

Article

Sustainable Performance Measurements for Public–Private Partnership Projects: Empirical Evidence from China

Yanhong Liang ¹ and Hongdi Wang ^{2,*} 

¹ School of Qilu Transportation, Shandong University, Jinan 250100, China

² School of Public Administration, Zhejiang University of Finance & Economics, Hangzhou 310018, China

* Correspondence: hdwang@zufe.edu.cn

Received: 23 May 2019; Accepted: 29 June 2019; Published: 3 July 2019



Abstract: The world is witnessing a global momentum of public–private partnership (PPP) development, along with the inherent complexities associated with the long-term construction, operation, and maintenance periods of numerous PPP projects. Performance measurements for PPP projects are critical for ensuring stakeholders’ interests in a sustainable way, without scarifying future generations’ interests in terms of economic, environmental, and social sustainability. A system of five-dimension sustainable performance measurements for PPP projects is proposed in this study and a questionnaire survey was conducted to solicit professional opinions on its effectiveness based on current PPP practice in China. A total of 79 professionals with PPP working experiences in China participated in the survey, among which five were chosen for interviews to validate and deepen the understandings of the findings. It reveals that the five dimensions have essential impacts on current PPP practice in China, though with varying extent of importance. The private sector has developed a sense of achieving a long-term financial return, which might have indeterminate results on the benefits of end users. The increasing trend of sustainability concerns in the PPP project performance measurement is confirmed, and it is partially due to the central government’s “High-Quality Development” initiatives. This study contributes to the theoretical discussions of establishing sustainable performance measurements for PPP projects, and it has practical implications for the public sector to improve PPP project evaluation methods and incentive mechanisms, so as to promote project sustainability.

Keywords: Public–Private Partnership; Project Performance Measurement; Sustainability

1. Introduction

Public–private partnership (PPP) has been widely recognized as an important and effective way to procure public works with less public financial input and more private participation. A massive number of PPP projects have been in operation or are under construction, and more are being planned. The Ministry of Finance of China has launched three batches of PPP demonstration projects before 2017; 30, 216, and 516 projects for the first, second, and third batch, respectively, according to the China PPP Center [1]. The EU had implemented 1435 PPP projects until 2009, as one of the measures for dealing with the economic crisis [2]. It was reported that in 2017, the White House initiated public spending plans with the scale of over \$1 trillion in the next 10 years to stimulate the U.S. economy through infrastructure construction, with PPP as one of the financing approaches. In particular, China’s Belt and Road Initiative, covering 60% of the world’s population, opens up unprecedented opportunities for PPP implementation in the international construction market, and the total investment in the expansion of regional transportation and communication infrastructure is expected to be over \$1.4 trillion from 2015 to 2030 [3].

All construction projects including PPP projects shall be responsible for the sustainable future of human society, in terms of meeting current needs without scarification of future generations' interests [4]. Infrastructure projects account for a significant portion of global greenhouse gas (GHG) emissions, increasing global concerns about the climate change aggravated by GHG [5–8]. While PPP is increasingly popular all over the world, antidotes of PPP project failures and cost overruns are not rare, and they pose a threat to the sustainable development of human society [9,10]. Some research has attempted to link PPP to sustainable development [11,12]. China's construction companies are under great influence from the central government and local governments, and have more incentives to fulfill their social responsibilities (partially imposed by the governments) in exchange for market opportunities, resource accessibility, and government support, compared to companies in other countries such as the U.S. and EU. Meanwhile, China's construction companies are very active in the international construction market, for example, in the "Road-and-Belt" areas. Their PPP experiences will affect the PPP project sustainability in the host countries. Therefore, the research in China shall provide much reference value of construction companies' PPP competency and sustainable responsibilities for the whole world.

Performance measurements serve as an effective and decisive method to ensure the sustainable performance of PPP projects, given that plenty of critical successful factors for PPP project delivery have been explored [13]. The current "iron triangle" of project performance measurements, including schedule, cost, and quality, could easily lead to project failures or suboptimal outcomes [14]. It is worth mentioning that the inherent complex project features and long duration make PPP projects more risky in adopting traditional triangle performance measurement models. To achieve project sustainability, life-cycle perspective and stakeholder management shall be well materialized in the establishment of performance measurements for PPP projects. First, project performance shall be measured from multiple stakeholders' perspectives, such as that of the developer, contractor, local community, and future societal development [15]. Integrating various considerations and interests of potential stakeholders contributes to the economic, environmental, and social good for them. Besides, it shall be done in a long-sighted manner with the recognition of uncertainties and risks in the long project life. Potential stakeholders in the whole project life cycle shall be identified, and meanwhile, their interests shall be considered in a dynamic way throughout the varying phases in the project life cycle. Therefore, sustainable criteria must be included in the performance evaluation of PPP projects.

