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Henjewele, C., Sun, M. and Fewings, P., 2014. Comparative Performance of Healthcare and Transport PFI Projects: Empirical Study on the Influence of Key Factors. International Journal of Project Management, 32(1), pp.77-87
doi:10.1016/j.ijproman.2013.01.008

Comparative Performance of Healthcare and Transport PFI Projects: Empirical Study on the Influence of Key Factors

Abstract

Private Finance Initiative (PFI) has been used on many projects in the UK in the delivery of public services. Cost, time and risk performance in public projects was anticipated to be improved by the superior skills of the private sector. So far, there are limited empirical studies on the life cycle performance of PFI projects, especially performance comparison between different sectors. This study investigated and compared variations in costs, time, and client requirements tracking it through the strategic business case stage to the operational phase in healthcare and transport sectors. It explored the influence of sector-specific factors, project size and maturity of the PFI on these variations. It used documentary analysis of full business cases of five PFI projects and a questionnaire survey of 44 PFI projects in the UK. The findings reveal that there are still considerable cost and time overruns and requirements changes in PFI projects in both sectors over the development of the project and its early use. The health sector was better than the transport sector for time overruns but was worse on costs. Smaller-value projects outperformed larger projects on costs variations but underperformed on time.

Key words: Private Finance Initiatives; Variations; Value for Money; PFI Maturity

1 Introduction

In recent years, Public-Private Partnership (PPP) has gained popularity worldwide (Grimsey and Lewis, 2005) as one of the ways to provide the public sector authorities with additional finance to develop new social objectives. It is especially popular in times of economic hardship when public finance is under increasing pressure. PPP come in many forms, including Private Finance Initiative, concessions and joint ventures (Robinson, *et al*., 2010). The exact form of PPP adopted by a country, its context, sector and application depend on the country's social, political and economic environments (Grimsey and Lewis, 2005). The main benefit of PPP is that it can assure the procuring authority the best possible performance by sharing risk and innovative skills with the private sector in providing public services in order to achieve greater efficiency and cost effectiveness, whilst also reducing cost overruns and project delays (Tang et al 2010).

Several authors have reviewed performance of PPP projects from various perspectives (Clifton and Duffield, 2006; Raisebeck *et al*., 2010; Yang, et al., 2010; Mahalingam, 2010). The key issues investigated include management of risks and finance, structuring an arrangement, performance management and measurement, etc. (Tang *et al*., 2010). Most of these studies come to the conclusion that PPP performance often falls short of expectation for a variety of reasons, including the lack of experience (Carrillo *et al.*, 2006), lengthy procurement and negotiation periods (Akintoye et al., 2003), the high levels of risks involved (Daube *et al*., 2008) and various country specific barriers (Chen and Doloi, 2008; Mahalingam, 2010).

The UK has used private finance initiative (PFI) to procure projects in various sectors since 1992. By March 2012, there were 717 PFI projects, with an estimated capital outlay of £54.7 billion (HM-Treasury, 2012). On average, PFI contributes between 5-10% of capital outlay required for public sector infrastructure (Burger and Hawkesworth, 2011). Government agencies have carried out several performance reviews in attempts to ensure lessons from previous projects are used effectively (HT-Treasury, 2003; 2006b; 2008; National Audit Office (NAO), 2003; 2009a). The continuous learning from past projects has significantly improved performance of PFI and made it one of the most interesting cases for learning for developed and developing countries (Leahy, 2005; Kleiss and Imura, 2006; Daube *et al*., 2010; Cheung and Chan, 2011). Handley-Schachler and Gao (2003) specifically recommend that developing countries wishing to adopt the PPP route should learn from PFI's successes and failures.

By 2009, the National Audit Office (NAO) had published 72 reports evaluating various aspects of value for money (VFM) and the Treasury produced three policy reports. Some

examples of the reports, including those published on behalf of these agencies, which have evaluated cost, time and operational performance are:

- Mott MacDonald (2002) reviewed 50 large public procurement projects, including 11 PFI projects. Their review concluded that PFI projects were relatively more certain in time and cost than conventional projects. Most projects were delivered earlier than planned, while cost overruns were as low as 1 per cent.

- HM-Treasury (2003) studied 61 PFI projects. Overall, 88% were delivered on time or early, there were no cost overruns from the public sector side, and operational projects were performing as expected.

- NAO (2003; 2009) studied construction performance of PFI projects. The 2003 study of 37 projects found 78% of the projects had no construction related cost overruns, while 24% were delivered late. The similar study conducted in 2009 of 114 projects showed that new projects that were implemented between 2003 and 2008 were underperforming. Sixty nine percent of projects were being delivered on time and 65% were delivered to contracted cost versus 78 and 76%, respectively in 2003.

- Partnerships UK (PUK) (2006) studied 105 PFI projects. It found that 80% of all users were always or almost always satisfied with services provided and around 90 per cent of PFI projects were performing satisfactorily or better.

- The Ipsos MORI (2008) surveyed 151 PFI projects and found that 73% of respondents rated the performance good or very good and only 4% rated it poor. The Respondents were happy that user satisfaction was high.

