Conceptual Framework for the Performance Measurement of Public-Private Partnerships

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Abstract: Public-private partnerships (PPPs) have been used widely to deliver economic and social infrastructure projects. There has been widespread debate about the factors that contribute to their success and failure. Critical to their successful implementation is effective performance measurement of the projects. With this in mind, a comprehensive review of the normative literature in association with PPPs (e.g., critical success factors, roles of public sector, concessionaire selection, risk management, cost and time issues, and finance) is undertaken and a conceptual framework for dynamic life-cycle is proposed. The paper provides both public sector and private entities with an insight into effective and efficient performance measurement within the context of PPP infrastructure projects. DOI: 10.1061/(ASCE)IS.1943-555X.0000210. © 2014 American Society of Civil Engineers.

Author keywords: Performance measurement; Public-private partnerships; Infrastructure projects.

Introduction

Over the last 20 years, the delivery of infrastructure projects using public-private partnerships (PPPs) has enabled governments to better provide public services, such as health, education, water supply, transport, and electric power to communities (Pongsiri 2002). There have been many PPP successes and some failures reported in the normative literature (Hodge 2004; Regan et al. 2011a, b), though debate about their use has moved beyond ideological arguments about the advantages and disadvantages to focusing on how they can be structured to achieve public policy goals (Yong 2010). “To achieve the potential benefits that can be provided by PPPs they must be designed to deliver performance improvements within a framework that shares costs and risks between the public and private sectors” (Yong 2010).

The PPP markets of Australia and the United Kingdom, for example, are considered to be sophisticated and mature (Hodge 2004). Yet, despite their maturity with implementing PPPs, ineffective performance measurement has been identified as a factor that has contributed to the problems associated with the delivery of the Latrobe Regional Hospital and Deer Park Women’s Prison in Victoria, Australia, and Ashfield Prison in the United Kingdom (Yago 2002; House of Commons 2003; Roth 2004). According to Yuan et al. (2009), the absence of effective performance measurement in PPPs acts as a trigger for producing below optimum service quality of infrastructure. However, many PPP projects have not undergone a comprehensive form of ex post evaluation in terms of what has been delivered (Hodge 2005; Regan et al. 2011b), and limited research has been undertaken to discuss how to comprehensively measure PPP infrastructure project performance (Hodge and Greve 2007; Yuan et al. 2009). There is widespread consensus that performance measurement plays a decisive role in business success, particularly at the project level (Love and Holt 2000; Kagioglou et al. 2001; Bassioni et al. 2004; Qureshi et al. 2009). Moreover, monitoring and measuring performance are the core activities of contract and project management, which is an essential part of PPP policy in most countries, especially Australia and the United Kingdom (Chinyio and Ganeson 2009; EIB 2012). Against this contextual backdrop, this paper provides a review of the literature on PPPs and construction project evaluations, and proposes a conceptual dynamic life-cycle performance measurement framework for PPP infrastructure projects.

Scope of PPP Research

Various definitions of PPP can be found in the normative literature. For example, the European Investment Bank (EIB 2004) suggests that PPPs are “the relationships formed between private sector and public bodies often with the aim of introducing private sector resources and/or expertise in order to provide and deliver public sector assets and services.” The Public Private Infrastructure Advisory Facility (PPIAF) in Europe provides a definition in which a PPP “involves the private sector in aspects of the provision of infrastructure assets or of new or existing infrastructure services that have traditionally been provided by government.” There is no universally accepted definition of a PPP and its meaning differs between countries. Essentially, governments embrace PPPs as they offer the following benefits (European Commission 2003):

- Accelerated infrastructure provision through allowing the public sector to translate capital expenditure into a flow of on-going service payments (income);
• Timely project implementation through the allocation of design and construction responsibility to private sector;
• Reduced whole life cost and motivated performance offered by the strong incentives of private sector to minimise costs and improve management over a project’s life-cycle;
• Reduced government risk exposure by transferring such risks to private sector;
• Improved service quality and innovation through the use of private sector expertise and performance incentives; and
• Enhanced prudent management of public expenditure and reduced corruption by the increase in accountability and transparency.

The defining features of PPPs, against other forms of private participation in infrastructure, include risk transfer, long-term contract relationships and partnership agreements (Akintoye et al. 2003; Zhang 2004b). Kwak et al. (2009) state that “the complexity of contractual relationships between participants, and the long concession periods associated with PPPs, makes them distinct from a traditional infrastructure development routes.” A review of the normative literature reveals that there are six core areas where research has been focused (Fig. 1):

1. Critical success factors (CSFs): CSFs are defined as “those few key areas of activity in which favourable results are absolutely necessary for a particular manager to reach his or her goals” (Rockart 1982). The identification of CSFs is considered to be the prerequisite in developing a PPP project protocol (Zhang 2005b). Hence, many studies have attempted to list the CSFs of PPP projects within the qualitative context (e.g., Tiong 1996; Qiao et al. 2001; Jefferies et al. 2002; Li et al. 2005a; Zhang 2005b; Jefferies 2006).

2. Roles and responsibilities of public sector: The public sector performs a pivotal role in facilitating PPP infrastructure projects (Tam and Leung 1997). A factor that has been identified as contributing to the failure of PPP projects is a lack of public sector support. A series of roles that the government can undertake to ensure the successful outcome of a PPP have been identified and include: (1) creating positive investment environment; (2) establishing sound regulatory framework and supportive authority; (3) selecting an appropriate concessionaire; and (4) constant involvement throughout a project’s life-cycle (Kumaraswamy and Zhang 2001; Pongsiri 2002; Koch and Buser 2006; Abdel Aziz 2007).

3. Concessionaire selection: “A concessionaire is a consortium formed particularly for a PPP project” (Kwak et al. 2009). It is the principal participant mainly responsible for most of the stages of a PPP project. Zhang (2004a) suggests that the selection of a suitable concessionaire can significantly influence the success of a PPP project. A number of studies have been undertaken in an attempt to explain how to select the most suitable concessionaire for a PPP infrastructure project (e.g., Treasury Taskforce 1999; Ahadzi and Bowles 2001; Zhang and Kumaraswamy 2001; Zhang et al. 2002; Zhang 2004a, b, 2005a).

