects such as delay or quality problem. Supervision network can be regarded as a specific kind of public service and may share some properties.

However, the current complicated situation in China’s supervision system leads to a complex supervision network, and the collaboration is not enough. Existing works failed to propose a model to present the complex supervision network, especially the collaboration between agencies. In this paper, an integrated collaboration model is presented. Based on the model, collaboration can be strengthened.

The rest of the paper is organized as follows. A brief review of study on construction supervision and virtual corporations will be given in Section II. Section III presents the current situation of government supervision of the construction projects, which is a specific example of public service and the motivation of our study. Section IV establishes the integrated collaboration model of supervision network. The frame and three detailed sub-models are also presented in this section. Section V proposes a case study to show how the model simplifies the situation. Section VI presents the conclusion and future work.

II. RELATED WORK

With its fatal important, the government supervision on these projects has been a focus of study for a long time. L.L. Xie et al. [1] reviewed the histories of quality supervision system of construction projects. After analyzing its actuality and existing problems, they studied quality office mechanism of construction projects and discussed the roles of the government in it. Z.Y. He et al. [2] analyzed the current situation and problems of the quality supervision in China, and then gave some advices on how to ensure the quality of the construction projects by supervision. X.Q. Wang et al. [3] analyzed the supervision system of public projects abroad in developed country and then pointed out some measures to develop the supervision system of the public projects in current situation. These studies mainly focus on some specific aspect of supervision such as quality, and they tend to concentrate on the mechanism part. There is a lack of technical solutions under current mechanism.

For the past several years, services science, which aims to study systematically service, is emerging and enjoying a bright future. As Chinese government makes efforts to change from economy-oriented to service-oriented, government supervision can be regarded as a kind of public service. Thus the problem can be studied in a new vision. J.D. Cao [4] studied the current situation of government information services from the aspect of service science. In addition, he pointed out the necessities and ways to integrate government information platform. But until now, there seems to be no studies on the government supervision from the aspect of service science.

Because of the desperate need for firms to remain competitive when facing market opportunities and environmental changes, a new organizational structure, the virtual organizational structure, is emerging now. The concept of virtual corporation was developed as an organizational theory by Preiss et al. [5] and was utilized mainly in the field of corporation. For Byrne [6], a virtual corporation is a temporary network of corporations that comes together quickly to deal with fast-changing environment. T.J. Strader et al. [7] presented an information infrastructure framework to manage electronic virtual organizations. They also identified the life cycle phases which virtual organizations go through. Lethbridge [8] put forward six patterns of virtual corporation from the aspect of organization communication form- the star alliance, market
alliance, values coalition, parallel alliance and so on. Chen et al. [9] discussed the construction and management of virtual corporations and proposed three organizational modes of virtual corporations.

III. MOTIVATION

Nowadays, the supervision of construction projects is facing some problems. Due to historical reasons, duties of government sectors vary but are often related. One may rely on the official documents of another sector to draw its conclusion. On the other hand, different sectors may focus on different aspects of supervision such as environment, quality and finance.

As a result, many government agencies will be involved in the whole process of the supervision of one single construction project. For example, a typical construction project will be under the supervision of Development and Reform Commission, Planning Commission, Environmental Protection Sector, Land Sector and so on. However, because of the gap between different government agencies, the interaction can be very hard. Information in different agencies can hardly be exchanged and project construction units must submit official documents to one government agency themselves after getting it from another, which makes the process less effective.

If choosing to ignore the interactions and collaboration among sectors, the network can be modeled using a bipartite graph, which just shows the relations between agencies and projects. Nevertheless, although there are few interactions currently, their influence should not be ignored. Taking the interactions and collaboration into consideration, the network can be modeled with a 2-level structure (Fig.1).

- In many cases, official documents are not exchanged directly between two related agencies, which is very inefficient.
- Agencies all need information to make decisions, but in current situations, they tend not share information with each other, which may increase the risk in supervision.

IV. SUPERVISION NETWORK MODEL

A. Framework

In order to deal with the problems mentioned before, an integrated collaboration model of construction supervision should be proposed. To better understand the model, a framework of modeling is set up first. To begin with, considering the fact that each project need to interact with different agencies, it’s essential to organize these agencies, so organization model is needed. To form the relations of these isolated agencies, process mode should be the key line. More often than not, the relationships are information or official documents that need to be exchanged in reality, so data model should also be in the framework.

B. Supervision Network Model

Based on the discussion above, the Supervision Network Model is established (Fig.2).

