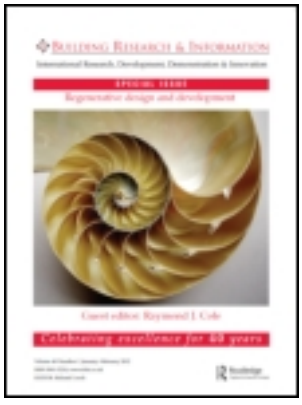
Comparing the fit between BREEAM assessment and design processes



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RESEARCH PAPER

Comparing the fit between BREEAM assessment and design processes

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This paper explores the mapping of the environmental assessment process onto design and construction processes. A comparative case study method is used to identify and account for variations in the 'fit' between these two processes. The analysis compares eight BREEAM projects (although relevant to LEED, GreenStar, etc.) and distinguishes project-level characteristics and dynamics. Drawing on insights from literature on sustainable construction and assessment methods, an analytic framework is developed to examine the effect of clusters of project and assessment-level elements on different types of fit (tight, punctual and bolt-on). Key elements distinguishing between types include: prior working experience with project team members, individual commitment to sustainable construction, experience with sustainable construction, project continuity, project-level ownership of the assessment process, and the nature and continuity of assessor involvement. Professionals with 'sustainable' experience used BREEAM judiciously to support their designs (along with other frameworks), but less committed professionals tended to treat it purely as an assessment method. More attention needs to be paid to individual levels of engagement with, and understanding of, sustainability in general (rather than knowledge of technical solutions to individual credits), to ownership of the assessment process and to the potential effect of discontinuities at the project level on sustainable design.

Keywords: BREEAM, building assessment methods, building design, design process, environmental assessment, implementation, sustainable building, team dynamics

Introduction

Environmentalism and sustainability pose major challenges for firms in general and for construction firms in particular. In the UK, as in many countries, government policies and industry strategies are beginning to converge around a small number of methods, tools and instruments designed to realize these goals. While a great deal of attention has been given to the technical development of such tools and to their effects on the built environment, far less attention has been directed to their impact on design and construction processes. This paper contributes to that small but growing literature by examining the effect of the Building Research Establishment's Environmental Assessment Method (BREEAM) on design and construction processes. Whereas most research in this area focuses on general effects, this paper uses the comparison of eight case studies to explore variations in the effect of BREEAM on the construction process.

The European Union (2002) Energy Performance of Buildings Directive (EPBD) and the UK Climate Change Act of 2008 placed sustainable buildings firmly on the UK policy agenda. Since then a myriad of tools and instruments have been developed to support, guide and assess construction projects. BREEAM is among the most successful of these tools, at least in terms of uptake. Over 15 000 buildings have been certified since BREEAM was first launched in 1990, nearly half of them since 2008

(BRE Global, 2013). Most UK construction professionals involved in new commercial buildings have at least encountered BREEAM and many, especially specialist engineers, work with it on a regular basis. Despite the growing prevalence of the method, little systematic research has been conducted into the effect these methods have on core building practices and processes.

This paper is the second of two papers on BREEAM. The first examined construction professionals' attitudes towards and experiences with the method (Schweber, 2013). In contrast, this paper focuses on the effect of the assessment process on design and construction processes. More specifically, the comparative case study method is used to identify variations in the effect of BREEAM on project team design decisions, where design is defined broadly to include architectural design, construction practices and procurement writ large. By this definition, design is not confined to a particular phase of a building project or set of actors, but begins at conception and continues through to handover (and beyond, although these subsequent decisions are beyond the scope of this paper).

As the phrase 'Environmental Assessment Method' indicates, BREEAM was initially developed to assess and certify buildings. Viewed from this perspective, its primary function is to capture and communicate something about the environmental quality of a building to the public and to the property market. The method involves a series of steps leading to the assignment of a numerical score and certification. However, in the past decade both the Building Research Establishment (BRE) and policy-makers have also promoted it as a design tool.

As the discussion below indicates, research into methods, instruments and tools often focuses on their formal features. Implicit in much of this work is an assumption that technical features dictate use and effect, leading to uniformity across cases. In contrast, this study begins from the assumption that local context significantly influences the use and thus the effect of tools and methods. Thus, while all projects can be assumed to use BREEAM for assessment purposes, not all projects engage with its (potential) design function in the same way.

The paper is exploratory; its aim is to develop an analytic framework for more systematic enquiry. Its two main objectives are, first, to develop an initial classification of types of design effect and, secondly, to relate those types to differences in project-level characteristics and elements. The comparative case study method contributes to these aims by comparing clusters of elements that come together in particular local contexts to produce observed design effects. While the focus is on BREEAM, the proposed analytic framework should prove relevant for the study of assessment methods more broadly (including methods such as Leadership in Energy and Environmental Design (LEED) and GreenStar) and for the study of tools and instruments more generally.

This study differs in two ways from previous research. First, instead of focusing on the statistically independent effect of each factor, the paper uses the comparative case study method to explore the effect of different combinations of factors on the decision-making process. Secondly, instead of taking environmental assessment methods (EAMs) as evidence of 'green building', the study distinguishes between the effect of BREEAM and the environmental quality of the buildings with which it is associated. Both are important questions; but they are not the same. This paper focuses on the former. The research asks: 'What effect does BREEAM have on design decisions?' and 'Do the above-mentioned elements help to account for variations in the effect of BREEAM on design and procurement decisions?'.

The paper begins with a brief review of two related literatures: a somewhat diffuse literature on sustainable construction and a second literature on building assessment methods. The literature on sustainable construction is used to identify project-level elements seen to influence the environmental quality of buildings and their building assessment scores. Whereas the literature on sustainable construction examines the effect of assessment methods on the built environment, research into assessment methods at the project level highlights the effect of the method on project team dynamics. Elements from both literatures provide an initial framework for the data analysis that follows.

Literature review

Sustainable construction

Research on sustainable construction can be divided into: (1) general goals and approaches, (2) technical problems and solutions, and (3) challenges that construction professionals face in meeting these goals and implementing these solutions. The discussion that follows draws on the first and third of these themes, as they relate to the use of EAMs.

One of the catchwords in the literature on general approaches to sustainable construction is 'integration'. The term is both useful and distracting. It is useful in that it points to a relatively well-established consensus regarding the challenge and conditions for sustainable construction. It also serves to link discussions of sustainable construction with more established concerns for 'improvement', which also posit 'integration' as a magic bullet, with the promise to solve all the sector's problems.[1] It is distracting because it subsumes

within it a wide variety of different organizational and project-level characteristics and types of processes. In an attempt to synthesize and operationalize the literature on integration, Ibrahim, Costello, & Wilkinson (2013) identified 15 different key practice team indicators, each corresponding to a different concept or aspect of the term. By grouping them together under one heading, many scholars fail to examine the relations between them.

When it comes to building assessment methods, this theme has led to a variety of studies on the relation between project team integration (in the broadest sense) and sustainable construction. In a comparison of dominant construction practices with sustainable construction, Lützkendorf & Lorenz (2011) argue that sustainable construction requires greater disciplinary specialization and greater functional dependence between components than traditional construction, which in turn depends on greater integration between project team members (see also Robichaud & Anantatmula, 2011; Rohracher, 2001). Moving on to more empirically based research, a number of scholars have tried to test such claims by developing quantitative indices for different dimensions of project team integration and sustainable construction and by testing the statistical relation between them.

