DIGITAL INNOVATION IN CONSTRUCTION: EXPLORING THE FIRM-PROJECTS INTERFACE

Amna Shibeika[1] and Chris Harty

School of Construction Management and Engineering, University of Reading,

This paper reports on an in-depth qualitative study of the diffusion of digital innovation in a large UK engineering firm. Previous research in the diffusion of innovations in construction emphasises either projects or the firm with little attention to the interface between the firm and its projects, and the effect of this interface in diffusion processes. This research however employs a contextualist process approach which accounts for more than the individual choice, and considers non-linearity and iteration within the chronology of a diffusion process. The findings of this research provide a case for learning and capabilities development for BIM across the firm through strategic technology group which the firm mobilised to provide innovation championship and digital leadership. It also captures important tensions and challenges at the interface between the firm and its projects, which are largely related to the need for standardised processes across the firm to achieve repeatable solutions, and at the same time being able to meet the unique requirements of specific markets and projects. The implications of these findings in practice and in research in the diffusion of innovations in construction are discussed.

Keywords: BIM, diffusion of innovations, digital innovation, project-based firms.

INTRODUCTION

The advantages of the flexible and informal form of project-based organisations to innovation have received considerable attention in organisation and management literature (Galbraith 1971, Mintzberg 1983, Teece 1996, Hobday 2000). However, this project-based nature of organisation also poses challenges for diffusion especially with regard to learning, knowledge transfer, and capability development over time and space.

While learning and accumulating knowledge is a critical component of innovation implementation and consequently diffusion, it remains problematic for project-based firms. Lessons learnt in projects are often lost as they are not automatically incorporated into the firm's business processes. Instead, this knowledge remains tacit across different individuals (Reichstein, Salter and Gann 2008). Understanding the organisational conditions and norms which influence learning and knowledge transfer in project-based firms, and subsequently impact the diffusion of new innovations, is critical, as is the nature of the knowledge creation and transfer between construction projects and to the firm.

In the construction management literature, construction projects as temporary project-based organisations have received considerable attention (Morris and Hough 1987, Flyvbjerg, Bruzelius and Rothengatter 2003, Davies, Gann and Douglas 2009, Gann *et al.* 2012). And construction firms' organisation and innovation have attracted similar

[1] amna.shibeika@gmail.com

Shibeika, A and Harty, C (2015) Digital innovation in construction: Exploring the firm-projects interface *In:* Raidén, A B and Aboagye-Nimo, E (Eds) *Procs 31st Annual ARCOM Conference,* 7-9 September 2015, Lincoln, UK, Association of Researchers in Construction Management, 1167-1176.

attention (Sexton and Barrett 2003, Dodgson, Gann and Salter 2005, Barrett and Sexton 2006). However, less is known about the interface between the firm and its projects. Therefore, the purpose of this paper is to explore the diffusion of innovation within the project-based firm at the interface between the firm and its projects, with specific focus on digital innovation because of its rapid diffusion within the industry due to government discourse. The aim is to understand how the firm mobilises resources and builds capabilities to diffuse digital innovation, not only between projects but also between projects and the firm.

LITERATURE REVIEW

Within the construction's *"complex web of contractual and managerial relationships"* (Mike and Nick 2001: p 339), learning and knowledge transfer are influenced by the transient and multidisciplinary nature of projects. While major infrastructure projects are themselves considered temporary organisations they are embedded in more permanent contexts. These permanent contexts vary from organisational units, organisations, inter-organisational networks, and organisational fields (Sydow, Lindkvist and Defillippi 2004). The tension is always between the performance demands of current projects, and the knowledge and learning carried to future projects or as Sydow and his colleagues discuss: *"coordination within and across organisations is often critical for ensuring, for instance, that knowledge gained in particular project is stored for use in other projects or that project routines are improved over time"* (Sydow, Lindkvist and Defillippi 2004: p 1476).

Two streams of research are found in the literature to address the issue of project-based learning: In one hand there is a body of research that is concerned with the codification of knowledge through tools and digital systems which are reported to have limited success in solving the problem of knowledge sharing and learning within project-based firms in practice (Newell 2004). Scholars also argued that *"there is no single model for managing technical support and R&D in project-based environments"* (Acha, Gann and Salter 2005). This is attributed to the focus of the knowledge codification studies being only on the outcomes rather than the dynamics of the knowledge management and learning processes itself (Prencipe and Tell 2001).

