Business Process
Reengineering: Charting
a Strategic Path for
the Information Age

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This is an age of fundamental and accelerated changes. The decline of
Communism, advances in information technology, the emergence of
new industrial powers, and intense global competition are just a few
of many developments that even futurists could not have foreseen. Organizations as large and powerful as IBM and GM are undergoing massive
restructuring to "reinvent" themselves in order to survive and prosper in the
new age. For most firms, the pressure from these severe economic condi-
tions does not leave them with many choices. An increasing number of
firms are marching to the drumbeat of business process redesign (BPR),
alternatively called reengineering, to radically alter many age-old proce-
dures in order to reduce cost and improve competitiveness. Reports of suc-
cessful results from many reengineering efforts have been reported recently.
Eastman-Kodak Inc., AT&T, Cigna RE, and Hallmark, among others,
report increases in productivity and reduction in staff after business reen-
gineering. In many of these firms, information technology (IT) played an
important facilitating role in process redesign. As more and more firms
decide to adopt BPR as the primary vehicle for organizational transforma-
tion, it becomes imperative for top executives to develop a high-level per-
spective on this strategic endeavor.

In this article, a framework will be proposed to help develop this high-
level perspective. Two critical dimensions are conceptualized to capture the
characteristics of a business process: degree of mediation and degree of
collaboration. A process with a high degree of mediation involves a large
number of steps in a sequential manner, while processes with a low degree
of mediation have most of the participants contribute directly, often simulta-
neously, to the final outcome. For the degree of collaboration dimension,
the participants in a process, regardless of the pattern of mediation, may
exchange information with each other and make mutual adjustments to
facilitate the accomplishment of process outcome. Depending on the extent of such information exchange, one can identify processes having higher or lower degrees of collaboration. This gives rise to a framework that delineates four general process patterns: high-mediation/low-collaboration, high-mediation/high-collaboration, low-mediation/low-collaboration and low-mediation/high-collaboration.

The proposed framework will be used to show how various types of information technologies (IT) may be utilized to alter the characteristics of a business process through BPR. In addition, the framework can assist in evaluating the potential of candidate processes for BPR and in charting a strategic approach to be followed in reengineering.

Information Technology and Business Process

A business process, according to Davenport and Short, is “a set of logically related tasks performed to achieve a defined business outcome.” Typically, maximum performance gains are achieved with the reengineering of a process where these related tasks are performed by personnel from several different functional units. To avoid confusion, the term “function” will be used in this article to refer only to those tasks of a given functional department that are involved in the process, while the entire functional department or area will be referred to as the “functional unit.” For example, in the process of conceptualizing a new product, some consumer behavior specialists (function) from the marketing department (functional unit) participate to evaluate its market potential, a number of related researchers (function) from R&D (functional unit) examine its technical feasibility, and a few analysts (function) from the finance area (functional unit) evaluate its profit margin.

Business processes have existed and evolved long before the advent of modern computers. Interestingly, major changes in business processes have not occurred as a result of computerization as the majority of computer systems in organizations merely automate or support existing business procedures. These procedures typically operate within the confines of a particular functional unit. They were made more efficient with computerization, but the walls between functional units stood firm. As the turbulent environments of the 1990s push uncertainty to an unprecedented level, many organizations are now attempting to leverage the advancing IT to facilitate the cooperation between functional units and increase the organization’s flexibility and responsiveness. Such efforts often involve the fundamental redesign of business processes that cross functional units.

Throughout our discussion, the terms Business Process Redesign and Business Process Reengineering (BPR) are used interchangeably, referring to the critical analysis and radical redesign of existing business processes to achieve breakthrough improvements in performance measures. Although
some of these processes may operate within one functional unit, many important business processes cross departmental boundaries. At Bank One, for example, the sequential flow of paper documents among many units is being drastically altered through the use of imaging technology which enables the many functions involved in the mortgage approval process to perform different processing steps on the same document concurrently. Another example occurred at Frito-Lay where the introduction of hand-held computers and databases drastically improved the complex process of coordinating the activities of 10,000 salespersons.

While the importance of IT in process redesign may have received attention only recently, its effects on fostering process thinking have been in the making for many years. For example, data-base technology has facilitated a process-oriented approach to system development because a database can be shared by several functions in different functional units participating in the same business process. As the data-base technology matured, many organizations began to build systems centered around business processes that cross functional units. A West Coast pharmaceutical manufacturer, for example, used relational databases to build such a system to track the full life cycle of its products. As the project progressed, the analysts discovered that between 30% to 50% of the tasks performed were redundant, and many aspects of the process were redesigned as a result.

