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A CRITICAL REVIEW OF THE BARRIERS TO THE INTEGRATION AT SITE LEVEL OF SUSTAINABILITY PRACTICES INTO UK CONSTRUCTION PROJECTS

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Abstract *Construction practices are an important part of the grand sustainability agenda of enabling a safe and viable environment for future generations. Despite the significantly high amount of research on sustainability issues, there is a lack of detail relative to factors preventing its development and implementation at the level of construction project site practices. The aim of a literature search, which is being reported, was to investigate information and research into the barriers to the adoption of sustainable construction practices on projects with emphasis on those affecting the introduction of appropriate practices. Significant literature has been found on global barriers such as cost, supply chain issues and lack of knowledge. However, the effect of these on the inception of sustainable construction at the project site level has received a small fraction of the attention. In this regard, barriers have been found to be diverse ranging from stakeholder issues through to the attitude of individuals. To aid the future investigation of their applicability to projects these barriers have been broadly categorised as being either external (supply, demand and trading environment) or internal (resources, cultures, systems and human nature) to the project. However barriers which are applicable at the project site level are poorly defined with little clarity as to the magnitude of their effect on preventing sustainable construction occurring. In addition to commonly reported barriers such as Client and stakeholder desires, less commonly reported social and behavioural factors are discussed. This review and paper provides a basis of further studying the key barriers working against the achievement of sustainability as well as specific site practices which will deliver this goal as a first step towards the development of a strategy to achieve this in practice.*

1 INTRODUCTION

Kibert (1994) produced one of the seminal definitions of sustainable construction as "the creation and responsible management of a healthy built environment based on resource efficient and ecological principles." This is one of a significant number of definitions of sustainability and the number of which continues to grow and is of current academic interest (Zabihi et al., 2012). This was heralded as a new paradigm (Bordeau et al 1998) that the industry needed to address as one of the largest consumers of natural resources (Griffiths, Smith and Kersey 2003). However the entire issue is encapsulated by Bidarianzadeh and

Fortune (2002, p. 569) as "the construction industry, undeniably, has a huge impact on the environment and the term 'sustainable construction' may seem to contain an oxymoron can an industry such as construction traditionally so thoroughly dependent on the use of nature's resources and concerned primarily with creating new structures, answer increasing societal and, in turn governmental demands for a sustainable industry?"

Kibert's (2007) work follows up on earlier work and the changes that have occurred over the past decade and particularly notes that there are shortcomings in relation to legislation and perception. The industry has gotten to grips with the general terminology and the issues which are present however there has been a limited uptake of the issues into the mainstream. This is backed up by a claim that the industry needs to move away from a voluntary system of sustainability assessment and towards a legislation driven agenda.

The basic principle of sustainability is built on the three pillars of environment, economics and social issues however there is an absence of balance (Dewick and Miozzo 2002) in the UK with slow progress towards the inclusion of social and environmental considerations compared to other European countries. It should be noted that those countries considered as European is not clear and has changed over time with the expansion of the E.U. Balance needs to be maintained in all aspects of the inception of sustainability. The need for balance is highlighted by Young's (1997) definition of sustainability "as a three legged stool, with a leg each representing ecosystem, economy and society. Any leg missing from the 'sustainability stool' will cause instability because society, the economy and the ecosystem are intricately linked together." Zabihi et al (2012, p. 575) illustrate the changes in balance which have occurred "at first the important point was emphasis on resources limitation namely energy and the method for reduction of its impact on natural environment. In the past decade, the emphasis was on technical issues of building and construction such as materials, building parts and components, construction techniques and energy. Today, most of non-technical issues were taken into consideration and social development was raised as sustainable development indices".

This paper looks at the main issues that have been highlighted relative to barriers to the inception of sustainable construction as found via a literature review and especially applicable to practices at site level. Section 2 covers construction sustainability practices; section 3 commonly reported barriers to sustainability and section 4 further historical and behavioural barriers.

