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Knowledge transfer in construction project teams delivering sustainable office buildings in the UK and Germany

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Abstract

One of the main barriers preventing construction industry worldwide shifting towards delivering sustainable buildings as standard is the transfer of knowledge on how to build sustainably. This is partly because still only a small number of professionals possess the specialised knowledge and experience to design, build and operate sustainable buildings successfully. Also, there is a lack of understanding on how knowledge can be transferred and widely adopted between all relevant professionals and operatives, despite the significance of this transfer in the delivery of sustainable buildings. This results in a gap between the design performance and the actual building performance in use. This gap needs to be closed in order to secure a certain quality of sustainable buildings. Therefore this paper reviews the relevant literature on sustainable construction, then discusses its benefits and main barriers, and concludes by providing a basic understanding on the possibilities to enhance the unique knowledge transfer of how to build sustainably. It presents the background of an ongoing research project, which compares knowledge transfer practices in construction teams delivering sustainable office buildings in the UK and Germany.

Keywords

Sustainable construction, green office buildings, knowledge transfer, percieved value, barriers.

1. INTRODUCTION

Sustainable development as a concept has been gaining increasing attention across various sectors since the Brundtland Commission Report in 1987 (Ugwu, 2005). Furthermore, many new policies, legislation and initiatives emerging, that are related to environmental performance and sustainability have emerged in many countries around the world (Dixon *et al.*, 2008). Such developments mainly followed the Rio de Janeiro Summit in June 1992, and the South African summit in 2002 (Ugwu, 2005).

There are many definitions for sustainability, a holistic one is provided by Elkington (1998) as economic prosperity, environmental quality and social justice. This is often referred to as the three pillars of sustainability or the triple bottom line definition of sustainability (Ellison and Sayce, 2007). Within the built environment all three aspects are equally important. This is evident in the UK Green Building Council's (2008) definition of sustainable buildings: 'Buildings which are resource efficient, have zero or very low emissions, contribute positively to societal development and well being, and contribute positively to the economic performance of their owners/occupiers and to national economic development more generally.'

Although there seems to be a need for sustainable buildings, previous research has shown that barriers preventing construction industry shifting towards a green industry standard include difficulties in the process of putting this new knowledge on how to build sustainably into practice (Ugwu, 2005), a general lack of knowledge on sustainable building techniques (Nelson, 2007), and a gap between the design and the eventual performance of these buildings (Kurul *et al.,* 2010). Therefore this paper aims to contribute to the understanding of knowledge transfer in construction project environments delivering sustainable buildings. It presents the background of an ongoing research project, which compares knowledge transfer practices in construction teams delivering sustainable office buildings in the UK and Germany. The intention is to support a certain standard of green building quality through better knowledge exchange in the industry.

This paper begins with the synthesis of the relevant literature on sustainable construction, followed by its benefits and barriers. It further provides a basic understanding of current knowledge transfer practices and the possibilities an enhancement of these would offer to overcome some barriers preventing sustainable construction.

2. LITERATURE REVIEW

2.1 Perceived value of sustainable buildings

Besides the direct ecological impacts of buildings, significant resource reductions can be achieved at relatively affordable costs in the built environment, compared with other industries (Nelson, 2007). Due to rising energy prices and more affordable greening technologies, there are also attractive returns on green building investments (Nelson, 2008). A study sponsored by the US Green Building Council, found out that on average green buildings cost only about 2.5 percent more than their conventional counterparts (Galbraith, 2008). However, the capital cost of sustainable buildings is likely to reduce as a result of increasing demand and growing availability of sustainable building materials (Dugard, 2007). While there is a certain payback period as RICS (2005; cited in Dixon *et al*., 2008) confirms the relationship between property value and sustainability, the financial case remains unproven for many professionals (Nelson, 2007). This might be due to the lack of data and experience in valuation of green buildings.

