

## 37 IMPLEMENTING TECHNOLOGICAL CHANGE IN CONSTRUCTION ORGANISATIONS

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### *Abstract*

*The advancements in information technology and developments in hardware and software platforms have often created the need for companies to undergo organisational changes in order to embrace the latest technologies. The extent to which this has occurred varies considerably, and is often carried out on an ad hoc basis in order to establish operational systems for immediate use. However, to realise the full potential of the technology, appropriate implementation needs to be carried out to suit particular requirements and establish systems that, not only function correctly, but allow users to make full use of the technology. Addressing technological and organisational issues, together with the employment of appropriate methodologies is therefore essential to successful implementation. This paper focuses on the organisational change that must accompany the implementation of integrated information systems within construction organisations. Knowledge is drawn from experience gained from research on the implementation of an integrated Management Information System within a medium sized construction firm. Key problem areas identified that need to be addressed are those of communication, planning and gaining top management commitment. Greater communication is required both laterally and vertically. Staff at lower levels, need to communicate via user groups and also need to be informed by senior management of proposed changes. Planning needs to take place whereby realistic and measurable short term goals are set in order to realise longer term goals. Resistance to change at management level also requires special attention. Threats and opportunities facing managers with respect to the new system need to be evaluated and dealt with accordingly. The accompanying social change which must occur in order to embrace integrated systems cannot happen of its own accord. It must be an integral part of the implementation process if staff are to make the transition from 'computer management' to 'information management'.*

**Keywords:** *technological change, methodologies, integrated management information systems, implementation, construction organisations*



## **INTRODUCTION**

The integration of construction processes using Information Technology (IT) offers considerable potential for construction firms (Griffiths, 2000). However, despite these promises, there are often significant implementation problems associated with the adoption of integrated Management Information Systems (MIS) (Taylor, 2000; Thong, 2001; Huang, 2000; Shrivihok, 1999; Hsin, 2000; McKeen and Guimaraes, 1997). The implementation process is essentially, multi-faceted and includes technical, business and organisational aspects. Both the technical and business dimensions are well documented (Hinds, 2000; Whyte and Bytheway, 1995). The organisational dimension, however, is the least documented and is something that is perceived as an interference that is usually dealt with after the system has been installed. It is in fact the lack of attention to this organisational dimension that has been the dominating factor in the poor implementation of integrated systems that do not realise the goals they originally set out to achieve (Thong, 1997; Horwitt, 2000).

In order to investigate the organisational problems associated with implementing an integrated MIS, the case study of a medium sized construction firm is used as an exploratory vehicle (Blaza, 1995).

## **THE CASE STUDY**

The construction company used as the case study, initially established several aims in considering computerisation. These were to:

- reduce the amount of paperwork involved in completing routine tasks
- increase the productivity of staff
- produce timely and consistent information

In order to achieve these aims several objectives were identified and included:

- carrying out a systems analysis of the company to examine the present systems in operation
- designing a new improved system, having identified the problem areas, deficiencies and additional management information requirements
- applying IT to the revised system proposals

In assessing the viability of achieving the proposals put forward, an initial analysis of the company had to be carried out which included the identification of problems and specific requirements.

To identify the problems and determine the feasibility of solving them, the following strategy was used:

- determine what information would be useful and how to collect it
- identify information sources
- collect and analyse the information
- describe the current systems
- identify the problems in the current system
- propose alternative solutions
- evaluate costs/benefits of proposed solutions

- summarise findings and decide on further action

Information collection was by way of interviews and concentrated on the managers and supervisors who possessed an overview of the business, its problems and needs, and provided a background of information. Additionally, interviews were carried out with staff at lower levels of the organisation as the project progressed and as more detailed information was required. This method of collecting information also allowed the build up of rapport with staff in order to gain their support for the research work.

The interviews encompassed the surveying, estimating, buying, contracts, planning and accounts departments of the organisation. Company brochures and documents were also collected to assist in understanding internal procedures and systems that were in operation.

The initial interviews with staff indicated that the level of awareness of IT within the company was extremely low, with the exception of the accounts department. It was also evident that any systems implementation to solve the problems identified could not take place rapidly. The implementation of an information system first required sub-division down into manageable, functional components. In this way staff could be shown results at an early stage in the project, thus enabling them to evaluate the progress and value of computer systems which would facilitate the acceptance of gradual changes.

Standalone application development at departmental level was identified as a requirement in order to:

- introduce technology gradually into the company and provide a basis for further implementation at a later stage
- increase the level of awareness of technology and convince staff of the potential benefits of computerisation
- provide a learning mechanism to discover the problems of introducing new technology into the company

Integration of the standalones systems could then be carried out at a later stage providing the required integrated MIS.

