VISUALISATION AND INFORMATIONS

Case Study

IMPLEMENTATION ISSUES FOR BUILDING PRODUCT MODELS (BPM) IN AUSTRALIA: A FRAMEWORK FOR INVESTIGATION

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ABSTRACT

Although much research has been undertaken into the development of Building Product Models, little has been done to investigate their apparent failure to be implemented within the Australian Construction Industry. Currently their implementation has been limited to a small number of demonstration projects and architectural firms using 3D CAD-based systems.

The aim of this paper is to establish a framework for the investigation of issues affecting the widespread implementation of Building Product Models within the Australian Construction Industry.

The issues contained within this framework have been identified from the relevant literature, with this paper discussing how these issues can be grouped into three main categories: Awareness, Organisational and Project related. In grouping the issues in this way, a holistic understanding of the potential concerns affecting such implementation can be gained.

Through the development of such a model we may now begin to grasp the complexity of issues affecting the widespread implementation of Building Product Models within the Australian Construction Industry and start to understand the connections that exist between such issues.

Keywords : **Building Product Model (BPM), Implementation Issues, Australian Construction Industry**

1. INTRODUCTION

Technologies are increasingly becoming part of our daily lives, with the speed of their uptake rapidly growing (Gleick, 1999).

This rapid development in technologies has allowed many industries, such as aerospace, automotive, manufacturing and electronics, to undertake major transformations of their business activities and create new and more effective business processes. Although industries such as these have been able to embrace technologies to transform existing business processes, and to create new ones, the Construction Industry (CI) has resisted implementing technological changes to its procedures. Many of the construction industry's current practices are based around those developed as the result of decades of incremental change.

Although a number of technologies, such as Computer Aided Design (CAD) and other specialist softwares, have been adopted by the construction industry, these technologies have had the tendency to automate existing procedures in an effort to improve task efficiency, rather than readdressing the procedure as a whole.

The result of such task-based implementation has been a focus on technology's ability to automate existing tasks, rather than on improving the overall process effectiveness (Aouad et al., 1999)

Since 1967 the vision for such a process improvement has existed within the construction industry. This vision involved the modelling of a building as an object, rather than a series of lines (Eastman, 1999). This concept directly questions the industry's current procedure and involves the implementation of new technologies.

Since the initial creation of this vision, the technology to achieve it has been developed and the benefits of such changes documented. However, widespread implementation has yet to be seen.

2. BUILDING PRODUCT MODELS (BPM)

2.1 DEFINING THE BUILDING PRODUCT MODEL (BPM)

The concept of modelling a building as a series of objects has taken on a number of terms over the years. One such term that has gained acceptance is that of "Building Product Model" or BPM. Eastman (1999) defines a Building Product Model as "a digital information structure of the objects making up a building, capturing the form, behaviour and relations of the parts and assemblies within the building". This definition broadly covers the large number of technologies that currently exist, while still adequately defining the procedure.

2.2 THE BENEFITS OF BPMS

It is suggested by Eastman that the concept of a building product model offers a potentially richer representation of project information than any set of drawings, with a model being able to be implemented in a number of ways (Eastman, 1999).

Through the use of a model, a building can be ‘constructed’ electronically, therefore allowing the project’s participants to identify possible problems with the design before physical construction takes place. In this way scheduling, material and other issues can be dealt with before starting physical construction.

The concept of a Building Product Model (BPM) also allows for the creation of a unifying technology for the industry (Best et al., 1996).

Use of a Building Product Model in this manner also helps to reduce the fragmentation of the industry through the creation of a unifying framework by which to store and access information. Overall the benefits relating to the implementation of Building Product Models within the construction industry include time savings for projects, better information exchange and cost savings (Aouad et al., 1999)

2.3 BPM’S CURRENT USAGE

While there have been many prototypes of building product models developed since 1967, there are now only a few building product models in existence (Eastman, 1999).
Those models that have been developed thus far, have been done so by a specified consortia of users and vendors (Eastman, 1999), and as such have not achieved widespread implementation.

The result of this has been that Building Product Models thus far have typically been restricted to use on ‘demonstration’ projects, where external groups have assisted with their implementation.

Although building product models are still to be fully developed, they currently offer a large number of capabilities that are yet to be utilised by the industry.

2.4 BPM’S POTENTIAL FUTURE USAGE

Weisberg (2000) argues that the next few years will see significant changes in the way developers, designers, consultants and contractors manage the entire building process due to the implementation of technologies such as Building Product Models.

