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Using a Positivist Case Research Methodology to Test Three Competing Theories-in-Use of Business Process Redesign[1]

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Abstract

We test three practitioner theories-in-use of business process redesign derived from the business process reengineering (BPR) literature using a positivist case study of a U.S. company that undertook BPR. The evidence refutes the domi-

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nant technocentric theory-in-use that gives a determining role to IT in achieving effective business process redesign. The evidence also refutes an alternative sociocentric view—one that gives a determining role to just the social/human aspects in achieving effective business process redesign. Instead, the study provides support for the sociotechnical theory-in-use. For critical researchers and skeptical practitioners, the overarching lesson of our case study is that business process redesign is but the latest arena in which researchers and practitioners are relearning old lessons by repeating the past mistake of adopting a technocentric approach and sociocentric approach to designing and managing organizations. The future direction we suggest for researchers and practitioners interested in areas such as BPR, ERP, and e-commerce implementation, all of which involve business process redesign, is to adopt, *from the beginning*, an orientation that is not just technocentric or sociocentric, but gives equal consideration to the technical and social dimensions, and the interactions between the social and the technological.

Keywords: Business process redesign, business process reengineering, case study, IS management, positivist perspective, research methodology, theory-in-use, sociotechnical.

I. INTRODUCTION

Because it has been a decade since business process reengineering (BPR) established itself as a major area of concern to managers and management researchers, the time is ripe to begin evaluating what BPR has wrought. Furthermore, to the extent that there is a growing interest in the implementation of enterprise resource planning (ERP) systems as well as intranets, which themselves necessitate the application of many BPR principles, an assessment of BPR becomes all the more important. In this study, we take a step in this direction. Our objective in this paper is to contribute to the body of knowledge on business process

redesign[2] by deductively testing certain concepts and relationships pertaining to three competing theories-in-use of business process redesign that we discern in the existing BPR literature. The empirical testing involves observations of a major information technology (IT) enabled reengineering initiative at a real company. Our reason for using case research methodology is that the evidence in this study comes from the real life setting of a single site where a company attempted to implement BPR.

In this paper, we review the body of knowledge on BPR, where we focus on the practitioner-oriented literature and on academic commentaries on practice in order to identify the theories of business process redesign embedded in practitioner thinking; we discuss our positivist case research methodology and discuss how our case study meets the standards of positivist rigor; we provide background information about our case site; we present the evidence from our case and test the competing theories deductively; and finally, we discuss the implications of this study.

We believe that our paper makes two important contributions. First, through deductive testing, the study invalidates the frequently held technocentric perspective-in-use as well as the sociocentric perspective-in-use regarding business process design and indicates the need for adopting a predominantly sociotechnical perspective; and second, the study can serve as an exemplar for the positivist case research methodology.

Before proceeding with a discussion of the theories-in-use embedded in the literature, we briefly cover some of the basic definitions of BPR terminology that we use in this paper. The literature has defined BPR in different ways (e.g., Davenport 1995; Keen and Cummings 1994; Hammer and Champy 1993; Schnitt 1993; Sethi and King 1998; Smith and Willcocks 1995). The need for adopting an appropriate definition of BPR has been recognized (Manganelli and Klein 1994). In fact, BPR

[2]In the next section, we explain the terms business process reengineering (BPR) and business process redesign (redesign).

projects have been known to fail because key stakeholders of a BPR initiative have lacked a clear understanding of what the term BPR means (Hammer and Stanton 1995). While we believe that several definitions proposed in the literature have merit, we define BPR (drawing on existing literature) as *an organization's activities of redesigning and implementing broad cross-functional business processes with the aid of IT enablers and/or organizational enablers in order to obtain significant performance improvements.*

Business process reengineering can be seen as consisting of two analytically separable steps—*business process redesign* and *implementation of the redesigned business processes*—that are often, although not always, undertaken sequentially within an organizational BPR initiative. The first step, *business process redesign*, involves reformulating the way an organization conducts its business. It involves the envisioning of new, broad cross-functional business processes, including the supporting roles of IT enablers and/or organizational enablers, all for the purpose of obtaining significant performance improvements. An effective redesign of business processes provides a solid foundation for the implementation of the redesigned processes and thus has a strong potential for contributing significantly to the success of an overall BPR initiative (Bjørn-Andersen and Turner 1994; Jones 1994; Stoddard et al. 1996). The second step involves the *implementation* of the envisioned processes and the accompanying organizational redesign. In this paper, we focus primarily on the first phase, that of business process redesign.

II. STATE OF THE ART OF BUSINESS PROCESS REDESIGN

A review of the BPR literature shows that a significant proportion of it is practitioner oriented, whether written by practitioners or by academics. This practitioner orientation has been noted by some leading BPR researchers, who have issued a call to the academic community to go beyond simple descriptions and "lessons learned," and to strive toward "understanding models and attributes of successful BPR" (Grover and Kettinger 1995, p. viii). While there have been a few attempts

to develop “frameworks,” “models,” and “constructs” as a foundation for testable scientific theories (e.g., Grover et al. 1995; Grover et al. 1995b), the overall literature on BPR has been characterized as “atheoretical” (Guha et al. 1997).

Our own conclusion regarding the state of the BPR literature is consistent with that of Guha et al., but only partially. That is, while Guha et al. believe that there is no theory of BPR, we believe that there is no *scientific* theory of BPR (or of any subset of BPR, such as business process redesign, which is the focus of our paper) present in the literature and ready for rigorous testing. Instead, drawing on the classic work of Argyris and Schön (1978), we believe that the BPR literature largely represents a form of knowledge (theories-in-use) falling in the realm of everyday people (here, managers, executives, and other practitioners), in contrast to another form of knowledge (scientific theories) falling in the realm of academic researchers (for instance, business school professors who do social-scientific inquiry). While a theory of action or theory-in-use (Argyris and Schön often use the two terms synonymously and interchangeably) utilizes everyday concepts from the world of practice, as opposed to a scientific theory, which uses formal theoretical concepts accepted in the world of research, the two types of theories are similar in that they are both *theories* that can and should be tested and, when refuted by the facts, be discarded, making room for a better theory (Argyris and Schön 1978). Argyris (1993, p. 250) further elaborates on theories of action and the implications such theories have for researchers:

> Theories of action are at the core of human competence, self esteem, and self-efficacy. Individuals gain confidence by acting in ways that they and others evaluate as effective….Although theories of action are not theories about some objective truth, they do make claims about how to act effectively—indeed what is effective in the first place for a particular individual or group. These claims must be subjected to the most rigorous tests available, not only because that is good science but also because we as researchers owe it to practitioners who may use the knowledge produced by our research and to the people who receive services from the practitioners.

Argyris (1993, p. 250) further adds:

> In order for theories of action to be tested in everyday life, it must be possible to derive from them the actual behavior required for effectiveness. In other words, theories of action must produce actionable knowledge.

In this paper, we identify three theories-in-use in the practitioner-oriented BPR literature on redesign. Then, as prescribed by Argyris in his own work and his work with Schön, we test these practitioner theories-in-use by comparing their predictions against data from everyday life (in the case study).

Before proceeding with a discussion of the theory, we would like to clarify that, embedded in the huge fragmented body of text on business process redesign, there are potentially an infinite number of propositions about the topic. In fact, in some cases, contradictory propositions have been advanced or suggested by the same authors in different portions of the same work, while, at times, different theories have been implied by the same authors in different works (Maglitta 1995). The key point here is that *the literature in this area is not at all internally consistent.*

The propositions implied in the practitioner-oriented literature on business process redesign can be classified into three broad but mutually exclusive theoretical perspectives, which we label as *technocentric*, *sociocentric*, and *sociotechnical*. It is worth noting that an examination of the practitioner literature shows that *each of these three theories exists prominently in the world of practice*, regardless of whether it is consistent or inconsistent with the other perspectives held by the same or different practitioners or authors. In our opinion, a first step to furthering knowledge in BPR (or in related areas such as ERP that draw on redesign principles) is to identify which parts of the literature are valid and which parts are invalid, and thus need to be discarded. This leads to the research question for our study: *Which of the competing theories-in-use reflected in the practitioner-oriented BPR literature is/are invalid in explaining (or guiding) effective business process redesign?* We

now discuss the three theories and derive the propositions within them that feature prominently in the literature.

THE TECHNOCENTRIC THEORY OF REDESIGN

Based on our review of the practitioner-oriented literature, we have identified and articulated concepts forming what we see as the *dominant theory-in-use* (the technocentric theory) held by practitioners regarding business process redesign. We will refer to the academically oriented BPR literature only to the extent that its academic authors are examining the technocentric perspective among BPR practitioners. We expand this theory below.

The technocentric theory has its roots in the logic of *technological determinism* and emphasizes the role of IT in determining the process and outcome of BPR redesign and implementation. Within this perspective, information technology is seen as an independent force determining aspects of an organization at different levels of analysis (Markus and Robey 1988; Orlikowski 1992). In the history of technology literature, Bimber (1995) refers to this perspective as a *nomological account* of technological determinism. In his words (pp. 83-84):

> The claim here is that technology itself exercises causal influence on social practice.…technological determinism can be seen as the view that, in the light of the past (and current) state of technological development and the laws of nature, there is only one possible future course of...change….In Nomological accounts, the technological-driven society emerges regardless of human desires or values.

In addition to the nomological account described above, the technocentric perspective encompasses situations where a "strategic choice"[3] of IT is made by organizational participants who believe that the chosen/implemented technology will deterministically lead to certain organizational forms or characteristics. In the practitioner BPR literature as well as the broader IS literature, the technocentric perspec-

[3]Orlikowski (1992) uses the term strategic choice differently to include the social constructivist as well as the sociotechnical perspectives.

tive manifests itself in *the omission of the role of human agents or the existing organizational social system* in organizational change and *positing IT as a necessary and/or a sufficient condition* for the change.

In academic commentaries of BPR practice as well as practitioner BPR literature, the technocentric theory among practitioners has been recognized time and again. For example, in their paper, Guha et al. (1997, p. 120) clearly state that "earlier practices and writings (in business reengineering) espoused an IT-centric position." Willmott and Wray-Bliss (1996, pp. 67-68), in their commentary on BPR, state:

> much of the BPR literature adopts an "essentially technical model of IS and organizations"...in which ICTs basically drive the reengineered effort. Hammer for instance elevates ICTs to the status of being "*the* critical enabler" of reengineering….It is information technology, not workers, managers or customers etc. which "permits companies to reengineer business processes" (Hammer and Champy 1993, p. 83).
>
> For Hammer (1990, p. 104), information technology and reengineering are virtually synonymous.

Finally, Roy et al. (1998, p. 193) have recently reported, based on four case studies and a survey of 38 projects, that "most BPR efforts are technically oriented."

Technology Capabilities as the Driver of Redesign

An important aspect of the technocentric theory-in-use on redesign is that it views a predominantly IT-oriented approach as necessary for the *creation of effective business process configurations* (statement S1, below). For example, Venkatraman (1991) suggests that managers must be able to visualize and choose from the different process designs made possible by the capabilities of IT. Along similar lines, Stoddard et al. (1996) observe, based on their study of Pacific Bell's BPR initiative, that IT plays a prominent role in the redesign process by helping to create new alternatives to accomplish work, and that redesigners' knowledge of advanced IT features makes the effective formulation of a radical redesign possible. Hammer and Champy (1993, pp. 84-85) emphatically and unambiguously argue for the need to

redesign business processes using a technology-driven methodology, and provide guidelines accordingly:

> To recognize the power inherent in modern information technology and to visualize its applications requires that companies use a form of thinking that business-people usually don't learn….Most executives and managers…are good at defining a problem…then seeking and evaluating different solutions to it. But applying information technology to business reengineering demands inductive thinking[4]—the ability to first recognize a powerful solution (in this case, IT) and then seek the problems it may solve.

