Avoiding Performance Failure Payment Deductions in PFI/PPP Projects: Model of Critical Success Factors

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Abstract: The overall aim of this paper is to identify critical success factors that would help Private Finance Initiative/facility management (PFI/FM) contractors to avoid performance failure payment deductions in Public Private Partnership/PFI (PPP/PFI) projects (constructed facilities). Using focus groups discussions, 36 possible factors that could influence performance failure payment deductions were identified and put together in a questionnaire survey. Analysis included reliability analysis that enabled identification of 29 reliable factors from the initial 36 factors. Using linear multiple regression, the best seven predictors that could help PFI/FM contractors to avoid performance payment failure deduction were identified from the 29 reliable factors. With the aid of another set of data and Spearman's rank correlation analysis, the seven predictors referred to as critical success factors were validated to confirm their dependability and wider applicability. The seven critical success factors include: (1) good working relationship with client, end-users, subcontractors, and suppliers; (2) minimal use of subjective measures as key performance indicators (KPIs); (3) a functioning help desk in place to receive service requests and complaints;, (4) explicit and realistic performance standards, criteria, and weighting systems; (5) quality of service delivery that meets requirements of output specification; (6) use of the Just-in-Time approach compared with a prescheduled maintenance regime; and (7) PFI/FM contractor active participation in the design process. The research findings would help both PFI/FM contractors and private project consortiums to maximize their profits/returns on investment by improving their performance and avoiding payment deductions in PFI projects. Public sector clients and occupants/users of their facilities would also achieve full value for money by enjoying facilities that adequately meet their needs and requirements. **DOI: 10.1061/(ASCE)CF.1943-5509.0000367.** *© 2013 American Society of Civil Engineers.*

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Introduction

Since 1992, the United Kingdom (U.K.) government has changed its approach from a traditional delivery of providing a range of public service projects, such as hospitals, schools, prisons, roads, etc., to privately finance, design, construct, manage, and operate these facilities. This is popularly known as the Private Finance Initiative (PFI) or Public Private Partnership (PPP or P3). PFI involves using the private sector's finance, management skills, and capabilities in the provision of public sector projects and services (Akintoye et al. 1998; Carrillo et al. 2006, 2008). The main guiding principles are to use the private sector in the provision of constructed facilities using a whole life approach—delivering and maintaining for the whole life of the concession (not just constructing works and then walking away). It is what Robinson and Scott (2009) referred to as BEST (Build, Evaluate, and Stay Throughout) compared with BAD (Build And Disappear) practices (Winch 2000).

The whole life approach encompasses facility management (FM) (operation and maintenance) of the projects (constructed facilities) throughout the entire contract term (concession period), usually 25–30 years (El-Haram and Agapiou 2002). The private sector consortium that is expected to deliver the whole project (including finance, design, construction, operation, and maintenance) to the Authority (government or public sector client) is usually called a Special Purpose Vehicle (SPV). SPV is a project consortium consisting of (1) lenders and investors who provide money to finance the project, (2) a construction contractor who is responsible for the design and construction phase of the facility, and (3) a FM contractor or service provider who manage and operate the constructed facility, including delivery of associated services over an agreed duration with the public sector client. Although in some cases a single company could act as both the construction contractor and FM contractor, in other cases, it could be two separate entities with an interface agreement between both contractors. In the U.K. the later is more common, particularly for PFI building projects. Because of these two cases, in this paper, the writers have used a PFI contractor to indicate a situation where a single company takes both responsibilities and a FM contractor if the situation only involves operation and maintenance of the facility. Where necessary, the acronym PFI/FM contractor has been used to denote both types of operations in the paper.

The public sector client does not pay for the construction of the facility and would only pay (the unitary charge) for the project based on it usage after the facility has been constructed. This unitary charge is the payment for using the constructed facility and its associated services. It contains subelements that are used for debt servicing, equity return, and service provision (Yescombe 2002). It is based on a principle of only paying for services according to the performance achieved or quality delivered under the contract

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agreements. In this case, the public sector does not purchase assets or even have an active interest in the property (Jones 2000). Instead, the public sector client purchases services and specifies its requirements in terms of performance output specification (Robinson and Scott 2009). For example, a local authority such as the U.K. National Health Service (NHS) would not just procure a hospital building that consists of theaters, but would purchase services of operating theaters that have internal temperature and lighting levels among other things within specified limits. This gives the SPV, through it PFI/FM contractor, the scope to determine how best to deliver the services to the required quality and performance levels. Where the services do not meet the performance standards imposed by the public sector client (e.g., the required specified temperature), penalties in form of payment deduction, usually called performance failure payment deduction, are paid or deducted from the unitary charge by reducing the amount due to the project consortium for that particular month (Yescombe 2007). Such penalties are intended to incentivize and improve the performance of the project company and its PFI/FM contractor to enable achievement of value for money for the public sector client (Abdel Aziz 2007). The National Audit Office (NAO 2009) confirms this by highlighting that the use of penalties in the PFI contract is one of the most important reasons for delivery of projects to the contracted price.

With this background, the main objective of this study identifies critical success factors that can help PFI/FM contractors and the project company to avoid payment deductions because of performance failure in PFI/PPP projects (constructed facilities). Another payment deduction in the operation of a PFI/PPP constructed facility is unavailability deductions, which usually occur where a particular service is unavailable. It means part or whole of the facility is not capable of providing the service as required. Examples of this include a building that does not provide shelter from wind and rain, or a nonprovision of heating, light, water, or other utilities. This study focuses on the performance failure deduction compared with the unavailability deduction because of the infrequency of the latter. According to Yescombe (2007), "once construction of a facility is complete, the chances of any prolonged period of unavailability are quite small." This was supported by a U.K. report on schools' PFI projects, which found that availability mechanisms worked well, but performance management process needed more improvement (Partnerships UK 2005). This study therefore examines performance failure deduction in terms of critical success factors that enables its avoidance. Cooke-Davies (2002) defines critical success factors as the inputs that lead either directly or indirectly to the success of a project. According to Muller and Turner (2007), critical success factors are elements of a project that can be influenced to increase the likelihood of success. These are independent variables that make success more likely. The success of a project in this case is to avoid payment deductions because of performance failure.

The hypothesis of this study is that there are unique factors that can influence and help to avoid performance payment deductions in PFI/PPP constructed facilities. Relying on the epistemological tradition of empiricism, this study initially utilized focus groups discussions to explore possible factors and later confirm their wider applicability through a questionnaire survey. Data generated were used to construct a regression model to predict avoidance of performance failure payment deductions. The model was later validated using another set of data from the industry. The findings of this paper would be of interest to all stakeholders of PFI/PPP projects, because identifying these critical factors would not only help in reducing or eliminating payments deductions, but would also ensure delivery of services to the agreed performance levels. PFI/FM contractors might seek to utilize the important identified factors to improve their performance in the management of PFI/PPP constructed facilities.