The first level is agency level. It contains all the sectors and agencies which may be involved, that is to say, they are potential members in the supervision task. The second level is the organization level. Each organization, whose members are selected from the first level, is responsible for the supervision of one project. One agency can be involved in several organizations at the same time. Also, the organization mode may vary, which will be further discussed in the organization model. The third level is the process level. A supervision task can be seen as a whole process containing several task-nodes, which are in the charge of members in the second level. In the process, each member takes its duty by task flow. To accomplish the task-node, they may need some information. It may come from either previous task-node or the construction unit of the project, thus forming data flow. The information in the data flow should follow some basic rules, as will be discussed in the data model.
C. Process Model

Now in China, many government sectors and agencies are responsible for the supervision of construction projects. However, they are isolated and the interactions among them are not enough. In order to strengthen the collaboration to make supervision more effective, there need to be a model which can organize the network.

As mentioned before, a supervision task can be seen as a whole process and processes in related agencies can be seen as its sub-process (Fig.3). Once the supervision task begins in an agency, the process begins. And it ends when the supervision is about to finish. In reality, some agencies rely on others or official documents they approved to make decision. And in the process, they are strictly sequentially related. The output of previous node serves as an input of the successor node. Although government agencies may tend to refuse to cooperate with others as it may decrease their authority, they can still be attracted for the potential benefit of sharing information.

D. Organization Model

Since all the related agencies are linked together by process model, organization model is needed to organize them. We can apply the concept of virtual corporations to our field, only to keep in mind the fact that the aim of a corporation is to make a profit effectively while government agencies may mainly focus on the quality of the supervision rather than the cost of it.

In total, there are 3 modes to choose from, star-like mode, parallel mode and federation mode. There is no denying that government agencies must follow the administrative orders from higher authorities. As a consequence, it can be an important factor of when choosing the proper form.

1) Star-like mode

In star-like mode, there is a key agency which plays the most part in the alliance. It sets rules and is responsible for the operation of the organization. The mode is fit for the situation where one of the agencies is superior to others or is selected as the one in charge by higher authority.

2) Parallel mode

In this mode, no leaders can be found in the virtual organization. All partners of it work equally. They negotiate when it comes to disagrees. The potential risk of this mode is the communication cost, so it’s fit for simple case where there are only a few members.

3) Federation mode

In federation mode, there is a federation of several agencies to take charge of the supervision, and others agencies are called peripheral members. The federation acts as the key agency in the star-like mode, while others follow its instructions. Members of the federation, however, work like the parallel mode. So it somewhat combined the characteristics of star-like mode and parallel mode, and is fit for complicated situations.

E. Data Model

Data model is needed for two reasons. First and foremost, management informationization level of construction projects develops rapidly with the fast development of technology, but the informationization level of supervision is simple. The data model helps to collect basic data. In addition, the aim of the government supervision is to understand the current state of the project so as to assess and evaluate the project. In order to accomplish this goal, all the agencies need some common information. With the help of data model, relevant agencies can reduce their work load through information sharing and then focus on the most important thing.

To make information orderly and easy to share, an index system is essential. The index system we proposed can be divided into three layers - the target layer, the criteria layer and index layer. The target layer is simple, i.e., collaborative supervision in construction projects. The criteria layer aims to cover projects in all fields. The indicator layer specifies indicators to correspond to the criteria layer. In reference to the documents of the National Development and Reform Commission, the criteria we presented are as follows: A. project approval; B. exploration & design; C. bid & contract management; D. investment control & financial management; E. schedule management; F. quality management; G. safety & environmental management; H. risk management class; I. acceptance & audit; J. post project evaluation (Fig.4).
V. CASE STUDY

In this section, we will take the review and approval for direct investment to infrastructure projects as an example. The process model and organization model are shown as follows, and the data model is omitted as it’s relatively simple.

1) Process model

In this situation, the project will be under the supervision of Development and Reform Commission of the City (DRCC), Planning Commission of the City (PCC), Environmental Protection Agency of the City (EPAC), Land Agency of the City (LAC) and Construction Commission of the City (CCC). However, these agencies are isolated. Although each has its own supervision process, yet the processes are disorganized. With the model we proposed, this situation can be easily modeled, shown in Fig.5.

![Process model diagram]

Figure 5. Process model of the case

2) Organization model

As the process model shows, the whole process is relatively simple and the Development and Reform Commission of the city plays an important part in it. In this circumstance, the star-like mode is the appropriate choice and Development and Reform Commission of the City can be the key member.

VI. CONCLUSION

In this paper, existing situation and problem of supervision network in China is introduced and analyzed first. To simplify the complexity and help agencies to cooperate, the Supervision Network Model is presented. It aims to unite isolated processes to realize government synergetic supervision of construction projects. Also, the concept of virtual corporation is applied to this field to organize the alliance. In addition, some optional organization modes are discussed. To exchange information seamlessly, the data model as well as the index system is presented. Finally, an example of the model is included.

However, there are some further researches which are not involved in this paper. For example, each agency usually has its own information system, so it is necessary to propose a technical solution to renew information periodically in spite of disparate systems and interfaces. And another aspect is the life cycle and management style of the supervision organization in the organization model.

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REFERENCES


