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Exploring the relationship between information technology and business process reengineering

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Abstract

This study examines a series of relationships between information technology (IT) and business process reengineering (BPR). Specifically, it argues that those aspiring to do business process reengineering must begin to apply the capabilities of information technology. This paper provides a summary of IT roles in initiating and sustaining BPR and examines several companies that have successfully applied IT to reengineering. The paper also addressees barriers to successful implementation of reengineering and identifies critical factors for its success.

Keywords: Businesses process reengineering; Restructuring; Information technology; Information technology performance; Organizational change; Process innovation

1. Introduction

The term ''reengineering'' first appeared in the information technology (IT) field and has evolved into a broader change process. The aim of this radical improvement approach is quick and substantial gains in organizational performance by redesigning the core business process. In the 1990s, many US companies embraced reengineering as an effective tool to implement changes to make the organization more efficient and competitive. The motivation was usually the realization that there was a need to speed up the process, reduce needed resources, improve productivity and efficiency, and improve competitiveness [14,32,33].

The changing economic environment has led to an increasing interest in business process reengineering (BPR) by progressive firms around the world. One study shows that about 87% of firms surveyed were either engaged in BPR projects, or indicating their intention to take up BPR projects in the next few years [25]. Hammer and Champy reinvigorate the topic in their book, ''Reengineering the Corporation,'' published in 2001. They reintroduce the goal of making major gains in reducing ''waste'' in the organization. They suggest that we reexamine every single process and rebuild businesses [12].

Another reason for BPR relates to the increasing emphasis placed on integrating business web sites with backend legacy and enterprise systems, as well as organizational databases. Such integration may require substantial reengineering [3,20,23]. In his new book, James Champy argues that BPR was

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1990s remedy for sluggish corporations that lacked customer focus and competitive ability. Today, he sees reengineering as only a beginning. In this decade, businesses will need to continue by using technology to add customers, suppliers, and other partners to the process redesign mix. The redesign of work will be between a company and its customers, suppliers and partners. He calls this process X-engineering—crossing organizational boundaries. Companies such as Cisco, Dell, Intel and Solectron are examples of successful X-engineering implementations [4].

In the 1990s, significant reduction in the cost of IT resulted in enormous investments in IT applications that have stimulated increasingly complex organizational change. Information technology has been used to break down communication barriers between corporate functions, to empower line workers and to fuel process reengineering. In most cases, IT has been used to expedite office work rather than to transform it. Top executives consider IT a potent source of competitive advantage.

Working together, BPR and IT have the potential to create more flexible, team-oriented, coordinative, and communication-based work capability [34]. IT is more than a collection of tools for automating or mechanizing processes. It can fundamentally reshape the way business is done and enable the process design. In leading edge practices, information technology makes BPR possible and worthwhile. BPR and IT are natural partners, yet their relationships have not been fully explored [9]. Given the growing dominance of services, their recursive relationship is in need of further analysis and redesign.

2. IT capabilities and reengineering

IT has penetrated the office and services environment since the 1978. The shift from mainframe to PC based technology is breaking down communication barriers between employees and customers. Now managers and employees from various departments are designing and controlling complex business information systems.

IT capabilities involve improving information access and coordination across organizational units. It is so powerful that it can actually create new process design options, rather than simply support it. In his book, Business @ the Speed of Thought, Bill Gates argues that if the 1980s were about quality and the 1990s were about reengineering, then the 2000s will be about velocity. Gates advocates complete digitalization of all aspects of life. He argues that to be successful in the digital age, companies need to develop a new digital infrastructure similar to the human nervous system. This new digital system enables companies to run smoothly and efficiently, makes them respond quickly to emergencies and opportunities, provides a mean for quickly getting valuable information to the people in the company who need it. This in turn empowers employees to make decisions and interact with customers [8].

What is the relation between BPR & Information Technology? Hammer and Champy consider IT as the key enabler of BPR [13]. Davenport et al. argue that BPR requires taking a broader view of both IT and business activity, and of the relationships between them. IT capabilities should support business processes, and business processes should be in terms of the capabilities IT can provide. They believe IT's promise and its ultimate impact is to be the most powerful tool for reducing the costs of coordination [6].

