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A Knowledge Transfer Framework: The PFI Context

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Abstract

The UK's Private Finance Initiative market is predicted to rise to over £8 billion a year and there are indications of growing opportunities. PFI creates a long-term income stream and provides valuable opportunities for portfolio diversification. PFI has evolved at a fast pace and the momentum is set to continue. However, there are major challenges facing construction organisations. These include the lack of PFI experts, longer negotiation periods and tight time schedules to deliver large-scale schemes, high levels of investment and risks involved and limited knowledge transfer between PFI projects. Concerns over the level of knowledge sharing have prompted the development and evaluation of a Knowledge Transfer Framework that encourages construction organisations to transfer PFI knowledge between projects. It achieves this by building on a questionnaire survey of PFI clients and construction companies, case studies of companies involved in PFI, and research workshops to validate the framework developed.

Keywords: Knowledge transfer, Private Finance Initiative, framework

Introduction

The UK government introduced the Private Finance Initiative (PFI) in 1992 for the procurement of facilities to improve the level of public services. Through PFI, the responsibility and risk of design, build, finance and the operation of a facility has been transferred from the public to the private sector for a period of 20-30 years. PFI is at the heart of the Government's strategy to deliver better public services in the future, and the commitment to this mode of procurement is underscored by the significant investment to date, and expected increases in investment. A major review endorsed PFI but a number of recommendations were made for improvements in the contracting process (Bates, 1997). The increasing number of events, seminars and workshops organised by major bodies such as the Construction Industry Council (CIC), Chartered Institute of Building (CIOB), the

Institution of Civil Engineers (ICE) and the Public Sector Society is a reflection not only of the growing importance of PFI, but a recognition of the need for further improvement. A key issue in improvement is the transfer of best practices in PFI. There is a need for better understanding of what works best, and what does not on PFI projects. Knowledge transfer processes are thus essential in facilitating the application of best practices. This paper therefore examines the role and mechanisms for knowledge transfer in facilitating continuous improvement in Private Finance Initiatives (PFI) and develops a framework to assist in knowledge transfer.

The Private Finance Initiative

The Private Finance Initiative is seen as an alternative route for government to procure facilities and services without undue effect on the Public Sector Borrowing Requirement (Construction Industry Council, 1998). It involves the creation of a consortium or SPV (Special Purpose Vehicle) to deliver the PFI service. A consortium is necessary since no one company has the in-house expertise required to fund, design, build and operate the service. The main difference with traditional contracting is that the SPV has to deliver a service to the public sector for a period of 20-30 years post construction. This has required a change in thinking for construction companies to consider the long term performance of their products and a means of making sensible estimates of running costs in years to come.

In the UK PFI projects fall under a number of government departments, the main sectors are as follows:

- Schools under the Building Schools for the Future (BSF) programme under the Department for Education and Skills;
- Health e.g. the provision of hospitals for NHS trusts under the Department of Health;
- Transport e.g. highways management and street lighting for Local Authorities;
- Accommodation e.g. the provision of police and fire station for the Home Office; and
- Defence e.g. the provision of Sixth Form Colleges for the Ministry of Defence.

PFI and the Construction Sector

Construction organisations play a crucial role in the development and operation of infrastructure facilities central to the PFI strategy. Leading construction organisations are responding to the opportunities created, as there are benefits to be gained (Birnie, 1999). PFI has evolved at a fast pace and the momentum is set to continue. HM Treasury (2004) statistics show that over 600 projects have been signed at a capital value of almost £40B and expenditure is expected to increase from £2.B in 2005/006 to £3.8B in 2007/2008 (4ps, 2005; Black, 2002). Market analyst predict the PFI market will rise to over £8 billion a year and there are indications of growing opportunities in Europe, particularly in the emerging markets of Central and Eastern Europe (AMA Research, 2001). Investment in PFI creates a long-term income stream and provides valuable opportunities for portfolio diversification. Whilst this has brought new opportunities, there are a number of new challenges for construction. The first concerns the ability to maintain the pace in the implementation of PFI. The second relates to the catalogue of problems associated with procurement, construction and operation of PFI. This includes inefficiencies in PFI project processes as a result of the inadequate capture and transfer of expertise, significant transaction costs associated with longer negotiations and time schedules to deliver large-scale, often complex schemes, variable quality of facilities, high levels of investment and risks involved.

The Audit Commission (2002) argued that 'if PFI is to deliver value for money to the public sector, the higher costs of private finance and the levels of returns must be outweighed by lower design, construction, management and operating costs'. PFI could be cheaper if private firms make significant efficiency savings through innovation in design, construction and management processes. However, the Commission for Architecture and the Built Environment (CABE), the government's design watchdog noted that 'the expected increase in innovation from private sector providers has not been forthcoming' (CABE, 2002). Inefficiencies in PFI project delivery processes could be addressed by introducing appropriate mechanisms for capturing and transferring expertise and lessons learned in order to facilitate innovation.

PFI Stages

PFI projects are much more complex than traditional forms of procurement and therefore require a much longer lead-in time before construction commences. Typically, PFI projects consist of 13 main stages as stated below:

1. Needs Assessment;
2. Strategic Outline Case;
3. Outline Business Case;
4. Official Journal of the European Union (OJEU) Advertisement;
5. Pre-Qualification Questionnaire;
6. Preliminary Invitation to Negotiate;
7. Final Invitation to Negotiate;
8. Final Offer;
9. Preferred Bidder / Final Business Case;
10. Financial Close;
11. Construction;
12. Operation and Maintenance; and
13. Hand back.

