A COMPARISON OF TECHNIQUES FOR IDENTIFYING RISKS IN SUSTAINABILITY ASSESSMENT OF HOUSING

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Identification is the first stage in the risk management cycle - risks must be identified before they can be assessed and controlled. The literature outlines a range of available techniques for this stage, of which 16 have been applied to construction management problems. This paper investigates the applicability of two of these techniques for identifying the risks in the sustainability assessment of housing. The risk breakdown structure (RBS) and a brainstorming approach were tested in a workshop comprising twelve construction professionals and academics. The RBS method produced 39 risks which were general in character, while the brainstorming process suggested 82 risks which were more specific in nature. However, brainstorming also identified a set of risks which could not be categorised by any of those in the risk breakdown structure. These included risks relating to personal belief and understanding, which suggests that the rigid nature of the RBS has the potential to limit creativity in identifying risks. Whilst this research found that both techniques were appropriate to different extents for identifying risks in sustainability assessment, it was shown that there are fundamental differences in the level of detail and boundaries. This, therefore, questions the applicability of both to the same problem, and demonstrates that care must be taken when selecting an appropriate risk management technique. Further the final set of risks produced from this research has shown the synergy of a hybrid approach.

Keywords: brainstorming, housing, risk breakdown structure, risk management, sustainability assessment.

INTRODUCTION

Risk management in the built environment is a field which has received increased research attention and application in industry over the last three decades (eg. Edwards and Bowen 1998). There is a wide range of techniques available to manage risk and research has shown that appropriate selection of techniques is dependent upon the problem being addressed (Buntin and Chapman 1998, Lyons and Skitmore 2004). The research presented in this paper aims to compare the differences and effectiveness of two techniques for risk identification. The two techniques are a brainstorming and a risk breakdown structure (RBS) approach. These will be used to identify what risks are present in sustainability assessment methods. The concept of sustainability has

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numerous definitions. It is commonly acknowledged to encompass social, environmental and economic elements. Sustainability assessment is currently a key research area for the built environment (Kibert 2005). However the assessment methods for sustainability regularly fail to take risks and uncertainty into account. This research seeks not only to compare the two identification techniques, but to produce a set of risks which may exist when a sustainability assessment method for housing is developed.

RISK MANAGEMENT IN THE BUILT ENVIRONMENT

Risks and uncertainty are inherent in everything which is done (Kaplan and Garrick 1981). Within the construction industry and the built environment this is very much the case (Perry and Hayes 1985, Flanagan and Norman 1993). Over recent years the publication of systematic approaches for dealing with construction risks have established a risk management process (Thompson and Perry 1992, Godfrey 1996, Chapman 1997, Institution of Civil Engineers *et al.* 1998). The first stage in this process is to identify the risks. It is not possible to analyse and respond to risks which have not been identified. As a foundation, identification is vital to the risk management process. The subsequent stages cover analysis, response and monitoring.

There is a wide range of techniques available to identify risks. The research presented in this paper firstly uses brainstorming which is the most commonly used by practitioners (Akintoye and Macleod 1997, Bajaj *et al.* 1997). This is compared with a less frequently used approach, the risk breakdown structure. These two techniques were selected using a decision-support tool developed to select risk management techniques for use in the built environment (Forbes et al 2007). The tool selects appropriate techniques based on examples from the literature. Sustainability assessment was characterised as a social, economic and environmental problem. The tool proposed the use of the RBS and brainstorming techniques as the most suitable for identifying risks in such problems.

Brainstorming

Brainstorming is an approach to generate many ideas from a group of people (Osborn 2001). It need not necessarily be restricted to risk identification problems, but it has extensive application in the literature as a risk identification technique. It has been shown to be the most widely used technique in practice (Akintoye and Macleod 1997, Wood and Ellis 2003). There are some differences in the literature between types of brainstorming. These tend to be presented as either a structured or a simple approach. Frequently there is no distinction made between the two. A structured approach has been shown to produce more comprehensive solutions (Edwards and Bowen 2007).