2 CONSTRUCTION SUSTAINABILITY PRACTICES

Table 1 shows the overall project to produce a series of site practices relative to the inception of sustainable construction at site level. This paper deals with a subset of the research. In order for construction projects to address the requirements of sustainability there is a need for a clear series of practices which bring about the required end result. These practices or the potential range of practices have not been defined in peer reviewed literature, authors have however highlighted the key roles that construction sustainability practices need to fulfil. Khalfan et al, (2002, p. 8) encapsulated the six key requirements of sustainability as being:

- Minimisation of resource consumption;
- Maximisation of resource reuse;
- Use renewable and recyclable resources;

- Protect the natural environment;
- Create a healthy and non-toxic environment; and
- Pursue quality in creating the built environment.

Literature review	**Area of interest**	**Potential areas applicable**
Site working methods	Economic	Lean construction, value engineering
	Social	Health and safety, apprenticeship schemes
	Environmental	Pollution management, Dust management
Perception of barriers at site level	Internal	Lack of knowledge, cost distribution
	External	Regulatory restrictions
Perception of drivers at site level	Internal	Cost saving/operational efficiency, competitive edge, company survival, reduction of legal risks
	External	Government regulation, client procurement policy, peer pressure

Table 1: Outline of overall research project

The BREEAM system (BRE, 2011, 42) encourages responsible construction practices, specifically looking at the measurement of:

- Monitoring energy consumption on the site.
- Monitoring of water consumption on the project.
- Monitoring of transport to and from site including the quantities of waste from the site.
- Use of sustainable timber.
- Having an environmental management system.

Whilst the BREEAM system gives a list of specific actions that should be followed in order to bring about the goals of sustainable construction it does not show balance in relation to the three pillars; with no clear link to the environmental pillar (unless the monitoring actions lead to the reduction of resource usage which in turn can be realised as a reduction in costs) and no social effects. It could be argued that the BREEAM system addresses the social pillar through the development of a better working environment for the final users of the building or via the social benefits that are attached to the Considerate Constructors Scheme which is advocates.

Labuschagne at al (2005) looked at the various levels of operational sustainability within a corporation and highlighted the need for economic stability to include financial health; economic performance and potential financial benefits, whilst environmental stability was based on air resources; water resources; land resources and mineral and energy resources. The social pillar being dependent on internal human resources; external pollution; stakeholder participation and macro social performance. Whilst these are a useful starting point as they are descriptive of the sustainability areas that need to be addressed they do not give real detail as to the associated practices which are effective for achieving the required result.

3 COMMONLY REPORTED BARRIERS TO SUSTAINABILITY

Following extensive searches in relevant subject areas on the ScienceDirect, ProQuest, ingentaconnect and Web of Knowledge search engines 17 primary sources were found and reviewed dealing with barriers to sustainable construction these were categorised using the

areas listed in Figure 1. Two of these studies have provided ranked information on the barriers. One of these, Williams and Dair (2007) presented twelve barriers:

- Sustainability measure was not considered by stakeholders
- Sustainability measure was not required by client
- Stakeholder had no power to enforce or require sustainable measure
- One sustainability measure was forgone in order to achieve another (traded)
- Sustainable measure was restricted, or not allowed, by regulators

Adetunji et al. (2003) on their part carried out a detailed literature review and interviews (with 26 contractors of £500 to £100 million turnover, and engaged in road construction) to generate the following barriers to sustainably:

- Lack of knowledge of sustainability
- Cost of third party certification
- Distribution of cost-benefits
- Cost as a barometer of success
- Limitation of procurement policy
- Narrow and patchy focus
- Industry culture; fragmented nature of industry, short term focus and conservatism