4. Risk management: Risk identification, analysis, and allocation are critical in PPP projects, where the liability of the private investor in design and construction is limited and the public sector primarily faces the financial and operational risks. A plethora of studies have examined PPP risks and have provided valuable insights into PPP risk identification and allocation (e.g., Charoenpornpattana and Minato 1999; Wang et al. 2000a, b; Grimsey and Lewis 2002; Thomas et al. 2003; Li et al. 2005b; Xenidis and Angelides 2005a, b; Nisar et al. 2007; Sachs et al. 2007; Jin 2010, 2011; Xu et al. 2010; Chan et al. 2011). Fundamentally, risks in PPPs can be classified as the following: market risks, which arise due to uncertainties in the market demand for the infrastructure; planning risks, which arise from planning for private sector participation; project risks, which relate to uncertainties in construction, completion, operation and financing; political risks, which relate to wars, civil disturbances, and breach of contract; regulatory risks, which arise from a lack of suitably developed regulatory system; and systemic risks, which arise owing to fluctuations in exchange rates and changes in interest rates.

5. PPP cost, time and contract characteristics: It is common knowledge that cost and time savings center in any PPP infrastructure projects. In the literature, the time and cost performance of PPPs is implicitly linked to the project CSFs (NAO 2003; Raisbeck et al. 2010). Further, the characteristics of PPP contracts are significantly relevant to the cost and time of the projects. Considering this perspective, many researchers have explored PPP cost and time issues in association with the characteristics of specific contracting approaches (Herbsman and Gliagola 1998; Zietlow 2005; Anastasopoulos et al. 2009, 2010b, c, 2013b).

6. PPP finance: The success of a PPP project depends largely on well-planned financing. However, financing a PPP project is characterized as a difficult and complex task. This is because of the sheer number of internal and external factors that must be considered when initiating a PPP financing plan. A number of studies have attempted to uncover the complexity of PPP finance in areas such as the financing strategy and financial engineering (Levy 1996; Merna and Dubey 1998; Ye and Tiong 2000; Schaufelberger and Wipadapisotund 2003; Zhang 2005c; Devapriya 2006).

While an array of studies have investigated the initiation and outcome of PPPs over the past two decades, there have been limited attempts to examine them from a process management perspective (see Fig. 1) (Yuan et al. 2009; Liu et al. 2013). Process management is important for business success, whether it is at the organizational or project levels (Kagioglou et al. 2001). Theoretically, process management is an application of knowledge, skills, techniques, and systems to measure and improve the process to satisfy customer requirements (Smith and Fingar 2003). Effective and competitive processes are critical success factors for PPP projects (Jefferies et al. 2002; Koppenjan 2005). Performance measurement forms the heart of process management (Lebas 1995; Bititich et al. 1997), but has surprisingly received limited attention within the project life-cycle of PPPs (Robinson and Scott 2009; Yuan et al. 2009; Liu et al. 2013).

**Performance Measurements in PPP Projects**

Performance measurement is a process of quantifying and reporting the effectiveness and efficiency of the action performed towards influencing organizational objectives (Lebas 1995; Neely et al. 2005). Strategic objectives form the foundations of performance...
measurement (Solomon and Young 2007), PPP infrastructure projects have a common strategic objective: the achievement of best value, which emphasises efficiency, value for money (V/M) and performance standards (Akintoye et al. 2003; Zhang 2006b). This strategic objective covers the issues in relation to the “public client’s overall strategic plan and mission objectives, private sector’s long-term development and payoff strategy, the general public’s requirements of quality public facilities and services” (Yuan et al. 2009). V/M is a key component of best value. It has been viewed as the principal benchmark of the strategic objective of PPPs in the majority of the countries across the world (Akintoye et al. 2003; Grimsey and Lewis 2005; Henjewele et al. 2011). The Treasury Taskforce (1998) of the United Kingdom states that PPPs should be used only if they provide better V/M than traditional procurement. The Office of Government Commerce in the United Kingdom (2002) defines V/M as “the optimum combination of whole life cost and quality to meet the user’s requirement.” V/M focuses on overall outcomes achieved, covering a wide range of issues within qualitative and quantitative contexts such as whole life cost, service quality, maintainability, social benefits, and sustainability (Partnerships Victoria 2001; Department of Treasury and Finance 2007).

The V/M of PPP projects in Australia and the United Kingdom is typically determined and revealed by the public sector comparator (PSC) (Treasury Taskforce 1999). The PSC is a comparison between the cost of proposed PPP projects and the benchmark cost, which is a cost estimation of the specific service using traditional procurement (Grimsey and Lewis 2005). Due to the PSC’s focus on cost, the evaluations of PPP projects in Australia and the United Kingdom have been oversimplified (NAO 2000; Department of Transport 2002; Fitzgerald 2004; Allen Consulting Group 2007). In the rest of the world (e.g., EU countries other than the United Kingdom, the United States, South America, Africa, New Zealand, and Asia), cost performance also plays a dominant role in PPP project evaluations (Haskins et al. 2002; Sachs et al. 2005; Blanc-Brude et al. 2006; Anastasopoulos et al. 2011). Some values of PPPs in infrastructure development may not be entirely reflected by cost, but expanded by other issues such as project completion time and project quality (Yong 2010). Public sector projects regularly experience cost and schedule growth, particularly those that have been procured using traditional procurement (Grimsey and Lewis 2004; Kwak et al. 2009). Thus, several studies attempted to incorporate time into the evaluations of PPPs (NAO 2003; Zietlow 2004; Raisbeck et al. 2010). Table 1 provides a summary of the key studies that are concerned with the evaluations of PPPs with the comparison of traditional lump-sum projects. It can be seen that PPPs have generally performed better than traditional projects (i.e., in-house), especially in cost savings, where 4.5–50% costs can be saved in various types of PPPs. While Raisbeck et al.’s (2010) research is akin to previous studies they reveal that PPPs generate slightly more (but almost negligible) project delays than traditional procurement (2.5% versus 2.3%).

The evaluation integrated with V/M in a PPP project is a complicated process, and the uses of absolute time and cost measurements do not reflect the complexity associated with PPP delivery (Office of Government Commerce 2002; European Commission 2003). Amos (2004) suggests that the evaluations of PPPs should involve the performance indicators of technical efficiency, allocative efficiency and financial performance. However, technical, allocative and financial measures are still insufficient to fully capture V/M, because such critical issues as key stakeholders’ satisfactions (i.e., public client) cannot be addressed properly in these measurements (Henjewele et al. 2011).

Given the potential problems of evaluating PPPs, a comprehensive and strong evaluation is required for PPP projects (Hodge and Greve 2007). Yuan et al. (2009) propose an innovative performance measurement framework, namely key performance indicators system (KPIS), to comprehensively evaluate PPPs. The KPIS consists of five measurement aspects: (1) project’s physical characteristics; (2) financial and marketing indicators; (3) innovation and learning indicators; (4) stakeholders’ indicators; and (5) process indicators.

