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PERFORMANCE ASSESSMENT OF A PRIVATE FINANCE INITIATIVE ROAD PROJECT

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Abstract. Private Finance Initiative (PFI) projects are designed to fund long-term infrastructure projects and public services. A typical PFI road scheme involves the public sector client (Granting Authority), the private sector partner – Special Purpose Vehicle (SPV), the financial lenders, the road constructor and its supply chain, technical advisers (legal, financial, technical) and the operation and maintenance (O&M) company. The O&M period is the longest phase of a PFI road project and shall be carried out in accordance with the requirement of the Project Agreement (PA); in accordance with all statutory requirements and Environmental Statements; in accordance with the road project's Quality Plan; and in accordance with Good Industry Practice in order to satisfy the Granting Authority Requirements. The concession period of the study project is 30 years. It is the most important phase because during this time both the service details and payment is created. The payment of the unitary fee is conditional on the SPV meeting certain 'performance' and 'availability' requirements set out in the PFI contract. The fee can be reduced if these standards are not met. This practice of 'deductive payments' and 'non-performance' is one of the main justifications for PFI which is described by the UK government as transferring O&M risks to the private sector in a PFI road project. This paper reports the operational performance assessment for a PFI road project in Scotland–UK detailing physical and functional performance as the critical O&M criteria. The paper also discusses the findings in the case study which are based on a longitudinal Customer Satisfaction Survey conducted between 2005–2009 years. Also, this study has proposed a conceptual framework for the O&M management practice in PFI road projects in the UK, based upon a single empirical case study and the four years longitudinal study.

Keywords: road, project, availability, concession, operation and maintenance management, performance, PFI, SPV.

Introduction

A widespread feature of the last three decades in the UK has been the shift away from the in-house provision of services by the public sector towards the contracting out of services to be provided by the private sector. These services are a contribution and an addition to the provision of services by the government to the public, but the services are supplied by private sector employees. The Private Finance Initiative (PFI) was launched in 1992, as a legal framework for concessions in the UK to encourage private capital investment into the construction industry. In the PFI framework the public sector defines the output specification for the services to be purchased from the private sector with a predefined payment mechanism. Hence the public purchases a service but not an asset.

In the PFI framework, the public sector becomes the procurer and the regulator of the services and not the provider. In the particular case of PFI provision of road services, the public sector only pays for the received service and only if the service meets the predetermined output specification.

The objective of PFI procurement application in road projects is to provide service of high quality to the end user by increasing efficiency of resource allocation, called Value-for-Money (VfM), risk transfer, resilience and affordability issues which characterizes the success of the PFI in road project investments. The provision of public goods or services through partnerships is based on two different motives: private firms care about making money by building public goods and delivering services, while governments are concerned with saving money through private participation.

The bundling of construction and operation and maintenance contracts in a PPP give the private partner greater incentives to make investments in the construction phase to lower subsequent O&M costs. Also, the transfer of the construction risk to the private partner should be explicitly priced in a PPP.

Private finance in turn brings in clear risk allocation and incentive mechanisms, which are defining characteristics of PPP. The first investment, of the private sector in a PPP project, would reduce maintenance costs in the operational phase and it would also improve the quality of the end-product offered to consumers by having superior durability and better safety characteristics. The process actually followed in this concept is related to the economy (obtaining appropriate resource input at minimum cost), efficiency (generating maximum output from input), effectiveness (ensuring outputs achieved desired results) and equity (ensuring rewards of achievement are fairly shared). Bundling delivers the socially optimal amount of investment in *the first investment*, but it tends to deliver too much investment in *the second investment case*. Sustainable urban development has various approaches and different priorities in different countries and successful strategies for a sustainable urban development should be more-or-less compatible with political, economic, social, cultural, institutional, technological, environmental, legal and regulatory situations in the country under consideration (Kaklauskas *et al.* 2009).

There has been always a fear about the transfer of public services to be delivered to the private sector. Zhang and Jia (2010), Chan *et al.* (2010), Iyer and Sagheer (2010), also argue that the biggest problem is the fear of the society that once the provision of public services is transferred over to the private sector, the latter will provide public services of a lower quality and the management control will be lost.

Some authors (Chiara, Garvin 2008; Jun 2010) recognise that the most successful and efficient form of PPP is the private finance initiative (PFI). What makes the PFI different is that the public sector retains a substantial role in the projects and the private sector provides capital assets as well as the services. Increasing levels of partnering with the private sector have evolved and by this partnering agenda the public sector receives the benefit to increase its efficiency through the introduction of managerial change and expertise drawn from the private sector. PFI is underpinned by a theory focusing on the delivery of services rather than the ownership of assets in traditional procurement systems and involves the use of private finance to implement projects that would otherwise be funded from the public budget (Robinson, Scott 2009). It is therefore a radical change of policy that addresses some of the shortcomings of the traditional public procurement systems by encouraging long-term cooperation between the public and private sectors, facilitating innovation and underpinned by a performance-based approach linked to incentives to improve the delivery of core public services.

Therefore, there are 'two fundamental characteristics' of any form of PFI projects:

- there must be a genuine 'risk transfer' to the private sector; and
- the project must provide 'value for money' to the taxpayer.

The objective of this paper is to analyse these issues in the case study research project through Customer Satisfaction Survey conducted between 2005 and 2009 of the O&M period of the project. The paper is organised in 9 sections. In sections 1 to 5 a detailed but concise explanation of PFI deal will be made. In sections 6 and 7 objective of the research and its methodology will be detailed. Lastly, the findings and results of the research (section 8), the discussion of findings (section 9) and conclusions of the research will be detailed.

1. PFI/PPP Marketplace

1.1. PFI/PPP Marketplace in Europe

According to the European PPP Expertise Centre EPEC (2010) the UK remains the most active market in terms of number of deals but Spain has become the largest market in value terms. In 2010, the value of PPP transactions reaching financial close in the European market totalled €18.3 billion.

The countries with very low transactions in the EU are Lithuania and Bulgaria. In the sector breakdown transport sector accounted for just fewer than 50% of the European PPP market value in 2010. Meidutė and Paliulis (2011) stated that the application of the PPP principle is insufficiently developed in Lithuania and the partnership projects are carried out at a municipal level. There are virtually no PPP projects implemented at a national level that would cover some sector of importance for the society and where the public sector would be represented by central authorities.

