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STRUCTURAL EQUATION MODEL-BASED PERFORMANCE MEASUREMENT SYSTEM FOR TRANSFERRING PPP WATER PROJECTS: A CHINA PERSPECTIVE

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Abstract. A series of performance measurement need to be carried out throughout the project life cycle to ensure the successful transfer of public-private partnership (PPP) assets and meet stakeholder needs. More and more water projects are stepping into the transfer phase, but less studies carry out in-depth and systematic discussion on the performance measurement of PPP water projects at the transfer phase. Hence, to fill this gap, this research establishes a new performance measurement system (PMS) for evaluating the performance of the PPP projects stepping into the transfer phase based on the key performance indicators (KPIs). Through case study, expert interview and questionnaire, this paper formulates the logical basis behind PPP water projects at the transfer phase and subsequently constructs the transfer performance measurement system (TPMS) of these projects. Then, it conducts a confirmatory analysis of the impact relationship between the indicators based on structural equation modeling (SEM). Findings of expert interview and questionnaire indicate that there are 7 primary and 26 secondary indicators, and the model has a good fit. The TPMS will provide governments, operators and other stakeholders with a comprehensive and complete understanding as to indicators required of an effective performance measurement of PPP water projects.

Keywords: PPP, water sector, transfer phase, performance measurement.

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1. Introduction

The PPP mode has become the most important trend in the global public construction industry (Garvin & Bosso, 2008). The UK launched the "Private Finance Initiative (PFI)" program as early as 1992 and upgraded it to "Private Finance 2 (PF2)" in 2012 (Quiggin, 2019). According to the World Bank (2017a) data, there are 5,800 PPP infrastructure projects in 139 low- and middle-income countries, with a total investment of US$ 1,429.869 billion (from 1990 to July 2017).

The duration of cooperation in PPP projects generally lasts 10–30 years. The long cooperation period of PPP projects and the large number of stakeholders involved makes them much more complex than traditional projects, which indicates that a better complete PMS should be developed to manage PPP projects (Mladenovic et al., 2013). Whether the transfer phase goes smoothly in the whole-of-life cycle will affect the sustainable development level of the project, but most PPP projects have not yet approached this phase, hence the less attention given to it, however, successful completion of the transfer phase directly affects the public interest. Researchers from all over the world discuss PPP project at the transfer phase on risk management (Shrestha et al., 2017; Opawole et al., 2019), opportunistic behavior management (Wang et al., 2019) and transfer successful factors (Yuan et al., 2009). The above research provides a good foundation for a comprehensive understanding of the transfer phase.

Study on PPP performance measurement has become key topic in PPP project management (Liu et al., 2016). According to the regulations of related organizations on the performance management of PPP projects, projects should run through its whole-of-life cycle (Okudan et al., 2020). In other words, the performance management of PPP projects should not only involve the project preparation, procurement, or implementation phases, but should also include the transfer phase (Bao et al., 2022). However, a few studies focus on transfer phase, most researchers carry out research on construction phase (Xu et al., 2022), operation phase (Sun et al., 2019; Ming et al., 2021; Su & Cao, 2022) and whole life circle of PPP projects (Yao & Chen, 2012; Ismail et al., 2021).

In addition, some widely used PPP reference guides in the world can provide a certain reference for the transfer of PPP projects, such as the Caribbean PPP Toolkit (World Bank, 2017c), PPP Certification Guide published by APMG (World Bank, 2016), etc., and also provide some useful suggestions for transfer management. But the recommendations in these guidelines are too broad and theoretical to provide specific guidance on transfer practice in a given area.

In general, there exist various theories on project performance indicators and research methods, most of these focus on the preparation, construction, and operation phases of PPP projects, with only a few studies on the transfer phase (Liu et al., 2015a).

Water projects are the foundation for the construction and development of agriculture and industry (Surachman et al., 2022; Savenije, 2002). The water sector refers to a collection of entities that produce and provide water products and services, mainly water, sewer, and stormwater systems and services, and also includes some corresponding derivative industries, such as production and utilization of reclaimed water, treatment of sludge (Grigg, 2002). According to the World Bank's PPP annual report, 51 projects were in the water sector in 2019 with a total investment of $4 billion, which is a 5% increase from $3.8 billion in 2018. Most of these investment commitments came from China, which accounted for 83% of the investment in the water sector involving 44 projects with a total investment of $3.3 billion. Other countries such as Brazil, Côte d'Ivoire, Uzbekistan, and Mexico have also made water investment commitments (World Bank, 2019). PPP water projects contain a number of stakeholders and more fixed assets and

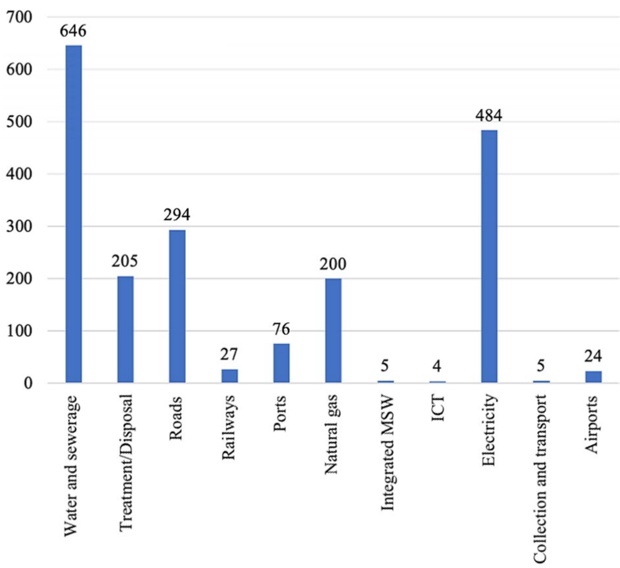

Figure 1. China's PPP projects achieving financing closure from 1990 to 2021 (World Bank, 2017a, 2019, 2020)

technical staff which makes it more complex to manage, so it is of great significance to take water sector as typical sector to discuss PMS (Dharmapuri et al., 2020).

In particular, water sector is as a key sector for developing PPP projects in China, as early as the mid-1990s, one of the three PPP pilot projects initiated by the central government included a water project, with these projects about to gradually reach the transfer phase. Since China's water projects have a long history of development and have a sufficient number of projects and investment, taking China's water projects as the research object has high reference significance (Qian et al., 2020). Figure 1 shows the PPP projects (by industry) that have achieved financing closure in China from 1990 to 2021, indicating that a large proportion of PPP projects are in China's water industry.

More and more water projects are stepping into the transfer phase, but less studies carry out in-depth and systematic discussion on the performance measurement of PPP water projects at the transfer phase – which is a key gap this study seeks to address considering successful completion of the transfer phase directly affects the public interest (Yuan et al., 2015; Cui et al., 2018). As for the key influencing factors of transfer success, the relevant research has not analyzed the correlation among these factors and the degree of influence on transfer success in detail, while structural equation modeling (SEM) method can systematically analyze the multivariate relationship and find out the key influencing path. The research related to water performance management is of great urgency, and practitioners should pay more attention to performance measurement of PPP water projects at the transfer phase and construct the influence path. Meanwhile, PPP projects involve many industries, but a systematic industry-by-industry and phase-by-phase PPP project PMS remains unformulated (Kim & Thuc, 2021). Therefore, this paper exploratively carries out performance measurement research of PPP water projects of the transfer phase and establishes the TPMS of PPP water projects.

The specific research objects can be summarized into the following two aspects:

1. Establish the transfer performance measurement indicators system of PPP water projects: identify the performance indicators of PPP water projects at the transfer phase, evaluate the importance of the above indicators, and determine the key performance indicators of PPP water projects.
2. Clarify the influence relationship and influence path among key performance indicators based on SEM: Analyze the influence relationship and influence path among key performance indicators determined in objective 1 based on SEM.

2. Literature review

PPP mode can achieve "the best combination of cost and quality in the whole-of-life cycle", and the performance measurement of PPP mode will measure the rationality and benefit of operation of PPP projects, and put forward suggestions for improvement.

