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Case Study

Exploiting Information Systems and Technology Through Business Process Improvement

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An increasing number of business managers have been looking at business process reengineering (BPR) as a way of applying information technology (IT) to their businesses. Their belief is that process improvement which includes an IT component will allow them to gain competitive advantage and provide quality products and services to their customers. Furthermore, core business processes in most of today's organizations are supported by information systems (IS), and if benefits are to be realized from BPR it will often involve reengineering the information systems that support these processes. The relationship between process improvement and IS/IT is difficult to grasp at times. However, it is widely believed that the two are mutually dependent in the majority of organizations. Given this, it is essential to explore this relationship further. This paper examines how BPR has provided an opportunity for the IS community to combine the rigour of the IS discipline with organizational change and also for IS/IT to facilitate BPR. It is suggested that the two approaches have much to learn from each other. Case studies in three organizations both in the UK and abroad are used to demonstrate how IS/IT plays a significant part in organizational change and business reengineering initiatives. This paper examines the possible reasons why so many reengineered IS/IT systems are failing to support business needs, and examines whether BPR offers a partial solution by analysing the systems development work in the three cases. Copyright © 1999 John Wiley & Sons, Ltd and Cornwallis Emmanuel Ltd.

INTRODUCTION

Against the background of ever-increasing competition, more and more organisations are trying to make fundamental changes to the way they operate. As competitive pressures expand many companies are responding by looking for possible improvements in every function and process. The growing realisation is that an understanding of core business process flows is essential if increased productivity and genuine cost savings are to be achieved (Hammer and Champy, 1993; Johansson *et al.*, 1993). In this context, many organizations need to reengineer their business processes and information systems repeatedly to meet the changing nature of modern business.

Information systems, supported by the plethora of information and communication technologies, sustain the core business processes in most of today's organisations. As Silk (1990) stresses, the main benefits of information technology have moved beyond the efficiency and effectiveness gains of the 1960s and 1970s and towards strategic advantage which will transform the organizations of the 1990s. Therefore, if real benefits are to be realized from business process improvement it will often involve reeningeering the information systems and information technologies (IS/IT) that support these processes. Process improvement (or reengineering) initiatives are already changing the way we view IS/IT, and conversely IS/IT often plays a central role in a process improvement environment (Ho, 1996).

This paper explores this relationship first by reviewing the relevant literature and then by briefly considering case studies of organizations engaged in process improvement.

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The following section looks in detail at the BPR–IS/IT relationship, the role of IT professionals in process improvement, systems failure and the congruence between BPR and IS development lifecycles. These issues are considered in the context of the cases presented in the third section. Finally, the fourth section discusses the conclusions and suggests future areas for further consideration.

LITERATURE REVIEW

The BPR and IS/IT relationship

The relationship between BPR and IS/IT may be seen as operating on two levels:

(1) The technology and technical systems compared with the BPR projects, as distinct from
(2) Systems analysis compared with business improvement methods and processes.

It is important not to confuse the technological artefacts with system development processes (Hinton, 1994). With this in mind, the next section will compare the development lifecycles of BPR with that for information systems.

Surveys on the use of IS/IT in business process reengineering programmes reveal that IS/IT is enabling the majority of the BPR initiatives. An increasing number of business managers are looking at BPR as a way of applying IS/IT to their business in order to gain competitive advantage and provide quality products and services to their customers (Hickman, 1993). Coombs and Hull (1995) suggest that over the last decade IS/IT has become increasingly bound up with organizational change and single out IS/IT as the most significant enabler of BPR. Similarly, IS/IT are identified as one of the top ten critical success factors for BPR programmes, and in practice over 75% of the top 30% most successful BPR programmes viewed IS/IT as critical for both enabling radical process redesign and supporting redesigned processes (Willcocks, 1995).