The evaluations have often led to conflicting judgments due to what De Wit (1988) describes as the lack of a clear distinction on what is actually being measured to determine success. For example, Monbiot (2001) regards the Skye Bridge in UK as a failed PFI because public pressure persuaded the Scottish Executive to nationalize the crossing despite the fact that the bridge was constructed on time and to cost, and it has continued to provide a valuable service to customers. The split is such that, on one hand, proponents credit PFI schemes for the continuous improvement in project completion and modernization of underfunded services such as healthcare, schools, major transport networks and prison services (Akintoye *et al*., 2003, Carrillo *et al*., 2008; Raisebeck *et al*., 2010). While on the other, opponents, such as Pollock *et al*., (2007), dispute the success on grounds that they only reflect some project phases. Other authors, including Gaffney and Pollock (1999), Shaoul

(2005), Pollock (2011) and Hodkinson (2011) argue that the overall cost to achieve the perceived positive performance is unsustainable.

This study looks at the link between project attributes and performance. Project attributes have been used as one of the decision criteria on the suitability of a project for PPP route (Cheung and Chan, 2011); however, some of them have not been substantiated empirically. It aims to promote evidence-based policy and decision-making, while also sharing lessons from previous projects. Experience from PFI is used in this study to evaluate how different types of project arrangements perform in terms of meeting client requirements, delivery time and cost. It compares the performance of healthcare projects versus transport sector projects; small-value against large-value projects; and recently developed versus long running projects. Findings should strengthen decision-making and inform future policy direction particularly those requiring PPP projects to reach a certain capital thresholds to achieve good VFM.

To avoid aforementioned confusions, the study will assess performance based on the traditional '*iron triangle*' (Toor and Ogunlana 2010) that considers cost, time and quality. De Wit (1988: 168) considers these indicators as essential part of project performance monitoring capable of determining project success if measured by comparing a number of projects. Some studies also agree that variations in any combination of three factors (cost, time and client requirements) imply unpredictability, which can affect the VFM (Pollock *et al*., 2007, NAO, 2008, Raisebeck *et al*., 2010).

2 The influence of key project attributes

The choice between PFI and other methods of procurement is strictly based on performance and value for money (VFM). Although the concept of VFM is contextual (Daube *et al*., 2008; Sobhiyah *et al*., 2009; Ke *et al*., 2010), it generally describes the optimum balance between cost and quality to achieve the desired needs (HM-Treasury, 2006a) - which are commonly used in the project management literature. HM Treasury argues that VFM is a comparison of whole life performance based on three indicators: economic, effectiveness and efficiency (HM-Treasury, 2008). Therefore, VFM and performance can arguably be seen as interlinked concepts, only that VFM looks forward whilst performance looks backwards.

The performance of a PFI project is assessed on how well the project meets client's output specifications (Chinyio and Gameson, 2009). Output specifications describe at a general level client's requirements on performance standards, including the physical conditions and the design as well as the scope and level of requirements for each service category

(Robinson and Scott, 2009). In return, the private sector is guaranteed a regular income stream through annual payments (unitary charges), covering capital investment, risks, operation and maintenance costs and services.

Project performance evaluation is a dynamic process that uses multi-dimensional parameters (De Wit, 1988). However, some project performance factors, including external causes, organizational cause and project internal causes are the most common because of their influence on cost, time and client requirements (Sun and Meng, 2009). Only a few studies, including Kakabadse *et al*., (2007) and Carrillo *et al*., (2008) have attempted to link project attributes and performance based on outputs and outcomes from projects. The link between project attributes and performance in terms of cost, time and quality is better covered in the literature from traditionally procured projects (Ahsan and Gunawan, 2010, Bhargava *et al.*, 2010; Creedy *et al.*, 2010; Wambeke *et al.*, 2011; Jorgensen *et al*., 2012). Since these studies dealt with the construction phase of traditionally procured projects, the findings could be relevant to the construction phase of a PPP/PFI project, which shares close proximity with traditional projects, but for other phases, this need to be substantiated.

A review of existing studies found that three key project attributes are often believed to have major impact on performance of PFI projects. They are size of the project; sector specifics which affect the nature of the project; and PFI maturity (time at which the project was procured and developed). These attributes underlie other project characteristics, such as the degree of project complexity, level of risks and accrued experience (Akintoye *et al*, 2003; Raisebeck *et al*., 2010).

2.1 Size of the project

Project size is reported to impact PFI projects performance and value for money (HM-Treasury, 2003; 2008; Chiang *et al*., 2010; Cheung and Chan, 2011). The UK's Treasury department requires PFI projects to reach a minimum capital threshold to offset high transaction costs and justify that there will a sufficient transfer of risks (HM-Treasury, 2003; 2008). Some small projects for schools and street lighting bundle several into a single contract, with larger upfront outlays, to reduce lifecycle cost and increase construction productivity (Grimsey and Lewis, 2007). Cheung and Chan (2011) also argue that large projects affect procurement time due to increased complexity. To the contrary, Demirag and Khadaroo (2010) concluded from a survey of 141 PFI schools that project size does not affect the overall outcomes. Clients (Head teachers) from small projects (<£20 million) were more satisfied with the cost and quality of interior design of the buildings, while those from large projects (>£20million) were in a better position to afford costs. Similarly, Carrillo et al. (2008) investigated the experience of 100 PFI projects in the UK, which included *small*

projects of capital value less than £30 million, *medium* with capital cost between £30-70 million and *large* with capital value over £70million. The study showed that the majority of clients and construction organizations believed bidding costs for PFI were high regardless of project size. These studies do not provide justification for the assertion that PPP/PFI projects should reach a certain minimum threshold to perform better as claimed (HM-Treasury, 2003; 2008), as experience from traditionally procured projects also shows there is no conclusive relationship between project size and variations in time, cost and quality (Bhargava *et al*., 2010, Creedy *et al*., 2010). Jorgensen *et al*. (2012) specifically argue that any observed relationship between project size and overruns will depend on the variables used - studies that used actual costs were likely to find a positive correlation, while those using estimated costs would find an inverse correlation.