The relevance of these studies for this paper lies in their use of building-level environmental assessment certifications as proxies for high-performance sustainable construction. For example, Mollaoglu-Korkmaz, Swarup, & Riley (2013b) examined the relation between project delivery methods, project team integration and LEED building scores in 12 case studies in the United States. They operationalized 'integration' by the 'early collaboration of the project's participants, method and timing of communication and the chemistry among participants' (Mollaoglu-Korkmaz, Swarup, & Riley, 2013a, p. 72). The research found the expected relation between project team integration and procurement method (with American Construction Management at Risk and Design–Build contracts providing higher levels of team integration than traditional Design–Bid–Build). It also found that in those cases where these conditions were not present, early contractor involvement proved critical for LEED scores.

Another contribution of statistical studies on the relation between project team integration and BREEAM scores involves the synthesis of a much broader literature on project team dynamics. Factors deemed to be particularly important for sustainable construction include collaborative working among team members and strong commitment (Ozorhorn, 2013), owners' commitment to green building (Beheiry, Chong, & Haas, 2006), early involvement of cross-disciplinary teams (Robichaud & Anantatmula, 2011), early involvement of specialist engineers (SEA, 2009), project teams' experience with prior experience in sustainable construction (Horman *et al.*, 2006; Robichaud & Anantatmula, 2011), and project team experience with EAMs.

From the perspective of this paper, one of the difficulties with these studies lies in their assumption of independence between factors and in their concern to identify general or universal laws governing the relative importance of discrete factors for the observed outcome. In contrast, this study begins from the premise that the effect of these factors varies not only with their value (high or low, present or absent), but also with the dynamic relation between them. The aim of the research is to identify clusters of elements that come together in particular local contexts to produce observed effects.

A second limitation lies in the conflation of BREEAM or LEED scores with sustainable construction. By adopting BREEAM or LEED scores as proxies for high-performance sustainable construction, these studies obscure the processes by which assessment methods come to influence building designs. This paper avoids that problem by adopting a narrower, yet hopefully less problematic, research problem. As indicated above, the paper focuses on the relation between project-level elements and the effect of BREEAM on design decision, thereby suspending claims regarding the environmental quality or 'sustainability' of highly rated buildings. While not the intention, this decision also removes the confusion that stems from the attempt to compare scores across multiple versions of BREEAM by building type and year.

From the literature on project team integration and sustainable construction, this paper takes the suggestion that the design effect of building assessment methods varies with a number of project-related elements or dimensions. In particular, these include: prior experience of working together; better project team collaboration; greater communication and coordination; higher levels of commitment and engagement; the early involvement of key actors; prior experience in sustainable construction; and prior experience with BREEAM. All these factors are deemed by some authors to enhance the design effect of EAMs. In addition, studies on contract type suggest that certain methods of procurement will support 'integration' and thereby the design effect of BREEAM.

Environmental assessment methods (EAMs)

A second relevant literature is the growing body of research on building-level assessment methods. Cole (2005) described this literature as focusing on either the refinement of existing methods or a comparison between them. In both cases, he argued, authors tend

to focus on the technical content with 'little or no reference to the organizational or market context within which the methods operate' (p. 458). While the uptake of tools has increased dramatically since then and research has proliferated, Cole's characterization of this body of work remains largely accurate. This paper attempts to begin to address that gap by focusing on the project-level context and its impact on the way in which BREEAM is used.

The UK version of BREEAM comes in a number of categories for different types of new commercial buildings. Each category specifies credits for a wide variety of items and organizes them into nine weighted categories, including: Management, Energy, Transport, Water, Materials, Waste, Land Use and Ecology, Pollution, and Health and Well Being. To obtain BREEAM certification, an external BREEAM assessor prepares a formal submission and submits it to the BRE. The BRE then evaluates the file and certifies the building with a rank ranging from Poor to Excellent. In 2008, the BRE added a fifth category of Outstanding.

Descriptions of building assessment methods in general and BREEAM in particular have been presented elsewhere (Cole, 1998; Cooper, 1999; Crawley & Aho, 1999; Kajikawa, Inoue, & Goh, 2011; Schweber, 2013) as have comparisons between tools (Forsberg & Von Malmborg, 2004; Haapio & Viitaniemi, 2008; Reed, Wilkinson, Bilos, & Schulte, 2011; Todd, Crawley, Geissler, & Lindsey, 2001; Ürge-Vorsatz, Koeppel, & Mirasgedis, 2007) and will not be repeated here. Instead, the discussion focuses explicitly on the relatively small number of studies that examine the project-level implementation of EAMs. Whereas the literature on sustainable construction focuses on the effect of project-level factors on green building, the small but growing literature on BREEAM in practice focuses on the effect of BREEAM on project teams and the building process.

A number of authors signal the potential use of BREEAM as a design tool, although few actually study it. Writing in 1998, before clients had begun to ask for BREEAM in significant numbers, Cole (1998) noted that 'existing assessment methods are used as design tools, even though they were not specifically designed to do so' (see also Crawley & Aho, 1999; Kajikawa *et al.*, 2011). Similarly, the BRE website openly refers to BREEAM as 'The world's leading design and assessment method for sustainable buildings' (BRE, n.d.). Writing a number of years later, Cole cautioned against the potential limits which the use of EAMs as design tools pose for innovation:

> Many existing assessment methods are used as design tools, even though they were not specifically designed to do so. [This, in combination with the fact that most assessment methods are voluntary is deeply problematic in that they may] potentially institutionalize a limited definition of environmentally responsible building practices at a time when exploration and innovation must be encouraged … Building owners may commit their designers to achieving a high performance score on a specific assessment method.
>
> (Cole, 2005, p. 463)

Curiously, very little research has been done on the actual effect of BREEAM on design decisions (see below).

Research that considers the effect of BREEAM on project teams highlights its (potential) impact on communication and project team integration. A number of authors claim that BREEAM enhances communication amongst project team members and between project team members and stakeholders:

> An important indirect benefit is that the broad range of issues incorporated in environmental assessments require greater communication and interaction between members of the design team and various sectors within the building industry, i.e. environmental assessment methods encourage dialogue and teamwork.
>
> (Cole, 1998, p. 14)

Cole's point about the potential of BREEAM to support project team communication has recently been picked up by Kajikawa, Inoue, and Goh (2011) in a review of the EAM literature where communication and knowledge transfer are identified as key themes for future development of the method (other themes include comprehensiveness, design guideline and signalling). In a complementary discussion, Lorenz, Trusk, & Lützkendorf (2007) argue for greater integration of assessment methods across the different phases of a construction project. While this literature creates a space for enquiry into the effect of EAMs on project team dynamics, it tends to work with a quite generic, stylized model of both BREEAM and the building process.

In the past decade the shift in focus from 'green building' to sustainable development has introduced new themes into the analysis of EAMs. These new functions reflect the value that the concept of 'sustainable development' places on governance processes both as ends in and of themselves and as vehicles for the specification of values and goals. When it comes to the EAM literature, a number of authors point to the potential role of EAMs as dialogic tools to support stakeholder engagement (Conte & Monno, 2012; Kaatz, Root, & Bowen, 2005). At the moment most of this literature is prescriptive, with little evidence of current methods actually contributing to this aim. Moreover, a growing number of authors challenge the adequacy of EAMs – with

their primarily technical focus and reliance on generic frameworks – to contribute to the governance aims of sustainable development (and thereby to genuinely sustainable construction) (du Plessis & Cole, 2011; Kaatz, Root, Bowen, & Hill, 2006).