To summarize, the technocentric practitioner theory-in-use holds that, for effective business process redesign,[5] process designers must, first, identify new technologies and comprehend their (unique) properties/capabilities and, second, actively and creatively find organizational problems to solve and opportunities where they can take advantage of their understanding of the features of the newly identified technologies. They advocate this approach as superior to the traditional approach of acquiring information technology (i.e., an approach that involves the design and implementation of IT based on predetermined organizational requirements) since the traditional problem-driven or requirements-driven redesign initiative is constrained by the state of affairs in the organization prior to reengineering (Hammer and Stanton 1995). Based on this literature, we offer the following *practitioner belief statement*[6] TS1 (Technocentric Statement 1), which portrays IT-driven redesign as a necessary although not sufficient condition for effective redesign:

> ***TS1:*** *Effective business process redesign can occur only if the redesigning is IT-driven.*

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[4]It may be noted that Hammer and Champy use the term inductive thinking in a way that differs from the use of the term in the academic community, where induction refers to generalization from the observation of specific cases.

[5]We discuss the evaluation of redesign effectiveness in a subsequent section (section V, Testing Statements) using the notion of "expectation failure."

[6]We purposely use the label "statements" rather than "propositions" to emphasize that they are derived from practitioner beliefs rather than from formal theories.

We remind the reader that we offer this not as a formal proposition from a scientific theory, but as a statement that captures an important element of the practitioner theory-in-use regarding business process redesign, as reflected in the literature.

IT as the Central Object of Redesign

Within the technocentric theory-in-use of business process redesign, there is also a view that *IT is the central object of redesign in the redesign process*—i.e., an effective (re)design of the IT is taken to be a sufficient condition for effective redesign of business processes (statement S2 below). The following quotation accurately captures this idea (Lucas and Baroudi 1994, pp. 18-22):

> Traditional organizations are using technology to make changes in structure without making major modifications to the entire organizations….The traditional organization may call its redesign efforts "reengineering"….We believe that the ***design of information technology is the design of organizations*** [emphasis added].

Manganelli and Klein (1994, p. 261) have also recognized the strong existence of the technology orientation among practitioners. In their words, "Another thing we hear said is 'We're reengineering; we've acquired image processing' or 'We're reengineering; we're moving to client/server platforms.'" The assumption that many practitioners appear to be making as evidenced from the above quotation is that the acquisition of technologies such as image processing or client-server platforms *is by itself a sufficient condition* for (effective) redesign and implementation. A similar technocentric view among practitioners of BPR has been called "the magic bullet theory" and documented by Markus and Benjamin (1997):

> When we listened closely to what these people told us, we heard expectations about what it means to be a change agent that differed sharply from ours. Even non-adopters of change management best practices believe that they are change agents if they initiate or develop IT, because they think IT itself has the power to create organizational change. These people describe IT as a magic bullet —and believe that they have built the gun....IT specialists—the tool builders—play the role of designing and building guns. Builders of guns that fire magic bullets do not have to worry very much about who

> is going to aim and fire the gun. After all, magic bullets always hit the right targets. So, the gun builders can focus on the performance characteristics and aesthetics of their craft, without worrying about the shooters' aim or the targets' ability to dodge.

It is also interesting to note that within the technocentric perspective, as apparent from the quotations above, the effective design and creation of enabling IT is considered a sufficient condition for not only effective redesign but also successful implementation (Anthes 1996). It is assumed that successful installation of hardware and software that satisfy functional requirements of the organization will automatically lead to effective BPR implementation. This emphasis on designing and installing IT as a sufficient condition for effective redesign and implementation of business processes, reflected in the discussion of the literature, is captured in the following statement:

> **TS2:** *Successful design (and installation) of enabling IT guarantees the effectiveness of business process redesign (and the effectiveness of the implementation of redesigned business processes).*[7]

Computerized BPR Tools for Process Mapping

The technocentric practitioner theory-in-use also views *computerized BPR tools as having a positive influence on the development of effective business process redesigns* (statement TS3, below).

Mayer et al. (1995, p. 247) have defined reengineering as "the use of scientific methods, models and tools to bring about the radical structuring of an enterprise," thus underscoring the importance of tools, mostly computerized, that provide graphical capabilities and embody different methods/models such as integration definition (IDEF), activity-based costing, entity-relationship, and simulation. That a

[7]Even though the focus of this paper is on the *redesign*, TS2 includes both redesign and implementation, because the BPR literature pertaining to TS2 does not clearly distinguish between the two steps (redesign and implementation).

large market exists for such tools in the domain of redesign practice is evident from an examination of trade journals on BPR (such as *Enterprise Reengineering),* which feature a large number of advertisements of computerized BPR tools by IT vendors in each issue, along with occasional reviews of some of the tools by recognized experts in the field. In Table 1, we provide a *sample* of claims made by different vendors regarding the computerized tools offered to BPR practitioners. Most advertisements suggest that the use of BPR tools will contribute to the effectiveness of the redesign in terms of cost, speed, ease of process-mapping, ease of redesigned process implementation, and lowered project risk.

Table 1. Sample BPR Tools and Their Contribution to Redesign Effectiveness

Sample Tools	**Claims regarding contribution to business process redesign effectiveness (extracted from the advertisements in a representative issue of *Enterprise Reengineering*[a])**
System Architect	The fast affordable route to Business Process Rengineering.... Without a large investment of time and money, System Architect lets you reengineer your business process with ease.
ProcessMaker	ProcessMaker provides tool support for a number of process Engineering methodologies….Process Engineering [Redesign] is important, having the right tools makes it easier.
Business Process Navigator	Understand your present processes and identify opportunities for dramatically increasing their effectiveness. Make discoveries early, reducing risks and lowering your time and cost.
COSMO and Pen Analysis Intelligent Whiteboard	…significantly accelerates BPR modeling sessions and the creation of draft models—speeding the process [of redesign] and reducing the costs.
Process Charter	Build process fast and then evaluate multiple What-if scenarios with built-in process analysis and powerful simulation tools…. Process Charter helps you better manage every process throughout your organization.

[a]Volume II, Issue 5, August 1995.

Kettinger et al. (1997) summarize their detailed study of 102 computerized BPR tools as follows (p. 63):

> In summary, the tools survey indicates that an expanding suite of tools are being used to provide structure and information manage-

> ment capability[8] in conducting BPR techniques and possess the potential to accelerate BPR projects.

Consistent with this point of view, Carr and Johansson (1995) of Coopers and Lybrand explain and illustrate the importance of using such tools and propose the following "prospective best practice" for BPR initiatives: "Take advantage of modeling and simulation tools" (p. 150). Klein (1998, p. 245) also recognizes the importance of BPR tools, and states:

> By using tools, the BPR practitioner expects to improve productivity, finish projects faster, produce higher quality results and eliminate tedious housekeeping work in order to concentrate on value-added work. To produce these benefits, BPR tools should be useable by businesspeople (managers and professionals), not technicians.

An important aspect of usability is "learnability," which is further highlighted by Manganelli and Klein. They caution that while several benefits (such as improved productivity, faster projects, higher quality levels, and elimination of tedious work) can be expected from reengineering tools, "these benefits come only after first learning the tool" (p. 214).

Finally, highlighting the importance of BPR tools, Davenport (1993, p. 216) points out three "paramount" dangers associated with the failure to pursue opportunities provided by advanced technological tools: first, failures to employ these tools may reduce the pace at which the redesign will progress, and this may reduce the chances of the initiative's success; second, these tools are likely to improve the quality of the product of redesign; and third, the non-use of BPR tools could indicate that managers are not aware of technological opportunities, consequently undermining the importance of the initiative.

To summarize, *the BPR literature has presented many statements indicating that BPR tools (which are easy to learn and use) have a positive moderating influ-*

[8]Kettinger et al. (1997) view BPR tools with repositories and data indexing features to facilitate "collective knowledge sharing" as having *information management capability*.

ence on redesign effectiveness. The above discussion leads us to the following statement reflecting practitioner belief regarding the use of tools for redesign:

TS3: *The use of computerized BPR tools*[9] *will enhance redesign effectiveness.*

As mentioned earlier, the literature on business process redesign also reveals the existence of two competing streams of thought that we label as the sociocentric theory-in-use and the sociotechnical theory-in-use. We discuss the sociocentric theory-in-use next.

THE SOCIOCENTRIC THEORY OF REDESIGN

Practitioners adopting the sociocentric perspective to business process redesign assume that organizational outcomes (including the formulation of effective redesigns) occur not due to the technology but due to human motives and human action. This perspective underplays the role of technology and focuses (almost exclusively) on the role of social factors/processes in explaining BPR-related outcomes. Changes in all aspects of organizations (including technology) and their successes are ultimately attributed to social processes such as leadership, communication, etc. or to arrangements in the organizational structure. The book by Hammer and Stanton (1995), and the surveys by Bashein et al. (1994) as well as by Coopers and Lybrand (Carr and Johansson 1995), among others, strongly indicate the existence of the sociocentric theory-in-use among the practitioners. Within the sociocentric perspective, the success of process redesigns is believed to be influenced by *at least* two key factors: the "process vision" of leaders of a redesign initiative and the composition of the reengineering team.

[9]Computerized tools, here, include flowcharting/process-mapping tools and simulation tools. For this statement, it is also assumed that computerized tools must be easy to learn and use.

Process Vision of Leaders as the Driver of Redesign

According to Carr and Johansson (1995, p. 45), the person in-charge of a redesign initiative should be a *leader* whose primary function is to "establish and communicate the vision." The leader should be capable of creative and imaginative thinking, have a clear sense of the objectives and potential impacts of the reengineering effort, and have a firm belief in the envisaged process changes. According to Hammer and Champy (1993, p. 103), the role of the leader is "to act as visionary and motivator....by fashioning and articulating a vision of the kind of organization that he or she wants to create."

Davenport (1993, p. 118) describes "process vision" in more tangible terms as "consisting of specific, measurable objectives and attributes of the future process state" that can provide "the necessary linkage between strategy and action." According to Davenport, key activities necessary for developing process visions include assessing business strategy to obtain a sense of direction for future processes, receiving input from process customers regarding performance objectives, benchmarking for performance goals and guidelines from other similar redesign efforts, and developing process performance objectives. It is also believed that any process change that is initiated without vision will usually fail to go beyond streamlining, resulting in marginal reductions in costs and headcount, thereby proving to be less than effective (Davenport 1993). Thus, to summarize, much of the literature seems to suggest that appropriate "redesigns" of processes must come from the visionary thinking of top management, rather than through a bottom-up collaborative process, or through a process of technology-driven redesign as proposed by Hammer and Champy.

The critical importance of the leaders' vision for effective process redesign is included as a necessary condition in the following statement within the socio-centric theory-in-use:

SS1: *Effective redesign of processes can be accomplished only if the redesign is driven by leadership's vision regarding the reengineered processes.*

The Balanced Composition of the Redesign Team

The quality of process redesign is also believed to be significantly influenced by the members who serve on the reengineering team and, thus, a careful selection of these individuals is critical to the redesign effectiveness. Carr and Johansson (1995, p. 83) offer the following advice regarding the choice of team members:

> Choose team members with experience in strategic visioning, change management, and team improvement initiatives. People with varied backgrounds, even those without direct experience in the core process to be changed, are important because they can generate new insights and challenge the status quo more rigorously. They should be the "best and brightest" in your organization.