On the other hand there are studies which address the management and integration of knowledge within and across projects and teams through investigating learning mechanisms, this research highlighted important issues: First, The firm develops new capabilities across different organisational levels (strategic, project and operational). And learning for new capability development follows a two-way path that is a mix up of top-down strategy exploitation and bottom-up exploratory learning (Gann and Salter 2000a, Brady and Davies 2004). Second, the firm mobilises its resources between projects and the firm to develop new capabilities to gain competitive advantage, the new capability development process entail adaptation and change in the firm meaning that an integration capability has the potential to improve learning (Davies and Brady 2000, Brady and Davies 2004). And third, the differences between project processes and the firm business process lead to a double-edged effect for project-based learning which result in learning boundaries between projects and the firm (Scarbrough *et al.* 2004).

These issues shed light on some of the complexities of the project-based firm as a context for innovation and learning. However, it falls short of explaining the dynamics at the interface between the firm and its projects, and the integration processes between the different markets and sectors within one firm. Moreover, the growing

research in digital innovation in project-based firms to date has tended to either focus on major projects and networks (Boland, Lyytinen and Youngjin 2007, Harty and Whyte 2010, Whyte and Lobo 2010) rather than one project-based firm which is engaged in multiple infrastructure projects, or, cross-sectional comparative studies of groups of firms (Gann and Salter 2000b, Brady and Davies 2004, Dodgson, Gann and Salter 2005), which only provide a snapshot of the innovation process at a specific time. The research presented in this paper seek to present a diffusion process which account for both the firm and its projects, drawing from an in-depth, interpretative and contextual approach..

METHODOLOGY

The findings presented in this paper are based on an in-depth process research in diffusion of digital innovations in a large UK engineering firm conducted over four years (see (Shibeika 2014) for more information about the research method). The data is particularly drawn from observation of meetings of a technology group, which was set up in response to the UK government strategy to require BIM 'level 2' in its role as client on major projects by 2016 (Strategy 2011), also it was a recognition of the firm's UK strengths in digital delivery.

Observation is useful source of data, it provides first-hand and rich knowledge about the organisational phenomena under study (Lee 1999). The primary advantage of observation is that it provides behavioural and environmental evidence for complex interactions within the natural setting of the research (Marshall and Rossman 2006, Yin 2009). Despite its usefulness for building theory from case study research, observation techniques are underutilized in management research (Lee 1999). This is attributed to its labour-intensiveness and time consuming nature.

The first author observed technology-focused meetings between November 2012 and April 2013 which was part of a strategic initiative to diffuse BIM across the firm. The researcher attended those meeting as part of the firm, and was introduced as a researcher supported by the company to investigate technology use and management which would result in writing a case about the firm. This enabled note-taking with few opportunities to express the researcher's view of the technology and its diffusion when asked.

In this research, narrative was used as a primary analytical tool to capture important events related to the diffusion of digital innovation in the firm, and to reveal the underlying logics that give events meaning and significance (Pettigrew 1990).Constructing detailed stories from raw data is an analytical strategy well known for process studies, especially those in innovation, organisational change and strategic management (Pettigrew 1990, Van De Ven and Huber 1990, Van De Ven and Poole 2005, Langley *et al.* 2013). It is also a primary tool for contextualist investigations(Pettigrew 1990).

THE TECHNOLOGY GROUP MEETINGS

The membership of the technology group under study included technical directors from various market sectors within the firm: water operations, rail, airport planning, highways and bridges, tunnelling and earth sciences, commercial facilities, geospatial, and business economics. The group meet every month to discuss the firm's evolving BIM strategy. The group was supported by UK Regional Director, operating within the UK with the aim to pilot activities that will be extended to other regions in the future. The meetings lasted 2hours and 20 minitues on average, and involved the 10-

13 participants from different regional UK offices as well as the US head office. Professionals from a collaborating firm, technology developer, technology consultancy firm were also invited to three out of the five meetings.

In the first meeting, the scope of the technology group's activities was outlined. The agenda included the firm's involvement with major UK projects that are pioneering BIM, collaborating firms, and active industrial bodies involved on BIM standards development. Documents circulated before the meeting included a presentation by a technology director, which was presented to the firm's senior management team earlier in 2012. It introduced the concept of BIM and highlighted business benefits of adoption. A BIM white paper by a long term collaborating technology training and consultancy provider was also circulated by e-mail before this meeting.