In this study, a five-dimension sustainable performance measurements system for PPP projects is proposed and empirically tested through a questionnaire survey. The next section provides an overview of PPP development and performance measurements. Followed by this is the proposed system of sustainable performance measurements for PPP projects. Then, data collection and sampling of the questionnaire survey to experienced professionals in Chinese PPP projects is presented. Afterward are the data analysis results and findings, particularly the discussions of the effectiveness of the proposed sustainable performance measurements. Lastly, the conclusions, implications, and future work are presented.

2. Public–Private Participation

2.1. Development of PPP Research

There are various interpretations of the concept of PPP. Governments and industrial institutes developed various definitions in America, Asia, Australia, and Europe [16,17]. The U.S. National Council for PPP defines PPP as a contractual arrangement between public and private sectors, through which public services or facilities are delivered with the sharing of resources, risks, and rewards [18]. Under the umbrella of PPP contracts, a consortium (sometimes special purpose vehicle) will be formed by parties with different expertise, resources, and assets. In contrast to the contractual view in the U.S., other definitions emphasize the financing perspective, represented by countries like the UK, and the project organization perspective, such as Canada and China. Li and Akintoye [19]

conducted a comprehensive review of the concept of PPP and concluded that “the numbers and types of PPPs are overwhelming, making the definition of a PPP difficult.” Generally speaking, PPP is a procurement system for procuring public works, where the responsibilities of project financing, design, construction, operation, and maintenance are shared between the public and private sectors. Among various PPP types, concessionaire contracts are most preferred, such as Build-Own-Operate (BOO), Build-Operate-Transfer (BOT), Build Own Operate Transfer (BOOT), Design-Build-Operate (DBO), Design-Building-Financing-Operating (DBFO) and their variations [20–22]. PPP concessionaire contracts have been extensively used in transportation infrastructure (e.g., airports, railways, urban mass transit, and roads) and other infrastructural sectors (e.g., power plants, sewage plants, and water conservancy projects), in which financing is balanced through tolls or service fees [23,24].

From the vast literature of PPP research, six common themes are identified: (1) critical success factors [25–27]; (2) project financing [2,16,28,29]; (3) risk management [28–33]; (4) concessionaire design [34–37]; (5) roles and responsibilities of public sector [24,38–41]; and (6) efficiency of contractual arrangements [24,28,40,42]. The measurement of specific performance in PPP projects is often examined from the perspective of a single stakeholder, but calls have been made to consider multiple performance aspects within the rich context of all project stakeholders involved [43]. Additionally, the static approaches to measuring the PPP performance is reported to be not robust enough, and there is a call for life-cycle dynamic evaluation under the sustainable performance system to ensure the comprehensive and effective measurement of PPP performance [24]. The efforts on project performance measurements are far from sufficient, although its importance has been already widely recognized [13,44]. The establishment and enforcement of sustainable performance measurements are needed to guide the efforts of public and private sectors towards the expected sustainable outcomes of PPP projects.

2.2. Performance Measurements for PPPs

The concept of performance measurement shall be clarified by reckoning the differences between performance measurements, critical successful factors, and project success criteria. Critical successful factors (CSFs) are referred to as the key indicators directly affecting the project performance in terms of given project objectives [45]. Quite a number of studies have been done on the identification of CSFs of PPP projects, including a serial of subindicators within the broad categories of political, financial, technical, managerial, environmental, human, and cultural factors [16,25,28,45–48]. Most of those studies on CSFs argue that the identification and management of CSFs along the project delivery stages, especially at the early design stages, are essential to the project success [47,49]. Project success in the construction management area emphasizes meeting the project objectives, and the project performance measurement system is required to quantify the level of project success [15,43]. Tabish and Jha [46] found the positive relationship between project management traits and project success, and advocated the value-addition-oriented project progress performance management in order to ensure the final project success.

It is a complex and challenging task to design an efficient and effective performance measurement system for construction projects. The existing systems based on the “iron triangle” of schedule, cost, and quality have been commonly used to project evaluation all over the world [40]. Those systems are mostly efficiency-oriented and suitable for measuring project performance in limited obligations, but are criticized for lack of considerations of the satisfaction of stakeholders beyond the project management team [50]. In the context of PPP projects with long project life, the interests of a variety of stakeholders shall not be ignored by the project management team [51]. Otherwise, projects cannot be successful. Particularly, the evaluation of benefits to the project team, end users, and local society are frequently proposed to refine performance measurements [40,43,52,53]. For PPP projects, governments usually set up formal performance measurements at the operation stage in order to refine the “iron triangle” criteria specified for the construction stage [13,40]. The insufficient emphasis of long-term project performance could result in unexpected disputes and frictions among certain stakeholders in PPP projects throughout the project life cycle, particularly the end users and/or owners [15,43].