The objective of a structured approach to brainstorming is to obtain a large number of ideas from a group of people in a limited time. This is optimally 20 minutes with a group of 12 participants. These participants should consist of a leader; an associate leader; five core members and five guests (Osborn 2001). Four basic rules are set in this process, and should be conveyed to the participants in an introduction by the session's facilitator: i) criticism is not allowed; ii) participants should 'free-wheel'; iii) a large number of ideas is sought and iv) individuals should 'cross-fertilise' their ideas within the group (Rawlinson 1981, Osborn 2001). The leader should ensure that the rules are adhered to, and that the objective is clearly defined. This structured approach was used in this research.

Risk Breakdown Structure

The risk breakdown structure approach for risk identification is less widely known and used than brainstorming. It has been selected for a comparison because example applications have shown its application to social, environmental and economic problems (eg. Hillson 2003). Sustainability assessment covers these three problem characteristics.

The RBS follows similar principles to a work breakdown structure. The risks are split into manageable, definable packages in an hierarchical format (Chapman 2001, Hillson 2003). The identification of risks in such a structured format allows the assessor to review the risks and carry out the analysis stages of the risk management process. The highest level of the RBS (Level 0) contains the objective of the assessment. The RBS approach is not a list of the sources of risk, but a hierarchy which increases the level of detail about the source of the risk as the levels increase (Hillson 2003). The elements of each level of the RBS can then be considered in turn to review the risks. This structured approach acts as a prompt to increase the coverage of the identified risks from the experience of those involved.

An example of applying the RBS is provided by Chapman (2001). The example reviews the risks associated with construction design and is shown in Figure 1. The project risk is set as Level 0, and the associated Level 1 and 2 risks are given. Due to limited space the Level 3 risks are shown only for the Level 2 ‘statutory’ risks. For detailed coverage the reader is referred to Chapman (2001).

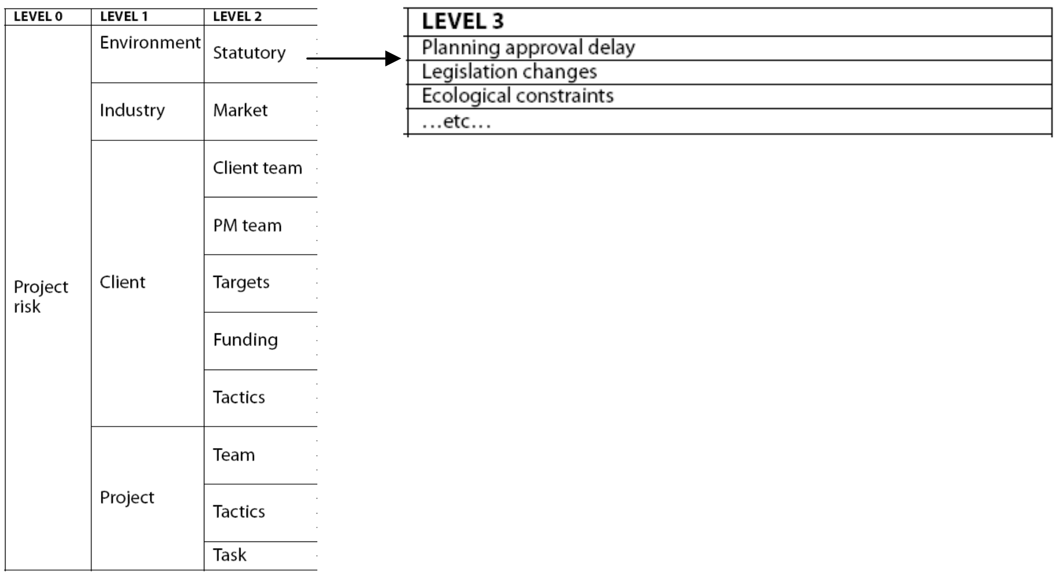

Figure 1: Construction design risks (after Chapman 2001)

SUSTAINABILITY ASSESSMENT

It is generally acknowledged that sustainability has three dimensions: social, economic and environmental. Sustainable development first gained prominence with the publication of the Brundtland Commission's Report "Our Common Future" (WCED 1987). It was that report which coined one of the most commonly used definitions of sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their needs". The concept has developed through the 1990s and into the early 21st century to become one of the key areas for research, investment and development. In the UK the construction industry is facing challenging targets to ensure that what is built, and the construction processes are sustainable (Department for Business Enterprise and Regulatory Reform 2007). Housing is one element of the built environment which impacts on sustainability in all three dimensions.