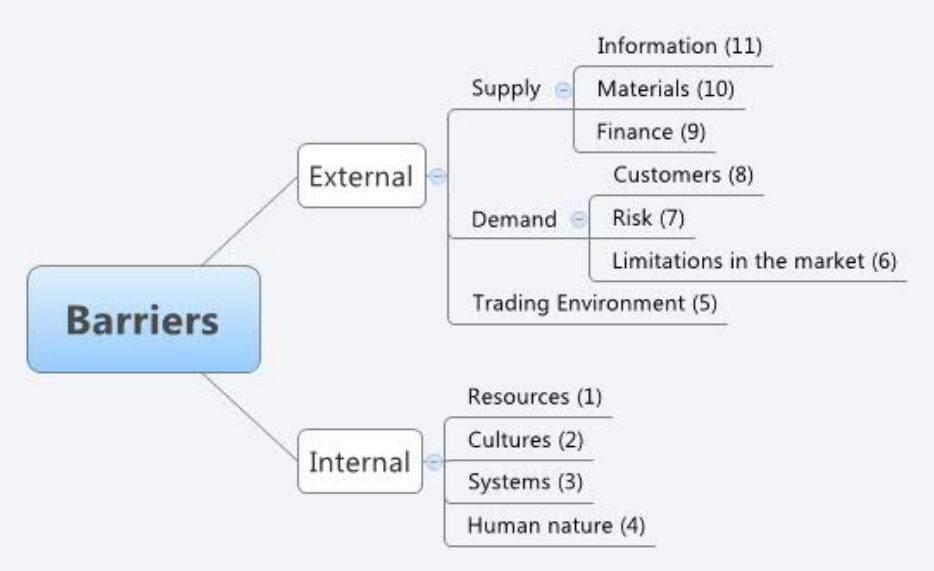

Figure 1: Categorisation of barriers

One of the lowest ranked barriers is supply chain management. As will be argued below the issues presented appear to be high level and not indicative of the potential issues at the site level. This may be due to the study participants being high level managerial or technical staff in the health and safety, environmental and sustainability disciplines rather than site based personnel such as site managers. However, a review of parallel issues to the inception of new construction practices highlighted a number of issues such as historical issues in the supply chain. These are detailed below and suggest a number of areas which need to be investigated at the site level which are not represented by previous studies regarding barriers to sustainable construction.

The identified barriers to sustainability can be provisionally summarised as:

- Many of the barriers are related to the decisions of the client through their purchasing influence. This could also be seen from the alternative direction as to whether without the effects of clients' requirements or government intervention there would be any significant level of sustainability being practiced or considered on projects.
- Risk and its avoidance is a strong barrier to sustainability.
- Government intervention is not a major barrier to sustainability.
- The majority of the barriers are external to the company.

Sustainability is based on the three pillars of social, economic and environmental factors. However there are a number of areas that are perceived as less important to sustainable construction. Whilst Clients and government intervention are significant in relation to decisions about sustainable construction and thus the economic pillar there seems to be less reported relative to the environmental and social pillars.

4 FURTHER BARRIERS TO SUSTAINABILITY

As already noted an important part of the inception of sustainable construction practices is an understanding of the hurdles which will need to be cleared to allow site practices to be adopted and changed to meet the new challenges that are ahead. This section of the paper looks at the issues that have been raised in relation to these barriers based on an in-depth literature review in this area. Research in the area has shown that the range of barriers is wide and varied. Further barriers are detailed below which relate to society, historic working conventions and behaviour of individuals. The authors suggest that additional factors will come into play at the site level, based on a review of parallel issues relating to social interaction and issues at the site level, these are expanded on below.

Table 2 summarises potential barriers that previous studies of barriers to sustainability have not alluded. An on-going effort is seeking to investigate some of the gaps which have been found and attempt to develop information on the inception of sustainability practices within the design and construction stages of projects, especially at the site level.

4.1 Social and behavioural factors

Looking at the barriers to the public engagement of the UK population with the Climate Change agenda, Lorenzoni et al. (2007, p. 445) summarised that, "A number of common barriers emerge from the three studies, which operate broadly at 'individual' and 'social' levels." Stoll-Kleemann, O'Riordan and Jaeger (2001) look at the psychological barriers distance and denial as to the need for behavioural change relative to the alternative energy debate, indicating a desire to remain with the Status Quo even in the face of evidence that this is not a tenable future and cannot be maintained indefinitely. There will be a significant barrier at site level to the engagement with the concept of sustainability and the need for the inception of modified working practices.

Loosemore and Andonakis (2007) looking at the nature of barriers to the implementation of Occupational Health and Safety Reforms in Australia noted that there are significant difficulties with the implementation of reforms due to the culture of risk transfer in the industry, with risk being passed down the contractual chain via contracts. The change in

regulations in health and safety in Australia has highlighted a number of issues in relation to the inception of regulations due to the sub contracting nature of the industry.