The degree to which IS/IT can and should be involved in BPR is an area for debate. Morton (1994) suggests that the largest short-term payoffs from process reengineering may come from reengineering processes with IS/IT support. While this short-term, financial perspective may help to explain the motivation behind IS/IT-related BPR projects, it fails to explore how this relationship may manifest itself. A number of authors suggest that IS/IT can support fundamental changes to the underlying processes and not simply be applied to the old, inefficient processes (Stickland, 1996; Hutton, 1995). Harrington (1991) and Davenport and Short (1990) promote the idea that process improvement should be combined with process automation. Kaplan and Murdock (1991) state that it is important to take an integrated look at both process and information flows simultaneously, focusing on how information is used in the process and how people interact with systems on both a formal and an informal basis. Earl's (1994) view on the relationship between process reengineering and IS stresses that systems analysis and BPR have a lot in common and share common methods, and suggests that process thinking is the same as systems thinking. Perhaps for this reason, it is not surprising that the initiative to move towards BPR frequently originates in the IS department (Childe *et al*., 1994). Increasingly, IS/IT methodologies, such as SSADM and IE, overlap with BPR, and Mills and Mabey (1993) note that IE often succeeds in reengineering business processes. In an environment where the majority of business processes in modern organizations are driven by IS/IT, the importance of these IS/IT methodologies cannot be ignored especially when process improvement often involves the reengineering of IS/IT systems. Likewise, process reeningeering methodologies and frameworks can also play a significant part in business systems analysis and design (BSAD) projects, particularly when redesigning IS/IT-driven processes. More importantly, in IS/IT-driven BSAD projects, BPR frameworks may be used to reshape the overall business structure. This will be explored in greater detail in the third section.

While the relationship between process improvement and IS/IT remains difficult to understand, it is clear that the reality is that BPR and IS/IT often go hand in hand. The literature has demonstrated that both the technical aspects and analysis methodologies for BPR and IS/IT are interwoven. Most organizations engaged in analysing their process will inevitably have to consider the supporting IS/IT systems. By the same token, an organization developing a new IS/IT system will have to bear in mind the ramifications for their business processes.

The role of the IT professional in a process improvement environment

The previous section suggested significant overlap between BPR and IS/IT system design and development. Moreover, Childe *et al*. (1994) suggested that BPR initiatives often start within the IT function. Given this, it is important to discuss the role which IT professionals can play.

Although process improvement should not be considered as an 'IS crusade', IT professionals are well positioned to contribute to BPR (Khalil, 1997). Davenport and Short (1990) support this view and suggest that although few IT groups have the power and influence to spearhead process redesign, they can play several important roles.

Process flows, particularly in manufacturing, are often the result of historical circumstance and should usually be redesigned before further automation is applied. The IT function can get involved in process redesign by developing a methodology for IT-enabled redesign (Davenport and Short, 1990). Likewise Avgerou *et al*. (1995) indicate that systems analysis and organizational process design have always been linked. This was also confirmed during case studies both in the UK and abroad (Weerakkody *et al*.,

1998). Unfortunately, there is little overlap between research in BPR and systems analysis, so that there is no shared vocabulary or perspective. This is evident in practice, where BPR and IS/IT system development often proceed independently resulting in a mismatch. Furthermore, BPR teams often have little communications with the IT professionals. Nevertheless, process reengineering initiatives often tend to rely on improvements to IS/IT systems to gain the desired benefits (Weerakkody *et al.*, 1996). Research also indicates that although IT professionals do not make up part of the high-level business reengineering team, they are often called upon at the systems-implementation stage. Although consultants and other promoters of reengineering may claim otherwise, in practice process improvement often needs the services of the IS/IT department (Weerakkody *et al.*, 1998). By being involved in the process improvement work IT professionals ensure that they contribute to individual process improvements, as well as the overall efficiency and effectiveness of the business. Consequently, it is maintained that although the role of the IT professional appears to be underestimated in BPR environments they can play a significant part in the process improvement work.

Why do so many IS/IT systems fail?

So far this paper has exposed the degree of integration between BPR and IS/IT. Given this mutual dependency it is, perhaps, appropriate to explore some of the reasons behind IS/IT failure.

