

MAPPING KNOWLEDGE DURING SUSTAINABILITY ASSESSMENT WITHIN A PPP SCHOOL PROJECT

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Increasingly, sustainability assessment is applied as a valuable tool for assessing and monitoring the performance of construction projects in delivering sustainable buildings. Sustainability assessment has been traditionally regarded as a technical process to determine the performance of projects against environmental, social and economic criteria. Calls are emerging for assessment to evolve as a tool better integrated with the subjectively based decisions taken across the project lifecycle, supporting stakeholder engagement and promoting a culture of learning about sustainability in practice. In order for assessment to fully realise this wider role; it is necessary to recognise the significance played by knowledge and its flow between stakeholders in the promotion of a common understanding of the actions required to deliver a sustainable urban environment. This paper presents the findings of a knowledge mapping exercise focused on understanding the nature of this flow during sustainability assessment across the lifecycle of 6 new schools funded under a public private partnership (PPP) contract. The analysis identified the key sources of knowledge drawn upon by decision-makers during four identified phases of sustainability assessment. Knowledge exists in a variety of types and forms, and the key sources were classified around an emerging set of categories relevant to the context in question. Variations were observed in the types of knowledge held by the different stakeholders and considered the nature of its transfer between the stakeholders and the key-decision maker. Identified was the need to support those managing the assessment with a range of knowledge sources, with particular focus on experts who can guide and support inexperienced project teams.

Keywords: sustainability assessment, knowledge management, partnering, case study.

INTRODUCTION

As sustainability increases in significance within construction projects, the evolution of systems to measure, assess and monitor the potential social, environmental and economic impacts associated with the design, build, maintenance and ultimate disposal has been the subject of much debate (Thomson *et al.* 2009). Traditionally viewed as a technically based tool focused on the quantification of the flow of resources intended or actually used within a project, sustainability assessment has been criticised for playing a purely reactive role in the development of a project. The likes of Cole (2005) and Kaatz *et al.* (2006) call for assessment to evolve to provide greater integration with the decisions taken regarding sustainability within a project and therefore engage with the subjective nature of the surrounding discourse. Assessment has a role to play in promoting an environment where stakeholders are

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forced to rethink their priorities by examining the potential impact of their project decisions on sustainability (Pope *et al.* 2004), and therefore deliver the sought after levels of stakeholder engagement, mediation and learning (Lee 2006). By providing tangible information to decision makers in an inclusive and transparent manner, a shared understanding of sustainability and its implications can be forged between the various stakeholders around the contextual requirements of the project (Mathur *et al.* 2008).

Despite the potential suggested by such an approach, its delivery in practice has been limited. Many have cited the absence of a common framework and language around which to consider and assess sustainability (Deakin *et al.* 2002) and a lack of a truly integrated tool (Brandon *et al.* 1997). Increasingly appreciation is emerging that a lack of understanding exists amongst practitioners around the concept of sustainability, the nature of assessment and the implications presented for practice; restricting the opportunity for the evolution of assessment (Walton *et al.* 2005). It is evident that instead of focusing on the introduction of ever more tools and systems for assessment, a deeper and broader understanding is required of the nature and flow of knowledge that surrounds the assessment (Wilkins 2003). Thomson *et al.* (2009) suggests that applying the principles of knowledge management to the assessment context has the potential to develop an understanding of the capture, storage and retrieval of knowledge considered and generated during an assessment.

This paper presents the findings of an attempt to understand how sustainability assessment is applied in practice across its different phases over the project lifecycle within an empirically based case study. The findings of a knowledge mapping exercise is presented which identified the sources of knowledge classified around an emerging set of categories, the type of knowledge held each stakeholder during the assessment and finally the mechanisms involved in its transfer to the key decision-maker. Considering an empirical example where assessment is applied within a project in a reactive manner, allows lessons to be drawn that can aid the evolution of approaches to assessment towards the aspired approach. The case study represents the application of assessment within a Public Private Partnership (PPP) form of procurement contract, and considers the implications of this contract on the flow of knowledge during an assessment.