Different authors suggest varying approaches to team selections. For example, according to Carr and Johansson, to obtain a variety of perspectives and to avoid resistance from different functional areas, cross-functional representation on BPR teams is considered a good practice. A central figure is the process-innovation consultant (internal or external consultant), who has an organization-wide perspective and is "politically neutral" regarding any process being reengineered. A facilitator, who may be an internal or an external consultant, is often included in the team to "promote cohesion" among the team members (Davenport 1993, p. 186). Hammer and Champy recommend that such teams should strike a balance between including *insiders* and *outsiders* (p. 110). While insiders often have credibility within the organization and also an intimate knowledge of "what is" (i.e., the current status of the processes in question), they often tend to be too immersed in the current state and confuse "*what is"* with "*what should be."* Outsiders, on the other hand, bring fresh perspectives to the design process but have less credibility in instituting radical changes. Also, their understanding of the organizational context or con-

straints within which the redesigned processes are to be implemented is likely to be limited, which may lead to process designs that are too impracticable. The importance of the composition of the reengineering team to creating effective process designs is included in the following statement as a necessary condition:

SS2: *Effective redesign of processes can be accomplished only if a balanced team undertakes redesign.*

THE SOCIOTECHNICAL THEORY OF REDESIGN

The sociotechnical theory-in-use, also referred to as the emergent perspective, focuses on "the dynamic interplay between the actors, context, and technology" (Markus and Robey 1988, p. 588). This perspective attempts to achieve a balance between the technologically oriented and the socially oriented views by adopting interactional assumptions regarding (or explanations for) organizational outcome. Mumford (1995), a prominent proponent of sociotechnical thinking, sees no fundamental difference between the way sociotechnical design and business process redesign is undertaken. This is evident from the following statement (Mumford 1995, p. 202):

> Today, business process reengineering is being hailed as an entirely new approach to efficiency improvement. However, it is difficult to see how it differs from socio-technical design. In fact, the first major socio-technical design experiment might now be seen as a classic example of process re-engineering although it had as its principal goal the improvement of working conditions rather than high production.

Another important aspect of the socio-technical perspective is that it argues that specific organizational outcomes arising from the introduction of technology in any pre-existing social system tend to "surface" depending on a number of situational factors. Scholars and practitioners adopting this perspective thus see specific organizational outcomes inherently as less predictable than do those who adopt the sociocentric or the technocentric perspective (Markus and Robey 1988).

Recursive Understanding of the IT-Social System Relationship

Within the sociotechnical perspective, the redesign of business processes can be accomplished only with a proper understanding of the capabilities and limitations of IT, and of the business process requirements that are embedded within social contexts (Davenport and Short 1991; Markus and Robey 1995). In the words of Manganelli and Klein (1994, p. 157), "Social design must be performed in conjunction with technical design: the social and technical components of a process must be congruent if the process is to be effective." This belief holds that redesign is driven neither by technology nor by the current understanding of the business process within the existing social fabric in the organization—rather a "joint optimization" is needed (Cherns 1976). The redesign process must involve the discovery of the requirements and process configurations not previously understood in light of new technological options available, and should also prompt the search for technologies that serve the emerging requirements (discovered during the course of the design process) in an efficient and effective manner. It must be recognized that while a consideration of both the social and the technical are seen as necessary, sociotechnical redesign need not always involve a *simultaneous* redesign of both the social and the technical systems. Instead, redesign often proceeds in a *sequential* fashion, the technical first followed by the social, or vice versa, as explained by Markus and Robey (1995, p. 602-603), who refer to this sociotechnical approach as "recursive-sequential design":

> In this approach, one design dimension implicitly dominates the others. The dominant dimension usually reflects the designer's primary expertise or speciality....The dominant dimension is designed first, becoming the "fixed" or center point around which all other elements are designed; the other dimensions are tailored to match it.

To summarize, the key to effective redesign is the creation of a "fit" between information technology, and the human resources and strategic objectives underlying the business process, by changing the technical and social components related to the focal business process either simultaneously or sequentially (Daven-

port and Short 1990; Grover and Kettinger 2000; Markus and Robey 1995). Thus, we have the statement STS1 (SocioTechnical Statement 1):

STS1: *Effective redesign of processes can be accomplished only if an understanding of both the IT and the business processes within the social context is used during redesign.*

Enhancing Functional Coupling

An approach used by practitioners that is consistent with sociotechnical thinking, has been articulated by Teng et al. (1994) and, thereafter, by Grover et al. (1995b) as the "functional coupling" framework. Teng et al. conceptualize organizations as having processes comprised of work-units/functions that have different types and degrees of functional coupling among them. *Functional coupling* of a process refers to the "way in which various functions are orchestrated while participating in a particular business process" (Grover et al. 1995b, p. 17). Functional coupling may be assumed to have two dimensions: the degree of *physical coupling* and the degree of *information coupling*. Physical coupling of a business process refers to the extent of flow of tangible input and output (e.g., physical objects, hand-off documents) among participating functions. A high degree of physical coupling of a business process implies that it is composed of functions in a *serial or sequential* order; a low degree of physical coupling implies *parallelism* among functions constituting the business process. The degree of information coupling refers to the extent of information exchange between two functions participating in a business process. Based on the frequency and intensity of information interchange, functions in a business process may be classified as *insulated* (involving low frequency/intensity of information exchange) or *collaborative* (involving high frequency/intensity). Combining the extreme ends of the two dimensions of functional coupling, one may classify processes as *serial-insulated, serial-collaborative, parallel-insulated, and parallel collaborative* (see Figure 1).

Low ◄——— Degree of information coupling ———► High

Degree of physical coupling	Insulated	Collaborative
SERIAL (High)	**Serial-Insulated Process (I)**	**Serial-Collaborative Process (II)**
PARALLEL (Low)	**Parallel-Insulated Process (III)**	**Parallel-Collaborative Process (IV)**

Figure 1: The Functional Coupling Framework (Grover et al. 1995)

Traditional functionally oriented business organizations have serial-insulated processes embedded in them (Teng et al. 1994; Davenport 1993). Thus, most redesign endeavors attempt to move organizations' processes diagonally from region I to region IV by reducing physical coupling and simultaneously increasing information coupling.

The proponents of this framework also discuss how communication and shared-resource technologies as well as organizational or social enablers such as cross-functional teams, case management, and specific organizational structures jointly act as catalysts to enhance the functional coupling among organizational units (Davenport and Nohria 1994; Grover et al. 1995; Teng et al. 1994). We note, however, based on the arguments of Markus and Robey (1995) presented earlier in the discussion of STS1, that the technical and the social catalysts may be applied sequentially or simultaneously. Based on the above discussion, we have the following statement:

STS2: *Effective redesign of a process can occur only if the redesigners seek to enhance the functional coupling in the business process through the use of technological as well as social enablers.*

We have identified and offered three theories-in-use through our reading of the practitioner-oriented literature on business process redesign. We know of no previous effort by academic scholars to infer and articulate formal statements capturing the underlying theories-in-use on redesign from the BPR literature, but such an effort would be welcome as another study with which to triangulate the findings of the current study. Our derivation of the propositions within the three theoretical perspectives allows us to proceed with Argyris's notion of good science, where we subject these practitioners' theories-in-use as reflected in the literature "to the most rigorous tests available" (quoted earlier). We now discuss our methodology.

III. CASE RESEARCH METHODOLOGY

A case study is "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin 1994, p. 13). The importance of case studies within the organizational studies and information systems disciplines has been recognized (e.g., Eisenhardt 1989; Markus 1997). While case studies are usually associated with the interpretivist tradition (e.g. Orlikowski 1992; Walsham and Sahay 1999; Walsham and Waema 1994), some have been undertaken from the *positivist* tradition as well (Benbasat et al. 1987; Lee 1989, Markus 1983; Paré and Elam 1997; Yin 1994). Neither approach is inherently superior to the other, and each is appropriate for different research objectives (Lee 1991). We adopt the positivist approach in our study and use a single, critical case design (Yin 1994).[10] Below, we provide the gist of the positivist case research methodology.

[10]According to Yin (1994, pp. 38-39), "One rationale for a single case is when it represents the *critical case* in testing a well-formulated theory [in our case, theory-in-use]. The single case can... be used to determine whether a theory's propositions are correct or whether some alternative set of explanations might be more relevant. In this manner... the single case can represent a significant contribution to knowledge and theory-building. Such a study can even help to refocus future investigations in an entire field." We discuss how our site satisfied criteria of "critical case" in the subsection on external validity.

A BRIEF REVIEW OF THE POSITIVIST CASE STUDY METHODOLOGY FOR THEORY TESTING

There are many accounts of positivism in the history of science and a comprehensive discussion of positivism is beyond the scope of this paper. Our conception of positivism is consistent with the views expressed by contemporary scholars in the fields of anthropology (Schweizer 1998), sociology (Ackroyd and Hughes 1992), organizational studies (Eisenhardt 1989; Lee 1991), and information systems (Lee 1989; Orlikowski and Baroudi 1991). This view of positivism represents a "marriage" of three traditions: (1) the *empiricist* tradition, which sought "the foundation of human knowledge in indubitable experience of the external world," and thus relies on "publicly verifiable, observable sensory data, systematically collected and collated, as the route to knowledge" (Ackroyd and Hughes 1992, pp. 21-22); (2) the *rationalist* tradition, which argued that "the route to indubitable knowledge is not through empirical experience of the empirical world, but through logical, that is rational principles which are beyond doubt" (p. 23); and (3) the *critical rationalist tradition*, whose primary proponent, Karl Popper, "concluded that positive evidence ('confirmation') and the inductive method (the search for rules that lead from limited observations to the establishment of valid generalizations) are not at the heart of science. Rather, negative evidence ('falsification') and deduction are at the core" (Schweizer 1998, p. 44). Arising out of this synthesis is *hypothetico-deductive* logic, which is viewed as being central to the world of positivist research today (Lee 1999). In the words of Ackroyd and Hughes (1992, p. 23), the hypothetico-deductive model

> uses the general statements of the theory as premises in a deductive argument, along with statements describing the conditions under which the test is carried out, [and] a testable conclusion, or prediction, [that] can be deduced and compared with empirical evidence. If the conclusion and evidence do not match, then the theory is falsified; if they do match, then this is some evidential support for the theory and its explanation. Subsequent research will then be devoted to determining its range of applicability and subjecting it to still further tests.

Our case research methodology is based on the view of positivism described above. The empiricist influence is reflected in the procedures for ensuring systematic documentation and the rigor of the research process, drawing mainly on Yin (1994). The rationalist and the critical rationalist traditions are reflected in the use of "pattern matching" to deductively test falsifiable statements derived from the literature.

A DISCUSSION ON THE RIGOR OF THE STUDY

In this subsection, we discuss how our case study addresses the requirements of the positivist case study method set forth by noted methodologists.

Construct Validity

Yin (1994) suggests three tactics to improve construct validity:

Using multiple sources of evidence*:* According to Yin (1994, p. 92), the use of multiple data sources can contribute to a high degree of construct validity, since "multiple sources of evidence essentially provide multiple measures of the same phenomenon." Specifically, for the MANCO[11] case study, conducted in 1996-97, we interviewed 17 key stakeholders of the reengineering initiative (Table 2), attended several meetings such as redesign sessions, "conference room pilot meetings" and "Monday morning meetings," and informally interacted with several stakeholders. In addition, the MIS manager gave us access to several documents, which related to: (1) the company background and its products; (2) the current reengineering project; and (3) a smaller version of the current project undertaken approximately two years prior to MANCO's BPR effort.

[11]MANCO is a pseudonym for the organization studied.

Table 2. Interview Statistics

Interviewee		*Number of formal Interviews*	*Number of Informal Interviews pertaining to redesign (including telephone interviews/ conversations)*
1.	CEO	1	0
2.	Senior VP	1	2
3.	Plant Manager	2	Few
4.	MIS Manager	3	Several
5.	Systems Analyst	2	Few
6.	Quality Assurance Manager	2	0
7.	Production Planning Manager	5	Several
8.	HR Manager	1	0
9.	Purchasing agent	2	2
10.	Engineering Manager	2	Few
11.	Accountant	1	0
12.	Manufacturing Engineer	Requested, didn't materialize	1
13.	Productivity Facilitator	3	Several
14.	Consultant (ERP Vendor)	1	2
15.	Consultant (Academic)	0	Several
16.	Sales Administrator	1	1
17.	Exports Coordinator	1	1

The sampling strategy utilized in acquiring as well as utilizing data for deductive testing was not random but *purposeful* (Patton 1990). Sampling of data *within* the MANCO case study was used throughout the period of the study with two main goals in mind: to obtain new information about a construct of interest and to enhance confidence in the measurement of the construct through constant triangulation. In particular, four purposeful strategies outlined by Patton (p. 182-183) were utilized:

- *Criterion sampling*—This involved selecting interviewees and deciding on questions for interviewees based on some pre-determined criteria. For example, during the study, in order to assess the role of MANCO's leadership during the initiative, it was important to have an opportunity to interview

with the CEO as well as the senior vice president. Similarly, in assessing the effectiveness of the redesign initiative, it was important to identify and interview a broad range of stakeholders who were influencing the redesign or were likely to be influenced by it.

