Analysis of the Factors Influencing the Complexity of PPP Project

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Abstract. By reading the domestic and international literature, this paper defines the project complexity as the number of project elements and the interaction between them, and divides it into task complexity, organization complexity and environmental complexity. Based on the studies, this paper analyzes the PPP project complexity from multi-element, uncertainties and dynamics, which is a highly integrated and complex project. Finally, this paper concludes that the more complex the project is, the more it should be managed from the overall goal, and put forward opinions and suggestions, which contribute to the complexity management of the PPP project in the future.

Introduction

In recent years, the continuous implementation of the “One Belt and One Road” policy has provided political guarantee for China’s “going global” and accelerated its urbanization. With such conditions, the development of China's infrastructure has been growing faster and faster. As an effective way for private capital to participate in infrastructure construction, PPP mode brings us great convenience as well as enormous challenges to our management work. It has the characteristics of long project period, many stakeholders, multi-level organization, dynamic project and strong uncertainty. These characteristics also aggravate the complexity of PPP projects to a certain extent, making the project difficult to manage. The complexity of PPP projects has brought unprecedented challenges to the management of construction projects. How to manage the complexity of PPP projects effectively has become a great challenge.

Literature Review

PMI defines project management as: “Project management is to use the knowledge, methods and instruments in all fields to carry out planning, cooperation and supervision so as to create more value for the full reutilization of resources so as to realize the specific objectives of the project.”[1] The complexity of the subject is still in continuous exploration and development. According to the statistics, the definition of complexity has been more than 45 so far[2], but most of them are defined from the perspective of task complexity. Gidado[3] pointed out that the complexity of PPP projects should be managed throughout the entire life cycle of the project. Lan-ping Zhou[4] concluded that the operation of PPP projects is also diversified, including O&M, MC, BOT, BOO, TOT, etc. and in the project planning phase, selecting what mode of operation is also worth considering. Di You[5] considered the PPP project as a complex system of social economy and technology. The nature of the PPP project management is to manage an open and complex system with multiple dimensions, multiple levels, multiple interfaces and multiple subsystems. From the project management point of view, Muxi Yu[6] consists that the complexity of the stakeholders is the key factor that affects the success or failure of the project.

Understanding Project Complexity

The complexity defined in this paper refers to the number of project elements and the interaction between them. The complexity of the project we usually refer to is task complexity. In fact the complexity of the project has three meanings: the complexity of the task and the complexity of the implementation of the task, which is called the project scope and stakeholders complexity and the
complexity of the environment where the project is located. What are the main factors that affect the complexity of PPP projects? In this paper, the multifactor including the number of elements and the interaction between them and the uncertainty which can’t be accurately predicted and the dynamics meaning the changing environment and goals over time are considered. The three factors are positively correlated and interacted as Figure 1 shows.

Analysis of PPP Project Complexity

Achieving project success is the ultimate goal of project management, and we study project complexity to manage project complexity better. The study of project complexity starts with the analysis of the project complexity. This paper introduce the complexity of PPP project from the three following sections: multifactor, uncertainty and dynamic.

Multifactor of PPP Project

a) Multi-layer of PPP projects

Throughout the life cycle, the PPP project goes through four stages: planning, financing, construction and operation, which can reach 30 years. The PPP project starts with the proposal of the project and ends with the project transferring to government or other companies. The decision-making stage is the planning stage for the implementation of the PPP project. It needs to plan the project proposal, feasibility analysis report and practical analysis of the PPP mode. The financing stage determines whether the company can obtain enough funds to make the project proceed. The construction stage is the key period of the entire PPP project. Its technical indicators, project quality, construction costs and key progress are all at this stage, which determines whether the project can operate successfully. Last but not the least, the operation stage refers to the project management before the project handed out. In each stage, it has its own internal level, shown in Figure 2.

Figure 1. Project complexity classification and influencing factors.

Figure 2. PPP project stages diagram.
b) Multi-factorality of PPP projects

A PPP project is a well-defined set of projects that consists of a number of mutually constraining and interrelated elements. The overall operation of a PPP project is not simply linked to the operation of a factor system. The benefit of project is not a simple summation of the effects of all elements of the system. There is a multi-dimensional overlap and synergy among various factor systems, and the results also depends on many external factors. For example, the project needs to be supported by various elements such as funds, related technologies, professionals and management organizations during the operation of the project, and these elements need to be effectively integrated to exert their value. Therefore, it is necessary to grasp the development trend and characteristics of the system as an integrated system. We can't simply judge the situations of the system from the performance of local or individual factors, and also consider the interactive effect of each factor system in the management so as to avoid the disadvantages.

c) Multi-stakeholder of PPP project

The clear division of labor in modern society, makes the business skills more and more single. A project implementation requires more and more business cooperators. From the project management point of view, the success or failure of the project is closely related to the complexity of the stakeholders. The typical characteristic of a PPP project is that there are many stakeholders with different motives for participating in the project and they usually pursue their own interests. For example, the purpose of a government party is for financing, performance and urban construction. The purpose of a developer is to provide a larger economy interest. In addition, it includes banks, guarantee parties, designers, builders, operators and so on. Different purposes mean different enthusiasm for participation in the PPP project. Managing the complexity of multi-stakeholder of PPP project scientifically and correctly is the key to the success of the project.