Grint and Willcocks (1995) reveal that IS/IT expenditure in BPR projects ranges from 22% to 36% of the total cost of the project. This level of expenditure is concerning when up to 90% of IT projects fail to meet their goals and less than 25% properly integrate business and technology objectives (*OR Newsletter*, 1996). As Hammer (1990) stresses:

> Heavy investments in information technology have delivered disappointing results, largely because companies tend to use technology to mechanise old ways of doing business. They leave the existing processes intact and use computers simply to speed them up (p. 104).

Several factors have been identified as contributing to IS/IT failure. Hinton (1994) identified several areas of incongruence between IT professionals and users. This mismatch centred around different perspectives towards technological change, a lack of understanding of how users assimilate IT into their work, and a failure to understand that users are not an homogenous group. Similar research has talked of a 'culture gap' between IT professionals and business users (Grindley, 1992). Likewise, Jayaratna (1994) argues that often IT professionals lack the interpersonal skills, experience and understanding of the user areas to actively get involved in process improvement. Therefore, he suggests that the IS/IT experts need to step beyond their expert domain and gain knowledge of the organisation and its business environment. System failure has also been attributed to a lack of user involvement during the design phase leading to dissatisfaction with the 'finished' system (Allingham and O'Connor, 1992). Other research suggests that it is important to have top level commitment from senior management to avoid system failure (Behrsin *et al.*, 1994).

Hinton and Kaye (1996) have identified the time it takes to develop a new system as contributing to failure. They suggest that:

> The act of developing a computer system imposes a structure on particular organisational processes which are effectively frozen in time and context. The system design is fixed at the time the design took place and within the environment that was existing then. Hence, it concretes in whatever is the required information systems for that time.

Accordingly, as the human elements of an organization moves forward in a dynamic response to changing circumstances, the IT systems are effectively static and represent a past image of the organization. Effectively, the benefits of IT systems, the reduced costs or improved efficiency resulting from automation, may often contribute to their failure.

The BPR and IS development lifecycles

A comparison of the systems analysis and design methodologies and the more recent BPR literature reveals that approaches to both of these areas are based on the traditional, structured lifecycle approach. The traditional systems analysis and design lifecycle is based on the following stages: preliminary investigation and determination of requirements, systems analysis and design, software development, systems testing and implementation. Similarly, the majority of BPR approaches are centred around a cycle of: process identification, analysis, redesign and implementation approaches (see, for example, Wastell *et al.*, 1994; Maull *et al.*, 1995). Therefore, it can be argued that both the BPR and IS development lifecycles share a set of guidelines that are based on the same principle.

Many of the BPR tools marketed today have been designed by systems analysts whose approach to BPR is still based on traditional design and analysis techniques (Horner, 1994). Information Engineering (IE) is considered by BPR practitioners as one of the more helpful 'ready-made' IS methodologies available for BP&ISR. Watts (1993) sees IE as an integrated set of tasks and techniques capable of delivering high quality information systems to support the redesigned business processes and facilitate their ongoing improvement. By contrast, Mills and Mabey (1993) highlight the difference between IE and BPR. They further state that the objective of IE is to build high-quality information systems in line with business goals, while the objective of BPR is to radically improve the performance of business processes even at the cost of challenging and changing the business goals. Furthermore, Hickman (1993) describes IS/IT

models as normally static which limits their applicability for modelling a dynamic business environment, and warns that IS/IT models are constructed for use by IS/IT practitioners and so reflect IT values rather than business values. In comparison, Avgerou *et al*. (1995) analysing the appropriateness of soft systems methodology (SSM) suggest that it could serve as a systemic means to gain understanding about structural change or the redefinition of roles that may be necessary to accompany the development of new information systems in BP&ISR environments.

Both Morton (1994) and Doyle (1992) support the view that successful IS reengineering will usually not conform to any one methodology, product type or belief, but will probably involve an effective mix of methodologies.