Two striking features of the literature on assessment methods are its focus on the formal features of the method and the movement between description and prescription, such that it is never clear whether these effects are actual or potential. This slippage can partly be ascribed to a lack of empirical research into the impact of BREEAM at the project level. A notable exception can be found in Holmes & Hudson's (2002) study of a commercial office building. An important finding concerned the way in which project team members used BREEAM to further their own professional interests (Holmes & Hudson, 2002; Schweber, 2013). A second study by Thomson, El-Haram, & Emmanuel (2010) documented the deployment of BREEAM on a single project from the perspective of knowledge transfer. This study, like the work on communication mentioned above, treats BREEAM as a self-contained process that develops independent of the broader project team dynamics. As such it ignores the dynamic interaction between the assessment process and the design/construction process.

As this brief discussion indicates, the literature on EAMs reverses the (possible) direction of influence between project team dynamics and EAM scores. Thus, whereas the literature on sustainable construction focuses on the effect of project team characteristics on the environmental quality of the building (and by extension EAM scores), research on EAMs focuses on the potential impact of the method on project teams. Promises include enhanced communication, coordination and 'integration' variously defined. A number of authors develop these general claims by focusing on particular aspects. More specifically they underline the (potential) effect of EAMs on the specification and coordination of roles and tasks across a building project and collaboration amongst project team members. Finally, research at the BRE has found that experience with prior assessments is one of, if not the only, primary determinant of a successful assessment project (personal communication). Whereas in statistical research the direction of influence is critical, the comparative case method allows for a simultaneous enquiry into the effect of project team characteristics on BREEAM scores and the effect of the BREEAM process on project team dynamics.

Methods

Research design

A comparative case study research design was selected in order to explore the mapping of BREEAM onto design and construction processes. The comparative case study method is relatively common in sociology, but less usual in construction research. Comparative case study research calls for an analysis of each case as a whole, comparing processes and understandings across cases, rather than individual actors or elements (Ragin, 1989). Whereas most research on organizations tends to make claims either about universal relations or unique cases (McKelvey & Aldrich, 1983), comparative organizational research makes claims about differences. Similarly, whereas much organizational research is either deductive or inductive, comparative research is situated between the two (Haverman, 2009; King, Felin, & Whetten, 2009). As Whetten (2009) notes, comparative research is a method not a theory; as such it must always be used in conjunction with a particular theoretical frame. In the case of this paper, the theory is taken from literatures on sustainable construction and building-level EAMs.

A number of features of this approach recommend it for the research questions posed herein. First, the case study method allows for an enquiry into the way in which clusters of elements (such as good project team communication and early client involvement) support a particular outcome. Secondly, the method focuses attention on processes and understandings. When it comes to the study of BREEAM, this approach shifts the focus from formal features to the assessment method as a process. This move, in turn, supports enquiry into the mapping of the assessment process onto core building processes. Finally, by comparing cases, the method supports the search for variations or differences in 'fit' across cases and for configurations of elements which support them.

Case studies

The research for this study relies on eight case studies. Each case corresponds to a different BREEAM assessment. Six of the case studies were obtained from three BREEAM assessor firms, each of which provided two cases. In discussing the choice of cases, assessor firms were asked for one exemplary case and one case where they felt they had lessons to learn. In addition, a large engineering consultancy and construction firm offered two examples of what they referred to as 'routine' assessments in their capacity as project managers (PMs). As this suggests, cases were selected on the basis of the contact person's perception of the assessment experience, not the 'fit' between the assessment experience and the design and construction experience. Once the projects were selected, the authors sought permission from all the other key players in the project. In three cases this was not provided and alternate projects had to be selected.

Not surprisingly this process favoured relatively more successful projects and BREEAM assessments.

Having said that, the projects were not all flagship or exemplary projects. Five of the eight obtained scores of 'Very Good', while three achieved Excellent or Outstanding. All the project teams reported good project team communication and coordination (although not excellent BREEAM assessment processes). While the bias to better coordinated projects was not a serious problem given the interpretivist character of the research design and consequent absence of any claims to representativity, it does limit the conclusions. Findings concern the relation between the BREEAM process and projects in which there was an initial client commitment to green building (accounting for the BREEAM requirement) and a very competent, professional project team.

All the projects were of medium size; their construction costs ranged between £3.5 million and £11 million and all involved commercial buildings (a condition for a BREEAM assessment). These features are summarized in Tables 1, 3 and 5. In considering the findings, it is important to keep in mind that the cases were at different stages of the assessment process at the time of data collection. Three of the buildings had been completed at the time of the study; two had obtained their BREEAM design based certification but were not fully completed; two had submitted their initial file to the BRE but were awaiting a response; and one was preparing to submit its initial file. By the time of writing all the projects had been completed, such that the reported certification levels are current. For those projects that were not yet completed when the initial data were collected, a follow-up interview was conducted. Whereas in a study of one or two in-depth cases this difference in timing might prove significant, in a study of eight cases where the level of rich description and detail is necessarily less and the focus is on types of fit (across two to three cases) then it is less serious.

Data collection and analysis

Data collection combined semi-structured interviews with documentary evidence produced by the assessment process. Interview schedules were developed based on the literature discussed above. For each case, 1–2-h interviews were conducted with the main actors directly involved in the assessment process. In terms of formal roles this included some combination of the BREEAM assessor, client, architect, PM, design manager and specialist engineers (usually the mechanical and electrical (M&E) engineer and the structural engineer). In total 49 interviews were conducted. In three cases, key members of the team had left and could not be reached. In one case, this involved the client, in another, the BREEAM assessor, and in a third, the M&E engineer. While unfortunate, this gap does not significantly compromise the findings, given the focus on types of processes and effects and the comparison across types of cases rather than single cases.

When it comes to data analysis, comparative case study analysis differs from both positivist research[2] and case study analysis. In contrast with many positivist research designs, it does not seek to identify which discrete factor mattered most for a particular outcome. In contrast with case study analysis, it does not set out to provide rich, highly contextualized accounts of individual cases. Instead the method seeks to identify clusters of elements or configurations that support particular outcomes. More specifically, the method focuses on sources of difference (Bryman & Bell, 2003). In keeping with this general purpose, the aim of the data analysis was to identify clusters of elements which accounted for differences in three types of 'fit'.

In applying the comparative case study method, data analysis was divided into three stages. In the first stage, interviews were coded for categories derived from the literature and for new elements that potentially influenced variations in the effect of BREEAM on design decisions. At this stage, coding focused on discrete elements. Key categories included:

- firm-level characteristics including reported commitments to sustainable construction and histories of inter-firm relations
- project-level characteristics, including: type of contract, the selection of project partners, experience working together, individual project team aspirations for the building, perceived quality of communication and coordination, and the history of the project
- the BREEAM assessment process including: the main driver for the assessment, assessor involvement, past experience with BREEAM and the history of the assessment (as told by different interviewees and documented in reports and tracker sheets)

In a second stage these data were analysed for differences in types of 'fit'. Three types were identified: tight-fit, punctual-fit and bolt-on-fit (the labels changed in the course of the analysis, but the core characteristics of each type remained constant).