Unfortunately most people still rather acknowledge the economic benefit of energy saving costs, while neglecting the increasing evidence that sustainable buildings have the potential to deliver benefits in the following areas: economics, marketing, government, employee relations and risk management (Yudelson, 2008). They return higher rents, offer faster letting, secure greater occupancy, and generate higher resale value (e.g. Smith, 2006; Yudelson, 2008). Green buildings are designed to conserve natural resources and improve human health. They can deliver a variety of public benefits related to resource conservation, indoor air quality, carbon emissions and air pollution (Pivo, 2008). Moreover sustainable buildings offer greater public relations and marketing benefits, assistance with stakeholder relations and even aiding in recruiting and retaining key employees (e.g. Dugard, 2007; Yudelson, 2008). On the occupier side besides lower operating costs, a significantly increased occupant productivity and well-being represent the main advantages (Dixon *et al.,* 2009). In addition there is a reduction of risk factors, including marketing, financing and securing political authorization to develop (Yudelson, 2008). Engelhardt (2010) puts forward that as for any other insurance you have to pay a little premium, but without sustainability the buildings will soon be considered to carry certain risks and valued accordingly. The business case for green buildings is summarised in Table 1.

Table 1: Major business case benefits of green buildings (Yudelson, 2008).

1.	Energy and water cost savings/ lower operating costs
2.	Increased rent and occupancy
3.	Productivity and health benefits for office occupants
4.	Recruitment and retention of key personnel
5.	Risk mitigation (e.g. economic, financial, market, legal, political)
6.	Increased building valuation
7.	Marketing and public relations
8.	Increase in reputation value for public companies
9.	Possible incentive payments from government and utilities
10.	Access to capital from responsible property investing funds

However, there exists some uncertainty regarding the length of the payback period of green buildings. Figures vary between four years (e.g. Smith, 2006; Dugard, 2007), and 20 or even 30 years (e.g Nelson, 2007). These differing opinions on the payback period are perhaps due to a lack of data in this area. Nevertheless, it is clear that at this point, where the market is shifting towards sustainability, 'green' investors can be distinguished from other investors and divided into two main groups: investors intending on capturing outsized returns by being early to capitalize on green investing, and investors concerned with the societal impacts of their investments (Nelson, 2008). Many companies recognised the benefits of 'going green' in order to highlight their corporate social responsibility (Nelson, 2008), but find at the moment only a limited number of investible assets. This type of consumer behaviour of market leaders will set new future standards (*ibid*), and implies that the environmental impact of buildings is becoming important to all players in the property market (Hinnells *et al*., 2008).

Hence sustainability is fundamentally transforming real estate market dynamics, as the nature of product demanded by tenants, constructed by developers, required by governments and favoured by capital providers is also changing (Nelson, 2008), and thus becoming more complex (Kamara *et al*., 2002). In 2009, Nelson declared that the current recession will only slow, but not fundamentally change the real estate market shifting towards sustainability. However, greenness will not replace known real-estate attributes such as price, location and conventional amenities, as accessibility of buildings and adaptability within use (Ellison and Sayce, 2007). Nevertheless sustainable features will increasingly enter into tenants' decisions about leasing space, and into buyers' decisions about purchasing properties (e.g. Yudelson, 2008; Dixon *et al*., 2009). At some point in the future, there will certainly be a tipping point, where green buildings become industry standard for a quality real estate product, although it is still unclear when this will be. However, owners, who fail to adapt quickly to the new standards will gradually become less competitive (Smith, 2006), and may find their viability exposed, since older, less efficient, conventional buildings are already devalued (Hinnells *et al.*, 2008; Pivo, 2008).

Nelson (2007) states that as every new product, green buildings bring risks along with rewards. The main risks can be associated with less experienced construction firms through underestimated construction costs, product missing the mark, or inability to deliver on promises. Furthermore there are considerable regional variations in adoption of sustainable construction practices (Nelson, 2008). For that reason the question remains, if the green building delivered is as sustainable as designed. There have been several studies comparing the actual performance of sustainable buildings with their intended one, revealing differing results (e.g. Robinson, 2008). For instance, a New Buildings Institute study in 2008 compared intended energy efficiency with actual energy performance of LEED certified projects, and revealed that the results differed widely from the intentions. This proves a need for linking design intent to operational performance (Robinson, 2008). Therefore the next section attempts to identify main barriers preventing construction industry shifting towards a high-quality sustainable standard.