- *Theory-based or operational construct sampling*—This involved picking appropriate interviewees and/or segments of their interviews, as well as documentary evidence (such as redesign team organization charts) pertinent to constructs such as "balanced team" that were being "measured" to test a theory-in-use.
- *Chain sampling*—This became a useful strategy for identifying additional interviewees whom other informants viewed as having useful insights regarding the issues in which the researchers were interested.
- *Opportunistic sampling*—Because of the dynamic nature of the fieldwork, any emergent opportunity for conversing with stakeholders had to be exploited to the fullest. In this case study, in addition to formal interviews for which appointments were sought, useful data was gathered by sitting in on the Monday morning meetings whenever possible, by conversing with employees, including shop floor workers in the company cafeteria about their views on the BPR initiative, interviewing external consultants about their view of MANCO's initiative as compared with other organizations whenever they appeared to be taking a break, and also gaining an understanding of many "inside" issues during an informal dinner at the home of one of the key redesigners.

Having key informants review the case study report: Yin (1994, p. 146) discusses such a review:

> From a methodological viewpoint, the corrections made through this process will enhance the accuracy of the case study, hence increasing the construct validity of the study. In addition, where no objective truth may exist…the procedure should help to identify the various perspectives, which can then be represented in the case study report.

Two individuals—the MIS manager and an academic consultant, both of whom had an overall understanding of the project—agreed to review the entire case study draft. The MIS manager wrote the following memo to the first author of this study after carefully examining the case study:

> *I think this is excellent. You have captured the overall spirit of what has happened here over the last several years. The changes I've indicated are mostly to "disguise" some of the players' names.*

The consultant similarly indicated to us that the case-study was an in-depth and accurate portrayal of the MANCO situation. In addition, throughout the research process, facts presented in the case were corroborated through other forms of "member checking" (Erlandson et al. 1993; Trauth 1997) using triangulation tactics such as (1) verifying interpretations and data gathered in earlier interviews in the course of the interviews and (2) furnishing copies of various *sections of the report* (including the first author's emerging pictorial reconstructions of the custom order-processing business process) to various stakeholders, and requesting written/oral commentaries or feedback.

Maintaining a chain of evidence: In order to ensure construct validity and reliability, Yin (1994) recommends that a case study be constructed such that a reader or external observer would be able to trace the chain of events occurring in the case study. This concern was addressed by creating *a detailed processual narrative of the case study*, as proposed by Paré and Elam (1997), prior to testing the statements. Such a detailed narrative can provide the reader with a sense of the sequence of events that led to a particular outcome from the point of origin, and thus can allow the reader to make an independent judgment regarding the validity and reliability of measures of constructs used in the case study. For example, in trying to measure if the redesign at MANCO was technocentric, a reader of this case study does not need to rely merely on the authors' measurement, but can independently follow the chain of events described in the narrative—the change in structure and culture, the collection of requirements from different functional units,

consolidation and creation of criteria for selection of enabling software, development of a preliminary process vision, presentation of technology solutions by vendors, evolution of the redesigned processes with the understanding of technological options and limitations, etc.—to evaluate the authors' conclusion that the redesign at MANCO was not technocentric.

Internal Validity

Only with internal validity can it be inferred that "a relationship between two variables is causal or that the absence of a relationship implies the absence of cause" (Cook and Campbell 1979, p. 37). According to Yin (1994), *pattern matching* may be used to enhance the internal validity. This technique essentially involves *qualitative but logical deduction* (Lee 1989) wherein an *empirically based* pattern is compared against a *predicted pattern derived from rival theoretical perspectives* (e.g., Markus 1983). Yin (1993, p. 60) underscores the importance of pattern matching using rival theories:

> I have found no concept more helpful in conducting research than the concept of rival theories….The most common rival theory has been the null hypothesis. A null hypothesis is simply the absence of target hypothesis. In an experiment, the target hypothesis might be a significant relationship between two variables, and the null hypothesis would be the absence of this relationship (the existence of the phenomena "by chance" alone). However, for doing case studies, the best rival is not simply the absence of target theory or hypothesis. Instead, the best rival would be a rival theory, attempting to explain the same outcome but with a different substantive theory than that of the target theory or hypothesis.

Also, according to Yin (1994), the rival theoretical perspectives need to be sufficiently distinct, such that there is little overlap among the "independent variables" in the rival propositions/statements. In our study, each of the three rival theoretical perspectives indicated different "independent variables" or conditions for effective redesign. For example, according to the technocentric theory-in-use, Hammer and Champy's notion of "inductive thinking" or a technology-driven design approach is

seen as a necessary condition for effective redesign; according to the sociocentric theory-in-use, the (pre-)existence of a leader's vision regarding the reengineered process is seen as a necessary condition for effective redesign; and finally, for the sociotechnical theory-in-use, effective redesign is possible only if the recursive relationship between the business processes and IT is recognized and used to inform the process of redesign. Having identified the "independent variables," we then conducted the case study to collect data not in a random way but, as Patton (1990) suggests, in a "purposive" way to identify material pertinent to the statements of the competing theories-in-use.

External Validity

This type of validity pertains to the *generalizability* of the findings (Light et al. 1990). In this study, we show that the events and behavioral patterns occurring at MANCO, the site of an intensive examination of a BPR initiative, do not match the patterns predicted by statements of (for example) the technocentric theory-in-use. It is important to note that in this study we are interested in deductive generalization as opposed to inductive generalization (Baskerville and Lee 1999) and, therefore, *the criterion of generalizability is to be applied to the statements (or theories-in-use) that we are testing, and not to the case study.* In other words, one of the questions we ask ourselves is, "Is the technocentric theory of redesign generalizable?"[12] The empirical material from the MANCO case in refuting this theory-in-use, as we see in the following section, demonstrates that *the technocentric theory on redesign cannot be considered generalizable*. In the hypothetico-deductive logic of positivism (described earlier in this section), a single empirical refutation is sufficient to falsify, or at the very least, raise serious doubts regarding the status of generalizability of a theory (Ackroyd and Hughes 1992; Lee 1989). In this regard, the use of one case is similar to the use of one experiment, in that one instance of either method is suffi-

[12]We ask a similar question with respect to the alternate sociocentric and sociotechnical theories-in-use as well.

cient to reject or disprove statements being tested.[13] However, for such disconfirmation to be truly convincing, Markus (1989) suggests the use of two strategies in selecting a "critical" case: First, the case selected should "be representative of a presumably large class of cases that fits the requirements of theory or theories to be tested" (p. 24). This guideline is also referred to by Patton (1990, p. 173) as a "typical case" sampling criterion. This criterion is satisfied in the case of MANCO, which was described by middle and top management of the company, the BASYS[14] vendor, and external consultants as undertaking a major reengineering initiative, thereby making it a suitable site to examine theory or theories of business process redesign. Indeed, the authors gained entry into MANCO based on the match between the company's initiative and the stated goals of the research project (which was to study BPR). The description of the project also matched, to a great extent, definitions of BPR available in the then current literature on this topic. Also, a BASYS consultant stated in an interview that the package chosen "allows you to rethink your processes and rethink the way you are doing things… it is a package that can support reengineering within a corporation," thus indicating that MANCO's initiative involved redesign of business processes and their implementation. Finally, there is no reason to believe that MANCO was a unique organization based on its product line, mixed-mode manufacturing strategy, the inter-functional feuds, and islands of information. In fact, the latter two characteristics were quite common among companies that chose to undertake BPR around that time, making MANCO a fairly "typical" case for studying BPR.[15] Thus, following Markus (1989), we argue that while it is not possible to estimate exactly how many organizations MANCO

[13]We note that, epistemologically speaking, statements cannot be conclusively proved to be true (Lee 1989; Yin 1994). Of course, based on a number of empirical validations of statements derived from a theory, a consensus regarding the generalizability of a theory may be reached within a community of researchers or practitioners.

[14]A pseudonym for the software selected for BPR at MANCO.

[15]In this regard, we realize that the size of MANCO would make it more representative of small/mid-sized companies than of large corporations.

might be representative of, there is no reason to believe that testing theories in MANCO would provide absolutely unique and unrepresentative results.

The second strategy that Markus suggests is that the chosen case should be very likely to confirm the main theory of interest. In such a case, if the theory fails, the disconfirmation can be considered decisive (Markus 1989; Patton 1990). In our study, the main theory of interest was the *technocentric theory-in-use* (with socio-centric and sociotechnical theories-in-use being the "alternate" or rival perspectives). An examination of MANCO's profile suggests that the company was likely to adopt a technocentric point of view in its BPR effort. The company was founded and led by engineers, and it was fundamentally engaged in designing and manufacturing air purification technology, thereby making the overall culture of the company technology-oriented, if not technocentric. In addition, the fact that the redesign initiative was headed by the MIS manager, who had been primarily in-charge of technical (hardware and software) issues of the company, would further point toward the strong possibility of MANCO adopting a technocentric approach to redesign. Thus, if it could be established that MANCO experienced effective redesign but did not adopt a technocentric approach or discontinued a technocentric approach that it had initially adopted, the disconfirmation of the technocentric theory-in-use would become all the more decisive.

Reliability

The underlying concern of reliability is "whether the process of study is consistent, reasonably stable over time and across researchers and methods" (Miles and Huberman 1994, p. 278). Yin suggests two tactics to ensure reliability of the study: creation of the case study protocol and development of a case study database.

Case study protocol: This protocol guides the investigator in conducting case study research in a standardized manner. The protocol for the study, created in accordance with Yin's guidelines (1994), consisted of the following documents:

1. A one page pre-proposal outlining the objective of the study and the type of access to data required for completion of the study.
2. A broad description of the envisioned research report with chapter by chapter summaries of the proposed contents.
3. An 80 page proposal consisting of the research question, literature review, derivation of competing theoretical statements, description of the epistemology and methodology to be adopted, a brief description of case study sites, and a list of relevant readings.
4. An evolving set of questionnaire outlines used to guide interviews.

Development of case study database: Yin recommends that a case study database have the following four components: case study notes, case study documents, tabular material, and a case study narrative.

Our *case study* notes primarily consisted of hand-written notes on the margins of the interview transcripts or on the questionnaires used for interviewing. These notes highlighted important points that were relevant to the statements being tested and, occasionally, provided cross-references to other interviews referring to the same issues. Our *case study documents* included key interview questionnaires, transcripts of some of the interviews, company background information, and project-related documents. Our *tabular material* included a profile of MANCO's products, summary of all statements to be tested, and the results of the testing. The central component of the case study database was, however, our case study narrative, also called an interim case summary by Miles and Huberman (1994, p. 274), which attempted to synthesize information from all of the different sources gathered up to that point. This interim summary allowed the representation, with some coherence, of the sequence of events that occurred in the organization and facilitated meaningful discussion with, and validation by, stakeholders of the case study. This 35 page chronological description of events and processes at MANCO served as the main data input for the deductive testing, supplemented by some additional transcribed quotations from the taped interviews.

Other Concerns

In addition to following the guidelines mentioned above, and consistent with the empiricist ideal of eliminating "speculative assumptions not founded on observation" (Schweizer 1998, p. 44), we adopted a realist ontology as described by Van Maanen (1988) rather than a social constructivist (Walsham and Sahay 1999) or an impressionist perspective (Harvey 1997; Van Maanen 1988), focusing on what organizational participants *said* or *did*, rather than on what (we thought) they *meant* through our interpretation of symbols.

Finally, we used the following *post hoc* evaluation criteria for positivist case studies based on Popper's ideas of falsifiability, logical consistency, survival, and relative explanatory power (Lee 1991). In our case study, we stated propositions in a falsifiable form (and some propositions were actually falsified). The propositions within the three perspectives were consistent with one-another. Our case study was also able to rule out certain theories-in-use (the technocentric and the sociocentric theories of redesign). However, the study found evidence in favor of the sociotechnical theory-in-use of redesign, thereby showing that the sociotechnical theory had higher explanatory power than the others.