In the second meeting, BIM market sectors' positions were identified through discussion on the feedback by each market sector on their current BIM situation especially in regards to current BIM projects, major clients requiring BIM, drivers, challenges, benefits and considerations within each market sector. A presentation by the firm's US headquarters was also given through video conferencing, and the firm's BIM leaders across the globe were introduced to each other. Documents circulated by e-mail in advance of the meeting included a presentation by a major BIM technology provider about the concept of BIM and its application on infrastructure projects, presentation on BIM application on a major UK airport terminal project, and overview of the firm's software training as a result of a global licensing agreement with a major software provider.

A collaborating firm was invited to the third meeting; their BIM manager demonstrated a BIM portal. This presentation generated discussion and questions about the benefits and challenges for designing such portal. Documents circulated in advance to this meeting were: presentation by the firm's Digital Delivery Director to the US headquarters on the opportunities for BIM roadmap for the firm, and a report on the outcomes of a BIM workshop for a major UK rail project with which the firm is engaged.

The fourth meeting focused on a presentation from the rail sector on their market sector's BIM journey, and the highways and bridges market sector's BIM roadmap. The group compared and contrasted these two presentations and discussed how the market sectors within the firm can learn from each other. Also a document for the standard use of a software package for highways and bridges was presented and discussed. That document was developed in collaboration with the firm's technology training and consultancy provider. Documents that circulated by e-mail in advance to this meeting were an industry report on the business value of BIM in North America and document outlining the firm's BIM vision for a new major underground station project.

A major BIM software provider was invited to the fifth meeting to provide up to date information on data management technology. The meeting also discussed the feedback from the group presentation to the firm marketing directors on the value of BIM to the business. The documents associated with this meeting was the recent UK standard, PAS 1192-2, and the Construction Industry Council (CIC) guidance on BIM and professional indemnity insurance when using BIM.

In addition to the technology group meetings, the firm hosted an industry event for BIM in April 2013, which involved presentation by the firm's Digital Delivery Director and discussion with wide range of firms representing different construction

companies, software providers, major projects organizations, and academic institutions. This director presented the firm BIM history and introduced the technology group and its activities.

FINDINGS

The activities of the technology group highlighted important issues related to the diffusion of digital innovation in the firm. These issues were concerned with internal processes of learning and exchange of ideas and knowledge among the firm's different teams, and external processes of knowledge transfer to the firm from collaborators and industry bodies. Furthermore, the analysis of the technology group meetings revealed the role of the group as focal in the firm and also showed that the group activities involved knowledge brokering to develop new digital capability for the firm. There were three distinct and interrelated mechanisms for learning associated with this firm-centred imitative:

Capturing existing competencies for BIM
The data shows that the meetings of the technology group were seen as a forum to exchange BIM knowledge across diverse projects and clients within the different market sectors of the firm. This is particularly evident on the interaction and the circulated documents in relation to developing shared and contextual understanding of BIM through reporting on motivations for and challenges of BIM delivery across the firm market sectors, capturing existing digital competencies which can be developed into BIM competencies, and sharing lessons learned and best practice from leading practice areas and exemplar projects to inform new competency development.

The main challenges faced the newly formed group were the diverse interpretations for BIM by the different clients, and the varied requirements and competencies for BIM by the various market sectors. The first task for the members of the group was to outline their markets' BIM positions by identifying each market sector client's needs, current BIM projects and capabilities, and to develop generic as well as market sector specific roadmaps for BIM strategy and project execution plans.

The presentations by three market sectors within the firm in the fourth meeting, and the report by the associated director of the Business Economics sector on the market position for his sector showed that there were rising numbers of clients requiring BIM, but at the same time, there were some clients who are still unaware of BIM, at least as a term. This highlight challenges for managing clients expectations. Another issue was the suitability of BIM to all types of projects. For example the Water Director expressed his concerns that the projects his market sector is engaged with are small compared to transportation projects for example. This shows that BIM can't be diffused as a simple product or process, it rather need to be scaled up or down depending on the market sector and the projects.