It has been argued that innovative uses of IT would inevitably lead many firms to develop *new, coordination-intensive structures*, enabling them to coordinate their activities in ways that were not possible before. Such coordination-intensive structures may lead to strategic advantages [30].

IT roles can be categorized into three phases: before the process is designed, while the process design is underway, and after the design is complete. Table 1 provides a summary of IT roles in initiating and sustaining BPR.

2.1. Phase 1: before the process is designed (as an enabler)

BPR is a strategic action and requires a clear understanding of customers, market, industry and competitive directions. Furthermore, like any other strategic action, it requires consistency between the company's business strategy and vision. Defining business strategy and developing a strategic vision requires understanding the company's strengths and weaknesses, and the market structure and opportunities.

Table 1
IT roles in initiating and sustaining reengineering

Before the process design	During the process design	During the implementation
• Create infrastructures and manage information that support evolving organization	• Bring vast amounts of information into the process	• Create a digital feedback loop
• Foster process thinking in organizations	• Bring complex analytical methods to bear on the process	• Establish resources for critical evaluation of the reengineered process
• Identify and select process for redesign	• Enhance employees' ability to make more informed decisions with less reliance on formal vertical information flows	• Improve IT processes to meet increasing needs of those divisions that have gone under reengineering processes
• Participate in predicting the nature of change and anticipate the information needs to support that change	• Identify enablers for process design	• Institute a program of "cleanup" and damage control in case of failure
• Educate IT staff in non-technical issues such as marketing, customer relationships, etc.	• Capture the nature of proposed change and match IT strategy to that change	• Communicate ongoing results of the BPR effort
• Participate in designing measures of success/failures of reengineering	• Capture and disseminate knowledge and expertise to improve the process	• Help to build commitment to BPR
	• Communicate ongoing results of the BPR effort	• Evaluate the potential investment and return of reengineering efforts
	• Transform unstructured processes into routinized transactions	
	• Reduce/replace labor in a process	
	• Measure performance of current process	
	• Define clear performance goals and objectives to drive the implementation	
	• Define the boundaries and scope of the process	

The activities in this phase may include:

- Developing a strategic vision.
- Identifying the customer's objectives.
- Establishing goals/targets related to market share, costs, revenue enhancement, or profit margins.
- Assessing the potential for reengineering.
- Defining boundaries and scope of the appropriate process.
- Keeping management committed.

IT capabilities can provide good insight into the existing conditions. IT is one of several enablers, including human resources and organizational change, that all must be considered together to bring about change in business processes.

Many companies ignore IT capabilities until after a process is designed. An awareness of IT capabilities can and should influence process design. Michael Hammer recommends companies to redefine the process first and automate it second.

IT can play important roles in this phase of BPR efforts as follows:

1. The opportunity IT provides is to utilize newer and better technology to develop a strategic vision and to help improve the business process before it is designed. For example, an important Wal-Mart vision was to eliminate unnecessary distribution steps and cost and to provide value to customers. To accomplish this, Wal-Mart developed a strategy that included linking its suppliers to its retail stores. IT, eventually enabled Wal-Mart to implement this strategy. An enterprise-wide information system was developed that directly connected all retail locations, distribution warehouses, and major supplies [7].
2. The capabilities of IT to track information and break down geographic and organizational barriers are useful in understanding the company's strengths and weaknesses, and market structure and opportunities. Communication technology

helps to overcome geographic barriers and thus enable broader acceptance of the process change. At General Electric e-mail systems are used to speed analysis and design sharing and to hold frequent virtual meetings between group from different regions and overseas.

3. The focus is on finding different approaches to manage a process. These approaches can be found and be adapted from practices of companies outside of the industry. The organization should benchmark against other industries and combine it with the experience and expertise of the team members to adopt an entirely new process technology.
4. BPR requires a flexible organization design. The existing rigid infrastructure of the organization must be altered to facilitate cooperation between various departments by using cross-functional teams instead of individuals working in isolated departments. Flexible infrastructures adapt to changing external drivers. Therefore, the flexible infrastructure includes processes for continuously evaluating existing tools to see what should be removed, and continuously seeking user input about what works or does not.
5. To achieve effective teamwork, each worker should develop several competencies. The IT organization is no exception. The demand for close collaboration with other functions dictates the need for IT staff to broaden their portfolio of skills especially in non-technical issues such as marketing, customer relationships, etc. The combination of the Internet and the Intranet services allows a collaborative team effort from around the globe.
6. Alliances and other methods of cross company coordination are becoming common-place. In an attempt to gain market shares, many firms are teaming and collaborating with suppliers and distributors.

