

Analytical Framework for Developing the Management System of PPP

Partnership Value

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Abstract

Decision-making behaviors of public and private sectors are the critical factors to the success of PPP projects. Viewed through decision theory, partnerships between public and private sectors are the main factor influencing this decision-making behavior, which constitutes a valuable asset-partnership value. Hence, studying the management system of PPP partnership value is beneficial for increasing the value of PPP projects. This study develops an analytical framework for managing PPP partnership value. First, this study reviews PPP partnerships, partnership value, measurement and management of partnership value. Then, three core components that establish the framework are discussed in detail, including the mechanism, measurement and management of PPP partnerships value. This study introduces a new analysis and management framework of PPP projects based on value, which is helpful for achieving the management of PPP projects by measuring and managing the partnership between the public and private sectors.

Keywords

PPP, management system, partnership value, value creation, SNA, Agent

1. Introduction

Value creation (VC) is the key standard to the establishment of relationships among project participants (Austin, 2010). Previous research suggests that the evaluation criteria for executing public private partnership (PPP) projects is whether this project is able to achieve value for money (VFM) (Clifton & Duffield, 2006), which is a decision-making method based on risk-sharing. However, in practice, even PPP projects that pass VFM are often renegotiated or terminated ahead during execution, resulting in wasted resources and reduced management efficiency. Consequently, the value of PPP projects is damaged. For example, due to excessive commercialization of Beijing National Stadium PPP Project, the operating rights were revoked by Beijing Municipal Government. That means the partnership between the public and private parties is terminated ahead of time (Liang et al., 2011). Other more examples are listed in Table 1. These failed examples highlight the impact of PPP project participants' behaviors on partnership stability and project success, ultimately leading to fluctuations in PPP project value. Therefore, special attention should be given to the impact of decision-making behaviors of public and private sectors on VC.

According to the decision theory, the factor of "Value" and "Fact" determine decision-making behaviors of interest subject (Simon, 2013). When "Fact" is unable to change, managing "Value" is a way to adjust cooperators' decision-making behaviors. In PPP projects, the public party and private party build a close partnership on account of "key resources" (e.g., capital, technology and management ability). Such a partnership is a vital factor influencing "Value." On the one hand, the existence of the partnership increases the capital value and social benefits through complementary of resources, so as to gain the value growth of the PPP project. On the other hand, asymmetric information of participants would be reduced through building the same goals, which can cut down the governance cost of the PPP project (Rangan et al., 2006). The partnership between the public sector and private sector is a kind of social capital,

and the value derived from it is called partnership value (PV), which can achieve the VC of the PPP project through value growth and cost reduction. Therefore, in the process of PPP project, PV is the foundation of behavioral decision-making, which has an important influence on the VC of PPP. As a result, studying the management system of PPP PV is beneficial to manage the decision-making behaviors of PPP public sector and private sector, so as to manage the VC of PPP project.

Table 1. Examples of PPP project value termination and the reasons behind it

Project	Reasons for value termination	Country of origin	Reference
Beijing National Stadium	Excessive commercialization of the private firm	China	Chinyere (2013)
Kuala Lumpur LRT Project	Bankruptcy of the private firm	Malaysia	Rahman et al. (2014)
Jakarta Outer Ring Road	Concession cancelled, and project nationalization by the public sector	Indonesia	Soomro and Zhang (2013)
The Amsterdam South Axis Railway Station	Lack of transparency	Netherlands	Klijn and Teisman (2003)
Mumbai Metro Railway project	Cost Overrun, and lower-than-expected traffic growth	India	Kudtarkar (2020)

This paper commences with a comprehensive literature review on PPP partnerships, spanning from defining PPP partnerships to managing PV. This review lays the theoretical groundwork and suggests potential avenues for constructing a PV management system. The subsequent section delves into the analytical components of the system, including mechanism, measurement and management of PPP PV. While these three components are distinct, they are intricately linked. In the section after that, we discuss the research methods that can be used. Collectively, an overarching analytical framework for developing a PPP PV management system is established in Section 4. Finally, the study is concluded in the last section, which also offers recommendations for future research.