In different research, researchers have different opinions on the division results of the whole-of-life cycle of PPP mode. However, the existing research on the performance of PPP mode is mostly carried out for each phase of PPP project, and there is correlation among phases. Therefore, this paper clarifies the division of the whole-of-life cycle of PPP mode.

Performance measurement is the focus of this research. By reviewing the related research on performance measurement, this paper finds that the existing performance measurement of PPP projects is mostly concentrated in the design, construction and operation phases. Meanwhile, there are few studies on the transfer phase, and most of them focus on the risk management and successful factors of transfer. It is worth noting that the successful completion of the transfer phase will directly affect the public interest, so the performance research at the transfer phase is essential.

2.1. The whole life cycle theory of PPP projects

The "whole-of-life cycle" theory is the key theoretical basis for using the PPP model to deliver public services because it considers the costs and benefits of the whole-of-life cycle of the project and maximizes efficiency of service delivery. In order to fully understand the differences of existing research on the whole-of-life cycle of PPP projects, and then make up for the insufficiency of improving the management efficiency of PPP whole-of-life cycle, it is necessary to make the systematical review on PPP literature from the perspective of the whole-of-life cycle.

The Project Management Institute defines the project life cycle as a series of successive phases from start to end (Project Management Institute, 2013). The life cycle of a construction project can generally be divided into four phases: feasibility study, design, construction, and operation (Zou et al., 2007). Although different projects have different phases of life cycles, the common factors can be summarized to establish the basic framework of project management such as naming each life cycle phase and determining the number of phases depending on available factors including project management system, construction purpose, participants, and project characteristics, among others.

PPP infrastructure projects are usually large-scale projects that require continuous operation and maintenance (Price Water House Coopers, 2010). This includes projects such as water projects, power plants, roads, bridges, and railways. Due to the complexity of PPPs, many governments and organizations, such as the World Bank (WB), Asian Development Bank (ADB), the Australian Department of Infrastructure and Regional Development (DIRD), and the European Investment Bank (EIB), among others, have compiled reference guides for developing PPP projects. By summarizing these common guidelines, the detailed PPP project life cycle can be divided into 8 phases: project identification, project preparation, bidding, preferred bidder, contract signing, design, construction, operation, and transfer (World Bank, 2017b; Asian Development Bank, 2008). The European Investment Bank also proposes that project procurement includes bidding, preferred bidder, and contract signing, while project implementation includes its design, construction, operation, and transfer, revising the four phases clearer and more concise (European Investment Bank, 2012). The Chinese Ministry of Finance (2014) divides the life cycle of PPP projects in a similar way to that of EIBs, with the difference being that project transfer is defined as a separate phase to emphasize that the government needs to take more responsibility at the project transfer phase. Meanwhile, in other phases (i.e., design, construction, and operation), the project is primarily in the responsibility of the project company. Moreover, the infrastructure that has been transferred will continue to provide products or services to the public, which can be considered as a post-transfer operational phase. In general, different scholars have different results on the phase of PPP project whole-of-life cycle in different research, and there is an interactive relationship between phases. For ease of discussion, this study divides the whole-of-life cycle of PPP projects into six phases (Figure 2).

2.2. Project performance measurement theory

In the construction industry, performance used to be mainly reflected by several factors, such as cost, time and quality, but practitioners found that it was no longer enough to describe complex construction projects (Kagioglou et al., 2001; Ward et al., 1991). This section starts from the theory of project performance measurement, reviews the related research of performance measurement, and summarizes the commonly used performance measurement methods in the construction industry, so as to provide reference for the performance measurement at the transfer phase.

Performance refers to the measurement of the effectiveness of behavior, which usually refers to the dynamic process of an individual or organization to complete a certain task or achieve a certain goal. Performance measurement, sometimes referred to as performance measurement or performance appraisal, is the process of quantifying and

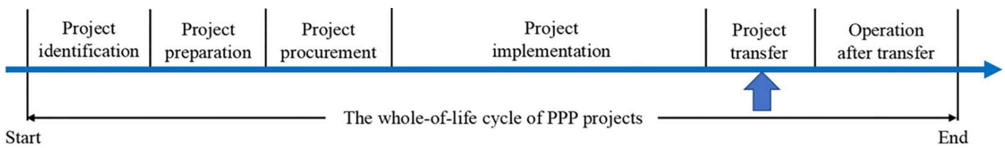

Figure 2. Phase division of the whole-of-life cycle of PPP projects (adapted from European Investment Bank, 2012; Chinese Ministry of Finance, 2014)

reporting on the effectiveness and efficiency of actions taken to impact an organization's strategic goals and is a results-oriented management method (Neely et al., 2005). Historically, the construction industry has been criticized for its poor performance, hence many researchers have emphasized the use of performance measurement to improve its current situation. Lin and Shen comment on the performance measurement of the construction industry, and argue that the large increase in relevant and recently published studies is caused by three reasons (Lin & Shen, 2007). First, the performance measurement method has been applied in other industries in a rapid way. Second, construction projects are becoming more complex. Third, the industry's project management and technology have developed rapidly. Before, performance measurement of construction projects focused on time, cost, and quality (Ward et al., 1991; Kagioglou et al., 2001). With the development of performance measurement technology, performance measurement has expanded to the level of project companies and project stakeholders whose indicators include customer satisfaction, business performance, health, safety, environment, among others (Yu et al., 2007; Yang et al., 2010).

PMSs may include various forms, but the design and implementation process of these different types of PMSs are nonetheless alike. Table 1 summarizes the overall process of effectively designing and implementing a PMS. For the specific design of different systems, it is necessary to consider both the purpose of measurement and the characteristics of the project or organization. For example, between traditional and PPP projects, or even between different project phases, each exhibit their own unique and contextual characteristics, hence the different areas of focus when carrying out performance measurement.

Performance measurement is regarded as a revolutionary concept in the field of management, which also originated in the field of business, now spread throughout other industries (Luu et al., 2010; Neely, 1999). Currently, researchers and practitioners focus on parameters that measure organizational performance through metrics and data from projects (Goshu & Kitaw, 2017). To better monitor the project, many methods have been developed to evaluate overall performance (Nassar & Abourizk, 2014). This includes well-known methods such as the S-curve method (Moselhi et al., 2004), the Program Review Technique (PERT) (Fleming & Koppelman, 2000), the Earned Value Management System (EVMS) (Colin & Vanhoucke, 2015), and the Stochastic S-curve (SS) (Barraza et al., 2000). Many researchers such as Bassioni et al. (2004), Beatham et al. (2005), Horta et al. (2010), Lin et al. (2011), Khosravi and Afshari (2011), Haponava and Al-Jibouri (2012) have also proposed other frameworks and models of performance management systems (PMS).

Some performance measurement frameworks composed of a set of indicators or standards have been formed and adopted in the construction industry. Overall, three types of models are more commonly used: (1) the European Foundation for Quality Management (EFQM) model, (2) the Balanced Score Card (BSC) model, and (3) the Key Performance Indicator (KPI) model (Yang et al., 2010).

Table 1. The design and implementation process of a PMS (adapted from Poister, 2003)

No.	Procedure	Definition
1	Ensure that managers agree the evaluation system	The system getting support from some key groups (eg, senior managers, intended users of the system, customer groups, sponsor groups, experts, etc.) will be more effective.
2	Organize the evaluation system development process	–
3	Determine the purpose and parameters of the evaluation system	The purpose of the performance evaluation system is closely related to the management and decision-making process, and the parameters are mainly related to the evaluation scope and constraints.
4	Determine work results and other performance criteria	Questions involved: What are the key indicators for monitoring performance? What are the results of performance evaluation? How do concepts such as efficiency, quality, output, customer satisfaction apply to this specific area, etc.
5	Define, evaluate and select evaluation indicators	This procedure is the central procedure of performance evaluation, involving the specific definition, evaluation and selection of relevant performance indicators.
6	Develop a data collection program	There are a variety of ways to get data of performance evaluation, and collection quality should be paid more attention to while ensuring data credibility.
7	Describe the system design process in detail	The frequency and route of reporting depends largely on the specific purpose of the evaluation system. For the form of analysis and reporting, regardless of the technique or means employed, strive to represent the data in the clearest and most meaningful way. In addition, developing a software to support the performance evaluation system will greatly improve the speed of data entry, processing, reporting, and reporting.
8	Perform system tests	Testing the system increases the likelihood that the system will work effectively.
9	Implement the system	–
10	Use, evaluate and modify the system	The management system is faced with challenges. In the early stage, attention should be paid to monitoring the operation of the system and evaluating its effect in time. It is possible to rely on experience to make recommendations for revising goals and propose about performance standards.