2.2. Phase 2: while the process is being designed (as a facilitator)

This stage involves two activities: technical and social design. During the technical phase, information is consolidated, alternatives are redefined, process linkages are reexamined, and controls are relocated prior to applying technology. The social design focuses on human aspects and involves employees who will affect corporate changes: defining jobs and teams, defining skills and staffing needs, and designing incentives are considered carefully.

This stage also requires development of test and rollout plans. After the objectives are identified, the existing processes are mapped, measured, analyzed, and benchmarked, and then are combined to develop a new business process. Development of people, processes, and technology are integrated.

During the process design, accountability for development, testing and implementation must be clearly defined. Real benefits to the business result when IT becomes involved with more fundamental changes to the business process itself.

The crucial roles that IT plays in this phase of BPR efforts are:

1. IT can facilitate the reengineering design process through the use of project management tools. These help identify, structure, and estimate BPR activities and help to control contingencies that arise during the process. Project management tools along with electronic communication, enable ongoing communication of the reengineering process between users and facilitators.
2. Gathering and analyzing information about the performance and structure of a process is an important step in identifying and selecting process for redesign. Mapping or flow-charting the existing process and then measuring the results in terms of cost, quality and time are the most successful. IT can facilitate this step with the use of tools that provide modeling and flow simulation, document business processes, analyze survey data, and perform structuring evaluation. Technologies such as computer-aided systems engineering (CASE) are designed primarily to draw process models. The ability to draw models and make changes rapidly speeds redesign and facilitates the ''process'' of process design. At Xerox, for example several divisions are moving directly from process modeling to automated generation of computer code. They report high user satisfaction and improved productivity with the resulting systems. In addition, IT is capable of storing and retrieving unstructured, multimedia information that can be useful for developing process prototypes. The maintenance and operating workers at Union Carbide's plant in

Taft, Louisiana used flow-charting to redraw their old process and create new ones. The results were a saving of more than US$ 20 million [26].

3. Computing technologies have facilitated a process-oriented approach to system development where a database is shared in different functional units participating in the same business process. Ford Motor Corporaion, for example used databases in its accounts payable process to cut down many intermediate steps and to overhaul a sequential flow of paper documents among involved functions. As the project progressed, the reengineering efforts achieved a 75% reduction in the workforce. In addition to shared databases, imaging technology has facilitated a process-oriented approach because in processing loan applications, for example the digitized image of an application can be worked on by several employees directly.
4. Telecommunication technologies such as LANs, groupware, etc. have improved collaboration among personnel of different functional units in their efforts to accomplish a common business process. At Texas Instruments, for example, the process for new product development was dramatically improved when a design team in different countries used global network to work on design directly without sequential flow of documents. As a result, the development cycle time for various products decreased substantially (more than 30% in some cases) [21]. At Ford, the process for new car design was improved when computer-aided design (CAD) systems were utilized. Members of design teams share a common design database across the Atlantic to exchange design ideas, criticism, and opinions without meeting face to face.
5. Making data digital from the start can provide a whole range of positive results. When figures are in electronic form, employees can look at them in any detail or in any view they desire, can study them and pass them around for collaboration. For example, Seven-Eleven Japan used IT to not only improve inventory control, but to provide key information to management and improve quality of sales information to make better operation decision on a regional basis. In 1979, the company established an on-line network and from there introduced the Electronic Point of Sale (EpoS) system in 1982 [28]. At Hewlett-Packard Co., the sales process improved drastically as 135 sales representative were trained to use laptop to retrieve up-to-date inventory information from the corporate database during the customer meetings. In addition, sales persons used these laptops to communicate with their peers and superiors. As a result, time spent in meeting decreased by 46%, travel time was cut by 13%, time spent with customers increased by 27% and sales rose by 10% [1].
6. Input from employees and information on customer requirements is essential in reengineering. IT applications allow organizations to build a data base to track customer satisfaction, analyze complaints, and obtain employee's feedback for ways to improve customer satisfaction. At Frito Lay each of the 10,000 salespersons uses a hand-held computer to record sales data on 200 grocery products, reducing many clerical procedures. The data is transmitted to a central computer, which, in turn, send instructions (such as changes in pricing, and product promotions) to all salespersons through their hand-held computers. This process greatly enhances collaboration between marketing and sales and also makes weekly summaries and analysis available to senior managers [22].
7. IT capabilities are used for information exchange and to improve inner organizational collaboration. For example R.J. Reynolds Tobacco Co. used EDI technology in conjunction with varied technologies of electronic commerce such as document imaging with electronic work queues to reengineer its accounts payable function.
8. IT can also be used to help identify alternative business processes. IT can help companies to achieve multiple objectives in redesigning processes. Expert systems and technological databases can provide information on current and future capabilities of technology, human resources and organization change. American Express improved quality, cost, and time of its credit authorization process with an ''Authorizer's Assistant'' expert system. The successful redesign led to 25% reduction in the average time for each authorization, a 30% reduction in improper credit denials and a 7 million annual reduction in costs due to credit losses. IT makes it possible to develop much richer processes.