ROLE OF KNOWLEDGE DURING ASSESSMENT

Developing a team's knowledge base is essential to its ability to solve problems and to make informed decisions (Salter and Gann 2002), and it is primarily acquired by individuals through their exposure to those who hold knowledge and the sharing of experience with others through a variety of means (Matsumoto *et al.* 2005). The approach advocated to assessment by the likes of Kaatz *et al.* (2006) aims to stimulate the learning process of stakeholders around the concept of sustainability, the implications of its application, and the tools for its assessment. It is argued that this can be facilitated by exposing stakeholders to the exchange of knowledge during decision-making and discourse associated with of assessment in practice (Wilkins 2003; Mathur *et al.* 2008). Delivering the required knowledge transfer depends on the ability of those managing the assessment to understand the nature and flow of knowledge between the associated stakeholders and the contribution made to the decision-making process (Thomson *et al.* 2009). Enhancing the knowledge base of the relevant stakeholders during an assessment in the short term aims to enhance their

ability to contribute to the assessment, but in the long term seeks to enable the transfer of the acquired knowledge for the benefit of future assessments.

Knowledge exists in a variety of forms and requires methods of transfer that are appropriate for the context and stakeholders involved. Two dominant types are identified with knowledge either existing as explicit or implicit by nature. Explicit knowledge is commonly understood as that which is documented, public, structure, fixed in content, externalised and conscious (Egbu 2006); residing for example in books, documents, formulas, project reports, contracts etc (Vestal 2005). Implicit knowledge on the other hand depends on the context within which is generated and by nature is not codified, and when captured requires to be written down in a manner that reflects the context (Vestal 2005). To achieve improvements in the flow of knowledge, an understanding is required of these differences and the requirements associated with managing this knowledge during an assessment. A significant type of implicit knowledge that requires consideration is the role of tacit knowledge which is associated with know-how, past-experiences, expertise, found through interaction between individuals, and through the memories of others (Mohamed *et al.* 2006).

METHODOLOGY

To engage with the complex and context specific nature of knowledge surrounding sustainability assessment, a case study approach was identified as a suitable lens to examine the real life experience of assessment in practice. Located within the phenomenological paradigm, the case study provides the opportunity to explore the social setting around which the predominantly subjective nature of the knowledge flow during assessment (Yin 1993). Developing a better understanding of the real life experience of specific projects provides the opportunity to relate the lessons learnt to the wider development of assessment practice. The case study explored in this paper represents an approach to assessment that is reactive by nature across a programme of schools construction projects which is managed using a Public Private Partnership (PPP) form of procurement contract. The case study aids an understanding of how sustainability assessment is being adopted in practice; enabling us to consider the impact the adoption of this form of procurement contract has on the management of the sustainability assessment and the implications this has for the flow of knowledge that surrounds it.

A series of semi-structured interviews were conducted with those members of the project team involved or influenced by the application of the sustainability assessment within the project. In this case these were with the project director (from the prime-contractor), two members of the design team and the facilities manager. Each provided an overview of the project and the assessment, in addition to questions aimed at exploring the knowledge flow and requirements during the assessment. Each interview lasted around 2 hours and transcribed in preparation for analysis, with support provided through the consideration of documentation such as assessment reports, project plans and reports, transport plans, and consultant's reports etc. Analysed was conducted under the principles of grounded theory with the aid of NVivo qualitative software, and categories were developed and relationships established from the data itself. During later stages of analysis, interview data was triangulated with the analysis of the project documentation to ensure its consistency. Finally a comparison with established thinking and a validation with those interviewed were conducted to ensure the legitimacy of the findings. Three stages of analysis were used for each phase of the assessment, a description of the activities

involved, the identification and classification of knowledge sources using categories emerging during the research, and the findings of a knowledge mapping exercise for each source, pathway and receptor.

Knowledge mapping is a technique that is used to understand the different types of knowledge that requires to be managed within a context. Techniques deployed were cognitive mapping, and organisational network analysis (ONA) (Vestal 2005) in order to understand the relationship between stakeholders, identify who is involved during an assessment, define what their role is, what knowledge they hold, what knowledge they require, and its preferred method of transfer. Mapping techniques were considered from the likes of Vestal (2005), Eppler (2008) and Egbu (2006). The overall approach was similar to Eppler's (2008) description of a 'knowledge application' approach focused on the type of knowledge applied to a certain process stage. Egbu's (2006) work was also drawn upon with consideration of the specifics of knowledge (i.e. documents, database etc), and observing the processes; roles and competencies of the stakeholders involved. Given the context specific nature of the flow of knowledge during assessment, a tailored approach was required and that a mixture of representations would provide a greater value.