In Hungary, there is no specific PPP law and the concept of PPP remains a commercial concept rather than a defined legal term. The legislative amendments in the country treat PPP projects as 'long-term financial obligations' and establish a procedure for public sector entities to assume such obligations. The legal framework for PPPs in Hungary consists of general PPP law and laws that are specific to individual PPP projects. The M6 road Project is a 59 km road Project with a total value of 966 million Euro and is one of the largest Hungarian PPPs between Pecs and Szentel ring having the operation phase between 2013–2038 (EPEC 2009). According to Cuttaree *et al.* (2009) Hungary, Poland, Croatia, Bulgaria and Czech Republic stand out in the ECA (Europe and Central Asia) Region with the number and value of implemented transport projects. The same paper reports that it is difficult to tell whether the implemented PPP projects actually delivered high quality transport infrastructure or services at a lower risk-adjusted cost compared to traditional procurement arguing that meaningful VfM (Value for Money) analysis was not conducted in these countries.

1.2. PFI/PPP Marketplace in the UK

There are a total of 935 PFI deals in the UK government departments between 1987 and 2008 with a contract value of £65.94 billion corresponding to an average capital contract size of £64 million (IFSL 2009).

By nature transport projects are quite large and since 1987 transport projects (roads, bridges, trams, and light railway) have accounted for 8 of the 21 largest deals in the UK. The signed PFI transport projects which hold a 26.40% share within the total in the UK is shown in Table 1 (IFSL 2009).

There are around 700 PFI contracts in the United Kingdom. Over 500 of these are in England with a combined capital value of almost £50 billion.

The forecast PFI payment for these projects for 2010–2011 is estimated at £8 billion. They are usually long-term arrangements typically spanning for 25÷30 years. HM Treasury estimates that the total commitments on current PFI contracts for the next 25 years for the United Kingdom are approximately £200 billion (NAO 2011). The estimated capital spending by the private sector (signed deals) for PFI projects in the transport sector in the UK in 2010–2011 and 2011–2012 is £749 (20.12% of all PFI spending) million and £838 (35.46% of all PFI spending) million respectively (HM Treasury 2010).

Table 1. The PFI signed transport project sector breakdown (IFSL 2009)

Years (£ million)						
2003	2004	2005	2006	2007	2008	Cumulative 1987–2008
442	457	403	292	497	not available	16605

2. PFI Construction and Operational Performance in the UK Numerical Values

National Audit Office (NAO 2001, 2003) studies of 98 projects and an HM Treasury (2003) study of 61 projects have provided initial indications of overall project performance through seeking the view of public sector PFI managers on achievement of expectations and VfM. Evidence from these studies in the UK about the PFI performance is shown in Table 2. Delivery to time occurs on 76% of the PFI projects, compared to the non-PFI benchmark of 30%. This corresponds to an improvement of the order of 250÷300%.

Delivery to budget occurs on 79% of the PFI projects, compared to the non-PFI benchmark of 27%. This corresponds to an improvement of the order of 290%. The improvement must be qualified; delivery to budget means that the client has incurred no increase. However, this does not mean that construction costs have not increased, merely that the PFI agreement has no provision to allow the contractor to pass on such increase to clients.

Evidence from the same studies in the UK about the PFI operational performance is shown in Table 3. Full assessment of the operational performance of PFI will only be possible at a much later stage in the contracts.

The latest National Audit Office's Report into the performance of PFI construction (NAO 2009) shows a continuing picture of success for PFI in project delivery, and points to the key features of successful projects that can be replicated to good effect in traditional procurements. The report picks out three important elements of the success of the PFI process delivery:

- the nature of the PFI contract, with its emphasis on clear output specification and a deferment of payment until completion;
- good project management and clear communication between partners to a contract;
- thorough planning at the procurement phase, which is often forced on the PFI process by the need to review, allocate and price risks before contract close.

Table 2. PFI Construction Performances in the UK

Performance features	National Audit Office (NAO 2001, 2003)	HM Treasury (2003)
1. Delivering on time	• 76% (PFI); • 30% (Non-PFI);	88%
2. Delivering to budget	• 79% (PFI); • 27% (Non-PFI);	79%
3. Quality of design	• The consortia in PFI projects: • invested in good design and construction at start of the contract; • achieved better quality buildings and reduction in maintenance costs while maintaining the assets to the standards agreed in the contract; • placed more emphasis on aesthetics of design than before.	

Table 3. PFI Operational Performance in the UK

Performance features	National Audit Office (NAO 2001, 2003)	HM Treasury (2003)
1. Achievement of expectations	N/A	• 25% 'far surpassing'; • 16% 'surpassing'; • 35% 'as expected'; • 24% 'less than expected'
2. Value for Money (VFM)	• 6% 'excellent'; • 46% 'good'; • 29% 'satisfactory'; • 15% 'marginal'; • 4% 'poor'	N/A
3. Overall performance of the private sector matching up to expectation at the time of contract close	N/A	• 25% 'far surpassing'; • 51% 'as expected' or 'better'; • 18% 'less than expected'; • 6% 'much less than expected'

In the NAO (2009) Report, 114 projects are screened, 37 of which were in the 2003 report. Among the 114 projects, 85 projects are either schools or hospitals, four are waste projects and three are housing pro-

jects (none of the latter 2 categories were included in the 2003 report). However, no road projects were included. A comparison of NAO (2009) and NAO (2003) reports is shown in Table 4.

The achievement of Public Sector PFI managers expectations is as expected or better in 76% of the responses. The 35% response of 'as expected' is not qualified in the report. It does not distinguish whether this 'as expected' is compared to the claimed benefits of PFI procurement or to 'traditional project' expectations. Regarding the overall performance of PFI, Sir John Bourn, Head of the National Audit Office, reporting to Parliament on 5 February 2003 stated that, 'Most construction work under the Private Finance Initiative (PFI) is being delivered on time and at the cost expected by the public sector. Central government has generally obtained a much higher degree of price certainty and timely delivery of good quality built assets, compared to previous conventional government building projects' (NAO 2003). Hence PFI surpasses the public sector expectations on achievement, VFM and overall performance.

A survey conducted by KPMG (2007) was based on the responses of 93 contract managers in the private sector across a range of PFI services. The reported findings showed that most contracts were performing well and close communication with contracting parties and regular assessment of operations appeared to be key factors in the success of PFI contracts. The outcome of the research indicated that 59% of the contracts are performing 'very good' and 26% are performing 'good' and 83% of the respondents stated that the contract is delivering a positive annual profit.

