# CHAPTER THREE

# *Business Process Reengineering*

Business process reengineering (BPR) has been receiving attention from industries as well as the academic community, because it is likely to change management practice and working processes in organisations in the future. However it is commonly agreed that BPR is important but also problematic. In this chapter we explore the principles and assumptions of BPR and identify the factors affecting its successes and failures. Especially we highlight some major debates currently found in the literature of BPR. These debates include the definitions used to describe business processes and BPR, the scale of the changes involved in BPR, and the significance and role of information technology (IT) in BPR, especially IT systems. As the main theme of this thesis is applying EM to BPR, it is essential to understand some factors which cause BPR projects failure due to the poor design of the supporting systems under the conventional paradigm.

## 3.1 Business Process Reengineering: Introduction

BPR is known by many names, such as 'core process redesign', 'new industrial engineering' or 'working smarter'. All of them imply the same concept which focuses on integrating both business process redesign and deploying IT to support the reengineering work. In this section we attempt to explore two questions: where does BPR come from and what is involved in BPR (i.e. its principles and assumptions).

## 3.1.1  What is BPR?

Generally the topic of BPR involves discovering how business processes currently operate, how to redesign these processes to eliminate the wasted or redundant effort and improve efficiency, and how to implement the process changes in order to gain competitiveness. The aim of BPR, according to Sherwood-Smith (1994), is "seeking to devise new ways of organising tasks, organising people and redesigning IT systems so that the processes support the organisation to realise its goals".

## *The Definition of BPR*

It is argued by some researchers (for example, van Meel et al., 1994; MacIntosh and Francis, 1997; Peltu et al., 1996) that there is no commonly agreed definition of BPR. Peltu et al. consider that this lack of an accepted definition of BPR makes it difficult to assess the overall success or failure of its concept. Thus it is essential to make clear what the definition of BPR is before we propose any framework and techniques for BPR. The book *Reengineering the Corporation: A Manifesto for Business Revolution* by Hammer and Champy (1993) is widely referenced by most BPR researchers and is regarded as one of the starting points of BPR. The following is their definition of BPR:

> [Reengineering is] the fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed. (p. 32)

Another BPR father, Davenport (1993), describes 'business process redesign' as:

> ... the analysis and design of workflows and processes within and between organisations. Business activities should be viewed as more than a collection of individual or even functional tasks; they should be broken down into processes that can be designed for maximum effectiveness, in both manufacturing and service environment.

These definitions suggest that we should concentrate on *processes* rather than functions (or structures) as the focus of the (re-)design and management of business activity. The definitions of the term 'proc-

ess' by different researchers are also slightly different. For example, Hammer and Champy (1993) define a process as:

> a collection of activities that takes one or more kinds of input and creates an output that
> is of value to the customer. (p. 35)

For Davenport (1993) it is:

> A process is a specific ordering of work activities across time and space, with a begin-
> ning, an end, and clearly identified inputs and outputs: a structure for action. (p. 5)

And Warboys et al. (1999) define a process as:

> A process is structured change, i.e. there is a pattern of events which an observer may
> recognise across different actual examples (or occurrences) of the process, or which
> may be made manifest, or implemented, in many different occurrences. (p. 32)

In BPR, the process to be reengineered is the so-called *business process*. Davenport describes a business process as "simply a structured, measured set of activities designed to produce a specified output for a particular customer or market". Riemer (1998) describes business processes in an object-oriented style: "business processes are series of steps that change states of business objects (that is, customers, orders and inventory), thereby causing business events". However we should note that BPR is concerned with customer-orientation. Thus the outputs of business processes should not only achieve the company's objectives, but also need to satisfy customers' requirements. From these definitions we can conclude that business processes start and end with customers, and the value of business processes is dependent upon customers.

## The Origins of BPR

Some researchers argue that the original concept of *reengineering* can be traced back to the management theories of the nineteenth century. As one report in *The Financial Times* (1994):

> The purpose of reengineering is to make all your processes the best-in-class. ... Freder-
> ick Taylor suggested in the 1880's that managers use process reengineering methods to

> discover the best processes for performing work, and that these processes be reengineered to optimise productivity. ... In the early 1900's, Henri Fayol originated the concept of reengineering: To conduct the undertaking toward its objectives by seeking to derive optimum advantage from all available resources. (p. 8)

Similarly, Galliers (1998) observes that "BPR ... far from being a new departure, is in fact a reversion to the *classical* school[1] of strategic thinking popularised in the 1960s". That is, organisations make such radical changes when they meet competitive pressures which challenge their current processes. BPR can be viewed as a response to such change and therefore fits in the classical school of strategy where organisations adjust themselves to new forms in order to maximise their profits. However it is commonly agreed that BPR first came and attracted academic and industrial attention in 1990 as a result of two papers by Michael Hammer (on reengineering, see Hammer, 1990) and Thomas Davenport (on business process redesign, see Davenport and Short, 1990). In 1993 they further published two key books (Hammer and Champy, 1993 and Davenport, 1993) which brought widespread attention to the emerging field of BPR.

The concept of BPR is widely regarded as having been introduced as a perceived solution to the economic crisis and the recession of the late 1980's and early 1990's (Butler, 1994; Arnott and O'Donnell, 1994). As Butler describes it: "the '80s were a time for financial reengineering ... the '90s are for technological reengineering". Hammer and Champy (1993) propose that "BPR can help organisations out of crisis situations[2] by becoming leaner, better able to adapt to market conditions, innovative, efficient, customer focused and profitable in a crisis situation".

Before BPR emerged (and even today), it was widely accepted by industries and business enterprises that a work should be broken down into its simplest (and most basic) tasks. This leads to the structure of enterprises becoming hierarchical – or functional – in order to manage such divided tasks.

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1. Galliers points out that the four schools (approaches) to business strategy since the 1960s are classical, processual, evolutionary and systemic.

2. Hammer and Champy gives a brief history of management problems in a chapter ("The Crisis that will not Go Away"), in which they point out three forces (the three Cs) are driving today's business environment to become more and more complex and thus 'the crisis will not go away": (1) *customers* take charge; (2) *competition* intensifies; (3) *change* becomes constant.