In a final third stage the other researcher recoded all the data. The aim of this second round of coding was to identify clusters of elements within each case and across cases that accounted for differences in the type of 'fit'. In considering the findings, it is important to keep in mind that the analysis relies almost wholly on interviews and formal documents. As such, it reflects individuals' perceptions of what happened and what mattered. While the account is more robust than if only one person had been interviewed,

it remains an amalgam of different perspectives, offered at a single point in time.

Ethics procedures were followed in conformity with University of Reading requirements. Information and consent forms were distributed prior to each interview, data were anonymized immediately after transcription and copies of the transcripts were sent to each interviewee for review and final approval. Case study names were changed to hide individual and firm identities. Direct quotes will be referenced by formal roles and project pseudonyms to protect confidentiality; they should not be taken as claims regarding professional roles.

Findings

An initial analysis of the data led to a classification of the eight building projects into three categories corresponding to the type of 'fit' between the assessment process and design and construction processes. These included:

- tight-fit, where BREEAM was present throughout the design and building process
- punctual-fit, where BREEAM figured at key moments but was not continuously on the agenda
- bolt-on-fit, where the assessment process had little effect on everyday design and construction decisions

One case, Bailey Primary School, proved difficult to classify. It was eventually placed in the bolt-on-fit category on the grounds that BREEAM only entered into design and construction processes in the very beginning and at the very end of the project, making it more similar to the other bolt-on-fit cases than the punctual-fit cases.

In analysing the data, a number of elements proved to be roughly similar across all cases. These included the level of communication and coordination, which all interviewees on all projects reported to be good. While there were undoubtedly variations across the projects, none seemed significant enough to account for differences in type of fit. Similarly, while the type of formal contract varied across projects, these differences were not found to have a systematic effect and thus will not be discussed.

Enquiry into the effect of BREEAM on project team dynamics proved inconclusive. When asked explicitly about the effect of BREEAM on project team integration, interviewees conceded that BREEAM might have had some effect, but did not see it as significant. As one interviewee explained:

> I think that's probably ... a bit of a stretch, but it's not entirely wrong. I think ... it widens the design meeting ... and involves everybody else ... It's maybe not the biggest thing in the world, but it's certainly adding some value.
>
> (Client/developer, The Barnes Academy)

Similarly, one M&E engineer with BREEAM training noted:

> I mean, who knows how ... I think it was a very integrated and cooperative design team. I think it went very well. But who knows how much that was down to BREEAM or just the design team happened to get on well.
>
> (M&E engineer, Barford Court)

As with the effect of contracts and communication, this lack of clear effect may be partly due to the fact that all eight projects were deemed to have relatively good communication and coordination, such that the effect of BREEAM was negligible. Had the study included projects with serious breakdowns in communication, the findings might have been different.

Comparative analysis of the documentary and interview data suggested the relevance of five project-level characteristics and three assessment-specific characteristics. The five project-level characteristics included: prior experience working together, personal commitment (and consequent level of engagement with the project), timing of the involvement of specialists, personal commitment to sustainable construction and continuity of project. The three assessment-level characteristics included: the level of assessor involvement, continuity of assessor involvement and the project team's prior experience with BREEAM. In addition, individual firms' experience of working together (in contrast to personal experience) and the relative importance of sustainability in individual firms' image and practice seemed relevant. However, given their overlap with project-level elements, they were not privileged in the analysis.

Tight-fit assessments

Three cases in the sample were classified as tight-fit: Barnes Academy, Readett Community Centre and Barford Court (Table 1).

Barnes Academy

Barnes Academy offers a case in which all the elements deemed essential for sustainable construction came together. The project was characterized by a high level of commitment to the project, a high level of

Table 1 Tight-fit assessments cases

Case study	Readett Community Centre	Barford Court	Barnes Academy
Type	Community centre	Office	School
Cost (£, millions)	3.7	8.0	6.9
BREEAM scheme	2008 Bespoke	2006 Office	2008 Education
Initial target	Excellent	Very Good	Outstanding
Final Certification	Outstanding	Excellent	Outstanding
Time of study	On-site	On-site	On-site[a]

Notes: [a]Waiting on design stage certification.

commitment to sustainable construction, extensive prior experience working as a team and extensive prior high-target BREEAM experience.

The clients included a representative from the local council and a client/developer, both of whom were committed to sustainable construction. Both clients saw BREEAM as a way to realize their goals for the project. The council representative saw it as a way to ensure that the building was genuinely 'green' (despite his own lack of technical knowledge). The client/developer had her own three-pronged strategy for sustainable construction. These included: (1) a commitment to carbon-neutral buildings, (2) a fabric-first approach and (3) the highest BREEAM target possible.

Turning to the BREEAM target, the council representative initially set the target at Very Good, but was persuaded by the client/developer to raise it to Excellent. The target was raised a second time to Outstanding when that option became available in 2008. To meet this ambitious target, the client/developer not only studied the BREEAM manual, but also brought it to every meeting and consulted it regularly. Both clients viewed the project as a flagship project.

Client commitment to sustainable construction and to the project more generally was matched by the enthusiasm of the project team as a whole. The BREEAM target provided an important focus for that energy. As the design manager explained:

> everyone wants it, so it makes it a lot easier in some respects. Obviously, it's hard work, there's a lot of time, a lot more of my time involved in getting an Outstanding from an Excellent, but at the same time it's motivating, isn't it?
>
> (Design Manager, Barnes Academy)

The team's ability to deliver this ambitious goal was helped by their prior experience as a team and with BREEAM. As the client/developer explained:

> Well, the contractors that we work with, we've spent a lot of time ... educating them ... into how the whole process works. So, RS have done seven or eight of these things now. They have a design manager (who) takes responsibility for it and drives it through.
>
> (Client/developer, Barnes Academy)

In addition, all the key project team members, with the exception of the architect and the school client, had extensive experience working with BREEAM. While the architect did not have BREEAM experience, he worked in a firm that had a BREEAM assessor on hand for consultation.

A striking feature of most of the interviews for this case was the project team's focus on sustainable building, rather than on BREEAM. While BREEAM was present in every decision the team made, it was never treated as an end in itself, but rather as a means to achieve their goal of an environmentally sound building.

Readett Community Centre

Readett Community Centre offers a slightly different scenario, but one which also delivered BREEAM Outstanding. In this case everyone except for the client, the flood-risk surveyor and the ecologist were from the same multidivisional, multinational firm. What they lacked in experience with sustainable construction they made up for in motivation, long-term working relations and proximity. The team's motivation rested on two factors. First, this project was the first they had delivered for the local council in a new framework arrangement. Success would bring them a future stream of work; failure could damage their chances on the next project. Secondly, while the firm itself was not a niche sustainability firm, it had a small ambitious Sustainability Unit. Like Barnes Academy this was a flagship project with strong client motivation and engagement.

At some point in the process both the Sustainability Unit and the client's aspirations converged around a commitment to zero carbon. For the client, zero carbon was seen as a way of bringing pride to a relatively deprived community. For the Sustainability Unit, it opened the door to a BREEAM Outstanding score and contributed to their efforts to persuade senior management to invest in their unit.

The Readett Community Centre team differed from the Barnes Academy team in their relative lack of BREEAM experience. Neither the architect nor the PM had extensive BREEAM experience. While the specialist engineers did, none of them had any sense of ownership *vis-à-vis* the BREEAM process. Physically, they were located in a different regional office, which limited their day-to-day involvement with the PM and architect. This, however, was balanced by a very proactive BREEAM assessor who was brought onto the project at the initial concept stage and attended design meetings regularly. Thus, although the assessor needed to chase both the architect and the specialist engineers for evidence, the assessor's personal commitment to the task (fuelled by her commitment to the Sustainability Unit and its future within the firm) meant that everything was provided in the end. The point here is not that some project team members failed to engage as fully as they might, but rather that the assessor assumed ownership of the process. As the cases below suggest, this is not standard practice.