2.3. Phase 3: after the design is complete (as an implementor)

The bulk of the reengineering efforts lie in this phase. The reengineering efforts include planing and managing people, processes, and technology and driving the implementation toward the business vision. The objectives of this stage are to pilot test the new approach, to monitor the results, and to provide extensive retraining of employees. As reengineering efforts go forward it is important to define and redefine performance goals and objectives, maintain a strong commitment to the vision, break the barriers between the departments, and be flexible as the business environment changes.

IT can facilitate the following processes in this phase:

1. Implementation of the new process through the use of project management and process analysis tools. These help identify structure and estimate all associated activities. They facilitate tracking and managing employee's expectations against commitments. Contingencies and problems that arise during the implementation phase can be handled and controlled.
2. Electronic communications enable ongoing and real time communication of the process between users and facilitators. IT helps to overcome geographic barriers.
3. Evaluating the potential investments and returns of the reengineering efforts is absolutely essential. How can the value of any specific reengineering process in the company operation be objectively questioned? The reengineering team or management should have enough information to determine the value the new process contributes to the overall performance. Pacific Bell developed process value estimation (PVE) methodology to compute the amount of value-added by a given process before and after BPR effort. Pacific Bell management is using the methodology to target ''right'' process for reengineering and to evaluate the changes that have made and the returns of the reengineering efforts [17].
4. A fundamental source of difficulties is the fact that process are reengineered but infrastructure is not. The rigid infrastructure of the organization must be altered to facilitate cooperation and to cross-functional barriers between departments. Cross-functional teams must replace individuals working in isolated departments. Recently, there has been a significant growth in collaborative computing products. These range from software for conducting meetings on-line to complex programs that enable a number of users to collaborate in real time, sharing documents, managing projects and handling different tasks. These include idea generation, brainstorming, group outlining, voting, teleconference, meet-me-service, etc.
5. As other business divisions undergo reengineering process, IT organization should be improved to meet their increasing needs. For example, in 1993 CIGNA implemented reengineering of its 1000-person IT department—CIGNA Technology Services (CTS). The main reason was to meet the increasing needs of the business divisions. A team based structure resulted, and the benefits included a major change in the philosophy of the unit. Where the unit was previously technology focused, reengineering brought about a focus on using technology to meet business strategies. Management style changed from control-based and functional, to leadership-based and team-oriented. The hierarchy was flattened, increasing flexibility [2].
6. ''Digital feedback loop'' makes it possible to have a specific definition of success, a specific beginning and end in terms of time and tasks, intermediate milestone and finally a budget.

IT is only useful if it helps employees do their work better and differently. Organizations are not working with the employees in the organization to infuse technology. Successful reengineering requires that companies first concentrate on crucial business processes that effect competitive factors, customer service, cost reduction, product quality and time-to-market. Obtaining greatest benefit from IT requires that current processes not be simply automated or existing automation improved.