2.2 Sector specifics

The second attribute is the claim that PPP/PFI may not perform well in some projects due to sector specifics (HM-Treasury, 2003; NAO, 2005). The claim is valid from a certain point of view, such as risks or financial viability, which also affects traditional projects (Lam, 1999; Irfan et al., 2011; Bhargava et al., 2011; Wambeke *et al.* 2011). For example, ICT services are considered unsuitable for PFI because it is difficult to determine long-term risks, thereby creating uncertainty for VFM (HM-Treasury 2003). Although some studies conducted by the NAO (2005; 2007) in the UK suggested differing performances between services sectors, little evidence exist on the impact of sector specifics on cost, time and quality. NAO (2007) established that the average tendering period for PFI schools was 25 months, while for hospitals and other PFI projects they were 38 months and 47 months respectively. Earlier, NAO (2005) found that 60% of PFI projects undertaken by the Environmental Agency in the UK were completed on time and 77% were on budget; while in comparison, 63% PFI projects in the NHS were on schedule and all projects from the NHS estates were on budget. In both reports, there was no attempt to explain the cause for the –inconsistency in performance given that all sectors follow the similar procurement processes, which were discussed early in this paper. Therefore, the present study will investigate healthcare and transport projects, which differ in the type of infrastructure and perceived complexity, perform in terms of variations in cost, time and client requirements.

2.3 Stage of PFI Maturity

Andersen and Jessen (2003) describe maturity as a subjective quality of receptivity to best projects management. It is a measure of ripeness of procuring authorities to knit together actions, attitude and knowledge to increase project success. Since its launch, PFI went through steady changes and adjustments, including reviews of PFI process in 1997 and 1999, improved guidance and better institutional setup, are expected to have addressed

shortfalls associated with limited experience (De Lemos et al, 2000; Carrillo et al, 2008; Raisebeck *et al*., ,2010). There is optimism that newer projects are likely to perform better than earlier projects (Ipsos Mori, 2008). However, evidence for the National Audit Office (2007; 2009) call for further actions. NAO (2007) evaluated 49 PFI projects, which reached a financial close between 2004 and 2006, and concluded there were no improvements in the tendering process. NAO (2009a) concludes from a survey of 114 projects that construction performance was declining. Both studies did not assess the impact of maturity on cost, time overruns and the stability of client requirements.

3 Research objectives and methods

3.1 Objectives

This study seeks to investigate the impact of the above key project attributes on performance of PFI projects. More specifically, (1) it will examine the impact of these attributes on variations in cost, time and output specifications at different project stages; (2) it will carry out such an examination in different sectors for comparison purposes.

3.2 Research methods

Accessing financial information is often a challenge for researchers wishing to investigate VFM performance of PFI projects. Other studies, such as Pollock et al., (2007) and Raisebeck et al., (2010) opted for documentary research, which used vetted information. This study seeks to gather information from multiple sources, including documentary analysis, questionnaire survey and interview, to triangulate results. It began with a detailed documentary analysis of full business case documents of five PFI projects and government reports. The documentary analysis was crucial to the content and design of the questionnaire to identify quantifiable parameters that are updated at key review stages. Variations in these parameters are identified and analyzed through a questionnaire survey involving a larger number of PFI projects – the focus in this paper.

The survey used a structured questionnaire administered to PFI client teams from healthcare and transport infrastructure projects. More in-depth information was gathered by interviews with some selected respondents of the survey. Healthcare and transport were selected because they were the only sectors that responded positively to request for information and involvement in survey. These two sectors combined account for nearly 35% of total PFI capital and 25% by number of projects, therefore are appropriate representative of all PFI projects because they include projects of varied project sizes, project types and complexities.

A selective sample of 96 projects, including 54 projects from the healthcare and 42 from the transport sector, was drawn based on four criteria: (1) representation of the sectors; (2) coverage of different development stages; (3) wide range of project sizes (capital value); and (4) projects developed from 1997 onwards. Since 1997, PFI underwent progressive improvements in operational guidance and organizational structure (Carrillo et al., 2008; De Lemos et al., 2000). The sample represents more than half of the effective population of 178 projects from both sectors at the time. Eighty contacts for the sample projects were verified – as some had switched to traditional procurement methods or changed contacts. The questionnaire was sent to client representatives of the 80 projects.