Barford Court

Finally, Barford Court offers an example of how a team of high-end, sustainability minded individuals, from different firms, without extensive experience of working together, can nevertheless engage with BREEAM in a continuous manner. In this case, a relatively inexperienced client selected a PM who in turn selected an architect, with expertise in sustainable design. Once appointed, the architect effectively served as the client representative on the project. While the client did not begin with any particular vision for the building, the architect brought to the project a distinctive approach to sustainable construction, informed by 'The Natural Step'.[3] The architect also selected specialist engineers and a BREEAM assessor from his preferred M&E firm. As in the Barnes Academy project, the Barford Court project benefited from the team's prior experience of working together on sustainable building projects. In contrast to the Barford Court and Readett Community Centre projects where the clients were very hands on, the Barford Court client trusted the PM and architect and largely deferred to their decisions.

When it comes to BREEAM, Barford Court exemplifies the combined effect of ownership, prior BREEAM experience and shared commitment. The architect and M&E team had considerable BREEAM experience and a strong commitment to do something special and sustainable. The M&E engineer had been trained as a BREEAM assessor and acted as the assessor's representative at team meetings, drawing attention to the BREEAM implications of specific decisions as they were discussed. This cooperation was undoubtedly enhanced by the fact that they both come from the same firm. The PM had less experience with BREEAM, but worked for a firm with in-house experience. Finally, the local contractors were new to the BREEAM game.

In this case, the architect and assessor assumed ownership of the BREEAM process, overseeing its implementation and making sure that documentation was delivered to specification and on time. This was helped by the fact that every credit of the BREEAM pre-assessment was costed up-front and included in the specifications for the contractor.

Preliminary discussion: tight-fit assessments

The three cases outlined in this section document three distinct BREEAM–project team configurations, each of which allowed for a maximum input of BREEAM into the building design and each of which was partly motivated by the clients' association of a high BREEAM score with both quality and reputational value. In terms of the effect of BREEAM on design and construction processes, the cases discussed above suggest two general points. The first concerns the importance, not of BREEAM experience on its own, but of the combination of BREEAM experience and a strong project-level sense of ownership of the BREEAM process. In Barnes Academy, the client developer embodied this combination and was supported by a proactive assessor and a team with a shared history of high BREEAM assessments. In Barford Court, the architect oversaw the BREEAM process, with the support of a proactive assessor. The Readett Community Centre offers an example where this 'marriage' was absent, thus drawing attention to its importance. In this latter case, while the specialist engineers had a great deal of BREEAM experience, their physical distance from the rest of the team and the specialist engineers' sense that BREEAM was the Sustainability Unit's responsibility meant that their expertise did not feed into daily design decisions. This was compensated for by an exceptionally proactive assessor.

A second suggestion concerns the role of BREEAM in supporting an already existing commitment to sustainable construction. In all three cases, BREEAM was treated as a tool to keep sustainability on the agenda and deliver it, rather than an end in itself. In two of the three cases, an important element in the incorporation of BREEAM into design and construction decisions would seem to have been the project teams' prior experience of working together to deliver specifically

Table 2 Project and BREEAM elements in tight-fit assessment cases

Case study	Readett Community Centre	Barford Court	Barnes Academy
Project characteristics and process			
Prior experience working together	High	High	High
Commitment and engagement	High	High	High
Early involvement of specialist	High	High	High
Commitment to sustainable construction	High	High, but new	High
Continuity of project	High	High	High
BREEAM characteristics and process			
Level of assessor involvement	High	High	Medium
Continuity of assessor involvement	High	High	High
Prior experience with BREEAM	High	Medium	High

sustainable buildings. This observation points to a more general phenomenon, namely the existence of sustainability project teams who are brought together by the PM, architect or contractor because they are known to share his/her approach and can be trusted to deliver.

As this discussion suggests, while BREEAM does not ensure either a sustainable design or an 'integrated' project team, the combination of high team engagement, a clear commitment to sustainable construction (independent of BREEAM), BREEAM experience and active ownership of the assessment process give it an important role in sustainable design and construction.

Table 2 summarizes the main elements identified as relevant for distinguishing the three tight-fit cases discussed above from the other cases.

Punctual-fit assessments

The two cases of punctual-fit assessments involved more standard projects, with less widely distributed sustainability and BREEAM expertise. Both punctual-fit assessments involved school projects (Table 3).

Table 3 Punctual-fit assessment cases

Case study	Heather Woods Secondary School	Ramley College
Type	Residential school	School
Cost (£, millions)	5.4	5.0
BREEAM scheme	2008 Bespoke	2008 Education
Initial target	Very Good	Very Good
Final Certification	Very Good	Very Good
Time of study	On-site[a]	Completed

Notes: [a]Waiting on design stage certification.

Ramley College

Ramley College was the initiative of a very proactive headmistress who had transformed a failing secondary school into a 'high performing school' (in terms of academic achievement) and now wanted to build a sixth form college on the premises. While she was very committed, she was also very busy and did not know much about construction. When it came to sustainability, her focus was primarily on social sustainability. However, she used BREEAM as a framework to monitor the quality of the building and the project team.

The PM chose the rest of the team; while she had worked with the design-phase M&E and assessor, she had not worked with other members of the team. Moreover, project team members were located in different parts of the country and much of the communication was done by e-mail. As the contractor explained:

> I think communication has been very good. … Everybody's been copied into information. People are very keen. Obviously, the odd e-mails have come into their own a little bit, and they, sort of, fly around, but everybody's been using it in a responsible manner. We insist on having regular design meetings and workshops to make sure that any information that is, sort of, bandied about across the consultancies is tied together at regular meetings.
>
> (Contractor, Ramley College)

When asked to describe the building, most members of the project team described it as a 'standard, straight forward job', although one or two pointed to the natural ventilation and atrium as distinctive features.

The most experienced member of the team in terms of sustainability and BREEAM was the contractor who came from a high-end firm with a reputation for sustainable construction. The firm has its own commitment to achieve high BREEAM scores on all projects, independent of client requirements, however the contractor was brought in relatively late in the process (despite being a Design–Build contract). To the disappointment of the PM, the contractor did not engage with specific design decisions; to the delight of the assessor all site-specific BREEAM requirements were delivered beyond expectations and with precisely the right kind of documentation. Other project team members came from firms with good general reputations, but without distinctive sustainability profiles.

Turning to the BREEAM process, everyone on the team had some prior experience working with BREEAM. As noted above, the contractor (and their appointed service engineers) had extensive experience delivering BREEAM Excellent buildings. The architect had participated in one previous project in which BREEAM credits were lost unnecessarily, and he was determined not to repeat the experience. The PM had also been involved in a previous assessment, but this was the first time they were project managing a BREEAM assessment. In this case, the architect and PM's lack of experience driving an assessment was balanced by their strong sense of ownership. While the client initially targeted Excellent, this was changed to Very Good relatively early on, on cost grounds.