2.2 Barriers preventing sustainable construction

Although there are significant drivers to the sustainability market (Dugard, 2007), such as

- general growing concern about energy prices and climate change
- threat of legislation
- demand of green buildings exceeding supply

there are also barriers constraining its growth, such as the length of payback period, initial investment costs and lack of supply (Dixon *et al.*, 2009). Whilst socially responsible investment products have rapidly become a major investment market in the equities sector, property investors are still struggling to find an effective response (Ellison and Sayce, 2007). Even if lack of demand is not a key barrier, occupiers believe that the additional costs of sustainability and undersupply are restricting market growth (Dixon *et al.*, 2009). The industry talks about the so called 'circle of blame' (see Figure 1) as the main reason for slow progress in the delivery of sustainable commercial buildings, whereby the four main stakeholder groups in the commercial property sector: investors, developers, occupiers and constructors, blame each other naming availability and demand of such buildings as main reasons (Dixon *et al.*, 2009). This was echoed in 2008 by the Royal Institution of Chartered Surveyors with asking questions as: 'How and when does an abundance of interest in sustainability and a strong will to go green translate into sufficient demand for a viable market?' (Robinson, 2008).

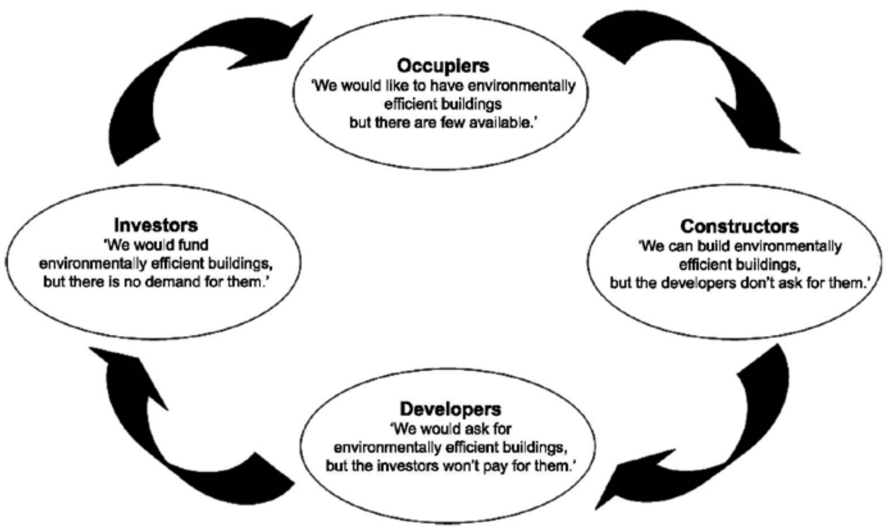

Figure 1: The vicious circle of blame (Cadman, 2000; in Keeping, 2000).

However, the reasons given seem to assume that each stakeholder group possesses the capacity and the knowledge on how to build sustainably. But despite the proximity of legal targets, e.g. in the UK, coming gradually into force, still only a small number of professionals in the industry possess 'the specialised knowledge and experience to design and operate sustainable buildings successfully' (Nelson, 2007). Previous research has shown that for professionals the main barriers to adopt sustainable building techniques are personal know-how and commitment (WBCSD, 2009), which reflects not only a lack of training and education in relevant techniques (Dixon *et al.*, 2008), but also personal commitment and a supportive environment and business acceptance. Regarding the UK construction industry Kurul *et al.* (2010) identified main barriers to delivering sustainability as follows:

- plethora of initiatives and policies
- silo-based structure of the industry
- need to up-skill staff

Factors influencing the consideration from sustainable aspects for different professionals in the field of different countries are displayed in Figure 2, an outcome of a World Business Council of Sustainable Development study in 2009.