Despite the comprehensiveness of Yuan et al.’s (2009) proposed framework, issues associated with performance measurement have been largely ignored. In the case of stakeholder and process indicators, Neely et al. (2001) suggest that the relationship between organization and stakeholders is reciprocal in nature, and performance measurement should highlight not only stakeholder satisfaction, but also their contribution to the organizations. A development process of a PPP is more complex than that of traditional lump sum projects and it is divided into a series of phases (EIB 2012). Failing to assess the performance of each phase in PPPs may lead to that

### Table 1. Key Findings of Studies of PPP Evaluations

<table>
<thead>
<tr>
<th>Authors</th>
<th>PPP projects</th>
<th>Traditional lump sum projects</th>
</tr>
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<tbody>
<tr>
<td>Arthur Anderson Enterprise LSE (2000)</td>
<td>Cost: 17% savings</td>
<td>N/A</td>
</tr>
<tr>
<td>NAO (2000)</td>
<td>Cost: 10–20% savings</td>
<td>N/A</td>
</tr>
<tr>
<td>Department of Transport (2002)</td>
<td>Cost: 20% overruns</td>
<td>N/A</td>
</tr>
<tr>
<td>Haskins et al. (2002)</td>
<td>Cost: 30–40% savings</td>
<td>N/A</td>
</tr>
<tr>
<td>Mott MacDonald (2002)</td>
<td>Cost: 50% savings</td>
<td>Time: 4–39% overruns</td>
</tr>
<tr>
<td>Pakkala (2002)</td>
<td>Cost: 14–20% savings</td>
<td>N/A</td>
</tr>
<tr>
<td>NAO (2003)</td>
<td>Time: 76% on time</td>
<td>Time: 30% on time</td>
</tr>
<tr>
<td>Liatatad (2004)</td>
<td>Cost: 91% on budget</td>
<td>N/A</td>
</tr>
<tr>
<td>Zietlow (2004)</td>
<td>Cost: nearly 30% savings</td>
<td>N/A</td>
</tr>
<tr>
<td>Sachs et al. (2005)</td>
<td>Cost: 10–20% savings</td>
<td>N/A</td>
</tr>
<tr>
<td>Blanc-Brude et al. (2006)</td>
<td>Cost: 1–25% savings</td>
<td>N/A</td>
</tr>
<tr>
<td>NSW Auditor-General (2006)</td>
<td>Cost: 24% extra cost (ex ante evaluation)</td>
<td>N/A</td>
</tr>
<tr>
<td>Allen Consulting Group (2007)</td>
<td>Cost: 7–23% savings</td>
<td>N/A</td>
</tr>
<tr>
<td>Anastasopoulos et al. (2010a)</td>
<td>Cost: 11% savings</td>
<td>N/A</td>
</tr>
<tr>
<td>Raisbeck et al. (2010)</td>
<td>Cost: 4.53% savings</td>
<td>N/A</td>
</tr>
<tr>
<td>Anastasopoulos et al. (2011)</td>
<td>Time: 2.5% overruns</td>
<td>Time: 2.3% overruns</td>
</tr>
<tr>
<td></td>
<td>Cost: 1.2–11.6% overruns</td>
<td>Cost: 13.8–91.5% overruns</td>
</tr>
<tr>
<td></td>
<td>Significant cost savings</td>
<td>N/A</td>
</tr>
</tbody>
</table>
the evaluation for the underlying projects cannot comprehensively measure the project performance on the basis of VfM (Henjewele et al. 2011; Liu et al. 2013).

Performance Measurement in Construction

Designing a performance measurement framework to measure business and project related processes is a complex and challenging task. The concept of performance measurement has received a considerable amount of attention as it is a critical activity that organizations must perform in order to achieve their strategic goals (Neely et al. 2005), especially for those operating in the construction industry where both organizational and project goals need to be met (Love and Holt 2000; Bassioni et al. 2004). Performance measurement in construction has been focused on three levels: (1) industry; (2) corporate; and (3) project (Elyamany et al. 2007), with emphasis being placed on key performance indicators (KPIs) and performance measurement systems (Bassioni et al. 2004; Haponava and Al-Jibouri 2012).

“KPIs are measures that are indicative of performance of associated process” (Beatham et al. 2004). Establishing KPIs have become the most popular performance measurement metric in the construction sector (Bassioni et al. 2004; Beatham et al. 2004; Chan and Chan 2004; Haponava and Al-Jibouri 2010; Lai and Lam 2010). Table 2 identifies the KPIs that have been developed in relation to the performance measurement of construction projects. Most construction organizations measure performance on the basis of traditional quantitative methods, such as financial reports and at the project level using time, cost, quality, and safety. Although KPIs have been widely applied in performance measurement in construction, their use has received a great deal of criticism. For instance, Bassioni et al. (2004) contend that the use of KPIs for internal decision-making processes is limited as they provide no insight into performance improvement. Moreover, KPIs are lagging indicators and thus cannot be used in monitoring and improving the work when the project is under construction (Kagioglou et al. 2001; Haponava and Al-Jibouri 2012).

Apart from KPIs, performance management systems (PMSs) have also been considered in construction (Alarcon and Ashley 1996; Kagioglou et al. 2001; Bassioni et al. 2005; Lai et al. 2008a; Chan 2009). A PMS “is a structure in which strategic, tactical and operational actions are linked to process to provide the information required to improve the program or service on a systemic basis” (del-Rey-Chamorro et al. 2003, p.47). Despite their widespread application in construction, PMSs have been developed at the industry and company levels with only limited numbers of studies examining the project level (Bassioni et al. 2005; Lai et al. 2008; Chan 2009). For example, Alarcon and Ashley (1996) developed a general performance model (GPM) and Kagioglou et al. (2001) proposed a balanced scorecard (BSC) that encompasses the project perspective for the purpose of systematically measuring construction project performance.