Service Delivery and Performance Management in Private Finance Initiative/Public Private Partnership Constructed Facilities

The service quality and delivery in a PFI/PPP constructed facility is based on four important elements shown in Fig. 1, and include (1)

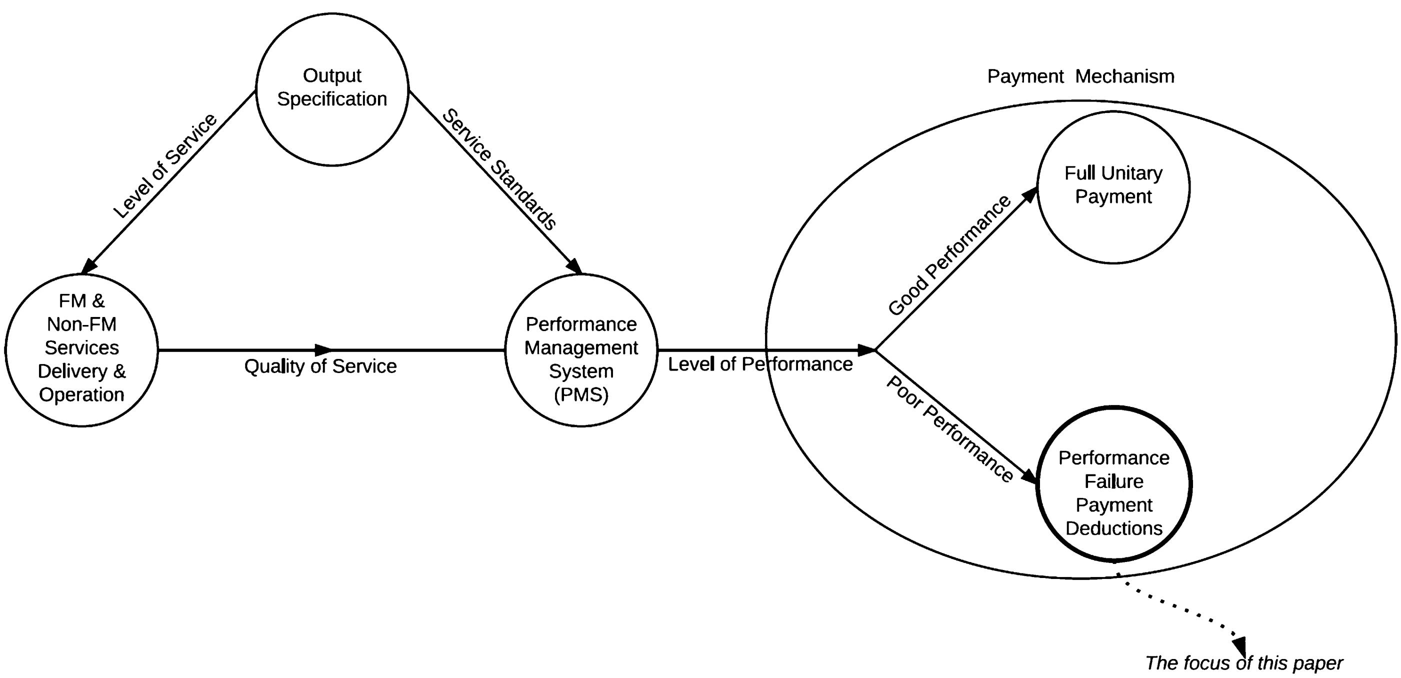

Fig. 1. Framework of PFI service delivery and performance management in constructed facilities

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output specification, (2) FM and non-FM services delivery and operation, (3) a performance management system, and (4) payments mechanism. These elements are confirmed by Robinson and Scott (2009), with the exception of the second element, which is acknowledged implicitly. Normally, the public sector client will specify the level of service required in the output specification in terms of output standards that must be met by the PFI/FM contractor through delivery of FM and non-FM services (Heavisides and Price 2001). The quality of service from the FM and non-FM provisions are measured and monitored through a performance management system (Fitzgerald and Melvin 2002). The corresponding level of performance is what determines the payments from the public sector client. Where the quality of service does not meet the minimum service standards specified in the output specification, payment deduction can be triggered in the form of performance failure payment deduction (Yescombe 2007). Each of the elements is further discussed in detail in the following.

Output Specification

This is arguably the most important document in PFI/PPP procurement (4ps 2006). It is the medium through which the public sector client defines their needs in output terms that the service provider (PFI/FM contractor) delivers throughout the project term (NAO 1999; Straub 2010). According to the Private Finance Unit of the U.K. Ministry of Defense (MOD-PFU 2010), it serves three major purposes, which include:

1. It is the contractual statement of the public sector client's service requirements, which must be defined before formal engagement with the private sector industry;
2. It forms the basis upon which the bidders prepare their proposals and tenders are evaluated; and
3. It also forms the basis against which performance or qualities of service delivered by contractors are monitored during operation of the constructed facility.

The output specification, also referred to as performance-based specification (PBS), differs from the traditional technical specification, because the latter involves defining how a service should be delivered by specifying or prescribing materials, labor, etc., whereas the former is about what the constructed facility does in terms of service required and levels of operation (Meacham et al. 2005; Gruneberg et al. 2007). The output specification is therefore prepared in alignment with user's needs, as conveyed in the "Statement of User Needs" or "Key User Requirements" (MOD-PFU 2010). A typical output specification normally contains two parts that include both physical accommodation and service performance standards (Robinson and Scott 2009). The physical accommodation includes the physical aspect of the facility that is expected to meet the desired needs of the users. For example, the provision of a classroom block in a school would not just form part of the output specification. It would contain outputs for the provision of space for students to learn, keep their personal belongings, interact among themselves, work/revise, and surf the Internet so that the user can achieve the outcome of good morale, improved learning, and scholarship. The service standards contain the extent and levels of service required, weightings of service delivery depending on priority, performance assessment criteria, rectification period if service fails, and ratchet mechanisms for repeated or wide spread failures, among other things. Sources of problems with regards to output specifications usually relate to lack of completeness and clarity. The 4ps (2006) recommends a clear output specification, with the public sector client, SPV, and PFI/FM contractor understanding its implications and agreeing to as much detail as possible before contract close.