3. The current state of reengineering

Many companies considered reengineering to be the productivity breakthrough of the 1990s. American

Table 2
Reported IT enabled reengineering successes

Company	Process	Role of IT	Reported benefits
American Express	Credit authorization	Expert system was used to achieve multiple objectives in redesigning credit authorization	US$ 7 million annual reduction in costs 25% reduction in the average time for authorization 30% reduction in improper credit denials
Cisco Systems	Sales	Web based automation is used for online sales	Handles 75% of sales online 20% increase in productivity in 2 years
Deere & Co.	Product development	CAD and CAM are used for design, production and materials management	Reduced inventory costs Decreased manufacturing overhead
Dell Computer	Supply chain	Internet based technology to fulfill individually customized products with delivery target of 5 days or less	Reduce inventories to a 5 day's worth, down from 13 in 1997, resulting in a US$ 50 million saving
FedEx Corp.	Procurement	The Internet technology is used to automate and streamline its whole paper-based inefficient procurement processes	Purchasing cycle times have been reduced from 20 to 70% Number of suppliers have been reduced by more than half Better service for its own employees
Ford Motor Corp	Accounts payable	Relational database overhaul a sequential flow of paper document Imaging technology facilitates a process-oriented approach	75% reduction in workforce, from 500 to 125 14 days reduction in payment time to suppliers
Frito Lay	Purchasing	Hand-held computer records data on grocery products	Enhanced collaboration between marketing and sales Saved 30,000 to 50,000 work hours per year Lowered the sales staff by 600 people Eliminated 10% of the distribution centers
Hewlett-Packard Co.	Sales process	Laptop Computers were used to provide frequent exchange of sales intelligence and corporate directives	46% reduction in time spent in meetings 27% increase in time spent with customers 10% increase in sales
Pacific Bell	Billing department	New printing technology	30% reduction in paper consumption US$ 10–12 million reduction in postage costs
Pfizer Inc.	Product development	Web based document management	Sliced the old 1-year drug approval timetable nearly in half
R.J. Reynolds	Accounts payable	EDI, electronic receipt settlements and imaging technology with electronic work queues reengineer accounts payable function	53% reduction in invoice processing costs 25% reduction in clerical staffing requirements 16% annual increase in transactions volume
Texas Instruments	Product development	Global network and advanced computing resources enable design teams in different geographic areas to work on pre-design development without meeting face-to-face	30% reduction in time needed to develop an instrument

Table 2 (*Continued*)

Company	Process	Role of IT	Reported benefits
Wal-Mart	Procurement/distribution process	EDI and Bar Scanners provide just-in-time inventory levels Satellite systems are used for data transmission between sites	2% cost advantage over its nearest competitors
Seven-Eleven Japan Co. Ltd.	Inventory control	Point-of-sale (POS) and electronic ordering enhance business efficiency Satellite[a] communications and an integrated services digital network (ISDN) are used for data transmission between stores and district office	Enhanced information-sharing among stores, headquarters and suppliers Enhanced business efficiency Improved overall ability to meet customer needs

[a] See Fig. 1 for a detailed view.