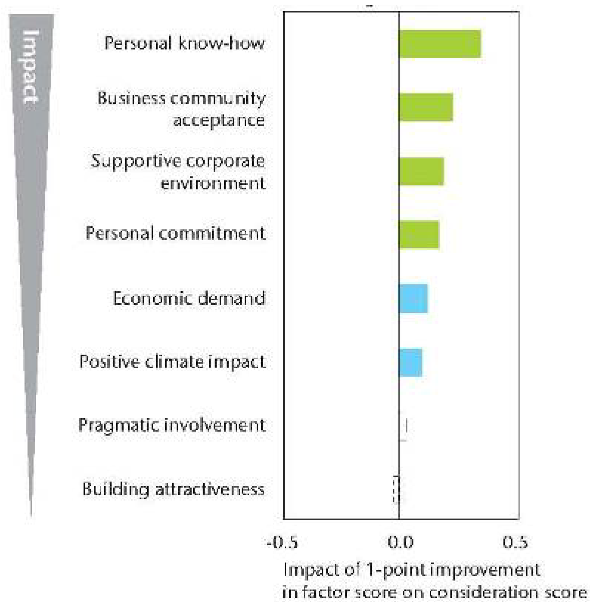

Figure 2: Factors influencing consideration of sustainable practices (WBCSD, 2009).

Although all project team members have to constantly absorb new technology and techniques in order to remain competitive (Fong, 2003), Dixon *et al.* (2008) discovered that sustainability engagement is higher for senior staff, and generally in larger organisations. However, not much attention has been given to operatives, who are largely responsible for the delivery of the building. Hereby Ugwu (2005) stresses the importance of the translation of strategic policy initiatives to concrete design guidelines and actions at the micro level. This requires top down and bottom up approaches in analysing current practices in designing for sustainability (Bierkeland, 2002; cited in Ugwu, 2005), and how construction companies connect, deploy and manage this sustainability knowledge (Ugwu, 2005). The difference between practical, experienced-based and theoretical knowledge (Nahapiet and Ghoshal, 1990), could result in difficulties in how to put the new building techniques into practice. Although nowadays almost all actors involved in the construction process claim to strive for sustainability, this discourse is not put into practice accordingly. The way sustainability is perceived and translated into practice, varies widely between actor groups (Rohrbacher, 2001).

Kamara *et al.* (2002) put forward that the application of general knowledge management strategies to the architecture engineering and construction (AEC) industry should 'reflect the context of this industry with respect to the way it conducts its business and the types of knowledge which are critical for its success.' As sustainability issues are changing the definition of tasks within this sector (*ibid*), difficulties might emerge because of fast technical changes (Cohen and Levinthal, 1990), which require adjusted KM strategies. There is considerable research on green buildings and the technological solutions which help to achieve the required performance levels. However, there is still a lack of understanding on how knowledge can be transferred and widely adopted between professionals and operatives, despite the significance of this transfer in the delivery of sustainable buildings. This might result in green buildings, which are not performing in a sustainable way, although they are assumed to do so. Hence these buildings could be an unproductive investment, and moreover do not support achieving governmental targets, such as cutting down carbon emissions in the long run. Therefore we argue in the next section that enhanced knowledge transfer mechanisms could offer a solution.

2.3 Knowledge transfer within construction teams delivering sustainable buildings

In all organisations, the politics of knowledge sharing are an issue (Egbu, 2004). Within the built environment, where the need for innovation and improved business performance requires the effective deployment and utilization of project knowledge, the need for strategic knowledge management is also being acknowledged (Kamara *et al.*, 2002). However, characteristics such as professional silos with their own knowledge and language render knowledge transfer in project teams even more difficult (Bresnen *et al.*, 2003). This fragmentation, displayed in Figure 3, has vital implications for attempts to develop shared perspectives on innovation, knowledge and learning (Bresnen *et al.*, 2003).

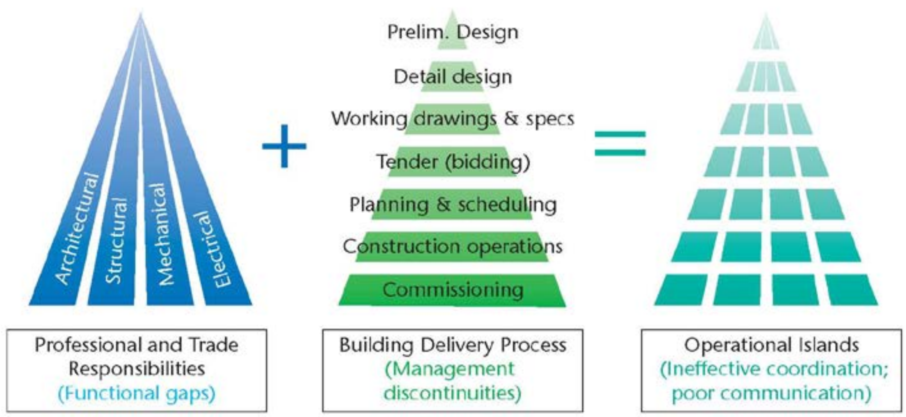

Figure 3: Players and practices in the building market (WBCSD, 2008).