There are also contradictory views to the official statements and reports regarding the performance and benefits of PFI in the UK. UNISON (2004) commented on the Treasury Guidance 'PFI: Meeting the Investment Challenge', 'Draft Value for Money Assessment Guidance' and 'The Green Book – Appraisal and Evaluation in Central Government'. UNISON has been critical of the less transparent process that compares the actual costs of a PSC (Public Sector Comparator) with the actual costs of a PFI project. Unison also argued that a number of assumptions about the underlying benefits of PFI were nowhere supported by evidence and requested any evidence that the Treasury has used to produce the guidance. Furthermore, Pollock *et al.* (2007) in criticising the Treasury's 2003 policy statement, 'PFI: Meeting the Investment Challenge' argued that the data in the statement have been used by the government in response to criticism of the policy and to support the government public-private partnership (PPP) policy both in the UK and abroad. Furthermore, they argued that the study cited by the government that actually compares conventional and PFI procurement performance and claims based on them are misleading; and the Treasury's claims about the superiority of the PFI based on time and cost overrun arguments have no evidence and are therefore biased.

3. Design–Build–Finance–Operate (DBFO)

Most of the road projects are executed through DBFO contracts. A DBFO contract is a long-term contract entered into between a Government Agency or Local Authority – the Granting Authority and a Contracting Vehicle – a Special Purpose Vehicle (SPV) which consists of a design and build (asset) provider (DB) a finance provider (F) and an operation and maintenance (service) provider (O).

In such contracts the private sector provides the assets, arranges debt financing from commercial banks and equity for the balance of the funding requirement and on-going operation and maintenance services in respect of the assets. The public sector pays an annual charge, referred to as the Unitary Charge, over the contract life which is used to repay the banks and to remunerate the equity holders.

DBFO is an output focused contract and it sets out a functional specification. In an output based contract specification the public sector specifies the require-

Table 4. Comparison of NAO (2009) Report with NAO (2003) Performance of PFI Construction

ITEM	NAO Report 2009	NAO Report 2003
Contractual completion deadlines	69% of PFI projects completed within one month after contractual completion deadlines	76% of PFI projects completed within one month after contractual completion deadlines.
Price increase after letting of the contract (on budget)	65% suffered no price increase (this percentage is likely to lie between 55÷75%)	78% suffered price increase
No price increase / no price increase as a result of public sector or third party-initiated changes	90% of those reported either suffered no price increase or suffered price increase as a result of public sector or third party-initiated changes	No comparable analysis
Project success rating	91% of PFI projects were rated either as 'very good' or 'fairly good' by the key users. No PFI projects were rated as 'poor'	• 25% 'far surpassing'; • 16% 'surpassing'; • 35% 'as expected'; • 24% 'less than expected'
On-time delivery of the projects	69% (this percentage is likely to lie between 60÷78%)	76%
Delay	31% (this percentage is likely to lie between 22÷40%)	24%

ments – the what, and leaves the private sector to determine and decide the best way – the how, to meet the specification. This arrangement increases the scope for the private sector to innovate in designing solutions and O&M service provision to meet the output specification. Despite the additional private sector borrowing costs and the necessity for the private sector service provider to make profit, combining the private sector's innovation and management skills across the design, construction and operational phases of the road projects, generate significant performance improvements, improve quality, and enhance risk management and efficiency savings delivering improved value for money for the public client and gaining the maximum utility from tax money of the tax payers and minimise any adverse impact on environment and maximise benefits to road users. In summary, the intention is to achieve a final scheme which fulfils the undertakings which have been given in consultation and which at the same time allows the contractor maximum freedom to use his expertise and experience to the best advantage in technical, programming, environmental and economic terms to deliver a scheme which is fit for purpose and will be managed and operated safely and satisfactorily over the concession contract period with minimal adverse impact on the environment yet which will meet the Public Sector's objectives for the project.

A Special Purpose Vehicle (SPV), a limited liability company, is created to undertake the contracted services, to own the assets and to be the contracting party with the granting authority. The SPV enters into the primary contract with the granting authority which typically involves providing both assets and services over the contract duration. The SPV then enters into matching back-to-back contracts with a construction contractor for the provision of the built asset often on a guaranteed maximum price (GMP) contract, and an operation and maintenance (facilities management) contractor for the provision of services.

Once the back-to-back contracts are established, the funding requirement of the SPV can be determined. The SPV funding requirement is met with a high proportion of project debt, often up to 90%, and the balance of the funding is secured as equity or subordinated debt from the SPV shareholders. The public pays no upfront payments during the construction of the asset. All the design and build expenses are borne by the private sector through debt and equity financing. The financial institution (bank, insurance company, etc.) makes the monthly payments to the works contractor as per the financial agreement between the SPV and the lenders. These payments are drawdown from the loans given to the SPV. The granting authority starts its payments to the private sector only when the performance of the services specified in the Output Specification of the granting authority is satisfied. The project debt advanced to the SPV depends exclusively for its repayment on the payments made to the SPV by the granting authority.

The granting authority contract with the SPV is for a single annual payment, the 'Unitary Charge' which incorporates a capital charge annualised over the contract life and an annual operation and maintenance (O&M) charge. The total cost to the public sector of the DBFO contract is the net present value of these 'Unitary Charges'.

The terms of contract between the SPV and the granting authority are set to cover the total costs of the SPV, including the capital charges and service and transaction costs (legal and financial advisory fees).

4. A92 PFI Project

The A92 between Dundee and Arbroath is a vitally important strategic route for the east coast of Scotland, serving the towns of Dundee, Monifieth, Carnoustie, Arbroath and Montrose. It also serves as a major route for commercial traffic to these towns, and the ports of Arbroath and Montrose. The existing single carriageway road carried up to 18000 vehicles per day. The traffic volume increases and the accident record of the existing A92 and associated roads is considered to be a major factor in the continuing decline in economic activity in the area. A consequence of these problems on the A92 is that traffic was diverted to the less suitable coastal corridor route – the A930. The affected local authorities – Angus Council and Dundee City Council – aimed to improve the safety, quality of life and economic opportunity in the area by upgrading the A92 and carried out other improvements within the A92/A930 route corridor.

The project was not viewed purely as a road improvement project by the councils. The councils were ensuring that the scheme fits within the government's integrated transport policy and maximised the opportunities created by the upgrading to implement an integrated transport system within the largely rural route corridor. The aim was to provide alternative transport options to rural as well as urban communities, reducing reliance on the car. The upgrading of the A92 and the other roads included in the scheme brought significant benefits to all modes of transport. In terms of public transport, the improvements allowed bus operators to provide a more consistently reliable service along both the A92 and the A930. This improvement in journey time reliability has facilitated by the reduction in accidents on both routes and the removal of congestion, particularly at peak periods. It was predicted that this will encourage more people to use buses rather than cars. This project demonstrates how local councils can use innovative procurement methods (PFI/DBFO) to achieve their transportation objectives.