Three departments were selected by the company for computerisation with specifically identified systems development requirements. These included:

- Estimating department – tender enquiries and tender analysis system
- Buying department – material enquiries and supplier selection system
- Surveying department – bonus system for directly employed labour, and sub-contract management system, including enquiries and payments

A starting platform from which the applications could be developed was therefore necessary. Research was carried out into various tools available and a decision was made to obtain software development tools which could be used to develop ‘tailor’ made applications to meet company’s requirements. The SMART integrated package was selected on the basis of its flexibility in addition to having its own programming language and being suitable for networking.

## **DEVELOPMENT OF THE IMPLEMENTATION MODEL**

The purpose of using an implementation model was to enable greater control over introducing technology into the company, and an appropriate methodology therefore needed to be established. However, in practice, selection of a suitable methodology is not as simple as it might first appear, and the process may be subject to certain constraints.

In the case study, three factors, namely existing skills base, cost and organisational fit of the methodology were important factors in the selection process.

- (i) existing skills base - the systems implementor should be conversant with one or more methodologies. If this is not the case, training will be a requirement which may cause delay to the implementation.
- (ii) cost - some methodologies may involve stages that require particular tools or processes that are costly in terms of human effort, time and organisational finances.
- (iii) organisational fit - some methodologies, or elements of them, may simply not be appropriate to the culture of an organisation.

Consequently, it may not always possible to choose the methodology that appears to be the most appropriate. These factors influenced and played an important part in shaping the implementation model. In this research an experimental approach was adopted whereby the traditional systems life cycle was used as a basic structure. Within this structure, suitable tools and themes were employed from other methodologies and used in the production of systems.

Figure 1 shows the substages of the model adopted. The requirements specification, feasibility study and maintenance stages, are consistent with the traditional systems life cycle. The model stages of systems analysis and design, and implementation and testing, were broken down into a series of smaller and more manageable substages appropriate to the task at hand.

The systems were implemented using a 'bottom up implementation' approach, and this involved implementing simple modules first, as pilot schemes. Developed modules were then integrated to form more complex systems to satisfy company information requirements. Following these stages, the positive and negative attributes of the implementation model were then assessed.

## **THE POSITIVE ATTRIBUTES OF THE IMPLEMENTATION MODEL**

The positive attributes of the implementation model were classified under a number of headings as follows:

### **The Pilot Scheme**

Several pilot schemes were introduced into the departments selected which were prototypes of applications identified as being suitable for computerisation. The pilot systems were extremely successful in that they increased the level of awareness of IT and acted as a catalyst for further and more complex systems implementation. The pilot systems also removed the perceived

threats to the users, generated by fear of the unknown. The users were then in a better position to identify their requirements and contribute to the design of the integrated system. The pilot schemes had also equipped staff with the appropriate knowledge and experience for further computer usage. The pilot scheme was therefore of great value in involving all prospective users. This indicated that staff cannot be expected to make any significant contributions to systems design and development without first being given the opportunity to explore and discover the potential of IT.

