SUCCESSFULLY IMPLEMENTING SYSTEM INNOVATIONS WITHIN THE CONSTRUCTION PROJECT ENVIRONMENT

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The construction industry has recently realised that their low levels of innovation has the potential to seriously damage the long- term future and sustainability of the industry. The source of the problem within the industry centres on the implementation process as opposed to idea generation and creativity capabilities. This has been significant in highlighting the need to address the problem of implementing construction innovation. This paper focuses on the implementation process of innovation within the project environment, where the industry largely operates as a mode of production. The implementation of partnering within three publicly funded construction projects are used as case studies for this research, and analysed using the principles of grounded theory to produce a model of the implementation process. Partnering is defined as a system innovation (management based innovation) and the paper focuses on this context of innovation implementation. The paper provides a model of the innovation implementation process highlighting the factors of influence and requirements for its successful management. The findings draw attention to the dominance of factors influencing the innovation process that relate to the team and the need for facilitation of the overall cultural environment within the project.

Keywords: case studies, construction projects, grounded theory, implementation process, innovation

INTRODUCTION

The need to improve the level of innovation within the construction industry has been the source of discussion within the U.K. both academically and industrially over the past decade. The significance of this has raised the awareness that the current low levels of innovation have a negative influence on wider problems such as productivity, quality and the increasing difficulties within project management currently facing the industry (Nam and Tatum, 1989). These low levels feature as concerns within reports such as Egan (1998) and Fairclough (2002) which acknowledge the need to break away from time- honoured traditions (Chinowsky, 2001) and embrace the ever changing environment in which modern businesses operate. Gann (2000) and Nam and Tatum (1989) have cited the low levels of innovation as a symptom of an industry that has failed to acknowledge and adapt to market needs and change its practices. This need to improve the levels of innovation within construction has been representative of the wider agenda of 'rethinking' the nature of construction, to address the wider competitiveness problems.

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Over the past decade much of the research relating to innovation within construction has attempted to ask the question: How and why a situation such as this has occurred and developed almost within out corrective action being taken? Construction as a mode of production is largely founded on the principles of problem- solving and operates in a largely one off project environment, conditions that require a high degree of creativity at all levels of a project team. However, academics such as Nam and Tatum (1989), Mitropoulos and Tatum (2000), Gann (2000) and Winch (2000) suggest that the low level of innovation within construction is not related to levels of idea creation or creativity, but are rooted in the industries inability to effectively adopt and utilise innovations. This apparent failure to effectively manage the implementation process of innovation is a situation clearly restricting the evident potential for change and improvement.

This paper investigates the effective implementation of innovations within construction, by assessing the problem from a project perspective. It is argued that the majority of research tackling the innovation problem has been focused at strategic or industry levels, or on particular types of innovations. As a result it has failed to understand the implementation problem within the project environment. The work of Gann and Salter (2000) and Gann (2000) has been significant in highlighting the need to understand innovation within project- based industries such as construction. This paper provides a model of the implementation process for system innovations based on the context of three construction projects using partnering as an innovation.

REVIEW OF CONSTRUCTION INNOVATION

Innovation within construction has neglected the project environment as a viewpoint from which to address the problem. Koskela and Vrijhoef (2001) observed three predominant lines of enquiry to which innovation has been assessed, these being, a) an assessment of the problems of implementing specific types of innovation, thus failing to understand the generic situation, b) assessments of the problem from a strategic or industry viewpoint (e.g. Egan (1998) and Fairclough (2002)), and c) within the emergence of the organisational perspective. This has resulted in a high level discussion, with limited assessments of specific individual case studies, failing to address the wider generic problems of innovation implementation. The Rethinking Agenda has identified the significance of innovation at the high level highlighting the need for a cultural change. The emerging awareness of the strategic and cultural need for innovation within the construction 'organisation' and the apparent failure to assess innovation within the project environment, is symptomatic of a wider neglect within general management literature to assess innovation within the context of project-based industries, as identified by Gann and Salter (2000).