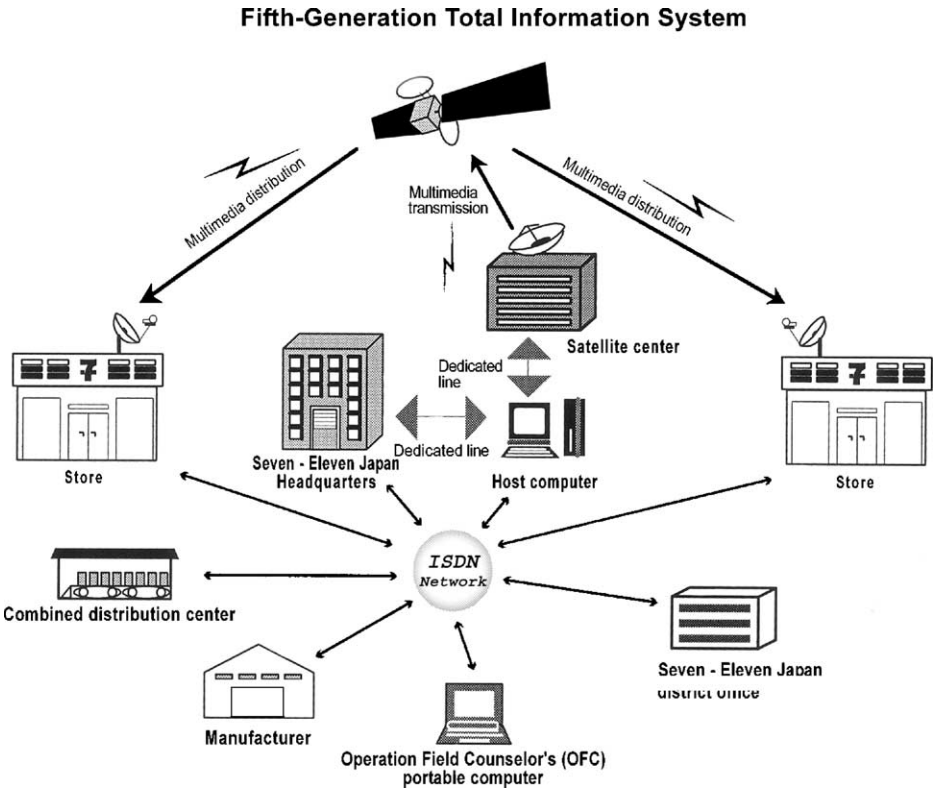

Fig. 1. Seven-Eleven Japan's Information Systems Source: Corporate Outline, 1999, Seven-Eleven, On-line (http://info.sej.co.jp/contents_e/sej04.html).

businesses spent more than US$ 30 billion on reengineering projects in 1994, and as much as US$ 50 billion in 1995 and 1996.

Reengineering efforts have produced a wide range of results. Some users achieved large cost reductions, higher profits and throughput, etc. In many of these firms, IT played an important role in process redesign (Table 2). Many innovative IT applications stem from a combination of breakthrough ideas and from modifying the ideas that have succeeded or failed in other companies Fig. 1.

4. Barriers to effective implementation

Despite all the energy, money, and efforts spent by companies trying to make their organizations' reengineering efforts successful, reengineering is still an unfulfilled promise. Even substantial reengineering pay-offs appear to have fallen well short of their potential [10,11,19,18,24]. In his 1996 article, Harari suggested that BPR is dead [15]. This is true, not because the concept is flawed, but because of implementation problems.

4.1. Misunderstanding of the concept

The concept of reengineering is widely misunderstood (see Table 3). Those who label any organizational change as reengineering have victimized it. Lack of understanding of the concept and inappropriate application will all contribute to organizations' failure to appreciate the promise of reengineering [16].

Reengineering is process design, process management, and process innovation. Reengineering involves revising organizational processes. It means designing the core business process instead of analyzing the current one. It involves reconfiguration of work to serve

Table 3
What reengineering is not

Downsizing	Reengineering eliminates work, not jobs or people
Restructuring	Reengineering is concerned with how work is done, not how an organization is restructured
Automation	Reengineering enables new process design, rather than providing new mechanisms for performing old ones
More of the same	Reengineering is a revolution

customers better. Reengineering forces us to challenge the way that organizations are run and to redesign the organizations around the desired outcomes rather than functions or departments. Reengineering forces a new way of thinking. Peter Drucker states, ''Every organization has to prepare for the abandonment of everything it does.'' The old way of managing, the vertical organizations, the promotion and compensation schemes, and the whole decision making schemes no longer work.

4.2. Misapplication of the term

Reengineering is not cheap. It is a challenging process that will require hard work by both management and employees. Reengineering is a powerful tool for creating seamless organizations. Business process reengineering should not replace TQM or other organizational initiatives. In fact without a continuous improvement process, reengineering cannot be successful.

4.3. Lack of proper strategy

A major reason given for the high failure rates of BPR efforts was that the efforts had not been connected to the corporate goals [35]. Robert M. Tomasko, author of Rethinking the Corporation states, ''Don't fix stuff you shouldn't be doing in the first place.'' [29]. Reengineering is about operations; only the strategy can show what operations matter. Reengineering programs should concentrate on understanding the existing process. The output goals must be stated in clear and quantitative terms. Reengineering could provide executives with more accurate estimates of the required number of employees to run a particular process more effectively.

4.4. Unrealistic objectives

Evidence suggests that reengineering always takes longer than expected, always involve more people resources than are available, and always presents problems no one anticipates. According to a survey by Arthur D. Little, only 16% of senior executives were fully satisfied with their reengineering programs. About 68% were experiencing unanticipated problems. It was concluded that much of this came from setting unrealistic targets. It was also pointed out that nobody knew whether reengineering programs did grow revenues and profits.