2. Literature Review

2.1 PPP partnership

(1) Research tendency PPP partnership

According to literature review, it was found that research on the essence of PPP focuses on two views, i.e., cooperation or partnership (Osei-Kyei & Chan, 2015; Roehrich et al., 2014; Zhang & Kumaraswamy, 2001). Different cognitions towards PPP essence could influence the decision-making behaviors of public and private sectors, so as to impact the VC and the sustainability of projects (Hodge & Greve, 2007; Linder, 1999). Importance is attached to the partnership-oriented PPP concept. Steijn et al. (2011) find that building a partnership between the public sector and private sector is able to strengthen the dependence of both sides. Value growth and management innovation are more likely to be achieved through common regulations and organizations (Shi et al., 2016; Steijn et al., 2011). Therefore, it is believed in this study that the essence of PPP is a kind of partnership. It is a tight connection that transcends cooperation by investing proprietary resources to achieve common goals. Therefore, the partnerships in PPP projects are characterized by unified objectives, complementary resources and ability, risk-sharing, collaborative effect and VC (Chou & Pramudawardhani, 2015; Kivleniece & Quelin, 2012; Kwak et al., 2009). The definitions of these characteristics are listed in Table 2. Meanwhile, the time dimensions of partnership are the whole life cycle of PPP projects including decision-making, construction and operation stages.

Table 2. Definitions of PPP partnership characteristics

Characteristic	Definition	References
Unified objectives	Unified overarching goals or performance objectives to be achieved	Yuan et al. (2009); Villalba-Romero and Liyanage (2016); Xiong et al. (2015)
Complementary resources and ability	Both parties have complementary resources and abilities to delivery projects	Quelin et al. (2019); Devkar et al. (2013)
Risk-sharing	Risk is allocated equally between public and private sides	Villalba-Romero and Liyanage (2016); Wang et al. (2018)
Collaborative effect and value creation	Enhance value for infrastructure outputs	Cui et al. (2018); Villani et al. (2017)

(2) Research tendency on PPP connotation

The research on PPP connotation has a spiral progression. At an early time, the purpose of allowing private investors to participate in the supplement of public products or service was to alleviate financial pressure and enhance efficiency (Grout, 1997; Maskin & Tirole, 2008). Glendinning is the pioneer who offered the concept of VFM (Glendinning, 1988). During this period, studies on PPP connotation focused on VFM (Clifton & Duffield, 2006), and led to a shift from qualitative evaluation (Grimsey & Lewis, 2002), to quantitative evaluation (Grimsey & Lewis, 2005). Subsequently, with the deepening of research, importance was attached to the bounded rationality of PPP stakeholders, asymmetric information and other factors gradually. After having analyzed the internal logic relationship of PPP projects' costs and benefits, Hart (2003) believed that PPP could be analyzed by HSV-type model, and it contained the characteristics of incomplete contracts. In this phase, scholars changed the governance of PPP from "project" to "stakeholder", began to try using incomplete contracting theory and relational contract theory to govern PPP projects (De Bettignies & Ross, 2009). The development of PPP in practice is also further promoting academic research. With the implementation of PPP projects, scholars realize that ambiguous property rights and stakeholders' opportunistic behavior can bring unknown risks to the decision-making of public and private sectors, which would result in value damage. During this period, the connotation of PPP is the value based on risk (Siemiatycki & Farooqi, 2012). The first goal of risk management is to reduce PPP value losses and realize value growth. Thus, it can be seen that PPP connotation has shifted from VFM to stakeholder and then VC.