Mitropoulos and Tatum (2000) suggest that the innovation problem within construction was rooted predominantly in the inability to effectively implement innovation, as opposed to an idea creation problem. The need to consider innovation implementation is therefore required to take place within the context in which construction operates as a mode of production namely project- based. General management predominantly considers innovation within the context of industrial sectors such as manufacturing, where management has significant control over the environment in which the innovation occurs. In contrast construction is project driven, existing within an environment that is predominantly multi- party and temporary by nature. Although general management has considered innovation projects within the organisational context, these remain within the wider strategic

context of the organisation and therefore are tied to its structural processes and cultural behaviours. Consequently there is a need, as Gann and Salter (2000) have observed, for innovation to be considered within the project driven environment and from a construction perspective, to understand effective implementation of innovations.

INNOVATION AS A PROCESS

Recognising that innovation through its very definition (Freeman, 1989 (cited in Tidd et al, 2003)) exists as a process, assists attempts to understand and engage with the concept in practice. Researchers such as Cooper (2001) identified the stage- gate approach for innovation, and Van de Ven et al (2000) observed that the innovation process could be compared to a journey passing through several stages and phases. Models such as these have highlighted the need for facilitation throughout the innovation's lifecycle, in order to improve the chances of successful implementation. This observation can be seen by the establishment within many manufacturing organisations of an innovation manager or team, set up with the purpose of overseeing the lifespan of the innovation.

Within construction it is necessary, to adopt the notion that an innovation occurs as a process and therefore requires to be managed throughout its lifespan. Due to the multi- party and temporary nature of construction innovation is traditionally not regarded as a process requiring management, unlike the remainder of the project. As a consequence, the project can potentially fail to exercise control over the innovation's journey, resulting in poor or unsuccessful implementation of a potentially good innovation. Tidd et al (2003) and Rogers (2003) suggest an innovation occurs when those implementing it have no previous experience of it suggesting that the creation aspects of the process can either occur within the project or can be imported. As a consequence, an innovation requires consideration as a process from its point of entry into the project, wherever it is generated.

DIFFERING TYPES OF INNOVATION WITHIN CONSTRUCTION PROJECTS

Totterdell et al (2002) argue that innovations have to be considered as possessing differing attributes, which affect the management requirements of the innovation. The common manner to assess the innovation's attributes has been to assess the innovation by its a) type, b) scale and c) with relation to its source of origin. These are criteria that have been commonly followed by the likes of Tidd et al (2003) and Burns and Stalker (1995) who argue that individual innovations require to be tailored in a management sense, depending on the nature of the organisation and the attributes of the innovation. Within the construction project there is a need to understand the attributes that an innovation possesses, in order to increase the effectiveness of its implementation, due to the individual nature of the project environment.

This paper investigates the findings of a particular type of innovation. Within the construction project there are three main types of innovation that require to be considered, a) the system innovation (project management innovation), b) the process innovation (technological innovation representing the entire project) and c) the component innovation (the innovation of a particular element within the construction project) (adapted from Rogers (2003) and Tidd et al (2003)). It is acknowledged that whilst product innovation is a major driving force within innovation thinking

generally, it is difficult to represent this concept at the project level within the construction industry, due partly to the uniqueness of each project and the level of importance that a product innovation places on a project. This paper focuses on innovation within system innovations, with the aim of providing a model that represents the implementation processes for this type of innovation within a construction project.