These stages require a mix of different companies involving financial advisors and funding suppliers, specialist legal advisors for the complex contractual issues, construction experts in the form of designers, construction contractors, cost planners, facilities managers, etc. The challenge is to transfer knowledge gained from different stages of PFI projects to the relevant stakeholders.

PFI Challenges

Considerable negative publicity has surrounded PFI projects. These include the problem of life cycle costing (El-Halam et al., 2002), value for money in terms of the use of Public Sector Comparators (Handley, 2003; Broadbent et al, 2003) and quality of the end product (UNISON, 2003). Other research on PFI have focused mainly on risk management (Akintoye et al, 2003), costs (Construction Industry Council, 2002) and barriers (Ezulike et al, 1997). In a

recent study Robinson et al. (2004) highlighted a number of problems associated with PFI procurement as follows:

- The different levels of PFI experience between construction organisations and client organisations. Client organisations had substantially fewer staff and less experienced PFI staff leading to construction organisations having to 'educate' their clients;
- Inadequate client briefs;
- Affordability/ funding gap meaning that the public and private sectors had large differences in their estimate of the work;
- The high transaction costs of PFI bids; and
- The lengthy negotiation period requiring up-front resources from construction organisations.

Coincidentally, the study showed that the majority of the problems occurred at the bidding stage with the Construction and Operation stages facing fewer problems. This emphasises the need for the transfer of knowledge, particularly at the early stages of PFI projects. The expectation is that as PFI matures, both client and construction organisations will become better equipped to cope with the increased and more complex demands expected from PFI projects.

Knowledge Transfer on PFI Projects

Knowledge transfer is an area of increasing interest. Argote et al. (2000) provide a summary of the various mechanisms available. These include personnel movement, training, communication, observation, technology transfer, alliances, etc. A number of authors have also proposed models or frameworks to enhance knowledge transfer (Goh, 2002; von Krogh et al. 2001; and Szulanski, 2000; Argote and Ingram, 2000). However, these have not yet filtered into the construction sector and hence have not yet been exploited. One of the reasons may be that these frameworks are at a conceptual level (Argote and Ingram, 2000) and highlight factors to consider, rather than practical actions for a firm to address. For example, Goh (2002) highlights factors such as leadership, problem-solving/seeking behaviours, support structures, absorptive and retentive capacity and types of knowledge.

This may somewhat explain why an Ernst and Young report (2002) argued that “it is perhaps a good time to reflect on how PFI has developed and why it has turned out to be more challenging than the original enthusiasts thought”. The report indicated that there are still concerns over the level of knowledge sharing. The Audit Commission (2003) highlighted the need for the early lessons learned in PFI to be "recycled effectively during future investment" to improve performance. HM Treasury (2004) also stressed the importance of information sharing for the better performance of PFI projects.

Knowledge Transfer Needs

All construction projects require knowledge transfer but the case is even more critical for PFI projects. The main reason for this is that it is a relatively new form of procurement, where all parties are new to the process. PFI is a costly commitment hence any mistakes made because of lack of current knowledge, can be critical for the length of the service period of the contract. In PFI all parties are learning and the PFI process is continuously evolving as seen by the need for bodies such as 4ps (Public Private Partnership Programmes) to provide support for local authorities.

Construction organisations in PFI alliances could benefit significantly from knowledge transfer. Studies shows that a significant proportion of construction organisations recognise the benefits of knowledge transfer such as reducing rework, avoiding re-inventing the wheel, improved utilisation of tacit knowledge and best practices to facilitate continuous improvement and innovation (Robinson et al, 2001). Knowledge transfer could also be an effective mechanism for mitigating risks, a key issue in an increasingly complex PFI environment. However, the implementation of a knowledge strategy is still underdeveloped in construction organisations. A key challenge is, therefore, to address what knowledge needs to be transferred and how best to do so.

Types of Knowledge Transfer

Robinson et al. (2004) study highlighted the procurement stages (stages 1 to 10) as the most problematic area requiring both knowledge creation and knowledge sharing/transfer.

Construction companies point out that they have little data for costing the maintenance of a facility over a period of 20-30 years. This is critical if sensible estimates are to be made which do not exacerbate the affordability/funding gap problem. In addition, because some PFI projects consist of the construction of multiple structures (e.g. a number of schools for a local authority), there is a need to transfer lessons from one structure into future buildings. Thus, there is a need to not only transfer knowledge throughout the lifecycle of the project but to transfer the lessons learned from one PFI project to another that may be happening simultaneously or with a (limited) time lag.

Mechanisms for Knowledge Transfer

There are a number of mechanism for sharing or transferring knowledge. These tend to fall into two main categories – Tool and Techniques (Al Ghassani, 2003). Tools rely on the use of IT to share typically explicit knowledge, that which is easy to document and store.