Issue	**Reference**
Social and behavioural	
Lack of engagement with climate change issues	Lorenzoni, Nicholson-Cole and Whitmarsh , 2007
Distancing from sustainability issues	Stoll-Kleemann, O'Riordan and Jaeger, 2001
Risk transfer through supply chain	Loosemore and Andonakis , 2007
Supply chain issues (fragmentation)	Briscoe, Dainty and Millett , 2001
Confrontation and adversarial nature of construction	Yitmen , 2007
Historic	
Forming the required contracting team	Egan, 1998 and Latham, 1994
Productivity and resistance to change	Winch , 2003

Table 2: Potential alternative barriers to sustainability

The issues of the supply chain have been highlighted as significant when it comes to the inception of change due to the continuing adversarial nature of the relationships (Briscoe, Dainty and Millett 2001, p. 251). It has been noted that there has been a significant amount of information produced in terms of the barriers to sustainability the largest proportion address the national and international barriers. A lesser amount has been written about the project or site level barriers to the inception of sustainability. The issues outlined below point to the influence of human factors which is in contrast to the high level barriers to inception sustainable construction practices detailed by earlier studies.

4.2 Historic barriers to change in construction

When looking at the barriers to sustainability it should be noted that the barriers need to be viewed in the context of the historical barriers to progress and innovation which are an integral part of the industry as a whole. There have in the past been a number of major reports that have looked at issues in relation to the way in which the construction teams in the industry work and the formation of a working framework. These have been headed up by Egan (1998) and Latham (1994).

It has been noted by Dulaimi et al. (2002) that these are not new issues and that there is a deeper historical basis that has prevented innovation and change in the construction industry. The issues raised by Latham and Egan were raised by Banwell, (1964), however, without the profile of the newer reports and their Government backing these issues and the concerns that were raised were given little heed to. The overall effect has been that change has occurred but this has not been as far reaching as the report authors would have liked and as a consequence suggests some of the challenges that will be faced in trying to bring about new construction practices to align with the needs and requirements of the sustainability and green agendas.

Yitmen (2007, p. 1319) commenting on the work of Barrett (2004) notes that "Construction is often typified as: confrontational, lacking vision, risk averse and engaged in cut throat competition, exacerbated by a lack of trust, inappropriate tracts and poor

communications, involving uninformed team members and widespread organizational amnesia." It is against this backdrop that sustainability needs to be incepted.

Winch (2003) comments that the construction industry has a low level of productivity and clarity compared to other industries, something that is put down to the low rate of innovation that is prevalent in the industry. Construction can be considered backwards when compared to other industries that have gone through many changes to bring about a streamlined and efficient manufacturing process. The research will need to look in depth at the potential effect that any remaining historical issues will have on the inception and ability of construction firms to undertake sustainable construction. For sustainable construction practices to be incepted these issues will need to be overcome and the lack of recognition in previous studies shows clear need for the issues to be raised and understood such that the barriers presented can be addressed.

4.3 Barriers in health and safety lessons for sustainable construction inception

Loosemore and Andonakis (2007) looking at the nature of barrier to the implementation of Occupational Health and Safety shows a method of contracting which parallels the makeup of the UK industry and therefore some of the issues that arise will be similar; the issues of dealing with on site multi trade workers and their ability to change without significant input from the principal contractor. How the small trade contractors will be brought along to achieve the overall goal of sustainability is a question that will need to be addressed.

These parallel issues have been investigated to look for insight into the potential issues that may be faced in bringing about new construction practices to align with the requirements of sustainable construction. In particular health and safety has the image of an undesirable regulatory barrier in the construction industry. Therefore there may be things to be learnt from these other construction related items that will assist in finding out the issues that are faces and may also give some insight into what will be required to overcome some of them.

Frazier et al (2013) looked extensively at safety culture and its implementation which presents information on parallel issues when looking at the development of a sustainability culture on site. The primary issue of a site based culture is to ensure that employees are all involved. This is important as Kotter and Haskett (1992) highlight that the alignment of employee and management goals provides strong and positive outcomes. Similarly Hayter et al (2002) note motivated and engaged employees can have a positive impact in business performance.

In addition a positive culture will allow the end goals to be achieved without significant monitoring and management. Therefore if sustainable construction practices are to be enacted management will need to develop a suitable culture and need to engage employees and also as noted below the supply chain.

4.4 The supply chain as a barrier

The nature of contracting, a principal contractor taking the lead and employing a delivery team of subcontractors is a much used method of procuring a project. The contractor is therefore a sum of its parts.