METHODOLOGY

System innovation

Within this paper a system innovation relates to 'the creation and implementation of a new management means of achieving the end product within the production process' (adapted from Rogers (2003) and Tidd et al (2003)). Systems innovations are of particular relevance as the Rethinking Agenda has suggested that the industry should assess the suitability of a number of manufacturing based management concepts and attempt to adapt them, to their context. This paper will focus on the implementation of partnering as an innovation that has become established over the last 5 years and is currently being seen, as a means of reducing contractual disputes and also improving the general culture within construction projects. Three publicly funded construction projects were studied: the construction of a new secondary/ primary school with the local council as the client and two, client based housing association projects. Although partnering has existed for a number of years, the implementation of the concept within all of these projects represented a significant change of practice for a high proportion of the project teams and thus an innovation for their organisations. The case studies, although attempting to implement a similar innovation, represent sufficient individual diversity to supply effective comparison, whether it is through differing conditions, experience levels within the team, or differing project and external factors affecting them.

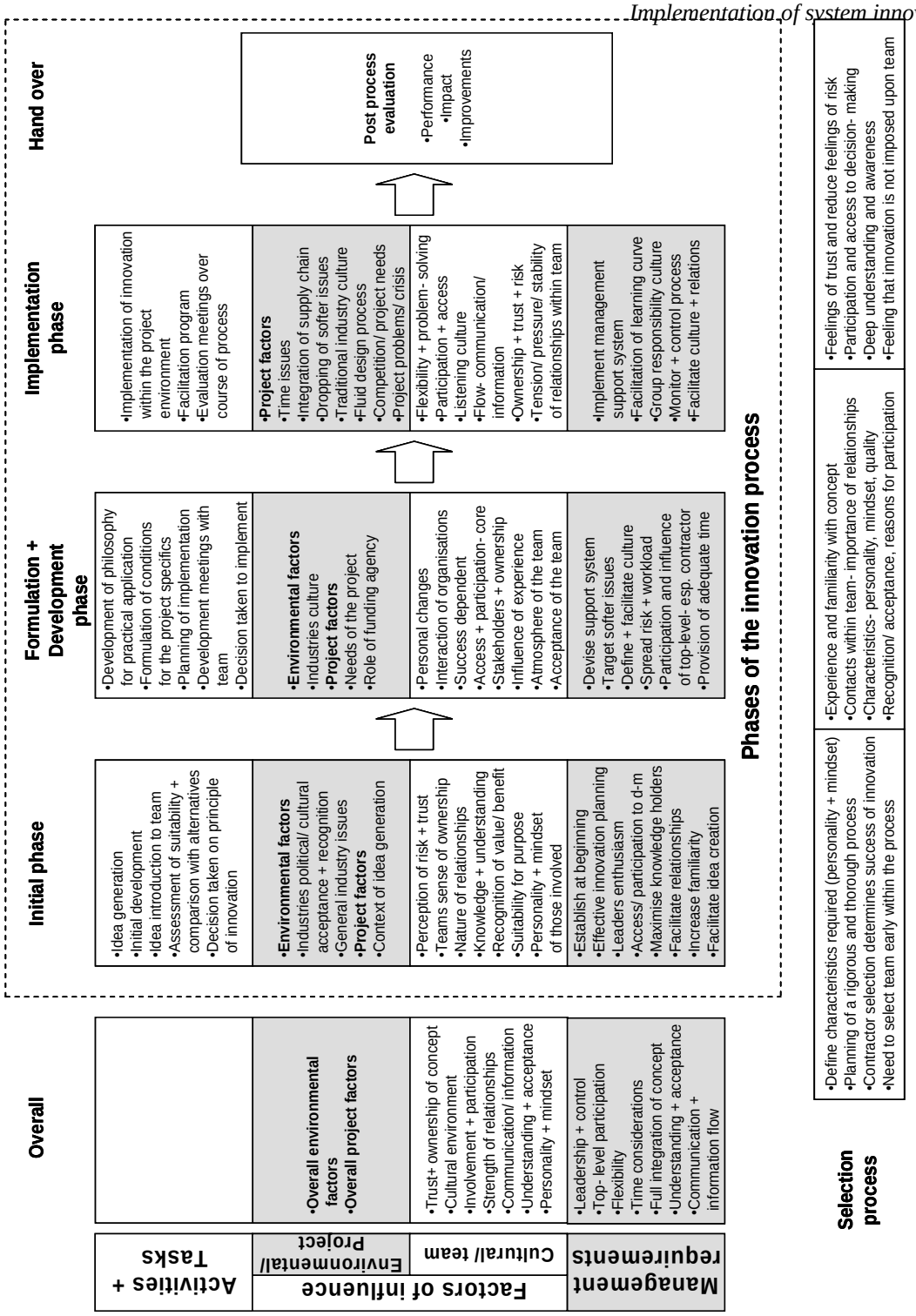

Figure 1- The System Innovation Process Model

A case- study approach- longitudinal

The longitudinal approach was selected as it allows interviews to be conducted over the course of the project's lifespan. Interviews were conducted with all of the relevant members of the project team, with a series of follow up interviews conducted when required to ensure that changes in individuals' opinions and observations are recorded. This is the only effective way, within a live project, to map the innovation. The analysis of the interview transcripts was conducted using the principles of grounded theory (Glauser and Strauss (1967)), with the assistance of the Nvivo (QSR) qualitative methods tool. The creation of the node structure remained completely open and uninfluenced apart from the interview transcripts; as the intention within this

research is to theory build (construct a model) as opposed to testing established thinking.

The system innovation process model

The model developed from the grounded theory approach is shown in figure 1. This takes the form of a process, with four distinct phases which the innovation passes through from idea creation to the termination of its use. The four phases, flow as a journey with the transfer from one phase to another occurring when the requirements of the activities of the phase have been satisfied (similar to Cooper's (2001) use of decision gates within the stage gate model). The model demonstrates four attributes for consideration within each phase, 1) the activities or tasks, 2) the environmental factors of influence, 3) the cultural factors of influence within the project team and 4) the management requirements identified for successful progression. The model includes a series of overall influences and management requirements for the innovation process as a whole which operate through all four phases. The inclusion of the selection process and its requirements is also necessary within the model, and this has to be considered over the course of the innovation process due to the fluid nature of the team's selection during the project.