2.2 PPP partnership value

(1) PPP partnership value

The research on "relationship" dates back to social capital theory. At the earliest time, this theory emphasized that individuals do not exist alone but in the network (Coleman, 1988). Wilson and Jantrania (1994) first defined the relationship value from the marketing point of view, believing that the relationship is a valuable asset. The existence of a relationship caused the value of both sides to increase, and he also pointed out that any relationship would create certain value. Up to now, basic research on PV, value of cross-sector partnerships and cross-enterprise partnerships has been productive, mainly focusing on the sources of PV, dimensions and applications (Siemiatycki & Farooqi, 2012). In the meantime, a great number of scholars have carried out related research on influencing factor of value, the using methods of "value classification" and "interest-cost classification" (Kivleniece & Quelin, 2012; York et al., 2013). Liu and Leung (2002) built a soft value management and discussed the relationship among project value, participants' decision conflicts, commitment and satisfaction. In terms of PV of PPP, Kivleniece and Quelin (2012) first offered the idea that the sources of PV are externality, resource complementation and cost efficiency from the perspective of private sectors. Based on the cooperation of stakeholders, Tantalo and Priem (2016) recognized the composition of PV and driving factors of VC and built the collaborative mechanism of stakeholders.

(2) Research on the mechanism of partnership value

VC is the premise of cooperation between subjects. Furthermore, any relationship is a valuable asset. Hence, PV has a profound impact on project VC. Analyzing this mechanism is beneficial to figure out the influences from the relationships between stakeholders on projects, which can promote management efficiency. VC is a key for economic subjects to gain competitiveness, which depends on the value made by target users in the future and the value that has been gained now (Lepak et al., 2007). Factor theory of value proposes three value elements (VE): capital, land and labor. Utility theory of value, equilibrium price theory and effective demand theory provide theoretical support to VC. With the diversification and networking of economic organizations, the VC of mixed organizations containing alliance relationships and partnerships has attracted more attention gradually (Teece, 1992). Research shows organizational governance and structure have important influence on the VC of mixed organizations (Morck et al., 1988). Meanwhile, value chain theory, innovation theory and resource competition theory offer a theoretical basis to study the factor identification and mechanism of PV.

Therefore, in conclusion, the definition of PPP in this study is that: PPP is a kind of partnership established by the public sector and private sector in the whole project life cycle to realize the value creation of project through the investment of proprietary resources.

2.3 Measurement and management of PPP partnership value

(1) Traditional calculation method of value

VFM is the current decision-making criterion of public projects adopting PPP, PFI, BOT or government direct investment. The difficulty is to identify and measure the "value" in VFM. Evaluation methods mainly include cost-benefit analysis and public sector comparator (Ball et al., 2007). On this foundation, financial net present value analysis (Grimsey & Lewis, 2002) and real option approach (Liu et al., 2014) are derived. All of these methods are

based on the analysis of cash flow. However, as research on PPP connotation deepens, the research methods on PPP project value have changed gradually. They have shifted from risk analysis of public and private parties (Siemiatycki & Farooqi, 2012) to recognition of the key successful factors of PPP (Osei-Kyei & Chan, 2015), and then gradually moved towards measuring PPP project value based on the calculation of PV.

(2) Social network analysis

Social network analysis (SNA) originated in the 1930s and designed to analyze structural and quantitative problems on the relationships among individuals (or organizations) in social issues (Burt, 1980). In the 1990s, SNA was introduced to the management field, mainly used for analyzing entrepreneurial strategic alliance, internal organizational structure and stakeholders' relationships. Because SNA can express and quantify the complex network relationships among nodes, it is beneficial to analyze relationships between the project stakeholders. Loosemore (1997) first applied SNA to study stakeholders in engineering projects, and the research shows that the key content of project risk management is governing the relationships between stakeholders. Chowdhury et al. (2011) built the SNA network among PPP project stakeholders and analyzed different impacts of different stakeholders on the project. SNA can quantitatively express the partnership between public and private sectors in PPP projects and can be used to calculate its PV. However, the disadvantage of SNA is failing to achieve dynamic analysis. Due to the change of external conditions and stakeholders in different stages, the network of PPP projects is in dynamic change. Therefore, using SNA alone cannot represent the changes of PV in the whole life cycle.