The group members' also discussed existing digital competencies within their market sectors. For example in the second meeting the airports practice area representative expressed that *"we model passenger movement in airports but we don't give these models to our clients"*. This shows that this market sector despite being seen as less advanced is in fact capable of providing visualisation techniques to their clients; this can be considered as a BIM competency which the firm can strengthen and market as a BIM capability. To capture similar competencies, the highways group started with a web survey about current BIM software and skills within their sector, the survey targeted the various skills groups' discussion forums within the firm's intranet.

Exemplar projects across the firm's portfolio were discussed during the group meetings to highlight benefits and challenges of BIM and to capture lessons learnt. One particular example of the knowledge sharing activities within the technology group is the presentation by the Rail Director in the fourth meeting to share the rail sector history of using BIM from 2007 to 2012 showing how digital capabilities grew and evolved over time through project work and despite the hesitance by some clients, and the lack of suitable resources at the start. The rail group currently considered as one of the hot-spots with regard to systems and processes for BIM, this presentation has provided a learning opportunity for the less digitally-aware sectors in planning their BIM roadmaps.

Gathering information through interacting with industry technology groups
The observation of the technology group activities shows that the firm developed new capabilities through making sense of existing technology developments within its operating environment. This was evident on the firm participation on emerging industry standards through: the involvement with professional institutions and mega projects BIM committees, learning from collaborating firms, and seeking updates from technology providers.

Members of the group including the group leader took part in several BIM action groups within different institutional and professional bodies, as well as being members of several mega UK projects' BIM experts groups; they shared information with the rest of the technology group. For example in the fourth meeting for the group an engineering director joined the meeting halfway through to report on standards developments within one engineering professional institution. Moreover, government strategy, as well as competitors' activities, was discussed in light of the information gained through the interaction with these professional communities. National and international BIM reports and guidance was main item of the meetings' agendas, and was normally circulated before the meeting and discussed in more details between the attendances.

The data shows that the development of BIM strategy and capabilities within the firm was not in isolation from other firms within the industry. This was evident in the presentation of the BIM strategy for one of the firm's long term collaborators in the third meeting to learn lessons from the experience of this collaborating firm. These communication channels with collaborators improved learning, and also made the buy-in from top management more feasible as it enabled the group to demonstrate tried and tested tools and systems that can improve the firm's digital capabilities to compete for BIM projects. Furthermore, the presentation and discussion with the major technology provider during the fifth meeting informed the firm with new directions for the development of BIM technology. This complements the firm's efforts on being up-to-date with developments on BIM processes and standards across the industry.

Mobilising resources to respond to clients
The analysis also demonstrates that the technology group activities sought to build BIM capabilities through the consolidation of existing and new competencies into repeatable and customised processes and systems to enable the firm to successfully bid for new BIM projects. This was evident on: devising firm wide BIM standards and working processes, getting the buy-in from senior management to financially support the BIM task group activities, and developing business propositions and publicity materials for the firm to share with their clients.

One example from the observation of the technology group and its activities was the document developed in collaboration between the firm‘s highways market sector and a software training consultancy to specify processes and routines for the use of a software package from a famous technology provider within BIM environment, this document was discussed in the fourth meeting, it demonstrated how this type of document can be tailored to other types of packages and markets.

With the BIM concept still being ambiguous and clients were not sure about their needs, the group facilitated basic shared understanding of BIM to enable the firm to better understand clients’ needs and develop business propositions to enhance bidding for new complex projects. Members of the group prepared a presentation about the benefits of BIM for the business which presented to the marketing directors of the firm in their February meeting; the presentation was received positively by the marketing directors who are responsible for identifying new markets and managing clients’ relationships. The group members considered this presentation as their chance to get the buy-in from top management and to get the required financial support for training and resources.

As the firm was operating within a competitive environment and facing more uncertainties associated with the digital delivery of infrastructure projects in which the firm engaged, the group developed some publicity materials to show the firm’s BIM capability and to attract more work based on these capabilities.

The activities of the group and the learning mechanisms discussed above show the integration efforts for building new digital capability and diffusing BIM across the firm. This required building communication channels within the firm among its various projects and market sector. And also communication channels across the boundaries with the industry and technology providers. However, building and managing these communication channels and adopting learning mechanism to support diffusion faced numerous challenges at the firm interface with its projects and with both the industry and technology providers. Continuous efforts were sought to align the firm strategy with: varied clients’ needs, emerging industry best practice, and evolving technologies.