Facilities Management and Non-Facilities Management Services Delivery and Operation

In the PFI/PPP contract, service delivery and operations could range from hard FM services (such as fabric maintenance, mechanical, and electrical services, etc.) to soft services (such as cleaning and housekeeping, site security, central switch board services, etc.) depending on the nature of the project (Robinson and Scott 2009). For example, in a PFI road project, apart from actual maintenance of the road to avoid deterioration and maintenance of traffic lights, soft services could include cleaning of the road surface and replacement of broken signs, etc. (Yescombe 2007). In a school PFI project, non-FM services could also be included as part of the output specification, which the PFI/FM contractor has to provide, and might include caretaking, porterage, janitorial, catering, waste management, and site supervisory services (BSF 2008). According to Wiggins (2010), FM service entails development, coordination, and management of all core, noncore, and support services of an organization, together with buildings to positively assist the client organization in the delivery of its strategic objectives.

The PFI/FM contractor normally delivers their services using two modes of strategies that include (1) in-house service delivery, and (2) outsourcing to specialists (Atkin and Brooks 2009). Most building operations that include maintenance are normally delivered in-house, whereas support service operations, such as cleaning, catering, mail, security, etc., are usually outsourced. The maintenance operations are expected to comply with the output specification using a variety of maintenance service regimes. These include planned and unplanned maintenance services (Wiggins 2010). The planned maintenance could either be preventive in nature (preventive maintenance) (Straub 2010) or to restore an item to a state so that it can perform its required function after a fault (corrective maintenance) (BSI 1993). Chanter and Swallow (2007) further classified preventive maintenance into (1) scheduled maintenance (carried out at predetermined intervals of time, mileage, etc.), or (2) condition-based maintenance, which is initiated as a result of knowledge of the condition of an item from routine or continuous monitoring. In contrast, unplanned maintenance has no preset plan and is mostly emergent in nature, "which is necessary to put in hand immediately to avoid serious consequences" (BSI 1993). Although both corrective and emergent maintenance are used to restore functional performance after failure, their differences lies in the urgency of the latter, which is not a prerequisite for the former.

Performance Management System

Under the PFI/PPP contract regime for constructed facilities, there is usually a mechanism by which public sector clients measure and monitor performance or quality of service delivered by PFI/FM contractors against agreed standards set out in the output specification. This is referred to as a performance management system (PMS) (NAO 2010). The overall goal of any PMS is to ensure organizations and its associated services function effectively and efficiently (Straub et al. 2010), and in this case to achieve value for money (Akintoye et al. 2003). PMS includes performance measurement and monitoring regimes (HM Treasury 2007a). A performance measurement system deals with what and how to measure. For the what to measure, a typical approach is to create a matrix of key performance indicators (KPIs) (Yescombe 2007). In the case of how to measure, it is usually based on weighting systems, where each section of the service delivered is given a weighting based on the level of their criticality (HM Treasury 2007a). In contrast, the performance monitoring regime deals with who and when to monitor the performance. Each is further discussed in the following.

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Key Performance Indicators

Cox et al. (2003) defined KPIs as compilations of data measures used to assess the performance of construction operations. The U.K. NAO (2003b) acknowledged that most PFI contracts use KPIs as a benchmarking tool for contractors' evaluation with regards to service delivery. Despite the classification of KPIs into results-oriented and process-orientated indicators by Takim and Akintoye (2002), it is the former that is normally used in the PFI contract. It could either be objectively or subjectively measured or a combination of both (Lam et al. 2010). For example, objective measures in a road project could include the number of accidents, speed of traffic, etc., whereas teacher and student satisfaction surveys could constitute subjective measures for a school project. A combination of both was used in the evaluation of a PFI hospital project by Wang (2008), which included length of waiting, the length of stay, the methicillin-resistant *Staphylococcus aureus* infection rate, the *Clostridium difficile* infection rate, and patient experience.

Weighting Systems

From existing literatures, three approaches have been identified as possible methods on how to measure performance under a PFI contract. These include (1) a performance scoring system, (2) fixed deductions, and (3) performance penalty points. Under the performance scoring system, performance services are scored and measured according to a percentage scale (NAO 2005). The performance score is calculated after grouping individual services into bundled services and weighted in proportion of the total services based on their importance (NAO 2003c). Individual service performances are measured against associated KPIs and scored to achieve scores for each bundled service. The minimum performance score for which payments are paid in full is usually 95%, as evidenced from some PFI projects in the U.K. [e.g., Laganside Courts (NAO 2003a); Home Office Headquarters (NAO 2003c); Darent Valley Hospital (NAO 2005)]. If performance falls below a 95% score, greater payment deductions are made from the full amount payable for that month as the performance score declines. Fig. 2 shows an example of a portering, internal security, and transport section of a PFI Hospital in the U.K., where payment receipts declined, once the performance scores were below 95% [Darent Valley Hospital (NAO 2005)].

The second approach on how to measure performance is to use a fixed deductions method. This is normally used for specific incidents where failures that occur are germane and fundamental to the main operation and existence of the project. A typical example includes escape from prisons by prisoners, which would normally attract a heavy fixed fine under existing PFI prison projects in the U.K. (NAO 2003b). Another example is in relation to performance failures in admission wards, operating theaters, and accident and emergency sections of a PFI hospital, which are germane to patients' health care. The third approach for performance measurement includes the use of performance penalties in the form of penalty points (HM Treasury 2007a). In this case, KPIs and the associated number of penalty points for failure on each incident are identified and agreed upon during contract negotiation and before project startup.

A more grievous incident would attract higher penalty points (NAO 2003b). For example, in a U.K. PFI prison project, an incident involving assaults against other prisoners or staff members would accrue 20 points, whereas failure to comply with a cleaning schedule by cutting grasses outside the prison would only gain 2.5 points, as shown in Fig. 3. After a set period (usually quarterly or yearly), the accrued number of points is compared with the contractually agreed baseline. The baseline is based on built-in tolerances, in which higher resources are required to meet contractual obligations than would normally be needed (HM Treasury 2007a). If the accrued performance points are greater than the baseline total, then the contract sets out how much the unitary charge should be reduced, as shown in Fig. 4. All three methods of the weighting systems can be used unilaterally or jointly depending on the nature of the PFI project.