Briscoe, Dainty and Millett (2001, p. 251) undertook a review of construction supply chain partnerships and concluded that on, the basis of their analysis of a series of interviews that they showed, "how significant attitudinal barriers are present between many of the SME suppliers and the main contractors." Whilst this is a study which is now dated it shows the

continuing adversarial relationship and issues in construction that earlier research has highlighted. Thus the supply chain partnerships may well present a significant barrier to sustainability. The following review of literature will show minimal coverage of this issue which is fundamental to site level sustainability practices.

Van Bueren and De Jong (2007, p. 549) commenting on the work of (Rittel and Webber, 1973; Connolly, 1983) points out that, "Sustainable development is a contested or wicked concept." This is further elaborated on by looking at the imbalance between the needs of sustainable construction and the drivers of any work that of generating a profit. They conclude from the work that was reviewed that, "Everyone seems to be in favour of the goals, but it is very difficult to implement tangible policies and objectives. When priorities have to be set and concrete choices made (such as the allocation of profits and losses), the concept alone cannot reconcile conflicting values." However, the baseline research is somewhat historic and may not take into account the changing aspirations of the public and the ever growing Corporate Social Responsibility Agenda.

One of the barriers to movement in this field will be the inability of the industry, company or supply chain to adapt to the need to innovate.

Kibert (2007) in a review of sustainable construction notes the changes that have occurred since the Latham (1994) and Egan (1998) reports and the developments in construction supply chain management, however, based on the information presented it is clear that the construction process is about the establishment of a supply chain with a significant proportion of work being undertaken by companies who work on a construction management basis. Therefore most of the UK's construction companies can be seen only as the sum of their parts with the majority of contractors being defined by their supply chain. It is therefore important for the supply chain to be robust and in the context of this paper the requirement for the supply chain to take on the requirements of sustainable construction practises.

The take up of supply chain management has been slow within the construction industry potentially due to the continually changing nature of the supply chain with each new project.

Kibert (2007) asserts that the biggest barrier to implementing a successful supply chain partnership was a lack of top management commitment, followed by the poor understanding of the concept and an inappropriate organisation structure to cope with the changes.

It is clear that construction firms are normally the sum of their parts with the majority of contractors being defined by their supply chain. It is therefore important for the supply chain to have the same goals and understanding of the main contractor; this presents a barrier to the efficient and timely uptake of new innovation and in the context of the research the new and ongoing changing requirements of sustainable construction.

Loosemore and Andonakis (2007, p. 581) reviewing the way in which project teams are assembled from a health and safety perspective notes that, "Trade subcontracting is a key feature of the construction industry, providing economic flexibility and specialist expertise for principal contractors in a highly competitive, uncertain environment of increasing technical complexity. However, trade-subcontracting has also created many management problems for principal contractors which have been widely recognised as contributing to inefficiencies in the industry, not least in the area of OHS because of the complex web of constantly changing contractual relationships which can confuse responsibilities for OHS management and reporting." This directly relates to the social pillar of sustainable construction. There is additionally noted to be barriers in the form of implementation costs, language and educational barriers and a fear of change.

5 CONCLUSION

The change in health and safety regulations in Australia has highlighted a number of issues regarding the sub-contracting nature of the industry. The issues that arise therein are similar to those in the UK construction industry as their methods of contracting are likewise parallel. The issues of dealing with a fragmented supply chain may come to the forefront as may the ability of supply chain partners to change without significant control from the principal contractor. A question that future research needs to address is how will the small trade contractors be brought along to achieve the overall goal of sustainability?

Whilst there has been a significant amount of research in relation to the barriers to the inception of sustainability and even to a degree the barriers at the site level, it is argued that there are specific barriers which may be present and have not been reviewed due to the lack of research at the site level rather than within the central management functions of contracting organisations.

It has been noted from the literature reviewed that there are a number of gaps in the current research. From these many gaps, the principal areas that have been chosen by the authors for further investigation are;

- Development of practices which when enacted will have the largest potential to bring about sustainable construction at the site level.
- Understanding the drivers which significantly affect the inception of sustainability at the site level
- Identifying factors which mitigate the inception of sustainability in projects.

These issues have significant importance to contractors and design teams in their attempt to bring about sustainability in construction. They thus provide a strong basis for the targeted investigation of the barriers that are present at the site or project level.

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