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*§ 3.1  Business Process Reengineering: Introduction*
*Yih-Chang Chen (2001) "Empirical Modelling for Participative Business Process Reengineering"*

These hierarchical or functional structures were commonly used for a period. However enterprises of these structures later encountered some problems, especially when the competitive environment has changed beyond what we can recognise[3]. Today, many enterprises face competition from the global business environment as well as the fact that the taste of customers is becoming complex. As Hammer (1990) argues, "in order to achieve significant benefits, it is not sufficient to computerise the old ways, but a fundamental redesign of the core business processes is necessary". New organisational structures, which are more suitable to today's environment in which enterprises can understand their current activities and find potential problems, are needed. MacIntosh and Francis suggest that it is becoming more important "to develop new products effectively than to produce old products efficiently". By introducing fast developing information technology, enterprises try to redesign their structures and seek new ways of operation, which results in many enterprises moving toward *combination* but not *division* of labour. Hammer and Champy conclude that previously divided tasks are now being re-unified into coherent business processes. Thus one reason why BPR becomes popular is that it provides a mechanism to make the changes better to fit the competitive environment to which the enterprises must adapt themselves in this new and post-industrial age.

## *3.1.2 The Key Concepts*

BPR seeks to break from current processes and to devise new ways of organising tasks, organising people and making use of IT systems so that the resulting processes will better support the goals of the organisation. This activity is done by identifying the critical business processes, analysing these processes and redesigning them for efficient improvement and benefit. Vidgen et al. (1994) define the central tenets of BPR as:

- radical change and assumption challenge;

- process and goal orientation;

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3. For example, MacIntosh and Francis (1997) point out some problems: information could not easily be transferred without repeated, manual reprocessing and the layers of management served to relay and communicate information across and through the enterprise.

- organisational re-structuring;

- the exploitation of enabling technologies, particularly information technology.

That is, by focusing on business objectives, we analyse the processes of the organisation, eliminate non-essential or redundant procedures, and then use IT to redesign (and 'streamline') organisational operations.

## *BPR as Radical Change*

BPR is a radical change, rather than incremental change. Hammer and Champy (1993) highlight this tenet as:

> Re-engineering is ... about rejecting the conventional wisdom and received assumptions of the past. ... Reengineering is the search for new models of organising work. Tradition counts for nothing. Re-engineering is a new beginning. ... To succeed at reengineering, you have to be a visionary, a motivator, and a leg breaker. (p. 49)

Similarly Davenport (1993) advocates radical change:

> Objectives of 5% or 10% improvement in all business processes each year must give way to efforts to achieve 50%, 100%, or even higher improvement levels in a few key processes. ... [Radical change is] the only means of obtaining the order-of-magnitude improvements necessary in today's global marketplace. ... Existing approaches to meeting customer needs are so functionally based that incremental change will never yield the requisite interdependence. (p. 1)

One reason the change in BPR is radical rather than incremental is "to avoid being trapped by the way things are currently done" (Vidgen et al., 1994). Dr Robinson of IBM UK highlights rapid IT innovation and increasingly intensive global competition as two main reasons why organisations have had to consider the introduction of radical change[4] (cf. Peltu et al., 1996). Robinson (1994) concludes that radi-

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4. He further explains the progress of microelectronics in making IT cheaper and more powerful had been combined with advances in telecommunications to transform the opportunities available to re-invent business processes, management methods and organisational cultures and structures.

cally re-visioned processes drive the *shape* of the organisation, rather than current *structures*. Even such radical changes are not limited to inside one organisation but forge with other organisations, which generate new views of an organisation (Vidgen et al., 1994):

> Possible [radical] changes to the organisation are not limited to internal re-orderings, ... Links can be forged with other organisations even though they are competitors. This leads to a view of the organisation as *a fluid mix of interests* rather than a fixed entity with an objective existence. It is recognised in the BPR literature that advances in technology bring opportunities that were difficult to imagine before the technology had been created. There is a sense of innovatory solutions looking for problems and the exploitation of unexpected consequences that cannot be predicted by a purely conceptual approach. At its best, BPR can be seen as a mix of *conceptual thinking* and *practical experience* gained through creative experimentation and faith.

## *BPR, DSS and TQM*

When discussing radical change in BPR, we find that BPR, DSS (decision support systems) and TQM (total quality management) have much common with each other. Firstly they are all focusing on business processes. Arnott and O'Donnell (1994) characterise DSS as relevant to BPR as it was the first information system (IS) movement to explicitly focus on the fundamental redesign of business processes rather than on the efficient application of a new computer technology. Also BPR and DSS have a common aim which is to improve business processes via radical change. The most significant difference between BPR and DSS is the *scope* of analysis: BPR focuses on the whole organisation whereas DSS focuses on one individual decision.

BPR is also different from TQM in that BPR concentrates on major discrete changes to business processes, whereas TQM concentrates on minor continuous improvement to business processes. That is, the improvements in TQM are smaller than the ones in BPR. Butler (1994) elucidates the difference between BPR and TQM as:

> [TQM approach] which favours steady incremental gain, may often take a number of years to complete. For firms in highly competitive industries, this lagtime can allow com-

petitors to forge ahead. In contrast, results from BPR can be realised within 12-18 months, but it is a far riskier undertaking, and should not be regarded as a 'quick fix' solution.

Furthermore, whereas BPR is commonly viewed as a top-down solution from management[5], TQM involves staff from all levels for problem solving and suggests bottom-up improvement. Employees' resistance to change has been identified as one major barrier to the success of BPR (cf. subsection 3.2.2). It was reported by MacIntosh and Francis (1997) that those companies that had introduced TQM prior to taking on board BPR, faced less resistance to change. As we believe that these two approaches are compatible, we propose in this thesis a concept of 'participative BPR' which combines both of them. Section 3.2 will describe the problems of BPR due to human factors, and motivate the concept of participative BPR. The details of participative BPR will be further described in chapter 6.