The nature of the lifespan of the innovation (system) process is closely tied to the overall duration of the project process. The first two phases of the innovation process enjoy the same duration periods as the inception and development phases of the overall project. The implementation phase of the innovation process occurs once the project moves to the design and construction phases. This phase requires to accommodate the potentially phased nature of the project and also the fluid nature of the design phase. The hand over phase of the innovation process mirrors the hand over phase of the project also. The close alignment of the stages and phases of the innovation process with that of the overall project process highlights the importance of the innovation to the project as a whole. The next section briefly explains within the context of the four attributes.

Overall

Within a phased model such as this, there is a requirement to represent and consider the influencing factors and management requirements for the overall process. These are factors and requirements that have influence within all of the phases of the innovation process, and require observation and consideration by those involved. The research identified the innovation process as being affected by a range of environmental factors connected to both the project and the industry. The project has considerable influence over the innovation through factors such as budget problems, site features, timescale issues and periods of crisis. The innovation is influenced by the industry both culturally and structurally on the innovation process, with factors such as the inability to utilise specialised contractors, the influence of publicly funded projects and issues relating to insurance when using the innovation.

These key themes arise in the overall factors of influence and management requirements namely, 1) facilitation of the cultural environment, 2) the need for effective management and leadership of the process, and 3) the facilitation of the team's acceptance and interaction with the innovation. These themes need to be targeted on a process wide basis and not solely within individual phases of the process for the success of the innovation.

Selection process

The case studies highlight the influence of the selection process in shaping the overall culture of the team and their ability to interact with the innovation process. The nature of the 'construction project' makes a singular point of selection for a team difficult due to the varied and fluid nature of the required participation within the team. Within the model therefore the selection process is displayed as a process separated from the flow of the innovation process, and represents the requirements from the process when an individual of the team is selected. The case- studies illustrated that the principles and requirements of the process with regard to the innovation should be constant for all the team members regardless of status or role. The selection process represents an overall project activity and is not solely guided by the needs of the innovation, however within the context of the system innovation the facilitation of the selection process to the needs of the innovation becomes an area requiring attention.