Sustainability assessment of the built environment provides an answer to the question of whether what is being constructed is sustainable in the long-term. However, selecting an assessment method is not simple: there are in excess of 600 tools available to measure sustainability (Walton *et al.* 2005, El-Haram *et al.* 2007). These tools tend to be 'black-box' type systems allowing very little knowledge of the system to be visible to the user. There is seldom any acknowledgement of risk or uncertainty in the process.

The sheer number of available tools indicates that there is uncertainty over the way sustainability should be measured. Indeed, among some of the key topics in sustainability there is debate. For example, The Stern Review (Stern 2007), among others, concluded that the change in world climate is caused by man-made carbon emissions; but other researchers argue that it may not be as a direct result of human activity (eg. Bellamy and Barrett 2007). It is therefore a further outcome of the research presented in the paper to identify the risks associated with developing a sustainability assessment tool. This is restricted to the sustainability assessment of housing to maintain focus for this research.

THE WORKSHOP

A risk identification workshop was used to implement and test the two techniques. This one-off workshop aimed to produce two sets of risks which could be compared. A second outcome of the workshop was the compilation of a set of risks from the question: “What are the risks associated with developing an indicator of the sustainability of housing?” - the nature of sustainability was presented to the attendees as encompassing social, economic and environmental elements. There is currently controversy surrounding the exact definition. This was not debated within the workshop because of time constraints, and to maintain a focus.

Table 1: Workshop participants by experience

Background/Experience	Quantity
Local Authority/Government Bodies	2
Academia	4
Client	1
Environmental Consultants	3
Other	2
Total:	12

Twelve invited participants attended the workshop. The individuals all worked within the built environment and construction fields. Those present had expertise in sustainability assessment, house building, general construction and as client bodies. The attendees by type are given in Table 1. In addition to the attendees there were two facilitators who introduced and chaired each of the items on the agenda.

RBS Approach

The first agenda item for the workshop was the RBS approach. The approach was unknown to all but one attendee. An example from construction design was used to demonstrate the process (Chapman 2001). Following the introductory example and a brief discussion all participants felt comfortable enough with the RBS to proceed.

Presentation of the breakdown structure had to be appropriate and easy to understand. This was delivered in the workshop using interactive software. The software produced a breakdown which was edited and displayed on a screen as the workshop progressed.

Level 0 of the structure was defined as “Risks associated with developing a sustainability indicator of housing”. The participants identified the high level risks that they considered important for Level 1. This process was then repeated to produce Level 2 risks for Level 1 risks in turn. It was agreed between the attendees and facilitator that there would be no real advantage of proceeding to Level 3. The process of producing the breakdown to Level 2 took 45 minutes.

Brainstorming Approach

The second item on the agenda was the brainstorming session. This addressed the same question as the RBS approach. The session was chaired by an experienced brainstorming facilitator and all of the attendees were familiar with the concept. However, to ensure that everyone had the same level of knowledge concerning the structured approach the facilitator outlined the four rules of brainstorming, and presented some warm-up exercises. The attendees were then encouraged to consider different means of phrasing the questions to encourage a range of creative perspectives.

Following this introductory session, the attendees were then allowed to produce their answers to the question: "What are the risks associated with developing a sustainability indicator of housing?" The introduction lasted for 10 minutes, and the brainstorming for 20 minutes.

RESULTS

The RBS approach produced 11 risks at Level 1 and 39 at Level 2. Level 1 risks covered general sources and Level 2 more specific associated sources of risk. However, 'Misuse of Indicators’ at Level 1 failed to produce any Level 2 risks. Those groups which had the most Level 2 risks were i) over complexity; ii) appropriateness and iii) omission. The idea generation from the brainstorming approach returned 82 risks; these risks were produced in no apparent order.