4.5. Management failure to change

Lack of leadership is a frequent cause for the high failure rate of BPR projects. ''BPR implementation requires a top–down, directive leadership style. Yet, it also requires the management of motivated, skilled, independent-thinking people doing non-programmable tasks for which a non-directive leadership style is most suited'' [27].

A fundamental source of difficulties is the fact that process is reengineered while management does not. Reengineering forces changes in management style. It forces managers to reevaluate not only what they do, but also who they are. Management must change the way they think, organize, plan, deploy, inspire and reward the performance. They must learn to organize work in a holistic, integrated way. They must create an environment where generalists are replaced with specialists, and where preoccupation with internal activities is shifted to a design focused on customers.

4.6. Failing to recognize the importance of people

Many companies who attempt reengineering focus on process design and ignore or underestimate the importance of people. Without a proper approach to dealing with employees involved, the implementation is guaranteed to fail. Reengineering changes all aspects of a business. When a process changes, the jobs of those who do the work in that process must also be changed.

Reengineering efforts changes almost everyone's job causing employees at all levels to require new skills. Furthermore, reengineering usually involves the

process of combining many job categories into one, which requires extensive technical crosstraining. Thorough skills' assessment of the workforce should be undertaken through job-analysis and needs-analysis. The analysis should determine what skills are needed and what changes have to take place.

Reengineering causes enormous change in the organization therefore it has a tendency to cause organizational anxiety. One of the challenges of implementing reengineering is coping with the reaction of employees. Employees' resistance to change and their fears about job displacement need to be alleviated and explained. Making employees' feel they own the reengineering efforts can improve employee's moral and soothe negative feeling [31].

4.7. IS failure to change

IT can be one of the greatest barriers to BPR. Many reengineering efforts have been stopped because radical change would require IS redesign. Resistance on the part of IS personnel has more often been a failure in implementation than an enabler.

5. Summary

BPR is going through its second wave. BPR is gaining importance as organizations develop inter-organizational relationships, alliances, and other methods of cross company coordination. A lot of the value and innovation in organizations today comes from knowledge workers and knowledge work processes. Davenport argues that the following processes ought to be considered [5]:

- Inter-organizational processes: Web services—SOAP and the UDDI Web services directory, XML.
- Marketing and customer-facing processes: marketing automation, workflow for semi-structured processes, customer insight analytics.
- New product development processes: collaborative product commerce applications; intellectual property management.
- Information access and analytical processes: role-based and active portals, digital content services, and the integration of information management, knowledge management and e-learning.

The rapid evolution of information technologies and its declining costs are creating opportunities to change and improve the way they conduct business.

IT is the most effective enabling technology for BPR. It helps in meeting the objectives of reengineering in three ways: by providing information across functional levels and establishing easy communication, improving the process performance and finally by helping the reengineering effort by modeling, optimizing and assessing its consequences.

IT can play an important role in success of reengineering, but only when the organizations adopt a change in mindset regarding the role of the IT function. Without visionary leadership and support most IT changes will be ineffective and there is little chance that innovative forces can be mobilized to facilitate process redesign and organizational transformation.

In many cases, IT was the biggest barrier to rapid and radical change because radical change required IS redesign. IT is clearly an enabler of reengineering. In many cases redesign process cannot be implemented until employees can access new sources or domains of information.

Organizations often fail to achieve reengineering objectives because they trivialize the concept. Reengineering require creative thinking. It requires a new perspective on the part of management—may be even a new philosophy.

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References

[1] J. Berger, P. Angiolillo, T. Mason, Office automation: making it payoff, Business Week 12, 1987, pp. 134–146.
[2] M. Bower, S. Jarvenpaa, D. Stoddart, CIGNA Corporation Inc.: Managing and Institutionalizing Business Reengineering, Harvard Business School, Case number 9-195-097, 1994.
[3] M. Broadbent, P. Weill, D. St. Clair, The implications of Information Technology information infrastructure for business process redesign, MIS Q. 23 (2), 1999, pp. 159–182.
[4] J. Champy, A., X-Engineering the Corporation: Reinventing Your Business in the Digital Age, Warner Books, New York, 2002.