Performance Monitoring

According to the U.K. (HM Treasury 2007b), performance monitoring should occur at three levels and include: (1) self-monitoring by the PFI/FM contractor through its own quality management system, to record its own performance failure; (2) an evaluation of the contractor's quality management system by the public sector client with the right to conduct planned and random spot checks; and (3) ability of users to report failures through a help desk. In the self-monitoring regime, the PFI/FM contractor would normally produce reports for monthly meetings, highlighting failures that have occurred, achievement of milestones against timescales, users' feedback, and action taken to address problem areas (HM Treasury 2007b). The public sector client would normally obtain a right to audit and to verify information contained in the report (Partnerships UK 2006). Computerized systems also makes the auditing straightforward and accurate. In some cases, where the contractor fails to report a performance failure, the PFI contract may contain provisions

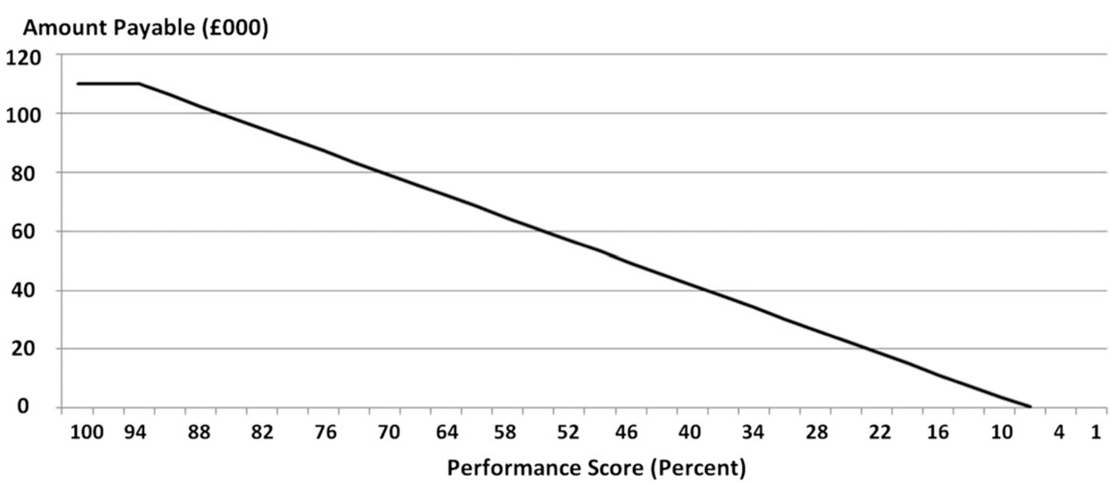

Fig. 2. U.K. Darent Valley Hospital: monthly performance related Payment for Portering, internal security, and Transport (NAO 2005)

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Performance Measure	Performance Penalty Points per incident
Failure of security procedures	5
Key/lock compromise	50
Assaults against prisoners or staff members	20
Failure to ensure prisoners see health care staff on arrival	1
Failure to comply with cleaning schedule	2.5

Fig. 3. A selection of PFI contractual performance measures in U.K. prisons (NAO 2003b)

Prisons	Penalty Performance Points acquired Over One Year	Adjusted Baseline	Cost per point	Performance Deductions	Deductions as percentage of annual payment	Escape Fines
PFI–Prison–1	6362	2848	£94	£331,121	3.0	£0
PFI–Prison–2	3964	1784	£227	£406,392	1.5	£0
PFI–Prison–3	3964	6849	£293	0	0	£0
PFI–Prison–4	6157	6443	£141	£0	0	£0

Fig. 4. Performance payment deductions in some of the U.K. PFI prisons (NAO 2003b)

for further payment deductions, normally referred to as reporting failure deductions (4ps 2004).

Payment Mechanism

The payment mechanism is the heart of any PFI contract (HM Treasury 2007a), and generally aims to achieve six principal objectives, which include:

1. Reward and determine payment for work done by the PFI/FM contractor (Abdel Aziz 2007);
2. Put allocation of risk and responsibility between the public sector client and PFI/FM contractor into financial effect (4ps 2004);
3. Establish incentives to deliver high-quality services and performance (HA 2006);
4. Enable achievement of public sector client project objectives, including best value for money throughout the project duration and the concession period (HM Treasury 2006a);
5. Strengthening of long-term partnerships and relationships (HM Treasury 2006b); and
6. Supporting effective contract management of the PFI project (Partnerships UK 2006).

The key features of PFI payment mechanisms have been highlighted by many U.K. Government department documents (HM Treasury 2007b; 4ps 2004, 2007) and include (1) "no payment until constructed facility and associated services are available," (2) "single unitary charge for the service delivered (incorporating availability and performance)," (3) "payment deductions for substandard performance," and (4) "payment deductions reflects severity of failure." Apart from these key features, the payment mechanism must clearly set out a time period for repair and rectifications of failures, depending on the criticality of the affected area, before payment deductions can be triggered. It must also include ratchet mechanisms, whereby recurrence or widespread failures across key services in a project would lead to higher deductions (Yescombe 2007). In general, Treasury Taskforce Private Finance (1998) advised that the key to a successful payment mechanism includes a strong linkage and integration to output specification, KPIs, performance measurement, and contract monitoring. This would prevent discrepancies within the whole PFI contract mechanism, thus enabling successful service operation and performance from the PFI/FM contractor.

Research Methodology

To identify a comprehensive list of factors that would help PFI/FM contractors to avoid payment deductions as a result of performance failure, it was imperative for the study to use a methodological approach that would be explorative in nature. Hence, a philosophical paradigm of empiricism was employed with two major cynosures. The first facilitated authentic representations by capturing actual meanings and interpretations that actors subjectively ascribe to phenomena through their experiences and everyday realities (Alvesson and Deetz 2000). This was against the imposition of an a priori theory or variables from existing literature that would just be tested in a deductive approach (Johnson and Duberley 2000). The second enabled confirmation of the wider applicability of these subjective representations and actual meanings across industry practices. Accordingly, a two-way research process consisting of focus groups discussions and a questionnaire survey were used to satisfy these two cynosures, respectively. The focus groups helped to bring together important stakeholders in PFI projects, particularly with respect to management of constructed facilities. These included PFI/PPP managers, project managers, facility managers, specialist-service managers, and other project team members involved in management of constructed facilities. The general advantage of the focus group for this task undoubtedly came from their ability to provide access to a wide range of perspectives in a rather short time, enabling deeper insights into group thinking and shared beliefs, and at the same time, allowing individual participants to express their own opinions (Sommer and Sommer 2002). It further helped

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participants to build on one another's responses and come up with ideas they might not have thought about in a one-on-one interview.

A total of five focus groups discussions took place in five different PFI/FM contracting organizations that dealt with operation and maintenance of PFI constructed facilities. The membership of each focus group was based on previous or current experience of working in a operation and maintenance phase of a PFI/PPP project. On average, each focus group consisted of seven participants with a hierarchical cross section of managers, ranging from line supervisors to senior head office–based managers. The choice of more than one firm for the focus group discussion was to avoid specificity to a type of organization or single organizational culture and to ensure external validity of research findings. The five PFI contracting firms were selected based on convenience sampling using the research team network of contacts within the U.K. construction industry compared with random, selective, or stratified sampling. Similar studies that used convenience sampling method in PFI/PPP studies include Li et al. (2005) and Akintoye et al. (1998). On average, the five firms were in operation for 27 years and were involved in more than five PFI/PPP projects. During the focus group discussion, each participant was encouraged to discuss openly what factors they thought might help to avoid performance failure payment deductions in the operations and management of PFI constructed facilities. Although the research team maintained openness and neutrality throughout each focus group discussion, conversations were steered when discourses drifted from the main topic area and when some individuals tried to dominate the discussion. The focus groups discussions lasted for a mean of 55 min. All discussions were taped and video recorded, and were later checked against all the notes taken so that any useful data were not missing. The data were later transcribed and combined, and a comprehensive list of factors was compiled.