It is worth noting at this point that most authors of positivist studies write in the third person, but we boldly use the first-person in this study in order to call attention to our belief that even a positivist scientific theory cannot exist independently of knowing subjects and, instead, must be part of an on-going social activity. By writing in the first person, we also intend to emphasize that our voice is distinct from the voices of the people whom we interviewed, and that the interview quotations that we are choosing to present therefore necessarily also reflect our own interests as IS researchers, not just the interests of the interviewees themselves. At the same time, by intentionally and extensively exposing our reasoning and evidence, we intend to be enabling our fellow researchers to assess our voice and to conduct subsequent studies to replicate, challenge, or otherwise build upon our study in a cumulative scientific fashion. For instance, another researcher could perform

another positivist study, but at a different organizational site, and then present evidence (including interview data) consistent with or contradictory to ours, or another researcher could use our findings of refuted statements as the basis on which to motivate a subsequent interpretive study in the manner explained by Lee (1991).

IV. THE CASE STUDY: THE COMPANY AND ITS PRE-BPR SITUATION[16]

In this section, we provide a description of the company (MANCO) that we intensively studied and, as a background to empirical testing, show why MANCO was interested in BPR. For easy reference, we have summarized key points of MANCO's reengineering initiative in Table 3.

INTRODUCTION

Two visionary engineers, Tom Martin and Bill Robinson, foreseeing the increasing demands for high quality air purification equipment world-wide, co-founded MANCO in the mid-1960s. From its humble beginnings in a garage with six employees, MANCO, in the next 30 years, had grown to a well-established organization with an impressive array of products whose world-wide yearly sales were over $25 million. Most of the 250 employees of MANCO were located at the headquarters in a major city in the midwest region of the United States; the remaining employees were stationed at regional offices in the U.S. and in subsidiaries in Great Britain, Germany, and Australia. MANCO's strategy for remaining competitive in its world-wide market was based on the principles of product differentiation and customer service. The distribution strategy was multifaceted, reflecting the variety of product lines. The company used a mixed mode manufacturing strategy: make-to-stock, assemble-to-order, and make-to-order. Production planning was an important component in the manufacturing process since the bills-of-material varied between three and seven levels for different products, and over 80% of the orders were for product

[16]The names of the stakeholders and the organization have been disguised.

configurations that had been previously built by the company. Over its three decades of operation, MANCO had earned considerable repute in the air pollution and dust collection industries. Furthermore, the increasing international concern on environmental issues such as air pollution ensured a growing market for MANCO's products. In addition, competition in the industry was moderate and, overall, MANCO's prospects appeared excellent from the external market's point of view.

Table 3. MANCO Case Summary

ORGANIZATION CHARACTERISTICS	
Age as of 1996	30 years approximately
Industry	Air purification equipment
Size (before reengineering)	250 approximately
Culture (before reengineering)	Fragmented, inter-functional hostility, politically charged, task-oriented, narrow compartmentalized thinking, sluggish action
Size/Revenue (after reengineering)	Same headcount (i.e., no change); revenue increased considerably
Culture (after reengineering)	Agile, cheerful, cross-functional cooperation
REENGINEERING:	
The "definition-in-use" of reengineering	"Organizational reform" for excellence *using common-sense and IT*
Reason for reengineering	To avoid "extended mediocrity"
Goals of the initiative	To excel and take advantage of market opportunities by creating an agile and efficient organization. The intermediate goals included redesign and implementation of appropriate organization structure, business process, and enabling technology.
Nature of the reengineering process	Radical, structural reorganization, followed by IT-enabled process change, followed by incremental adjustments of the social organization and technology
Formal definition of success	Cross-functional integration, creation of useable information for effective management
PROCESS REDESIGN:	
Nature of the redesign process	Autocratic changes in the structure, followed by participative, iterative redesign
Nature of the vision (redesign)	*Organizational agility* was the broad vision articulated by the top management; vision for specific processes evolved through interactions of different social/ functional options with different technical options. The redesigned processes were not formally represented on paper, but shared in the minds of the team and close associates.

Primary role of top management in the redesign	Created structural and cultural context for effective cross-functional processes; complete support provided to reengineering team throughout
Role of the consultants	Virtually no role in initial phase of structural and cultural change; in the latter phase involving redesign, the consultants from BASYS played a supportive role in helping the redesign team to see the possibilities offered by the software package, and facilitate the customization of the software package to the rede-signed processes (implementation).
Role of the redesign team	To discover business processes and the human organization suitable for the company. Also responsible for implementation
Role of IT envisaged	Providing a set of tools, accelerated information sharing, detailed management information
Role of computerized BPR tools for process modeling	Limited; use of tools discontinued during redesign
Whether redesign was seen by stakeholders as effective	Yes, for the most part
IMPLEMENTATION:	
Nature of the implementation process	Extremely planned; three pilots
Nature of communication	Superficial (sometimes misleading) formal communi-cation. (For example, potentially negative effects of reengineering were systematically omitted from the discussion with employees by management during company-wide profit-sharing meetings.)
Nature of IT implementation management	Very systematic
Nature of pre-existing IT infrastructure	Poor
Role of top management	Complete support; senior VP had hands-on involvement
Main problems faced in implementation	Moving to a more sophisticated IT infrastructure
Morale during implementation	High overall
Whether the implementation was being seen as successful by stakeholders	Yes

Unfortunately, the organization itself had become increasingly dysfunctional over the years. Customer complaints were on the rise, and it was as if MANCO had lost the ability to listen and correct problems. In order to secure bookings, the Sales department was promising customers delivery dates that, in fact, were unachiev-able. In addition, the Sales personnel were often booking orders without accurate specifications— practice that further delayed engineering design and manufacturing activities, and consequently the shipping of the product. The Engineering function did not appear to have the time or the interest to produce or update drawings and

documents that Manufacturing needed to fabricate and assemble ordered products correctly. There were often errors in engineering designs and design modifications because of a lack of coordination between the electrical and mechanical engineering groups. Meanwhile, the Manufacturing function was in a state of constant battle with Engineering regarding issues of ownership and update rights to bill-of-material and routing information, to mention a few. There was clearly no sharing of information among the functional areas. Symptoms of these problems had started to manifest themselves as unreasonable lead-times, as a high proportion of rework necessary, and as deteriorating quality of products.

THE DIAGNOSIS

According to employees of MANCO who were interviewed, the company's ailments originated from five areas: functional leadership, organizational structure, organizational culture, information technology infrastructure, and inefficient business processes.

Leadership, Structure and Culture

There was a serious problem with MANCO's functional leadership, especially at the VP (vice president) level. The VPs had served the organization well in its early years; however, as the organization continued to grow, they built "inward looking" empires with insurmountable territorial walls. These walls made coordination among different stages of the business processes a nightmare. The present plant manager recalled:

> *We were all focused inward at being the best we could be...and we began to all focus on local goals as opposed to global goals....No one VP [was] in charge of an entire operation...they were in-charge of segments...and so [they] had a lot of gridlock...and the symptom of that was animosity between the factory and Sales, between Sales and Engineering, between Engineering and Manufacturing...so we all became very territorial.*

A consultant who was at that time attempting to improve MANCO's marketing-operations interface, soon realized that the fundamental barrier to such an improvement was the nature of relationship among the VPs. Within the fragmented and hostile environment that the VPs created and maintained, there could be no trust across functional areas, and hence, no chance of cross-functional cooperation. One of the frustrating symptoms that the consultant encountered during his work with MANCO was the futility of the VP level meetings:

> *I thought these meetings were supposed to be strategic in nature. In reality, these turned out to be finger-pointing sessions...every time... where insignificant operational issues were angrily debated....even those issues were often not resolved.*

The organizational structure (see Figure 2) also contributed to this territorial attitude. The vice presidents were all at the same level and wielded almost equal power in the organization. They also had comparable influence on the person who was president and CEO. This person had historically given his VPs as much autonomy as possible to enable them to carry out their duties without unnecessary constraints or interference from others.

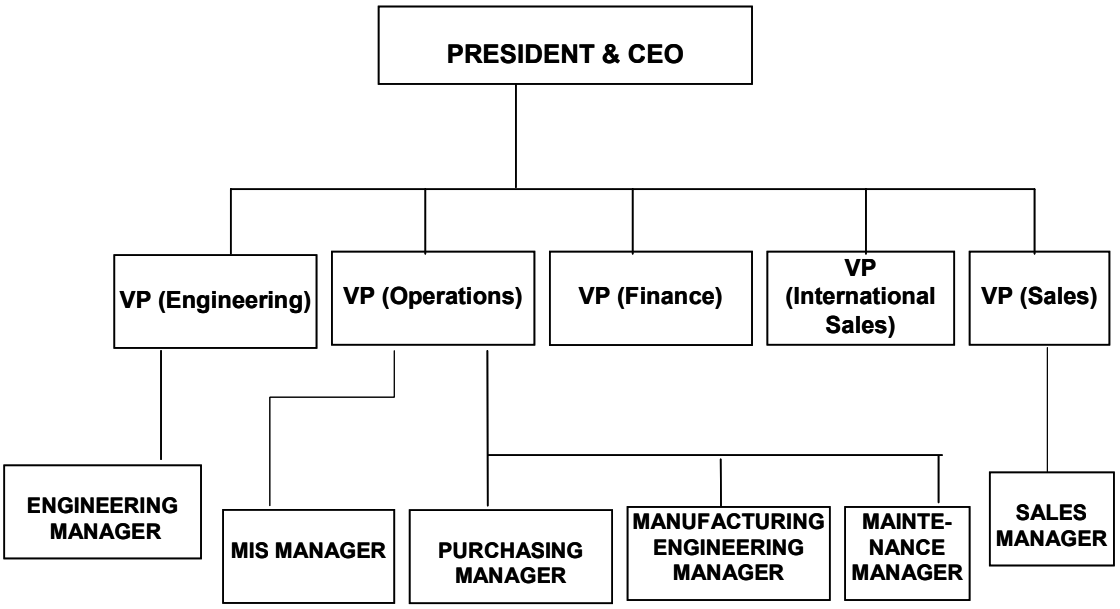


Figure 2. Simplified Management Structure of MANCO Before the Reengineering Initiative

Territorialism had also emerged on the shop floor with foremen controlling different groups of workers assigned to different specialized activities or products. Foremen were concerned only with their own local goals, and created a similar inward focus among their subordinates, the hourly workers. The plant manager described the situation as follows:

> *We had a lot of territorial disputes about floor space, about machinery, about people...resources. One group would not share their resources with another. If [an] assembly department did not have any work to do, their foreman would give them make-work projects...clean the shelves, sweep the floor...do whatever...he never asked another foreman if he could use some help.*

The existing organizational culture legitimized unproductive mindsets such as "*they* screwed up," "this is not *our* job," and "engineers should be on their drawing boards, *not* on the manufacturing floor." On the shop floor, there was little ownership of work because of the fragmented nature of the manufacturing work-force working on different parts of a product. Workers were expected to accomplish structured tasks specified by supervisors, and most of them did what they were told in (what the HR manager termed as) a "brain dead" fashion. The focus of workers was on clocking the desired number of hours rather than on adding value to the company's activities through active participation and involvement or through creation of a defect-free product that would be appreciated by the customers. Also, most employees were hardly aware of or concerned about the "bigger picture"—the *overall performance* of MANCO.

Information Technology

In addition to problems in leadership, organizational structure, and organizational culture, MANCO had serious concerns about its existing information technology. A senior manager commented that "to exploit the market opportunity we are positioned in," MANCO *had* to ensure that "we don't have anything in our way, such as the *archaic* computer system. We literally struggle to put together information that most companies can hit a button [for]." Even the MIS manager had her doubts

regarding MANCO's existing systems, especially the hardware, wondering if it was not "too dangerous to be on something that if something broke, it wasn't able to be fixed."