Comparison of Results

The outputs from the two approaches were compared. The risks from the brainstorming were mapped to Level 1 categories of the risk breakdown structure. This allowed the unstructured output of the brainstorming to be presented in an ordered fashion. All of the RBS Level 1 sources of risks had at least one brainstormed risk; these Level 1 sources are given in Table 2. This table also shows the number of risks developed though brainstorming which mapped to each of the Level 1 items. There were 59 of the 82 individual brainstorming risks mapped to the RBS structure. Some of the brainstorming risks were considered to be relevant to more than one of the RBS sources. In total, due to cross mapping to more than one Level 1 resulted in 71 occurrences of these 59 brainstormed risks.

Table 2: Comparing the RBS and the brainstorming risks

Level 1 RBS Risks	Quantity Mapped from Brainstorming
Omission	5
Lack of consensus	7
Appropriateness	16
Accuracy	6
Method of Measurement	10
Communication	6
VFM	1
Legislative Framework/Policy	12
Ignorance	3
Over complexity	5
Total:	71

The largest number of risks from brainstorming related to the RBS categories of "Appropriateness", "Method of Measurement" and "Legislative Framework/Policy". The most obvious difference between the two sets is that the RBS risks have produced general sources whereas the brainstorming risks tend to be specific. These three areas demonstrate this clearly by brainstorming resulting in a greater level of detail of specific risks than that provided by the RBS. An example of the mapping exercise for "Legislative Framework/Policy" is given in Table 3.

Table 3: Extract from comparison of the RBS and the brainstorming outputs

RBS: Level 1	RBS: Level 2	Brainstormed Risks
Legislative Framework/Policy	Planning Building Regs International Alignment	No policy or legislative requirements Imposed solutions Failure to challenge authority Lack of long term plan Lack of political courage Short Term Politics/economics Failure to implement No policy or legislative requirements Imposed solutions Failure to challenge authority International competition Everyone playing to different rules

Following this mapping process there remained 23 risks from brainstorming which did not relate to any of the RBS categories. These 23 were grouped into three categories to characterise the trends within these remaining risks. The three categories are Personal/Belief System (10); Commitment from Government/Other Organisations (6) and Other (7) – including war, population estimates, inertia. The number in brackets refers to the number of brainstormed risks associated with each.

DISCUSSION

It is acknowledged that this study is limited by the use of the same group of attendees during the same workshop. It is possible that the group were conditioned by the RBS approach during the brainstorming. Notwithstanding this fact the outputs from the two approaches are different in their nature, if not vastly different in content.

The most obvious difference between the two approaches is the number of the risks that were returned. The brainstorming returned 82 risks, whereas the RBS only returned 39. This includes all 38 Level 2 risks, and the Level 1 Risk – Misuse of Indicators – which did not proceed to any Level 2 elements. This difference is not surprising as the key objective of brainstorming is to generate a large number of ideas.

It is expected that only a small number of these will be of high quality. At first glance, the difference in number would indicate that the brainstorming produced up to twice as many risks. However, on closer examination the nature of the risks from the two approaches varies. The RBS tended to result in general sources as risks in both Level 1 and Level 2 (Level 1 being a higher level than 2). In contrast the brainstorming method has produced risks which were more specific and fall under one of the Level 1or 2 categories of the RBS. For example under the RBS category “Errors in Tools/Data Used for Models”, the mapped risks from brainstorming were i) acceptance of existing tools; ii) use wrong tool; iii) human error; iv) user error and v) believing we have got it right. Whilst each of these is a risk in its own right, they may not be appropriate to every assessment context. The headline risks produced by the RBS, on the other hand, allow the sources to be addressed in the context of the assessment being carried out.

The general sources of risk from Level 2 of the RBS which featured strongest in the number of risks produced from brainstorming were (i) the time dependent nature of the assessment – that it must be appropriate to the time for which it is being carried out; (ii) errors in tools and (iii) errors in the data used to build tools. Two other areas which featured heavily when brainstormed were marketing of the tool, and the impact that could have on the output and the assessment, and the legislative planning framework being a risk when carrying out an assessment. This indicates that the workshop attendees considered it possible to cascade these particular sources into a wide range of specific risks.