Further detailed information about the project can be found in a study made by Akbiyikli *et al.* (2011).

5. Operation and Maintenance Period and its Management (O&M)

A key principle in PFI is therefore the link between performance and incentive payments to the private sector based on the successful supply of services to the public sector (Grout 1997). Performance monitoring provides a powerful incentive for PFI contractors to deliver the standard of services required by the public sector client

stipulated in the output specification (Ng, Wong 2007). But the service delivery aspects of PFI projects cannot be examined until projects become operational. At the operational phase, service delivery can be regularly assessed to determine compliance with the output specification and payment deductions for performance failures in accordance with the payment mechanism. However, there is limited research on the operational aspects of PFI schemes.

Operation and Maintenance (O&M) is the longest phase of the PFI road project. Usually it stretches over 30÷40 years. It is the most important phase because during this time the service delivery and payment conditions are created. The payment of the annual 'Unitary Charge' is conditional on the SPV meeting certain 'performance' and 'availability' requirements set out in the PFI contract. The fee can be reduced if these standards are not met. This practice of 'deductive payments' and 'non-performance' is one of the main justifications for PFI which is described by the UK government as transferring operational and maintenance risks to the private sector in a PFI road project.

Fig. 1 shows the procurement and operation and maintenance phases with notional cost and revenues for a road project. This figure is based on actual data from a case study of a road project in the UK.

The PFI brief – Output Specification – clarifies the functional requirements and physical performance criteria. This provision has a profound impact on the O&M management in road projects. The O&M brief in PFI is the main 'driver' for the design, development and realisation of a road project. The design and build (D&B) phase in the PFI mechanism becomes the 'means' to the 'end' and the 'end' is the service provision to the Public Sponsor and payments to the private sector partner.

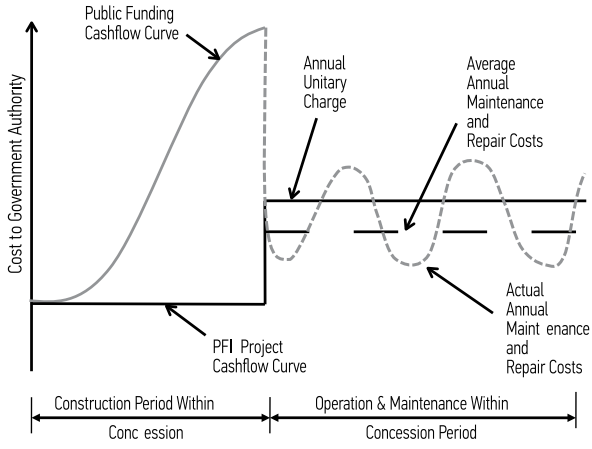

Fig. 1. Notional revenues and costs for a PFI road project (Akbiyikli *et al.* 2011)

An O&M Whole Life-Cycle (WLC) Management Framework is proposed in Fig. 3 in the conclusion which is based on the PFI Framework for road projects in Fig. 2, disseminating a knowledge base for future road projects.

The other secondary parameters of the framework in Fig. 3 are: innovation, effectiveness, efficiency and certainty. Innovation, according to Freeman and Soete (2012) is 'the actual use of a nontrivial change in a process, product or system that is novel to the institution developing the change'. Another example of direct and concise definition is provided by Cobbenhagen (2000) who presents 'renewal with respect to products, markets and technological production processes' as one of the commonly used definitions of innovation. The possibilities in construction projects are directly related to the procurement path chosen to create a product or service and this is possible through the interaction with suppliers, clients and government agencies. Innovation must satisfy the criteria set by the regulatory framework, contract for the works, VfM and the quality of the output product/service set by the client.

Effectiveness ensures the consistency between the intended results and the actual results of the PFI activities to obtain an appropriate quality. It concerns the cost of outputs from an activity and conformance of those outputs to the PFI Output Specification. The effectiveness is both related to process and product and its typical measures are time, cost, quality and people. Therefore, effectiveness reflects the level of performance achieved throughout the useful life-cycle of the asset.

Efficiency is about 'ensuring that maximum output is obtained from a given amount of resources devoted' (Glynn 1984). Efficiency minimizes the resource requirements for the delivery of agreed outputs for obtaining an appropriate quality. It concerns the ratio of inputs (economy) to outputs (effectiveness) in a PFI road project. Efficiency reflects the management of the delivery and operation of the asset throughout its useful life-cycle.

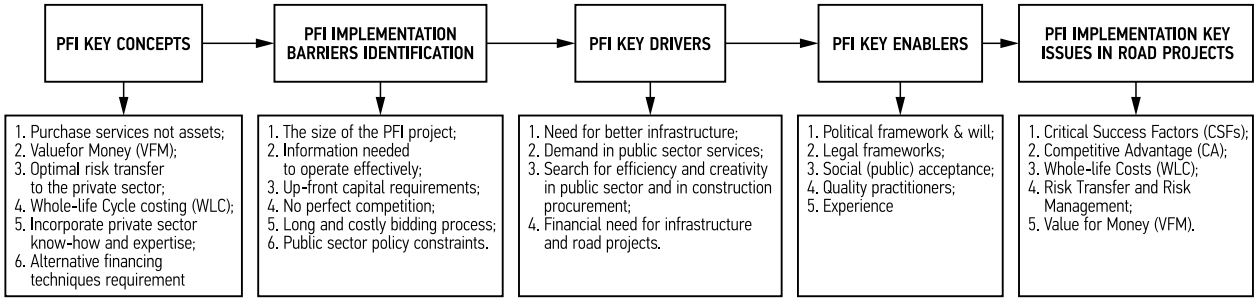

Fig. 2. PFI Framework for road projects

The certainty parameter is associated with achieving improved risk awareness, response and risk transfer; avoidance of project changes and change orders in order not to deviate from the agreed guaranteed maximum price (GMP) and cost certainty; and achieving a high level of control of time and quality in PFI road projects. This is also associated with the avoidance of conflict and litigation throughout the life-cycle of the project.

The SPV has 'Payment' as the output of the framework which comprises an *availability element* and a *shadow-toll element*. The *Payment Mechanism* is closely related to the *Performance* of the constructed asset since it contains the interrelations between *risk, value, quality* and *function*. The Payment reflects the SPV's bankability; the SPV needs to ensure that it has access to sufficient finance and obtains income from the operation of the constructed road over the concession period to cover the cost of borrowing to finance the duration of the concession.