The compiled list of factors was put together in a preliminary questionnaire survey. This served as a pilot study with the aim of evaluating the relevance, complexity, length, and layout of the questionnaire before being sent out to the wider industry. The respondents included four FM directors and three PFI facility managers with a mean of 17 years' experience and who worked on a mean of four PFI projects. Their comments, which included rewording and shortening of some questions, were subsequently used to produce a final questionnaire. In the final questionnaire, participants were asked on an individual basis to indicate the importance of the factors on a seven-point Likert scale, where 1 represented a response of not important and 7 represented most important. Another part of the questionnaire asked participants to rate the overall success of their company in avoiding performance failure payment deduction in previous PFI projects, also on a seven-point Likert scale, where 1 represented a response of not successful and 7 represented very successful. The data collected from the survey were subsequently analyzed using the *Statistical Package for Social Sciences* (*SPSS*) software.

Using the current list of U.K. PFI/PPP projects in operation from the HM Treasury website (http://www.hm-treasury.gov.uk/ppp_pfi_stats.htm), a total of 200 PFI/FM organizations were randomly selected and sent the final questionnaire. This was done via e-mail or postal mail for those that could not be contacted by e-mail. Ninety-one questionnaires were returned, representing a response rate of 45.5%. Four of the questionnaires were incomplete and were consequently discarded, leaving only 87 usable questionnaires for analyses (43.5%). Of the respondents, 17.2, 5.8, 35.6, 19.5, and 21.9% were FM directors, SPV managers, facility managers, maintenance engineers, and facility site supervisors, respectively. They had a mean of 15 years of experience in the construction industry and were involved in a mean of three PFI projects. Table 1 shows the list of all 36 factors.

Analysis of Results

In an effort to achieve the main study objective, which included identifying critical success factors that could help to avoid payment deductions because of performance failure, a rigorous statistical process was employed. This included reliability analysis and multiple regression modeling, followed by model validation using nonparametric testing of Spearman's rank correlation coefficient. The purpose and rationales behind these analyses included the following:

- Reliability analysis: to statistically examine whether the 36 factors in the questionnaire consistently reflected the construct it was measuring;
- Regression modeling: to identify the critical success factors that significantly predicted avoidance of performance failure payment deductions; and
- Spearman's rank correlation coefficient: to examine how well the identified factors from the regression model actually predicted avoidance of performance payment deductions. This enabled comparison of model-predicted scores with the actual rating by respondents on a new sample of data to validate the model.

Reliability Analysis

Reliability analysis was carried out to statistically examine the consistency of factors and its scale was used in measuring avoidance of performance failure payment deductions. It helped to confirm the wider applicability and validity of the factors identified from the focus group discussions, whereas at the same time it enabled consistency, such that the factors yielded the same result over time. Using a common reliability scale named Cronbach's α, it was possible to statistically test the internal consistency of the 36 factors in the questionnaire. Mathematically, Cronbach's α is written as

$$\alpha = \frac{N^2\overline{\mathrm{COV}}}{\sum S^2_{\mathrm{factor}} + \sum \mathrm{COV}_{\mathrm{factor}}} \tag{1}$$

where N = the total number of factors; $\overline{\mathrm{COV}}$ = average covariance between factors; S_{factor} = variance of each factor; and $\mathrm{COV}_{\mathrm{factor}}$ = covariance within a factor. The Cronbach's α has a reliability coefficient that varies from 0 to 1. The higher the reliability coefficient, the greater the internal consistency of the whole data to statistically measure the construct it was designed to measure (Norusis 2008). Field (2005) suggests that a value of 0.7 or greater is an acceptable value, with a substantially lower value indicating unreliable factors in the measure of the construct. The result of this statistical test is shown in Table 1. The overall reliability of Cronbach's α is 0.913, indicating a very good reliability and internal consistency with most of the data. In Table 1, two important data are included in the third and fourth columns, labeled Correlated item: total correlation and Cronbach's α, if item deleted, respectively.

The Correlated item: total correlation column is the correlation between each factor and overall reliability of the whole data. In reliable data, all factors should correlate with the overall reliability, and any correlation coefficient less than 0.3 should be dropped, because that particular factor does not contribute to the data reliability, and therefore, is not a good measure of the construct (Field 2005). The values in the column labeled Cronbach's α, if item deleted are the value of the overall reliability, Cronbach's α, if the factor is not included in the calculation or if it is deleted. This means that the deletion of the factor would improve the overall reliability. Because the overall reliability of this data is 0.913, any factor effectively contributing to the data should have values equal to 0.913 or less. In contrast, a factor that is not contributing would therefore

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Table 1. Reliability Analysis

No.	Factors	Corrected item: total correlation	Cronbach's α if item deleted
	Cronbach's α reliability coefficient = 0.913		
F1	Strong interface among output specification, KPIs, and performance monitoring systems	0.584	0.910
F2	Quality of service delivery meets requirements of output specification	0.502	0.905
F3	Clear and transparent output specification	0.612	0.909
F4	Routine self-monitoring of performance and regular internal audit by PFI/FM contractor	0.482	0.911
F5	Good working relationship with client, end-users, subcontractors, and suppliers	0.448	0.901
F6	Involvement of PFI/FM contractor in drafting output specification	0.411	0.911
F7	Functioning help desk is in place to receive service requests and complaints	0.512	0.903
F8	Prompt and effective response to client/end-users requests	0.405	0.911
F9	Explicit and realistic performance standards, criteria, and weighting systems	0.637	0.908
F10	Routine satisfaction surveys and feedback from client/end-users to improve quality of service	0.587	0.909
F11	Efficient communication among internal and external service providers	0.499	0.910
F12	Minimal use of subjective measures as KPIs	0.450	0.901
F13	Effective planning and scheduling of maintenance work	0.550	0.910
F14	Availability and sufficient rectification period in PFI/FM contract	0.546	0.910
F15	PFI/FM contractor active participation in design process	0.643	0.908
F16	Availability and adequate funding of maintenance reserve account	0.515	0.910
F17	Design complies with requirements of output specification	0.473	0.911
F18	Regular consultation with the client on maintenance schedules and plans	0.435	0.911
F19	Timely feedback to subcontractors/suppliers on unachieved targets	0.481	0.910
F20	Commitment to continuous improvement and innovation	0.419	0.911
F21	Use of highly skilled and competent workmanship in service operation	0.544	0.910
F22	Preference for usage of long-term durable materials compared with low-quality products	0.465	0.911
F23	Use of Just-in-Time approach compared with prescheduled maintenance regime	0.563	0.910
F24	In-depth understanding of payment mechanism and its calibration	0.521	0.910
F25	PFI/FM contractor performance monitoring procedures are clear and well documented	0.471	0.907
F26	Early identification and effective management of service operations risks and liabilities	0.511	0.911
F27	Amiable management of conflicts/disputes with client, end-users, subcontractors, and suppliers	0.431	0.909
F28	Strong Interface between major elements' design life and life cycle maintenance	0.537	0.911
F29	Adequate and effective contingency plans in the delivery of core/germane services	0.499	0.908
F30[a]	Use of knowledge from past experience in PFI/PPP FM	0.270	0.917
F31[a]	PFI/FM contractor has clear procedures for management of its subcontractors	0.252	0.955
F32[a]	Timely payments of supplier/subcontractor(s) fees	0.277	0.924
F33[a]	Steady devotion and commitment to maintenance schedules	0.293	0.915
F34[a]	Efficient deployment of personnel, material, and plant resources	0.224	0.933
F35[a]	Adopting principle of prevention is better than cure in service delivery	0.266	0.916
F36[a]	Use of proven maintenance methods and techniques	0.253	0.931