[5] Davenport, H. Thomas, The New Reengineering, 2002? http://www.darwinmag.com/read/090102/order.html.
[6] Davenport, H. Thomas, J.E. Short, The New Industrial Engineering: Information Technology and Business Process Redesign, Sloan Management Review, summer, 1990, pp. 11–26.
[7] R.T. Furey, S.G. Diorio, Making Reengineering Strategic, Planning Review, July–August, 1994.
[8] B. Gates, Business @ the Speed of Thought: Succeeding in the Digital Economy, A Warner Business Book, New York.
[9] V. Grovera, T. James, A.H. Segarsb, K. Fiedlera, The influence of information technology diffusion and business process change on perceived productivity: the IS executive's perspective, Information & Management 34 (3), 1998, pp. 141–159.
[10] V. Grover, S.R. Jeong, W.J. Kettinger, J.T.C. Teng, The implementation of business process reengineering, Journal of Management Information Systems 12 (1), 1995, pp. 109–144.
[11] G. Hall, J. Rosenthal, J. Wade, How to Make Reengineering Really Work, Harvard Business Review, November–December, 1993, pp. 119–131.
[12] M. Hammer, J. Champy, Reengineering the Corporation: A Manifesto for Business Revolution, Harper Collins, New York, 2001.
[13] M. Hammer, J. Champy, Reengineering the Corporation, Harper Collins, New York, 1993.
[14] M. Hammer, Michael, S.A. Stanton, The Reengineering Revolution, Hammer and Co., 1995.
[15] O. Harari, Why did reengineering die? Management Review 85 (6), 1996, pp. 49–52.
[16] S. Heusinkveld, J. Benders, Surges and sediments: shaping the reception of reengineering, Information & Management 38 (4), 2001, pp. 239–251.
[17] T. Housel, A. Bell, V. Kanevsky, Calculating the value of reengineering at pacific bell, Planning Review 1–2, 1994, pp. 40–55.
[18] S. Jarvenpaa, D. Stoddart, Business process redesign: radical and evolutionary change, Journal of Business Research, January, 1998
[19] J. Johannessen, B. Olsen, J. Olaisen, Organizing for innovation, Long-Range Planning 30 (1), 1997, pp. 97–109.
[20] R. Kalakota, M. Robinson, e-Business, Roadmap for Success, Addison Wesley, 1999.
[21] M. Magnet, Who is Winning the Information Revolution? Fortune, November, 1992, pp. 110–117.
[22] T. Malone, J. Rockart, Computers, Networks and the Corporation, Scientific America, 1991, pp. 128–136.
[23] M. Nissen, Redesigning reengineering through measurement-driven inference, MIS Q. 22 (4), 1998, pp. 509–534.
[24] Pegels, C. Carl, Total Quality Management: A survey of Its Important Aspects, Boyd & Fraser Publishing Company, 1995.
[25] C. Ranganathana, J.S. Dhaliwal, A survey of business process reengineering practices in Singapore, Information & Management 39 (2), 2001, pp. 125–134.
[26] T.A. Stewart, Reengineering: the hot new management tool, Fortune 23, 1993, pp. 41–48.
[27] N. Sutcliffe, Leadership behavior and business process reengineering (BPR) outcomes: an empirical analysis of 30 BPR projects, Information & Management 36 (5), 1999, pp. 273–286.
[28] E. Sutherland, Seven-Eleven: A Case Study in Japanese retailing, 1995.
[29] R.M. Tomasko, Rethinking the Corporation: The Architecture of Change, AMACOM, New York, 1993.
[30] Teng, James, V. Grover, K.D. Fiedler, Business Process Reengineering: Charting a Strategic Path for the Information Age, California Management Review, July–August, 1994
[31] R. Thomas, D. Dunkerley, Careeing downwards: middle managers' experiences in the downsized organization, British Journal of Management 10 (2), 1999, pp. 157–181.
[32] M. Verespej, Reengineering Isn't Going Away, Industry Week, 20 February, 1995, p. 42.
[33] S.R. Wellins, J.S. Murphy, 1995, Reengineering: Plug Into the Human Factor, Training & Development, January, pp. 33–37.
[34] M.E. Whitman, IT divergence in reengineering support: performance expectations vs. perceptions, Information & Management 30 (5), 1996, pp. 239–250.
[35] I.-L. Wu, A model for implementing BPR based on strategic perspectives: an empirical study, Information & Management 39 (4), 2002, pp. 313–324.

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