The Public Sponsor has 'Affordability' and 'Value for Money' as the output of the framework. Affordability for the Public Sponsor is the ability to access funds and that the expenditure of the available funds provides an adequate return when compared with other investment alternatives. The overall Affordability of the project relates to the ability of all parties to complete the project with the available resources.

Due to the long concession periods of PFI projects, the temporal aspects of risks are particularly important. The case studied road project have a 37 years concession period and the impact and probability of occurrence of a particular risk type changes as the project advances through the different project stages. As a consequence of this the uncertainty can either decrease or increase. The uncertainty attached to each risk is the key factor in managing it.

Risks; their identification, allocation and quantification are a central concern in PFI road projects. The PFI risk management approach focuses on the management of the uncertainty and unpredictability of the risks listed in Table 5 that can occur. These risk categories are predicted from a case study research of the A92 PFI road project in Angus Council in Scotland.

All the above risks are framed in an O&M Sub-Contract which is to operate and maintain the road project in accordance with the standards, specifications, procedures and other requirements as set out in the Project Agreement. Non-Performance points will be allocated on a pass through basis from the SPV to the O&M Company in the event of failure to operate and maintain to the required standards.

Out of the 17 identified risks in Table 5 only 2 risks (11%) reside with the Public Sponsor. All the other 15 risks (89%) reside with the Private Sector (SPV). Particularly the Unforeseen Defect Risk, a major issue is transferred to the Construction Sub-Contractor until 'Handover' when it passes to the O&M Contractor. Another major risk is Traffic Loading Risk which in practice is shared between the Operation and Maintenance Company and the SPV.

Table 5. Typical physical performance and functional performance risks in A92 PFI road project (Eaton, Akbiyikli 2005)

Operation and maintenance risks	Risk ownership		
	Public sector	Private sector	Shared
1. Unforeseen defects (including pavement failure)		✓	
2. Accident damage		✓	
3. Vandalism		✓	
4. Weather		✓	
5. Traffic loading		✓	
6. Renewal and replacement of Structures and Infrastructures		✓	
7. Utilities access		✓	
8. Replacement of drain, signs, barriers, etc.		✓	
9. Pavement patching		✓	
10. Existing structures failure			
11. Hand back inspections		✓	
12. Road safety audits		✓	
13. Staff costs		✓	
14. Inadequate performance of sub-contractors		✓	
15. Force majeure	✓		
16. Termination for contractor default		✓	
17. Other termination	✓		

In practice it is necessary to develop management procedures for monitoring and responding to O&M Requirements. According to De Zwart (1995) O&M Management has to develop a strong innovative capacity in order to respond rapidly, adequately and relevantly to the demands of higher management and the wishes of the end-users.

In road projects the O&M Company Management expertise links the Public Sponsor's strategic, tactical and operational issues explicitly to the corporate strategic business plan in order to better deliver the service outcomes. The main issue in roads is the service delivery on time and quality and affordability to the public sector creating VfM of the core activities. The core activities in roads are defined as those relating to delay of users, adverse effects on the environment, adverse effects of accidents and emergencies to users, performance and availability of road.

O&M Management from project inception to the end of the concession period needs to adopt a planned approach that takes into account public sponsor input, evaluation of options, and implementation costs at strategic, tactical and operational levels. This has to develop as an overall framework for the vision and purpose of the public sponsor and establish and apply a rationale that guides and systematically identifies how services may contribute to the public sector's project aim and

objectives. Besides this, management requires a planned approach to the evaluation of options and the provision of resources and development of appropriate policies and systems to establish what is needed in O&M activities in a changing environment.

In O&M management, operation and maintenance activities are different issues. Operation is essential to running a road in a manner to satisfy the end-users' needs. Maintenance is essential to keeping a road running in the manner for which it was designed. The functional and physical performance requirements cannot be separated because when the physical performance of a specific O&M issue is defined its functional performance should also be defined.

The O&M Management in road and infrastructure projects are focused on the management and delivery of the infrastructure outputs: by minimizing operating and maintenance expenses; by maximizing investment value and quality of service. This management is based on the 'continual upkeep and quality servicing' of the constructed road project.

6. Objective of the Research

The O&M process is the business strategy within the continuous improvement domain of the PFI road project. O&M performance is the 'output' of this PFI philosophy and reflects the strategic value of PFI in the sense that it achieves the quality of the service specified in the Public Sponsor's Output Specification – Client Satisfaction; it provides an understanding of the relationship between the performance and availability requirements of the constructed road – Asset Availability and Performance; it gives a clear indication of revenue generation potential-Equity and Debt Lenders' Satisfaction; it is where the end-users utilize the physical resources – end-user Satisfaction; it is where the private sector innovation, management and skills are tested – Private Sector Innovation and Management Skills; it is where the public sector test its Value for Money (VfM) and affordability issues – VfM and Affordability for the Public Sponsor and it is where the aggregated road project risks are tested – Risk and Risk Management.

The SPV through its O & M contractor shall: keep the PFI road sound, free from undue deterioration and undue wear to ensure and secure that delay of road users is minimised; that all accidents and emergencies are responded to as quickly as possible; that users are given adequate information and forewarning of any events on the road and that traffic data and O&M data shall be collected and provided to the Granting Authority.

Gruneberg *et al.* (2007) argued that 'if a supplier has a responsibility for how something performs, then his or her contractual liability must extend into the performance period' which increases the risk to the contractor. According to McDowall (1999, 2000), the output specification has changed attitudes to specifying buildings and services by concentrating on those aspects of performance important to clients and the way the completed facilities will perform.

As PFI projects are based on service delivery it is crucial to have an effective performance monitoring to assess compliance with service level agreements. This research therefore focuses on the performance period or operational stages in terms of the way the PFI process is managed and controlled to give end user satisfaction. The aim is to examine whether the performance is effective in ensuring compliance with the output specifications so that the road users are satisfied throughout the service delivery period.

7. Research Methodology

The research in this paper is concerned broadly with exploring and making sense of both the evolving context associated with integrated procurement and emergent practice of O&M period in a PFI Road Project in Scotland in the UK.

A phenomenological (interpretive) qualitative approach is used to inductively and holistically understand human experience in the specific setting of a PFI project. This approach tries to understand and explain a phenomenon, rather than search for external causes or fundamental laws (Easterby-Smith *et al.* 2001; Remenyi *et al.* 1998).

This research is based on questionnaire survey analysis and semi-structured interview to understand the satisfaction of the road users as a part of the performance of the PFI road project and benchmark the results obtained. The research is a longitudinal one and is based on a single case study. The presented research covers the first four years of the operation and maintenance period of the studied project. Case study in this research is both a research method and a study of a particular project. Since the research is based on a single case study the potential for generalisation of findings is low. But for the particular project we get a very good indication in evaluating and comparing the requirements of the Output Specification of the project.