[a]Factors deleted in the list based on Corrected item: total correlation and Cronbach's α.

have a value greater than 0.913. Based on these rules, seven factors were removed from the list of 36 factors as a result of having a Correlated item: total correlation less than 0.3 and/or Cronbach's α, if item deleted greater than 0.913. The remaining 29 factors are discussed in Multiple Regression Modeling for further analysis.

Multiple Regression Modeling

After identifying the reliable factors that would produce consistent results over time through reliability analysis, the next step was to construct a regression model to identify critical success factors that would help PFI/FM contractors to avoid performance failure payment deduction. This was achieved using linear multiple regression. This approach was adopted on the premise that one or more factors (independent variables or predictors) would correlate maximally with the outcome variable (dependent variable). Mathematically, this is written as

$$Y_i = (b_0 + b_1F_1 + b_2F_2 + b_3F_3 + \cdots + b_nF_{ni}) + \varepsilon_i \qquad (2)$$

where Y = outcome or value of dependent variable; b_0 = constant and is the intercept at the Y axis; b_1 = coefficient of the first predictor (F_1); b_2 = coefficient of the second predictor (F_2); b_3 = coefficient of the third predictor (F_3); b_n = coefficient of the nth predictor (F_n): and ε_i = error term, which is the difference between the value predicted and actual value of Y for the ith respondents.

Applying the preceding regression equation to this study, the independent variables are the 29 factors from the reliability analysis in Table 1. The dependent variable is the avoidance of performance failure payment deduction, which was measured in the questionnaire using respondents' ratings on overall success of their company in avoiding performance failure payment deduction. The two set of variables were input into the *SPSS* software, and a stepwise regression method was used.

Table 2 shows the model summary that contained seven possible models and their predictors. The third column of the table shows R^2, which is called the coefficient of determination and is the correlation between the observed values of Y and the values of Y predicted by the multiple regression. R^2 normally ranges from 0 to 1, and a large

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value shows how well the model predicts the observed data. Because Model 7 has the highest R^2, it is therefore selected as the regression model for this study. With the R^2 having a value of 0.719, it means the model can explain 71.9% of the variability in the outcome variable. This suggests that the model is good at predicting avoidance of performance failure payment deductions in PFI projects.

Other criteria that help to confirm the accuracy of the model include the adjusted R^2, standard error of estimate, the Durbin-Watson test, and the significance level of the F statistic. The adjusted R^2 suggests how well the model generalizes beyond the existing data, and ideally should be the same or close to the values of R^2 (Dancey and Reidy 2007). Their difference normally refers to a loss of predictive power or shrinkage and is very small in this model, with a value of 0.051 (0.719–0.668). This accounts for 5.1% less variance in the outcome, signifying a good cross validity of the model. The standard error of estimate is a measure of the error of predictions in the model. In a good model, it is expected that the predictor variables would have a perfect relationship with the outcome variable, thus less error, and should be very small and close to zero. In Model 7, this value is 0.3398, which is small and shows the good predicting power of the model. Furthermore, Pallant (2005) highlighted that for any two observations predicted, the errors (residuals) must be independent and not correlated. Durbin-Watson statistics tests these correlations and varies between 0 and 4, with a value around 2, indicating that the residuals are uncorrelated, and thus, are a good model (Field 2005). In this regression, this value according to Table 2 is 1.97, which is approximately 2, and thus, shows lack of autocorrelation. Finally, ANOVA also substantiates whether the model is a significant fit of the data overall and should be less than 0.05 (95% confidence interval). Table 2 confirms this fitness for Model 7 with a value of 0.000.

After examining the model predicting power and fitness, the next phase is to identify the predictors in the model along with their significance. Accordingly, Model 7 shows that there are seven best predictors of avoidance of performance failure deduction from the 29 factors that served as independent variables for the regression analysis. Please note that the 29 factors were the reliable factors identified after conducting reliability analysis on the initial 36 factors that were included in the questionnaire survey. These seven predictors (Table 3) are referred to as critical success factors for avoiding performance failure payment deductions in PFI constructed facility and include:

- F5: good working relationship with client, end-users, subcontractors, and suppliers;
- F12: minimal use of subjective measures as KPIs;
- F7: functioning help desk is in place to receive service requests and complaints;
- F9: explicit and realistic performance standards, criteria, and weighting systems;
- F2: quality of service delivery meets requirements of output specification;
- F23: use of Just-in-Time approach compared with prescheduled maintenance regime; and
- F15: PFI/FM contractor active participation in design process.