To conclude, the stakeholder perspective sharpens the meanings of project management for the highly complex PPP projects and also the methods and techniques to implement project management.

Sustainable performance measurements for PPP projects must be effective in the long term, especially with their inherent features of high complexity and long project life. It is a necessity to evaluate projects in a longer period in addition to the efficiency and effectiveness of project delivery, as time could accelerate uncertainties and risks [13,14,51]. Along the rapid PPP development in China, a number of project overruns and failures are reported due to unexpected conflicts between public and private sectors at the operation stages and weak contingent measures for risk alleviation, e.g., low profits for the private sector due to similar projects constructed by local government in the Hangzhou-Bay cross-sea bridge project [54] and decreasing electricity bills in the Shandong-Zhonghua power plant [55]. While there are a lot of time-dependent risk factors identified in the research on critical successful factors for PPP delivery, some of these factors shall be reflected in the performance measurements in order to ensure the sustainable performance of PPP projects. Furthermore, the system design of sustainable performance measurement for PPP projects shall not be apart from the implementation strategies throughout the project life cycle. It is a reflection of the tactical sustainability goals of the project team and must be in line with the sustainable requirements of the host government in the long run [56]. The sustainability-promoting actors and practices shall be encouraged to have a better score in the sustainable performance measurement system [56,57].

While companies are looking forward to participating in the fast developmental of PPP projects, their concerns on project sustainability are increasing [58]. The gap between the perception of importance and the actual effectiveness of realizing project success in practice is still wide. A system of sustainable performance measurements for PPP projects is urgently demanded.

3. Five-Dimension Sustainable Performance Measurement System for PPP

From the stakeholder perspective in a long-sighted manner, the measurements are explored through considerable literature reviews and interviews with experienced practitioners and researchers on PPP projects. Taking a PPP social infrastructure project for example, the involved stakeholders mainly include the end users, the private sector (banks, real estate developers, contractors, subcontractors, etc.), and the public sector (government departments of planning, transportation, environmental protection, etc.). The private sector emphasizes the primary goal of economic profit, business capabilities, and future opportunities [55], while the public sector goes beyond the economic concerns but also the social “net” benefits, i.e., maximizing the positive environmental and social impacts and minimizing the negative ones [36]. Comparatively speaking, the public sector is more long-sighted than the private sector about the project outcomes in the long term, and the balance between them shall be coordinated throughout the whole project life.

Based on the previous research on project performance measurement of PPP projects, a system of five-dimensional sustainable performance measurements for PPP is summarized first, and then justified through a workshop. Following the principle of completeness and simplification, three scholars in the area of PPP performance management, two practitioners with PPP experience, and four students went through each item of the sustainable performance measurements for PPP in the workshop. The life cycle of a PPP project mainly includes the conception, design, and build phase, operation and maintenance phase (private sector in charge), and transfer and ex-post management phase (public sector in charge). At the beginning of the conception, design, and build phase, the identification of potential critical risk factors from the stakeholder perspective could serve as precautions to ensure PPP project performance. Meeting design goals shall also be evaluated at this phase, when the main contractual relationships occur between the private and public sectors. Throughout the operation and maintenance phase, benefits to the private and public sectors shall be periodically evaluated to ensure that the PPP project is on the right track, while the benefits of end users shall also be guaranteed. After transfer, the essential relationship will be between the public sector and the end users, and the issues

of how to sustain a PPP project for the future shall be emphasized and periodically evaluated. The finalized sustainable performance measurement system in this study is shown in Figure 1.