Examples are project extranets and groupware. Techniques use a more human-centred approach to transferring mainly tacit knowledge, that which is based on expertise and intuition and is difficult to transfer. Typical examples are communities of practice and post-project reviews. There is now increasing amount of advice from bodies such as the Department of Trade and Industry, Construction Excellence and the Construction Industry Research and Information Association on how knowledge can be shared and the types of techniques and tools available. However, Brooking (1996) points out only 20% of an organisation's knowledge is actually used whilst Newell et al. (2002) highlight the need for organisations to have a supportive organisational culture and trust to encourage knowledge sharing. The challenge is identifying which mechanism best suits the organisational context.

Knowledge Transfer Problems

Knowledge sharing networks in alliances such as those created to execute PFI projects raise complex issues such as confidentiality, reliability, copyright, the dissemination of a firm's unique stock of knowledge outside its boundaries, and the trade-off between co-operation and competition or what is referred to as 'co-opetition' (Levy et al., 2001). The ability to learn is also crucial to effective knowledge transfer and an organisation's absorptive capacity to

manage new knowledge depends on prior knowledge and technical capability (Gann, 2001). Learning starts at an individual level, building individual technical capabilities to become a knowledge organisation. Knowledge transfer can facilitate the creation of learning networks that are spread throughout organisations (McAdam and McCreedy, 1999) that are necessary for the improvement of skills and competencies to support the delivery of PFI projects. Organisational readiness relates to both hard (e.g. resource requirements, IT infrastructure, hard performance measures) and soft (e.g. organisational culture, incentive structure, trust, soft performance measures) issues necessary for knowledge transfer to be successfully implemented. Relying on 'goodwill knowledge philanthropy' that knowledge transfer can take place without a proactive approach involving creating knowledge sharing networks, enhancing learning capacity and other support mechanisms have been shown to be ineffective. The long-term commitment in PFI projects provides an opportunity for construction organisations to take a stake in continuously improving the PFI project delivery processes and the constructed facilities. The relatively small number of construction organisations involved in PFI, the repetitive nature of PFI in specific sectors, alliances created, and long-term relationships with clients and other stakeholders can provide a stimulus for learning, knowledge transfer and innovation.

Research Objectives and Methodology

The research undertaken for this study formed part of an Engineering and Physical Science Research Council/Innovative Manufacturing and Construction Research Council funded study that aimed to develop mechanisms for encouraging construction organisations to transfer knowledge between PFI projects. This was expected to lead to performance improvement on PFI projects. The specific objectives of the research were:

1. To establish current level of participation and the key sources of problems in PFI projects in order to establish the scope for improvement;
2. To assess existing knowledge transfer practices and organisational capability to support the delivery of PFI;

3. To establish a knowledge transfer process model for continuous improvement in PFI;
and
4. To develop a toolkit to enable organisations to be more proactive in managing
knowledge in PFI projects.

This paper focuses on the last objective, that of developing a knowledge transfer toolkit for organisations. However, it draws on the findings of the first three objectives and summarises how these have aided the development of the toolkit.

A number of different research methodologies were used to inform the development of the toolkit. These included a questionnaire survey, case studies of client and construction organisations (consulting engineers and construction contractors), and workshops. The justification for these different research methodologies and their outcomes are summarised below.

The Questionnaire Survey

A questionnaire survey was conducted to investigate the level of participation and the key sources of problems in PFI projects. A questionnaire survey was considered the most appropriate way of obtaining the views of a large number of clients and construction companies on specific PFI issues. A total of 121 large construction organisations were contacted by telephone using the database from the 2003 New Civil Engineer's Consultants File (NCE, 2003a) and the 2003 Contractors File (NCE, 2003b). Questionnaires were then sent to 86 construction organisations that were involved in PFI. The respondents included partners, associates, PFI/PPP directors, procurement, contract and commercial managers, business development directors, bid directors and managers and other senior personnel involved in PFI projects. Another 87 questionnaires were sent out to survey client organisations using a database of NHS, education-sector, and transport PFI projects. The respondents included PFI project/programme directors and managers, strategy and partnership, planning and development directors and other senior managers and directors.

A total of 100 completed questionnaires (52 construction and 48 client organisations) were received out of 173 (86 construction and 87 client organisations) to give an overall response rate of 58%. The data collected was analysed from the perspective of the different stakeholders (construction and client organisations) to establish current practices and perception, identify key sources of problems, the scope for improvement, knowledge transfer issues and future challenges.

A summary of the findings of the questionnaire survey is as follows:

- 70% of construction organisations and 92% of client organisations rate the 'Affordability/ funding gap' as a key concern in PFI.
- High bidding costs remain a key obstacle and there is a need to explore alternative approaches to streamlining the bidding and selection process.
- Other challenges facing PFI are market capacity, political uncertainty and press/public perception.
- PFI projects are taking too long to reach key procurement stages across all sectors. The defence sector is particularly problematic with an average timescale of 34.5 months between the Preferred Bidder and Financial Close stages.
- Health, Education and Transport are the dominant sectors in terms of PFI activities but there are opportunities emerging in other sectors (such as Leisure) and outside the UK.
- 76% of construction and client organisations believe there is considerable scope for knowledge transfer in PFI projects through learning from other consortium members and the live capture of project knowledge.
- The most popular mechanisms for knowledge transfer are post-project reviews and discussion forums.

This data was then used to inform specific questions that were posed in case studies of companies and the format of the toolkit developed.