Table 2. KPIs at the Construction Project Level

<table>
<thead>
<tr>
<th>Authors</th>
<th>Aspects for measurement</th>
<th>Measurement levels</th>
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<tbody>
<tr>
<td>Kumarawamy and Thorpe (1996)</td>
<td>Cost/financial, project duration, quality, health and safety, quality of workmanship, functionality/utility</td>
<td>Project</td>
</tr>
<tr>
<td>Songer and Molenaar (1997)</td>
<td>Cost/financial, project duration, quality, client and project manager satisfaction, user expectation and satisfaction, quality of workmanship, meeting specification, dispute minimization</td>
<td>Project</td>
</tr>
<tr>
<td>Lim and Mohamed (1999)</td>
<td>Cost/financial, project duration, quality, client and project manager satisfaction, user expectation and satisfaction, quality of workmanship, health and safety, functionality/utility</td>
<td>Project</td>
</tr>
<tr>
<td>Love and Holt (2000)</td>
<td>Product, service performance, corporate ability, individual ability, productivity, quality, environment, and financial aspects</td>
<td>Company</td>
</tr>
<tr>
<td>Cox et al. (2003)</td>
<td>Time, cost, quality, safety, and productivity</td>
<td>Company and project</td>
</tr>
<tr>
<td>Sohail and Baldwin (2004)</td>
<td>Time, cost, quality, stakeholders’ roles and responsibilities, partnership, and social-economic factors</td>
<td>Project</td>
</tr>
<tr>
<td>Lai et al. (2008b)</td>
<td>Time, cost/financial, quality, safety, customer satisfaction, project team performance, change and material management</td>
<td>Project</td>
</tr>
<tr>
<td>Haponava and Al-Jibouri (2010)</td>
<td>Time, cost/financial, quality, safety, value and objective, stakeholders’ requirements, communication</td>
<td>Project</td>
</tr>
<tr>
<td>Hwang et al. (2010)</td>
<td>Schedule (time), cost/financial, and dimension (space)</td>
<td>Project</td>
</tr>
<tr>
<td>Lai and Lam (2010)</td>
<td>Time, profit, environment, quality, safety, effectiveness of process, level of dispute, staff satisfaction, and innovation</td>
<td>Project</td>
</tr>
<tr>
<td>Idrus et al. (2011)</td>
<td>Quality of finished project, construction cost, construction time, occupational health and safety, labour dependency, contractor’s project management, quality of coordination by the construction team, contractor’s manpower capacity, construction flexibility, environment friendliness, level of technology</td>
<td>Project</td>
</tr>
</tbody>
</table>
Propagation of a PPP Dynamic Life-Cycle
Performance Measurement Framework

Evaluating PPP projects is more difficult than that of traditional projects as there are many components (e.g., documentation, financing, taxation, technical details, and subagreements) and risks (e.g., market risks and project risks) arising from the complexity of the long-term contractual arrangement and they can change dynamically and substantially over the projects’ life-cycles (Grimsey and Lewis 2002; Robinson and Scott 2009; Raisbeck et al. 2010). The traditional development process of a PPP infrastructure project contains eight stages (e.g., project selection and definition, PPP option assessment, getting organised, pretending work, bidding process, contract and financial close, contract management, and ex post evaluation) with the project being subjected to evaluation in the final phase (EIB 2012). This kind of evaluation, as noted above, is a product-oriented measurement where the measure for project performance is simply a review (Haponava and Al-Jibouri 2012).

The aforementioned eight stages of the development process of a PPP can be summarized into three major interrelated phases: (1) Initiation and Planning; (2) Procurement; and (3) Partnership (e.g., construction, operation, and maintenance) (EIB 2012). These phases are referred to as the PPP project life-cycle. A PPP project has a dynamic and constantly evolving process (Chinyio and Gameson 2009); therefore, the product-oriented evaluation cannot effectively assist project managers to control and improve the processes associated with the delivery of an asset. Haponava and Al-Jibouri (2012) proffer that the PMSs designed for construction projects should concentrate on the process-based evaluation where evaluation for each project phase is a focus, rather than the static product-based measure. Bearing this perspective in mind, it suggests that a dynamic life-cycle perspective needs to be used to measure the performance of PPPs and a phase-based evaluation is required to replace the traditional product-oriented approach.

Understanding the underlying needs and requirements of stakeholders involved with the delivery of a PPP is an essential part of a performance evaluation model. At the project level, “stakeholders are individuals or organizations that are affected by or affect the development of the project” (El-Gohary et al. 2006). PPP stakeholders include government, consumers, investors, and even employees (e.g., public client, concession contractors, financiers, consultants, and end-users) (ADB 2008). An effective integration of a set of stakeholders is imperative for delivering successful PPPs (Yong 2010).

PPP projects are normally undertaken by a special purpose vehicle (SPV), which is a consortium responsible for developing, building, operating, and maintaining an asset that is procured over the concession period (Zheng et al. 2008; Yong 2010). SPVs exhibit a dual character, implying that they are operating in the context where goals at company and project levels must be met. Hence, the evaluation related to SPVs should focus on the outputs at both company and project levels. Accordingly, the PMSs integrated with the project-related issue is deemed to be more suitable for PPP evaluation than the use of sole KPIs as KPIs focus on project rather than company performance (Kagioglou et al. 2001). Corporate-related issues (i.e., strategies) cannot be addressed properly in the KPI framework. Several PMSs have been adapted to measure project performance in construction (e.g., Alarcón and Ashley 1996; Kagioglou et al. 2001; Yuan et al. 2009); however, most of the developed systems originate from the BSC (e.g., Kagioglou et al. 2001; Yuan et al. 2009).

Over the last two decades, the BSC has been the most reputable PMS applied widely across industries (Kennerley and Neely 2003). Despite its widespread application, the BSC has been the subject of extensive criticism. Neely et al. (2001) criticized some measures of the BSC as too narrow to capture the factors essential to business success. For example, the view of stakeholders in the BSC encompasses only customers and shareholders, and neglects suppliers, alliance partners, employees, regulators, and local community or pressure groups, all of which are critical to the performance and success of an organization/project. Moreover, the BSC fails to highlight “the relationship between the measures proposed for certain goals” (Kagioglou et al. 2001), and no mention is made to the contribution of stakeholders to organization (Mooraj et al. 1999). In summary, the components of the BSC cannot keep pace with the increasingly changing nature of today’s business, especially under the conditions of multiple stakeholder integration (Neely et al. 2001).

One important principle in performance measurement is that the developed measures must reflect the context to which they are applied (Neely 1999). As mentioned above, effective involvement of multiple stakeholders is crucial to PPP project success. Nevertheless, the BSC has deficiencies in measuring organizational performance against a multiple-stakeholder environment. For that matter, it cannot comprehensively capture the nature and context in which PPPs operate, and thus the BSC is an inappropriate choice for PPP evaluation. On the basis of the characteristics of PPPs, a performance measurement framework that deals with the complexity triggered by multiple stakeholders is an ideal tool to underpin the performance measurement of PPP projects (Liu et al. 2013). Thereby, the performance prism is deemed to be more suitable as it is a more holistic framework structured to shed light on the complexity derived from multiple stakeholders and assist with directing and guiding performance measurement design for long-term success in a particular business environment (Neely et al. 2001). In addition, the performance prism addresses the reciprocal relationship between the organization and stakeholders, which is capable to indicate not only how key stakeholders contribute to business success, but also what such contributions must be strengthened to improve the performance of an organization (Neely et al. 2002).