In general, most of the current performance measurement methods are greatly simplified in practice, and many important aspects are ignored when describing the success of PPP projects. At present, there are a few performance measurement methods suitable for PPP mode, but the commonly used methods are typical and referential, which will provide reference for subsequent research.

2.3. PPP project performance measurement research at the transfer phase

Performance measurement research is the basis of PPP project transfer performance measurement research, it is worth noting that the successful completion of the transfer phase will directly affect the public interest, so it is indispensable to study the performance measurement of the transfer phase. Therefore, this section reviews the project performance measurement, the main research at the transfer phase and the performance research at the transfer phase, and clarifies the importance and necessity of the performance measurement research at the transfer phase.

Firstly, the research of PPP project performance measurement should be paid attention to. PPP project performance measurement is based on the project objectives and interests of project stakeholders (e.g., investors, contractors, constructors, government, the public, etc.), from the perspectives of investment, process control, results, and effects, where a comprehensive and objective measurement of all aspects of the project is provided (Bao et al., 2019). To ensure the successful transfer of PPP assets and meet stakeholder needs, a series of performance measurements need to be carried out throughout the project life cycle to ensure that they are "future-proof" (Liu et al., 2014; Luu et al., 2008; Love et al., 2015). Hence, performance measurement of PPP projects has received considerable attention. For example, Yuan et al. (2009) proposed an innovative performance measurement framework, the key performance indicator system (KPIs), to comprehensively evaluate PPP projects. Haponava and Al-Jibouri (2012) proposed process-based KPIs to evaluate the performance of PPP projects. After a relatively comprehensive literature review on PPPs (e.g., critical success factors, roles of public authorities, concessionaire selection, risk management, cost and time issues, and finance), Liu et al. (2015b) proposed a conceptual framework for PPP performance measurement. Meanwhile, Love et al. (2015) proposed a life-cycle-based performance measurement method and also incorporated BIM (Building Information Modeling) technology.

Secondly, as mentioned, a PPP project can be divided into six phases, where the transfer phase is a key phase in its whole-of-life cycle, but few studies focus on the PPP project performance measurement at the transfer phase. The progress of the transfer process greatly affects the success of subsequent operation phase. Meanwhile, performance management systems designed for projects should focus on process-based measurement with measurement performed at each phase (Haponava & Al-Jibouri, 2012).

Given this, this study takes PPP water projects as the research object and conducts a performance measurement study of its transfer phase based on KPI model. The transfer performance measurement is the measurement of the series of actions (e.g., transfer preparation, asset overhaul, asset assessment, etc.) taken to successfully transfer the project. Shrestha et al. (2017) identify the key risk factors at the transfer stage of wastewater treatment projects, which provides a reference for the division of the transfer stage. Opawole et al. (2019) identify the key risk factors of BOT mode and proposed conceptual allocation and mitigation measures for each risk factor. Wang et al. (2019) investigate the influence of the standby letter of credit in the transfer stage (SLOT) on private investors' opportunistic behavior and establish a model that can meet and constrain the needs of both government and private investors. Yuan et al. (2009) point out that the successful transfer of PPP projects may require factors such as new employee training, transfer price and project facilities standards when transferring, which provides a reference for the transfer performance measurement system. In addition, Chan et al. (2005) use IDEF0 method to construct the whole-of-life cycle process model of BOT projects. Furthermore, Bao et al. (2019) develop a generic transfer process model with hierarchical processes and sub-processes, which includes the discussion of transfer performance measurement.

Meanwhile, there are few literatures related to PPP performance measurement. For example, Yao and Chen (2012) summarize PPP performance management techniques and practices, analyze key performance indicators and explain how these indicators improve PPP project performance. Ismail et al. (2021) examine the important performance indicators of PPP projects in the whole-of-life cycle. Xu et al. (2022) study the performance of PPP project at the construction phase based on BIM technology. Most researchers study the performance measurement at the operation phase. Ming et al. (2021) take 17 typical expressway PPP projects as examples to select measurement indicators, and establish the performance measurement indicators system at the operation phase from three dimensions, namely, output, effect, and management. Sun et al. (2019) construct an operational performance measurement system for waste treatment projects. Su and Cao (2022) develop a performance monitoring and measurement model for water environment treatment public-private partnership projects. The above performance management research can provide reference for the performance measurement at the transfer phase, and make the performance management research in the whole-of-life cycle of PPP continuous and complete.

However, these researchers focus on the risk management or the performance measurement of the whole work process at the transfer phase, don't discuss the implementation process of transfer performance measurement in detail. For most PPP projects, the transfer phase will eventually come, and whether the transfer phase can be successfully completed will directly affect the public interest.

Therefore, the transfer phase needs further study to ensure the successful transfer of PPP infrastructure projects and the sustainable provision of public services or products.

3. Methodology

3.1. Research framework

Figure 3 shows the study's research framework. Through a comprehensive literature review, the work logic of PPP water projects at the transfer phase was systematically established and the main indicators of performance measurement during the transfer process were preliminarily identified.

To further coincide with the development status of PPP water projects, this paper selects 2 projects: the Chengdu No. 6 Water Plant B Project and the integrated urban-rural water supply and drainage project as benchmark cases to improve the logical model of PPP water projects at the transfer phase. The former case is China's first BOT (Build-Operate-Transfer) pilot water project led by the government and is also the only PPP water project in the country that has been transferred after contract expiration. Most of China's PPP water projects refer to its development process and adopt a similar governance structure, risk allocation, and payment mechanism, etc. This project can therefore be used as a benchmark for China's PPP water projects. Summarizing its transfer process aids the transfer management of other similar projects. Meanwhile, the latter project is part of the third batch of national-level demonstration projects, the first batch of provincial-level demonstration projects, and the first PPP project participated by the Sichuan Provincial PPP Guidance Fund. The project includes three public-private partnership models of TOT (Transfer-Operate-Transfer), ROT (Retrofit-Operate-Transfer), and BOT. It is a large-scale and successfully operated PPP project which can be used as a case to study the operation characteristics of water PPP projects.

The case study benefits from access to an unusually large number of informative secondary sources because the performance of these two projects is under immense scrutiny from local governments, professional bodies and the media. Data is obtained from publicly available sources such as the relevant reports of local government websites and media web pages, so as to reflect the real progress of case projects. Due to the voluminous secondary data available, it needs to be filtered after the collection. In this study, the secondary data is compared and verified through multiple channels, and invalid or incorrect information is eliminated, so as to keep the secondary data relevant to the study and more accurate. In addition, we also conduct semi-structured interviews with the senior managers of these two projects to understand the views and experiences of the core participants, which can be used as supplementary materials for the secondary data of these two projects. Respondents are usually the direct stakeholders of the project, and their perception of the project can often prove the secondary data obtained as mentioned above, and even dig out some contents that are difficult to be reflected by secondary data from their interviews. All interviewees agree to have their interviews recorded and transcribed, during the interview, the interviewees will mainly elaborate the case project according to the interview theme. After the interview is completed, the interview content will be summarized, which will help us to further understand the operational characteristics and transfer logic of water PPP projects, and at the same time assist us to develop and improve the logical model for the transfer of PPP water projects. Finally, the improved logical model of the transfer process of PPP water projects is shown in Figure 4.