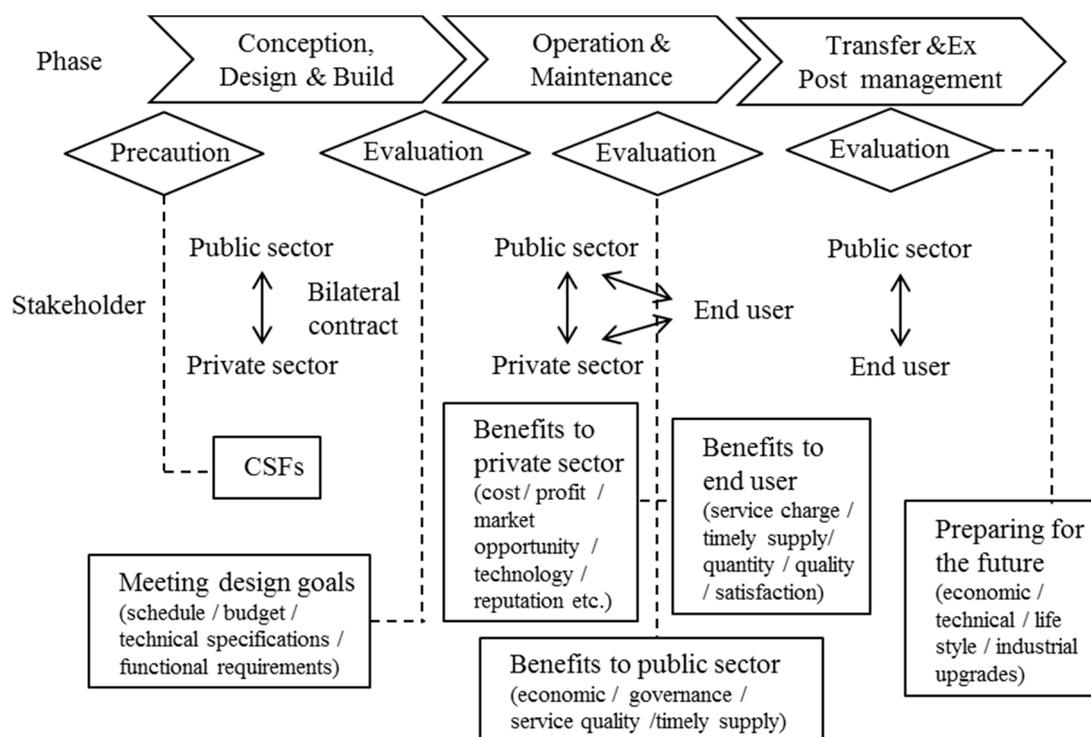


Figure 1. Five-dimensional sustainable performance measurement system for PPP. PPP: public–private partnership; CSF: critical successful factors.

The first dimension entitled “**meeting design goals**” addresses the fundamental objectives of construction projects. Four items are included, that is, the project shall be delivered on schedule, in budget, with functional requirements, and with technical specifications (they are also involved in most relevant project performance references, e.g., [25,43,51,59]). The second dimension entitled “**benefits to the end user**” is designed to include five aspects from the perspective of end users. Project outcomes shall meet the needs of the end users in terms of reasonable service charge, timely supply, quantity, quality, and overall satisfaction [43,51,53,59–61]. The item of overall satisfaction is specifically set to include other beneficial aspects that the end users think highly of. The third dimension entitled “**benefits to private sector**” is constituted of eight items, including cost management, marginal profit, investment return, market opportunities, technical advance, experience and knowledge gains, reputation improvement, and competitiveness enhancement [25,43,53,60]. Among the eight items, the former four are about direct profit-making and the latter four are to measure the long-term probability. The fourth dimension entitled “**benefits to public sector**” includes four items of economic benefits, government reputation, service quality, and timely supply of public works [25,26,44,60]. All the items in this dimension shall be evaluated in a medium-to-long term across the stages of conception, design and build, operation and maintenance, transfer, and ex-post facilitate management. The fifth dimension entitled “**preparing for the future**” includes four items of the long-term contributions to economic development, technical innovation, lifestyle shifting, and industrial upgrades, which are inspired by the work of Toor and Ogumnlana [44], Liu et al. [40], and Atmo and Duffield [55]. Since all PPP projects initiated or permitted by the government have the obligations to improve societal welfare, a system of sustainable project performance measurements for PPP must be in line with the “three red lines” for sustainable development in the long run.

4. Data Collection and Sampling

A three-part questionnaire survey was developed to solicit opinions on sustainable project measurements for PPPs from experienced construction professionals. Part 1 is a cover page introducing the fast PPP development in China and the necessity of developing sustainable project measurements for PPPs, as well as the targeted respondents with PPP working experience. Part 2 includes a series of self-reflection questions on the importance of five-dimension sustainable performance measurements in their PPP practice. For each item in every dimension, respondents were asked to choose a particular scale out of five-Likert scales according to their agreement on the statement. Taking the first item in the dimension of “meeting design goals” as an example, the statement goes as “project delivery in time is a prerequisite for ensuring a successful PPP project.” Part 3 contains open-ended questions soliciting respondents’ views on the five-dimension project measurements system for PPPs and suggestions of additional criteria.

The questionnaire survey was distributed to professionals in Chinese construction companies involved in China’s first and second batches of PPP demonstration projects through email. Several acquaintances working in PPPs were also included in the contact list. Snowball sampling was employed to expand the respondent coverage. In the email, a respondent is asked to recommend potential PPP expertise in his/her company or beyond for this questionnaire survey. The data questionnaire survey lasted for six months. A total of 552 emails were sent out to potential respondents and 82 effective replies were received, among which 3 respondents with no PPP experience were removed. Therefore, the valid sample size is 79, with the response rate of 15.1%. The respondent information is shown in Table 1. In order to deepen the interpretations of the above results, five out of all the survey respondents were approached for interviews when the preliminary data analysis results were ready.