3.3 Questionnaire design

Quantifiable project parameters for evaluation in the survey were identified from five full business cases of PFI projects from the healthcare. The five projects were chosen among 19 accessible business cases. Selection criteria were adequacy of the information for analysis; timeliness and relevancy about information sought. Since no business cases were accessible for transport projects, parameters identified for the healthcare were standardized to suit both sectors. The documents only covered project appraisal up to the financial close. For analysis of the operational phase, the report by the National Audit Office (NAO, 2008) was used.

An initial list of 11 parameters was compiled from the business cases. Client requirement was the most diverse item. This typically included: project scope, which specifies main types of works and departments covered; number of beds required; facilities management (FM) services with soft FM services such as cleaning and hard FM services such as planned and responsive maintenance; equipment, including medical and non medical equipment to be supplied; space requirement or floor areas; number of rooms with specific reference to theatres, consultancy rooms, offices.. Following the initial identification, the requirements were standardized into four items: project scope, delivery units, equipment, and FM services. For example, specifications such as number of beds, floor areas and number of rooms were rephrased as “delivery units”, as they are clearly not relevant in the transport sector.

Timescale and costs are common to all PFI projects. Timescale refers to detailed project schedules covering from one milestone to the other. Costs were generally presented according to the Treasury’s VFM assessment (HM-Treasury 2006a). Typical cost categories included in the business cases were capital cost, unitary charges, revenue cost, and consultancy fees. For the operational phase, three cost parameters, including capital cost, operating costs, and unitary charges, were identified from the NAO report (2008). Capital cost, which is further divided into initial and lifecycle cost, is the investment incurred by the

private sector during the course of the contract period, to design, construct, and maintain the asset so that it remains fit for its intended purpose. Unitary charges are the payments the public sector authority makes for the facilities and services provided by the consortium. Revenue costs or externalities incur because of the activities in PFI, while consultancy fees are paid for external advisory services. The Authority operating the asset and/or running the services also incurs operating cost excluded from unitary charge.

Therefore, 10 quantifiable parameters were presented in a questionnaire for evaluation. The questionnaire contained 16 questions grouped in four sections:

1. Section 1 asked general questions about the respondent and the project. The information sought includes the project value, the infrastructure built, and the project stage.
2. Section 2 asked details about changes made in the development phase, the magnitude of the changes and the reasons for the changes.
3. Section 3 targeted operational projects seeking information about changes made at the operational stage and the reasons hitherto.
4. The fourth section sought opinions particularly on how the respondent ranked the effectiveness of various methods to address uncertainty. Finally, respondents were asked to indicate their agreements or disagreements with the four proposed underlying causes of cost uncertainty.

3.4 Summary of responses

Forty-four respondents returned completed questionnaires representing a rate of 55%, which is better than many previous studies investigating the client side of PFI, including studies by state agents or authorities (HM-Treasury 2006b; Ipsos 2008). Responses received were from 15 project directors; 16 PFI/ project managers; 12 contract managers; and only one had a non-managerial role in the PFI team. 28 transport and 16 hospitals as table 1The projects were a mixture of old and new projects including 21 projects that were approved at OBC to continue with PFI procurement before 2000 and 21 received a go ahead after. Only one project was yet to secure OBC approved and one did not provide information on OBC approval status.

The response covered projects at different stages and sizes as shown in table 1. The high representation of operational projects was beneficial to provide more information than those at earlier stages. The response from each sector was tested for internal consistency of the scales by using Cronbach's alpha coefficients. Results for each as well as the combined response ranged from 0.722 to 0.985, which exceed the 0.70 guideline (Santos 1999).

Table 1: breakdown of the response and projects involved

Project stage	Number of Projects by Value (£million)					Total number	% of total response
	<£20	£(21-74)	£(75-149)	£(150-349)	>£350		
Planning	0	1	0	1	0	**2**	**5**
Bidding	0	2	2	1	2	**7**	**16**
Construction	0	3	0	3	3	**9**	**20**
Operating	3	8	6	7	2	**26**	**59**
Total number	**3**	**14**	**8**	**12**	**7**	**44**	**100**

4 Preliminary analysis of the project variations

PFI projects follow several review stages, through which a respective business case is approved (HMT, 2006a). The stages are:

- Strategic business case (SBC) stage– where the client interprets strategic business requirements into service specifications and develops project objectives
- Outline business case (OBC) stage - where project and procurement options are appraised and bidding documents, including output specifications and the PSC, are developed.
- Procurement starts with the invitation to expression of interest from bidders and ends with the financial close. The procuring authority develops a full business case (FBC) after negotiation, which documents value for money and expected operational performance (HM-Treasury, 2006a).
- Design and construction is transferred to the winning consortium of private sector contractors. Performance is evaluated based on time, cost, quality, and client satisfaction (NAO, 2003, HMT, 2003).
- At contract completion, the project enters into the final operating phase where operational performance and user satisfaction are critical performance measures (PUK, 2007; NAO, 2008).

The analysis compared the performance of different types of projects under three main headings: (1) Output specifications performance, addressing requirements change; (2) Schedule performance, addressing time overruns; and (3) Cost performances, addressing different elements of cost overruns. In the questionnaire, respondents were asked to indicate variations in the planned parameters at three transitions or review stages:

- Stage 1 - from the SBC to OBC;
- Stage 2 - from the OBC to FBC;

- Stage 3 - during the operational phase.