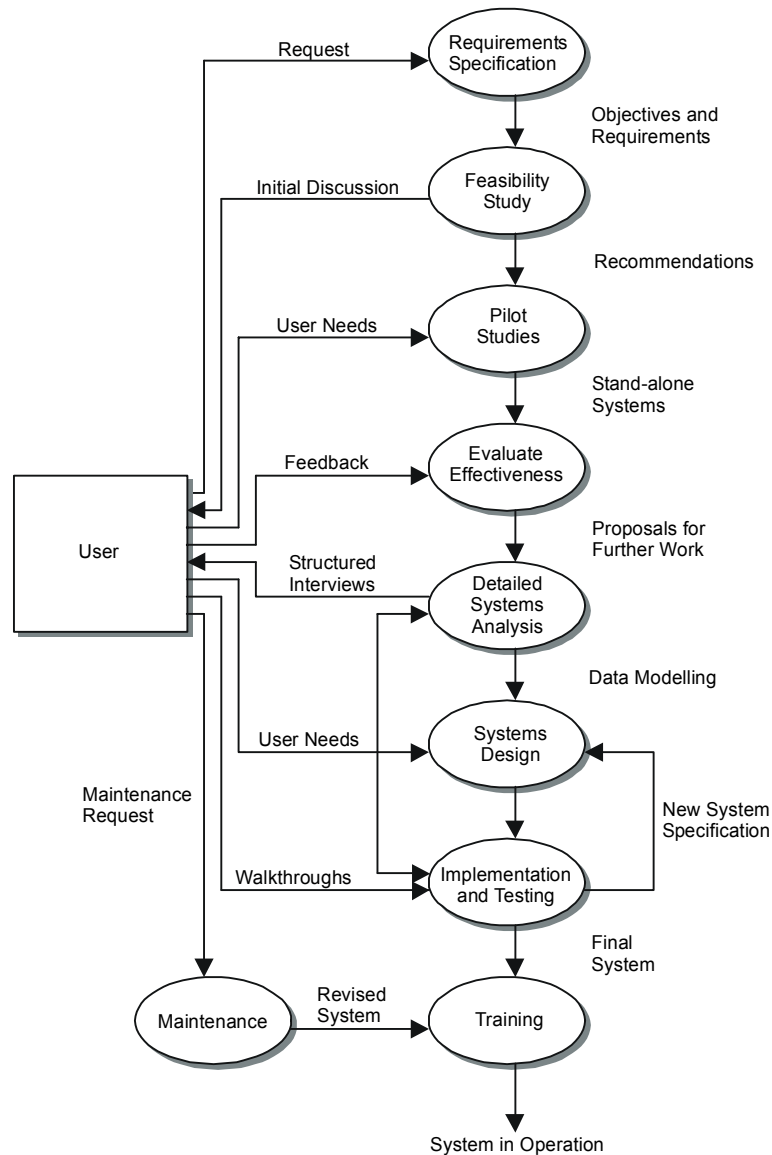
### **Staff Training**

In addition to the pilot schemes, staff training was organised at the stage when the integrated system was being designed. The training involved current users, prospective users and management. The prospective users felt more confident about using computers and became more receptive to the idea of the new systems. However, the prospective users felt that they would need re-training as in some cases there was a considerable time gap between the training courses and system implementation. They felt that after a period of longer than three weeks from training, they would be able to recall little of what they had learnt. This suggests that training should be an ongoing part of systems development that occurs at various stages of the systems life cycle, as training needs continuously change.

### **THE NEGATIVE ATTRIBUTES OF THE IMPLEMENTATION MODEL**

The negative attributes of the implementation model can be related to several issues:

## Resistance to Change



□ *Figure 1 Case study implementation model*

Although resistance to change was anticipated at the start of the project, it was expected to be mostly from the staff at the lower levels of the hierarchy who were using the systems. This problem was addressed by the use of pilot schemes and user involvement which led to acceptance of the systems implemented by the majority of staff. All the staff stated that they were willing to do whatever the company required with regard to training and using new systems. This attitude, coupled with the introduction of the new systems using pilot schemes and appropriate training, adequately dealt with the resistance to change at the lower levels of the hierarchy. However, reluctance was evident from senior management towards the integrated system. The implementation model, although giving adequate attention to resistance from users, had failed to

address the problems experienced by management. The threats to the managers' existing powerful positions within the company had not been considered and appropriately addressed and hence they resisted the implementation of a fully integrated system.

### **Lack of Planning and Communication**

There was a lack of both long term planning and communication of short term goals.

The implementation was conceived as a short term project of two years' duration. Little consideration had been given to what would happen after systems implementation. The interviews with staff revealed that they were concerned about the absence of any in-house user support once the systems implementor had left the company. The users did not want to invest time and effort in mastering and exploiting the potential of the system in order to provide better and more accurate information, as it was perceived as being a short term investment.

### **Systems Not Viewed Cross Functionally**

One problem that occurred concerned the subcontract payment system. This had been revised after implementation to meet the requirements of the accounts department which was the recipient of the information generated. This indicated that during the design, systems must be viewed cross functionally. The perspective gained by interviewing each member of staff using a particular system was too narrow. This suggests that prior to finalising design, systems must first be viewed cross functionally in order to satisfy user requirements. This point reinforces the value of adopting a systems approach. It is important to examine all aspects of interaction between subsystems assessing the nature and strength of the interaction.

### **Lack of a Shared Vision**

Many of the staff also felt that they knew little about developments occurring in other departments or the development plans for the company as a whole. The lack of teamwork between departments had been highlighted in the initial systems analysis, and it was felt that more teamwork would have helped staff gain a shared vision of the integrated system. Staff could have also supported each other with system problems and gained an increased understanding of how to utilise the new systems.