Rationale for the case study approach:

- the study is of an exploratory nature in understanding the O&M period in A92 PFI road project in the UK;
- within the context of unit of analysis of a road project (testing of phenomena within a context).
- The case study chosen is a typical one of PFI road construction projects in the UK.

8. Findings and Results of the Research Between 2005–2009

The findings in the case study are based on a longitudinal Customer Satisfaction Survey conducted between 2005–2009 years for A92 in Scotland. The results of the first year 2005–2006, served as a benchmark to determine customers' perception of O&M Contractor's performance throughout the study period. It is accepted that the first year's perceptions may be artificially high due to the road being upgraded from a single to dual carriageway. The percentage of Customer Satisfaction Surveys completed and returned continued to be encouraging high with 28% of the forms being completed and returned in 2008–2009 for analysis. This was the

same as the year 2007–2008 and only a slight reduction from years 2005–2006 and 2006–2007 which were 33% and 40% respectively. The survey for the year 2009–2010 is not available for evaluation.

The overall results of the survey classified as perceptions of maintenance quality, perception of safety conditions and perception of travel conditions are presented in tabular form in Tables 6–8.

Table 6. A92 customer satisfaction survey – O&M period (2005–2009), perception of maintenance quality (%)

	Very good				Good				Average				Poor				Very poor			
	2005–2006	2006–2007	2007–2008	2008–2009	2005–2006	2006–2007	2007–2008	2008–2009	2005–2006	2006–2007	2007–2008	2008–2009	2005–2006	2006–2007	2007–2008	2008–2009	2005–2006	2006–2007	2007–2008	2008–2009
Quality of road surface	59	55	65	59	32	39	21	35	2	5	10	4	3	1	0	0	5	0	4	1
Qual. of cycle track, footpaths	42	33	46	38	40	53	40	49	8	11	12	11	3	3	0	2	7	0	2	0
Grass cuttings on verges	23	23	29	27	49	48	46	43	21	20	19	20	6	7	6	9	2	3	0	0
Litter picking	18	20	22	28	37	50	49	38	22	21	18	22	15	4	9	10	7	4	2	1
Traffic signs	36	24	45	29	39	51	37	51	16	14	6	14	6	6	19	3	3	4	2	3
Landscape maintenance	25	19	27	28	56	42	45	41	15	24	20	22	14	8	6	6	0	7	2	3
Weed killing	15	13	25	25	8	41	42	30	24	32	19	30	7	13	12	11	7	1	2	3
Road markings	35	36	35	34	34	35	41	47	18	4	12	15	10	1	8	0	3	4	4	4
Reflective road studs	27	33	42	33	40	45	32	48	23	11	12	13	8	4	10	3	2	7	4	3
Road sweeping	21	24	28	25	58	53	48	44	15	21	18	22	4	1	4	8	2	0	2	2
Winter gritting	36	31	37	40	42	61	43	43	17	7	13	16	5	1	7	0	0	0	0	1
Snow cleaning	31	23	30	35	44	60	46	43	23	15	19	21	2	2	3	0	0	0	2	1
Street lightening	28	22	31	22	33	57	33	41	23	9	15	22	8	9	19	13	7	3	2	1

Table 7. A92 customer satisfaction survey – O&M period (2005–2009), perception of safety conditions (%)

	Very good				Good				Average				Poor				Very poor			
	2005–2006	2006–2007	2007–2008	2008–2009	2005–2006	2006–2007	2007–2008	2008–2009	2005–2006	2006–2007	2007–2008	2008–2009	2005–2006	2006–2007	2007–2008	2008–2009	2005–2006	2006–2007	2007–2008	2008–2009
Overall impression of safety for road users	40	36	42	44	45	51	33	44	12	7	19	9	2	4	6	2	2	3	0	2
Safety arrangements during frost/snow	32	17	35	30	36	59	38	52	29	22	20	15	2	2	7	2	2	0	0	2
Overall safety at pedestrian crossings	32	22	26	35	48	46	41	38	14	28	30	22	2	3	2	5	5	1	0	0
Overall safety at roundabouts	36	24	28	33	39	50	38	42	20	24	32	22	2	2	2	2	3	0	0	2

Table 8. A92 customer satisfaction survey – O&M period (2005–2009), perception of travel conditions (%)

	Very Good				Good				Average				Poor				Very Poor			
	2005–2006	2006–2007	2007–2008	2008–2009	2005–2006	2006–2007	2007–2008	2008–2009	2005–2006	2006–2007	2007–2008	2008–2009	2005–2006	2006–2007	2007–2008	2008–2009	2005–2006	2006–2007	2007–2008	2008–2009
Adequate of information provided on road signs	42	31	48	33	32	46	30	44	17	15	16	16	3	7	4	5	6	0	2	2
Acceptability of journey time	56	43	51	55	31	49	31	34	10	5	16	9	4	3	2	0	0	0	0	2
Qual. of the road environment e.g. Landscaping	32	25	36	30	45	37	40	39	19	33	20	20	2	4	2	9	2	0	2	2
Adequate number of customer care signs	24	17	21	22	47	36	32	35	22	37	45	31	4	8	2	10	4	2	0	2
Adequacy of customer care process (e.g. phone lines)	31	26	23	25	44	37	40	48	19	30	33	18	3	7	3	8	3	0	0	3

9. Discussion of the Findings

An effective road system is a prerequisite of the growing demands of modern life. The success of industry and commerce depends upon an effective and efficient transport system. The delivery of transport policies and services more effectively and efficiently depends on the quality of the constructed asset and the O&M of the same. This is possible by introducing the best practices into the business of public administration and this is done through PPP/PFI mechanism.

Based on research of single PFI road project in the UK the O&M Services are carried out:

- in accordance with the requirements of the Project Agreement (PA);
- in accordance with all Statutory Requirements;
- in accordance with the Environmental Requirements;
- in accordance with the Quality Plan;
- in accordance with Good Industry Practice.

Maintenance activities were subdivided into three categories, namely:

- preventive maintenance consisted of scheduled operations performed to keep the systems operating;
- responsive maintenance referred to operations that were initiated by a fault or trouble report;
- emergency maintenance was initiated by a fault or trouble report which required immediate action.

The O&M management in the case study project covered the following:

- management of routine, winter and capital maintenance;
- inspection of the constructed asset;
- accident investigation;
- data provision and processing.