CONTEXTAL BACKGROUND TO CASE STUDY

Initiated in 2001, the projects were procured using a Public Private Partnership (PPP) contract, with the prime-contractor identified as preferred bidder in 2002, with the 'Schools Partnership' emerging from the agreed contract to oversee the delivery and operation of the schools for a 30 year term (involving the prime-contractor, facilities management and the funding bank). The initial stages of the project were driven by the education department within the local authority, with sites identified in line with the council's strategic plan representing a mix of green field sites and direct replacements on the sites of existing schools. The client body are keen to apply BREEAM for schools (Building Research Establishment Environmental Assessment Method) as a tool for sustainability assessment within these projects (BRE 2007). They acknowledged the need within the public sector to display transparency, recognising that the sustainability performance of these projects was considered as part of this and the increasing application of assessment within such projects. Despite their inexperience in applying such tools, the authority recognised the growing expectation of its consideration in future projects.

FLOW OF KNOWLEDGE ACROSS PHASES OF ASSESSMENT

The research focused on four key phases of sustainability assessment around which the key-decisions are taken i.e. identification of project sustainability issues, selection of sustainability assessment tools, implementation of the assessment and consideration of tool outputs (Thomson *et al.*, 2009). This section aims to illustrate the nature of the analysis which provided the basis for the discussion presented in the following section.

Stakeholder mapping

Prior to beginning the knowledge mapping, it was necessary to conduct an initial exercise to identify who was involved during the different phases of the assessment, and the findings are displayed in Figure 1. Observed were the different roles played by the stakeholders across these phases and categories were developed to reflect this. It is important to note the dominance of the project board and client representative in the selection of both the project sustainability issues and the tool, and the noticeable

absence of the design team and the sustainability assessor. In addition, a transfer of responsibility was noted towards the prime-contractor in the later phases.

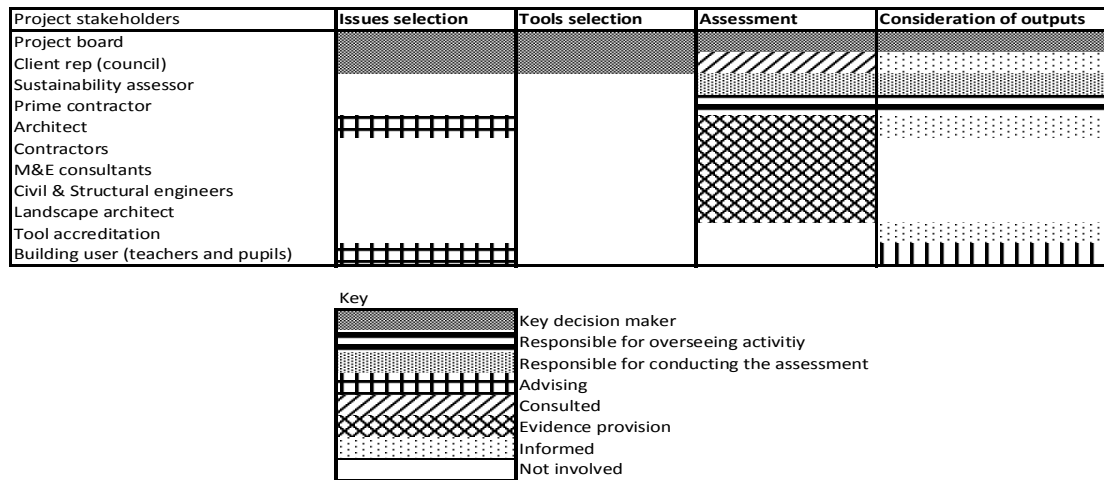


Figure 1: Project stakeholder involvement in phase of assessment

Identifying and categorising the sources of knowledge

Different types of knowledge sources were considered across the phases of the assessment and the research set out to understand these variations. Classifying knowledge allows for differentiation to be provided between knowledge that is explicit by nature (i.e. document based) and that which is implicit (be it values and requirements of stakeholders, expert knowledge, or tacit knowledge supported by individuals past experiences). An example of this exercise is provided in figure 2, illustrating the type of explicit sources considered during identification of project sustainability issues, and displaying some of the emerging categories.