The construction phase was purposely omitted because it would evaluate the performance of the private-sector consortium responsible for the construction rather than the public sector client that mostly monitors the contract. Responses were on a three-point scale (1 = Decreased; 2 = No change; 3 = Increased).Given that the data collected was on an ordinal scale; descriptive analyses were adopted to convert ordinal scales to scores such as total of variations and mean scores (MS) that are easy to compare. Total variation (%) is a net sum of 'decrease' and' increase', which indicates the uncertainty about the plan - higher percentage shows more variations. Mean Scores (MS) were computed based on the formula adopted from Mbachu and Nkado (2006):

$$Mean\ Score\ (MS) = \sum_{i}^{j} (P_i * R_i)$$

Where: P_i= rating point $_i$; $R_i^{\%}$ = percentage response to rating point i,

MS indicates an overall decrease or increase: MS = 2.0 – 'No change'; MS < 2.0 – 'Decrease'; MS >2.0 – 'Increase'.

To clarify the results, non-parametric Spearmen's ranked correlations or Spearman's rho (ρ) tests were undertaken to explore interactions among parameters. Spearman's rho is suitable for data measured using ordinal scale of measurement (Hill and Lewicki 2007). It can objectively measure movements among paired variables without requiring that link to be represented by a linear relationship. However, correlation coefficients offer a limited interpretation of interactions between variables; therefore, these were squared to establish coefficients of determination (ρ^2) that measures the power to influence. Results for variations at each transition stage are summarized in table 2. The results are separately discussed to interpret performance in terms of output specifications, time schedules, and costs.

Table 2: projects performance at different project stages

Performance parameters	Stage1		Stage2		Stage3	
	Total variations	Mean score	Total variations	Mean score	Total variations	Mean score
Project scope	35	2.35	33	2.19		
Planned delivery units	31	2.10	52	1.78		
Scope for Equipment	17	2.17	26	1.89		
Planned FM services	7	2.07	12	1.96		
Timescale	57	2.50	65	2.65		
Consultancy fee	38	2.38	57	2.57		
Revenue cost	48	2.41	44	2.22		
Capital costs	61	2.55	53	2.33	10	2.10
Unitary charges	54	2.46	52	2.22	59	2.59
Operating cost	-	-	-	-	66	2.66

The first part of the preliminary analysis focuses on variations in the client's requirement at stages 1 and 2. The analysis in table 2 shows that client requirements, including project scope, delivery units, facilities management services and equipment, identified at the strategic outline case stage were not constant:

1) They were likely to vary as the project progresses to the outline business case stage and full businesses stage. On average, client requirements increased (ms>2.0) at the OBC stage and decreased (ms<2.0) at the FBC stage. Project scope was the only exception to this trend as it increased throughout. It is evident from the analysis that client requirements undergo several iterations before and during procurement.
2) There is a statistical correlation between these variations, which suggest that client requirements are interactive. For example, projects that increased the FM services at the OBC stages were likely to reduce them during procurement (ρ^2=52%; P<0.01) or for healthcare projects, omit equipment (ρ^2=19%; P<0.05). The analysis further demonstrates that most projects change client requirements at least at one of the stages or both and only a few do not change at any stage. For example, while 38% of projects had no change in scope at any stage, 52% changed the scope at either stage 1 or 2 and seven percent changed at both stages. Similarly, 39% of projects had no change in delivery units at any stage, while 50% varied at stage 1 or 2, and 11% changed them at both stages.

The findings raise the need to explore the relationship between variation in client requirement and both cost and time. For brevity, only schedule performance and the impact

of changing client is explored in the coming part of the preliminary analysis and the remaining interactions will be explored in the third part.

Schedule variation at each stage is the difference between planned and actual time to accomplish the stage. As shown in table 2, there were significant increases in time (delays) at both stages (MS>2.0). In summary, the results draw three conclusions:

1) Planned schedules to develop project business cases and to procure the contractor are not only unpredictable but also probably optimistic. More than half (54%) of project delayed the completion of OBC and 65% were procured out of schedule (delayed at FBC). Only less than 20% of projects have no time variations at any stage, while more than 80% delayed at either stage 1 or at stage 2.
2) Change in client requirements is an important risk factor for time overruns. Around 67% of delays at stage 1 and 75% at stage 2 are from projects that also changed at least one of the client requirements.
3) Since time performance is one of the critical indictors of VFM, time overruns put VFM at risk.

The conclusions lead to another interesting quest to investigate the relationship between time and cost variations, which are explored in this final part of the preliminary analysis. Cost was the only category analyzed for all three stages: Capital cost and unitary charges are 'contractual costs' because the long-term costs to the client. These were analyzed for all three stages. On the other hand, consultancy fees and revenue cost are transactional costs to develop a PFI project and apply at stage 1 and 2 only. Operating cost is a running cost that applies at stage 3 only.

Previous studies have shown that delays affect transaction costs such as advisory fees and expose projects to external risks such as policy change and inflation, which are difficult to control (Akintoye *et al*., 2003; Ahadzi and Bowles, 2004).
Table 2 confirms that there were continuous overruns (MS>2.0) in all cost items throughout. Results from this analysis lead to the following conclusions:

1) Cost items including capital cost, unitary charges, revenue cost and advisory fees constantly increased. At the end of OBC (stage 1), contractual costs (capital cost and unitary charges) were worst affected, while at the end of procurement or FBC (stage 2), there was a slight improvement in these costs but transactional costs, particularly consultancy fees, worsened. At the operational phase (stage 3), a significant number of projects overran the operating cost and unitary charges, but few overran capital cost -mostly due to major changes to the facilities or services.