The study concluded that the maintenance management in the case study road project:

- continuously throughout the life-cycle of the concession the proposed framework for O&M will meet the statutory requirement of the Council for ensuring that the constructed road is maintained to a satisfactory standard;
- the private sector will do the O&M in a structured way which took proper account of the road users' needs and delivered VFM;
- the private sector will deal effectively with the demands of the road and will be responsive to change.

The local council's policy to introduce more competition into the O&M market and encourage the development of a private sector road O&M industry through PFI is on the right track. The performance based on payment regime in PFI road projects is expected to contribute to the intended quality and timely service provision in the case study road project. It is understood from the available project related agreements and documents that the SPV through its O&M contractor will deliver quality services on time and to specified standards.

The O&M management procedures should be developed and implemented by the private sector contracting party SPV to produce inputs to and general reports from a Project Database in PFI road project. Besides Design Certificates and Check Certificates, a Final Construction Certificate signed by the Designer, the O&M Contractor and the SPV should be provided by the SPV.

The 2008–2009 results were as impressive as 2007–2008 years with very high percentages of users still indicating that they perceived the services provided were above average compared with that provided for similar types of roads.

The surveys allowed the customers to include any comments that they wished to make. A number of the comments were complimentary in nature such as the 'more pleasant and safer journey', 'the new A92 is excellent', and 'excellent care of the cycle path during winter'.

This paper, based on the four years study, has also developed and proposed a conceptual framework for the O&M management practice in PFI road projects in the UK, based upon a single empirical case study shown in Fig. 3 detailing physical performance and functional performance as the critical O&M criteria.

The conceptual framework identified that the functional and performance requirements need to be considered right at the beginning of the life-cycle of the project and O&M has to be focused on delivery of the services by minimizing operation and maintenance expenses and maximizing the quality of services and satisfying the end-users' needs.

The O&M service provider is required to, as it is also in the PFI mechanism philosophy, be involved in all the phases of a PFI road project to respond to all the issues concerning the whole life-cycle of physical and functional performance of the designed and constructed asset to achieve the full satisfaction of the Granting Authority and end-users.

The primary parameters in the O&M Framework are Physical Performance and Functional Performance. The Physical Performance is related to the designed and built asset and in road projects covers the issues such as maintenance, durability and environmental impact. The Functional Performance is related to the proper functioning of the constructed asset and it covers driving comfort, safety and easy access.

The A92 project has a performance based payment mechanism and the main payment element weightings have been agreed as performance 75% and usage 25%. The performance element is based on availability (70%) and operating (O&M) performance (5%). There is no explicit safety element as such but safety audit requirements are included in the operating performance regime. 5% (1/20) of the availability payment is allocated for availability of footways/cycle ways. The availability payment in the operation and maintenance period is made monthly as 1/12 of the annual figure where the entire road project is wholly available (with the exception of agreed periods for the clearance of accidents etc.) for the full month. Where the road is not wholly available for use, lane unavailability charges are calculated to reflect the economic cost of closures to the travelling public is deducted from the availability payment.

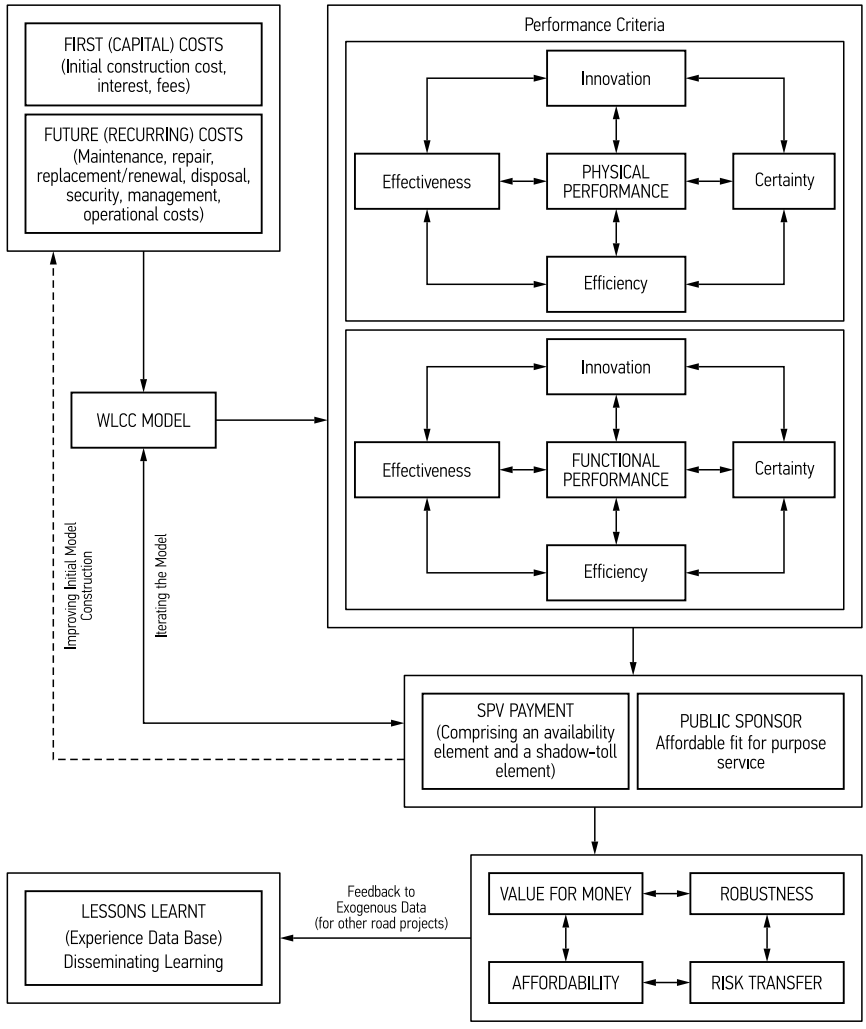

Fig. 3. WLCC Framework for A92 PFI Road Project

The research finding regarding penalties is considered to be 'insignificant' since during the four years of O&M period only once one lane unavailability situation occurred. The usage payment is based on the individual traffic volumes at four measurement points in both directions (eight counters) on the A92. Payments is based on the number of vehicles coming within 5 traffic bands light and heavy traffic categories of vehicles at the measurement points and with vehicles in the bottom and top bands attracting no payment. During the study period (2005–2009) no penalties applied for usage payments. For other items there are some penalties but not financial extent.

The interviewees from the Special Purpose Vehicle (SPV) in the road case study considered the WLCC of the constructed road, which according to their experience led to higher construction quality than the traditional procurement. This higher construction quality, according to the same informants, was to reduce the need for longer term maintenance throughout the life-cycle of the project.