MANCO's primary computer system was a minicomputer, acquired more than 15 years previous to the BPR effort, when it was considered the state-of-the-art; it ran an MRP package with inventory control, product structure, purchasing and receiving modules, and several in-house developed modules for functions such as order-entry, invoicing, lead processing, financials, labor reporting, Kanban replenishment, sales analysis, sales history, bookings analysis, territory management, sales force tracking, and customer returns tracking. The minicomputer served 60 terminals and 20 printers all around the manufacturing and office facility. The system supported flat-files and had no relational DBMS capabilities, which seriously constrained the ability of the MIS department to make *ad hoc* reports available for management decision making. Reports generated through the applications often did not have up-to-date relevant information. Also, the large number of reports tended to create information overload for many users. Fortunately for the MIS department, top management as well as colleagues from other departments realized that these inadequacies primarily resulted from the poor technological infrastructure and lack of state-of-the-art software tools rather than from any deficiency of the information systems personnel. Most organizational members appeared to have a positive disposition toward the MIS department, and considered the MIS manager to be a competent individual. The Quality Assurance manager, for example, described her as a "real authority" whose judgments and insights were well respected by all.

Word processing at MANCO used WordPerfect 5.1, which ran on a UNIX-based Compaq network. MANCO had also acquired a number of IBM PC compatibles in the immediately preceding few years, and these personal computers (PCs) were either connected to departmental Novell-based Local Area Networks (e.g., supporting CAD/CAM in the Engineering department, or running Human Resources applications), or existed as stand-alone machines shared by a few people in a particular department. These PCs handled the functions of supporting

contact management, customer complaints tracking, engineering drawings, scheduling, word-processing, spreadsheets and some local database management. A systems analyst described the company's situation as follows:

> *What we have now is...several systems that can speak to each other with much difficulty, and often not at all.*

In his opinion, MANCO consisted of "islands of information" with "no real connectivity"; this explained MANCO's problems of data redundancy, lack of data integrity, and difficulties in data sharing and integration.

Another problem arising from the absence of a fully networked information system with database capabilities was the sea of redundant paperwork in MANCO. The vast amount of paper was slowing down the entire organization and frustrating employees who, burdened by paper-management functions, hardly had time to focus on their "real jobs." Comments such as "I do a lot of copying," "I generate a lot of paperwork." and "We need a system that will eliminate paperwork" were common across the organization's functions and levels. A purchasing agent talked at length about the problems of inter-departmental information exchange through using paper rather than through accessing an on-line database system:

> *Our current system does not do a lot of back and forth communication within some of the departments....Engineering is a stand alone department as far as we are concerned...we don't get back a lot of information from them...we don't have on-line capability to acquire drawings, give information back to Engineering in a timely fashion, or look for some of their plans in terms of design and development that is going on. There is a lot of paperwork shuffling through our current Engineering chains…everything that they do they have to funnel us a piece of paperwork before we actually get into the system and realize what is going on...I think we are going to gain a lot across the company in terms of a shared database.*

It was clear to all perceptive organizational members that information systems (IS) were a key to MANCO's future success in the global market place.

In summary, a radical change was needed in this area to eliminate or minimize problems of communication and coordination, data redundancy, lack of data

integrity, lack of data integration, excessive paperwork, the inability to provide required management information within a short period, and finally, the inefficiency of certain business processes. Only then could MANCO hope to remain competitive in the coming years.

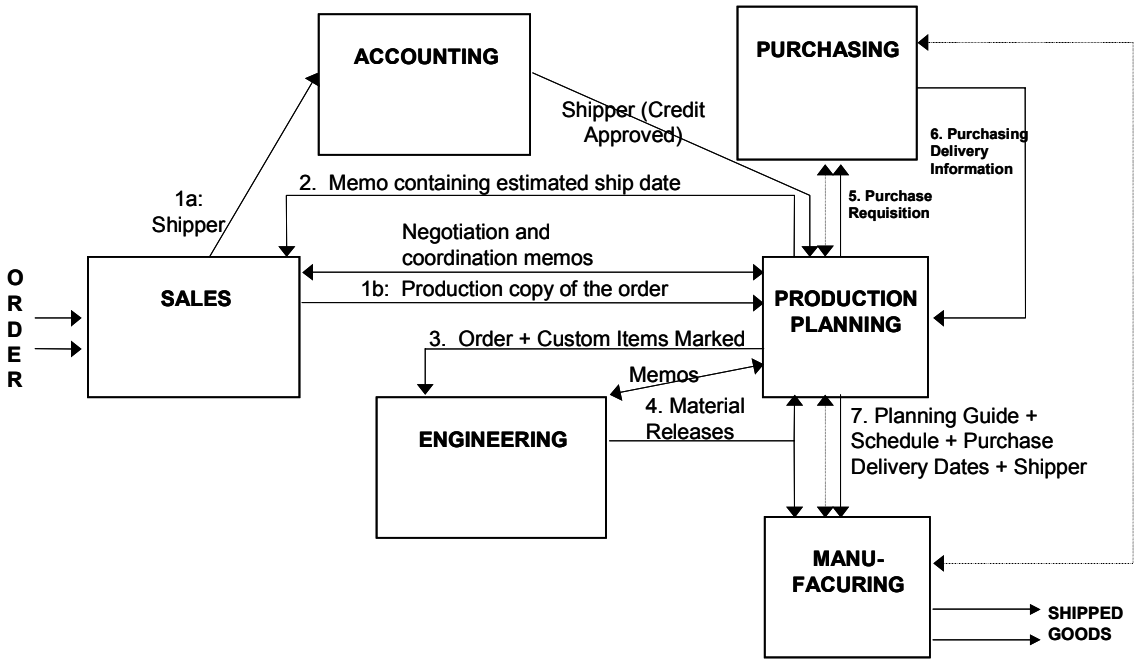
MANCO's Business Processes

Like most other companies, MANCO had several traditional business processes: order-processing, manufacturing, credit approval, product design, etc. In this case study, we focus primarily on *custom order processing*, which extends across a number of functional areas. We offer a simplified diagram showing information flows within custom order processing (Figure 3[17]) that we constructed based on interviews with different stakeholder. Formal lines of communication or information exchange are represented using solid lines while informal lines are represented using dotted lines. The focal process may be described as follows: Sales agents would bring orders to the Sales department. The Sales department would primarily have two functions at this point: first, to make the commission payable to the agent for the order; and second, to make copies of the order and forward one copy (referred to as the production copy) to Production Planning and another copy (referred to as the shipper) to Accounting. On receiving the shipper, Accounting would initiate a credit-check[18] on the customer. Only if and when satisfactory credit status of the customer could be ascertained would the shipper be passed to Production Planning from Accounting. Meanwhile, the production copy would have reached Production Planning, which would then be examining the order and sending a memo back to Sales with the estimated shipping date. If Sales and Pro-

[17]The diagrams (Figures 3, 5, and 6) do not depict the detailed process steps, but instead, show the information flows among the functional units that were manifestations of the underlying processes at different stages of the initiative, from the interviewees' points of view. This representation, while not using notations often used in BPR, can help the reader visualize, without introducing unnecessary details, the problems at MANCO and how the redesign, when implemented, would help make MANCO efficient and effective.

[18]This credit check could take up to 21 days.

duction Planning were not in agreement regarding the shipping date, several memos would be exchanged before any mutually acceptable date could be finalized.



Note: The dotted lines represent informal communication among the functional units.

Figure 3. Custom Order Processing at MANCO Before the Reengineering Initiative

When the shipper (credit approved) would finally arrive at Production Planning, the production copy of the order would be forwarded to the Engineering department which was required to provide releases (i.e.,revised bill-of-materials and drawings) as soon as possible so that Manufacturing could meet the shipping date. When Production Planning received the releases from Engineering, Production Planning would first issue a purchase requisition to Purchasing for custom items. On receiving purchase delivery information from Purchasing, Production Planning would generate the planning guide—a step-by step guide for manufacturing the custom product. Next, Production Planning would issue a schedule for allocating machines and labor, and for providing deadlines regarding the completion of diffe-

rent subassemblies.[19] The planning guide, schedule, shipper, and purchase delivery information would then be forwarded to Manufacturing. In case of incomplete product specifications, Production Planning would send memos to Sales, and sales personnel would, jointly with the customer, provide necessary information, based on which the planning guide or schedule could be finalized. If Manufacturing required any clarifications regarding the releases, it would notify the Production Planning function, which would then send official memos to Engineering. Clarifications would also be communicated back, through official memos and documents, from Engineering to Production Planning. Production Planning staff would then forward the necessary documents to Manufacturing.

The dysfunctional structure and culture of MANCO significantly contributed to the ineffectiveness of the process. For example, the sales agents, both internal and external, were paid commissions even before a Purchase Order was generated by the customer or complete specifications of the order were obtained. Even the Sales managers of MANCO were evaluated on bookings rather than on shippings. As a result, Sales had absolutely no stake in timely shipping of the product and, therefore, had little incentive to ensure that complete specifications were provided to Manufacturing in the production copy or even to respond promptly to requests from Production Planning to provide complete specifications. Other difficulties arose because of the relationship between Production Planning and Engineering. Production Planning unilaterally decided on the date when Engineering was supposed to provide the releases, which would often not be compatible with the existing schedules of the engineers. Engineers, who saw their role primarily as developers of new products and considered these minor modifications in the form of releases as low priority activities, would, in turn, provide incomplete releases with drawings not updated, and this would further delay the manufacturing process. When Production Planning would send memos, there was again no real reason for Engineering to

[19]Given the unavailability of sophisticated computer tools at MANCO, the planning and scheduling was actually done manually by planners within the Production Planning function.

respond quickly, given that each department wanted the other not to succeed in its goals. Yet another interesting problem arose because of the lack of communication among the different functions. A former foreman explained:

> *Sales would put...[a] certain requested date on an order...so they would take an order today...and they would want to ship it in a month....well, the first place it has to go is credit approval. If they have trouble getting credit approval, you are already delayed....Sales thinks we have a month to build it...but if they use up a week in credit approval, use up a week or so in Engineering...and it takes two or more weeks to order parts, one month is gone...and suddenly it is down to rush-rush to production.*

A major problem was that no department knew the status of an order until it was its turn to process it. When Accounting was performing the credit check, Engineering and Manufacturing had no way of knowing that such an order had actually been placed. Even Production Planning, once it had received the production copy from Sales, did not consider the order to be active until it received the shipper. Potentially, the approval could take up to 21 days, and then engineering and manufacturing would have to be done within seven days, greatly disturbing existing schedules and resulting in tremendous overtime expenses as well as opportunity costs. Also, goods produced under such circumstances could hardly be expected to be of top quality.

V. TESTING STATEMENTS FROM THE PRACTITIONER THEORIES-IN-USE

In this section, we present our assessment of the redesign effectiveness and test the statements from the theories-in-use identified and articulated earlier in the second section.

CRITERIA FOR EVALUATING REDESIGN EFFECTIVENESS

Evaluation of redesign effectiveness and BPR implementation success is a complex activity much like the evaluation of IS implementation success, and no uni-

versally accepted criteria exists for such evaluations (Boudreau and Robey 1996; Jones 1994). While several criteria for evaluations have been proposed (Boudreau and Robey 1996; Eccles 1998; Sethi and King 1998), we believe, drawing on Lyytinen and Hirschheim's notion of "expectation failure" (1987, p. 264), that an assessment of redesign effectiveness requires the recognition of the existence of multiple stakeholders of the redesign initiative, having different values, levels of power and interests, and hence, different expectations. This suggests that a thorough examination of the evaluations of the various stakeholders of the initiative is necessary. For the purpose of this study, we consider redesign to be effective *if different stakeholders state or indicate through observable behaviors* that such was the case.