In addition to the computing technologies (such as shared databases and imaging), telecommunication technologies (in the forms of local area networks, electronic mail, and groupware) provide opportunities for improving collaboration among personnel from different functional units in their efforts to accomplish a common business process. At GM, for example, the process for complying with federal pollution standards was dramatically improved when environmental engineers used electronic mail and bulletin boards to disseminate information on pollution control to specialists in functional units (such as production, logistics, and R&D) among several dozen sites.

While both computing and communication technology generate an undercurrent of process thinking, it is important to realize that IT is not the only facilitator for process improvement and reengineering. Industrial engineers have striven to analyze and improve processes since the early part of this century. In fact, the radical redesign of business processes has been referred to as the “new industrial engineering,” in contrast to the old Taylorian industrial engineering based on task decomposition and specialization. In recent years, heightened attention on business processes is due in large part to the total quality movement, which has swept through the manufacturing industry and spread to the service sector, as well as non-profit organizations. Overall process performance, of course, depends upon the close coordination of the participating functions. In particular, the Quality Function Deployment (QFD) method provides a technique to translate external
performance measures to internal ones for the various related functions.\(^6\) Thus, TQM and BPR share a cross-functional orientation. Davenport observed that quality specialists tend to focus on incremental change and gradual improvement of processes, while proponents of reengineering often seek radical redesign and drastic improvement of processes.\(^7\)

To effectively leverage IT in reengineering processes, certain characteristics of a business process may be altered—as a result of IT application—to achieve dramatic improvement in critical measures of performance. These characteristics pertain to how different functions are coupled to each other and orchestrated to produce a common process outcome. The framework proposed here describes such coupling patterns as they currently exist in business processes. The identification of different patterns based on these descriptive process characteristics can help set strategic direction and guidelines in efforts to alter the current coupling patterns of business processes through BPR.

**Functional Coupling of Business Processes**

In a typical organization, business processes evolve over time and their legitimacy and procedural rationality are seldom questioned. There is no assurance that people involved in a particular business process fully understand how the related functions participate in that process. The way various functions are orchestrated in accomplishing a process—i.e., the *functional coupling* of a process—can be differentiated along two dimensions: degree of mediation and degree of collaboration.

**The Degree of Mediation Dimension of a Business Process**—Many functions are involved in a typical business process. Each participating function has inputs and outputs. These outputs would either directly facilitate the process outcome or serve as inputs to other participating functions. This input-output relationship may involve the actual transfer of a physical object from one function to another, as in the movement of finished products from the factory to the warehouse. Or it could be the issuance of a document by one function to authorize certain actions in another function, as in the release of funds upon receiving a letter of credit from the bank.

The extent of such *sequential flow of input and output* among the participating functions in a business process constitutes the *degree of mediation dimension* of the process. As illustrated in Figure 1, a process at the very high end of this dimension (pattern 6) involves a large number of intermediate steps performed by various functions contributing *indirectly* to the process outcome (labeled X). Some business processes (such as business expense processing, with its layers of management approvals, auditor evaluation, and filing of receipts) involve many indirect steps and can be seen to cluster around the high end of the mediation dimension. At the other
extreme (pattern 1), several functions contribute directly to the process outcome without the mediation of sequential steps. For example, for the process of launching a new product, the production function and the advertising function both provide inputs to product sales. However, the advertising function needs neither to physically possess the merchandise nor await authorization slips from the production function, in order to advertise the product. Essentially, therefore, the two functions contribute directly to the process of new product launching. Between the two extremes, there are many gradations, corresponding to fewer indirect steps (patterns 5 and 4) and a mixture of both indirect and direct steps (patterns 3 and 2).

**The Degree of Collaboration Dimension of a Business Process**—The second dimension of business processes is related to the degree of collaboration between functions through *information exchange and mutual adjustments* when participating in the same process. Like the degree of mediation, the degree of collaboration can be more or less. The frequency and intensity of information exchange between two functions can range from none (completely insulated) to extensive (highly collaborative). However, there may
be undesirable consequences from the practice of insulation. For the new product development process in a manufacturing firm, success depends on the collaboration between the engineering function and the production function. If the two functions are insulated from each other, it becomes more likely for the engineers to produce design specifications that are impractical for the production staff to set up large scale production. This would invariably lead to substantial change to the original specifications, resulting in lengthy delay, loss of potential sales, and even loss of strategic opportunities. According to experts, around 60% to 70% of manufacturing quality problems start with the engineering function. In recent years, many organizations have attempted to improve the collaboration between various functions related to new product development, to shorten the development cycle. The development of Jeep Cherokee at Chrysler, for example, took only a total of 39 months, rather than the usual 5 or more years, from the initial product conception to actual production.