## **EXTENSIONS TO THE IMPLEMENTATION MODEL**

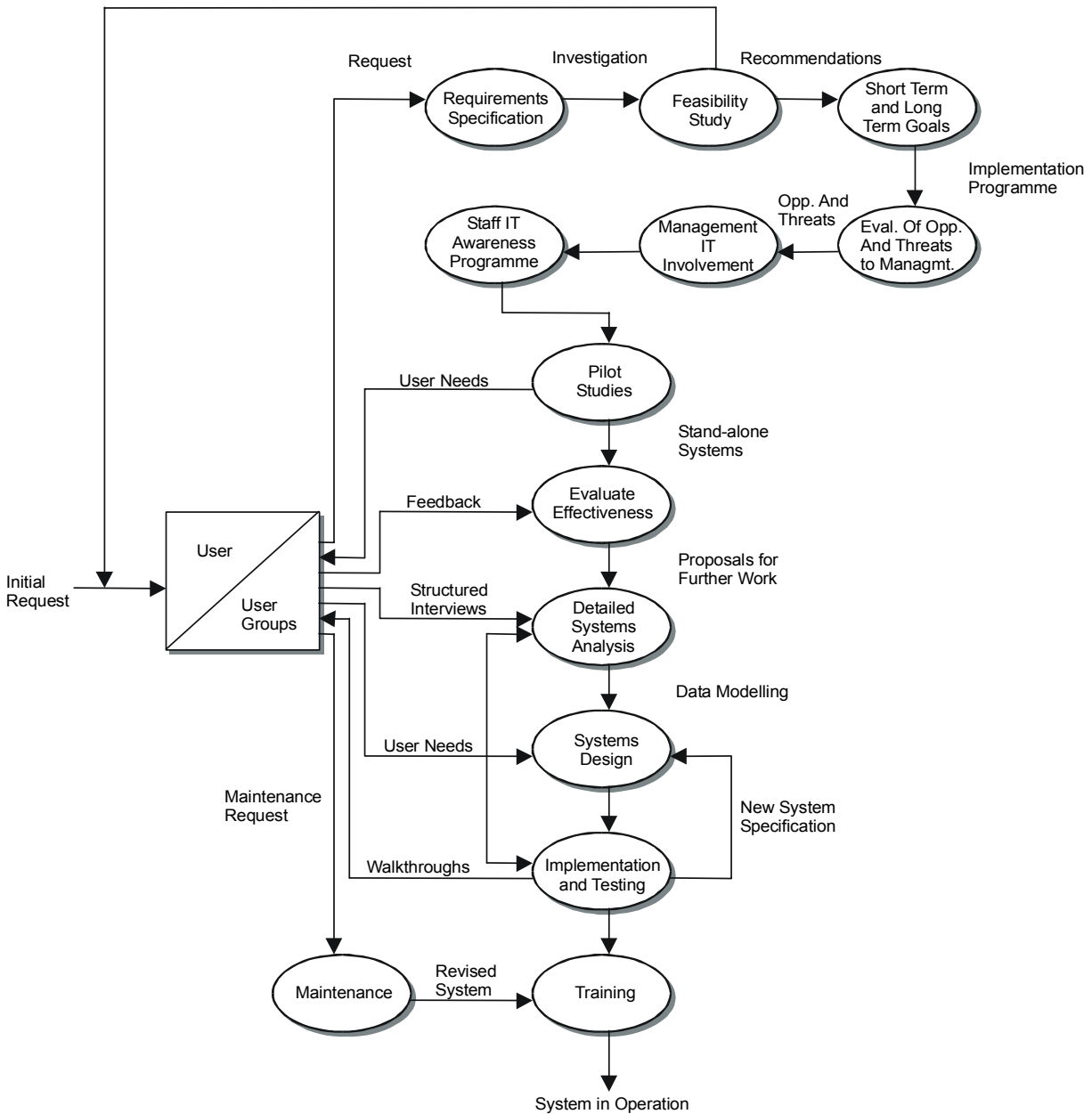
Having identified both positive and negative attributes of the implementation model, further extensions to the model were established in order to overcome the problems encountered.

By far the most significant problem was resistance to change from senior management and their lack of participation in the implementation of the integrated system. Without top management commitment, finances will not be committed, and the enthusiasm and motivation vital for a successful implementation will not be transferred to staff at lower levels of the organisation. Although measures to overcome resistance to change were put in place, these were insufficient and a more effective organisational change programme was required. The new implementation model incorporating the proposed extensions is shown in Figure 2.