Table 1. Profile of respondents.

Survey Respondents		
Item	Number	%
<i>Working Experiences in PPPs</i>		
1–5 years	42	53.17
6–10 years	28	35.44
>10 years	9	11.39
<i>Roles in PPPs</i>		
Public Partner	21	26.58
Private Partner	49	62.03
Others	9	11.39
<i>Roles of Public Sector</i>		
State-owned enterprise	11	52.38
Government agency	5	23.81
Local government	4	19.05
Central government	1	4.76
<i>Roles of Private Sector</i>		
Designer	6	10.34
Contractor	5	8.62
Consultant	5	8.62
Operator	3	5.17
Supplier	2	3.45
Financier, Contractor, Consultant, and Operator	12	20.69
Contractor and Operator	10	17.24
Financier, Contractor, and Designer	6	10.34
Others	9	15.52

Table 1. Cont.

Survey Respondents					
	Item		Number	%	
<i>Working Experiences in PPPs</i>					
<i>Project types</i>					
	Transportation		41	51.89	
	Energy		13	16.46	
	Housing		11	13.92	
	Water and Sanitary		3	3.80	
	Hospital		2	2.53	
	Others		9	11.40	
<i>PPP variants</i>					
	Build-operate-transfer (BOT)		34	43.04	
	Build-transfer-operate (BTO)		12	15.19	
	Design-build-finance-operate (DBFO)		11	13.92	
	Build-own-operate (BOO)		7	8.86	
	Build-lease-transfer (BLT)		5	6.33	
	Build-own-operate-transfer (BOOT)		3	3.80	
	Others		7	8.86	
Interviewee					
	A	B	C	D	E
<i>PPP Experiences</i>	4 years	3 years	8 years	2 years	5 years
<i>Sectors</i>	Private	Private	Public	Public	Private
<i>Roles in PPPs</i>	Contractor	Contractor	State-owned enterprise	Government agency	Financier, Contractor, Consultant
<i>Project types and PPP variants of the last project</i>	BOT Transport	BOT Transport	BLT Housing	BOT Water and sanitary	BOT Transport

As shown in Table 1, more than half of the respondents have work experience in PPPs of no more than five years, 35.44% have PPP work experience of six to ten years, and 11.39% have experience of more than 10 years. Among the total 79 respondents, 26.58% are working in the public sector, including state-owned enterprises, government agencies, local and central governments, while 62.03% of the respondents are working in the private sector and their firms' roles in PPP projects include designer, contractor, consultant, operator, supplier, or mixed roles (e.g., as the financier, contractor, and designer). The remaining 11.39% of the respondents failed to clarify their firms, probably because they are limited liability companies with certain equity shares from the governments or state-owned enterprises. Judging from the PPP project types, it is clear that transportation projects are the most popular in China's PPP development, with a high percentage of 51.89% among all the reported project types. Energy utilities and housing projects also have high preference, with a coverage of 16.46% and 13.92, respectively. As for the PPP variants, Build-operate-transfer (BOT) is the most popular procurement system among all PPP variants, with a percentage of 43.04%. Moreover, Build-transfer-operate (BTO) and Design-build-finance-operate (DBFO) are also very common in China with the percentage of 15.19% and 13.92%, respectively.

5. Data Analysis and Findings

5.1. Statistical Descriptions

The statistical descriptions, including number, min, max, mean, and standard deviation of questionnaire responses are calculated in SPSS 19.0 [62] and presented in Table 2. Some respondents failed to complete the questionnaire, with one or several questions left unanswered. Little's MCAR

test is conducted to test whether the values in the data sample are missing completely at random (i.e., MCAR), and the result is positive with the significance of 0.73. It indicates that the assignment of missing data shall have a weak effect on the data analysis. Expectation maximization algorithm is used to assign missing value in SPSS 19.0.

Table 2. Statistical description of questionnaire responses.

Performance Measurements	Number	Min	Max	Mean	S.D.
Meeting design goals					
Schedule	79	1	5	3.63	0.894
Budget	79	1	5	3.51	1.048
Technical specifications	78	1	5	3.76	0.856
Functional requirements	78	2	5	3.47	0.697
Benefits to end user					
Service charge	79	1	5	3.56	0.916
Timely supply	79	2	5	3.41	0.954
Quantity (sufficient supply)	79	2	5	3.61	0.724
Quality (contributions to welfare)	79	2	5	3.62	0.722
Overall satisfaction	79	2	5	3.56	0.635
Benefits to private partner					
Cost management	79	1	5	3.59	0.899
Marginal profit	79	1	5	3.16	0.898
Investment return	78	1	5	3.31	0.887
Market opportunities	77	2	5	3.78	0.805
Technical advance	76	1	5	3.42	0.853
Experience and knowledge gains	78	1	5	3.67	0.848
Reputation improvement	79	1	5	3.68	0.913
Competitiveness enhancement	78	1	5	3.56	0.862
Benefits to public partner					
Economic benefits	77	2	5	3.58	0.695
Government reputation	79	2	5	3.42	0.856
Service quality of public works	79	2	5	3.72	0.800
Timely supply of public works	77	1	5	3.61	0.934
Preparing for the future					
Economic development	79	1	5	3.43	0.947
Technical innovations	78	1	5	3.19	1.033
Lifestyle shifting	77	1	5	3.60	0.799
Industrial upgrades	76	2	5	3.08	0.813