In many ways Ramley College offers an example of a textbook assessment process. Everything went smoothly. The architect included detailed BREEAM credit specifications in the tender and the contractor's extensive experience with BREEAM Excellent buildings meant that it was already standard practice. As the contractor noted: 'it kind of rumbled along in the background'. The assessor was excellent, having been involved in one of the BREEAM Outstanding projects described above; however, in this project their involvement was limited to the six meetings for which they were paid. The only delays in delivering evidence that were reported concerned some of the specialist engineers who had been subcontracted by the contractor, leaving the assessor without direct access to them.

Heather Woods Secondary School

The second project in this category was a major refurbishment project, designed to transform an army base camp into a residential school. Like the Readett Community Centre (in the tight-fit category), all the project team members were from the same firm and all were located in the same office, with the exception of the assessor and engineer designer. There was an internal information and communication technology (ICT) cross-referencing system which the team used to communicate and update changes. As in the Readett Community Centre, sustainability features were driven by the firm's Sustainability Unit in the person of the assessor.

The BREEAM target of Very Good was both a planning requirement and a Department for Education and Schools (DfES) requirement. The project team itself had less direct BREEAM experience than the team responsible for Ramley College. The PM and design engineer had no BREEAM experience. The mechanical and structural engineers had done BREEAM buildings before, but the electrical engineer had not.

This relative lack of BREEAM experience amongst key project team members was balanced by a proactive assessor who worked side by side with the PM throughout the project. In addition, the feasibility study included monies for a deputy PM with the sole responsibility of delivering BREEAM. As one project team member reported, BREEAM was on the agenda at every design team meeting and the deputy manager and assessor touched base at least once a week to discuss the assessment and its progress.

As in Ramley College, the assessment process in Heather Woods Secondary School was relatively straightforward, although the process did suffer a bit when the deputy PM was withdrawn to reduce costs. When asked how he would rate the assessment process overall, the assessor responded:

> It was okay. It was one of the better ones. I mean, there were moments. I do feel like I had to spoon feed the M&E. . . . I mean [laughs], bearing in mind, RC who did the electrical spec . . . he literally sits as far away as you are now from me and JH sits in the next pod behind.
> (BREEAM assessor, Heather Woods Secondary School)

In part because of their proximity in the same office, whatever evidence issues arose were caught in time and at the time of the interviews, the project was on track to deliver its target of BREEAM Very Good.

Preliminary discussion: punctual-fit assessments

The two cases described above offer examples of 'standard' projects. In both Ramley College and Heather Woods Secondary School, BREEAM had a punctual effect on key design decisions. This effect is clearly

Table 4 Project and BREEAM elements in punctual-fit assessment cases

Case study	Ramley College	Heather Woods Secondary School
Project characteristics and process		
Prior experience working together	Medium–low	High
Commitment and engagement	Medium	Medium–low
Early involvement of specialist	Medium	High
Commitment to sustainable construction	Low	Medium–low
Continuity of project	High	High
BREEAM characteristics and process		
Level of assessor involvement	Medium	High
Continuity of assessor involvement	High	High
Prior experience with BREEAM	Medium	Low

evident in the case of Heather Woods Secondary School where the decision to replace the boiler was explicitly framed in terms of BREEAM credits. If BREEAM functioned as an orienting framework in the tight-fit cases, its job in the punctual-fit cases was to weigh in on discrete decisions; although, as the reference to a 'domino' effect below suggests, these often had spillover effects.

Turning to project-level characteristics, the two punctual-fit cases involved 'standard projects', which did not pose any exceptional challenges but which also did not generate the kind of intense commitment or motivation seen in the tight-fit cases. If one compares the cases, each offers an example of how the absence of certain project-level conditions can be balanced by the presence of others. In the Ramley College project, geographic dispersal and a lack of prior experience working together was balanced by the distribution of BREEAM experience across the team and a strong sense of ownership (of the BREEAM process), such that the architect and PM and contractor all took responsibility to keep it on the agenda. In contrast, Heather Woods Secondary School presents a case where the relative lack of direct BREEAM experience was balanced by a particularly well-integrated project team with extensive informal communication. In both cases, the continuous involvement of a high-end assessor also proved essential for the relatively trouble-free achievement of BREEAM targets.

Table 4 summarizes the project and assessment level characteristics of each of these two punctual-fit cases. The mixed profiles underline the importance of clusters of elements rather than single factors. In each of these two cases low values for certain key elements were compensated for by high values for others.

Bolt-on-fit assessments

Turning to the three bolt-on-fit assessments, the first thing to emphasize is that these cases were not poor projects. On the contrary, all the clients interviewed reported high levels of satisfaction. One of the three won a number of awards. However, a good building does not (necessarily) a good environmental assessment make. The three cases reported below (and in Table 5) provide an opportunity to consider how and why this is so.

Bailey Primary School

The first example of a bolt-on-fit project is borderline between a punctual-fit assessment and a bolt-on-fit assessment. Bailey Primary School involved the addition of a new building onto an existing school site. In this case, the acting client had left the council and could not be located, so their perspective is missing from the data. From what other team members said, the client was relatively hands-off during the process. The project was a traditional contract, led by an architect from a very good, but not particularly sustainability minded, firm and there was no PM. The architect and the M&E firms had worked together a number of times, but there were no other long-term relations between the team members. The M&E and the assessor were from the same firm and together they drove the sustainability features in the building. When asked about communication and coordination, the project team was not particularly forthcoming; most interviewees indicated that it was fine.

As in Heather Woods Secondary School, the BREEAM target was a condition for funding. Within the team, the architect had no prior BREEAM experience; nor did he have any sense of ownership over the BREEAM process. When, after some initial probing,

Table 5 Bolt-on-fit assessment cases

Case study	Bailey Primary School	Turney Rehabilitation Centre	Dunning Halls
Type	School	Residential health	Residential school
Cost (£, millions)	7.0	11.5	n.a.[a]
BREEAM scheme	2005 Schools	2008 Healthcare	2006 Multi-residential
Initial target	Very Good	Excellent	Excellent
Final Certification	Very Good	Very Good	Very Good
Time of study	Completed	On-site[b]	Completed

Notes: [a]The scale of the project was significantly curtailed midway through the design phase. Final figures for the section subject to the relevant BREEAM assessment were not provided.
[b]Preparing to submit design stage certification at time of the study.

he was asked if he was responsible for overseeing the assessment, he quickly replied 'no'. When asked who was responsible, he replied:

> Okay, at the point of a breakdown it would be our – the Architects' – responsibility as the Design Team Leader. So if someone wasn't delivering the information we would have to call them and say, you know, 'Chivvy up, we need to, kind of, get this information out.'
>
> (Architect, Bailey Primary School)

Two factors would seem to have contributed to the architect's lack of ownership, despite being the client representative and despite the absence of a separate project or design manager. First, the initial BREEAM pre-assessment predicted a high Very Good, suggesting that the team had significant room for manoeuvre. Secondly, and perhaps most importantly, the architect was not familiar with BREEAM and assumed that evidence could be collected and credits documented at the end of the project. While the contractor and specialist engineers had experience and knowledge of BREEAM, they did not go out of their way to keep it on the agenda. The result was that no one within the team owned the assessment process. In addition, once the pre-assessment phase had been completed, the BREEAM assessor took a back seat. As he explained, at least eight or nine months went by without any contact. While this might seem as a neglect of his responsibilities, it was well within the workload covered by the assessor fee.

The result was that BREEAM fell off the agenda. When the assessor did re-engage, he found that a number of credits had been lost. These included relatively 'easy wins' such as the user guide and 'ease of maintenance' credits as well as more expensive features, such as the quality of the glazing. In addition, a number of credits were lost for lack of correct documentation. In the end, the assessor did a great deal of last-minute chasing and the project scraped through with a low Very Good.