Table 2. Model Summary and ANOVA

					Change statistics				ANOVA	
Model	R	R^2	Adjusted R^2	Std. error of the estimate	R^2 change	F change	Sig. F change	Durbin-Watson	F	Sig.
1	0.578[a]	0.334	0.311	0.4896	0.334	5.245	0.026	1.97	14.302	0.009[b]
2	0.627[b]	0.394	0.361	0.4714	0.060	5.482	0.023		13.107	0.005[c]
3	0.740[c]	0.548	0.506	0.4146	0.154	7.108	0.01		13.071	0.003[d]
4	0.771[d]	0.594	0.548	0.3966	0.046	6.027	0.017		12.911	0.000[e]
5	0.795[e]	0.631	0.582	0.3815	0.037	5.285	0.026		12.716	0.000[f]
6	0.818[f]	0.669	0.617	0.3648	0.038	5.865	0.019		12.901	0.000[g]
7	0.848[g]	0.719	0.668	0.3398	0.050	8.772	0.005		14.189	0.000[h]

Note: Dependent variable—avoidance of performance failure payment deduction.
[a]Predictors: (constant), F5.
[b]Predictors: (constant), F5, F12.
[c]Predictors: (constant), F5, F12, F7.
[d]Predictors: (constant), F5, F12, F7, F9.
[e]Predictors: (constant), F5, F12, F7, F9, F2.
[f]Predictors: (constant), F5, F12, F7, F9, F2, F23.
[g]Predictors: (constant), F5, F12, F7, F9, F2, F23, F15.

Table 3. Regression Model Results

	Unstandardized coefficients					Collinearity statistics	
Predictors	B	Std. error	Standardized coefficients β	t	Sig.	Tolerance	VIF
(Constant)	2.02	0.60		3.38	0.013		
F5: Good working relationship with client, end-users, subcontractors, and suppliers,	0.23	0.07	0.34	3.55	0.011	0.60	1.67
F12: Minimal use of subjective measures as KPIs	0.37	0.09	0.36	4.20	0.003	0.78	1.29
F7: Functioning help desk is in place to receive service requests and complaints,	0.50	0.11	0.43	4.75	0.001	0.69	1.44
F9: Explicit and realistic performance standards, criteria, and weighting systems,	0.17	0.06	0.19	2.89	0.037	0.74	1.35
F2: Quality of service delivery meets requirements of output specification	0.20	0.07	0.24	3.07	0.019	0.90	1.11
F23: Use of Just-in-Time approach compared with prescheduled maintenance regime	0.22	0.06	0.26	3.11	0.015	0.80	1.25
F15: PFI/FM contractor active participation in design process	0.19	0.09	0.21	2.96	0.031	0.73	1.37

Note: Dependent variable: avoidance of performance failure payment deduction.

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To confirm the significance of these three predictors, the *t*-test significance value for each predictor and collinearity statistics, as shown in Table 3, are examined. If the significance level is less than 0.05, then the predictor is making a significant contribution to the model, with a smaller value demonstrating a higher contribution. For this model, all seven predictors have values that are less than 0.05, confirming their significance to the model. Factor F7: Functioning help desk is in place to receive service requests and complaints has the highest contribution, whereas F9: Explicit and realistic performance standards, criteria, and weighting systems has the least contribution based on their significance values of 0.001 and 0.037, respectively. The collinearity statistics measures whether there is strong linear relationship among the predictors that is not good for the model. This is measured using the variance inflation factor (VIF), which should be less than 5, and the tolerance statistic, which is the reciprocal of VIF and should not be less than 0.2 (Hair et al. 2006). In this model, all the tolerance statistics are greater than 0.2, whereas the VIF are less than 5. Both of these confirm that there is no multicollinearity among the predictors/predicting factors.

Using the coefficient values in Table 3, the optimum regression model, which is a mathematical representation of statistical correlation between the avoidance of performance failure payment deduction and associated critical success factors, could therefore be written as

$$Y = 2.02 + 0.23(F5) + 0.37(F12) + 0.5(F7) + 0.17(F9) + 0.2(F2) + 0.22(F23) + 0.19(F15) + \varepsilon_i \quad (3)$$

Model Validation

After construction of the regression model and identifying the seven critical success factors, it is necessary to confirm their wider applicability beyond the population surveyed that was used to create the model. To achieve this validation, another set of PFI/FM contractors were randomly contacted. A new questionnaire consisting of the seven critical factors and overall success rate in avoiding performance failure payment deduction on a seven-point Likert scale was designed. Participants were asked to rate the level of importance of the seven factors in helping to avoid performance failure payment deduction in their PFI/PPP constructed facilities. Thirty questionnaires were sent to 30 organizations that were randomly selected from the list of U.K. PFI/PPP projects in operation from the HM Treasury website (http://www.hm-treasury.gov.uk/ppp_pfi_stats.htm). These organizations were different from those that initially participated in the survey used in constructing the model. Seventeen questionnaires were returned (56.7%). From these questionnaires, the ratings of the seven critical success factors (predicting factors) were input into the regression model (Eq. 3), and the overall success in avoiding performance failure payment deduction was mathematically computed. The model-computed scores were compared with the actual ratings given by the 17 respondents in their questionnaires for overall success in avoiding performance failure payment deductions. Fig. 5 shows a linear positive relationship of these two sets of scores in a matrix scatter diagram. Spearman's rank correlation coefficient, a nonparametric statistic that examines association between two ordinal variables, was used to further confirm this linear relationship. The strength of the relationship is usually indicated by the coefficient, which ranges from −1 to + 1, with the positive or negative sign indicating the direction of the relationship (Corder and Foreman 2009). Using *SPSS* software, it indicated that the correlation coefficient was + 0.835, with a significance level of 0.00003 at a 99% confidence interval. This result showed a strong, linear, and positive relationship between the model calculated scores and the actual ratings given by the respondents. It means the regression model was a good predictor, and the seven factors were critical for avoiding performance failure payment deductions in PFI/PPP projects (constructed facilities).

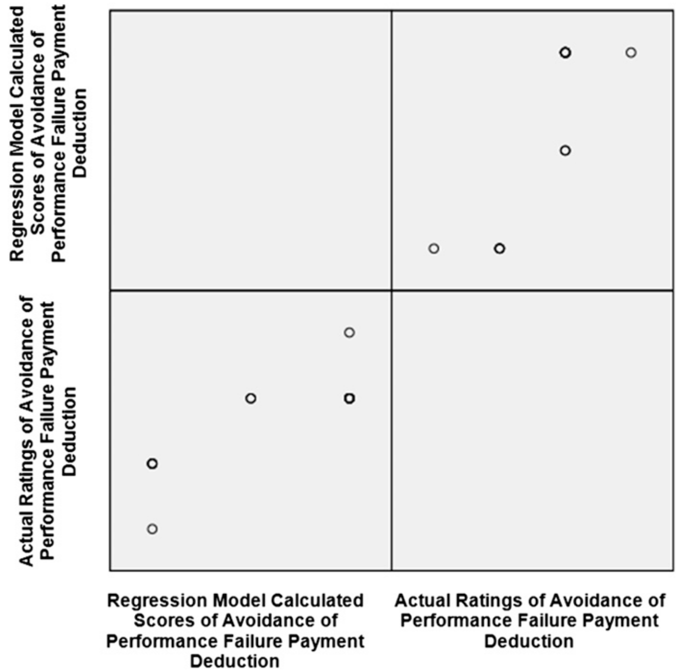

Fig. 5. Matrix scatter diagram showing regression model calculated scores against actual ratings of performance failure payment deductions

Discussion

The seven identified factors signify several implications for the construction industry, in addition to confirming some of the salient points arising in practice after the postconstruction phase. First, one of the identified factors that can help to avoid performance failure payment deductions is ensuring a good working relationship with client, end-users, subcontractors, and suppliers by the PFI/FM contractors. This comes from a perspective in which public sector clients are willing to endure shortcomings and work together with the PFI/FM contractors in relation to performance failures before triggering deductions, as long as they are quickly rectified and do not affect the germane operations of the client. The U.K. NAO (2001) suggests that this can be achieved if both parties take part in the spirit of partnerships, where understanding of each other's business and a shared common vision are considered at the outset before contracts are finalized. Smyth and Edkins (2007) confirmed that there is a need to shift from relational contracting to proactive management of relationships among PFI/PPP project stakeholders.