A Functional Coupling Framework of Business Processes—A functional coupling framework for business processes is presented in Figure 2. For simplicity of presentation, the two extreme patterns for each dimension are included, giving rise to four functional coupling patterns: indirect-insulated, indirect-collaborative, direct-insulated, and direct-collaborative. Each pattern is illustrated in terms of two functions, designated by A and B, as they participate in a common process in producing the process outcome, labeled as C. Collaboration between functions is depicted by 2-way dotted arrows, and input-output relationships are indicated by solid one-way arrows.

The environments for the four coupling patterns are also briefly described in Figure 2. Many traditional business processes evolved in an environment with limited uncertainty, where the output of function A can be specified in advance to meet the input requirements of function B, and the two functions can participate in the process without contacting each other and making adjustments. However, today's increasingly uncertain environment has rendered standardized rules and procedures too inflexible, and the penalty for an isolated function is the possibility that its output would be unsatisfactory or even useless to other functions in the process. To meet this challenge, the functional coupling pattern of many traditional business processes are being modified or even radically altered to reduce unnecessary mediation and enhance collaboration among the participating functions. The application of IT greatly facilitates this change.

Functional Integration and Information Technology

Reducing Degree of Mediation through IT—Many firms have reengineered their business processes from an indirect pattern, with many intermediate steps, to a direct pattern permitting two or more functions to proceed
Figure 2. A Functional Coupling Framework of Business Processes

Degree of Collaboration

Low <------------------------> High

Insulated

Coupling Pattern: Functions participate in the process sequentially with no mutual information exchange
Environment: Participating functions are sequentially dependent and face low level of uncertainty in I/O requirements
Example: Sales function (A) sends customer order to inventory function (B) for shipping

Collaborative

Coupling Pattern: Functions participate in the process sequentially with mutual information exchange
Environment: Participating functions are sequentially dependent and face high level of uncertainty in I/O requirements
Example: Engineering (A) provides manufacturing design specifications to production (B) with frequent consultation between A and B

Degree of Mediation

Low <------------------------> High

Indirect

Direct

Legends:

represents collaborative activities
represents I/O (input-output) relationships
represent participating functions
represents the final step of the process
independently. For example, this process change has occurred at Ford Motor Corp. in its accounts payable process as a result of IT-enabled reengineering. As can be seen in Figure 3, the old payable process at Ford involved three functions: purchasing, inventory, and accounts payable. These functions participated in the process indirectly, with many intermediate steps, and a sequential flow of paper documents. After reengineering, this high degree of mediation is changed with the help of a shared database. Now, work activities are no longer triggered by the flow of documents. Instead, every function participates in the process directly, with information from the shared database, without mediation from other functions, bringing the process from the indirect end of the dimension to the direct end. The reengineered process achieved a 75% reduction in the workforce, from 500 to only 125.

In addition to shared databases, the application of imaging technology has also turned many indirect processes into direct ones. In processing loan applications, for example, the digitized image of an application can be worked on by several employees directly. As one bank officer examines the document to verify the applicant’s employment status, another can work on credit inquiry, and yet another can perform credit scoring. As indicated in Figure 4, for those processes currently in Region I and Region II with high degree of mediation, innovative application of shared computing resources (such as imaging, common databases, and client-server systems) could significantly reduce the degree of mediation in a process and relocate the processes in Region III and Region IV following Path Y and Path Y*. As a result, the horizontal line separating the indirect and direct processes in Figure 2 can be pushed upward, leaving fewer processes still in the two indirect regions.

The use of shared computing resources to reduce the mediation level is a powerful testimony to the distinctive value of IT in creating a “public good,” i.e., a common resource to be accessed by multiple functions. This public good has many remarkable properties. First, unlike other forms of natural resources that are “used up” upon utilization, a shared information resource is not depleted upon usage and may retain its value to additional functions after access by the initial user. In the Ford case described above, for example, the order information left by the purchasing function in the database will be accessed by the inventory receiving department, and later used again by the accounts payable function. A second remarkable property of the shared information resource is its ability to provide comprehensive information that facilitates the accomplishment of process objectives on a more global basis. Prior to reengineering the accounts payable at Ford, clerks had to separately collect order information and inventory receiving information and then perform an “integrating” step to reconcile possible differences between the two pieces of information. With the reengineered process, there is now just one holistic procedure: paying the customer.
This is made possible because the information from ordering and receiving has already been automatically integrated in the database and the resulting information supports procedures that directly address the process objective.