While industries such as aerospace, automotive, manufacturing and electronics have been able to use modelling to improve their industries, the construction industry has currently avoided such a transition. However their eventual implementation is seen as almost inevitable due to the fact that the construction industry is “currently the only major industry that produces 3D products that is not using some form of product model.” (Eastman, 1999)

While these other industries may offer insights into the problems associated with their implementation, the construction industry differs in a number of ways and is seen as having its own unique issues that need to be addressed.

Therefore it is the aim of this paper to identify the issues that are affecting the potential benefits achievable through the implementation of Building Product Models.

3. ESATBLISHING A FRAMEWORK FOR ANALYSIS

3.1 IDENTIFYING THE ISSUES

A detailed literature review has been undertaken to identify the issues affecting the implementation of Building Product Models within the Australian Construction Industry.

While previous research has identified a large number of technical issues, a review of current literature has also revealed a number of non-technical issues.

Looking holistically, fourteen separate issues have been identified from the literature, and these have been grouped under the three broad headings of ‘Awareness’, ‘Organisation’ and ‘Project’.

A brief analysis of each of these fourteen key areas follows.

3.2 AWARENESS

Awareness is crucial to the implementation of Building Product Models. If one is unaware of a technology, then there is little chance that they will implement it.

It is for this reason that awareness has been identified as a starting point for the identification of issues affecting the implementation of Building Product Models.

It is only once a level of awareness has been achieved that the other issues identified in the literature will come into play.

3.3 ORGANISATION

Organisational issues, for the purpose of this framework, have been identified as those factors that relate to the implementation of Building Product Models from an organisational perspective. Organisational issues therefore relate to the goals and perspectives of an organisation as a whole as well as the individuals making up that organization.

3.3.1 Evaluation of Technologies

The manner in which a technology is evaluated will greatly effect the perceptions of that technology. If a technology is evaluated in a positive way, then it is more likely to be implemented than one that is seen in a negative way.

The issues relating to the evaluation of technologies identified within the literature include those based on both cost and productivity. Both of these evaluation methods, if not used correctly, can result in a technology being seen in a negative light which could reduce the potential for that technology’s implementation.

3.3.2 Over Reliance on Technology for Solutions

One possible issue to come from the evaluation of technologies is an over reliance on a technology as the result of an overly positive or optimistic evaluation of that technology.

Two main issues were identified within the literature as possibly leading to an over reliance on technologies. The first being the difference between the actual information made available by a technology and that received by an individual (Smith et al., 1977) and the second being the potential to rely on technology as a driver, with the assumption that a technology itself will result in beneficial changes. (Aouad et al., 1999).

3.3.3 Disappointment with Technologies

The over reliance on technologies can result in their failure to perform as expected, which can lead to disappointment. Based on the literature the main reason for disappointment with technologies is unfulfilled expectations, resulting from the implementation of flawed systems (Kamara and Anumba, 2001) or an over-reliance on a technology to provide benefits that were never realistically achievable (Sun and Aouad, 2000).

3.3.4 Ambiguity of Responsibility

Evaluating a technology in a pessimistic manner can lead to a number of factors affecting the implementation of a technology. The main issues identified in the literature that relate to ambiguity of responsibility are related to a fear of information overload, due to a perceived failure to determine participants' responsibilities (Emmitt and Grose, 2003), the fear of criticism over decisions with an increase in the number of participants potentially assessing a decision (Eastman, 1999), a perceived restriction to the design process due to the need to abide by another structure (Sun and Aouad, 2000) and the potential for confusion over the risk and reward distribution structure for a project, in that it could be unclear as to who is taking the risks and therefore who should receive the rewards (Loosemore, 1998).

3.3.5 Increased Structure

Another issue related to the pessimistic evaluation of technologies is that stemming from the fear of an increase in structure. This relates directly to the ambiguity of responsibility addressed above.

The literature suggests that the increase in structure could lead to a failure to allow for unintentional communication (Buckland, 1990), with information tending to be communicated through formal channels, a reduction to the unplanned access of information (Chang and Rice, 1993), and, finally, the possibility to increase the reliance on formal communications resulting in a reduction informal/relationship- building communications (Trenholm and Jensen, 1995)

3.3.6 Ownership & Control

Ambiguity over responsibility and the fear of an increase in structure can both relate directly to the ownership and control of project information. Professions currently have known ownership and control of information that is dictated by the traditional organisation structure. The literature suggests that this will change due to the implementation of building product models, which could result in the fear of sharing information. This fear may be due to the concern that the shared information may be used against them or that they may lose control and therefore not gain the benefits of the information's use.