Second, two other factors from the seven factors that can help to avoid performance failure payment deduction relates to explicitness and lucidity of the performance management system. The factors concerned include minimal use of subjective measures as KPIs, and explicit and realistic performance standards, criteria, and weighting systems. The problem of subjective measures in KPIs relates to interpretation and ambiguity, prompting the U.K. NAO (2005) to suggest that PMS works better if subjectiveness is minimized. Shahin and Mahbod (2007) suggest that KPIs (including associated performance standards, criteria, and weightings) should follow specific, measurable, achievable, relevant, time-sensitive (SMART)

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principles. In the case of the PFI performance regime, the KPIs should be specific rather than general, measurable against objective criteria, capable of being achieved (i.e., with built-in tolerances rather than requiring the attainment of perfection), relevant to the services provided, and assessment of standards and the scoring mechanism must be capable of being completed on time to calculate monthly unitary payment.

Third, having a functioning help desk has been highlighted from the regression analysis as the most important factor in the model. This would help users of the constructed facility to report any performance failure they come across, so that the PFI/FM contractor can quickly carry out reactive maintenance and rectify the problem to avoid payment deductions. Kincaid (1994) point out that it serves as a feedback system, which can be used for measuring performance of the FM function. The main essence of FM is to deliver a quality environment that meet users' needs and requirements based on an agreed level of service. The help desk also serves as a single point of contact for inquiries and normally provides valuable assurance to the customers (4ps 2007). A related factor to meeting a user's requirement is another factor in the model, namely, quality of service delivery meets requirements of the output specification. Quality service (also referred to as service quality in management literature) includes how well a delivered service matches customers' expectations, as highlighted in output specifications (Al-Momani 2000). Parasuraman et al. (1988) identified five determinants of service quality that may relate to any service that include (1) tangibles (physical evidence of the service: appearance of physical facilities, tools, and equipment used to provide the service), (2) reliability (the ability to perform the promised service dependably and accurately), (3) responsiveness (the willingness to help customers and provide prompt service), (4) assurance (the knowledge and courtesy of employees and their ability to convey trust and confidence), and (5) empathy (the provision of caring, individualized attention to customers).

Finally, the last two factors relates to use of the Just-in-Time approach compared with the prescheduled maintenance regime and the PFI/FM contractor's active participation in the design process.

Smyth and Wood (1995) highlight the benefits of the Just-in-Time approach in maintenance compared with planned preventive maintenance. These include reducing costs by stressing the elimination of waste and high customer focus that meets service level agreements. It is about "no delays, no stockpiles, no queues, no idleness and no useless motion" (Riggs 1987) in the delivery of perfect maintenance to meets clients' demands for a product or service at short notice (Muhleman et al. 1992). The issue of a FM contractor participating vigorously in the design process of constructed facilities has been duly acknowledged by previous research in the field (Nutt 1993; Preiser 1995; Eley 2001; Kelly et al. 2005; Chanter and Swallow 2007). El-Haram and Agapiou (2002) specifically declare this factor a part of the major roles and responsibilities of FM contractors in PFI projects. Preiser (1995) highlight that facilities managers should be involved and consulted in the early planning and predesign phases of a project to highlight possible problems at an early stage and provide valuable information on facility performance and operating costs. Chanter and Swallow (2007) assert that many of the problems encountered in constructed facilities normally stem from the design stage, particularly during a brief development phase, where a failure to establish users' requirements in sufficient details results in poor performance of the completed facility.

Conclusion

PPP/PFI is now established as a major form of public procurement in several countries, such as the United States, U.K., Ireland, Australia, Canada, France, Netherlands, New Zealand, and Germany, among others. This study examined critical success factors that could help PFI/FM contractors avoid performance failure payment deductions in constructed facilities. After conducting five focus group interviews in five PFI contracting organizations, 36 possible factors that could influence performance failure payment deductions were identified. These 36 factors were put together in a questionnaire survey with a return rate of 87 usable questionnaires for analyses (43.5%). Thorough analyses that included reliability analysis, regression analysis, and Spearman's rank correlation were conducted. The results from the regression analysis showed that seven critical factors could be used to avoid performance failure payment deduction in PFI/PPP constructed facilities. These factors included a good working relationship with clients, end-users, subcontractors, and suppliers; minimal use of subjective measures as KPIs; functioning help desk is in place to receive service requests and complaints; explicit and realistic performance standards, criteria, and weighting systems; quality of service delivery meets requirements of output specification; use of the Just-in-Time approach compared with the prescheduled maintenance regime; and PFI/FM contractor active participation in the design process.

In PFI/PPP projects, successful partnerships allow participants to work together to accomplish their objectives to their mutual benefit, that is, the public sector receives a service that represents value for money, and the contractor delivers that service for a reasonable return. This study contributes to knowledge with the identification of critical success factors that can help PFI/FM contractors to avoid payment deduction, thus fully recovering their financial investments, at the same time maximizing profit in their business operations. In addition, public sector clients can achieve full value for money in the usage of assets that meets their needs, consequently satisfying the principal objectives of PFI/PPP procurement mechanism. Although this study focused specifically on performance failure payment deductions, further empirical studies are needed to know the critical success factors that influence other payment deductions, such as availability deductions, repeated failure deductions, and FM operation of PFI projects as a whole. It would be useful to know the opinions of clients and their facility users regarding critical factors that determine their satisfaction in PFI/PPP constructed facilities. What was reported in this study was limited to the U.K. construction industry. The findings should therefore be interpreted within this context. Studies from other countries using the PPP/PFI procurement mechanism could also use the findings of this research to generate a comparative study. This would certainly provide valuable information and knowledge to both the academic and the construction industry at large on PPP/PFI procurement and FM of constructed facilities.

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