The Case Studies

Case studies were conducted to gain a more detailed understanding of organisations' PFI strategy, the scope for learning on key PFI stages, and organisations' approaches to

knowledge transfer. Case studies were conducted with seven of the project's industry collaborators (two clients and five construction organisations). A summary of the key findings are as follows:

- Companies targeted specific PFI sectors and developed expertise in that particular area. If they were not already operating in a sector, it was considered too late to start because of their competitors' knowledge;
- A number of problem areas were identified in the Outline Business Case, Preferred Bidder and Facilities Management stages by both client and construction organisations. These related to issues such as unrealistic budgets, poor historical data, contractual issues, shortage of experienced personnel, and management of stakeholder expectations. These were all identified as providing substantial scope for learning both from external and internal sources.
- Of the seven case study companies, four had knowledge transfer strategies, but only one had a strategy that specifically addressed knowledge on PFI projects;
- Neither of the client organisations had a knowledge transfer strategy although they considered it critical to their PFI operations; and
- Mechanisms used to transfer knowledge included Communities of Practice, 4ps (public private partnership programme - a government funded group that disseminates PFI knowledge), lessons learned, networking with government and advisors, PFI courses, regular in-house workshops, away days, the intranet, skills yellow pages, pairing staff less experienced staff with those more experienced.

This data was used in the development of the prototype toolkit by providing a better understanding of industry's concerns and needs in terms of format and content.

The Workshops

Three workshops were held with the project's industry collaborators to ensure that the project's industry collaborators were involved in the development of the toolkit and were able to propose improvements. The first workshop was held to critique the conceptual model proposed. The second workshop was held to review the prototype framework. This involved the industry collaborators using the prototype framework to address real PFI issues. The final

workshop was held to consider whether the proposed changes made to the prototype were satisfactory. Further details of the last two workshops are provided in the 'Evaluation of the Framework' section.

The Knowledge Transfer Framework

The main aim of the research was to deliver to clients and construction organisations a toolkit for improving knowledge transfer on PFI projects. In order to do so a conceptual model was devised to ensure that the project addressed the needs of industry. The conceptual model was evaluated in a workshop with seven of the project's industry collaborators. The conceptual model was subsequently developed into what was called a 'Knowledge Transfer Framework'.

The Conceptual Model

A conceptual model consists of three stages as shown in Figure 1.

<Insert Figure 1: Conceptual Model here>

Stage 1 provides a structure to review current PFI practices and identifies the scope for learning in order to improve PFI participation and explore further opportunities in PFI. Stage 2 investigates knowledge transfer problems in terms of the knowledge characteristics, knowledge transfer mechanisms, and barriers to knowledge transfer. Stage 3 aims to develop a learning culture to support continuous improvement in PFI. The conceptual model was evaluated by the project's industry collaborators and subsequently developed into a Knowledge Transfer Framework.

The Framework Description

The Knowledge Transfer Framework should be used collaboratively and involve PFI staff, business development managers and knowledge managers. It consists of three main stages.

Two of the three stages require supplementary documentation that was provided in the form of appendices. The Knowledge Transfer Framework was therefore made more user-friendly by providing a colour-coded flowchart. Figure 2 shows the flow chart indicating how the three stages and their supporting appendices fit together. In both the flowchart and the Knowledge Transfer Framework, Stage 1 documents are yellow, Stage 2 blue, and Stage 3 green. A description of each stage aim and outcomes follows.

<Insert Figure 2: Framework Flowchart here>

Stage 1: Improving PFI participation and exploring opportunities.

The aim of this stage is to provide a structure to review current practices and identify the scope for learning to improve PFI participation and explore further opportunities. The outcome of this stage is a form that identifies a key issue in a PFI stage that need addressing regarding knowledge transfer. It also identifies current knowledge transfer practices, how these may be improved and the scope for learning and knowledge transfer associated with respect to other PFI stages and other PFI sectors. A worked example of the Stage 1 form is shown in Table 1.

< Insert Table 1: Stage 1 Form>

Stage 2: Building a Knowledge Map and Transfer Capability

The aim of this stage is to investigate knowledge transfer issues in terms of what knowledge needs to be transferred, its characteristics, transfer mechanisms, and barriers to knowledge transfer. The knowledge characteristics are determined using a supplementary appendix that asks users to determine the characteristics of the knowledge to be transferred based on classifications with a sliding scale. Figure 3 shows a worked example of this form.

<Insert Figure 3: Knowledge Characteristics Template here>

The outcome of this stage is a form that identifies the type of knowledge that should be transferred, the characteristics of this knowledge, current practices and barriers to transferring knowledge to other PFI stages and projects. A worked example of the Stage 2 form is shown in Table 2.

<Insert Table 2: Stage 2 Form here>

Stage 3: Creating an Action Plan

The final stage produces an Action Plan to implement a knowledge transfer strategy and continuous improvement. The project's industry collaborators were clear in stating that they required an Action Plan which provided a list of tasks to be undertaken as well as deadlines in which to complete the tasks. Thus, the Action Plan was devised with three main steps.

These are as follows:

- Step 3a Identify tools and technologies required to support knowledge transfer;
- Step 3b Identify appropriate monitoring mechanisms for knowledge transfer; and
- Step 3c Assess the organisation's readiness for knowledge transfer.