5.2. Exploratory Factor Analysis

Exploratory factor analysis (EFA) is an effective statistical technique used to uncover the underlying relationship among variables, and it is performed in SPSS 19.0 with the varimax rotation approach, i.e., to maximize the variances of the factor loadings in EFA. Firstly, the Kaiser–Meyer–Olkin (KMO) test of sampling adequacy and Bartlett’s test of sphericity are conducted. The value of the KMO test is 0.744, which is greater than 0.5, indicating that the data is sufficient to do EFA [63]. The significance of Bartlett’s test of sphericity is 0.000, which supports the suitability of EFA [63]. Then, EFA is conducted and the results are shown in Table 3. According to the Variance Explained, the five dimensions of sustainable performance measurements for PPPs can be sorted by their importance in the practice: F1 (benefits to private partner), F2 (preparing for the future), F3 (meeting planning goals), F4 (benefits to public sector), and F5 (benefits to end user), in descending order. The result reliability in the EFA is tested through the calculation of Scale’s Cronbach’s Alpha. All the values of the Scale’s Cronbach’s

Alpha are higher than 0.70, which is the operational standard in EFA as discussed by Gliem and Gliem [64], and, therefore, the internal consistency of the five-factor group is acceptable and the results of factor loads are reliable. Besides, there are 4 items with communality lower than 0.4, indicating that they fail to load significantly on other variables. These are Service charge and Timely supply in the dimension of “benefits to end user”, Marginal profit in the dimension of “benefits to private partner,” and Industrial upgrades in the dimension of “preparing for the future.”

Table 3. Results of exploratory factor analysis.

Question Items	Communalities	F 1	F 2	F 3	F 4	F 5
Schedule	0.594			0.688		
Budget	0.728			0.727		
Technical specifications	0.777			0.815		
Functional requirements	0.567			0.657		
Service charge	(0.371)					0.443
Timely supply	(0.367)					0.535
Quantity (sufficient supply)	0.598					0.740
Quality (contributions to welfare)	0.648					0.773
Overall satisfaction	0.594					0.619
Cost management	0.828	0.908				
Marginal profit	(0.396)	0.546				
Investment return	0.707	0.768				
Market opportunities	0.629	0.753				
Technical advance	0.777	0.863				
Experience and knowledge gains	0.641	0.717				
Reputation improvement	0.532	0.684				
Competitiveness enhancement	0.624	0.757				
Economic benefits	0.585				0.661	
Government reputation	0.406				0.522	
Service quality of public works	0.765				0.849	
Timely supply of public works	0.703				0.805	
Economic development	0.483		0.551			
Technical innovation	0.617		0.608			
Life-style shifting	0.540		0.728			
Industrial upgrades	(0.103)		−0.214			
Eigenvalue		6.218	3.433	1.824	1.709	1.395
Variance Explained		24.872	13.731	7.297	6.835	5.581
Cumulative Variance Explained		24.872	38.603	45.901	52.736	58.317
Scale's Cronbach's Alpha		0.887	0.764	0.789	0.759	0.755

Note: F1 is factor for benefits to private partner; F2 is factor loading for preparing for the future; F3 is factor loading for meeting planning goals; F4 is factor loading for benefits to public partner; F5 is factor loading for benefits to end user; the five factor groups are ranked in descending order of Variance Explained; the 4 items with low communalities are highlighted in brackets.