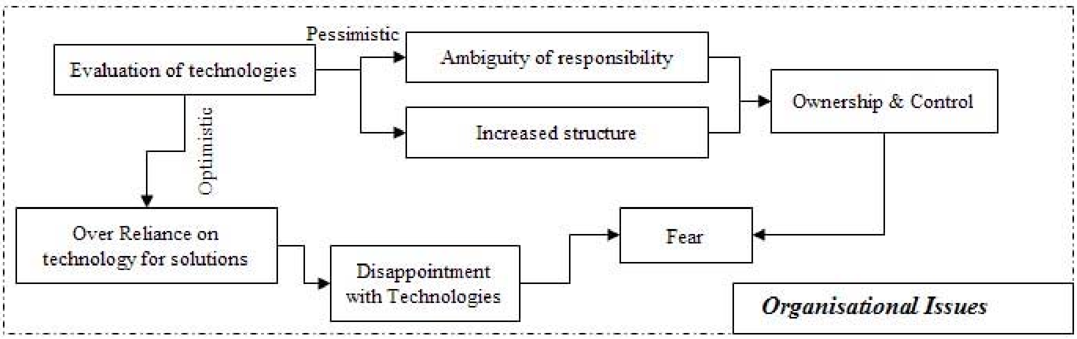
3.3.7 Fear

The final organisational issue that has been identified in the literature is that of fear.

The main issues identified were linked to the possibility for conflicting interests among participants (Grunederg, 1995), the protection of professions by their members with each profession seeking to protect their current position (Burkhardt and Brass, 1990), the fear of change (Hemmett, 1996), and the threats that are perceived by technologies which relate back to their pessimistic evaluation (Low and Sloan, 2001).

3.4 ORGANISATIONAL MODEL

The following model identifies a framework for the organisational issues identified above. It shows how these issues interact, from the way in which a technology is evaluated through to the potential for fear to develop as an obstacle to the implementation of a Building Product Model.



3.5 PROJECT

Project issues, for the purpose of this framework, are those issues that relate to the characteristics of a specific project Project issues therefore relate to the way organisations within the industry interact within a single project.

3.5.1 Project Characteristics

The characteristics of a project directly affect the implementation of a technology. In assessing the characteristics of projects two main issues must be considered. The first is that of an organisation's technical capability and the second is the ability of the project members to coordinate their efforts.

3.5.2 Technical Capability

If an organisation displays insufficient technological capability then there will be an inability to implement a technology.

The technical capability of an organisation is therefore crucial and can be explored on two levels. The first is the skills possessed (McCreadie and Rice, 1999) and the second is the accessibility of the required hardware and software. If the participants within a project have neither the required skills nor hardware then this will impede the implementation of a technology.

3.5.3 Coordination

If the project participants posses the required level of technological capability, then the next issue that needs to be addressed from a project perspective is the ability to coordinate the various project participants within the given project environment. Through the literature it is suggested that a number of factors exist, including the possibility of the task being seen as too big for one organisation, with a large number of organisations needing to work together (Eastman, 1999). This also leads to the potential for an uncoordinated uptake of technologies, which may result from the failure to identify a common goal for the project (Hillebrant and Cannon, 1990); (Atkin and Pothecary, 1994) The final issue identified in the literature would be a failure to address the requirements of the users within a project (Milis and Mercken, 2003).

3.5.4 Complacency

Should both the technological and coordination issues be adequately addressed by the participants involved and the technologies still fail to be implemented then the cause could be complacency. The issue of complacency has been viewed in a number of ways within the literature and can result from the industry's resistance to change (Mohamed and Tucker, 1996), the reliance on existing structures and procedures (Eastman, 1999), the task specific nature in which technologies within the construction industry are developed, the industry's reliance on incremental changes (Eastman, 1999), a failure to embrace technologies (McCreadie and Rice, 1999), and finally, the reluctance of users. (Milis and Mercken, 2003).