Turney Rehabilitation Centre

Turney Rehabilitation Centre was commissioned by a National Health Service (NHS) Trust. Within the NHS there is a general requirement of BREEAM Excellent for all new builds. The project team included an architect and specialist engineers from different medium-sized firms and a high-end contractor with no special sustainability profile. None of the firms involved was known for sustainable construction and the project firms and project team members had not worked together before. One of the most striking characteristics of Turney Rehabilitation Centre was the discontinuity in project team members. The PM changed three times towards the beginning of the project and was finally assigned to a young graduate. Similarly the electrical engineer was replaced part way through the project, although he was later brought back into the team. The project itself was on a brownfield site and the team had to do significant (and unexpected) remedial work to make the site safe for construction. Despite these issues, the project was delivered ahead of time, on budget and to an award-winning standard. While the discontinuities may not have affected the final product, they did affect the BREEAM process.

The initial pre-assessment report predicted the required Excellent score. However, once the pre-assessment was completed, the assessor was taken off the job to save money. The plan was to re-employ her towards the end of construction process to submit the final dossier to the BRE for certification. This might have been acceptable (from a BREEAM perspective) if the architect and/or PM had been experienced in sustainable construction and BREEAM, however in this case they were not. Formally, the PM had responsibility for delivering

BREEAM; however, this was the second project he had ever managed and he had his hands full with project delivery. The electrical engineer, who had begun with the project, had done a BREEAM course and was very knowledgeable, but he was replaced by someone else with no BREEAM experience and only brought back in towards the end. As such, he was not in a position to oversee the BREEAM process.

The result was that BREEAM was largely neglected for most of the on-site phase of the project. Interviews for this research were conduced half way through on-site construction. At that time, the initial design assessment had yet to be submitted and the PM had realized that BREEAM was slipping. As a result, they moderated their target to Very Good. Both the architect and client mentioned a calculation that BREEAM Excellent would cost an additional £30 000 and seemed to think it had been paid. Moreover, the client was under the impression that the project was still on target for BREEAM Excellent, although he was aware that there were problems. Follow-up telephone interviews suggested that the BREEAM process was not recovered. The original assessor was not brought back in to complete the assessment, although the reasons are unclear. In the end the project obtained a Very Good, but BREEAM is not mentioned in the extensive publicity surrounding an otherwise very successful project.

Dunning Halls

The final bolt-on-fit assessment was with the same contractor as Turney Rehabilitation Centre. Like the Centre, Dunning Halls was a solid, well-designed, well-delivered project, with significant discontinuities that contributed to a lower than initially anticipated BREEAM score. Dunning Halls was a school residential facility. The building was initially part of a much larger multi-building scheme. The architect and specialist engineers were from the same multidisciplinary medium-sized consultancy. A decisive moment in the project came during the detailed design phase when the client decided to abandon their ambitious development plans and to restrict the project to a single residential facility. This change in scope of the overall project had a direct impact on the BREEAM target. The initial target was Excellent, however this relied on other buildings in the multi-building scheme. When the project was reduced to a single building, the possibility of Excellent was deemed to have been lost.

Within the team, the architect and specialist engineers all had some BREEAM experience, however the design manager who was charged with overseeing BREAM did not. Moreover the assessor, from a large London-based firm, was brought in on the project relatively late. In addition, the assessor tended to rely on written communication; a number of project team members reported confusion over what was required for particular credits. According to one interviewee, the BREEAM process was largely a box-ticking exercise.

Preliminary discussion: bolt-on-fit assessments

A comparison of the three bolt-on-fit assessments highlights a number of common features both in the BREEAM process and in the broader project context. When it comes to the BREEAM process, all three bolt-on-fit cases failed to achieve the initial predicted target. In Turney Rehabilitation Centre and Dunning Halls the projects targeted Excellent, but the team delivered Very Good; in Bailey Primary School they predicted a high Very Good, but came in just over the Very Good threshold. In all three cases, the BREEAM process was overseen by an architect or project or design manager with relatively little BREEAM experience and little commitment to keeping it on the agenda. In all three cases, the assessor withdrew (or in the case of Turney Rehabilitation Centre was removed) from the process following the initial pre-assessment process. In all three cases, no one within the project team felt responsible for the assessment process.

Rather than 'blaming' one person or another, these observations underline the importance of the three BREEAM process characteristics: level and continuity of assessor involvement and prior experience of BREEAM. They also point to the crucial importance of project-level ownership. In the absence of these elements, BREEAM functioned purely as an assessment exercise, with little to no impact on the building process or product.

In addition, the reduced attainment of a specified target was also due to characteristics and contingencies associated with the project as a whole. In all three cases, the project was marked by significant discontinuities in team members and/or in the scope and remit of the team. While these project teams did not have significant prior experience working together, interviewees did not feel that this posed a major obstacle. All described project team communication and coordination as good, relative to other projects on which they had worked.

The characteristics of the three bolt-on-fit assessments are summarized in Table 6.

Discussion and conclusions

Through the literature review, a list of discrete elements were identified that are deemed relevant for the achievement of a high BREEAM score. Those

Table 6 Project and BREEAM elements in bolt-on-fit assessment cases

Case study	Bailey Primary School	Turney Rehabilitation Centre	Dunning Halls
Project characteristics and process			
Prior experience working together	Medium	Medium	Medium
Commitment and engagement	Medium	Medium	Medium
Early involvement of specialist	Medium	Medium	
Commitment to sustainable construction	Low	Low	Low
Continuity of project	High	Low	Low
BREEAM characteristics and process			
Level of assessor involvement	Low	Low	Low
Continuity of assessor involvement	Low	Low	Low
Prior experience with BREEAM	Low	Low	Medium–low

suggestions were used in the current study to explore the 'fit' of the assessment process with design and construction processes. While there is clearly a connection between a tight fit and a high BREEAM score, the two outcomes are not necessarily identical. Logically one can imagine a building project with so many external constraints (relative to BREEAM credits) that it would be impossible for even the best, most experienced project team to achieve an Excellent or Outstanding. In other words, BREEAM assesses building designs and buildings, not project teams and their efforts. Having said that, it is the project team who deliver the assessment and their efforts clearly matter.

Much of the literature focuses on the effect of: (1) formal contracting methods, (2) communication and coordination or (3) prior experience with BREEAM. In analysing the eight cases included in this study, neither of the first two elements proved to be relevant. This does not mean that they do not affect either the sustainability of the building or the BREEAM process, but rather that they do not distinguish between these eight cases. In contrast, 'prior experience with BREEAM' was found to be relevant, although not on its own.

In terms of 'prior experience with BREEAM', it is found that while experience mattered, it mattered differently across the three types of fit. For the tight-fit projects, prior experience with BREEAM came as an extension of strong personal commitments to and extensive experience with sustainable construction. In each of the three tight-fit cases, key individuals brought to the project an approach and set of sustainability goals which they defined independently of BREEAM. And all used BREEAM as one of a number of different frameworks and guides to help implement that approach. If one turns to the punctual-fit cases, in these projects experience with BREEAM mattered, but only if it was combined with ownership of the assessment process. Finally, lack of experience was an element in the relatively weak impact of BREEAM on everyday decisions in the bolt-on cases; although here too other elements also mattered.