2) Variations in cost items are interactive whereby change in one item would trigger changes on others. This is particularly strong between 'contractual costs', which showed strong correlations at both stages 1 and 2 (ρ^2=76% and ρ^2= 68%, respectively). At stage 3, variations in unitary charges strongly correlate with operating costs (ρ^2= 75%).
3) Variation on client requirements at both outline business case and full business case stages has no significant effect on cost. Projects were likely to overrun costs even when requirements remained unchanged and in some cases when they were reduced. On average, 16% of projects that changed client requirements also overran consultancy fees, while 40% of overruns in fees were from projects that had no variations in requirements. Cost overruns are probably due to underestimation and other external factors (Flyvbjerg *et al*., 2003).
4) Time overrun is an influential factor to both 'contractual' and 'transactional' cost overrun - the relationship is rather indirect. The analysis showed that 35% of projects that delayed the FBC also overran consultancy fees, while 19% paid extra fees even though they had not delayed.
5) Overruns in unitary charges strongly depend on capital cost in the pre-contract stages and on operating cost during the operational phase.

5 Influence of project size, sector specifics and PFI maturity

Having validated the unpredictability of client requirements, time and cost, the subsequent analysis explores whether these variations were influenced by the sector in which the projects were being implemented; size of the project, or experience acquired through the maturity of PFI. For the convenience of pair-wise comparison, project size, sector specifics and PFI maturity were defined as follows:

1. Project sizes are classified into 'small' and 'large'. Projects with capital value below £75million are classified as small and those with £75million or more as large. Other studies have classified project sizes differently. For example, school projects with capital cost below £20million are small and £20million and above are large (Demirag and Khadaroo 2010). Given that transport infrastructures are high-stake investments, the threshold is reasonable and best suits the nature of the projects involved. The £75million threshold is also used in healthcare projects for large schemes requiring departmental approval (Department of Health 2005).
2. By sector, projects are classified as 'transport' and 'healthcare'- no regrouping was required as this was predefined during the questionnaire design.

3. PFI maturity is divided as ‘old’ and ‘new’ based on a year 2000 benchmark point. Projects that achieved a corresponding stage before 2000 are ‘old’ and after 2000 are ‘new’ (figure 1).

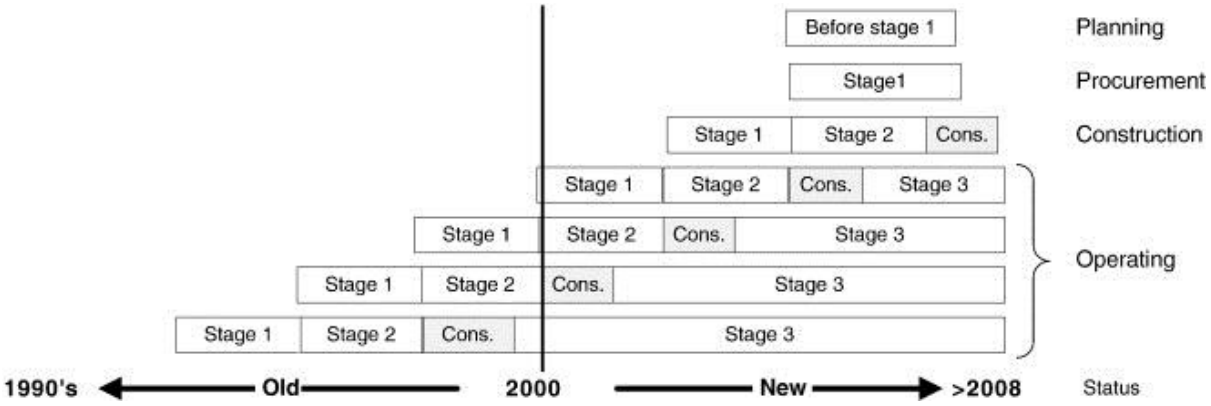

Figure 1 Project age and status at time of the survey

In figure 1, project status is as shown in table 1. As discussed earlier, the construction phase was not covered in the analysis. The more stages the project completed by 2000, the older it is, and the vice versa. Year 2000 is a crucial benchmark line for the maturity of PFI (NAO, 2009b). It divides projects between those with relatively inferior and superior implementation frameworks (Carrillo *et al*., 2008). This follows comprehensive reviews of the PFI process in 1997 and 1999 and the subsequent restructuring, which mostly came into effect from 2000 onward (Chinyio and Gameson 2009).

A pair-wise comparison using mean scores and non-parametric Mann-Whitney’s U-test was performed. Separate tests were performed for each pair to examine whether the difference in variations between the independent groups had equal values. The difference is conclusive when the P-value is smaller than 0.05 ($P<0.05$). For consistency, the comparison was limited to six parameters: project scope, delivery units, timescale, capital cost, unitary charges, and operating cost. FM services are excluded because these were relative stable. Equipment is excluded because the item mainly applies to one sector – healthcare. Mainstream costs including capital cost and unitary charges were preferred to transactional costs since these are consistent through all stages.