To verify the reliability and implementation of the PMS, this study designed a questionnaire and conducted semi-structured interviews with 3 practitioners with rich experience in PPP projects. These practitioners evaluated the rationality of the questionnaire and answered it to determine the clarity of the indicators presented.

The survey of the questionnaire adopted the focal sampling method to identify experts with sufficient expertise – these experts must have at least one practice or research experience in PPP water projects. According to these projects' implementation process, the respondents might come from 5 sources: 1) universities/research institutions; 2) public authorities; 3) private sectors; 4) consulting institutions; and 5) contracting enterprises. Herein, questionnaires were distributed to potential target groups by sending questionnaire links through online (social media based) and offline roundtable meetings. To ensure that the respondents accurately comprehend the research's purpose and content, the questionnaire was accompanied by the study's definition of "water sector" and "PPP transfer phase" along with a brief introduction of the research objectives. "Water sector" refers to a collection of entities that produce and provide water products and services, mainly water, sewer, and stormwater systems and services, and also includes some corresponding derivative industries, such as the production and treatment of sludge generated after utilization and sewage treatment. "PPP transfer phase" refers only to the transfer when the concession expires, excluding the case of early termination of the contract.

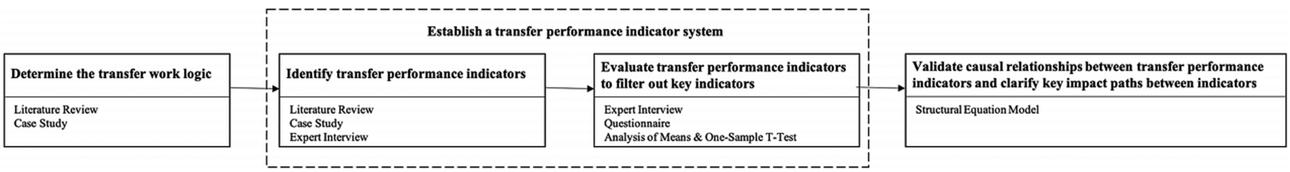

Figure 3. Research framework

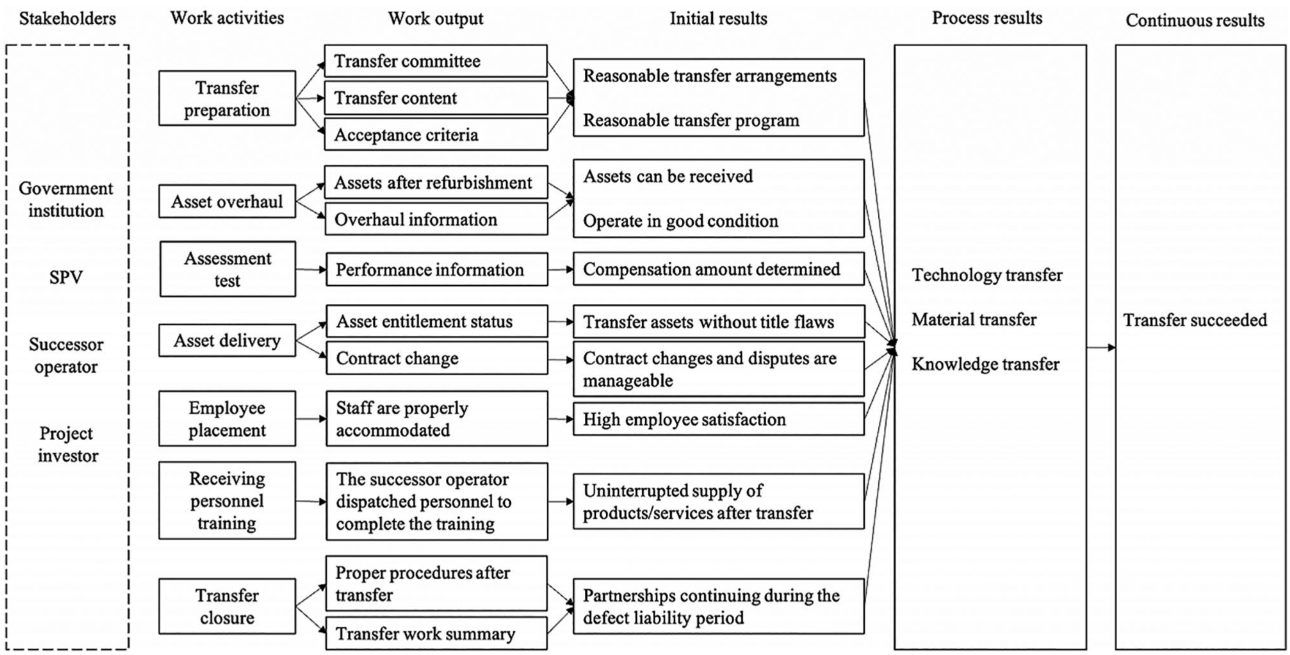

Figure 4. The logical model for the transfer of PPP water projects

Table 2. Cronbach.α test results of transfer performance indicators survey (sample size N = 134)

Transfer phase	Transfer preparation	Asset overhaul	Assessment test	Asset delivery	Employee placement	Receiving personnel training	Transfer closure	The whole process of transfer
Number of projects	5	2	4	4	2	3	6	26
Cronbach.α	0.901	0.851	0.927	0.926	0.811	0.931	0.931	0.976

Although 140 questionnaires were recovered, only 134 valid questionnaires were obtained, hence an effective recovery rate of 95.7%. After the reliability and validity test, the questionnaire has a good performance in the consistency of multiple responses and its accuracy is close to the true value. The test results are shown in both Table 2 and Table 3. Nearly half of the respondents are either senior managers or have senior professional titles, indicating that they can answer the questionnaire from multiple perspectives. The basic information of the respondents is shown in Table 4.

The collected data are first analyzed for means and one-sample t-tests using the Statistical Package for Social Sciences (SPSS) to identify key transfer performance indicators. The Structural Equation Modeling (SEM) method is then used to construct a logical model between the indicators to unveil the relationship between the indicators of the performance measurement involved in the transfer process of the PPP water projects and transfer closure.

3.2. SEM

To unveil the relationship between transfer performance indicators and transfer closure, the SEM Method can be used. This method reflects the relationship between latent variables by establishing a structural model and establishes a measurement model to reflect the relationship between latent and observed variables (Boomsma, 2005). Otherwise, it can also test model assumptions by questionnaire.

Table 3. KMO and Bartlett's test results of transfer performance indicators survey

KMO		0.945
Bartlett's Test of Sphericity	Approx. Chi-Square	3511.919
	df	325.000
	P value	<0.001

In socioeconomics and management research, variables such as intelligence, motivation, project characteristics, and customer satisfaction cannot be accurately and directly measured – and are hence called latent variables. Although latent variables cannot be directly and accurately measured, they can be estimated in some indirect ways. For example, some observed indicators can be used to measure those latent variables – commonly used statistical analysis methods such as multiple regression analysis and multivariate correlation analysis are generally used to explore and discover objective laws from existing data, which are, in essence, exploratory analysis method and therefore cannot handle these difficult-to-measure latent variables well. To solve such problems, Swedish statistician and psychometrician Joreskog and Sorbom (1993) proposed the Structural Equation Model (SEM) in the early 1970s, a confirmatory analysis model. The model can measure the above-mentioned latent variables and their corresponding indicators well.

There are three main steps to implement SEM (Cozzetto, 1994): the first step is to establish a model, including identifying its indicators, determining the relationship between these indicators and making assumptions, which are preliminary preparations for model fitting. Next is to confirm the validity of the indicators of latent variables, evaluate the overall fitness of the model through indicators such as CMIN, DF, CMIN/DF, GFI, CFI, TLI, RMSEA, etc., and continuously modify the model to meet fitness requirements. The last step is to calculate the causal relationship coefficient between variables, confirm the relationship between these variables through regression or path analysis between variables, and then verify the hypothesis.