## **Evaluation of opportunities and threats to management**

Opportunities and threats to managers regarding a new system should be evaluated. Each manager should be interviewed individually in order to determine the perceived threats. An IT awareness programme specifically designed for management should be aimed at removing these threats. Some of the managers felt that staff training was not relevant as it concentrated on operating the system and the managers themselves were merely recipients of the output. An awareness programme should outline the opportunities of an integrated system and convince management of the strategic potential in increasing the competitiveness of the company. The programme should examine what competitors in the industry are doing regarding IT developments and managers should be shown how to keep pace with these developments. Management should also be aware of the consequences of failure to adopt the new technology.





□ *Figure 2 Revised Implementation Model*

### **Initial Awareness Programme**

Many of the users were unaware of developments that were taking place in other departments, and the implementation plan for the company as a whole. An initial awareness programme, conducted before any systems design would have been useful, explaining the aims and objectives of the proposed new system and the role staff play in the new developments. Regular briefings should then take place addressing all staff and informing them of developments occurring in each department. These proposals will then enable staff to share a vision of IT developments across the company.

## **User Groups**

User groups should also be created with members from each department. The user groups can provide a forum for information exchange, generation of ideas, discussion of problems and an opportunity to voice opinions regarding any new systems implementation. The user groups would provide the company with synergy to further exploit IT and facilitate the development of cross functional systems. The pooling of energy within the company will create a driving force for systems acceptance and integration.

## **Planning**

In the same way a company produces business plans, IT planning should also form part of management activity. In addition to proposing long term objectives, it is important to set a number of short term goals, the achievement of which will realise longer term goals. These should be communicated throughout the company so each individual is aware of what is expected of them. Progress should be evaluated by assessing the extent to which short term goals have been realised. In this way horizons of change are perceived as being smaller and achievable. The long term goals should be clearly communicated throughout the company to remove any perceived threats or fear of the unknown which will inhibit systems implementation. All company directors need to assume a role in IT planning so that they feel a sense of ownership of the plan and hence will be more willing to pledge commitment to the advancement of IT within the company.

## **SUMMARY**

An analysis of the results from the post implementation review identified both positive and negative attributes of the implementation model. A revised model has been proposed, retaining those features that were deemed beneficial and including additional features to overcome the deficiencies of the original model. When comparing the new implementation model with the actual implementation model used, it was evident that the majority of changes occurred in the initial stages of implementation. This indicates that the initial groundwork was inadequate and far more preparation and planning was required before commencing the actual implementation of the systems.

Whereas it is not possible to prescribe a 'recipe' of how to manage the organisational dimension of implementation, the following elements are vital for the successful implementation of an integrated MIS.

## **IT Strategy**

IT planning needs to assume greater importance in construction companies. An assessment of current usage of IT and the future direction of IT in supporting the business should be made. The planning process should involve both IT specialists and representatives from all functional areas of the business. Short term and medium term plans will form a sprint for success whereas the long term plan will act as a performance ratchet, tweaking the systems already in place.

In formulating the plan, the maturity of IT in the organisation, the organisational structure and IT literacy of staff are important factors which will influence the implementation. Once the plan has been formulated, it must be communicated, if not sold to all members of the organisation.

### **An Integrated Organisational Change Programme**

In order for a company to truly embrace integration it must undergo the transition from 'Computer Management' to 'Information Management' where data are perceived as a corporate asset to be shared by all for the benefit of the organisation. Computer systems implemented within the organisation will imply the organisational structure within which they function. The installation of an integrated MIS needs to be accompanied by an integrated philosophy or culture change. This change must be planned and managed through appropriate organisational change programmes such as staff IT awareness courses and user groups which will help to break down departmental barriers and encourage a shared vision.

In addition to training on the systems installed, an initial awareness programme should take place prior to systems implementation. This will serve the purpose of informing staff of proposed developments and will also equip staff with a basic set of IT skills. Such a programme allows staff participation throughout the implementation process to be more effective and alleviate initial fears of the unknown, assisting in acceptance of the proposed changes.

### **Top Management Support**

The implementation of a system must have top management support to drive forward organisational developments and communicate their enthusiasm throughout the organisation. It is often the case that management may not fully understand the implications and organisational changes required in order to ensure the success of an integrated system until the project is well advanced. At this stage fears and reservations emerge when traditional procedures are challenged with new computerised systems which have no respect for departmental boundaries. This fear is cascaded down to lower levels of the organisation, hampering and destroying the momentum achieved earlier on in the project. It is therefore necessary to devise specific programmes for management in order to address their fears and concerns.

This paper highlights a number of important areas to be considered when implementing an integrated MIS. Some of these may appear to be obvious, or common sense, but are nevertheless frequently overlooked. Failure to pay attention to these areas will result in a difficult, if not, unsuccessful implementation.

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