5.1 Comparison of the performance by sector

The comparison involved 16 projects from the health sector and 28 transport infrastructures. Test results for the pair-wise comparison of the healthcare and transport sectors are presented in table 3. Results show no conclusive difference at stage 1 and 2, but transport projects performed significantly better in capital cost at stage 3. Differences in other parameters show that transport projects had fewer variations in client requirements only at

stage 1, but it generally performed worse in most aspects. Among the areas of underperformance, transport sector projects had higher increases in project scope and reduction in delivery units at stage 2; more delays at stage 1 and 2 and more overruns in unitary charges throughout. For example, 60 % of transport projects delayed the completion of stage 1 and 75% delayed stage 2. In contrast, delays for the healthcare were only 46% and 55% for stages 1 and 2 respectively.

Table 3: comparison between healthcare and transport projects (Mann-Whitney test)

Performance parameter	**Stage1**			**Stage2**			**Stage3**		
	Mean score (MS)		**p-value**	**Mean score (MS)**		**p-value**	**Mean score (MS)**		**p-value**
	Health	**Transport**		**Health**	**Transport**		**Health**	**Transport**	
Project scope	2.50	2.20	0.095	2.08	2.27	0.462			
Delivery units	2.21	2.00	0.296	1.92	1.64	0.326			
Timescale	2.46	2.53	0.599	2.55	2.73	0.329			
Capital cost	2.50	2.59	0.801	2.46	2.24	0.229	2.43	2.00	**0.001**
Unitary charges	2.36	2.53	0.556	2.17	2.27	0.831	2.57	2.59	0.929
Operating cost	-	-	-	-	-	-	2.57	2.68	0.599

In view of the established relationship between project complexity and performance (Sun and Meng, 2009; Irfan *et al*., 2011; Bhargava *et al*., 2011; Wambeke *et al.* (2011), the survey compared respondent's ranking of complexity. In diminishing order, the healthcare ranked as follows: design, PFI procurement, technology and equipment, output specifications and project organisation. Meanwhile, transport projects ranked PFI procurement, output specifications and design at the top, while project organisation and technology were the least complex.

The analysis supports that the relatively better performance of the transport projects, at stage 1, was due to the complexity of healthcare projects. Healthcare buildings involve complex designs and detailed output specifications. Follow up interviews clarified that these projects had difficulties on prioritizing requirements, agreeing on activity assumptions and defining the commissioning intentions. On the contrary, inconsistent performance for transport projects was due to some projects broadening the scope during procurement in response to the new sustainability agenda and better energy management technologies. The organisational complexities in transport projects also increased the difficulty in securing authorization, planning permissions and land acquisition.

The difference in cost overruns between healthcare and transport sector projects was found to be consistent with the perception of risks involved and its allocation (Lam, 1999). For example, healthcare projects, which were overly cautious on the risk of unaffordable unitary

charges, performed better on this aspect throughout. They also had fewer variations in operating costs. To minimise the risk, these projects avoided adding new requirements or in some case reduced them. However, this measure proved to be ineffective; because once the projects were operational, new facilities were added at much higher costs, which escalated all cost elements: capital cost, operating cost and unitary charges. On the contrary, transport projects did not add new facilities that required extra capital reinvestment but they experienced serious operational risks, which escalated the operating cost and unitary charges.

5.2 Influence of project size

Results for the Mann-Whitney test to compare performance between small (<£75million) and large (>£75million) projects are presented in table 4.

There is no significant difference in performance between projects of different sizes - and Bhargava, *et al*., (2010) drew similar conclusion from traditional projects. Nevertheless, two deviations were noticed: (1) small projects persistently reduced delivery units, while large project were more likely to increase them; and (2) small projects had more delays than large projects.

Table 4: comparison of the performance by project size (Mann-Whitney U-Test)

Performance parameter	Stage1			Stage2			Stage3		
	Mean score (MS)		P-value	Mean score (MS)		P-value	Mean score (MS)		P-value
	Smaller	Larger		Smaller	Larger		Smaller	Larger	
Project scope	2.30	2.37	0.717	2.22	2.17	0.877			
Delivery units	1.90	2.21	0.185	1.89	1.72	0.482			
Timescale	2.70	2.39	0.180	2.67	2.65	0.922			
Capital cost	2.49	2.60	0.633	2.30	2.35	0.827	2.00	2.19	0.105
Unitary charges	2.44	2.47	0.903	2.22	2.22	0.955	2.54	2.62	0.644
Operating cost							2.65	2.69	0.690

The difference between small and large projects could be due to two possible reasons.

1) Optimistic behaviours (Demirag and Khadaroo, 2010): the tendency for small project to identify requirements in excess and eventually reduced them when they found the scope would be unaffordable suggests they were optimistic to reach a certain threshold to attract the private sector and achieve VFM. The iterative process to balance client requirement with cost affordability made these projects spend more

time at both stage 1 and 2. Small projects had no facility-related cost increases at stage 3 and relatively fewer escalations in operating cost and unitary charges.