**Enhancing Degree of Collaboration through IT**—Unlike the mediation dimension where the input-output relationships are often dictated by necessity, the collaboration between functions can be discretionary, i.e., a function has the option to either collaborate or not to collaborate with other functions participating in the process. This makes the IT-enabled collaboration enhancement especially appealing as changes to the underlying mediation pattern are not always necessary.

As indicated in Figure 4, processes currently in Region I and Region III may be relocated in the two collaborative regions through Path X and Path X*, leaving fewer processes in the two insulated regions. This change is facilitated primarily through the application of telecommunication technologies such as electronic mail and other office systems products under the rubric of “groupware.” These technologies have great potential for improving communication and collaboration between different functions involved in a business process.\(^{12}\)

At Hewlett-Packard Co., for example, the sales process underwent significant change as 135 sales representatives were trained to use laptop computers to retrieve accurate and up-to-date inventory information from the corporate database during customer meetings.\(^{13}\) In addition, these portable computers provided salespersons with communication links to their peers and superiors, enabling frequent exchange of sales intelligence among the salespersons, as well as timely dissemination of corporate directives pertaining to promotion, pricing, and discounting. The results showed that time spent in meetings decreased by 46\%, and travel time was cut by 13\%. Meanwhile, time spent with customers increased 27\% and sales rose by 10\%. Senior marketing executives at HP attributed these improvements to changes in the way salespeople communicate with their boss and peers. Note that in this case there were no significant changes in the degree of mediation between functions, but a higher degree of collaboration was achieved between marketing, inventory, and the sales functions.\(^{14}\)

In an uncertain environment, collaboration is central to group activities, and telecommunication-based support systems can greatly enhance collaboration and team work. Without telecommunication support, the usefulness of shared computing resources such as databases may diminish. A team of engineers, for example, can share a common design database. In the absence of telecommunication, however, they can not simultaneously modify different parts of the same object, nor are they aware of each others’ changes. Telecommunication-based groupware can significantly enhance collaboration by providing a shared environment for teamwork. Approaches
Figure 3. Reengineering The Accounts Payable Process At Ford: Reducing Degree of Mediation Through IT*

BEFORE

A number of paper documents were processed sequentially by 3 functions who participate in the process indirectly with a work force of 500 clerks to perform many intermediate steps:

- The purchasing function issues a purchase order to the supplier and sends a copy to the accounts payable function.
- Upon arrival of purchased goods, the inventory function sends a copy of the receiving document to the payable function.
- When the invoice from the supplier arrives in the mail, the payable function matches it against the purchase order and the receiving document before issuing payment to the supplier.
- Much efforts are needed to resolve frequent discrepancies between the documents, and a total of 14 data items must be checked in the process.

* Adapted from M. Hammer, "Reengineering Work: Don't Automate, Obliterate," Harvard Business Review (July/August 1990)
With a work force of only 125, the 3 functions participate in the process directly by accessing a shared database, eliminating many intermediate steps and sequential flow of paper documents:

- The purchase order is entered into the shared database by the purchasing function.
- Upon receiving goods, the inventory function accesses the data base. If a match is found, the goods are shipped and the status of the order in the data base is updated. Otherwise, the goods are returned to the sender.
- The payable function routinely access the database to prepare payment checks for orders that have changed status, and invoices from suppliers are eliminated.
- Matching and discrepancy resolution of paper documents are no longer needed, and only 3 data items need to be checked in the process.
to provide such an environment have received much attention from researchers in recent years.\textsuperscript{15}

With the convergence of computing and communication technologies, it may be impossible to have one without the other. However, the primary impetus for vertical movement in Figure 4 is shared informational resources, even though utilization of these resources might require communications technology. Similarly, the major impetus for lateral movement in the grid is communication technology that supports collaboration between functions. However, as indicated in Figure 4, it is possible to follow the diagonal Path Z through the combination of communication technologies and shared computing resources to alter both the mediation pattern and the collaboration level of the process and relocate it in Region IV of the grid. A notable example occurred at Texas Instruments (TI). New product development at TI is now routinely conducted at locations in several different countries: India, Malaysia, Japan, and the U.S. The company’s global network and advanced computing resources enable design teams in different countries to sustain a high level of collaboration, while permitting them to work on different parts of the design directly without sequential
flow of documents. As a result, the development cycle time for various products decreased substantially. The time needed to develop a calculator, for example, declined 20% soon after design drawings began to be sent electronically in 1989, and a further decrease of 17% has been achieved since then.  