The SPV is responsible to maintain the road to the Output Specification throughout the contract life of the project, and in the event of any failure or deviation the SPV was aware that this could result in payment deductions. This issue, as emphasised strongly by the informants, incentivised the SPV to integrate input from the design and O&M management into the procurement and construction process. By placing responsibility for the operation and maintenance of the constructed road with the private sector for an extended period, it is believed that the cost of maintenance and repair is driven down. This again encouraged and enhanced the idea of the creation of an integrated team for the duration of the concession. The PFI concept encouraged the early involvement of the O&M contractors to the process in assembling the cost and ownership models in order to predict the cost and process of ownership over the period of concession in order to optimize the best and final offer for the project.

The SPV and its O&M Contractor felt free to do what they find to be convenient as long as it satisfied the 'performance criteria' in the Project Agreement. The Performance Measurements in the project are composed of the following:

- Response to emergencies;
- Defects – safety inspections;
- Yearly customer satisfaction survey;

- Council's audit reports;
- The O&M Contract Clauses (they are the benchmark). In the Maintenance Model there is the Routine Maintenance and the Major Maintenance. In the O&M Model of A92 between year 1 and 5 there is no major maintenance (white lines, skid resistance, some works in roundabouts and other minor works). Every 5th year a major resurfacing of the road is foreseen.
- Monthly O&M report is prepared.

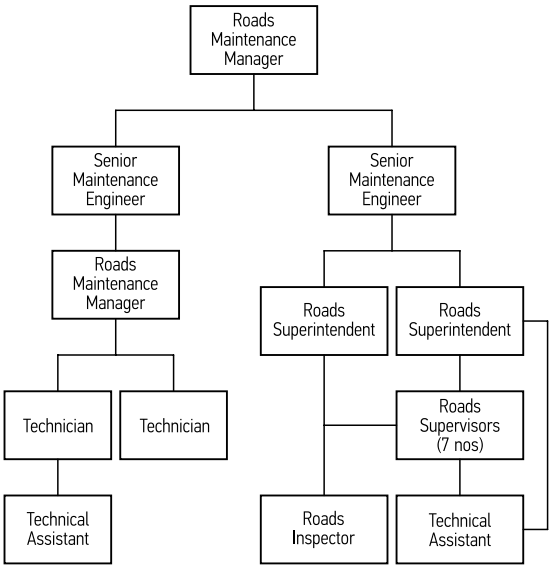

Fig. 4. Organisation chart of O&M contractor on A92

Council's duty in O&M period is to audit the performance of the A92. Council has staff to audit the O&M works run by the O&M Company. The Council has only two staff for this auditing job. There is monthly maintenance meeting between Council and O&M Company. The O&M Company's organisation in the Project is as shown in Fig 4.

'Change Request' is allowable to do in different way. Not many in the A92 project so far (only 3÷4 in new works). In 5 years O&M period (by April 2011) only 15 change orders issued. These are verification of Traffic Code, pedestrian safety issues, change of landscaping responsibility. There is no 'financial implication' from those issues so far. Implications for innovation are allowable in the project and are allowed. This is considered to be very important for the project.

There is no problem for 'flexibility' (new way of O&M) in A92 PFI road project. New way of operate and maintain is allowed. This is also considered to be a very important issue for the project.

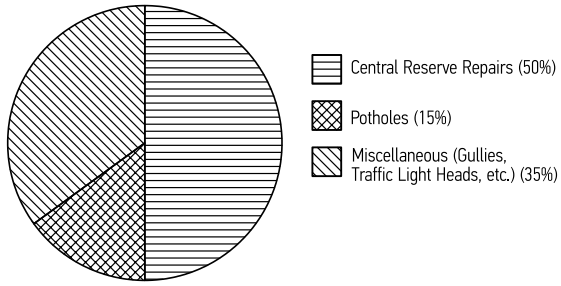

Fig. 5. A92 O&M period probability of occurrence of defects

Table 9. Key learning from A92 O&M period

Key learning from the research (based on semi-structured interview)	
Council	O&M Contractor
As far as the O&M is concerned A92 is a good quality road.	'Unavailability' is the main driving force. The penalties are significant. They are performing well in the A92.
The Council would do the A92 as PFI road again.	Reputation Damage is fundamental in business and in A92 image is considered to be more important than economics.
PFI is a specialised market. A lot of hard work but the A92 road project has VfM for the Council.	Trust building between O&M contractor and Council took some time. Working relation is considered to be good. SPV is gaining from the wider capacity and good working relation between O&M company and Council.
The main difference in the O&M period between the Traditional and the DBFO road is the payment mechanism and the related penalty points. Traditional O&M contracts are budget driven. In A92 the O&M company has some penalty points but financially insignificant.	Very good communication with Council's staff face-to-face on daily basis. It is not considered to have a co-location with the Council. They keep business borderlines separate. They have regular monthly and quarterly meeting on O&M.
	DBFO Contract is a living document throughout the O&M period. It is not the case in Traditional Contracts.
	In A92 there are only few defects compared to the trunk roads having hundreds.
	The Customer Satisfaction Surveys allowed the customers to include any comments that they wished to make. A number of the comments were complimentary in nature such as the 'more pleasant and safer journey', 'the new A92 is excellent', and 'excellent care of the cycle path during winter'.

Key learning based on semi-structured interview from the research is summarised in Table 9.

The faced risks in the O&M period, is also presented in Fig. 5, so far are:

- Penalty deductions (performance);
- Profit Risk (profit is the aim of existence in the O&M market);
- Probability of occurrence of defects: Central Reserve Repairs (50%), Potholes (15%), Miscellaneous – gullies, traffic light heads, etc. (35%). Risk register is monitored on yearly basis.

Conclusions

The research concluded that the A92 in its fifth concession year is performing very well to the full satisfaction of the Council, SPV and the customers. Understanding the true cost of the operation and maintenance is an essential and an integral part of PFI road projects; and all decisions taken early on the design and has a cardinal impact on the future operational success of the project and the O&M management system has to be an integral part of the Whole Life Cycle Cost (WLCC) framework of a PFI road project. The Customer Satisfaction Survey results so far show very clearly that the project satisfies all the performance criteria set for the project; namely, the strategic objectives (the project gives the service foreseen for it), efficiency, service delivery outcomes (the road is operated so well that the service level achieved the strategic objectives of both public and private sectors), quality (the users and the Council is fully satisfied) and effectiveness (the output to the private sector gave economically insignificant unavailability deductions and a good quality road to the Council).

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