3.5.5 Industry Structure

Problems encountered in the coordination of a project may in part be due to the way the industry is structured. A number of factors that could contribute to failure to implement technologies have been identified, including the 'Traditional' organisational structure that now dominates the industry (Mohamed and Tucker, 1996) and the organisational stability that exists because of this (Burkhardt and Brass, 1990), the standard methods of communication that have been developed as part of this 'traditional' organisation structure (Eastman, 1999), the reliance that has developed by professions for these existing systems, especially those based around paper systems (Emmitt and Grose, 2003) and finally the professional cultures (Brownell et al., 1997) that have developed because of this traditional structure being developed over a number of years.

3.5.6 Industry Environment

The industry environment is seen as being made up of two factors. The first factor is that of legal requirements within which the industry must operate and the second is the social environment that exists.

3.5.7 Legal requirements

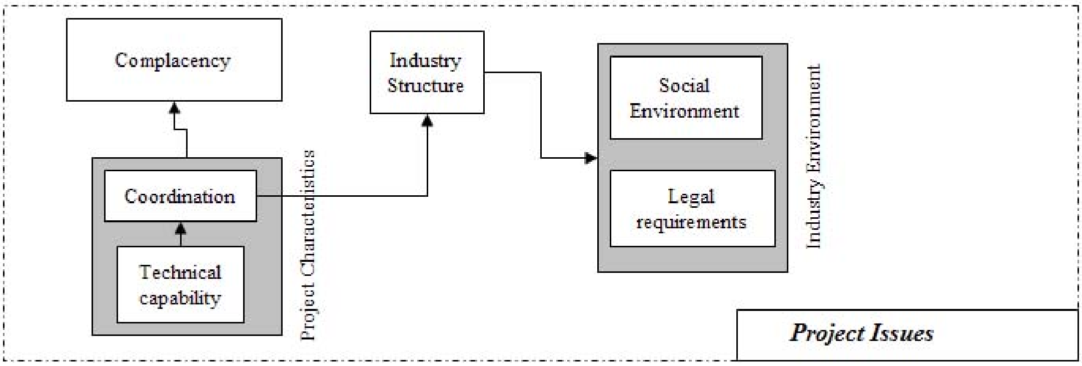
The construction industry's environment will be determined to a large extent by the legal constraints under which it must operate. These include the contractual requirements with which all participants must comply, the contractual nature of communications and the other bureaucracy requirements (Brandon et al., 1998) that exist as part of a project, including local and state government legislations.

3.5.8 Social Environment

The final issue to consider on a project level is that of the social environment. The social environment encompasses all the social issues that relate to the industry, including that of trust (Roberts, 2000) and the assessment of trust that exists between the participants in a project, the social context that exists, the participant's willingness to work within the system (Burkhardt and Brass, 1990), the profession-specific languages (Emmitt and Grose, 2003) that have developed, the need to work within the various organisational cultures (Brandon et al., 1998) and the context that is established for the remainder of the project to work within (Emmitt and Grose, 2003).

3.6 PROJECT MODEL

The following model identifies a framework for the project issues identified above. It shows how these issues interact on a project level and includes a number of factors identified within the literature that are said to affect the implementation of Building Product Models on a project level.