It is important to realize that for all the alternative reengineering paths, IT is only a potential enabler. Successful process reengineering often employs other behavioral or organizational techniques and methods, such as self-directed teams and process generalists, in conjunction with IT. The use of teams can greatly improve collaboration in a process. At Kodak, for example the black-and-white film operation took up to 42 days to fill an order, and was running 15% over budgeted cost prior to reengineering. The reengineered process, which is based on self-directed teams, cut the response time by half and operates with a cost 15% lower than budgeted.  

In addition to teams, the use of process generalists can greatly reduce the level of mediation in a process. At IBM Credit, for instance, a salesman’s financing request used to be handled by many specialists through five sequential steps, taking up to two weeks to fill. The use of a single process generalist, called a “deal structurer,” can now process the entire request in four hours, leading to a 100-fold increase in volume of deals handled.

Process Reengineering: Charting a Strategic Path

A Strategic Approach to Process Reengineering—The functional coupling framework provides a basis for identifying critical characteristics of a business process that may be altered via BPR through applications of IT. As indicated in Figure 4, there are a number of alternative paths for process reengineering, and guidelines are needed in selecting a strategic path. Before developing these guidelines, however, it is important to recognize that it is possible to chart the “right” reengineering path for the “wrong” process. As BPR is capable of achieving breakthrough performance, it should be approached as a strategic endeavor. To ensure that the right processes are reengineered, the first step of a strategic approach to process reengineering in an organization calls for the identification of those candidate processes that are critical to the firm’s strategic objectives.

While it is possible to identify candidate processes intuitively and to target certain processes for reengineering quickly, many organizations adopt a more systematic approach to ensure a thorough linkage between BPR and corporate strategy. This typically involves the identification of all business processes in the organization to establish the basis for a long-term BPR program. At Charles Schwab Corp., for example, top management undertook this strategic exercise and adopted a comprehensive, architectural
approach to BPR planning. This effort led to the Schwab Architecture and Migration Strategy (SAMS) model, which includes 24 interrelated business processes representing every activity of the brokerage firm. Eleven senior vice presidents met each month to guide and review progress and to serve as SAMS advocates.  

One technique for identifying business processes in an organization is the value chain method proposed by Porter and Millar. Comprehensive identification of business processes can be achieved by tracing from the “upstream” processes associated with inbound logistics through operations, and those related to “downstream” processes such as marketing, sales, and services. Guided by strategic management techniques such as the Critical Success Factors (CSF) method, each process can be evaluated as to its strategic relevance. This would help to identify a set of processes that are critical to the firm’s strategic performance and become candidates for BPR. The prioritization ordering among these processes can then be determined by the magnitude of their strategic relevance.

Assessing Reengineering Potential for a Process—Subsequent to the selection of candidate processes, each of these processes may be plotted on the 2-dimensional space according to their current levels of mediation and collaboration. The strategic path for reengineering a particular process can then be selected from one of the alternative paths discussed earlier. As can be seen in Figure 4, the two horizontal paths (Path X and X*) are suitable for processes with insufficient collaboration and the potential for collaboration enhancement is high. On the other hand, the two vertical paths (Path Y and Y*) are suitable for processes with high potential for mediation reduction where many sequential steps can be eliminated. Thus, the selection of an appropriate reengineering path, as outlined in Figure 5, requires a careful assessment of the process with regard to its potential for collaboration enhancement and the potential for mediation reduction. As each potential can be relatively low or relatively high, there are four possible assessment outcomes corresponding to the four cells in Figure 5.

Guidelines for the assessment of process reengineering potential are outlined in Figure 5. For each of the four possibilities, strategic paths for process reengineering are identified, the general process characteristics for each situation are briefly described, a description of typical candidates is provided to help recognize the types of processes expected to be found in each category, and actual examples are briefly cited to illustrate these typical candidates.

It is important to note that not all processes can and should be reengineered. As indicated in the first cell in Figure 5, the reengineering potential of some processes are restricted by mandate. Before marketing a new drug, for example, complete FDA approval is necessary, which may take many years. Also, many processes with physical input/output (I/O) flows
are inherently sequential. If such processes operate in a stable environment without great need for collaboration, they can remain in Region I.

Such physical I/O flows in a process, as in a factory assembly line, can be contrasted to informational I/O flows, as in the issuance of a document from one function to another. These process traits have been conceptualized in a different context by Porter and Millar who observe that a value-adding business activity has both physical and informational components. While the physical I/O flows in a process may limit its potential for mediation reduction, many business processes with informational input-output have great potential for mediation reduction, as indicated in the lower left cell of Figure 5. As exemplified by the Ford accounts payable case, these processes may be reengineered by storing the information being transferred in a common information resource (see Figure 3) to facilitate direct participation of the various functions in the process.