(3) Complicated computational experiments

In order to compensate for the disadvantage of SNA's inability to achieve dynamic analysis, this study proposes complicated computational experiments to analyze PPP projects. Computational experiments are a modeling system that can review the basic scenarios of management activities and micro subjects' behaviors. It is feasible to extract and analyze specific parameters, or multiple parameters, to assess their impacts on the entire system according to research-oriented requirements. This process helps derive the developmental principles of the research object, the interactive mechanism between the system and its environment, and the principles of dynamics throughout the entire project. This method is widely applied to finance, the management of supply chain, dynamic relationships between subjects and environment, decision-making, the evolution of cooperation and the control of complicated systems (Kim & Kim, 2010). In the field of construction, Son introduced an agent-based simulation to explore the evolution of collaboration within inter-organizational networks of construction project teams, drawing from game theory and social network perspectives (Son & Rojas, 2011). This system is helpful to understand the effect of organizational aspects on project management. For example, Osman (2012) developed a behavioral model to analyze user perceptions of service quality using agents in the context of infrastructure asset management. Thus, computational experiments based on Agent provide technological support for studying the interactive behaviors between public sector and private sector.

The research mentioned above provides solid theoretical foundation for deeply analyzing management system of PPP PV. However, there are still some deficiencies: 1) Previous studies have not defined and explained the "partnership" between the public sector and private sector from the perspective of organizational behavior theory. 2) The partnership built by the public and the private parties is able to achieve VC of the PPP project, but the relationship between PV and VC remains to be illustrated clearly. 3) The research on the measurement of PV is still at the qualitative level, lacking scientific experimental measurement. 4) Measurement and evaluation of VFM only exists in the project decision-making stage. Previous studies have not measured and managed PV on the whole project life cycle.

3. Developing the analytical framework

3.1 Mechanism of PPP partnership value

(1) Identify the value elements of partnership value

The main research purpose of this part is to recognize VE that constitutes PV based on factors theory of value. First, the value dimension (VD) of PV throughout the whole life cycle is determined, including "People", "Invisible Assets" and "Material". The initial database of VE can be identified by field investigation, literature research, and questionnaire. Second, the final VE can be selected according to the characters of real projects by expert interview. Finally, the partnership is taken as a core to decompose PPP project value unit (VU) for building PPP project VC models.

(2) Value creation mechanisms of partnership value

After having determined VD, VE, and VU, this part is to analyze relational mapping among them from systematic perspective thereby gaining the mechanism of PV. The proposed mechanism is presented in Fig. 1. In order to gain a more scientific mechanism, system dynamics analysis can be used to adjust the mechanism further after having measured PV.