## Process-Orientation: From Structure to Process

Many current business processes – with their functional structures – were designed to enable efficient management by separating processes into small tasks that could be performed by less skilled workers with little responsibility. Under this structure, the important decisions were made by the higher skilled and more trusted managers. Traditional (structural) approaches to a business engineering generally follow this sequential order: firstly business strategy is proposed, then the business structures and processes are planned, and finally they are implemented with IT.

In comparison, BPR is regarded as process-oriented which is trying to overcome some problems raised by hierarchical structures. That is, BPR as a process-orientation changes the structural relationships between management and employers into the interactive processes between them. BPR aims to break radically the existing process structures and replace them by fundamental and innovative solutions. The functional structure is a vertical structure in which there may exist barriers to separate the

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5. It is argued by some researchers that reengineering cannot be led from the bottom of organisations, because it may be blocked by organisational boundaries, "like a wave dashing against a sea wall" as Stewart (1993) describes.

functions in organisations. BPR emphasises business processes which are regarded as horizontal flows and cut across organisational functions. MacIntosh and Francis (1997) justify the claim that BPR highlights the delays, errors and inefficiencies which are introduced when passing information and work from one function to another.

## *3.2 Problems Facing BPR*

In 1996 Davenport published an article entitled *Why Re-engineering Failed: The Fad that Forgot People* in which he reports:

> To most business people in the United States, re-engineering has become a word that stands for restructuring, lay-offs, and too often, failed change programmes ... companies that embraced [re-engineering] as the silver bullet are now looking for ways to re-build the organisation's torn fabric. (Davenport, 1996)

Also in 1998 it was reported that only around 30% of BPR projects were regarded as a success (Galliers, 1998). The earlier promise of BPR had not been fulfilled. There are many reasons for the limited success of BPR. Some explanation of such high rates of failure for BPR projects have been discussed in BPR literature. For example, employees' resistance of change as they consider BPR as threats to their jobs (i.e. the increase in short-term contracts and lack of promotion); Galliers (1998) and Gerrits (1994) point out that currently BPR approaches lack detailed guidance and support for the actual implementation of reengineering: many publications describe the situation before and after BPR but do not discuss the path to reach the final situation; Chen et al. (2000a) explain that one reaction to this failure was to retain faith in IT as a dominant support and just admit that since it could not adapt – or at least not at acceptable levels of cost – then business activities must adapt to IT. For example:

> The pendulum has swung from 'continuous reengineering and re-inventing' to 'pick an application package and force our business processes to comply with the package'. (Riemer, 1998)

In this section we focus mainly on the role of IT in BPR and on human factors which affect the success of BPR. The reason is that there is still a gap between the need to model business process innovations and the capabilities of IT to support the task. In the last section, we propose participative BPR and modelling business processes, as the main idea of our EM approach to BPR is to consider the wider context of a desired 'system' in terms of the purposes, people and other resources which form the environment of the system.

## *3.2.1 Picking an Application and Changing Business Processes to Fit*

One central tenet of BPR is to exploit IT to support 'radical change'. Some authors view IT as the central enabler of BPR. However BPR has not really worked as its proponents expected. Davenport and Short (1990) attribute this problem a lack of appreciation of the deeper issues of IT, and stress that an awareness of the capabilities of IT can influence the business redesign process. They claim that IT has traditionally been used to hasten work but not to transform it and BPR is about using IT to do things differently. Thus IT plays an important role in BPR. Properly adopting IT can improve the competitive position of organisations. But inappropriately adopting IT may create barriers to responding to the rapidly changing business environment[6]. Further, simply picking IT packages cannot achieve successful BPR if it is simply used to speed up the process rather than reengineer it. As Davenport (1993) comments:

> ... information and IT are rarely sufficient to bring about the process change; most process innovations are enabled by a combination of IT, information and organisational/ human resource changes. (p. 95)

Hammer (1990) also has a similar arguments about IT in organisations:

> IT could either 'pave the cowpaths' of bureaucracy – unless the organisation changed drastically, its IT would continuously reflect and reinforce bureaucratic and functional

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6. For example, these IT tools may be designed for functional hierarchies, or they are TQM type tools – which are only in effect designed to support incremental improvements – cannot achieve the radical change in BPR projects.

> structures – or IT could help to create a leaner, flatter and more responsive organisation,
> a suggestion which is thus distinctly divergent from neo-classical economics, but only
> implicitly.

That is to say, while the information systems, or in a narrow sense the 'data-processing systems' (see the quotation from Galliers (1995) below), provide fast processing and response, they often fail to provide the flexibility for human communication – sometimes with serious consequences. This means IT may sometimes have a negative impact merely automating the existing processes[7], but it could also have a positive impact if we deploy it correctly in appropriate organisational arrangements. For BPR we need to change the structure and nature of operations, i.e. IT is the enabler to reengineer their processes and is an important driving force for business transformation. Galliers (1995) emphasises that the desire in BPR is to

> develop a flexible *information* systems environment (i.e. one that *informs*) rather than
> simply developing *data-processing* systems (i.e. systems that automate an operational
> task). The latter may be accomplished by replicating observable actions, while the
> former requires considerable awareness of the context in which information may be
> required and the manner in which it is likely to be interpreted to enable a required activity
> or decision to be made.[8] (p. 60)

As we will further detail in section 3.3, the introduction of information systems will not merely automate existing business practices, but will also shape the business. The purpose of reengineering the business is focusing on the latter in order to secure competitive advantage for the business.

## *3.2.2  Human Factors in BPR*

We have found that the focus of the BPR literature is on IT and process redesign techniques. However there are other complex issues such as human, organisational, cultural and political issues. Some

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7. Or we can say that mere automation of existing processes can at best lead to more *efficient*, but no more *effective*, processes.
8. He further differentiates both 'information' and 'data': information is the collection of data. "Information may be understood as being both *enabling* and *contextual*, while data is context-free and simply the raw material from which information (meaning) may be *attributed* ".

researchers determine that one of the main reasons for BPR failure is the neglect of the human element – the approach takes too much account of the scale of changes and fails to consider such change through people. Corrigan (1996) describes this situation thus:

> Given [BPR's] focus on business processes, many researchers have highlighted the lack of attention given by [BPR] to the human dimensions of organising, emphasising "how employees, not just processes must be re-engineered or debugged if they are to run effectively in systems".