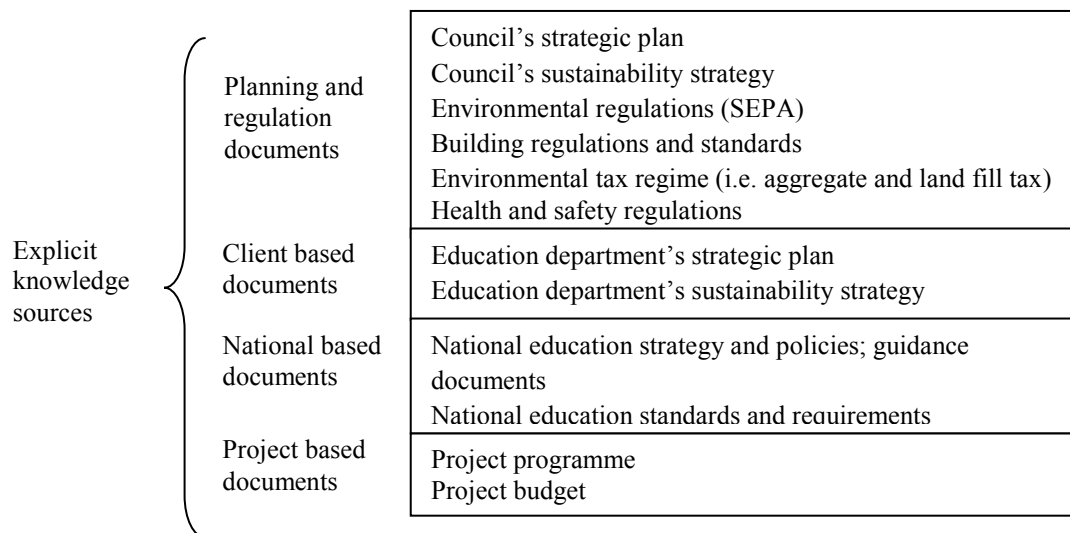


Figure 2: Example of the classification of explicit knowledge sources

Despite explicit knowledge being considered heavily within all phases, significance was attached to the implicit knowledge sources drawn upon to support their consideration. The sources of knowledge held by each of the stakeholders were mapped, revealing the limited expert and tacit knowledge held by the key decision-

makers relating to sustainability and its assessment across all phases. Observed during the first two phases was a lack of both expert and tacit knowledge within the team; however it was identified that both these sources were available during the later phases through the sustainability assessor and members of the design team.

Knowledge mapping

A mapping exercise was conducted to illustrate the flow of knowledge from the source, the pathway of its transfer and the receptor. Highlighted through this exercise were that multiple stakeholders can hold the same kind of knowledge, and that this can be transferred through a mix of formal (meetings etc) and informal (conversations etc) pathways. The key-decision maker requires access to the appropriate knowledge from the relevant source, to enhance the knowledge base required to make decisions. In order to develop a better understanding of the specifics associated with the flow of knowledge an alternative approach was adopted around a number of identified drivers for each phase of assessment (e.g. planning context, client requirements, regulations, best practice) observed to shape the nature of the knowledge requirements of the key decision-maker. Figure 3 illustrates an example of the emerging maps, showing the driver, key-decision maker, the sources of knowledge and the stakeholders holding this knowledge, and its pathway of transfer. This kind of map is potentially easier to interact with.