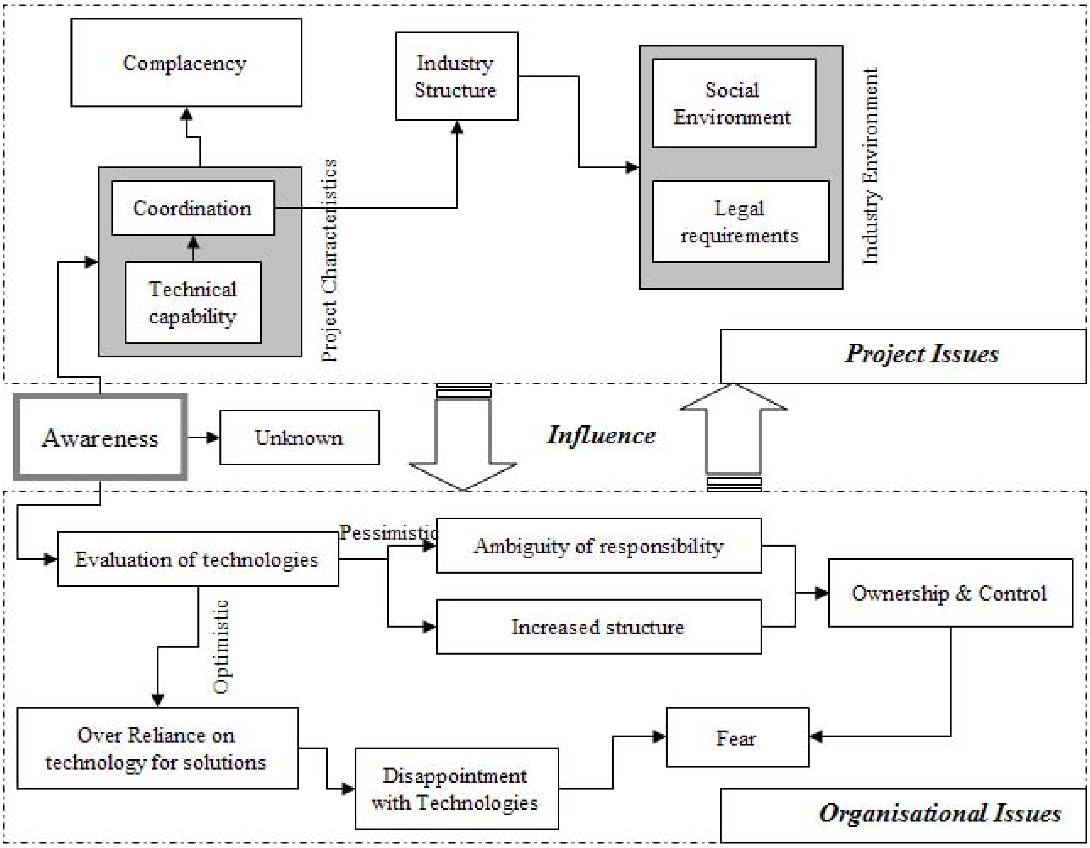
3.7 THE HOLISTIC MODEL

When exploring the implementation of Building Product Models it is initially advantageous to group the issues into a smaller number of key areas, so as to ensure a thorough investigation. However, to apply this at an industry level requires a more holistic view.

As such the development of a holistic model has been undertaken to identify the interaction that exists between these two groups.

Such interaction exists due to the interdependence of projects and organizations, in that a project is made up of a number of organizations, which are then directly influenced by the projects that they are involved in.

As such, the following model combines both the Organisational and Project Models to form a holistic framework of the issues affecting the implementation of Building Product Models.



The starting point for the above holistic model is that of awareness. While other studies have focused on technology as a starting point to the implementation of building product models, the above model takes a broader view and uses awareness as this starting point.

As can be seen in the above model, technology only forms one small part of the multitude of issues that can restrict the implementation of Building Product Models. By wrongly focusing on a single issue, such as technology, a large number of other issues are either neglected or misrepresented as being technical in nature.

The other benefit of this model is its holistic nature. To view these issues in isolation is misleading as all of these issues influence one another in some way. To consider an issue without also considering the context within which that issue exists could result in a misrepresentation of the issue; for example, if one is concerned about the control of information, they may fear the implementation of such a technology that relies on the sharing of information.

In this way the above framework allows for a holistic view of the issues affecting the implementation of building product models within the Australian Construction Industry.

4. DISCUSSION

The holistic framework established above brings together the issues currently affecting the implementation of Building Product Models within the Australian Construction Industry.

In order to test these issues, a number of factors have to be considered, such as the availability of data and its format, as well as the resource constraints that exist.

Due to the limited usage of Building Product Models within Australia there is a current lack of published data available as to such issues. As such it has been decided that use be made of a case study. Due to the limited number of projects currently available a single live case is to be used. Use of a single live case will allow for a rigorous investigation to be undertaken of each key project participant, while a project is being undertaken. By allowing for key participants to be investigated while a project is underway a better understanding as to the current issues will be able to be identified. This investigation is to take the form of a semi-structured interview that is intended to evaluate the framework that has been developed in this paper.

5. SUMMARY

A number of benefits to implementing Building Product Models within the Australian Construction Industry have been shown within this paper and evidence to support their eventual implementation given.

Although such benefits exist, the current limited level of implementation would suggest that the construction industry is currently struggling with their implementation.

The holistic model explored above has been created in an effort to identify the scope of issues restricting such implementation and to create a framework for their further analysis.

It is intended that such a framework be used as a starting point for the evaluation of these issues, and that such an evaluation will lead to the further implementation of Building Product Models within the Australian Construction Industry.

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