After review of literature, case studies, and expert interviews, this paper clarifies the logical model of PPP water projects at the transfer phase and establishes an initial model of the relationship between transfer performance indicators and transfer closure, as shown in Figure 5. All performance indicators and closure work indicators listed in the questionnaire are regarded as observed variables and presented in square boxes while the seven latent variables in the structural model are therein presented in oval boxes. In the measurement model, each latent variable is connected to its observed variable through a one-way arrow. In the structural model, each latent variable is also connected to others through a one-way arrow. For example, transfer preparation can be represented by the 5 measurement variables X11– X15, arrows point from the oval box to the square box and the oval box of transfer preparation points to the remaining 6 oval boxes of latent variables, respectively.

A total of 134 valid samples were recovered in this study which belong to a medium-sized sample of 100–200 and is sufficient to support a stable model (Kline, 2005).

4. Results

4.1. Analysis of the importance of performance indicators

First, this paper analyzes the mean value of 134 samples and obtains the importance scores of 7 primary and 26 secondary indicators. Next, it uses a one-sample t-test to verify whether the above indicators are all key transfer performance indicators.

After mean analysis, the mean scores of the following seven primary indicators are ranked from highest to lowest: X1 – transfer preparation (score: 4.10); X4 – asset delivery (score: 4.04); X2 – asset overhaul (score: 3.98); X3 – assessment test (score: 3.93); X7 – transfer closure (score: 3.91); X6 – receiving personnel training (score: 3.76); and X5 – employee placement (score: 3.72). Transfer preparation, as the primary procedure of transfer work, is related to the development of the entire transfer work.

Table 4. Basic information of the survey sample (N = 134)

Statistical variables	Category	Frequency	Percentage
Workplace	Universities/Research institutions	26	19.4%
	Public authorities	22	16.4%
	Private sectors	34	25.4%
	Consulting institutions	40	29.9%
	Contracting enterprises	11	8.2%
	Others	10	7.5%
Position / Title	Senior manager / Senior title	61	45.5%
	Middle manager / Middle title	44	32.8%
	Ordinary employee / Junior title	27	20.2%
	Others	2	1.5%
Years of experience in PPP related work	3 years and below	42	31.3%
	4–7 years	51	38.1%
	8–10 years	20	14.9%
	11–15 years	11	8.2%
	16–20 years	8	6.0%
	21 years and above	2	1.5%
Industries involved in or researched on PPP projects	Energy	28	20.9%
	Transportation	62	46.3%
	Water	83	61.9%
	Municipal Engineering	91	67.9%
	Others (comprehensive urban development, new industrial city, education, agriculture, ecological environment management, water, highway engineering, etc.)	21	15.7%

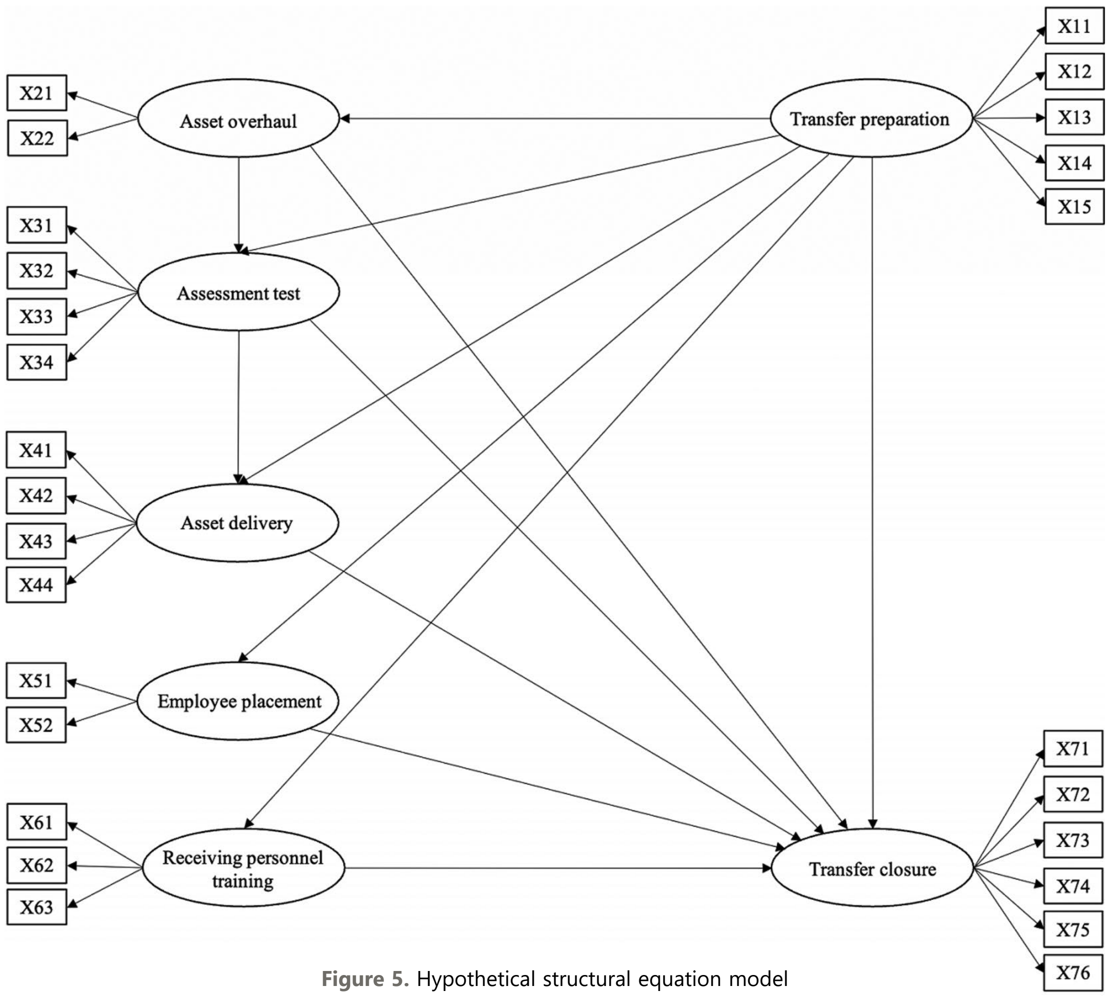

Figure 5. Hypothetical structural equation model

If the transfer preparation is subpar, properly carrying out the subsequent transfer work will also be difficult. Therefore, it follows that the transfer preparation score is the highest. The low scores in both employee placement and receiving personnel training follow actual expectations because during the questionnaire survey, some experts point out that these two work activities have less impact on the entire transfer process compared to other activities and consume human, financial, and material resources relatively less. Receiving personnel training is relatively simple in terms of procedures and the nature of work compared to other transfer activities. Moreover, fewer projects at the transfer phase lead to changes in the nature of employees' work or benefits, hence receiving personnel training and employee placement have less effects on transfer performance measurement. For PPP water projects, labor is both an asset and a stakeholder, so it is reasonable to list these two items for measurement at the transfer phase. Therefore, these two primary indicators are retained in the final questionnaire. Table 5 shows the mean of these indicators.

This study also conducts a one-sample t-test on the samples of transfer performance indicators survey which examines the overall mean of the transfer performance indicators to see if they are statistically significant at a 95% confidence level, have a p-value of 0.05, and a test-value of 3.00. The null hypothesis (H0) is that the mean is statistically insignificant. Meanwhile, the alternative hypothesis (H1) means that mean is otherwise. If the p-value is less than 0.05, H0 should be rejected, hence the relevant transfer performance indicators can be determined as key transfer performance indicators. Table 6 shows a summary of the results of the transfer performance indicators significance test.

As shown in Table 6, the standard p-values of all indicators are all less than 0.05, indicating statistical significance. Therefore, of the entire 26 transfer performance indicators are all crucial for effectively evaluating the transfer performance of China's PPP water projects, and thus can be defined as key transfer performance indicators.