The performance prism consists of five interrelated facets designed for measurement (Fig. 2) (Neely et al. 2001).

1. Stakeholder satisfaction: who are our stakeholders and what do they want and need?
2. Strategies: what strategies do we need to satisfy these sets of wants and needs?
3. Processes: what processes do we need to allow our strategies to be delivered?
4. Capabilities: what capabilities (people, practice, technology and infrastructure) do we need to put in place to allow us to operate our processes?
5. Stakeholder contribution: what do we want and need from our stakeholders?

According to Neely et al. (2001), the “Performance prism is a framework—a tool—which can be used by management teams to influence their thinking about what the key questions are that they want to address when seeking to manage their business.” Considering this perspective, as well as the five measurement facets, a set of core indicators (CIs) can be derived from the normative literature within the context of PPP performance measurement (Fig. 2 and Appendix).

The life-cycle perspective, as discussed above, needs to be applied in PPP evaluations. It is noted that a life-cycle of a PPP project is comprised of three main phases (EIB 2012). So, the life-cycle...
PMS to be developed is a phase-based evaluation framework. Generally, there are two kinds of evaluation at the project level in construction: (1) ex ante evaluation and (2) ex post evaluation. Ex ante evaluation is a preproject study that is applied to offer assistance in investment decision making on the basis of the calculations of feasibility and cost, while ex post evaluation is a comparison between expected outcomes and actual achievements and it provides insight into the management of future work (Farbey et al. 1992; Irani et al. 2001, 2005). In short, normally, two evaluation nodes can be seen in the evaluation systems of PPP projects, either at the initiation stage or at the end of the project. However, these kinds of evaluation fail to effectively and efficiently control the whole development process of a project (Haponava and Al-Jibouri 2012). To shift the evaluations of PPPs from ex ante and ex post evaluations to a comprehensive life-cycle performance evaluation, two additional evaluation nodes are placed at the interfaces between pretendering and bidding and contract and financial close and contract management (see Fig. 3). These four evaluation nodes are designed for project managers to measure project performance in each life-cycle phase under the CIs identified in the Appendix and Fig. 2.

The life-cycle evaluation is specifically dependent upon the implementation of business process management, where continuous improvement over the project life-cycle forms an integral part of its delivery strategy (Pedler et al. 1991). Organizational learning has been identified as a vehicle for delivering continuous improvement and incremental innovation in business processes (Buckler 1996; Scarbrough et al. 1998). To facilitate a learning organization, particularly for construction firms, the mechanisms that stimulate a learning and innovation culture must be embraced (Kululanga et al. 2001). However, few construction organizations have systems or mechanisms to capture and absorb their lessons learned or express their interest in doing so (Love et al. 2003). To shed light on this field, learning mechanisms have been embedded into the developed
Stakeholder Satisfaction (F1)

Stakeholder satisfaction is highly important for performance measurement, especially within the context of multiple stakeholders. The performance prism commences with the facet of stakeholder satisfaction as satisfying stakeholders’ wants and needs is the baseline for the existence of organization (Neely et al. 2001, 2002).

Throughout a PPP’s life-cycle, the SPV exists to satisfy a public client’s requirements, which focus on providing a service to the public using private-sector investment (Pongsiri 2002; ADB 2008; Zheng et al. 2008; Chinyio and Gameson 2009). The public sector client is actively involved in each of the project’s life-cycle phases (Kwak et al. 2009). Hence, the satisfaction of public client (CIF1,1, CIF1,3, and CIF1,5) must be assessed over a PPP’s life, and the user satisfaction (CIF1,12) is a determinant of PPP performance (Davis and Love 2011). Over the past decade, employees have been acknowledged by management researchers as the organization’s key stakeholders (Bourne et al. 2003). In PPP projects, many employees, such as advisors and consultants, must be employed to deal with the problems associated with taxes, accounting, legal, and the environment (Yong 2010). Their satisfaction for many aspects, such as salary, workplace safety, and working environment, can significantly affect...
the project performance. To address this prevailing issue, the CIs of the employee satisfaction construct (CI_F1,2, CI_F1,4, and CI_F1,6) are represented in all PPP phases, indicated in the Appendix.

**Strategies (F2)**

Strategy, in any organization, is not only the foundation of internal business processes, but also stakeholders’ behavioral goal (Neely et al. 2001, 2002). Without an appropriate strategy, it is impossible for internal business processes to effectively deliver satisfactory services or products to customers, and employees will be confused about what matters and how they should behave to achieve success (Neely et al. 2002; Bourne et al. 2003). A common strategy of PPP infrastructure projects is the realization of Vf/M (Akintoye et al. 2003; Zhang 2006b; Yuan et al. 2009). Vf/M has been acknowledged as the fundamental management philosophy that penetrates through the whole life-cycle of PPPs (Treasury Taskforce 1998; Arthur Anderson Enterprise LSE 2000; Grimsey and Lewis 2005; Henjewele et al. 2011).

Broadly speaking, Vf/M is the optimum combination of life-cycle cost and quality (physical quality and service quality) under user requirements and a specified timeframe (Partnership Victoria 2001). According to this definition, the assessment used to examine Vf/M in PPP evaluations should be concerned with project life-cycle cost as well as quality within the framework of the user satisfaction and project schedule. In other words, the CI of Vf/M (CI_F2,1) ought to constitute project life-cycle cost, physical and service quality of the asset, project duration and end-user satisfaction. Noteworthy, Vf/M is a concept covering a variety of issues and the measurement facets of the performance prism are interconnected; therefore, there are overlaps between the measures identified from the performance prism for evaluating PPPs. Take project quality, duration, and end-user satisfaction, for example. They are also the core components of the Stakeholder Satisfaction facet and Process facet, respectively. As a result, life-cycle cost is the only issue discussed here, and the other three indicators are demonstrated in the Stakeholder Satisfaction and Process sections.

Life-cycle cost, normally, is the most important factor that must be considered in any PPP before the implementation of the project and it is complex. This complexity is derived from various factors. According to Sing et al. (2013), time, contract, price, human factors, and variations to scope are the determinants of the final costs of construction projects. In fact, a project’s life-cycle is dynamic and can result in a substantial change in the predetermined cost of the project. However, in PPPs, the examination of the whole life cost is either an ex ante estimation or an ex post assessment, and there is no mechanism to control and improve the cost performance throughout the project’s life. With this in mind, the measurement designed for project life-cycle cost performance in the developed PMS is a constant cost assessment that incorporates not only the pre-project estimation and postimplementation examination, but also a process-based monitoring (see Fig. 2). The major aim of doing so is to capture the dynamic nature of the project life-cycle and provide the key stakeholders with a dynamic insight into the life-cycle cost of the project so as to achieve significant cost savings.