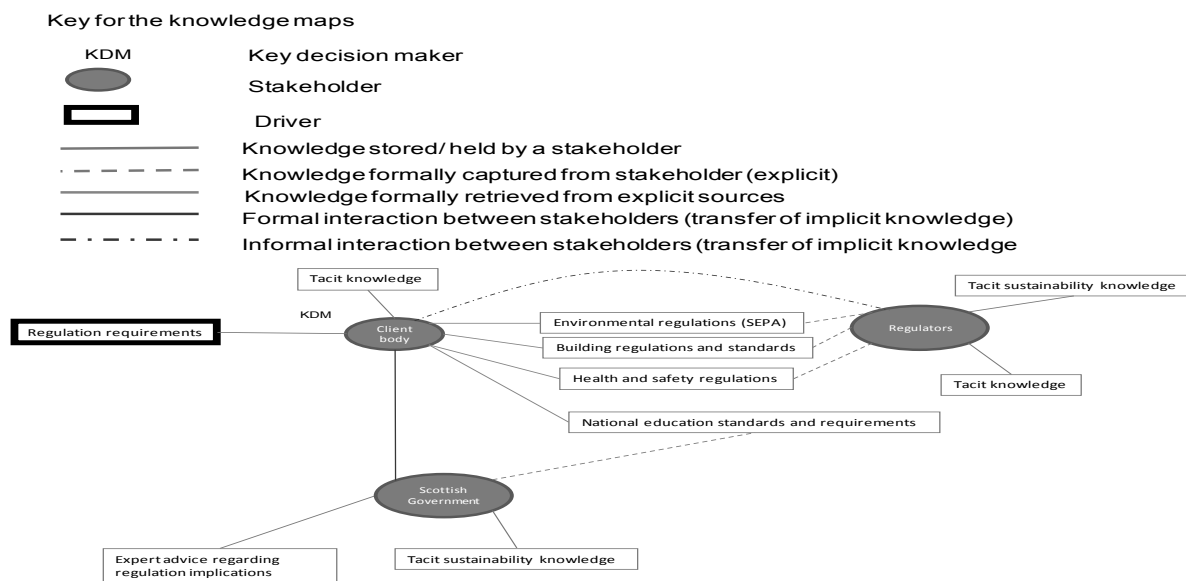


Figure 3: Example knowledge map for the driver of regulation requirements

The mapping revealed the attempt by the client representative to compensate for their inexperience with sustainability and its assessment during the early phases by seeking informal advice from multiple personal contacts. Concern was expressed during the interviews that the advice tended to be generic by nature and not contextual for the requirements of the project. Many argued that a sustainability advisor should have been employed to guide and provide knowledge support in a contextualised manner for the project. Acting as a consultant, this role would have provided an overview of the project based on training and experience of sustainability management and the individual tools. Whilst it was possible to identify that the design team and sustainability assessor held this type of knowledge during the later phases of the assessment, the mapping revealed that they were not included in the necessary pathways of discourse surrounding the assessment and associated decision-making.

The design team and sustainability assessor required to communicate through the prime-contractor, and as a consequence failed to engage in the discourse about the design and its implications for the assessment therefore failing to recognise the potential for improvement. The nature of the project's structure and perceived lack of incentive for improvement due to the inflexibility of the contract were identified as restricting factors.

DESCRIPTION OF EACH PHASE OF ASSESSMENT

Identification of sustainability issues

The local authority initiated the process with an initial set of sustainability issues they wished to reflect across the projects and therefore during the assessment. During this phase they were heavily informed by explicit knowledge sources such as local and national government documentation. However, significance was attached to advice taken from informal contacts known to the client representative based in other local authorities, and communities of practice (ICE, RIBA, and RITP). Drawing on knowledge from personal contacts, the client representative attempted to compensate for a lack of experience with out formally employing an expert consultant. The establishment of the project board saw a meeting between the board and client representative to re-evaluate the initial set of issues and accommodate the increased consideration for the whole life cycle introduced by the prime-contractor and facilities manager. In practice, the set of sustainability issues did not change but a slight shift in priorities towards minimising energy costs. Given the prior selection of the assessment tool, the project board and architect evaluated the suitability of the 'Good' rating sought by the client representative. Again, the team relied heavily on advice from external sources to consider the implications of this rating for the design and construction phases of the project. However, problems were observed in that knowledge from such sources lacks the contextualisation for the specific requirements of the project. The rating was confirmed by the project board at the following meeting, with the team satisfied with the achievability of the targets set.

Selection of the assessment tool

The application of BREEAM as an assessment tool was novel for the local authority on projects of this scale. Despite this inexperience, the client representative displayed an intention to apply a BREEAM assessment from the outset based on a realisation of its increasing role within future projects; and a desire to demonstrate engagement with the sustainability agenda. This perception emanated largely from explicit sources such as policy documents, industry publications and the media. Given the high profile nature of the projects, the client representative sought the advice of personal contacts who displayed experience and expertise in using BREEAM in similar projects for other local authorities. This knowledge was tacit by nature and based on this advice, the use of BREEAM for schools was placed as a requirement within the PPP contract, and outlined an initial rating of 'Good'. Following their appointment as preferred bidder, the prime-contractor engaged with the client representative and the rest of the project board to evaluate the legitimacy of the adoption of BREEAM for schools and the achievability of the initial rating set. Each party drew on a range of knowledge resources both explicit (e.g. project documentation) and implicit (e.g. stakeholder values and requirements) by nature, and emerged with a degree of satisfaction that the tool was appropriate and that the initial rating was both achievable and appropriate for the context of the project. As a result, it was included in the contract and became the expected level of performance for the completed buildings. These activities took

place in tandem with those of selecting the sustainability issues for the project, and whilst the priority of some of the issues changed when the project board became involved, the team felt that the BREEAM assessment and rating could be accommodated in the agreed approach.