Davenport (1993) emphasises that the success of reengineering programmes is dependent on and concurrent with effective organisational and human resource change. Thus it is essential to take a wider (contextual) view of these influences on the success of BPR (cf. subsection 3.3.1).

## *Resistance to Change*

BPR aims at the change in the organisation that is for the best. However as BPR is a radical rather than incremental change, it is not surprising that 'resistance to change' has been identified as a major barrier to the success of BPR (Corrigan, 1996; Quaddus, 1994; Peltu et al., 1996). Corrigan identifies one common situation in most organisations adopting BPR (through his interviews):

> Some of the interviewees pointed to the fact that employees were expected to agree and go along with goals and changes in working life that have been determined by senior management, and that they were the last to know about how change would affect them.

For these people, BPR is perceived as a threat to their jobs, either a threat directly to their existence or a threat to the quality and content of their jobs, or as causing the lack of promotion. People commonly asked: "Why change if it is working?". Extremely, as Peltu et al. (1996) verify, 'downsizing', i.e. sacking people, is the most obvious 'dark side of BPR'. Thus, to avoid this situation, as we discussed earlier about TQM, many companies try to introduce TQM prior to BPR for the reason of less resistance to change. Stewart (1993) notes that "you cannot do reengineering without an environment of continuous improvement or TQM". BPR can only work when those in the company who have to work with the new design have a role in creating it, and thus support such changes.

## *Personal View of Change*

The people in business – either employees or designers – take a very personal view of the radical change of BPR. For example, the BPR designers design BPR based on their perception, explanation and understanding of the organisation. The solutions they propose for BPR problems are derived from the theories or frameworks of BPR literature, as well as their understanding and attitudes to the organisation context. However each designer or even participant of an organisation has different knowledge and perceives the organisation in different ways – their individual contexts are different. Further, the participants have different experiences, theories and beliefs about why and how a process is operating and organised. We should note that the behaviours of participants generally come from their old contexts. This may cause conflict as newly designed processes can be so radical that they may not fit the participants' old experiences and contexts. Without their participation, BPR designers will not know the cause-effect relationships and how to modify the processes. As Kutschker (1995) reports:

> Obviously, process redesigners ignore this knowledge and repeat the mistakes designers of structural change have already made. The high failure rate of BPR may have its roots in the poor understanding of the deeper structure of organisations.

A way to avoid this is to involve designers and business people in the process, particularly in testing out the design. This is an issue that our participative BPR (to be detailed in section 3.4) emphasises. We believe that participants can be the drivers and a key successful factor of change, but can also act as potential blockers of innovation. The huge investments in IT and highlighting IT systems alone in BPR will not improve organisational performance or create any benefits. Thus even when BPR is enabled by IT, it is essential that BPR designers and IT people understand the human aspects in organisations. To conclude, human factors are much more important than technical factors. The BPR work must obtain the support of people affected by the changes for successful implementation.

## *3.3  System Development and Business Process Reengineering*

In the previous chapter we have discussed the issues of system development. In this section we will try to find out whether the failure of BPR is partly due to the poor design of computer systems, which were initially designed as an enabler of BPR but finally become the main factor of causing BPR failure as they hinder the organisational change and obstruct the innovation.

### *3.3.1  The Relationship between Information Systems and Organisations*

The BPR techniques consist of many different topics, such as system analysis and modelling, operations research, management information systems (MIS), human resource management, etc. Amongst these, in the author's assessment, system development techniques play an important role in BPR in understanding the current systems and in analysing the potential benefits of the redesigned systems, especially when such information systems are the enabler and supporter for the radically redesigned processes. We will discuss the role and impact of information systems on organisations. Then the defects of the conventional approaches of system development for the consideration of BPR, will also be discussed next.

### *Software Systems, Information Systems and Organisations*

The term *information systems* is widely used in business and means the systems inserted into an organisation to support data processing and the decision making within it. In general, information systems are regarded as a kind of structure which reflects the activities of the organisation (Parets and Torres, 1996) and a software system is a part of it. From this viewpoint, information systems represent a kind of abstraction of social systems which may include designed systems (i.e. computer systems) and human activity systems.

Figure 3.1 represents the relationship between the world and a software system. We regard software as a designed abstract system (or conceptual system) because it is a symbolic construct of