Each of the above steps are supported by supplementary documents in the form of appendices. Step 3a contains a matrix of Knowledge Transfer Tools based on the Nonaka and Takeuchi's (1995) SECI Model (Socialisation, Externalisation, Combination and Internalisation). The Knowledge Transfer Tools are categorised according to 'Entry Level' tools and 'Advanced Level' tools to allow organisations flexibility in choosing appropriate tools for their needs. This step also provides a glossary of terms to provide a better understanding of the tools available. Table 3 shows the matrix of the tools provided.

<Insert Table 3: Stage 3 Knowledge Transfer Tools here>

Step 3b provides a list of measures to monitor knowledge transfer. The workshops indicated that, because companies are at different levels of maturity in terms of knowledge transfer, they will need different types of monitoring mechanisms. This step therefore provides examples of 'Entry Level' and 'Advanced Level' measures depending on the type of knowledge transfer tool or technology used. Another request was that the metrics be categorised into individual, team and corporate metrics to allow appropriate selection for different constituents. This recommendation was taken on board. An example of the measures used for knowledge transfer techniques is shown in Table 4.

<Insert Table 4: Stage 3 Example Measures for Monitoring Knowledge Transfer here>

Step 3c allows organisations to assess their readiness for knowledge transfer. It can be used using either as a paper-based version or a web-based version. The readiness assessment entails organisations completing a list of questions categorised into:

- Organisational characteristics;
- Resource requirements; and
- Results monitoring mechanisms.

The inclusion of an Organisational Readiness assessment was considered important in helping to flag up issues that could have a detrimental impact on the company's knowledge transfer initiatives. Users are presented with a number of statements for which they have to respond using a Likert scale between 1 (Strongly Disagree) and 5 (Strongly Agree). The scoring system is based on the average score for each of the three categories. Scores less than 3.0 were considered poor (not ready), scores between 3.0 and 4.0 was considered fair (neutral) and scores over 4 were considered good (ready). The questions were evaluated by the project's industry collaborators to ensure their relevance and coverage. The outcome was a prioritisation of issues a company needs to address in order to improve knowledge transfer on PFI projects. Three forms of graphical output are available. These are radar plots, colour coded responses based on level of readiness and a traffic light system (red – poor readiness, amber – fair readiness, and green – good readiness). These provide good graphics to highlight key areas of weaknesses that need to be addressed. This therefore allows

companies to focus on and improve specific aspects that need attention in order to improve knowledge transfer.

Completion of the three steps results in an Action Plan for companies to implement. The Action Plan allows companies to:

- Identify tasks that need to be undertaken to facilitate knowledge transfer;
- Determine what tools and technologies are to be used to support these tasks;
- Identify which knowledge transfer metrics should be used;
- Address issues highlighted in the organisational readiness assessment; and
- Allocate named individuals with responsibility for monitoring progress within fixed timescales.

Table 5 shows the Action Plan form for this stage.

<Insert Table 5: Stage 3 Form here>

Framework Evaluation

The framework was developed in phases and modified based on feedback at three workshops held with the project's industry collaborators to ensure that it met the project's objectives as well as the needs of industry. Workshop 1 was aimed at critiquing the conceptual model proposed and identifying issues and mechanisms for knowledge transfer.

The first workshop involved five industry collaborators using a number of forms to identify key issues, these included:

- A PFI Process Diagram to identify critical PFI Processes requiring knowledge transfer;
- A PFI Transfer Prioritisation form to narrow down the most relevant issues to address; and
- A PFI Knowledge Transfer template that explored the types of knowledge required, who was involved, current practices, scope for improvement, and barriers to knowledge transfer.

The feedback from this workshop was used to develop the framework.

At the second workshop, the same five industry collaborators used the draft framework to address real issues that have arisen on PFI projects. Templates were provided for each of the three framework stages together with a list of Tasks and Guidance Notes on completing each stage. The industry collaborators selected two examples that had commonality across the clients, engineering consultants and contractors. These were (1) Benchmarking of PFI project data and (2) Risk Management. These examples were used in order to evaluate the framework's robustness, flow, consistency, gaps, etc. The feedback from this workshop included the following:

- The framework needed to provide more graphics to aid understanding of the flow across the various stages;
- The framework was considered too lengthy and needed to be shortened and simplified;
- Illustrated examples should be provided to alert users to the type of input required;
- Example tools and technologies should be provided under the SECI matrix;
- Although the questions on Organisational Readiness assessment were found to be comprehensive and well-structured, they needed (a) to identify which items were within the users' control and (b) a mechanism for highlighting the key issues more clearly.

These deficiencies were all addressed in the following ways:

- The original framework consisted of numerous forms with separate lists of tasks to complete supported by guidance notes and appendices. A flow chart was devised to graphically represent the different stages and their associated appendices. The guidance notes were condensed and placed on the page facing the form to be completed;
- Some of the forms were amalgamated, duplications removed and overall simplification of the flow between stages;
- Appendices provided worked examples of each stage using the workshop documentation to provide an aid for new users;
- The tools and technologies recommended were categorised into the SECI model and also according to entry or advanced level tools;

- The Organisation Readiness assessment was automated so that users would find it easier to select items under their control and also the results report used a traffic light system to highlight issues that were critical to address.