DOES BPR SUPPORT THE BETTER EXPLOITATION OF IS/IT?

Company A: the multinational technology solution provider

This case study looks at the process improvement work undertaken in the UK as part of a very large-scale global business improvement initiative in a leading multinational—technology provider and consulting organization. Several champions at senior management level supported the UK-based projects. Consequently, the project objectives were established at a strategic level and seen as fundamental to long-term organizational success.

The particular aim was to reengineer and standardize the way in which the company manages its customer relationships. Ten key business processes have been identified as central to this relationship. A number of systems are being developed to support these key processes, many of which integrate existing legacy systems. Of these systems 60% of the reengineered business processes were supported by totally new information systems, 30% involved integrating new and legacy systems, while 10% relied on reengineering legacy systems to match the redesigned business processes. By far the largest of these was the customer complaints-handling system.

The complaints-handling process had previously been reengineered and standardized by a process reengineering team, so the role of the systems development team was to reengineer the legacy system which supported this process. Changes were made to the legacy system by dividing the system into manageable modules and by directly modifying the system design and program code. The system development team preferred rapid changes and prototyping to traditional system development methods. The system development work was done in three different stages, summarized as follows:

- *Design—Identifying gaps between new and reengineered legacy systems:* This phase involved mapping the business processes and the new and reengineered information systems against the existing ones. In order to support the reengineered business processes, some of the legacy systems had to be integrated with or run in parallel with the new or reengineered IS/IT systems. In order to achieve this integration of systems and processes an analysis had to be made to identify potential gaps between the legacy and new systems and processes.
- *Development—Reengineering the legacy systems and bridging the gaps:* a number of problems were encountered at the design stage regarding the compatibility and integration between the legacy systems and the new/reengineered systems and sub-systems. Nearly half of the reengineered business processes were also suffering from some sort of compatibility problems with the legacy systems. If any gaps were identified in the design phase, changes were then made to the legacy systems during the development phase in order to bridge these gaps and improve the legacy systems and new systems integration.
- *Testing—New and reengineered IS/IT systems:* testing was considered as an extension of the development phase and was used as a learning exercise to further refine the systems, processes and documentation. The primary reason for testing was to ensure that all new applications met user requirements and were compatible with the legacy systems. Around ten experienced users conducted the tests by using controlled test data in a small client server environment. The tests had two objectives. First, they were to verify that the reengineered processes and IS/IT systems (including documentation) supported the business units. Second, they tried to understand how the new processes and systems would affect particular business units as well as prepare them for actual deployment.

The case study at Company A revealed that the work undertaken in the organization was focused primarily on high-level business reengineering. However, as described above, a large part of the process improvement work involved the reengineering of IS/IT systems, whether they were new systems, legacy systems or some combination of both. In this context, the process improvement work had forced the organization to improve the standard of their IS/IT systems. In doing so, the organization had to utilize their IS/IT resources, thereby involving the whole or part of the IS/IT function in the systems development and reengineering work. Thus, it is fair to state that although the project was 'process improvement'-led, it inspired the organization to exploit IS/IT more effectively which would have not happened through normal operational business activity.

Company B: An organically based materials provider

The second case study describes the reengineering of key processes in a typical public limited company in the Indian

sub-continent. The case considers the impact of process improvement on reengineering legacy IS/IT systems and the computerization of non-IT related processes.

Two processes were selected for reengineering by a team of five. The first process involved the reengineering of cash and cheque payments to suppliers, and the second process the reengineering and introduction of a new IS/IT system to automate the tracking of engineering projects by engineers and the finance department.

As with the first case study improvement to the first process required minor reengineering work to a legacy system that was supporting the process. Major inefficiencies and weaknesses were found in this legacy system at the process analysis stage. These had to be overcome if any worthwhile improvements were to be made to the process under review. In this context, the reengineering team proposed a solution, which involved a combination of changes to the manual activities in the process and the legacy system that was supporting the process. It was clear that substantial savings in the context of staff time, resources, and costs were possible if these changes were carried out. However, the reengineering team was unable to carry out these changes on their own and had to involve Company B's IT function to perform the changes to the legacy system.