Reengineering Potential of Operational and Managerial Processes—In addition to the physical/informational distinction, another helpful consideration in the assessment is whether the process is an operational process or a managerial one. An operational process, like the accounts payable process at Ford, typically has a complicated maze of indirect steps accumulated over the years. These operational processes, as indicated in the lower-left cell of Figure 5, are usually good candidates for Path Y reengineering strategy, taking advantage of shared data and knowledge bases or the imaging technology. Many processes following this path can be expected to settle in Region III with little need for continuing along Path X* to Region IV for additional collaboration improvement. In fact, as typified by the Ford accounts payable case, the need for direct collaboration between the functions is substantially absorbed by the shared data or knowledge base. When all functions involved in the process can get the latest status of a transaction from the shared database, there is less need to contact each other directly. If expert instruction is available from the knowledge base, the need to call human experts is also diminished.

For managerial processes, however, the need for collaboration is rooted in the higher level of uncertainty and the relatively unstructured nature of the process. While a purchase order unambiguously signals a decision to buy, a new product proposal from the marketing department will normally be subjected to deliberations and debates among the related functions. Therefore, a typical managerial process in Region I can be improved with modest efforts by crossing over to Region II through electronic mail or groupware applications.

For managerial processes with limited processing steps, or operational processes with little or no uncertainty, following Path X and Y with termination at the "halfway station" may be entirely appropriate. The decisions to follow Path Z, or to begin with Path X and continue with Path Y*
Figure 5. Charting a Strategic Path for Process Reengineering

Potential for Collaboration Enhancement

Low

- **Strategic Path**: Remain in a given region with no changes in mediation and collaboration levels.
- **Process Characteristics**: The process has an appropriate mediation pattern given the nature of the process, and further reduction in mediation is either unfeasible or uneconomical. Also, the process has a sufficient level of collaboration to handle the uncertainty encountered.
- **Typical candidates**: Processes with steps that are, either inherently or by mandate, sequentially dependent prohibiting mediation reduction. Processes with standardized physical I/O flows and relatively little need for information flows.
- **Examples**: A mail survey must be completely designed before printing which, in turn, must be completed before mailing. FDA approval is required before marketing a new drug.

High

- **Strategic Path**: Follow Path $Y$ (from Region I) or Path $Y^*$ (from Region II) to reduce level of mediation.
- **Process Characteristics**: The process has appropriate degree of collaboration, and further enhancement in collaboration is not needed. However, the excessive degree of mediation in the process can be reduced to simplify the process.
- **Typical Candidates**: Complicated operational processes with informational I/O flows.
- **Examples**: The reengineered accounts payable process at FORD (see Fig. 3). The reengineered mortgage approval process at Bank One.
### High

- **Strategic Path**: Follow *Path X* (from Region I) or *Path X* * (from Region III) to enhance collaboration.

- **Process Characteristics**: The process has an *appropriate mediation pattern* and further reduction in mediation is either unfeasible or uneconomical. However, the level of *collaboration in the process is insufficient* and can be enhanced to handle increased level of uncertainty and many unexpected I/O changes.

- **Typical candidates**: *Managerial processes with participating function in separate departments* in an organization facing increasing environmental uncertainty.

- **Examples**: Improved collaboration between engineering and production at Chrysler which has shortened the new product development cycle.

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- **Strategic Path**: Follow *Path Z* (form Region I) to enhance collaboration and reduce mediation simultaneously.

- **Process Characteristics**: The *excessive degree of mediation* can be reduced to simplify it. Also, *collaboration in the process is insufficient* and can be enhanced to handle increased level of uncertainty and many unexpected I/O changes.

- **Typical candidates**: *Managerial Processes with complicated steps attached. Complex operational processes in an environment of increasing uncertainty.*

- **Examples**: The improved process of new product development at TI and FORD where collaboration was enhanced through a global communication network. The mediation level was also reduced as different parts of the design can be worked on simultaneously by engineers at various sites.
(or beginning with Path Y and continue with Path X*) involve these considerations:

- If an operational process is being considered, does the process have certain managerial components giving rise to substantial uncertainty and ambiguity?
- If a managerial process is being considered, does it have many operational components involving complicated sequential steps?