Implementation of the assessment tool

Once the contract was agreed the prime-contractor assumed responsibility for the management of the assessment. They convened a meeting with the design team to outline the expectations and implications of the targeted rating for the emerging design and to present the process for collecting the evidence and data required for the assessment. It was agreed that the design team and associated consultants (i.e. ecologists, transport modeller) would submit evidence and data to a central contact to collect, store and liaise with the sustainability assessor following their appointment. The assessor was employed by the prime-contractor, to conduct the analysis, prepare the reports, and to submit the final report to the BRE for accreditation. Following the appointment, the sustainability assessor prepared a pre-assessment report identifying for each element of the agreed criteria, targets, evidence and data requirements. This provided the design and construction teams with explicit guidance of the sustainability expectations for their practices, in addition to outlining the individual responsibilities to complete the assessment. To support the dissemination of the report, a workshop was organised by the sustainability assessor to outline its contents and respond to the team's queries.

During the design phase, the sustainability assessor oversaw the management of the collection of evidence from the design team and supporting consultants. This was an iterative process to a certain extent, with the individual criteria being monitored to ensure that the rating is delivered in practice. However, it was evident that the disconnection between the sustainability assessor and the design and construction teams resulted in a lack of feedback between the assessment and project activities. This contributed to a lack of awareness that in practice the targeted 'Good' rating was easily achievable and that through some minor changes the potential existed to achieve the improved rating of 'Very Good'. If the sustainability assessor had been actively involved in communicating with the teams, instead of having to go through a point of contact within the prime-contractor, this situation would have become apparent. The sustainability assessor held the required expert knowledge and past experience to recognise this potential and recommend the necessary changes in design to deliver the improved rating. Instead he was removed from the flow of knowledge generated between the design and the assessment, unable to guide the improvements. The sustainability assessor compiled the evidence into an initial report and then shared it with the rest of the team.

Consideration of assessment outputs

The technical report representing the final assessment was not formally or widely disseminated by the project board due to a perceived lack understanding of its contents by wider stakeholders. However, it was clear that the design team were not included in the distribution of the document and this was identified to limit the opportunity for those involved to learn about the implications of their design on the buildings sustainability. Whilst they were made aware through a meeting of the final rating, a frustration existed amongst many in the design team at being kept at arms length from its detail by the prime-contractor's management structure. Whilst members of the project board could consider the implications of the assessment for the

operation of the schools, the design team were left frustrated by the knowledge that improvements could have been made if discourse had been permitted during the design process. However, they felt that their hands were tied by the nature of the contract and a general lack of incentive to initiate change due to the project management structure.

Implications of sustainable procurement

The case study reflects a pre-2003 approach to procurement where 'Value for Money' dominated the agenda with no formal obligation to include sustainability as a condition of the contract (HM Government, 2007). Client body's informal consideration of sustainability and the reactive approach demonstrated to assessment are reflective of this. Since 2003, PPP projects have considered sustainability as part of the SPV selection criteria with this significantly strengthened by the Sustainable Procurement Action Plan (HM Government, 2007) which places sustainability as core criteria in the procurement of all publicly funded projects. This potentially provides the contractual basis for a proactive approach to sustainability within the next generation of PPP projects. This removes the form of procurement as the problem, although this research suggests that attention is required for project management to ensure that the opportunity is provided for reflection and feedback in the management of sustainability across the projects lifecycle. Ensuring flexibility is provided in sustainability targets set, and in the design and construction practices is necessary to encourage improvement in line with an evolving agenda. Enabling feedback and the flow of knowledge between the various stakeholders involved in project decisions and the assessment is an essential component of this process.

CONCLUSIONS

The research displays the finding of a knowledge mapping exercise, presented through a range of techniques to highlight the diversity of knowledge sources considered the key decision-makers during each phase of assessment. If assessment is to emerge as a tool to aid the integration of sustainability within project activities the continued engagement between the key-decision makers, the rest of the team and wider stakeholders is essential. The case study stressed the significance of managing both explicit and implicit sources of knowledge during the assessment. Throughout the project lifecycle the target remained set at 'good', despite the potential to increase the target to 'Very Good' not being realised during the design phase. Insufficient feedback was observed between the activities of assessment and design, due to the project management restricting the flow of implicit knowledge between the assessor and the design team. This led to a failure to deliver the potential for improvement in the targeted rating and consequently the overall sustainability performance of the projects. The research suggests that with the speed which sustainability targets are shifting, implementing assessment in a reactive manner provides insufficient flexibility to evolve either the targets or decisions taken during the project. It is suggested that sustainable procurement resolves some of these problems for PPP projects, but that the upfront targets set need to be flexible and respond to feedback from the team.

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