Initial phase

This phase of the process incorporates a series of activities taking the innovation from the generation of the idea within the project, to the decision determining the acceptance of the innovation in principle for its further development. Management needs to ensure that an adequate environment for idea generation is provided culturally though the promotion of creativity and problem- solving attributes within the team. Following idea generation, the concept needs adequate resources for its initial development. The phase has to adequately assess both the suitability of the innovation for the project, as well as the provision of adequate consideration of the potential alternative options. The case- studies illustrated that a key management requirement for this phase is for the consideration of the cultural and team attributes in order to facilitate acceptance. The factors of influence and management requirements identified within the initial phase point to the need for acceptance through both a careful planning process and the clear presentation of the innovation, to ensure the teams trust, ownership, understanding, the recognition of its value and its overall suitability for purpose. The key management requirements enhancing innovation include; the team's knowledge, understanding and general ownership of the concept. The need during this phase is for management to provide understanding of the innovation, ensure cultural association and involvement within the team for the process, and provide enthusiasm for its use.

The nature of the innovation process is influenced heavily by the environmental factors acting upon the initial phase of the process. The context of the idea generation has considerable impact on the process depending whether the idea was generated internally or externally from the project team.

Formulation and development phase

Following the acceptance of the concept in principle by the team, the authority is then passed for the development of the philosophy for practical application. The formulation of the conditions and development of the innovation for the practical application of the given project is important particularly with regard to system innovations which tend to be based on a philosophy and require to be tailored for the needs and requirements of the project at hand. Planning of the implementation process is required within the phase and there is a requirement to achieve a high degree of involvement within the team in order to achieve their acceptance and to benefit from their contribution. The phase is influenced by environmental factors impacting upon the process, where the culture of the industry and the potential influence of the projects funding body define the nature and levels of resistance.

The case studies revealed that factors of influence requiring consideration within this phase focused on the need to facilitate the team's involvement, cultural acceptance of the concept and overall contribution to the process. The ability of the team to draw on experience (both internally and externally), and the need to ensure stability within the team in terms of relationships and personal is identified as being of influence to the overall success of the process. The perception of success within the team is identified to be of influence within the team by impacting upon their enthusiasm and mindset towards the concept.

The management requirement for this phase needs to ensure that the process is ready for the implementation phase of the process to begin. For a decision to be taken by the team to implement the innovation, those making the decision require to be convinced of its suitability for application. There is a clear need therefore to facilitate cultural aspects such as ensuring participation and influence within the process for the projects top- level, with particular benefits and emphasis placed upon the contractor. Management requires to ensure that adequate time is allowed for the planning of the implementation phase. The type of cultural environment desired within the project has to be defined in order to develop strategies to facilitate its existence. The planning and development of a management support system during implementation also has to be considered, in addition to the assessment of the need for workshops, meetings and additional facilitation of the cultural environment during implementation.

The case studies illustrated the need to ensure that the softer issues associated with the innovation are targeted for additional management assistance during implementation, as evidence showed that they became particularly vulnerable during periods of project crisis and were often dropped. Team members were identified as being influenced strongly by the perception of risk associated with the implications of the innovation during implementation. Management therefore requires to target this issue, ensuring that the risk posed by the implementation of the innovation on their project role is perceived as minimal.

Implementation phase

This phase incorporates the activities that take the innovation from a planned and developed concept, and implements it within the realties and difficulties of the project environment. Within the case studies the significant factors of influence related to the problems faced within the context of the project environment. Those most significant were, time issues (i.e. delays, the need to rush both project and innovation processes), pressures encountered relating to the specific needs and requirements of the project, and the influence of the traditions and complexities of the construction industry. The failure to effectively implement the innovation to the site level within projects is symptomatic of the cultural response taken by a team to such factors.