The third workshop was held to check that the changes proposed had been taken into consideration and to approve the final version of the framework and ensure it was ready for dissemination. As a final check, one very experienced PFI industry collaborator was asked to examine the framework to ensure that both the framework and the guidance notes were sufficiently clear and relevant to industry's needs. This resulted in minor cosmetic changes to the Stage 3 Form.

Feedback from the industry partners can be divided into two categories based on their level of PFI experience. Those collaborators with little PFI experience regarded the framework as providing ammunition for their line managers to adopt a more proactive approach to knowledge transfer based on the results of the questionnaire survey, the case study reports and the Knowledge Transfer Framework. The more experienced PFI collaborators saw it as a comprehensive and structured framework to encourage them to participate in knowledge transfer initiatives to improve their PFI portfolio.

Limitations of the Framework

The Knowledge Transfer Framework described above received favourable comments from its evaluation. However, the authors recognise that a single framework will not radically improve knowledge transfer on PFI projects. There are limitations in the framework proposed; these can be divided into scope and validation. In terms of scope, the framework promotes structured dialogue between willing participants within a single enterprise but it does not address the multi-faceted problems inherent in knowledge transfer across companies such as politics, cross-culture communications, etc. Further development will be required to ensure that the framework satisfactorily addresses these areas. It was considered prudent to improve internal knowledge transfer before embarking on external knowledge transfer.

In terms of validation, the framework is relatively new and, as such, the authors cannot yet provide data on the usefulness of the framework on real PFI projects. Efforts will be made to maintain contact with the original project partners in order to monitor the use of the framework and to make improvements as required. However, it is acknowledged that this will be a long-term activity because of the nature of PFI projects.

In terms of format, the automation of the framework is anticipated so that instead of the current 28-page document, an electronic version of the framework could be provided with the additional features of downloadable forms, context sensitive help, transfer of input between forms, improved information on tools available, increased graphical input, etc. In summary, there is scope for improvement but this would best be done on an incremental basis.

Conclusions

PFI projects play an important part in a UK construction company's project portfolio. However, both government and the construction industry recognise that there is tremendous scope for improvement in the execution of PFI projects. One way of improving PFI performance is to transfer knowledge from previous projects onto future projects and to other PFI teams. This paper has presented the development of a Knowledge Transfer Framework that enables organisations to be more proactive in managing knowledge on PFI projects. The framework consists of three stages that include exploring PFI participation and opportunities, mapping the organisation's knowledge and creating an action plan for transferring knowledge. The Knowledge Transfer Framework was evaluated using three workshops involving the project's industry collaborators. The framework was found to be an appropriate way forward since it provides a structured way for identifying key issues, understanding what tools and technologies are available, and implementing and monitoring knowledge transfer tools and technologies on PFI projects. There is considerable scope for improvements in the PFI project delivery process. The Knowledge Transfer Framework presented in this paper will enable both construction organisations and clients to improve their current practices and reap the attendant benefits.

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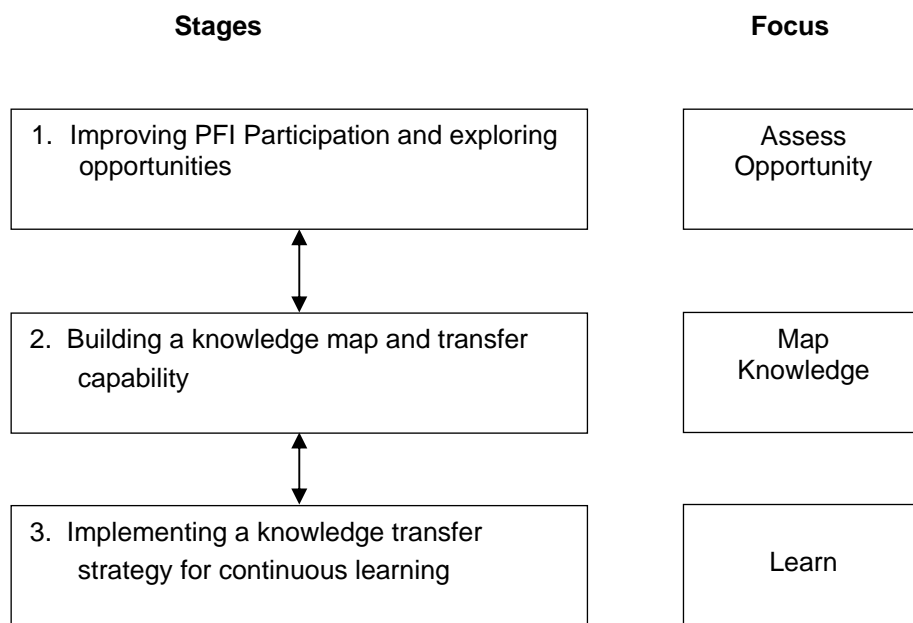