A BRIEF DESCRIPTION OF REDESIGN AND AN ASSESSMENT OF REDESIGN EFFECTIVENESS

The *first phase* of the reengineering initiative at MANCO involved the recognition of territorial walls in the organization, and their dismantling through the implementation of envisioned changes in the organizational structure, the reward systems, and the organizational culture. The CEO realized through experience that the primary cause for territorial walls and their dysfunctional impact on business processes was that the vice presidents (VPs) had been involved in turf battles with each other. He decided not only to replace the three VPs responsible for institutionalizing the inter-functional feuds but also to institute changes in the organizational structure that would prevent the resurgence of territorial sentiments among employees at any level. In addition, he promoted a senior Sales manager to the position of senior VP of Operations and put him in charge of the core cross-functional business process of the company: order-processing. Soon after his appointment, the new senior VP initiated (1) the redesign of the factory which involved (among other changes) "taking out" a layer of foremen; (2) a quality assurance program; and (3) profit-sharing and other incentives for encouraging honest com-

munication, cooperation and trust across functions. This entire phase was conducted without the involvement of external management consultants.

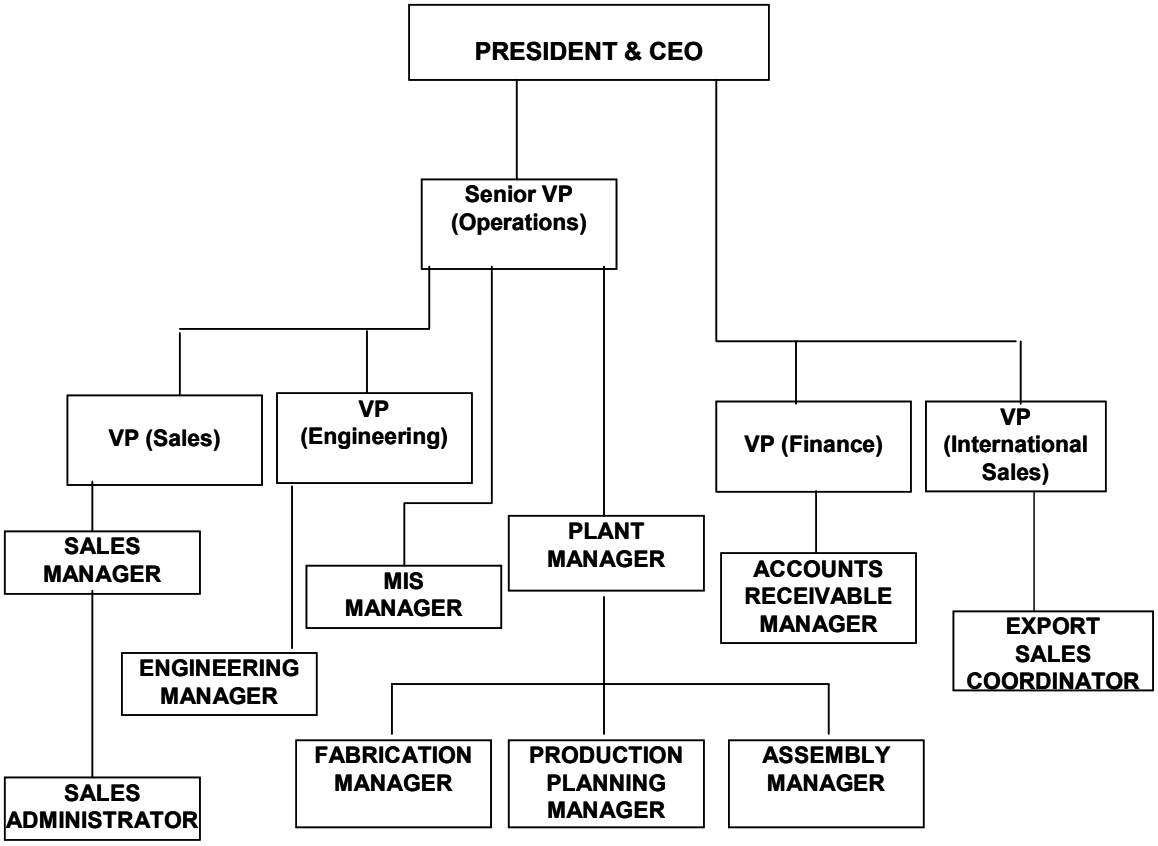
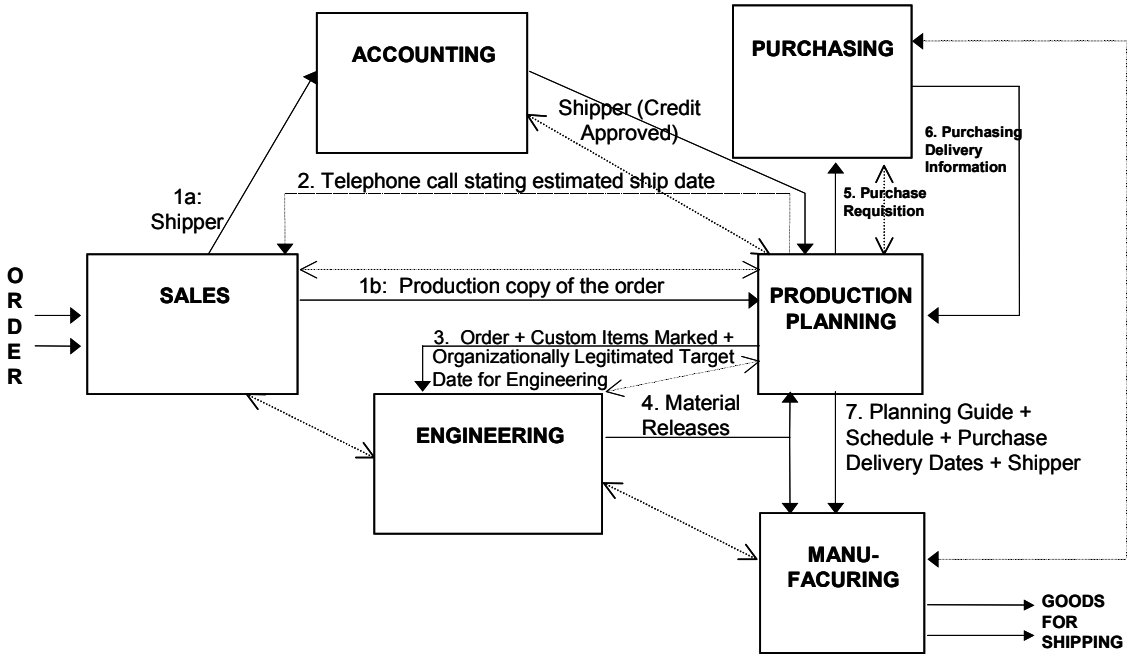


Figure 4. Simplified Organization Structure of MANCO (Relevant to Order Processing) After Phase I of the Engineering Initiative

Figure 4 depicts the organization structure while Figure 5 shows the process diagram for order-processing after the first phase of reengineering. It may be noted that the primary difference between Figures 3 and 5 is that Figure 5 shows a number of dotted lines among functional areas, indicating that informal cross-functional communications had opened up after the first phase. Stakeholders at different

levels in the organization attested to the success of this phase of redesign and implementation.[20] For example, the Plant manager explained:

> *Even though the process is the same…the culture and value systems changed remarkably. We started focusing on global goals, that being serving the customer.*



Note: The dotted lines represent informal communication among the functional units.

Figure 5. Custom Order Processing at MANCO After Changes in the Organizational Structure But Before IT-Enabled Changes

As another example, the Production facilitator felt that the reorganization provided a strong foundation for the IT-enabled change phase of the initiative:

> *It is very important that before you undertake a project on the information systems side that you have good working relationships between heads of all the departments…which we now have…and have not had in the past.*

[20] In this phase, redesign and implementation occurred simultaneously, and thus, the *redesign* could not be separately evaluated.

Supplying additional testimony was the Production Planning manager, who pointed out the benefit of having the senior vice president as the process owner for order processing:

> *Planning does not have any direct authority, but we have to be the link and satisfy both people [in] Sales and also Manufacturing. But with all under one person here [the Senior VP], that made it a little bit easier.*

Also attesting to the success of the business process redesign and implementation was the senior vice president, who was visibly pleased with the results of the structural and cultural changes, and said:

> *In the fiscal year that just ended…we said, let us ship the sales forecast and let us try to under-spend the operating budget, which we did, and we were able to have a record year.*

The sense of teamwork and cooperation across functions was evident to all organization members. Informal communication channels across functional areas had opened up, and it was not uncommon to see the Engineering manager walking down to the Production Planning area for a "chat" with the planners, or the Production Planning manager visiting the Purchasing agent to informally negotiate the purchase delivery date.[21] Territorialism had disappeared among the shop-floor workers as well, and the HR manager estimated that over 50% of the shop floor workers were positively affected by the recent changes.[22]

The *second phase* of reengineering involved the redesign of internal business processes and the selection of the appropriate software (BASYS[23]), followed by the actual implementation of the IT-enabled business processes. As mentioned earlier, we focus primarily on the redesign aspect of this phase in this paper.

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[21]Interviewees described these actions as unimaginable prior to the reorganization.

[22]The HR manager enjoyed close working relationships with many factory workers and was thus, in our view, in a position to evaluate the impact of the changes on the workers.

[23]BASYS is the pseudonym of the software finally selected by MANCO. BASYS was described by its vendors as "a fully integrated business management system designed for hybrid manufacturers of discrete products."

Figure 5 is our rendering of the redesigners' vision regarding "paperless" order-processing at MANCO. As in the previous diagrams, the dotted lines signify informal communication that is necessary for coordination. The solid lines represent information that a functional area enters into the system, or information that any area obtains from the shared database of the system. The diagram shows that if a customer were to make an inquiry regarding any product, MANCO's sales agents could, with the aid of the BASYS product configurator,[24] iteratively provide a customer with a number of configuration options of a basic product. Once the configuration was finalized, the order would be entered, and an expected shipping date would be provided by the system. In addition to providing a quick estimate of the shipping date, the configurator would ensure that the order entered through this process would necessarily (unlike the situation in the pre-BASYS process) be valid from a technical standpoint and would also include complete specifications.

Periodically, the planners in Production Planning would review the new orders and, if their own estimates were significantly different from the shipping dates proposed by the system, the planners would notify Sales and informally negotiate a new shipping date. Parallel to the activities of Sales and Production Planning described above, Accounting would update credit limits of existing customers, and determine the credit worthiness of new customers who placed orders. Since Accounting would update the BASYS database regarding the credit status of customers as soon as the information became available, all other departments would constantly be aware of the latest shipper status for different orders.

Once triggered by Production Planning, the configurator would take the order and then, using the existing bill-of-materials, generate the purchase orders (which Purchasing would periodically print out) and contact relevant vendors. Purchasing would be responsible for the input of any information it had regarding a purchase

[24]The configurator is offered as an add-on module to the basic BASYS system. According to BASYS documents, the configurator "lets non-technical personnel select features and options to configure a product on-line…[and] automatically generates the BOM and routings from the configurated order and supplies them to manufacturing."

order, such as delivery date or status. Other departments would thus have immediate access to this information. Also, based on the input from Production Planning regarding plans and schedules, the system would generate plans, schedules and relevant drawings for manufacturing the required product. We note that, in case of any revision, only the latest version of these documents would be available electronically in the computer, thus avoiding confusion arising (earlier) from the existence of multiple versions.

As can be clearly seen, with the configurator taking over most of the functions that Engineering performed with respect to custom orders, Engineering would be virtually freed from order processing responsibilities.[25] If and when a new order that could not be created as a combination of pre-existing parts and sub-assemblies came in, Engineering would have to become involved, and would update the configurator database as required.

Most stakeholders appeared to be excited about *the process as well as the product* of the redesign. For example, the Exports coordinator appeared very enthusiastic about the envisioned IT-enabled changes:

> *I can't express how excited I am about it because it will free me up to do more proactive things....I will have [information] at my fingertips.... it is going to allow me to focus in on really new exciting and challenging things that we have been planning for a while...and it is going to change my entire position for the positive.*

The Engineering manager was of the opinion that:

> *The redesign was hugely successful in that it will greatly impact the way the Engineering and the Manufacturing side will work together.... however, one problem is that the Sales side is not willing to change their commission structure...which will result in some implementation difficulties.*

[25]Note the absence of the loop between Production Planning and Engineering in Figure 6 that is present in Figure 3 as well as in Figure 5.