Due to the integrated nature of the legacy system concerned, the IT function needed a week to study the proposed changes to the target system. Much to the disappointment of the reengineering team, the IT function was of the opinion that the proposed changes to the legacy system could not be carried out. The reason given was the risk of what they described as a 'chain reaction' to other modules in the integrated system. Nevertheless, the IT staff agreed that the changes proposed by the reengineering team were genuinely effective and they admitted the fact that the legacy system concerned, which was introduced to Company B in the early 1990s, was highly inefficient and ill-equipped to meet the current business needs. They also agreed that the process improvement exercise encouraged the IT function to review and analyse not only the legacy system concerned, but also their other IS/IT systems as well.

Analysis of the second process revealed that the introduction of a new IS/IT system would significantly improve both the efficiency and effectiveness of the process. Given this, the reengineering team proposed improvements to a number of manual activities and developed a new information system to support the whole process. By introducing IS/IT to the core of the process, it was proposed to speed up and reduce the cycle time of the overall process. The automated system had a number of data entry standards and controls incorporated into it. Also, the computerized system involved automatic calculations, transferring of figures, validations, automatically picking up information from the database, the generation of a variety of management information reports and standard printouts.

Since the main reengineering effort was focused on computerizing the manual activities involved in the process, the work at this stage involved mostly systems design and development. A combination of the Structured Systems Analysis and Design Methodology (SSADM) and IDEF0 techniques were used to draw up rough sketches of the 'To Be' process and system models. While the initial analysis and design was carried out using a structured approach, the latter part of system development used Rapid Application Development (RAD). System and program flow charts, data flow diagrams, file formats, screen and report layouts were also drawn up, followed by the programming activity. While allowing for flexibility, maximum controls and standards were incorporated into the system, leaving minimum scope for errors.

When evaluating the process improvement efforts relating to both processes it is clear that they were centred more around IS/IT reengineering than process improvement. Although the outcome of the first reengineering effort was that the process could not be implemented due to a legacy system constraint, it answers the question set out in this paper in the context of the proposed information systems reengineering work. Likewise, the main reengineering effort in the second process was focused on computerizing the manual activities in that process and therefore involved mostly systems design and development. It is fair to state that the process improvement work at Company B was primarily centred around information systems reengineering and thus involved the exploitation of IS/IT to a large degree.

Company C: the petro-chemicals organization

Company C is a group of London-based engineers and chemists who are called upon to support subsidiary plants across Western Europe. Their activities range from research and development (R&D) activity, developing new production equipment and processes, through to troubleshooting expertise. The company was keen to reengineer its R&D processes to make them more responsive and flexible.

Several changes in the last decade have altered the way R&D activity is conducted. R&D staff are now expected to interact with a multitude of agencies external to their traditional boundaries. Their networks encompass other researchers in many locations world-wide, other internal departments (usually the sales function), customers, universities and so on. The scale and frequency of information exchange means that such networks would be impossible to sustain without the use of IS/IT systems. In addition, there has been an explosion of external sources of information, with the emergence of on-line electronic conferencing and bulletin boards, and the capacity for researchers to work on-line simultaneously from several geographical locations.

As a response to the possibilities offered by new forms of information and communications technology, Company C decided to reengineer some of its working practices. These

included information sharing within R&D projects and the client support procedure. In both these cases the impetus for change came from within the IT function. It should be noted that the IT function included people who had previously been engaged as engineers and were seen by the organization as hybrids in terms of their skills.

The BPR team identified several changes that needed to be made. This included the introduction of a document-handling protocol to effectively code documents and speed up their accurate transfer between R&D staff, as well as the introduction of new IS/IT systems and changes to the existing legacy systems to support this. While Company C expected improvements in the efficiency and effectiveness of these areas, they also hoped that some of the team-working activities would also be enhanced. It is important to note that not all documents were of an electronic nature and R&D staff still handled significant amounts of paper-based communication. Changes were made by prototyping the new and reengineered IS/IT systems. The new systems were introduced into one R&D project team to develop, test and fine-tune them before full deployment.