4.2. Construction of the comprehensive model

Unexpectedly, the initial model shows good results in various fitness measurements. As shown in Table 7, in the overall fitness measurement, other indicators (save for the low GFI value) show that the model fits well. Based on the measurement results of each index, it can be considered that the overall fit of the hypothetical model in this study is good. Therefore, the model remains unrevised and the initial model is also the final one.

Table 5. Mean analysis of transfer performance indicators survey (N = 134)

Primary indicator	Secondary indicator	Mean	
		Primary indicator	Secondary indicator
X1 – Transfer preparation	X11 – Effective communication between all parties involved	4.14	4.10
	X12 – Successor operator matching in a timely manner	4.04	
	X13 – Scientific and clear acceptance criteria	4.13	
	X14 – Reasonable transfer scheme	4.16	
	X15 – Sufficient number of transfer management executives with matching competencies	4.01	
X2 – Asset overhaul	X21 – Restorative repairs to assets on time	4.04	3.98
	X22 – Complete asset repair report	3.91	
X3 – Assessment test	X31 – Carry out asset performance assessment tests on time	3.99	3.93
	X32 – Complete fixed assets evaluation report	3.93	
	X33 – Complete equipment performance evaluation report	3.97	
	X34 – Determine compensation amount on time and in reason	3.82	
X4 – Asset delivery	X41 – Assets without any restricted legal status	4	4.04
	X42 – Complete technology transfer	4.07	
	X43 – Complete knowledge transfer	3.97	
	X44 – Complete material transfer	4.1	
X5 – Employee placement	X51 – Hire/Receive project company/private employee filing	3.72	3.72
	X52 – Employee satisfaction	3.71	
X6 – Receiving personnel training	X61 – Personnel completing training on time	3.78	3.76
	X62 – Scientific and reasonable training program	3.73	
	X63 – Complete training content	3.78	
X7 –Transfer closure	X71 – Transfer on time	3.96	3.91
	X72 – Fit the budget	3.91	
	X73 – Safe and environmentally friendly	4.09	
	X74 – Effective risk management	3.99	
	X75 – Continued partnership	3.74	
	X76 – Stakeholder satisfaction	3.79	

Table 6. The summary of transfer performance indicators significance test

Transfer performance indicator	t	df	Sig. (2-tailed)	Mean difference	95% confidence interval for difference	
					Lower limit	Upper limit
X11	14.925	133	< 0.001	1.1418	0.9905	1.2931
X12	13.275	133	< 0.001	1.0373	0.8828	1.1919
X13	15.025	133	< 0.001	1.1343	0.9850	1.2837
X14	16.489	133	< 0.001	1.1567	1.0180	1.2955
X15	13.518	133	< 0.001	1.0075	0.8600	1.1549
X21	13.966	133	< 0.001	1.0448	0.8968	1.1927
X22	12.220	133	< 0.001	0.9105	0.7631	1.0578
X31	13.286	133	< 0.001	0.9851	0.8384	1.1317
X32	13.556	133	< 0.001	0.9328	0.7967	1.0689
X33	13.367	133	< 0.001	0.9702	0.8266	1.1137
X34	10.277	133	< 0.001	0.8209	0.6629	0.9789
X41	12.503	133	< 0.001	1.0000	0.8418	1.1582
X42	13.481	133	< 0.001	1.0746	0.9170	1.2323
X43	12.959	133	< 0.001	0.9702	0.8221	1.1182

End of Table 6

Transfer performance indicator	t	df	Sig. (2-tailed)	Mean difference	95% confidence interval for difference	
					Lower limit	Upper limit
X44	15.126	133	< 0.001	1.0970	0.9536	1.2405
X51	9.020	133	< 0.001	0.7239	0.5651	0.8826
X52	8.957	133	< 0.001	0.7090	0.5524	0.8655
X61	10.222	133	< 0.001	0.7836	0.6320	0.9352
X62	10.053	133	< 0.001	0.7313	0.5874	0.8752
X63	10.195	133	< 0.001	0.7761	0.6255	0.9267
X71	13.462	133	< 0.001	0.9552	0.8149	1.0956
X72	12.346	133	< 0.001	0.9105	0.7646	1.0563
X73	14.479	133	< 0.001	1.0896	0.9407	1.2384
X74	13.286	133	< 0.001	0.9851	0.8384	1.1317
X75	9.970	133	< 0.001	0.7388	0.5922	0.8854
X76	10.348	133	< 0.001	0.791	0.6398	0.9423

Table 7. Model fit indexes for the SEM

Goodness-of-fit measure	Final SEM	Recommended level of GOF measure	Results	Reference
CMIN	516.953	The smaller the better		
DF	286	The smaller the better		
CMIN/DF	1.808	< 3 Excellent; < 5 Acceptable	Good fit	
GFI	0.792	> 0.8 Acceptable; > 0.9 Excellent	Poor fit	Bagozzi and Yi (1988)
CFI	0.933	> 0.9	Good fit	Bentler (1989)
TLI	0.924	> 0.9	Good fit	Bollen (1989)
RMSEA	0.078	< 0.1 Acceptable; < 0.08 Excellent	Good fit	Steiger and Lind (1980)

In addition, IBM Amos28.0 software is used to calculate the regression coefficients between the indicators and evaluate the model fit. A significance level less than 0.05, signifies a significant relationship between the indicators. Among 34 paths, only 5 paths are more than 0.05 (gray shaded areas in Table 8), while significance level of the remaining is less than 0.05. PPP water projects transfer performance indicators structural equation standardization model is shown in Figure 6 (Ng et al., 2010; Cho et al., 2009). The combined reliability is calculated by Eqn (1) below:

$$\rho_c = \frac{\left(\Sigma\lambda\right)^2}{\left[\left(\Sigma\lambda\right)^2 + \Sigma\theta\right]}, \quad (1)$$

where λ – indicator loading; θ – indicator error variance.

The higher the combined reliability, the higher the internal consistency. Fornell and Larcker (1981) consider that a combined reliability above 0.6 is acceptable. The combined reliability of transfer preparation, asset overhaul, assessment test, asset delivery, employee placement, receiving personnel training, and transfer closure are at 0.893, 0.851, 0.931, 0.929, 0.813, 0.933, and 0.932, respectively. Since all are greater than 0.7, this indicates that the model fit is ideal.

According to the standardized model, in the structural model, the coefficient of transfer preparation on asset overhaul, employee placement, and receiving personnel training during the transfer process is more than 0.8. Among the measurement model, X31, X42, X62 and X63 all reach above 0.9, indicating strong explanations for their corresponding primary indicators.

5. Discussion

According to the fitting results of the standardized structural equation model of the transfer performance indicators of PPP water projects, there is a correlation between the transfer performance indicators as shown in Table 8.

5.1. Structural model indicators

In the structural model, transfer preparation has an absolute effect on asset overhaul, employee placement, and receiving personnel training during the transfer process. Transfer preparation is the first step in the transfer phase, and it is important to arrange the transfer process in an orderly manner, because many tasks, such as asset overhaul, asset evaluation and performance testing, should be completed in a relatively short time (usually one to two years) before the franchise expiration date (European Investment Bank, 2012). Otherwise, the transfer cannot be carried out as planned, and conflicts may arise. This conflict is clearly reflected in the transfer preparation of the project of Chengdu No. 6 Water Supply Plant B.