**Processes (F3)**

To achieve Vf/M, it is necessary for both public sector and SPV to group appropriate internal business processes throughout the PPP project life. Within the framework of the Performance Prism, the measure of processes is used to identify what internal business processes should be improved to increase the effectiveness of the whole workflow (Neely et al. 2002).

Appendix identifies core process indicators for all phases of a PPP infrastructure project. In the PPP Initiation and Planning phase, a series of tasks are identified, including preproject environment analysis (political, economic, social, and legal), service need and desired output defining, risk management (identification, analysis, and allocation), and project structuring (financing, commercial, technical, and engineering) (Chinyio and Gameson 2009; EIB 2012). The performance quality of these aforementioned activities is a critical metric to evaluate the effectiveness and efficiency of the processes associated with PPP initiation and planning (Yuan et al. 2009; Yong 2010). Consequently, a set of CIs (CI_F3,1, CI_F3,2, CI_F3,3, CI_F3,5, and CI_F3,6) can be rationally derived. Noteworthy, the CI relating to the feasibility study (CI_F3,4) should not be neglected in project initiation and planning as it (e.g., affordability, bankability, constructability, and maintainability) has been identified as a critical success factor for PPPs (Zhang 2006a, b; EIB 2012). Additionally, it is essential to emphasize the CIs with regard to concession issues (e.g., selection criteria of concessionaire and concession period) (CI_F3,6 and CI_F3,7). There is a widespread consensus that an appropriate concession contractor and a reasonable concession period are critical to PPP project success. Zhang (2004a, b) and Salman et al. (2007) support this argument and identify the importance of appropriate concessionaire and concession period in the viability of PPP projects.

Bidding is an important function of the procurement of any PPP, in which activities such as prequalification, shortlisting, tender invitation, interaction with bidders, tender evaluation, and bidder selection must be conducted step by step (EIB 2012). Yuan et al. (2009) argue that a transparent and competitive bidding process is critical to the successful delivery of a PPP project and therefore the transparency and competitiveness of bidding procedure must be considered to be a process KPI of PPP projects. Based on this argument, it is reasonable to derive a CI of the transparency and competitiveness of bidding process (CI_F3,10) for the proposed life-cycle PMS.

After the completion of bidding, the PPP contract needs to be finalized under the final negotiation framework. This framework is vital and should typically include such issues as negotiation timetable and how to define and record the remaining problems and matters already agreed or settled (EIB 2012; Liu et al. 2013). Therefore, the core indicator of the comprehensiveness of final negotiation framework (CI_F3,11) is required. Additionally, the financial close of a PPP occurs in the procurement phase and it enables the funds (e.g., equity, loans, and debts) to start flowing to support the work organized to reach financial close (EIB 2012). The work organized to reach financial close must be effective and efficient; otherwise, the progress of PPPs can be delayed (EIB 2012). For that matter, the CI regarding the effectiveness and efficiency of financial close (CI_F1,12) is also worthy of being developed in PPP evaluation.

PPP projects enter the partnership phase (e.g., construction, operation, and maintenance) after the award of contract and financial close. The construction of the asset can last for several years, during which the indicators identified for traditionally procured projects can be used to evaluate the effectiveness of construction process, such as the TCO (time, cost, and quality—physical and service quality) and material management (CI_F3,15) as well as health, safety, and environmental impact (CI_F3,16) (Kagioglou et al. 2001; Partnership Victoria 2001; Zhang 2006a; Haponava and Al-Jibouri 2012).
An important activity in the partnership phase of a PPP project is contract management and it is critical to the success of the project. Several studies suggest that the effectiveness of contract management (CI_F3.17) must be considered in PPP evaluations (Zhang 2006a; Yuan et al. 2009). It is known that contract type plays an important role in PPP contract management. Hence, the evaluation for contract management in a PPP should encompass the characteristics of the contract, such as duration, service length/size, activities included, etc. In practice, there are typically six kinds of PPP contracts, including design-build (and its derivatives), warrant contracting, cost-plus-time (A+B Bidding) and incentives/disincentives, lane rental, and performance-based contracting (Anastasopoulos et al. 2013a). The characteristics of such contracts are relating to not only the project construction, operation and maintenance, but also to the project cost savings. Table 3 presents a brief pros and cons comparison of typical PPP contracts, by which project managers and evaluators in PPPs can understand what aspects they should be concerned when evaluating the project’s contract management effectiveness.

The final phase of a PPP infrastructure project entails operating and maintaining the asset to deliver a required public service under a defined legal and contractual regulatory framework. Compliance of legal and regulatory framework (CI_F3.14), profit and profitability (CI_F3.19), and effectiveness of operations and facility management (CI_F3.20 and CI_F3.21) are attractive points in the process evaluation of PPPs (Yuan et al. 2009). Moreover, PPPs are being run within the context of multiple stakeholders, and thus the effectiveness of dispute resolution (CI_F3.18) and effectiveness of interface management (CI_F3.22) are of the important process indicators in relation to the Partnership phase (Yuan et al. 2009).

It can be noted from Appendix that the CIs of interface management (IM) (CI_F3.9, CI_F3.13, and CI_F3.22) penetrate the whole life-cycle of a PPP project. The IM can be defined as “the management of communication, coordination, and responsibility across a common boundary between two organizations, phases, or physical entities which are interdependent” (Chan et al. 2005). It is a set of managerial activities critical to PPPs, particularly those regarding the management and coordination between organizations, the phases of the project life-cycle, and physical entities (Chan et al. 2005). With this in mind, the identification of the CIs in regard to interface management over project’s life is significant and necessary.

**Capabilities (F4)**

The operation of the business processes in organizations must be supported by certain skills, practical procedures, physical infrastructures and technologies, which are normally referred to as organizational capabilities (Neely et al. 2002). In the performance prism, the construct of capabilities is the least widely understood and it is established to measure whether the fundamental building blocks of organization’s competitiveness are strong enough (Neely et al. 2001). The capabilities required to complete PPPs vary during the phases of the project’s life-cycle. This is because of the project complexity of PPPs and the phase-based nature of the necessary detailed work designed to ensure the completion of the PPP development.

It has been acknowledged that employees are one of the most important components in any organization. So, skilled employees (e.g., advisors, consultants, and PPP experts) (CI_F4.1, CI_F4.5, and CI_F4.9) are a basic capability in SPV over the project’s life-cycle. In addition, today’s business environment changes dramatically. To maintain competitiveness, “how to enhance organization’s learning ability” has been an attractive topic in management research (Denton 1998). For a PPP infrastructure project, the operating environment is more complicated than that of a traditional lump sum projects; thus, an effective and efficient training and learning system (responsible to develop the appropriate training programmes) on the basis of different phases of PPPs is undoubtedly required during the whole project. The training and learning system is considered to be a necessary supporting infrastructure in PPPs (Yuan et al. 2009). This is the reason why the CIs of training and learning system (CI_F4.2, CI_F4.6, and CI_F4.10) have been built up from the initiation and planning phase to partnership phase.