The process improvements made by Company C have enhanced the speed and degree of interaction between R&D staff, and reduced the time taken troubleshooting clients. However, the gains in team working that were hoped for have failed to materialize. The conclusion is that, while the BPR activity did not set out to be, it was largely driven by new IS/IT possibilities. The possible over-emphasis on the technology clouded the BPR team's consideration of the social interactions taking place between R&D staff. Personal interaction remains the most valued form of communication. This is largely because of the richness of the communication medium. The value of tacit knowledge in personal communication is particularly significant to the work undertaken at Company C, and IS/IT systems have failed to facilitate this.

CONCLUSION AND DISCUSSION

Process improvement often involves the reengineering of legacy IS/IT systems as such systems support the business processes targeted for improvement. This paper has sought to explore this relationship by reviewing the relevant literature and comparing this with the realities experienced in three different organizations.

The primary objective of BPR is to see improvements in efficiency, effectiveness, productivity, and speed of service as well as cost savings. Arguably the IS/IT reengineering work in BPR projects should also be inspired by the same objectives. By seeking to achieve these objectives process improvement teams and IT professionals effectively initiate the process of analysing the organization's IS/IT systems and overall IS/IT strategy in general. This process will inevitably involve the IS/IT function and thus require the services of systems analysts, programmers and other technical people. As the case studies show, the overall impact of IS/IT on process improvement is significant, and IS/IT reengineering plays an important part in helping to achieve the overall objectives of any process improvement initiative. By having to combine IS/IT in process improvement, organizations are given the opportunity to rethink their IS/IT strategy and redesign their legacy IS/IT systems in line with current business needs. Given this, we suggest that companies can use their IS/IT resources to better effect as part of 'process improvement' projects, rather than under the banner of 'business systems analysis and design'. Therefore, at a strategic level it is argued that process improvement supports the better exploitation of IS/IT in organizations.

In identifying the positive aspects of this relationship it should be recognized that this is somewhat of a generalization. The case studies help to expand on this, as the three companies discovered different levels of compatibility between redesigned business processes and existing IS/IT systems. In both Companies A and B issues arose as a result of the incompatibility between the reengineered business processes and the proposed changes to the legacy IS/IT systems. It was clear in Company A that changes were required in both the BPR modelling approach and the IS/IT development approach to facilitate the integration and mapping of process models with new, reengineered and existing legacy information systems. The isolation of business process and information systems reengineering from each other and from the business unit users may be the most significant contributor to a number of problems encountered during the process improvement work in this organization. What is further evident is that business process changes that are recognized at a high level are sometimes difficult to translate into low level technical change. This view is supported by Childe *et al*. (1994) whose research stresses that process documentation can also cause problems for some IT professionals and business unit users. They also state that some of the business process documentation in BPR environments appears to be at a very high level and IT professionals, including the systems analysts and programmers, seem to have difficulties in understanding it. Further research needs to be undertaken to identify possible ways of facilitating this.

The case studies have illustrated situations where IS/IT systems can act as a barrier to BPR (as with Company B), but also facilitate business process change (as with Company C). The latter is a good example of where IS/IT opportunities move beyond the facilitation of BPR projects and may actually instigate new BPR possibilities. All three cases confirm how the incorporation of IS/IT skills is beneficial to BPR projects. However, as Company C demonstrates, a technological determinism can damage clear understanding of business processes, and should not be allowed to drive BPR projects to the exclusion of all other perspectives.

Our findings illustrate some of the complexities which exist in the BPR–IS/IT relationship and begin to show how

BPR may facilitate the better exploitation of IS/IT systems, given the appropriate supporting conditions. However, more research is needed to explore these conditions and find ways of transforming this into practical actions for organizations to take.

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