All of the RBS risk sources were considered by the 82 brainstormed risks. This did not occur the other way around. There are 23 which did not relate directly to the RBS. This is important in allowing the differences in the two approaches to be seen. The three categories which these 23 risks were grouped into show that most belong to personal belief systems and commitment from various organisations (eg. selfishness, responsibility, political and personal agenda, belief in experts, complacency, lip service). They do not relate to technical or implementation risks. This would suggest that the RBS is poorer in identifying those risks relating to beliefs and understanding. In contrast, both methods would appear to be strong in identifying technical and implementation risks. However these outcomes may partly be attributed to the conditioning of the group for the brainstorming following the RBS.

A comprehensive list of risks associated with developing an indicator of sustainability in a revised RBS (with the inclusion of personal beliefs and commitment) has been produced. The Level 1 source of 'misuse of indicators' has been moved to Level 2 under 'Appropriateness'. This is given in Figure 2.

Although for both the RBS and the brainstorming approaches the questions were phrased in the context of housing, there was no evidence in the risks identified that the participants restricted their thinking accordingly. It appears that the risks may be generic across all sustainability assessment of the built environment.

Level 0	Level 1	Level 2
Risks with Developing Indicator of Sustainable Hous ing	Omission	Tacit knowledge
		Measurement
		Unknowns
		Life Cycle
		Stakeholder Views
	Lack of consensus	Definition
		Appropriate Indicators
		Impacts - Consensus on them
		Context Specificity
	Appropriateness	Acceptability
		Time Dependency
		For whom?
		Scale
		Priorities
		Misuse of Indicators*
	Accuracy	Reliability of Data
		Conflicting Information
		Errors in tools/data use for models
		Transparency/Boundaries
	Method of Measurement	Bias
		Weightings
		Trade offs
		Scientific Knowledge
	Communication	Presentation
		Marketing
	VFM	Cost v benefit
		Cost & Boundaries
	Legislative Framework/Policy	Planning
		Building Regulations
		International Alignment
	Ignorance	Knowledge
		Timing
	Over complexity	Too Many
		Too difficult to understand
		Calculation
		Data is complex
		Too Expensive
		Too Subjective
		Over Simplified
	Conceptual Issues**	Beliefs
		Understanding

* Originally this source was in Level 1 of the RBS
** This category was not generated by the RBS but was added following the brainstorming exercise

Figure 2: Modified RBS for risks in with developing a housing sustainability indicator

CONCLUSIONS

The comparison of the two techniques has shown that both are suitable for identifying the risks associated with a sustainability assessment. The main difference between the outputs is that the RBS approach produces more generalised outputs, but the brainstorming approach identified specific risks which could fall into each of the categories of the RBS. Critically, the brainstorming identified further risks which did not fit into the structure. This is important for several reasons, not least that risks which are not identified cannot be managed. However, it is not impossible that had a different group of people been used, or the same group at a different time, the risks of personal belief and understanding would have emerged in the RBS. In this, the power of cross-fertilisation can be seen in using brainstorming rather than a RBS, as the group developed most of these risks towards the end of the session.

A further comparison of the two techniques has demonstrated that the brainstorming approach is more likely to produce 'unconventional' ideas which may have been restricted by the structure of the RBS. This is an important benefit of the brainstorming approach in developing a more comprehensive set of risks. However, this creative process also has disadvantages. Any time saved during the identification is offset with an increase in the evaluation time to get the risks in a usable format. However for the purposes of the research presented in this paper the initial development of a hierarchy with an RBS allowed this mapping process to be carried out relatively simply.

The comparison of the two techniques has shown that the brainstorming approach is more comprehensive, but can be more time consuming than the RBS. It has demonstrated the potential advantages of using a combination of two approaches. Additionally, through applying the two methods with the purpose of critically comparing them, insights into the nature of the outputs have been obtained which will assist users in selecting appropriate techniques for risk identification. This adds to knowledge in the differences between the two methods in application to risk in the built environment generally; not just in application to sustainability assessment.

In response to developing a set of risks for sustainability assessment, the combination of the two approaches has established a list which is considered to be comprehensive. This has demonstrated the advantages which can be obtained from the synergy of two or more techniques. The sustainability assessment problem was originally phrased in the context of housing, to ensure that a focus was maintained. However the resulting list of risks is considered to be sufficiently generic that it could be transferred to any sustainability assessment of the built environment. These should be tested in further applications.

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