CONCLUSIONS

The aim was to understand digital innovation in construction project-based firms. This is achieved through the exploration of the activities of a strategic technology group which the firm mobilised to diffuse BIM across the firm. The findings provide theoretical insights in the projects-firm interface and contribute to the construction project-based learning literature in the following key areas:

Integration and learning processes

Learning from previous and existing projects, and the transfer of this learning into future projects, was key in the diffusion of digital innovation in the firm, although it was not always simple or fully successful. The findings of this study resonate with previous studies which highlight project-based learning as double-edged (Bresnen, Goussevskaia and Swan 2005) or multi-dimensional (Prencipe and Tell 2001). While the project-based literature is dominated with exploration- exploitation models for learning, this study contribute to the literature by revealing a mixture of informal and formal learning processes between the different parts of the firm which influenced the diffusion of the digital innovation. Furthermore, it highlighted some challenges which

face learning processes at the firm-projects interface (Gann and Salter 2000b) and also the interface with the industry, technology providers and the clients.

The learning mechanisms facilitated by the technology group also resonate with the different typologies for project-based learning. Examples of these are: relating, reflecting and routinizing as suggested by (Söderlund, Vaagaasar and Andersen 2008), or replication and recombination (Davies, Gann and Douglas 2009). The difference here is the constant negotiation between the firm and its market sectors and the projects within which the firm is engaged. One of the main contributions of this study is that it shows how the tensions between the firm's strategy and industry best practices or between the firm's capability and the clients' needs and expectations make these mechanisms challenging in practice.

Technology champions and brokers at the firm - project interface
As the data shows, professionals engaged in the BIM diffusion initiative played the role of systems integrators (Winch 1998) and technology brokers (Hargadon and Sutton 1997). Systems integrators integrate top-down and bottom-up processes of strategy making and learning and so are involved in persuasion activities to achieve the buy-in from both the business and the projects. Technology brokers broker digital knowledge and experience across the different parts of the firm, and bring the latest industry best practice into the firm. However, in this case the activities of integration and brokering are happening within a complex interface between the firm and projects, a one which dominated by varied demands and challenges.

Further research

This study has shown that observation and narrative are useful approaches to understand the diffusion of digital innovation in a project-based firm. The findings of this research along with its contribution to construction project-based organisation and literature provide grounds for extra exploration and investigations not only around the nature and dynamics of the tensions between the firm and its projects, but also at the interface between the firm and the industry and between the firm and their clients.

REFERENCES

Acha, V, Gann, D and Salter, A (2005) Episodic innovation: R&d strategies for project-based environments. *"Industry and Innovation"*, **12**(2), 255-81.

Barrett, P and Sexton, M (2006) Innovation in small, project-based construction firms. *"British Journal of Management"*, **17**(4), 331-46.

Boland, J R J, Lyytinen, K and Youngjin, Y (2007) Wakes of innovation in project networks: The case of digital 3-d representations in architecture, engineering, and construction. *"Organization Science"*, **18**(4), 631-47.

Brady, T and Davies, A (2004) Building project capabilities: From exploratory to exploitative learning. *"Organization Studies"* (01708406), **25**(9), 1601-21.

Bresnen, M, Goussevskaia, A and Swan, J (2005) Organisational routines, situated learning and processes of change in project-based organisations. *"Project Management Journal"*, **36**(3), 27-41.

Davies, A and Brady, T (2000) Organisational capabilities and learning in complex product systems: Towards repeatable solutions. *"Research Policy"*, **29**(7/8), 931.

Davies, A, Gann, D and Douglas, T (2009) Innovation in megaprojects: Systems integration at London Heathrow Terminal 5. *"California Management Review"*, **51**(2), 101-25.

Dodgson, M, Gann, D M and Salter, A J (2005) *"Think, play, do: Technology innovation and organization"*. Oxford University Press.

Flyvbjerg, B, Bruzelius, N and Rothengatter, W (2003) *"Megaprojects and risk: An anatomy of ambition"*. UK: Cambridge University Press.

Galbraith, J R (1971) Matrix organization designs how to combine functional and project forms. *"Business Horizons"*, **14**(1), 29-40.

Gann, D and Salter, A (2000a) Innovation in project-based, service-enhanced firms: The construction of complex products and systems. *"Research Policy"*, **29**(7–8), 955-72.