Table 8. Model regression coefficients

Correlation Path	Unstandardized regression coefficients	Standard error	Critical ratio	p	Standard regression coefficients
Asset overhaul <--- Transfer preparation	0.890	0.093	9.557	< 0.001	0.859
Assessment test <--- Asset overhaul	0.617	0.147	4.209	< 0.001	0.611
Assessment test <--- Transfer preparation	0.357	0.141	2.529	0.011	0.341
Asset delivery <--- Assessment test	0.268	0.105	2.549	0.011	0.271
Asset delivery <--- Transfer preparation	0.719	0.122	5.916	< 0.001	0.695
Employee placement <--- Transfer preparation	0.815	0.103	7.899	< 0.001	0.809
Receiving personnel training <--- Transfer preparation	0.979	0.092	10.587	< 0.001	0.862
Transfer closure <--- Transfer preparation	0.158	0.271	0.585	0.559	0.163
Transfer closure <--- Receiving personnel training	0.153	0.094	1.621	0.105	0.179
Transfer closure <--- Employee placement	0.174	0.100	1.747	0.081	0.181
Transfer closure <--- Asset delivery	0.375	0.176	2.123	0.034	0.400
Transfer closure <--- Asset overhaul	–0.276	0.171	–1.614	0.107	–0.295
Transfer closure <--- Assessment test	0.317	0.162	1.954	0.051	0.341
X12 <--- Transfer preparation	0.997	0.096	10.358	< 0.001	0.786
X13 <--- Transfer preparation	0.972	0.093	10.488	< 0.001	0.793
X14 <--- Transfer preparation	0.941	0.085	11.100	< 0.001	0.826
X22 <--- Asset overhaul	1.000				0.857
X21 <--- Asset overhaul	1.013	0.081	12.436	< 0.001	0.864
X34 <--- Assessment test	1.000				0.806
X33 <--- Assessment test	1.001	0.081	12.432	< 0.001	0.888
X32 <--- Assessment test	0.960	0.076	12.657	< 0.001	0.899
X31 <--- Assessment test	1.055	0.081	13.045	< 0.001	0.917
X44 <--- Asset delivery	1.000				0.880
X43 <--- Asset delivery	1.020	0.072	14.225	< 0.001	0.870
X42 <--- Asset delivery	1.151	0.071	16.150	< 0.001	0.921
X41 <--- Asset delivery	1.036	0.081	12.846	< 0.001	0.826
X52 <--- Employee placement	1.000				0.785
X51 <--- Employee placement	1.124	0.118	9.495	< 0.001	0.870
X63 <--- Receiving personnel training	1.000				0.919
X62 <--- Receiving personnel training	0.961	0.054	17.893	< 0.001	0.924
X61 <--- Receiving personnel training	0.962	0.061	15.701	< 0.001	0.878
X71 <--- Transfer closure	1.000				0.842
X72 <--- Transfer closure	1.092	0.081	13.446	< 0.001	0.886
X73 <--- Transfer closure	1.020	0.088	11.554	< 0.001	0.810
X74 <--- Transfer closure	1.095	0.082	13.385	< 0.001	0.883
X75 <--- Transfer closure	0.976	0.088	11.046	< 0.001	0.787
X76 <--- Transfer closure	1.013	0.091	11.153	< 0.001	0.792
X11 <--- Transfer preparation	1.000				0.805
X15 <--- Transfer preparation	0.902	0.094	9.637	< 0.001	0.745

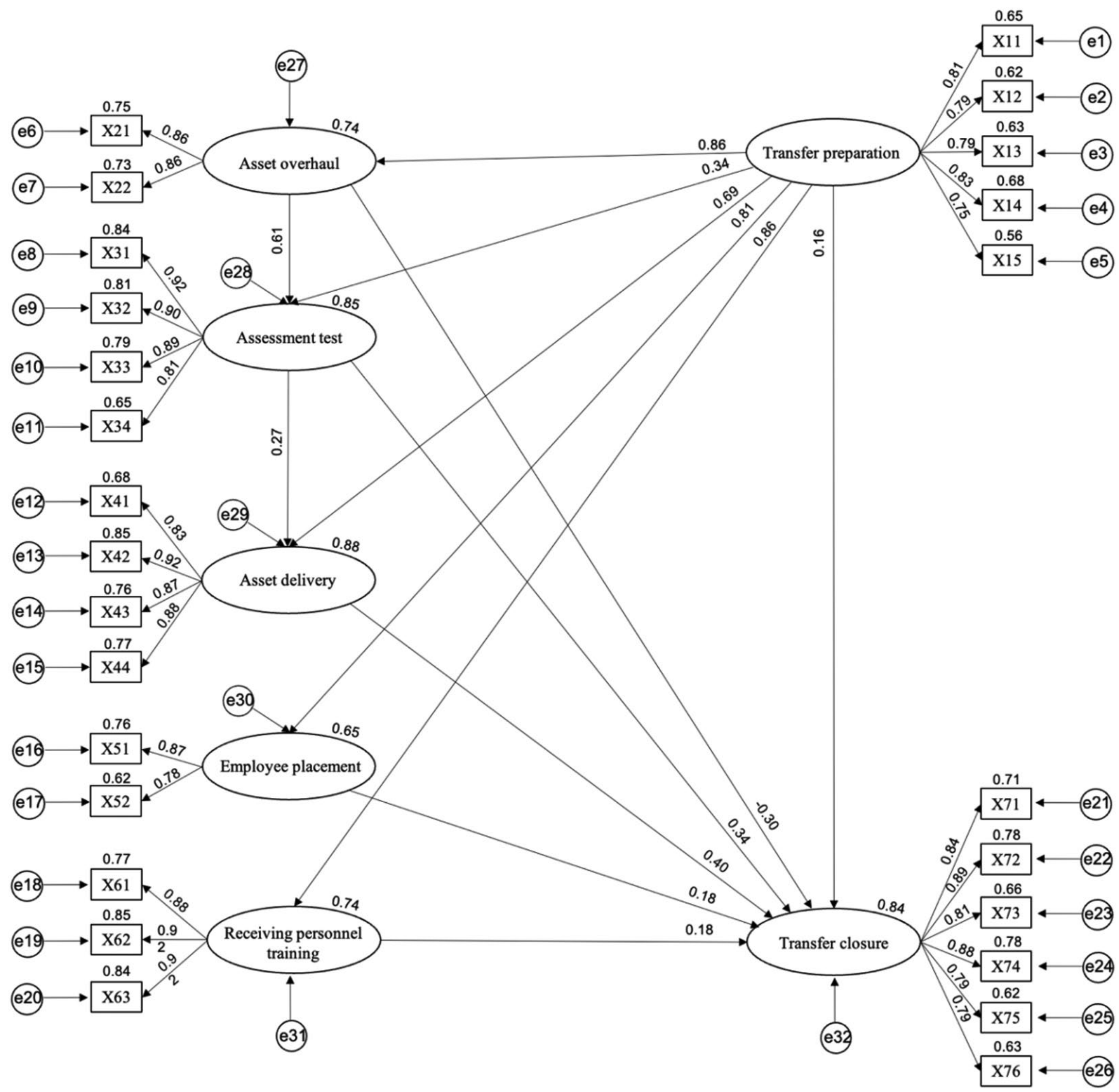

Figure 6. PPP water projects transfer performance indicators structural equation standardization model

Before the first transfer committee meeting was held on August 11th, 2015, the special purpose vehicle (SPV) submitted a preliminary transfer plan to public authority, and the transfer preparations for the project went smoothly at the beginning. However, surprisingly, it took a long time for the two sides to reach an agreement on the details of the transfer plan. The stalemate between the two sides continued until the scheduled start time of the asset overhaul, and the discussion on the transfer arrangement has never made substantial progress. Considering its own interests, the SPV decided to unilaterally start the overhaul work that had to be carried out after the transfer arrangement was issued, and at the same time, the SPV continued to negotiate with the Chengdu public authority on the transfer plan. In this situation, the Chengdu public authority can only make a compromise in the negotiations with the private sector, because the former cannot take into account the lengthy negotiation process and the necessary overhaul supervision process at the same time. The confusion caused by this procedure inversion further undermines the efficiency of negotiations, and at the same time, it also puts the overhaul process at risk of poor supervision. Therefore, before transferring the PPP project, it is necessary to formulate a set of the scientific and reasonable asset overhaul plan and acceptance criteria and ensure the asset overhaul works smoothly. Moreover, employee placement and receiving personnel training should likewise be considered in the transfer preparation process, and these two tasks can be incorporated into the detailed plan for transfer arrangements for overall implementation. The impact of transfer preparation on asset delivery and assessment test is also significant, therefore, during the transfer phase of a PPP project, key indicators such as transfer preparation should also be controllable.