5.3. Discussions

According to the results of exploratory factor analysis in Table 3, the dimension of “benefits to private partner” is the most important consideration in the current PPP practice in China. Among the eight items in this dimension, cost management is highly emphasized with the factor loading of 0.908. Investment return, market opportunities, technical advance, experiences and knowledge gains, reputation improvement, and competitiveness enhancement are also important in the evaluation of PPP project performance, with the factor loadings between 0.684 and 0.863. The item of marginal profit has a low communality of 0.396 and appears to be not as important as other items in the dimension of “benefits to private partner”. One of the incentives of the private sector entering the PPP market is to establish a long-term cooperative relationship with governments, so that continuous business

opportunities can be seized. The growing momentum of PPP development in China comes along with the release of the second batch of PPP demonstration projects in 2014. At this particular period, the private sector has no intention to exhaust short-term marginal profit. Thus, this item is reported as not that important as expected in the evaluation of PPP project performance, but the situation will likely be different in the future. Take Beijing metro line 4 PPP project for example, the fare is set to be RMB 2, the same as other metro lines, under the powerful influence from the Beijing government. Although the marginal profit seems to be suppressed, actually it does not jeopardize the financial benefits of the private sector due to the grant of fiscal subsidies. In addition, it is interesting that the interviewees revealed that reputation improvement and market opportunity are very cherished by the private sector, even at the cost of rising service quality with little or no compensation from the public sector. However, an interviewee from the public sector mentioned a concern that most PPP projects are not technically difficult to meet the planning goals and whether the technical and functional specifications can meet the future needs remains to be proven.

The dimension of “preparing for the future” is ranked as the second most important factor group. The items of economic development, technical innovation, and lifestyle shifting are important in the evaluation of PPP project performance, with the factor loadings of 0.551, 0.608, and 0.728, respectively. An interviewee from the public sector argues that the long-term contributions of PPPs to the local economic development shall be more emphasized. However, the current situation is that the governments lower their economic benefits to encourage the participation of the private sector, since the main purposes of developing PPP in China are to reduce local governments’ financial pressure and to promote economic development. The fourth item of industrial upgrades has a low communality of 0.214 and fails to load significantly on other items. On the one hand, PPP development in China is still at the infant stage and its impact on the industrial standards and capabilities of the construction industry needs more time to be explored. On the other hand, the construction industry has been known for its slow innovation process and the private sector usually takes a conservative attitude towards industrial changes.

The dimension of “meeting planning goals” is ranked as the third most important factor group. The “iron-triangle” criteria of time (schedule), cost (budget), and quality (technical specifications and functional requirements) are all reported as important in the evaluation of PPP project performance. Especially, the governments have very strict monitoring of the PPP demonstration project delivery in terms of time, cost, and quality. An example is given by an interviewee that the Qingdao Bay Bridge PPP project was opened in June 2011 under request from local government, when it had been not fully completed by that time. To a certain extent, it becomes a must for the private sector to deliver PPP projects in time, when some local governments seem to be obligated to push forward PPP development.

The dimension of “benefits to public sector” is ranked as the fourth most important factor group. The items of economic benefits, government reputation, service quality, and timely supply of public service are all important in the evaluation of PPP project performance, with the factor loadings of 0.661, 0.522, 0.849, and 0.805, respectively. Although the government reputation appears to be not more important than service quality and timely supply of public works, an interviewee argued that, in fact, China local governments think highly of their reputation and regard project delivery in time and service quality as two of the critical factors to maintaining reputation. It is worth noting that there is a high percentage of government ownership in most giant Chinese construction companies, and they are more concerned about the social sustainability aspect than others [58]. Maybe, it is one of the reasons that the item of economic benefits to the public sector is not valued as high as the items of service quality and timely supply of public service.

Although the dimension of “the benefits to end users” is ranked as the last one, the three items of public service quantity, public service quality, and overall satisfaction are important in the evaluation of PPP project performance, with the factor loadings of 0.740, 0.773, and 0.619, respectively. The other two items of service charge and timely supply have low communalities of 0.443 and 0.535, and seem to be not as valued as expected. Chinese governments normally suppress the service charge with their

powerful macroeconomic regulations and policies, and as a result, service charge on the end user is relatively low. The Beijing metro line 4 PPP project is given as an example in the interviews; the fare is set to be the same as other metro lines, under the powerful influence from the Beijing government, but actually, it does not jeopardize the financial benefits of the private sector due to the grant of fiscal subsidies. Regarding the timely supply of PPP service, one probable reason is the inefficient approval processes from governments in Mainland China [65]. Another reason was raised by some interviewees that, in most PPPs in China, the political, financial, and social considerations at the operational stage are not well addressed in the project delivery. The project team usually has limited responsibilities to deliver the project to meet the basic technical specifications, since the determination of service charge and timely supply largely depends on the negotiation between the government and project operators without the involvement of the project team. To sum up, service charge and timely supply in the dimension of benefits to end users shall pose more important positions in the future PPP project performance measurements and the governments shall take up the responsibility in doing so.