human conception. Cook and Daniels (1994) also suggest software as a concept model which partially mimics and abstracts the behaviour of things in the world. However they point out one potential problem: software cannot totally model the real world. This is because the world is unpredictable but software is predictable as its behaviour is preconceived. Also as software is a part of the world, it is impossible to design software on the assumption that its existence will not change the world. However conventional system development is concerned with software systems only and assumes that software will not affect the basic structure of the organisation (Kawalek and Leonard, 1996; Warboys et al., 1999). But now some problems of developing computer systems in this way arise because when new software solutions are provided, new opportunities for business change arise. That is, any designed information system is unlikely to be perfect and suitable for the purpose for which it was designed, and this is why today many organisations have faced *legacy system* problems because their computer systems cannot be changed to serve the changing circumstances of the organisation[9]. Warboys et al. (1999) emphasise this situation:
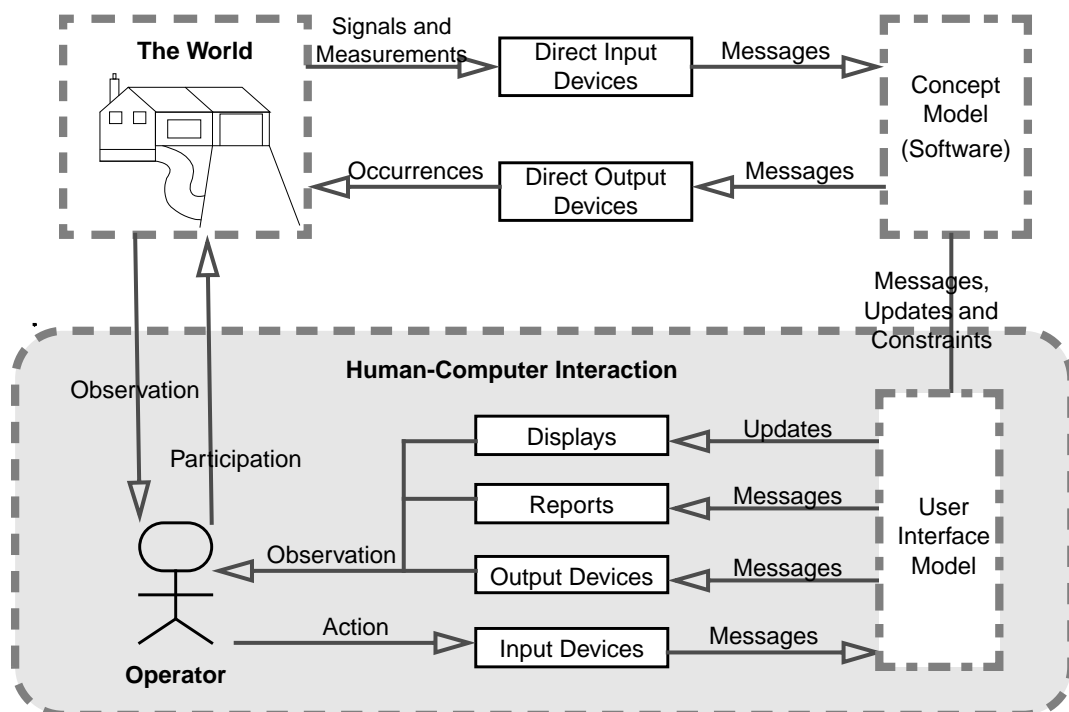


**Figure 3.1**  Linking the World and Software (adapted from Cook and Daniels, 1994)

It is not just that software systems are becoming more significant in modern organisations, but the form of the software system is changing. This in turn fuels, and is fuelled by, the drive to new ways of working, new strategies and new products. ... The high costs of developing bespoke software systems leads to a requirement that they be long-lived. This in turn means that their scope, functionality and the assumptions embedded within them are more likely to be breached by new needs which result from broader organisational changes. These changes occur, sometimes with rapidity, as the organisation seeks to survive, to compete and to innovate. (p. 10)

For BPR, it is likely that providing IT to support a process may change the process itself, which leads to further interactions and degrees of support. Thus if IT is adopted in organisations then a change to the organisational environment follows which represents a challenge to which IT may be required to adapt. This suggests that the process of reengineering is *dynamic* and will inevitably lead to further iterations in which the reengineered processes need to be re-assessed and redesigned. For this, we can conclude that business (re-)engineering and software development cannot be independent of each other. The redesign of business processes will decide the requirements of a software system; whereas the introduction of software systems will inevitably affect the way the business is currently running. We need to consider the development of software systems and the process of BPR as interdependent. Kawalek and Leonard (1996) suggest that the evolution of software systems should be based on two facts: first, the organisational context which the software serves is dynamic, and second, the outcome of the software system operation is uncertain. That is, a software system cannot move from steady state to steady state. It must constantly evolve to meet new goals, and to facilitate the development of organisational processes.

## *The Impact of Information Systems upon Organisations*

It is obvious that the introduction of software systems will change people's perceptions as well as their behaviour and, when such systems are implemented in a networked structure, this has far-reaching

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9. That is, software which was created to serve an organisation in a particular state may not be appropriate to serve the organisation in a future developed state. Ulrich (1995) claims that the failure of BPR is partly due to the limited ability of organizations to 'retool' existing information systems environments to support process redesign.

impact on the fundamental behaviour of organisations. Our perceptions of organisations and the relationships between IT and organisations may be different depending on which model we use. Harrington (1991) describes three metaphors of organisations: machines, organisms and processes, which represent three waves of organisation theory. The first wave, to perceive an organisation as a *machine,* suggests that IT can be seen as a controllable resource (the tool for management use) which is not part of the organisation and is used to achieve certain objectives. The introduction of IT does not affect the organisational structure but only the relationship between management and workers. The second wave, when an organisation is seen as an *organism*, regards IT as more integrated and less controllable. That is, IT is an element of organisation and also a determinant of organisational structure which cannot be predictable like a resource. The ownership of it is with workers rather than the management. The third wave perceives an organisation as a *process* and IT as a behavioural phenomenon. IT is managed by the users and determines the perceptions of human beings and thus affects their behaviour.

Conventional system development methods, as a reductionist approach, considers an organisation as a machine, whose behaviour is merely determined by the behaviour of individuals within the organisation. They tend to ignore the perceptual aspects of IT and concentrate only on its physical parts (i.e. the system itself) because it is hard to cope with the abstract things such as the perception and interaction of human beings. Such methods are not suitable for the analysis of BPR because they only reflect the situations before and after the implementation of the systems, but do not emphasis the change of people's behaviour affected by it. There is also a similar problem appearing in BPR, as it is common that many BPR methodologies are adopted by consultancies and attempt to reduce the dynamic levels of business processes to a predictable level by management techniques and adopting IT. Crowe et al. (1996) suggest that such methodologies focusing on static definitions of data, role and processes to reflect organisational structures tend to remain relatively fixed for long periods. However the dynamic processes cannot be well dealt with by static (i.e. linear) methods because people are operating in a dynamic manner and prone to error.

On a systems view, an organisation has got more meaning as a whole than just as a sum of parts. We cannot find the characteristics of an organisation merely by identifying its components. Especially

today the essential resource of organisations is from the skill and knowledge of people. Individual knowledge and technology are not only their own but also part of the organisation. Thus the behaviour of organisations can be regarded as a pattern of interactions between people. After the introduction of software systems into organisations, the behaviour can further be understood as a pattern of interactions between people, between people and software systems, and between the software applications. For this, Harrington (1991) suggests that we need the systems approach to analyse the impact of IT upon organisations, because the nature of IT can only be assessed in terms of its total impact. He describes an organisation as a creation of the mind and the perceptions of the people involved within it. Any change in the organisation will have an impact on people's perception of the organisation. When analysing business processes, we find that people interact with each other within the process and are also influenced by that process. How people will react in organisations depends on how they perceive a particular action, and their perception is important in the process of interaction. Today IT plays an important role in organisations because people use their systems to interact with others and the environment. Therefore any changes in IT may cause changes in organisational structure. Harrington comments on the successfulness of using the systems methodology to analyse the impact of IT on organisations because "it not only reflects the way we as individuals tend to aggregate, and thus captures the essence of how we organise, but also allows us a glimpse of a change effect in terms of the whole rather than part".