As indicated in the lower-right cell of Figure 5, a process would be a typical candidate for Path Z reengineering if the answer to either one of the above questions is yes. Consider the new product development process. The process is a knowledge-intensive managerial process, and yet there are also many sequential input-output flows—e.g., product specifications from R&D to engineering, design blueprints from engineering to production. For this process, therefore, great reengineering potential can be realized along Path Z, whereby the mediation level of the underlying operational procedure can be reduced by means of shared computing resources, and the spontaneous collaboration between functions can be facilitated by telecommunication. A case in point is the new car design process at Ford. Relying on computer-aided design systems, members of the design team can share a common design database across the Atlantic. The old physical input-output sequence of design documents circulating among the designers is gone. In the meantime, exchange of criticism and opinions can be fully supported through the network among members who have never met face to face.

The guidelines presented in Figure 5 should provide broad strategic directions for reengineering particular business processes. However, as is the case for most complex business decisions, a variety of additional factors are often involved. For example, the technical, economic, and operational feasibility of implementing the reengineering project along any path must be taken into consideration. In addition, the risk factor is also important. The more radical the change to a process, the higher the risk for unsuccessfully implementing the change—and this risk factor warrants management attention.

**From Process Reengineering to Organizational Transformation**

The success of the first BPR project in the organization will likely generate a great level of excitement and create momentum toward additional BPR projects. As IT-enabled reengineering continues to change business processes and improve their performance, the organization will undergo fundamental transformations from an industrial age organization to an information age organization. In this section, a number of salient attributes of this transformation are discussed in relation to the BPR framework presented
earlier. While there are other important aspects to this complex change process, the intent here is to present a broad overview so that business leaders can plan for the organizational consequences of process reengineering.

**Process Reengineering and Networked Organizations**—According to Rockart and Short, networked organizations “are usually conceived of as communication-rich environments, with information flows blurring traditional intracompany boundaries.” These can be thought of “more as interrelationships within or between firms to accomplish work than as ‘formal’ organizational design per se.” Therefore, the more an organization reengineers and improves its business processes across functional units, the more it gravitates toward a networked organization. For example, Chrysler Corp. has instigated a series of reforms to improve collaboration between functional departments. The product design function is now working closely with the engineering function and they no longer fight “turf wars” with each other. Thus, one may say that Chrysler is evolving toward a networked organization.

Recent research has shown that advanced IT applications would initially allow organizations to increase the amount and effectiveness of collaboration with existing structures. Innovative use of IT, however, would inevitably lead many firms to develop new, coordination-intensive structures, enabling them to coordinate their activities in ways that were not possible before. In terms of our framework, it may be possible to accommodate the IT-enabled changes along the two horizontal paths and the two vertical paths with existing structures. The diagonal reengineering route, Path Z, would potentially enable a new coordination-intensive structure. Such was the case at Frito-Lay, where a hand-held computer is used by each of the 10,000 salespersons to record sales data on 200 grocery products, reducing many clerical procedures and the mediation level. To enhance the collaboration between marketing and sales, the data is transmitted each night to a central computer which, in turn, will send instructions on changes in pricing and product promotions to all salespersons through their hand-held computers. This enhancement to collaboration is also evident in the use of an Executive Information System (EIS) which makes weekly summaries and analysis available to senior executives.

How much coordination is needed if 10,000 salespeople communicate to their superiors every day in a traditional hierarchical organization? Undoubtedly, this colossal amount of communication would quickly overload the processing capacity of the traditional corporate hierarchy, and yet such a coordination-intensive structure is now achievable with the aid of advanced IT through process reengineering. Networked forms and coordination-intensive structures may raise the organization’s capabilities and responsiveness, leading to potential strategic advantages. As a firm embarks on BPR
endeavors, therefore, it is incumbent upon its leaders to comprehend the organizational structural implications of the reengineered processes.

**Process Reengineering and Informational Empowerment**—An interesting question to ask about networked organizations is: If it is capable of improving collaboration and has many other potential benefits, why has the concept taken so long to evolve? The answer lies partly in that access to information in traditional hierarchical organizations is severely limited, either intentionally or due to primitive information technologies, or both. This “information poverty” and hierarchical bureaucracy reinforce each other. With the onslaught of information technologies, information poverty is rapidly being replaced by information richness. Access to corporate databases and freedom to communicate more widely with electronic mail are enhancing employees’ ability to make more informed decisions with less reliance on formal vertical information flows. This “informational empowerment” is in contrast to the position-based formal power structure in many traditional hierarchies.