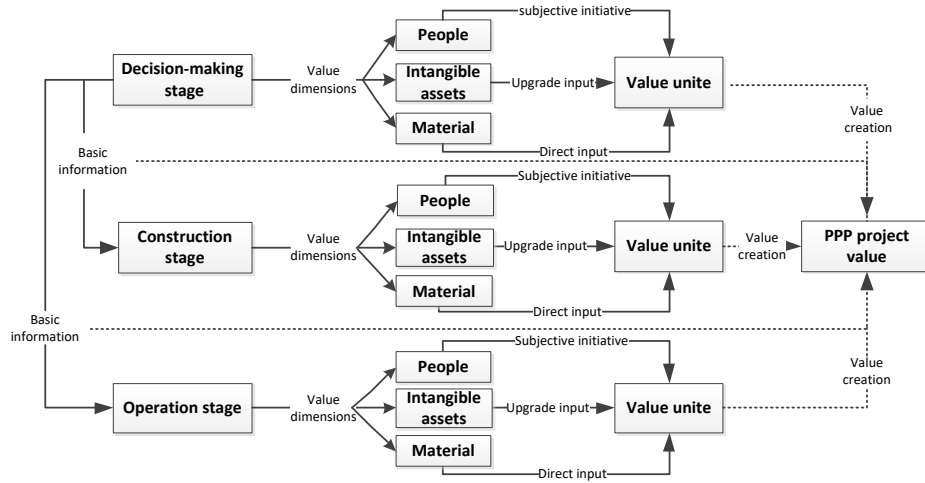


Fig. 1 The proposed analytical framework on mechanism of PPP PV

3.2 Measurement of PPP partnership value

(1) The analysis of social network

SNA can be used for structurally quantifying the partnership between public and private parties and computing its value. This part includes two steps: First, the first level social network can be constructed according to all stakeholders in PPP projects. Combining with VE, its static value can be calculated by calculating the static structural index (e.g. Degree Centrality, Egonet Density). Second, the second level can be constructed by extracting nodes of public and private parties. This level can be used to analyze small groups of social networks to realize the calculation of PV. The proposed SNA analytical framework on measuring PPP PV is shown in Fig. 2.

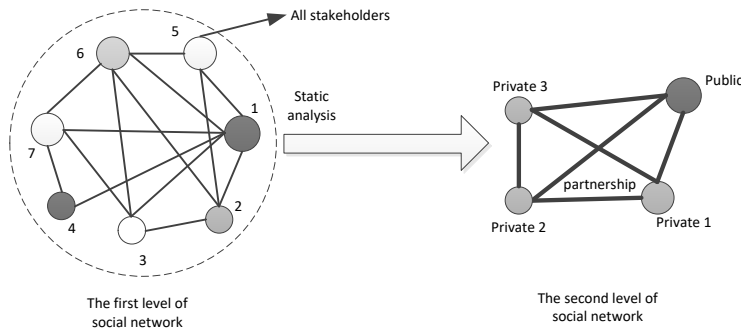


Fig. 2 The proposed SNA analytical framework on measuring PPP PV

(2) Establishment of computational experimental platform

SNA can structurally quantify PV. However, due to its inability to achieve dynamic analysis, it is difficult to expound the changes of VC. It is helpful to perform computational experiments by means of Agent technology. Based on SNA, this part first defines stakeholders as agents to perform problem describing and basic assumptions according to the measurement of PV and the mechanism. Then, the behavior rules and strategy within computational experimental platform are described. Furthermore, the parameters such as “engineering environment” and “social environment” can be adjusted. The design mapping of computational experimental platform is shown in Fig. 3.

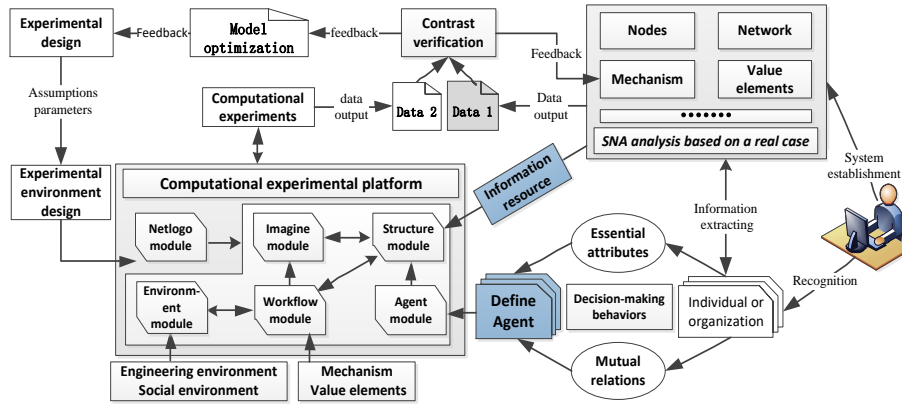


Fig. 3 the proposed design mapping of computational experimental platform

3.3 Management of PPP partnership value

Decision-making management and process management of PPP projects can be achieved through analyzing and measuring PV. The former refers to when performing decisions on PPP projects, partnerships that may exist can be described and assumed, and all agent rules and strategies can be set in the computational experimental platform to gain the potential situations regarding PPP VC. Some decision-making problems can be solved, such as the selections of private parties and PPP projects. The latter refers to when inputting partnership data that already exists in the management system, the platform can give the value results created by the PPP project during execution. These results can guide the management of actual projects. Taking an empirical study of a Chinese comprehensive water treatment PPP project as an example, the analytical framework for managing PV is shown in Fig. 4.