Developing the CIs of innovation (CI_F4.3, CI_F4.4, CI_F4.7, and CI_F4.14) is imperative in all project phases of a PPP. This is because organization’s capability in innovation relates to project’s performance in strategic planning, design, financing, procurement and construction (Shen et al. 2004). In short, innovation plays a vital role over the project life-cycle. In PPPs, financing is completed in the procurement phase and then construction commences. Accordingly, the measure for the capabilities of SPV in the post-transaction (construction, operation, and maintenance) should cover finance infrastructure (CI_F4.11), advanced technologies and equipment (CI_F4.13), and technology transfer ability (CI_F4.15). The research undertaken by Carrillo et al. (2006) explains that in PPP projects, technology transfer has a substantial impact on the performance of SPV in construction. Moreover, the CIs relevant to governance (CI_F4.8 and CI_F4.12) need to be placed in both the procurement and partnership phases. The contract of a PPP project includes a range of governance arrangements, such as the practices for monitoring and procedures for decision-making and problem solutions (NAO 2001). As a result, governance is significant for PPPs and it can substantially influence the performance of PPP construction, operation, and maintenance (Badshah 1998).

**Stakeholder Contribution (F5)**

The stakeholder contribution, as opposed to stakeholder satisfaction, is a measure for managing the dynamic tension between stakeholders and the organization (Neely et al. 2001). Specifically, the Stakeholder Satisfaction is applied to understand what stakeholders want and need from the organization, while the Stakeholder Contribution is designed to examine what the organization wants and needs from its key stakeholders. Take employees, for example, they want from their organizations a satisfactory salary, job security, safe work environment, and recognition. In return, the organizations want their employees to provide positive and valuable suggestions, work efficiently, and maintain loyalty (Neely et al. 2001). According to this point of view, the CIs, namely employees’ performance (CI_F5.3, CI_F5.5, and CI_F5.10), must be addressed in all project phases of a PPP. These indicators assist to evaluate employees’ creativity, productivity, and loyalty over a project’s life.

In addition to employee contribution, PPP infrastructure projects should incorporate the support from the public client, general contractor, subcontractors, suppliers, shareholders and creditors (Chinyio and Gameson 2009). Kwak et al. (2009) summarize that public client’s contributions in PPPs encompass the establishment of a favourable investment environment and legal framework in the project planning and design, selection of suitable concessionaire in the procurement, and active involvement of contract management after the project transaction. Therefore, it is appropriate to group the core indicators in association with the establishment of investment environment and legal framework (CI_F5.1 and CI_F5.2), concessionaire selection (CI_F5.4), and willingness to be actively involved (CI_F5.9). After PPPs move into the partnership phase, the performance of subcontractors and suppliers emerge to be a critical determinant of the project success (Chinyio and Gameson 2009).
Table 3. Comparison of Typical PPP Contracts

<table>
<thead>
<tr>
<th>Types of PPPs</th>
<th>Descriptions</th>
<th>Benefits</th>
<th>Disadvantages</th>
<th>Suitability</th>
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<tbody>
<tr>
<td>Design-build (DB)/ Design-bid-build (DBB)/ Design-build-operate (DBO)</td>
<td>The private sector is responsible for the project’s design, build, and finance as well as operations in some cases</td>
<td>• Easy administration; • Transparent and objective selection process (Pakkala 2002)</td>
<td>• Lack of innovation and life-cycle cost control; • Tendency for ordinary project quality; and • Possibility of order changes and cost overruns (Anastasopoulos et al. 2011)</td>
<td>These contracting approaches have been widely applied across the world and are suitable for social and economic infrastructure projects (Pakkala 2002)</td>
</tr>
<tr>
<td>Design-build-operate-maintain (DBOM)/ Design-build-finance-operate (DBFO)/ Design-build-finance-operate-maintain (DBFOM)</td>
<td>The private sector is responsible for the design, construction, operation, and maintenance or finance of a project</td>
<td>• High quality; • Favourable for innovation; and • Low risk in project failure (Pakkala 2002)</td>
<td>• More resources and skilled workers required (Pakkala 2002)</td>
<td>DBOM, DBFO and DBFOM are widely used in Australia, the UK and US. They are suitable for social and economic infrastructure projects (Kwak et al. 2009)</td>
</tr>
<tr>
<td>Warranty contracting</td>
<td>In the warranty contracting, contractors must comply with a contract that is under an assurance that no undue defect and failure exist in the asset over its useful life. Otherwise, contractor is responsible for product repair and replacement (Anastasopoulos et al. 2011)</td>
<td>• Higher quality; • Higher longevity; • Cost effectiveness; and • Long-term cost savings (Singh et al. 2007)</td>
<td>• Higher initial construction costs (Singh et al. 2007)</td>
<td>This kind of contract is suitable for roadway preservation and rehabilitation, and it is commonly used in the US (Singh et al. 2007)</td>
</tr>
<tr>
<td>Cost-plus-time (A+B bidding) and incentives/disincentives (I/D)</td>
<td>Cost-plus-time and I/D consider not only the initial costs (e.g., construction, maintenance, and rehabilitation), but also the duration of the project in bidding</td>
<td>• Time savings; • Cost savings; and • Less road user impacts (Arditi and Yasamis 1998)</td>
<td>• Possibility of order changes; • Possibility of cost overruns; and • Possibility of schedule overruns (Pakkala 2002)</td>
<td>These kinds of contracting are widely applied in the US and it is suitable for roadway preservation projects (Anastasopoulos et al. 2013a)</td>
</tr>
<tr>
<td>Lane rental</td>
<td>Lane rental is a contracting approach that allows contractors to rent a lane for work during rush hour (Herbsman and Glagola 1998)</td>
<td>• Time savings; and • Cost savings</td>
<td>• High pressure on the resources of all parties involved; and • Risk in production and on-site safety</td>
<td>Lane rental is widely in the UK and US, and it is suitable for rehabilitation and reconstruction projects (Herbsman and Glagola 1998)</td>
</tr>
<tr>
<td>Performance-based contracting</td>
<td>The performance-based contracting is an approach under the contract that specifies the minimum physical performance of a road asset required to be procured within a predetermined timeframe (Zietlow 2004)</td>
<td>• Cost savings; • Less uncertainty of expenditure for public agencies; • Fewer agency staff required; • Higher customer satisfaction; and • Stable financing (Stankevich et al. 2005)</td>
<td>• Difficulty in the design of appropriate performance standards; and • Difficulty in determining the obligation of public agency (Stankevich et al. 2005)</td>
<td>The performance-based contracting is suitable for roadway maintenance. It has been widely used in Australia, Canada, UK, Finland, New Zealand, Sweden, the US, and Latin America (Pakkala 2002; Zietlow 2005)</td>
</tr>
<tr>
<td>Hybrid contracting</td>
<td>Hybrid contracting is the “contract agreement that incorporates different characteristics of a range of contract type” (ADB 2006, p.43)</td>
<td>• Significant cost savings; and • High sustainability (Anastasopoulos et al. 2013a)</td>
<td>• Difficult to be administrated due to contract complexity (ADB 2006)</td>
<td>The kind of contracting is suitable for not only road preservation projects, but also PPP mega projects (WSDOT 2013)</td>
</tr>
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</table>
The lack of the CIs associated with subcontractors’ and suppliers’ contributions in the partnership phase can lead to the ineffectiveness of the project evaluation. For that matter, ClF5.11 and ClF5.12, namely subcontractors’ performance and suppliers’ performance, ought to be developed.