These observations draw attention to clear differences in the involvement of the BREEAM assessor in each of the three types of fit. In principle, the presence of the assessor should ensure that all projects can benefit from prior experience with BREEAM. However, as construction professionals know and research has begun to show, the assessor does *not* own or implement the assessment process, at least not usually. In both Readett Community Centre (tight-fit) and Heather Woods Primary School (punctual-fit) a very proactive assessor, together with a single-firm project team, managed a successful assessment despite the absence of prior BREEAM experience within the team. A second related, but distinct, element involves the continuity of assessor presence. One striking feature of all three bolt-on-fit assessments involved considerable disruptions in assessor presence on the project.

An important finding from this study concerns the relation between assessor involvement and project-level characteristics. As the discussion of ownership suggests, while assessors matter, they do not, on their own, determine the 'fit' of the assessment with the project. Instead project-level characteristics proved critical. This is especially striking in the bolt-on-fit cases where discontinuities in the project help to explain the neglect of the BREEAM process.

When it comes to the tight-fit cases another important project-level element was prior experience working

together. One of the striking features of the tight-fit assessments was the extent to which project team members had worked both with the other firms in the project team and with individuals from those firms. In each of the three cases, one or two key members of the project team actively went out of their way to recruit the others, on the grounds that their expertise and way of working was essential for successful delivery. Given the usual image of construction projects as temporary organizations with little prior experience working together, this finding would seem to point to the emergence of an informal practice of long-term informal partnering around shared sustainability commitments. The contribution of this element to the tight-fit of BREEAM with design and construction processes was undoubtedly enhanced by the high level of commitment and enthusiasm for the project.

In closing it seems worth repeating one of the key findings, namely the use of BREEAM as a design tool as well as an assessment tool in sustainable building projects and the absence of that design function in more conventional projects. While this may seem obvious, it is not completely logical. An important difference between those professionals characterized as being 'more sustainable' (*i.e.* those with more commitment, knowledge and experience) and the others is that the 'more sustainable' professionals have a well-thought-out approach to 'green building' that extends well beyond BREEAM. As such one might have expected them to reject the design function of BREEAM as too mechanistic or narrow. Conversely, in the absence of any such approach, one might have expected less committed or experienced professionals to have relied on BREEAM to guide them in meeting their client's commitments. However, the opposite is the case. Sustainable professionals used BREEAM judiciously to develop and support their designs (along with a number of other frameworks), while less committed professionals tended to treat it purely as an assessment method. This paradox can be partly explained by the additional functions associated with a high-end BREEAM score. For sustainable professionals, targets such as Excellent and more recently Outstanding have the additional function of communicating green value to clients and thus delivering reputational value.

A number of practical considerations emerge from these findings. These concern the role of the BREEAM assessor and the challenge of sustainable construction more generally. There are arguments both for and against whether the BREEAM assessor should be part of the project team or external to it. Proponents of an external role point to the importance of providing an external, 'objective' assessment; proponents of an internal view underline the role of BREEAM and, by extension, the assessor in ongoing decision-making. This study examined the extent and nature of that 'internal' role in eight building projects. It found first that BREEAM and BREEAM assessors can and sometimes do play a significant role in supporting design and construction decisions. It also pointed to some of the conditions influencing the engagement of BREEAM and, by extension, BREEAM assessors in the project team. These included shared commitment to and understanding of sustainable commitment and continuity in the project. Finally, it illustrated the way in which a proactive assessor can compensate for the absence of other elements. The more assessors and project teams are aware of these relations, the better able they will be to resource assessments appropriately.

A second practical implication stems from the importance of project-level ownership for the incorporation of BREEAM into everyday design and construction decisions. Formally, this responsibility usually falls to the design manager or PM. However, as these findings suggest, it also depends on either the individual's commitment to sustainable construction or the client's commitment (which effectively pushes the PM to care, at least for the life of the project). Either way, the study suggests that project and design managers need to be supported in this task, both through training and recognition.

Turning to the challenges of sustainable construction more generally, the study points to the importance of a cluster of different elements. Thus, while formal mechanisms such as the type of contract or building assessment methods are clearly important, they do not act on their own. Instead, their effect on design and construction processes, and thus on buildings, varies with project team characteristics. The emphasis in the literature on the importance of 'integration' suggests that both professionals and researchers are acutely aware of this general claim.

The theoretical contribution of this study lies in the translation of this very general concept into more specific social and organizational elements which directly impinge on environmental assessments and, by extension, sustainable construction. The comparison of clusters or configurations suggests that, at the project level, sustainable construction depends on a combination of a clear vision or approach (which extends beyond the use of one or more formal tools), a high level of project team commitment and engagement and early involvement of specialists. It also benefits from prior experience working together as a team (on sustainable projects) and continuity in the project brief and team. Finally, it suggests that characteristic of the BREEAM process both contribute to and potentially compensate for weaknesses in project-level elements; but that this contribution depends on a proactive, continuously involved assessor and clear project-level ownership of the assessment process.

This analysis suggests that in order for sustainable construction to diffuse, there is a need for greater attention to be paid to individual levels of engagement with, and understanding of, sustainability in general (rather than experience or knowledge of BREEAM and technical solutions to individual credits), to ownership of the issue and to the threat which any type of discontinuity poses to the realization of sustainability related project goals.

The analytic framework and observed effects discussed above rest on eight, relatively similar, cases. As such, the above suggestions should be taken as a starting point for more extensive research the effect of clusters of project and assessment level characteristics on the implementation of assessment methods. Examination of less well-coordinated projects may highlight additional project and assessment level elements as well as other ways of compensating for weak elements. A better understanding of these dynamic interactions would help to support the uptake and effect of BREEAM. Nor are these findings limited to BREEAM or building-level assessment methods. Policy-makers, professional associations and individual firm strategists all rely on a myriad of tools, instruments and methods to implement policies, be it to promote sustainable construction, innovation or growth. The research reported above underlines the need to consider not only formal features and requirements, but also the way in which project teams engage with them. More specifically, the analytic framework developed above offers an alternative to either general discussions of the importance of integration or long lists of discrete elements, most of which are far more mutually dependent than statistical analyses assume.

In summary, the research reported herein challenges the assumption that BREEAM and other policy instruments for the promotion of sustainable construction can be treated as generic formal tools. Instead, their effect varies across projects. For assessors and the BRE, it points to the need to incorporate systematic understandings of variations across types of cases into the training and approach to BREEAM assessments. For professional firms, it points to the need to bridge the gap between firm-level sustainability initiatives and project-level activity. More specifically, it calls on them to offer project teams far more support in delivering BREEAM and sustainable construction than is currently the case (outside of niche firms) with the aim of incorporating such delivery into firm wide standard practice. Finally, for policy-makers, it highlights the need to move away from the current technocratic, formal approach to sustainable construction focused on mandatory mechanisms such as BREEAM and formal project delivery methods to a more capacity building approach, focused on supporting specialized niche delivery teams, educating and incentivizing clients, and developing sustainability skills and expertise across the sector.

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Endnotes

[1]For a critical analysis of the 'improvement agenda' in the UK construction sector, see Green (2011).

[2]For a discussion of the difference between positivist and interpretivist research strategies as applied to construction research, see Schweber (2014).

[3]The Natural Step framework builds on a socio-ecological systems approach to sustainable development. The approach is associated by the Swedish non-profit organization with the same name. For more information, see http://www.naturalstep.org/.