Especially the flow of resources, as personnel and information, across time and space, from one project to the next and between project phases, impede capturing and transferring knowledge (Bresnen *et al.*, 2003). Most knowledge generated in one project, is buried in unread reports or simply lost, due to personnel turn-over. A failure to transfer this knowledge leads to wasted activity and impaired project performance (Carrillo and Anumba, 2002). The project teams are challenged by the need to incorporate new information into their understanding in order to solve the technical challenges they face, and thus fulfil ever-changing needs (Fong, 2003). This is even more important nowadays as sustainability issues are changing industry standards (Nelson, 2008).

The nature of projects where the ultimate goal is to deliver a ‘green building’ are more complex than standard ones (Meyers, 2008). This is due to the increased number of people involved, but also because of the modified technical knowledge. Furthermore the supply-chains of new sustainable building materials are more distributed than before. Sustainable buildings require high-tech components, which are supplied by specialized companies (e.g. building control technologies, solar energy solutions). Thus various sorts of new services and consultancy become important, as a high level of expertise is required for solving the complex problems of ecological optimization (Rohrbacher, 2001). As a result, a better co-operation and integration of various actors is required. The increasing importance of sustainability has important consequences not only on the technological practice of construction industry, but also on its structure and its communication channels (*ibid*).

Fernie *et al.* (2003) indicate that knowledge is personal, and therefore knowledge sharing takes place through the interaction of individuals. Hence social community plays a vital role in enhancing or inhibiting knowledge transfer (Bresnen *et al.*, 2003). As knowledge is a set of shared beliefs constructed through social interactions and embedded within the social contexts, Fong (2003) declares that social networks are the most important vehicle for knowledge exchange, with team members deeply reliant upon colleagues, friends and ex-colleagues as resources for generating knowledge. Moreover Nahapiet and Ghoshal (1998) claim that social networks are a valuable source for new knowledge, as the ‘combination and exchange of knowledge are complex social processes'. However, the difficulty is that success depends vitally upon interpersonal connections, rather than technological mechanisms (Bresnen *et al.,* 2003). Within a project environment the personal knowledge of whom to contact, i.e. how to use the personal network for accessing knowledge, appears to be most important (*ibid*). Borgatti and Cross (2003) found out that seeking information from another person is a function of knowing what that person knows, valuing what that person knows, being able to gain timely access to that person's thinking, and perceiving that seeking information from that person would not be too costly. However, previous studies (e.g. Hansen, 2002; Inkpen and Tsang, 2005) suggest that further research combining the concepts of social networks, knowledge content and knowledge transfer is needed to fully understand the interrelations and dependencies. We support these suggestions and further recommend an application to sustainable construction.

3. CONCLUSION

As sustainability is fundamentally transforming construction industry worldwide, the nature of product demanded by tenants, constructed by developers, required by governments and favoured by capital providers is changing, and thus becoming more complex. There is an increasing perceived value of sustainable commercial buildings. However, one of the main barriers towards delivering sustainable construction is the transfer of knowledge on how to build sustainably. There is a very diverse range of professions within the sector, from the brick-layer to the investment consultant, all carrying different kinds of knowledge that contribute to the project. Recent studies have revealed a gap between the designed building and the actual outcome. In order to put new sustainable building techniques into practice it is especially important to understand how knowledge can be transferred and widely adopted between all relevant professionals and operatives. This paper suggests that enhancing this special knowledge transfer between all project participants could help in the long run to secure a certain standard of green building quality through better knowledge exchange in the construction industry. Social networks could offer a possibility for this enhancement. Therefore we suggest further research combining the concepts of social networks, knowledge content and knowledge transfer. This could help improving sustainable construction.

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