## 3.3.2  The Defects of the Conventional System Development in BPR

There are some discussions which identify one of the causes of BPR failure as the failure of BPR implementation by information systems (cf. subsection 3.2.1). For example, Humphries and Dy (1996) conclude that the inability of implementing the newly reengineering business processes is one key reason to consider for BPR failure. Because there exists a gap between BPR and its implementation, and system development is related to the latter as such systems are required to support the redesigned processes. As we mentioned before, conventional 'waterfall' or 'spiral' lifecycle considers a serial rather than a concurrent approach to system development. That is, the requirements, design and implementation

stages are almost completely isolated from each other and normally failures do not show until the implementation phase. This is because these conventional methods concentrate mainly on the technical aspects of design (such as data, data flows or system functions), and the problems come from diverting these technical solutions at complex social and communicational problems. Mingers (1995) argues that such methods are usually either oriented towards computerising existing processes and assuming these processes are effective, or they assume the users know what they want and eliciting their requirements is straightforward. This situation may have been improved today by the greater participation of users in all stages of the development process, or by the development of more flexible systems. But the system development can still result in failure particularly when the system to be designed is very complex, and in BPR which radically transforms the process which is currently running and involves many users and stockholders with different perspectives. Current methods of system development cannot meet the goal of BPR because they concentrate on the initial design of the systems and assume the proper design can lead to a stable solution. Thus the problems of redesign, and design for continuous change, cannot be captured by such methods.

The impact of information systems upon organisations is more than that of replacing paper with computer systems. Because business processes will change, new opportunities may be hindered (due to the circumscribed and programmed processes), some flexibility may be lost and new dependencies arise. Even though current techniques of systems analysis can capture some of the business environment in their models, these models are still built with the [technological] solutions in the minds of designers and they cannot reflect the fundamental business structures which are essential for business reengineering and are needed to ensure the success. Warboys et al. (1999) also point out that the analysis of business today is mainly concerned with facts which directly influence the design of the computer system. It is not concerned with understanding the working of the system and improving the structure of the system by reorganising processes, people, etc.

We have emphasised the importance of understanding the organisation and the business which the information system is built to serve for the success of BPR. And Lewis (1995) reports that gaining an understanding of organisations requires two levels of analysis:

> The first is concerned with the organisational actions and decisions that have observable, substantive outcomes such as inventory levels or the average time taken to satisfy an order. The second is concerned with understanding how such organisational activities are perceived, interpreted and legitimated. (p. 191)

He concludes that conventional system development have concentrated on the former (i..e. the 'hard' systems thinking) but not including the latter (i.e. SSM). This is why most current methods of system development fail to tackle the issue described earlier. The missing focus of current methods is that not just considering the computer systems to be built, but also unexpected change is one of the big problems in the development of computer systems. From the perspective of SSM (and our EM approach), such 'understanding of the served business' should not be restricted to just investigating the existing business processes, and the system designers are today expected to comprehend as well as contribute to what the organisation may or may not aim at, and how it may affect the achievement of objectives in the future. This is why Lewis says that

> The simple, 'hard' systems thinking model that has influenced IS thinking so strongly in the past is that organisations can be understood as goal-seeking, adaptive-regulatory mechanisms. This is now being rejected in favour of more complex systems models of human organisations as purposeful, socio-political systems in which shared meaning and symbolic relationships are maintained and modified through human discourse and interaction. (p. 190)

The activities of BPR and its implementation (which includes system development) focus on different views and need different techniques or skills. What we need is to bridge these two activities otherwise the outputs of BPR may not be useful or achievable in the implementation stage or the systems developed may not support the newly redesigned business processes. Humphries and Dy (1996) propose an integrated conceptual framework to bridge this gap as they claim the only way is conceptual integrity, i.e. the BPR and system development methodologies in BPR implementation must implement a common set of shared concepts[10]. Through this the concepts used in BPR can be mapped directly to the

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10. Their framework is based on the premise that "a business process is equivalent to the lifecycle of a business object". Further detailed for their framework can be found at http://www.intranetsys.com (20 March 2001).

*§ 3.3 System Development and Business Process Reengineering*
*Yih-Chang Chen (2001) "Empirical Modelling for Participative Business Process Reengineering"*

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concepts in system development. In this thesis, by using EM, we propose another method to bridge the gap by observation and experience, which provides a natural and participative way to link these different stages and activities. We will detail our approach in the rest of the thesis.

## 3.4  EM Approach to BPR: Preliminary

In earlier sections we have surveyed some issues and problems causing the high rates of BPR failure, especially in respect of human factors and technology exploitation. In this section we preview the broad approach of EM technique to business processes, and the requirements of a BPR model and how EM is well suited for application to BPR. How we understand the relation of business processes to information (software) systems is crucial for understanding the potential contribution of EM to BPR. We suggest to widen our focus from developing information systems to include modelling business processes and persons. Our focus should include the participants – and their views, knowledge, capabilities and perceptions – behind business processes.

### 3.4.1  Participative BPR

It is evident that no BPR will be successful without the support and active participation of the people. Even after all persons agree to go with BPR, it is still a hard task for everyone to carry on. As Peltu et al. (1996) describe:

> The BPR process is a 'walk in the fog' because of the difficulty involved in reaching agreement among many stakeholders about the current situation and future needs.