Gann, D, Salter, A, Dodgson, M and Phillips, N (2012) Inside the world of the project baron. MIT Sloan Management Review, 53(3), 63-71.

Gann, D M and Salter, A J (2000b) Innovation in project-based, service-enhanced firms: The construction of complex products and systems. *"Research Policy"*, **29**(7–8), 955-72.

Government Construction Strategy. 2011.

Hargadon, A and Sutton, R I (1997) Technology brokering and innovation in a product development firm. *"Administrative Science Quarterly"*, **42**(4), 716-49.

Harty, C and Whyte, J (2010) Emerging hybrid practices in construction design work: Role of mixed media. *"Journal of Construction Engineering and Management"*, **136**(4), 468-76.

Hobday, M (2000) The project-based organisation: An ideal form for managing complex products and systems? *"Research Policy"*, **29**(7/8), 871.

Langley, A, Smallman, C, Tsoukas, H and Van de Ven, A H (2013) Process studies of change in organization and management: Unveiling temporality, activity, and flow. *"Academy of Management Journal"*, 56(1), 1-13.

Lee, T W (1999) *"Using qualitative methods in organizational research"*. USA: SAGE Publications, Inc.

Marshall, C and Rossman, G B (2006) *"Designing qualitative research"*. 4th ed. ed. Sage Publications, Ic.

Mike, B and Nick, M (2001) Understanding the diffusion and application of new management ideas in construction. *"Engineering, Construction and Architectural Management"*, **8**(5/6), 335-45.

Mintzberg, H (1983) Structure in fives: Designing effective organizations. UK: Prentice Hall.

Morris, P W G and Hough, G H (1987) *"The anatomy of major projects: A study of reality of project management"*. Wiley.

Newell, S (2004) Enhancing cross-project learning. *"Engineering Management Journal"*, 16(1), 12-20.

Pettigrew, A M (1990) Longitudinal field research on change: Theory and practice. *"Organization Science"*, 1(3), 267-92.

Prencipe, A and Tell, F (2001) Inter-project learning: Processes and outcomes of knowledge codification in project-based firms. *"Research Policy"*, **30**(9), 1373.

Reichstein, T, Salter, A J and Gann, D M (2008) Break on through: Sources and determinants of product and process innovation among UK construction firms. *"Industry and Innovation"*, **15**(6), 601-25.

Scarbrough, H, Swan, J, Laurent, S, Bresnen, M, Edelman, L and Newell, S (2004) Project-based learning and the role of learning boundaries. *"Organization Studies"*, 25(9), 1579-600.

Sexton, M and Barrett, P (2003) Appropriate innovation in small construction firms. *"Construction Management and Economics"*, **21**(6), 623-33.

Shibeika, A (2014) Diffusion of digital innovation in a project-based firm: Case study of a uk engineering firm. In: Raiden, A and Aboagye-Nimo, E (Ed.) (Ed.), *"Proceedings 30th Annual ARCOM Conference"*, 1-3 September 2014, Portsmouth, UK. Association of Researchers in Construction Management, 997–1005.

Söderlund, J, Vaagaasar, A L and Andersen, E S (2008) Relating, reflecting and routinizing: Developing project competence in cooperation with others. *"International Journal of Project Management"*, **26**(5), 517-26.

Sydow, J, Lindkvist, L and DeFillippi, R (2004) Project-based organizations, embeddedness and repositories of knowledge: Editorial. In: *"Organization Studies"* (01708406), 1475-89.

Teece, D J (1996) Firm organization, industrial structure, and technological innovation. *"Journal of Economic Behavior and Organization"*, **31**(2), 193-224.

van de Ven, A H and Huber, G P (1990) Longitudinal field research methods for studying processes of organisational change. *"Organization Science"*, **1**(3), 213-9.

Van de Ven, A H and Poole, M S (2005) Alternative approaches for studying organizational change. *"Organization Studies"* (01708406), **26**(9), 1377-404.

Whyte, J and Lobo, S (2010) Coordination and control in project-based work: Digital objects and infrastructures for delivery. *"Construction Management and Economics"*, **28**(6), 557-67.

Winch, G (1998) Zephyrs of creative destruction: Understanding the management of innovation in construction. *"Building Research and Information"*, **26**(5), 268-79.

Yin, R K (2009) Case study research design and methods.