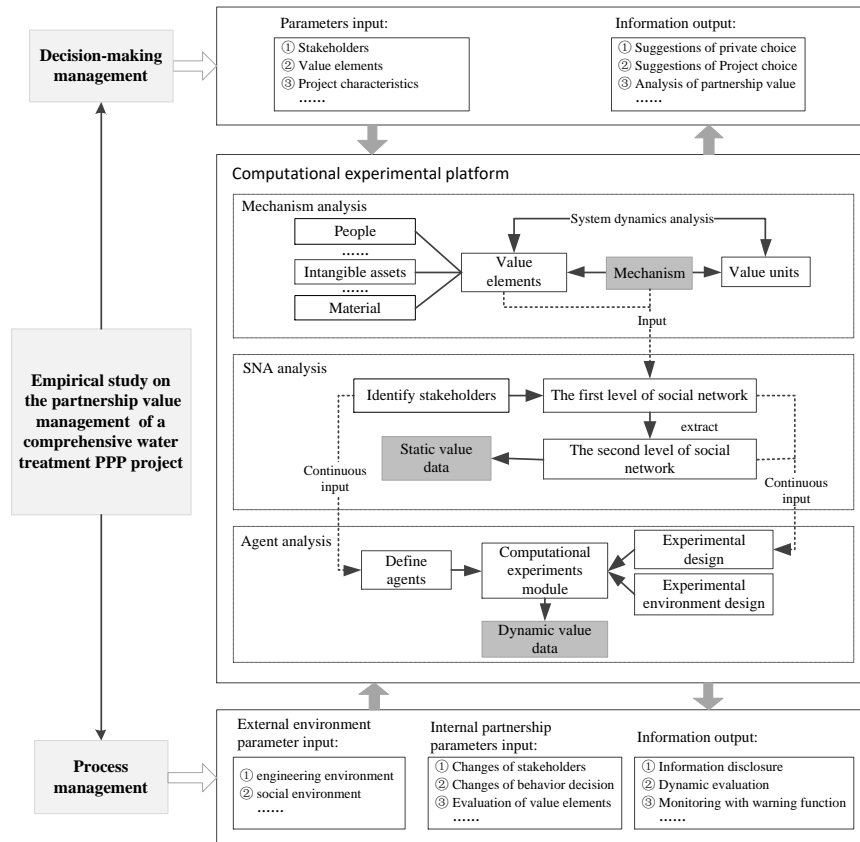


Fig.4. The analytical framework for managing PV

4. Conclusions

4.1 Research Summary

This study contributes an analytical framework for studying the value of partnerships in PPP project management. Specifically, this paper first reviews PPP partnerships, which provides theoretical foundations for establishing the analytical framework. This study then develops the analytical framework, including research components of the framework, and research methodology. Three components are detailed described: mechanism, measurement, and management of PPP PV. Finally, the research summary and future recommendations are provided.

4.2 Research recommendations

Partnerships are significant between public and private sectors in PPP projects. Moreover, whether the project can achieve value creation is critical to the success of projects. Based on the analytical framework established in this study, future research can collect data and further develop the PV management system. In addition, some other related aspects can also be investigated. This study calculates value based on SNA, other theories like social exchange theories, can be used to evaluate PV. Furthermore, this study mainly focuses on the relationship between public and private sectors. However, it is argued that relationships among other parties, such as design, construction, and operation firms are also critical to VC. Future studies thus can expand this study towards a more comprehensive PV management.

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