Scarbrough (1996) emphasises that an important question in all programmes for change is "what is required to bring about changes in how people relate to each other?". This suggests a reason for the high rate of failure of BPR, as it is not possible to change relationships without working within them. The IT tools and techniques chosen for BPR can only be the starting point. But the change will not be successful without people's learning, participation and adaptation – in order to understand the require-

ments and processes and then take responsibilities for such change. According to Sherwood-Smith (1994), business processes are purposeful processes, in the sense that they are people-controlled and subject to human behaviour. Hutchison (1994) and Lundeberg (1994) have a similar viewpoint. Each business process has some inputs and outputs. They identify the outputs as a combination of people outcomes and task outcomes, and the inputs as a combination of people preconditions and task pre-conditions. Thus business processes rely on the interaction of their participants. We argue that BPR is people-centred and driven by business needs, because it is the people who decide the value of the redesigned process according to their understanding and objectives. As Sherwood-Smith advocates:

> Administrative systems involving people should not be reengineered, they should be par-
> ticipatively re-designed.

Such a participative approach respects the culture and social context of an organisation because one important thing of BPR is to ensure the redesigned processes fit the organisational context and are acceptable to their people. This demands a high degree of communication and evaluation.

## *People Participating in BPR*

One of the early problems in IT development, as Lundeberg (1994) points out, is to know whether you are building the information systems that the users need or not. Chen et al. (2000a) argue that available software resources are often accepted as given and their limitations go uncommented although it is, we suspect, precisely their profound limitations that are a significant factor in the 'failure' of some BPR efforts. Many existing applications are designed to be offered in a 'take it or leave it' fashion (i.e. with no commitment to subsequently negotiating or adapting its functionality) which is inappropriate to a rapidly changing business environment. Further, as each person in an organisation has his knowledge and experience in every organisational activity, the members of the organisation should have some repre-sentation and voice in the BPR process. This is why Peltu et al. (1996) emphasise that, when initiating a 'clean sheet' radical change, it is necessary from a human perspective to complete the past before mov-ing ahead. We suggest *participative BPR* both as a means to fully understanding what the people need, and of evaluating existing processes and the effects upon the organisation.

Participative BPR – which is different from a traditional top-down approach to BPR – encourages all levels (including managers and workers) to get together to redesign business processes. This is similar to the definition of the approach by Sherwood-Smith (1994):

> A ... participative approach to BPR ... includes the radical innovative vision by management, the innovative use of IT and then takes on board the innovative insights of the staff to the system of organisation and operation.

Participative BPR is similar to one main theme of TQM: *employee involvement*. This aims to involve persons from all levels of an organisation in problem solving techniques. The difference is the improvements of TQM are generated bottom-up (whereas BPR is commonly viewed as a top-down solution imposed by management). We believe participative BPR – which combines both top-down and bottom-up – provide a comprehensive and shared understanding of current processes. Lundeberg, in his argument for focusing on business processes, cites one advantage of participative BPR as "an increased closeness between you and your knowledge of what you are achieving and the consequences of this for your own work situation". This is a natural way to progress from the present situation to meet the demands of the future.

The primary objective of our EM model is to enable the participants to develop and share a common understanding of the current state of business processes. Perhaps the main contribution of EM to BPR, as well as the way we consider software development, is to emphasise and focus on the *interactive* processes in which we participate. The EM model is used to identify possible changes in business processes which help the analysis of designers. This process in EM combines both analysis and design activities because the development is an interactive process where participants can establish a better understanding of the current business situation as well as the future one. Further as we describe in (Chen et al., 2000a), with frequent mergers and outsourcing of activities, businesses need computing environments which support unforeseen changes in needs and can exploit opportunities as they arise. The EM approach creates such environments and they support collaborative working.

## 3.4.2  Modelling Business Process

Organisations and business processes are complex, especially when they rely on the interaction of people. How deep an understanding of current processes is necessary before redesign to gain the best results is a controversial issue in the BPR literature. Some researchers argue the change in BPR being radical rather than incremental is "to avoid being trapped by the way things are currently done" (Vidgen et al., 1994). Hammer and Champy (1993) also argue that a very detailed analysis of the current process is not needed because the goal of the reengineering effort is not to improve the existing process but to design a 'totally new and superior design'. However we do not believe that there will be much gained from ignoring or paying less attention to the past. Pettigrew (1985) comments on the importance of this view:

> No observer of life or form begins with his mind a blank, to be gradually filled with evidence. ... The more we look at present-day events the easier it is to identify change; the longer we stay with an emergent process and further back we go to disentangle its originals, the more we can identify continuities. Empirically and theoretically, change and continuity need one another ...

The trend of BPR, as reported by Corrigan (1996) and Meester and Post (1998), now is to change the business processes in a less radical way:

> While 59% of the organisations ... claimed to be planning or doing BPR, most were improving existing processes, rather than 'reengineering' those processes identified as a result of a radical rethink of how the organisation needed to be reconfigured, and managed. ... It was therefore felt that the concept of 'reengineering' was too restrictive and was not felt to be an accurate reflection of the current reality of managing business processes. (Corrigan, 1996)

> ... the expectations of BPR as a radical change instrument were high but now we see a certain reluctance towards its application, given that the chances of failure are high, ... clever marketeers sell these products (BPR tools) as a new development in BPR, but in fact it is a way of mechanising an existing process without radically changing it. (Meester and Post, 1998)

In the subsection 3.3.1, we emphasised that business processes have to be understood to enable the participants to (re)design a new process. That is, it is important to understand the existing processes (the old culture, the legacy of the past, etc) both to help in the change to a new culture and different business processes, after BPR, and to avoid some unpredicted things emerging – especially when discovered after BPR effort – which sometimes turn out to be a disaster. It is not always possible to predict outcomes: "'Big bang' change is inherently risky!" (Scarbrough, 1996). We note some researchers, such as Jacobson et al. (1995), Schader and Korthaus (1998), Galliers (1998) and Vogel (1994), who support our view. As Vogel asserts: "BPR promotes a comprehensive and shared understanding of current processes, encapsulation of a vision, and a means and path of migration to progress from the present situation to meet the demands of the future". The following description highlights the nature of the BPR process:

> The [BPR] process is a learning experience requiring on-going assessment and review, which emphasises the need to develop and communicate a shared vision, leading to a review of existing structures and processes, but which takes account of customer requirements and the values, experiences and viewpoints of those whose job it will be to implement the change. (Galliers, 1998)

Jacobson et al. (1995) also address this theme in one chapter ('Reversing the Existing Business') in which they write:

> We do believe that you need a good picture of your current organization before you can finally decide on the best way to change it. If the reengineers understand the business as it is today, they will be able to avoid making unfeasible change proposals. (p. 153)

Before commencing BPR, we have to examine the existing business processes deeply in order to redefine and redesign their nature. To gain a wider picture of existing processes we need to consider the following questions: "How does the process under development fit into the whole business picture?", "Who are the participants [or the 'actors' in EM terms] in the process?", "What are the requirements of the process?" and "What is the final objective of this process?". As concluded by Arnott and O'Donnell

THE UNIVERSITY OF WARWICK

*§ 3.4 EM Approach to BPR: Preliminary*
*Yih-Chang Chen (2001) "Empirical Modelling for Participative Business Process Reengineering"*

(1994), the effect of BPR activities "may be new, it may be revolutionary, it may even be useful; but the seeds of its decline are there to be found – the past".

## 3.4.3  Requirements for BPR Models

We have justified in (Chen et al., 2000a) that how we understand the relation of business processes to software systems is crucial for understanding the potential contribution of EM to BPR. Adopting the viewpoint of EM, we claim that the issues involved in modelling a business organisation and modelling a software system are not so very different. In the remainder of this subsection we summarise the requirements of modelling techniques to support BPR and explain why we believe that EM is suitable as a modelling technique for BPR.

### Artefact

The BPR models should serve as a medium for communication between the participants involved in the redesign process. An artefact that can be held in common is needed to enable all participants to understand and discuss the process to be reengineered and gain a shared understanding of problems. In the BPR literature it is emphasised that reengineering should be achieved by active participation of people and not only be done by designers, managers or IT experts. To enable active participation, the model should be easily interpreted by participants.

Inevitably individual participants in the redesign process will have different insights and expertise, and their requirements may 'drift' throughout the process of interactions and experiences (cf. section 2.3 and Loomes and Nehaniv, 2001). Thus there exists a problem of requirements drift and inconsistency. How to merge the changes of multiple modellers and integrate views from the results of experiment which might cause such a problem need to be considered in the construction of the model. One benefit of interacting with the EM model is that it makes individual insights and shared understanding 'visible' and 'communicable'. We shall further discuss this issue in chapter 6.

*Creativity*

Simsion (1994) points out that BPR is recognised as a design process, requiring creativity, innovation and radical thinking. He further identifies *creativity* as necessary in view of the following characteristics of requirements engineering:

- Requirements as presented are never so complete or precise as to restrict the designer to a single option;

- There is no mechanical way of proceeding directly from requirements to the best design (or even a sound design);

- Proposed designs may include desirable features not specified in the original requirements. As a result, it may be necessary to modify the requirements to include these features;

- There is no way of assessing whether a given design is the best possible.

Traditional phases of system development – specification, design, implementation and testing – may be one barrier to creativity because of the lack of freedom in how to accomplish a task. EM has no such separate phases – it involves continuous development – in an open-ended and situated manner – throughout the evolution of the models. This is so-called 'cultivating requirements' in building an ISM (interactive situation model), where the seed-ISM being elaborated is refined and optimised into the final useful system. With the SPORE (situated process of requirements engineering) framework, people participating in the reengineering process can gain a sharing understanding and thus apply (or cultivate) their own creativity through collaborative interaction with each other (Sun et al., 1999; Sun, 1999). We will give further details in chapter 6.

*Design-In Change*

Business often changes in unpredictable ways and what used to be a standard process may not be sufficient for later situations. That is, in the dynamic business environment, there is no such thing as the right or standard solution. Pettigrew (1998) describes this change as a journey:

> In the complex and ever changing situation of business today it is very unlikely that any fixed standards of customer satisfaction, quality, efficiency or competitiveness are likely themselves to be sustainable for long. Hence the dictum that changes represent *journeys* and not *destinations*.

In these situations there is a need for a quick adoption of the processes associated with the new solutions. For modelling business processes, Warboys et al. (1999) point out that traditionally the focus in the information systems domain has been to *design for each change* and to improve maintenance processes, rather than *design-in change*. But we find that, even if we adopt the design-in change philosophy, the designing, testing and use of the resulting artefacts in conventional methodologies will also change human activities in such a way that the resulting system will conceptually differ from the one which was intended. Similarly, the changes in the dynamic organisational environment will also influence the human conceptions of relevant information. In the EM approach, we regard organisations as open systems which must constantly adapt in an integrated way in order to improve their processes and services.

The EM principles and tools directly support the modelling of a collection of agents, which perform structured activities, in an open environment where unforeseen changes may occur at any time. This maps to the business environment more naturally than to that of software systems. Further it is reasonable to view software systems as associated with the circumscribed cases of business processes. Thus when applying EM to BPR we are not immediately confronted with the usual mismatch that arises when the informal problem world (of business) meets the formal solution world (of programming). The SPORE framework we propose for participative BPR supports iterative and incremental modelling which means that the ISMs are built by adding new portions to the whole model. This delivery of small increments allows continuous feedback and evaluation of the progress achieved.

## *3.5  Concluding Remarks*

In this chapter we have explored the questions: "where does BPR come from?", "what is involved in BPR?", and considered some factors affecting its success and failure, especially the human factors and the role of IT in reengineering process. We also discussed the relationship between system development and BPR, and described the defects of conventional system development under the climate of BPR thinking. In the latter part of the chapter we gave the background to our approach to BPR and described briefly how EM principles fit into the thinking and practice of BPR.

In conclusion, the application of EM requires us to widen our focus from an intended computer system to include the entire business processes (the environment) and the people involved (the human factors). This means our focus should include participants – and their views, knowledge, capabilities and perceptions – behind the business processes. It also means shifting our first attention from software requirements to business requirements. The former should be a result of the latter. The scope for creativity in EM, through collaborative interaction of user participation, will be one important aspect of BPR.