Uncertainty of PPP Project

a) Uncertainty in legal protection of PPP projects

At present, most of the normative documents issued by the ministries and commissions in the country are principled guiding documents, and no legislative documents on the national level have been issued specifically on the PPP model. Because of the lack of PPP laws and regulations at the national level, only local or industrial management methods or regulations, the legal effect is very low. Lacking of overall and systematic, government and social capital cooperation construction can’t be legally established a clear and effective contractual relationship, which also affects the investment confidence of social capital.

b) Uncertainty in revenue estimates of PPP project

The problems in project revenue calculation are mainly reflected in three aspects. First, the advisory body is more casual in its estimation, and it is simply estimated that it has not been able to obtain and refer to the historical data of the same kind in the same region. Second, in the actual calculation of PPP project discount rate selection criteria vary, the choice of different discount rates, the calculation results will affect the size of the project government subsidies directly. Third, the current tax policy for the PPP project has not been issued, the project tax policy is unclear, and the project revenue calculation results are uncertain. At present, most projects use the current tax rate as the base measure. In the future, if the tax rate is set at a high level or low level, it will be unreasonable for the government to undertake and the various projects are not unified.

c) Uncertainty in power and responsibility system of PPP project

From the existing PPP project, it is found that social capital is often in a disadvantaged position, and interests can’t be guaranteed after disputes have taken place. This is also the most considered place for social capital. In general, risk is equal to yield, while pursuing its interests also means taking risks relative to interests. Interests of government departments are mainly reflected in the efficiency of public goods and services, while the interests of the private sector are mainly reflected in the economic interests. Different interest demands make the diversity of participants' goals unfavorable to the implementation of PPP. Therefore, it is necessary to properly formulate effective risk allocation
plan to standardize and coordinate their behaviors in risk sharing and safeguard the interests of all parties.

In the PPP model, the diversity of the investment structure and the diversity of cooperation between the government and the social capital lead to different combinations of each individual PPP project. There is no fixed pattern to follow and each PPP project is a new beginning. Such features led to the higher uncertainty than general project.

**Dynamic of PPP Project**

The PPP project presents dynamic characteristics over time. The characteristics of the system fluctuation in the PPP project are mainly reflected in the dynamics and changes of project organization, project management and project control as follows.

a) **PPP project organization dynamic**

Organization dynamics of the PPP project mainly reflects that the types of stakeholders are diverse in different stages of the project and their roles and forms of interest also show variability. At the same time, the PPP project organization at different stages has its own characteristics. Therefore, it is required that the project manager should respond to the continuously changes of the project timely and adopt dynamic project management and control measures according to the specific situations.

b) **PPP project management dynamics**

Under the influence of various factors, the PPP project exchanges materials and information with the surrounding environment continuously, making the development and implementation of the PPP project diversified and complicated. With the development of society and economy and the changes of national policies, the nature of PPP project may be transformed. For example, for highway projects, there is a certain risk of greater profitability in the early stage. However, with the gradual improvement of the profitability of highway tolls, the nature of the project is changed from the original quasi-operation to pure operation. At this time, profits risk is no longer important. On the contrary, when the nature of the project is changed from pure operating or quasi-operating to non-operating, the risk of profit comes once again. Therefore, in the PPP project, the nature of the project will be constantly changing, and the management objectives will also change with the project dynamics.

c) **PPP project controlling dynamics**

PPP project as a special type of project, the control of the target is also very important. In order to obtain return on investment, social investors will control their costs and adopt advanced technologies, scientific management mechanisms and management methods to achieve high production efficiency and business performance. The triangular of project management: quality-cost-progress are the objectives of project management control which must be taken into account, but these three factors are often mutually constrained. The project participants implement the target program and carry out dynamic management and empirical evaluation of the project timely and outputs feedback on the problems occurred in the implementation and management process. Through the adjustment timely and effectively, a new program is formed and then submitted for implementation, making sure that PPP projects are implemented within the expected target.

Three factors above have a great impact on the PPP project complexity, and the multi-element is the fundamental factor of project complexity. Uncertainty and dynamic are the key factors of project complexity, and they are interacted, making PPP project become a highly integrated and complex project.

**Discussion and Conclusion**

Without specific management, it makes no sense to study the complexity separately. The study of project complexity, after all, is to manage the complexity better and make the project more successful. PPP project is a highly integrated and complex project, which mainly manifests itself in the fact that the life cycle is getting longer and longer, and the project plan is getting harder and harder, and the
resource is more and more consumed, and the coordination of project stakeholders becomes more and more difficult. The cost of supervision and control is getting higher and higher, and the construction of the project system is getting more complicated. From a management point of view, the more complex the project is, the more it should be started from the overall goal of the project and prevent it from affecting the overall goal of the project because of unreasonable decomposition. Firstly, develop awareness of the complexity of PPP projects. We need to make innovations in developing methods and technical tools, giving full play to advantages and disadvantages, improving unfavorable factors, and preventing project risk factors in advance. Secondly, focus on process management. As the project progresses, managers should keep track of project dynamics, and keep abreast of the importance of influencing factors, and reduce the complexity of the project by adjusting and allocating limited resources reasonably. Finally, we will learn from other project experiences and lessons as a key file to prevent risks and manage the PPP project.

The advent of the PPP model has played a catalytic role in the development of social economy and engineering construction. At the same time, as the complexity of the project has increased, the number of stakeholders has increased, and the interaction between the project and the environment has been enhanced, and the project has become more prosperous Connotation and characteristics. Based on the study of the concept and classification of project complexity, this paper focuses on the analysis of the factors that affect the complexity of PPP projects, and puts forward the methods and measures to manage the complexity. However, there are limitations in this paper. The main one is that it analyzed the complexity of the project non-quantitatively, because the complexity of the project is a highly integrated emergent system of factors such as multi-element, uncertainty and dynamism, and there is no method to quantify project complexity accurately so far, which may be the main area of complexity or even project management in the further studies.

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References