The case studies revealed that cultural barriers within project teams restricting the performance of the implementation phase were predominantly the reaction to a crisis of some description within the project. It is apparent that during a project crisis there is an associated cultural resistance to the innovation, related to the perception of risk associated with the innovation's use when attempting to achieve the resolution of the crisis. Such cultural attitudes are largely formed on the basis of inexperience of the innovation and a lack of trust in its ability within the context. From a management perspective it is naive to assume that this problem can be prevented by the removal of project crises and the control of the influencing factors. The best method of protecting

the innovation during implementation is in the control of the cultural reaction to and implications of such factors and crisis. Protecting the innovation from the negative cultural affects of the project environment and the pressure that this places on those operating within is a task that can only be achieved through the provision of an implementation management support system.

The requirement for management to facilitate the implementation phase culturally requires it to be structured with the provision of workshops, team building sessions, the use of innovation facilitators where necessary, and regular meetings. The facilitation performs three central functions- a) it needs to facilitate the teams learning curve, by developing the levels of both understanding and acceptance which the team shares for the innovation, b) provide access and participation opportunity within the decision- making process for the entire team, c) facilitate the cultural relations within the team.

The case studies highlighted the need to monitor the implementation phase as the best mechanism for the leader of the process to achieve control. The ability to adjust the facilitation process when required and apply the appropriate levels of leadership can only be achieved by careful monitoring of the progress of implementation. The provision of feedback meetings and regular contact with the project team allows the leader to be reflective of the situation and adjust to the needs of the given context. This can be viewed as a preventative measure whereby the leadership can keep on top of the situation. However, evidence illustrates that for partnering projects due to the leadership position being occupied within the project predominantly by the client, this may prove difficult in reality and therefore requires consideration. It is necessary during this phase to protect and facilitate the innovation from the cultural problems presented within the project environment. However, it is important for management to ensure that this protection of the innovation is only provided when the needs of the project are catered for though the use of the innovation. When the project begins to suffer as a direct result or is hindered through the use of the innovation then management has to consider its suitability and the justification for continuing its implementation, and to begin an evaluation of alternatives. The role of the innovation management support system is to protect the innovation during implementation from the cultural uncertainties caused by difficulties resulting from project factors that put strain on an inexperienced team, and not to prop up a failing innovation that is no longer appropriate for the situation.

Hand over

The model shows the requirement for a final phase of the innovation process. This handover can be overlooked by management commonly as it represents the end of the project process and therefore also the termination of the innovations within the project. It is both beneficial and of value that the innovation process ends with a post process evaluation. The need to evaluate both the performance and impact of both the innovation and its overall management within the project requires assessment in order that those involved can learn and improve for future projects and use of the innovation. This is an activity that occurs within the context of the project's performance and therefore it is possible to conduct this at the same time. This is a process clearly observed in all of the case- studies as occurring at an individual team member level as they assess their interaction with the innovation. One of the case studies highlighted that it is necessary and effective to structure this activity formally at a team level to strengthen the process and maximise the learning experience throughout the team.

CONCLUSION

The importance of the team and the cultural aspects of the project to the innovation process are perhaps not surprising given the nature of the system innovation. Project management related innovations through their purpose target the team and culture of a project and aim to provide an innovative method by which they operate within the project. Therefore, it is logical to assume that the success of the innovation is significantly determined by the ability of the process to address the needs of the cultural environment and the need to engage with the team. The case studies highlighted three requirements of management attention to facilitate this, 1) an adequate lead in time prior to implementation for the development and planning of the innovation, 2) the need to regard the innovation as a process requiring management in the same manner to any other aspect of the project and 3) the provision of a management support system during implementation to facilitate the needs of the team and cultural environment.

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