The effect of asset overhaul on the assessment test is comparable to the effect of transfer preparation on asset delivery, which is significant according to the model calculation result. During the transfer process, the project company must first perform a restorative overhaul on all the assets to be transferred, and the government or its designated agency will then conduct value assessment and performance measurement tests on the overhauled assets where the results of the assessment test are related to the amount of compensation and the subsequent work of asset delivery, among others. An important feature of PPP water project is that the production process depends on a large number of facilities and equipment. This feature means that there are many facilities and equipment involved in the overhaul list for water PPPs. However, because there is no overhaul guide or experience of PPP water project generally recognized by the industry in China, the formulation of overhaul plan has to go through a long and controversial negotiation process. In other words, the more the overhaul list contains, the more disputes there will be. In the Chengdu No. 6 Water Plant B Project, there are more than 180 facilities and equipment involved in the overhaul plan, so it is difficult to reach a consensus on the details of the overhaul quickly. In addition, the clauses involved in the final recovery overhaul in the franchise agreement cannot provide effective help, but bring more controversy. For example, the agreement requires that the asset overhaul should include "inspection and repair, crack detection, testing and replacement of worn and defective parts". However, the contract does not specify under what conditions the parts need to be repaired or replaced. Therefore, both the private sector and the public authority understand the terms with unclear definitions from their own perspective, which leads to disputes. Therefore, asset overhaul is also an important procedure in transfer performance measurement process. The effect of each primary indicator on the transfer closure is relatively small because transfer closure work is mainly to improve the relevant procedures after the transfer and determine the matters for the continued operation of the project. For the transfer phase of the PPP water projects, the transfer closure does not directly bring output. As the final procedure of the transfer process, it seeks to coordinate the measurement of the implementation of the abovementioned other work activities. Therefore, the impact of these measurement indicators on transfer closure is relatively limited.

5.2. Measurement model indicators

Firstly, among the measurement models in the seven transfer performance measurement dimensions, the correlation coefficients of X31 (carry out asset performance assessment tests on time), X42 (complete technology transfer), X62 (scientific and reasonable training program), and X63 (complete training content), corresponding to their primary indicators at above 0.9. These findings are consistent with practical cognition. As mentioned above, assessment test is an important link in the transfer process, and the assessment test work is also controlled by transfer preparation and asset overhaul. Considering that the infrastructure will inevitably depreciate after decades of continuous service (Yuan et al., 2015), it is necessary for the public authority to require the private sector to thoroughly overhaul the infrastructure before transfer. After the overhaul, all relevant facilities and equipment should also be evaluated and tested to ensure that they reach acceptable conditions. Therefore, it is very important to carry out the asset performance evaluation test on time, so as to the public authority can confirm whether all the problems identified in the previous link have been successfully solved and whether the project status has reached the expected level, so that the remaining steps in the transfer stage can be carried out to ensure the smooth transfer. Asset delivery refers to the completion of asset transfer procedures according to the transfer arrangement, including the transfer of related technologies, rights and the handling of liabilities. In the transfer stage of water PPPs, private sector and SPV should actively fulfill their transfer obligations based on the transfer list. All transferred facilities, equipment and related assets shall not be bound by any property rights such as security right or mortgage or pledge, nor shall they have any creditor's rights or claims. For the transfer of water PPPs, matters related to technology are very important, because many existing PPP projects are built and operated by international water companies with independent research and development technology (such as the Chengdu No. 6 Water Plant B Project). Using the advanced technology and skills of private sector is one of the motives for the public authority to adopt PPP mode (Zhang et al., 2016), and this assertion is also true for most local governments in China and their authorized market entities, because their experience and knowledge in managing water projects are relatively lacking (Zhong et al., 2008). In other words, the technological gap between the public authorities and private sectors provide opportunities for cooperation between the two sides. However, when the project enters the transfer stage, this technical gap may also become a problem, because if the technology transfer is not complete, the project may encounter technical problems and affect the normal operation of the project in the future. Therefore, in the asset delivery stage, it is necessary to pay attention to the transfer of technology to prevent technical risks. When a water PPP project enters the transfer stage, most stakeholders may have successfully achieved their goals throughout the franchise period, and some of them, such as construction subcontractors and creditors, have even ended or are ready to end their participation in the project. For these stakeholders, the impact of the transfer process is limited. However, for stakeholders such as project employees and the public, their interests may be significantly affected by the transfer. For example, for project employees, because the project recipients may refuse to accept some employees, the interests of employees will be harmed. Therefore, before the transfer of the project, the SPV should conduct in-depth communication in advance to understand the real thoughts of employees. If the transfer causes employees to leave, make sure to inform them of the follow-up arrangements, and at the same time recruit vacant positions and conduct necessary training for new employees in time. The training plan for project recipients shall be submitted to the public authorities for approval, and training shall be conducted in strict accordance with the training plan. After the training is completed, the SPV and the asset receiver can carry out a joint examination to ensure that the designated personnel have reached the qualified requirements after training and are capable of operating, maintaining and managing the handed-over water PPP project. These measures will further guarantee the success of the transfer and the sustainable operation of the assets after the transfer. Secondly, X15 (sufficient number of transfer management executives and matching competencies) has the weakest correlation with transfer preparation, but nonetheless reached 0.745. Finally, the other secondary indicators also have strong correlation with the primary indicators and the difference of the results are discreet. Based on the previous analysis, the measurement dimensions of the transfer performance indicators divided by this study are reasonable and the TPMS is also relatively complete, which can be used as a reference indicator system for the transfer performance measurement of PPP water projects.

6. Conclusions

Based on project performance measurement, this study combines the essential characteristics of PPP water projects at the transfer phase by using a case analysis of two of these projects to establish a logical model for PPP water projects transfer work. This paper systematically establishes the TPMS for assessing the performance of PPP projects, aiding stakeholders to comprehensively monitor the process of the transfer phase and enrich the knowledge base of PPP projects, thereby helping practitioners to better implement them. This study draws some conclusions from both theoretical and practical perspectives.

According to the research results, the influence relationship and the influence path among the transfer performance indicators are clarified. Most studies of PPP mode have explored the related problems in the construction and operation phases, but researchers pay a little attention on the transfer phase, which because only a few PPP projects have reached this phase. Considering that the success of the transfer will affect the sustainability of the project, after the establishment of the TPMS, this paper explores the relationship among the influence factors and the relationship between the influence factors and the transfer success. The operation results of SEM show that the TPMS established in this study is reasonable, which will provide theoretical and practical support for decision makers.

According to the practical applications, all these experiences show that due to the lack of experience of local governments in PPP project transfer, more time is needed to decide the appropriate project recipients and acceptance conditions, which is the key factor of follow-up activities. Therefore, the public authority must promote relevant work before the formal transfer stage begins. At the same time, the SPV should complete the preparation of the preliminary asset overhaul plan, transfer list and employee placement. After having a clear understanding of their respective responsibilities and needs, both parties can get together and have an effective discussion on the transfer details to verify the rationality of the transfer arrangement and acceptance criteria. In addition, in practice, since most PPP water project contracts in China are based on the Chengdu project contract (Chen, 2009), the problems caused by the vague definition of the transfer stage in the franchise agreements of these projects will be more common. Therefore, both parties should also realize that the transfer arrangements may be constantly revised according to the feedback factors at all stages of transfer. In this case, it is helpful for the public authority and private sector to improve the rationality of their respective needs and shorten the negotiation time,so as to promote the successful transfer of the project.

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Author contributions

Chuan Chen and Jinchan Liu conceived the study and were responsible for the design and development of the data analysis. Chuan Chen, Jinchan Liu and Lin Huang were responsible for data collection and analysis. Jinchan Liu and Lanqian Zhang were responsible for data interpretation and wrote the first draft of the article, Jinchan Liu, Lanqian Zhang and Chuan Chen were responsible for the revision of the article.

Disclosure statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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