Figure 1: Conceptual Model of the Knowledge Transfer Framework

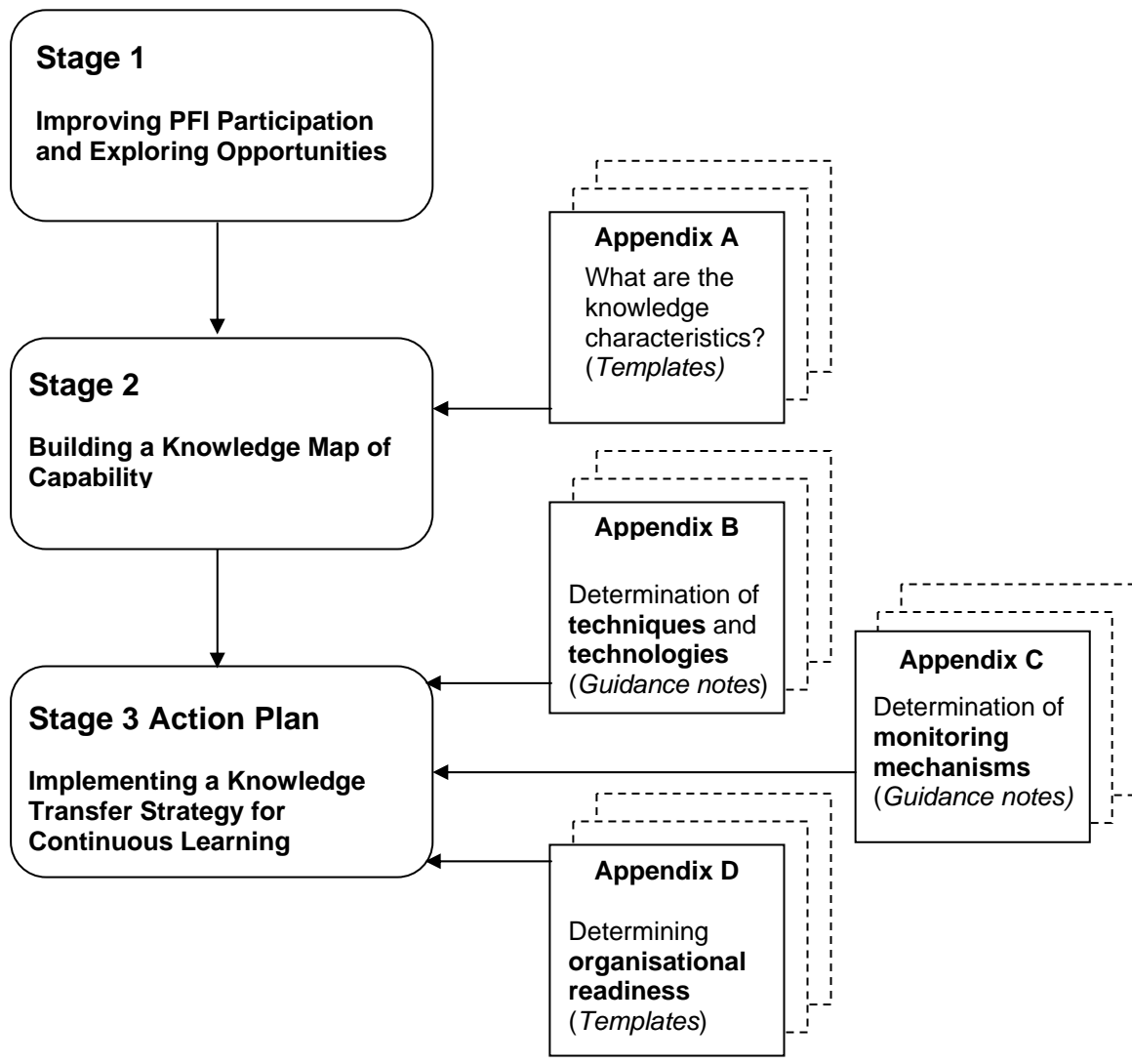


Figure 2: The Framework Flowchart

Stage	Tasks	
1.1	PFI stage to consider	Outline Business Case (OBC)
1.2	Description of issue	Affordability based on quality of output specification
1.3	Identify the PFI sector that the issue relates to	Education and Health
1.4	What are the current practices with respect to the issue?	Limited funding from central government; Technical standards and specifications dictate output; Balance of funding therefore needs to come from other sources; Incorrect advice from consultants who are not aware of recent standards.
1.5	Identify how current practices can be improved	Schemes may have to be re-scoped, e.g. 2 not 3 schools; Review facility Management standards; Increase council tax.
1.6	Identify the scope for learning/ knowledge transfer associated with the issue	Benchmarking using regional data and type of site. High scope for learning.