At North American Aircraft Division of Rockwell International Corp., for example, the introduction of an EIS led to “additional” reporting structures that were not included in the organizational chart.28 The implications of this development for the conduct of management in the future is enormous. One way to look at this is treating informational empowerment as a form of “unplanned” reengineering of managerial processes where IT-enabled collaboration and reduction of mediation layers take place unintentionally. With or without endorsement from top management, the process of management may change as a result of this informational empowerment. Realizing this, top managers may wish to ride the tide of IT-induced organizational changes and map out a strategy for reengineering and organizational transformation, rather than muddle through the change process without a plan.

**Process Reengineering and the Nature of Work**—When the world entered the industrial age, the assembly-line production system forced millions of workers to repetitively perform extremely specialized tasks. What effects will process reengineering have on individual workers? While answers to this question probably will not surface for years, there are some preliminary indications pointing to encouraging developments. It appears that the demand for direct operations and close collaboration with other functions dictate the need for workers to broaden their portfolio of skills. At PHH, a $4 billion firm specializing in employee relocation and other business services, CEO Robert D. Kunisch was quoted as saying:

> We have had service problems in our various companies because they were so structured, with specialists doing each function. Through business reengineering, we have formed teams of generalists to serve customers. These generalists do multiple functions
such as appraisals, purchases, calculations of equity, and listings and resales of homes. Before asking a specialist in one function to handle 10 functions, they've got to be properly supported with data and technology.  

With the division of labor being the modus operandi for Taylorian management in the industrial age, it is logical to expect a drastic departure from this principle as we embrace the paradigm of process reengineering in the information age. Central to process reengineering, according to BPR specialists at McKinsey & Co., is to make teams, not individuals, the focus of organization performance and design. To achieve effective teamwork, each worker should develop several competencies. The reward system in the newly designed organization will then be based not only on individual skill development and performance, but also on team performance.

**Promises and Perils of Organizational Transformation**—We have identified and elaborated on a number of significant attributes related to IT-enabled organizational transformation that may be spawned by process reengineering efforts. In developing these macro perspectives, it is important to remember that there will always be constraints and exceptions to generalized patterns. For instance, organizational realities such as local loyalties and identification with small working groups may lessen the appeal of networked forms. Transformational patterns can be expected to vary in speed and scope for individual organizations. Different industries may involve different facilitating and inhibiting factors. The road to organizational transformation will be fraught with resistance and difficult choices.

Expanding the use of process generalists does not necessarily mean that specialized experts are no longer needed. As discussed by many leading authors on the subject, the development of the networked organizational form will require a delicate balance between retaining the stability of the traditional structure on one hand and fostering the flexibility of the new structure on the other. Recent research reveals that firms that have embarked on the networked path have often evolved dualistic organizational systems: keeping formal structure and yet permitting self-managed teams; encouraging decentralized decisions by empowered cross-functional groups and yet striving to enforce a centralized coherent overall strategy.

**Conclusion**

Being a relatively recent development, the BPR movement has generated many success stories and virtually no discussion on the potential harms it might cause. For instance, task specialization in traditional functional hierarchies may slow down business processes, but separation of duties is an effective safeguard against fraud. Extensive reliance on process generalists in reengineered processes, therefore, may increase the likelihood of foul play and even embezzlement. Organizations eager to reap BPR
benefits should be warned to carefully evaluate its potential risk. Further studies are needed to examine positive as well negative impacts of BPR on organizations.

IT-enabled organizational changes have accelerated in recent years through the application of advanced IT. The development of business process reengineering as a concept and practice has further intensified these changes. Without visionary leadership from the top, however, most changes will be haphazard and there is little hope that innovative forces can be mobilized to facilitate process reengineering and organizational transformation. The various facets of this transformation presented here should be valuable to those who must lead their organizations to face the challenges of a new millennium.

References

5. Davenport and Short, op. cit.
9. This framework can be applied to multiple level of analyses. For instance, A, B, and C can each represent discrete tasks or groups of tasks within or across functional areas.
14. Analyzing the mediation patterns of a process calls for potential elimination of redundant, non-value-adding and sequential activities, which are relatively concrete and observable. A variety of methods can be used for such analysis. One may, for example, extend and adapt structured analysis and design methods for conventional information systems development for this purpose. See T. DeMarco, “Structured Analysis and Systems Specification” (Englewood Cliffs, NJ: Prentice-Hall, 1979). However, the analysis and possible redesign of the coordination pattern for a process must focus attention on communication-intensive activities such as deliberation, negotiation, authorization, and persuasion. These relatively unstructured activities are more difficult to track and analyze than physically coupled procedures. Methods for analyzing...


21. Ibid.

22. Davenport and Short, op. cit.

23. Cited by Davenport and Short, op. cit.


27. Ibid.


30. Steward, op. cit.