In the Appendix, under the Stakeholder Contribution, the CIs in relation to the willingness of private contractors, shareholders, creditors, and users to PPP participation (ClF5.6, ClF5.7, ClF5.8, and ClF5.13) have been constructed in the procurement and partnership phases. One of the case studies presented by Neely et al. (2001) shows that the measurement for stakeholder contribution should involve stakeholders’ willingness to participate in the business, such as customer’s willingness to repeat their business transactions. During PPPs, a major task in the project procurement is to attract private sector entities (e.g., banks, facility management organizations, and constructors) to join infrastructure development. Hence, their willingness to participate is undeniably a factor that can determine whether the public client can select an appropriate concessionaire and set up a robust finance structure. More importantly, the final objective of any PPP is to provide potential users with a good public service (or services) and therefore encouraging the users to use the asset (ClF5.13) is also essential.

**Conclusion**

Performance evaluation of PPPs has received limited attention, particularly from a dynamic life-cycle perspective. With this in mind, a dynamic life-cycle performance measurement framework has been conceptualized for PPP infrastructure projects. This framework consists of a set of phase-based core indicators under the five measurement facets of the performance prism. Owing to the phase-based feature, the identified core indicators of the proposed PMS are capable to capture the dynamic nature of PPP infrastructure projects.

By using the performance prism, the public sector and private investors who embark on PPP infrastructure projects are provided with an insight into the comprehensive evaluation of PPPs. The proposed conceptual model is a practical tool for PPP project managers and evaluation practitioners to monitor and improve project performance while the project is still being undertaken. In essence, the PMS that has been developed offers the impetus for real-time performance control, and the improved service quality.

The paper conducted an in-depth review of PPP performance measurement and proposed a conceptual framework, based on the theoretical lens of the performance prism, to examine their effectiveness and efficiency over the project life-cycle. The validation of the proposed PMS has not been presented in this paper, though ongoing research is currently in the process of testing and validating the developed framework as well as its relevant core indicators by using case studies and a range of questionnaire surveys. The case studies in future research will be on the basis of two representative social infrastructure PPP projects in Western Australia (e.g., hospital and car park) and focus on investigating and observing the whole development processes (life-cycles) of the projects. Further, a test of the importance and effectiveness of the developed “learning mechanisms” will be undertaken and presented for the purpose of comprehensively validating the practicability of the proposed framework.

**Appendix. Core Indicators (CIs) of the Performance Prism under PPPs**

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Initiation and planning (P1)</th>
<th>Procurement (P2)</th>
<th>Partnership (P3) (construction, operation &amp; maintenance)</th>
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<tbody>
<tr>
<td>Stakeholder satisfaction (F1)</td>
<td>ClF1.1: Public client’s satisfaction</td>
<td>ClF1.3: Public client’s satisfaction</td>
<td>ClF3.11: Public client’s satisfaction</td>
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<td></td>
<td>ClF1.2: Employees’ satisfaction</td>
<td>ClF1.4: Employees’ satisfaction</td>
<td>ClF3.13: Employees’ satisfaction</td>
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<tr>
<td>Strategies (F2)</td>
<td>ClF2.1: Value for money (V/M) (optimum combination among life-cycle cost, physical &amp; service quality of the asset, and the users’ satisfaction)</td>
<td>ClF3.10: Transparency &amp; competitiveness of bidding</td>
<td>ClF3.14: Compliance of legal &amp; regulatory framework</td>
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<tr>
<td>Processes (F3)</td>
<td>ClF3.1: Comprehensiveness of environment analysis (political, economic, social &amp; legal)</td>
<td>ClF3.11: Comprehensiveness of final negotiation framework</td>
<td>ClF3.15: TCQ &amp; material management</td>
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<td></td>
<td>ClF3.2: Appropriateness of definition on service need &amp; desired outputs</td>
<td>ClF3.12: Effectiveness &amp; efficiency of financial close</td>
<td>ClF3.16: Health, safety &amp; environmental impact</td>
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<td></td>
<td>ClF3.3: Effectiveness of risk management (identification, analysis &amp; allocation)</td>
<td>ClF3.13: Effectiveness of interface management</td>
<td>ClF3.17: Effectiveness of contract management</td>
</tr>
<tr>
<td></td>
<td>ClF3.4: Comprehensiveness of feasibility study (financing, technical &amp; engineering)</td>
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<td>ClF3.18: Effectiveness of dispute resolution</td>
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<td></td>
<td>ClF3.5: Appropriateness of financing option</td>
<td></td>
<td>ClF3.19: Profit &amp; Profitability</td>
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<td></td>
<td>ClF3.6: Appropriateness of concessionaire selection criteria</td>
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<td>ClF3.20: Effectiveness of operations management</td>
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<td></td>
<td>ClF3.7: Appropriateness of concession period</td>
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<td>ClF3.21: Effectiveness of facility management</td>
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<td></td>
<td>ClF3.8: Appropriateness of legal, commercial, technical &amp; engineering structure</td>
<td></td>
<td>ClF3.22: Effectiveness of interface management</td>
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<td></td>
<td>ClF3.9: Effectiveness of interface management</td>
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Appendix (Continued)

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<tr>
<th>Phases</th>
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<td>Constructs</td>
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<td><strong>Capabilities (F4)</strong></td>
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<td><strong>Stakeholder Contribution (F5)</strong></td>
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