The establishment of the five-dimension sustainable performance measurement system for PPP and its implementation can only be ensured by organizational collective endeavors of the whole project team. In addition, it calls for an interfirm project governance mechanism for the unification of individual (firm) and project sustainable goals. First of all, the external policy shall be designed so that the market competition environment shall be conducive to the fostering of project sustainability in the whole project life and sufficient economic and moral benefits shall be envisaged for the project team members in a PPP project as incentives. At the project level, regarding the form of interfirm temporal organization in a PPP project, formal and informal institutions shall be developed from the perspective of project networking [65]. Mutual monitoring among the individual firm executives could be utilized as a governance mechanism, under which the authority, incentive, and channels for communication and influence among the project team members could be enhanced for the improvement of project sustainability [66]. Also, the industry tournament incentives could be initiated to stir up the sustainable commitment of construction firms [67]. At the firm level, the leadership of individual project team members towards corporate social responsibility is essential to fulfilling their commitment to achieving project sustainability [68]. In doing so, a certain level of organizational decentralization is recommended, since the power of CEO is reported to be negatively correlated with a firm's choice to engage in CSR activities [57]. Also, the intrafirm compensation incentives shall be well designed to stimulate collective efforts towards the common goal of sustainable project performance in construction projects.

6. Conclusions, Limitations, and Future Work

A performance measurements system is one of the effective approaches to ensure the economic, environmental, and social sustainability of PPP projects in the long run. In this study, a system of five-dimension sustainable performance measurements for PPP projects was proposed based on the literature review. A questionnaire survey was conducted to solicit professional opinions on its effectiveness based on the respondents' PPP experience in China. A total of 79 valid responses were received, among which five respondents participated in individual interviews to express their understanding of current sustainable project measurement practice in their experience with PPP projects. It was revealed that the five dimensions of sustainable performance measurements are all valued in the current practice, though with varying extent of importance, and the emphasis on those sustainable performance measurement dimensions was increasing. Other than the primary requirement of short-term project goals and profit maximization for the private sector, long-term economic and social benefits are gaining more attention from the PPP practitioners in China. In practice, it is critical to ensure the PPP project progress in a sustainable way by balancing the interests and satisfaction among all the main stakeholders. As well, the arrangement or emergency plan to deal with an unreasonable imbalance among the five dimensions shall be made along with the longitudinal management of the sustainable performance measurement system.

The proposed five-dimension sustainable performance measurement system shall be adopted at the early stage of a PPP project as common goals for the main project team members. Along with this process is the proper design of formal and informal institutions of the interorganizational project networking to ensure the system effectiveness and the members' commitments to project sustainability. The system shall be well executed throughout the design, construction, operation, and maintenance stages in order to meet the targets of project sustainability for all stakeholders in the project life cycle. The external environment of policies, industry initiatives, and the internal governance mechanisms at the project and firm levels are both important. Chinese governments' commitments to sustainable and high-quality economic development have been comprehensively transforming the construction industry through their strong influences on construction companies. A number of sustainable performance indicators are quickly gaining popularity in China's PPP projects, and the sustainable considerations in China's PPP experiences shall and will spread to other countries, for instance, through the "Road-and-Belt" initiatives.

The study has significant contributions both theoretically and practically. Theoretically, the proposed five-dimension sustainable performance measurements system provides a new perspective to the theoretical debates on the sustainable development of PPP projects. The survey results provide empirical evidence of Chinese construction professionals' practice towards the sustainability enhancement currently in PPP development, and it is a valuable reference for the improvement of sustainable performance measurements. Practically, the findings have significant implications for the public sector to refine project performance evaluation methods and to adopt effective incentive mechanisms to promote PPP development in a more sustainable manner. Meanwhile, this questionnaire survey serves as an educational experience for the PPP pioneers in China to develop sustainability concerns.

The PPP development in China is moving at a rapid pace, and this study is framed, in terms of knowledge generalization, by the limited respondents and their PPP experiences. In future work, similar questionnaire surveys shall be issued to a wider range of construction professionals, and by doing so, it is perceived to see the sustainability improvement in China PPP practice in a dynamic way. The five-dimension sustainable performance measurements shall also be refined through theoretical discussions and practitioners' feedback to embrace more sustainable concerns and to better catch the essence in each measurement item. A good measurement system must be matched with proper institutional settings and effective governance mechanisms at industry, project, and firm levels. Future research work in this direction shall be encouraged to realize the promised project sustainability for all stakeholders in the long run.

Author Contributions: Conceptualization, Y.L. and H.W.; Methodology, Y.L. and H.W.; Software, Y.L.; Validation, Y.L. and H.W.; Formal Analysis, H.W.; Data Curation, Y.L.; Writing-Original Draft Preparation, Y.L. and H.W.; Writing-Review & Editing, H.W.; Project Administration, Y.L.; Funding Acquisition, Y.L.

Funding: This work was supported by the Humanities and Social Science Foundation of the Ministry of Education of China (Grant No. 18YJC630084).

Conflicts of Interest: The authors declare no conflict of interest.

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