2) Resource constraints (Ahadzi and Bowles, 2004): large projects tend to have better resources to employ experienced staff and external advisors to assist them develop sound business cases. Such cost for small projects would be unaffordable, hence more reliance on less experienced in-house teams. The analysis shows that large-value projects were more likely to endure variations during the operational phase where relatively fewer resources are required, but were relative stable during the development stage.

5.3 Influence of PFI maturity

A Mann-Whitney test for 'old' and 'new' projects (Table 5) provides some conclusive evidence that PFI maturity has a significant effect on project performance. The comparison reveals the following:

- SBCs of newer projects over specified the delivery units and were more likely to reduce them at the end of the OBC stage (stage 1), while older projects underspecified the delivery units therefore they were more likely to increase them.
- New projects had more predictable capital cost, but they were more likely to overrun time during Procurement (stage 2) than older projects.
- Almost 85% of older projects overran operating cost (at stage 3); while only 40% of new projects overran the cost.
- Older projects, which reached a financial close before 2000 and those that were procuring around this time, were the most uncertain projects. They have the highest variations in most parameters at stages 1, 2 and 3.

Table 5: comparison of performance by maturity (Mann-Whitney U-test)

	Stage 1			**Stage 2**			**Stage 3**		
	Mean variations		**U-test (Sig)**	**Mean variations**		**U-test (Sig)**	**Mean variations**		**U-test (Sig)**
Parameters variations	**Before 2000**	**After 2000**		**Before 2000**	**After 2000**		**Before 2000**	**After 2000**	
Comparison by dates of approval to proceed with procurement (year of OBC completion)									
Project scope	2.50	2.28	0.210	2.09	2.20	0.210	-	-	-
Delivery units	2.40	1.89	**0.037**	2.09	1.56	0.055	-	-	-
Timescale	2.67	2.39	0.312	2.40	2.80	**0.046**	-	-	-
Capital cost	2.70	2.45	0.328	2.73	2.06	**0.007**	2.15	2.00	0.255
Unitary charges	2.57	2.39	0.600	2.50	2.00	0.083	2.70	2.38	0.118

Operating cost	-	-	-	-	-	-	2.80	2.38	**0.033**
Comparison by dates of financial close (year of FBC completion)									
Project scope	2.50	2.38	0.490	2.40	2.06	0.259	-	-	-
Delivery units	2.50	2.06	0.120	2.00	1.89	0.502	-	-	-
Timescale	2.67	2.44	0.611	2.50	2.59	0.491	-	-	-
Capital cost	2.75	2.50	0.453	2.80	2.30	0.074	2.15	2.07	0.430
Unitary charges	3.00	2.33	0.156	2.60	2.18	0.183	2.85	2.40	**0.012**
Operating cost	-	-	-	-	-	-	2.85	2.53	0.055

In summary, newer projects, which began most of the PFI processes after 2000, performed better on cost and client requirements but worse on procurement time. Older projects performed better on procurement length but worse on cost and client requirements. Since earlier studies have not discussed the difference, the analysis cannot exclude the claim for better guidance (Ipsos Mori, 2008). Both HM Treasury and NAO have guidelines on the implementation of PFI projects, which insist on the need to have a clear definition of needs. The analysis shows that new projects have had an improved definition of client requirements thereby requiring fewer scope changes and therefore, they saved time at the OBC stage.

Some new projects, which were developed after the formalized PFI structure and process were in place, reviewed client requirements several times during the OBC stage and also before the full business case was approved. The affected projects spent much longer time during procurement, which agrees with what the NAO (2007) found (average tendering time increased from 33 to 34 months for projects procured between 2000 – 2003 and 2004 - 2006, respectively). The European Union's stiffer procurement directives, such as competitive dialogue, could be another possible cause. Hoezen *et al*., (2010) found that many clients struggled with the additional practical issues and dynamics of risks imposed by the competitive dialogue directive.

6 Conclusions

This study explored the effect of project attributes on the performance of PFI projects to validate some common claims relating to project size, sector specifics and maturity of PFI with time. The preliminary analysis, which underpinned the comparison of projects by attributes, found that the surveyed projects experienced substantial variations (in client requirements, time and cost) before they reached the financial close stage. Once these projects were operational, operating costs and unitary charges continued to escalate. Iterations in client's requirements are found to increase project development and procurement lengths, hence putting both contractual and transactional costs at risk of overrun.

Projects, regardless of their relative sizes or service sector, experienced variations at all stages. However, in some healthcare projects, more facilities and services were added during the operating phase, which resulted into a substantial increased in capital cost for those projects. On the other hand, transport projects are seen to have better defined client requirements, but still experienced more variations than healthcare projects. Healthcare projects, which require more detailed output specifications and complex design, are more likely to undergo reiteration in project scope and delivery units, but once they have settled on output specifications, they perform relatively better.

PFI maturity and the effort to improve guidance and organization structure brought in some positive results in the definition of client's requirements and improved predictability of time and cost at the Outline Business Case stage. However, further efforts are required to reverse the worsening of the procurement phase, which affects the robustness of value for money. This is particularly important for small projects, which in addition, need to combat over specifying output specifications and complete the milestones in timelier manner.

The study found no significant relationship between variations and project size or sector specifics, but PFI maturity has a significant impact on performance.

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