Table 1: Stage 1 Form

Knowledge Issue: Benchmarking

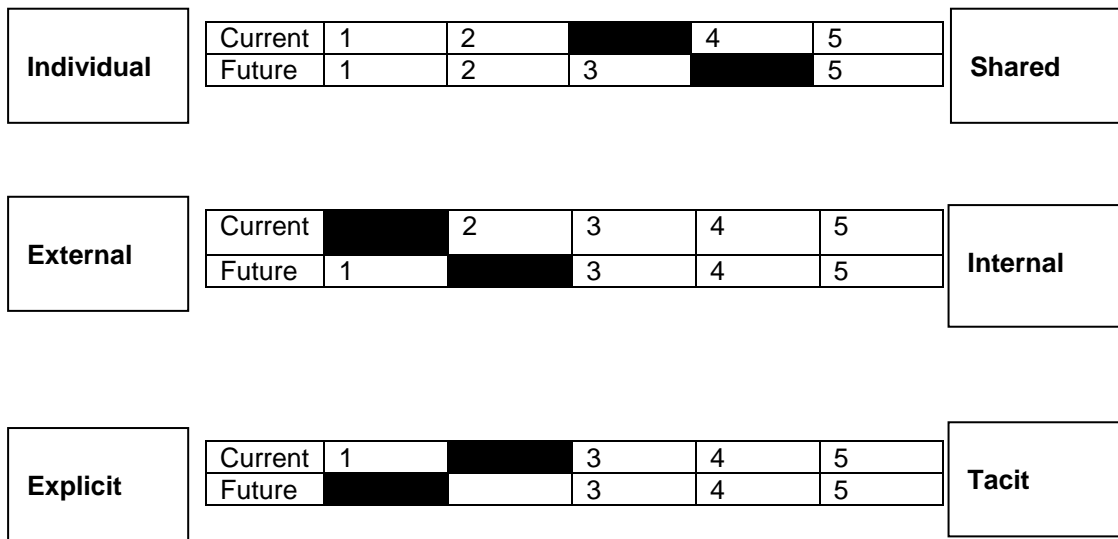


Figure 3: Knowledge Characteristics Template

Stage	Tasks	
2.1	Type of knowledge required	Benchmarking
2.2	State the current characteristics of the knowledge for each type listed in 2.1	Benchmarking knowledge is mainly: Individual; External; and Tacit.
2.3	What are the current mechanisms/ways for sharing this knowledge	Benchmarking knowledge: IT systems and Black book.
2.4	Identify the barriers currently associated with existing mechanisms	Quality of information. it is not reliable and confidentiality issues exist.
2.5	Identify the future knowledge characteristics.	Benchmarking knowledge should become Individual to Shared; External to Internal; and Tacit to Explicit.
2.6	Identify barriers relevant to moving from the existing to future characteristics.	Availability of resources; Leads to single-point expertise; Cultural change towards sharing between divisions; and Outturn costs available to encourage sharing.

Table 2: Stage 2 Form

Socialisation - <i>Tacit to Tacit</i>	Externalisation - <i>Tacit to Explicit</i>
<p>Entry Level: Brainstorming Conferences/Seminars/Exhibitions Face-to-Face Meetings Headhunting Mentoring Project Reviews Succession Planning Training</p>	<p>Entry Level: Best Practice Documents Databases Discussion Forum Document Archives Skills Yellow Pages</p>
<p>Advanced Level: Communities of Practice Video Conferencing</p>	<p>Advanced Level: Expert Systems Intelligent Systems</p>
Internalisation - <i>Explicit to Tacit</i>	Combination - <i>Explicit to Explicit</i>
<p>Entry Level: Conferences/Seminars/Exhibitions Corporate Universities Intranet/Extranet Search Engines Succession Planning Training</p>	<p>Entry Level: Intranets/Extranets Best Practice Documents Procedure Manuals</p>
<p>Advanced Level: Electronic Document Management Systems Groupware Virtual Reality Tools</p>	<p>Advanced Level: Data Mining Tools Document Management Systems</p>

Table 3: Stage 3 Matrix of Knowledge Transfer Tools

Scope	Techniques	Examples of ENTRY LEVEL Measures	Examples of ADVANCED LEVEL Measures
Individual Metrics	Mentoring	Frequency of meetings	Feedback (qualitative and quantitative)
	Conferences	Number of conferences	Evidence of positive impact/learning
Team Metrics	Brainstorming	Frequency of sessions	Documentation and dissemination of session result
	Communities of Practice	Number of active communities	Satisfaction survey of community members
Corporate Metrics	Project Reviews	Evidence that it occurs	Frequency Participation level Process change requests Lessons learned updates
	Succession Planning	Evidence of succession planning	Evidence of structured action plan

Table 4: Stage 3 Example Measures for Monitoring Knowledge Transfer

Stage 3 Tasks		Benchmarking			
3.1 Restate type of knowledge	Knowledge transfer solution	Measures for monitoring knowledge transfer		Responsible person and position	Review / completion time / key date
		Entry level metrics	Advanced level metrics		
3.2 Existing techniques to be improved (non-IT tools)		Number of quarterly project review meetings held	N/A at this point	A.N. Other, Managing Director	Quarterly reviews starting 20/04/05
3.3 New techniques required (non-IT tools)		Level of activity undertaken	N/A at this point	A.N. Other, Managing Director	Benchmarking group set up by 20/07/05
3.4 Existing technologies to be improved (IT tools)		Number of hits on project database on intranet	N/A at this point	B.S. Brown, IT Manager	Quarterly reviews starting 20/04/05
3.5 New technologies required (IT tools)		Number of hits on FM database	N/A at this point	B.S. Brown, IT Manager	FM database of costs completed by 20/01/06
Organisational readiness					
3.6 Identify organisational weakness to address in the short-term		Lessons learned for three projects recorded and published on the intranet		C.A. Smith, Business Improvement Manager	Process in place by 20/04/05
3.7 Identify organisational weakness to address in the long-term		Access to benchmarking data within 60 seconds		B.S. Brown, IT Manager	Intranet pages available 20/01/06

Table 5: Stage 3 Form