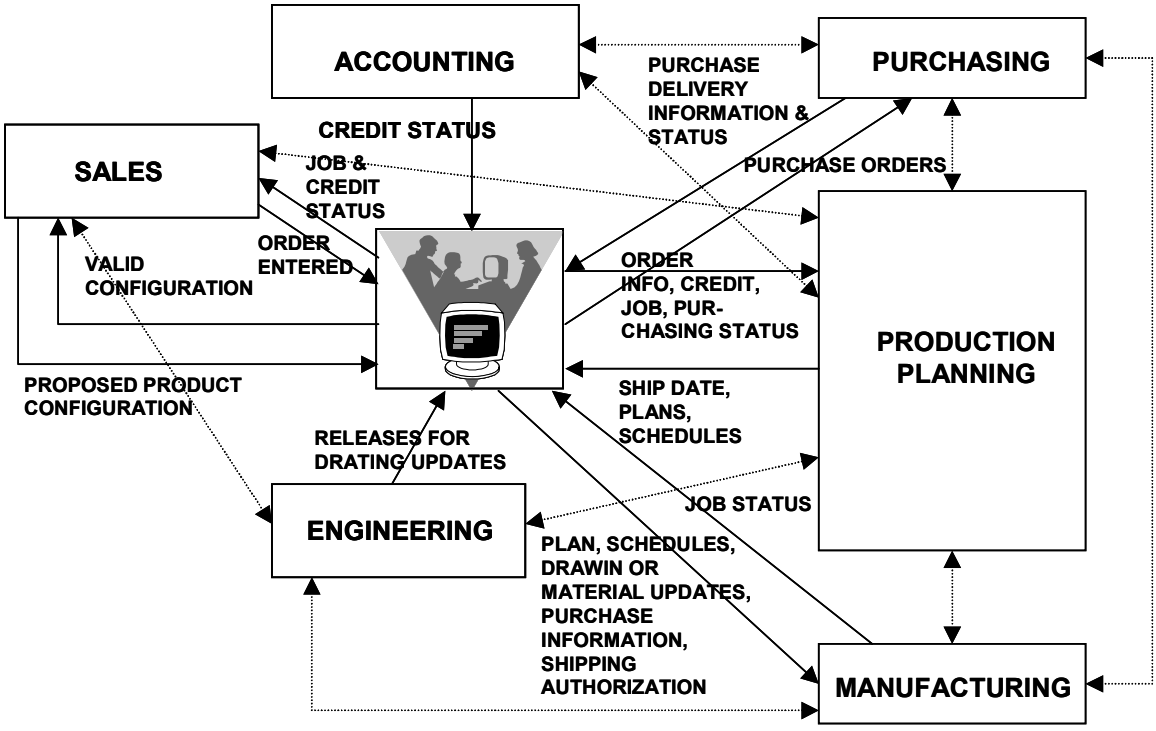

Figure 6. Expected Information Flows Connected with Custom Order Processing at MANCO at the End of Phases I and II of the Reengineering Initiative

The Production Planning manager also attested to the effectiveness of the redesign:

> *I believe that the redesign was effective because we got a detailed understanding of the organization...and determined what to do...in order to make it more efficient...and to have the different departments to work together without conflict.*

By *triangulating* the views as well as actions of these and other stakeholders, we conclude that the redesign of business processes was **effective**. This conclusion is further strengthened based on the facts that: (1) various stakeholders predicted success of the implementation even before the actual implementation started, expressing confidence in the process of redesign and the project leadership; and (2) various stakeholders described the implementation as successful after a large proportion of the implementation had been completed. While we do not intend to

imply that effective redesign is a necessary or sufficient condition for successful implementation, we do believe that the effectiveness of the redesign enhanced the confidence of the stakeholders and facilitated the implementation of the redesigned process.

TESTING THE STATEMENTS IN THE PRACTITIONER THEORIES-IN-USE ON REDESIGN

In this subsection, we discuss the deductive testing of the three theories-in-use, outlined earlier. For convenience, we have categorized the statements by two key aspects of business process redesign,[26] the first associated with the drivers/ enablers of the process of coming up with the redesign, and the second associated with the technological enablers and social enablers of the envisioned processes. We show the propositions along with the results of the deductive testing in Table 4.

TS1: *Effective business process redesign can occur only if the redesigning is IT-driven.*

This statement posits IT-driven redesign as a necessary (but not sufficient) condition for effective redesign. The evidence at MANCO refutes this statement, since effective redesign was accomplished even though the redesign effort was *not* IT-driven.

In the first phase, the redesign was undertaken by the CEO and, later, by a few handpicked members of MANCO's management team. These individuals conceived of the changes in MANCO's organizational structure and culture, not based on capabilities of IT, but relying on common-sense application of organization theory and quality management principles primarily to enable cross-functional collaboration in the company.

[26]It is worth mentioning here that not all aspects of redesign are relevant or viewed as equally important in the literature. For example, it is clear that a technocentric theory would have little to say about social enablers of envisioned business processes. Also, because we have focused on key representative propositions of the three theories-in-use, we do not claim that the literature is completely silent in areas where we indicate "No statement regarding redesign tested" in the table.

In the second phase, the redesign process at MANCO started with different departments proposing functional requirements and other changes that were necessary to make their business processes more effective. Most of the change requests *did not originate from MANCO employees' awareness of capabilities of new information technologies* but instead originated from their effort of addressing difficulties that they were experiencing in their own work.

Table 4. Results of Deductive Testing

Aspect of Business Process Redesign	Technocentric Theory-in-use	Sociocentric Theory-in-Use	Sociotechnical Theory-in-Use
Drivers/ Enablers of the process of redesign	**TS1:** Effective business process redesign can occur only if the redesigning is IT-driven. **(FALSIFIED)** **TS3:** The use of computerized BPR tools will enhance redesign effectiveness. **(FALSIFIED)**	**SS1:** Effective redesign of processes can be accomplished only if the redesign is driven by leadership's vision regarding the reengineered processes. **(FALSIFIED)** **SS2:** Effective redesign of processes can be accomplished only if a balanced team undertakes redesign. **(FALSIFIED)**	**STS1:** Effective redesign of processes can be accomplished only if an understanding of both the business processes within the social context and IT is used during redesign.
Drivers/ Enablers of the envisioned processes	**TS2:** Successful design (and installation) of enabling IT guarantees the effectiveness of business process redesign (and the effectiveness of the implementation of redesigned business processes). **(FALSIFIED)**	No statement regarding redesign tested.	**STS2:** Effective redesign of a process can occur only if the redesigners seek to enhance the functional coupling in the business process through the use of technological as well as social enablers.
Overall evaluation	Comprehensively falsified in the context of MANCO	Falsified in the context of MANCO, although there appears to be some supporting evidence.	Survived empirical testing in the context of MANCO; however, the possibility of being falsified in a different context remains.

Based on these change requests and outcomes of several meetings of the business process redesign team, a requirements list for the process-enabling IT was created, and 10 IT vendors were invited to present software products that could satisfy MANCO's requirements. One of the reengineering team members (the Export Coordinator) described how the IT requirements and, consequently, the vision of the new business processes evolved:

> *It was a series of meetings….We met…weekly and you just began to interact…and Judith [the MIS Manager]…controlled how the meetings were to go…and that helped you define everything…and when companies [the IT vendors] came in to give their presentation, that is when you started getting into the nuts and bolts of it….So it is a process…it is something that you just don't go in and [say]…OK, I am going to want this, this, this…you had to think about what was needed [regarding the business processes], and you brainstormed, then.. you talked about what is definitely needed. You went back to your bosses…[and asked] them what they were looking for…you would brainstorm with that and then go back to the meetings.*

As the team learned about different features available in different technologies, the redesign team members modified their views of how any particular business process should function. With this modified vision, the team members then sought other features in the systems that they had not thought of previously. MANCO's redesigners utilized their evolving understanding of the capabilities and limitations of different IT's *along with*, not prior to, their understanding of their business process (re)designs. Iterative thinking informed by technological and functional/social issues was also evident, although initially the redesigners appeared to have a tendency to make IT fit their current business processes.

We presented evidence in the previous subsection that MANCO's redesign was effective. Based on the evidence in this subsection, it is also clear that the redesign process *did not involve what Hammer and Champy refer to as "inductive thinking"—that is, the business processes were not redesigned using an IT-driven methodology*. Instead, the redesign originated from the recognition of a dysfunctional social organization, and thereafter, from functional requirements, and *only*

subsequently involved IT during the recursive interaction of technological and organizational requirements and capabilities in the redesigners' minds consistent with the competing *sociotechnical theory-in-use of redesign* (Davenport and Short 1990; Grover et al. 1995b; Markus and Robey 1995; Mumford 1995). Hence we reject statement **TS1**.

TS2: *Successful design and installation of enabling IT guarantees the effectiveness of business process redesign (and the effectiveness of the implementation of redesigned business processes).*

This statement posits successful design and installation of enabling IT as a sufficient condition for effective redesign and implementation. The falsification of this statement would involve identifying an empirical pattern of successful design and implementation of enabling IT that did not lead to effective redesign and/or effective implementation of the redesign.

The evidence at MANCO refutes TS2. The redesign started with the CEO and a few other members of the management envisioning and making radical changes to the social organization, not to the technological component of the organization. Next, the MANCO employees from different departments brought their requirements to the redesigners' attention. The redesign team then attempted, in an iterative fashion, to identify the IT that would fit the evolving redesign. At no point did the redesign team members focus on designing the *enabling IT itself*. This evidence by itself, however, is insufficient to falsify the statement (since the successful design and implementation of the enabling IT is proposed as a sufficient, but not necessary condition, in S2). On the other hand, we also had access to historical evidence pertaining to MANCO's order-processing, and we observed that MANCO had, a few years prior to its BPR effort, *attempted unsuccessfully* to streamline/reengineer order processing using software that had already been successfully

customized in-house at MANCO.[27] Evidently, inaction by and conflict among the VPs had prevented the seven member OPI (Order Processing Improvement) team from redesigning organizational aspects and implementing recommendations. The MIS manager, who had been a member of the OPI team, wrote in a memo:

> *Although every area agreed to abide by [the proposed] solutions, we were concerned about obtaining results because we could only rely on the goodwill of the different areas and we knew that was transient….We would like to believe there were compelling reasons why... recommendations and agreements were not followed, but we cannot comprehend what could have taken precedence over processing customer orders efficiently.*

Reflecting on the "failed project," the Production Planning manager stated:

> *It all goes back to trust and honesty and truthful communications….if you don't have this foundation, whatever system you have will not work.*

To summarize, historical evidence at MANCO indicates that effective design and implementation of IT alone did not automatically result in effectiveness of redesign and implementation of a business process. Hence we reject statement **TS2**.[28]

> ***TS3:*** *The use of computerized BPR tools*[29] *will enhance redesign effectiveness.*

Essentially, this statement posits that the use of a computerized BPR tool (e.g., for process mapping) will have a positive moderating effect on the redesign effectiveness. This statement can be falsified by showing that the use of compu-

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[27]Multiple stakeholders of the "failed project" indicated that there was nothing wrong with the software implemented in the project.

[28]This finding is likely to ring true especially to ISD researchers who have, for many years, emphasized the need for taking a sociotechnical approach that would balance the social and the technical in software design and implementation (e.g., Bostrom and Heinen 1977; Davis et al. 1992; Markus 1983; Robey 1987) rather than one that would adopt the traditional technology-imperative approach. The falsification of TS2 brings to our attention the fact that the lessons that were learned so painstakingly in the context of ISD have not been effectively transferred to the world of practice and need to be relearned in the context of BPR.

[29]Computerized tools, here, include flowcharting/process-mapping tools and simulation tools. For this statement, we also assume that computerized tools must be easy to learn and use.

terized tools had a negative or no effect on redesign effectiveness. Indeed, the evidence at MANCO refutes statement TS3.

In the first phase, no BPR tool was used by the CEO or others involved. For the redesign effort in the second phase, the MIS manager at MANCO had acquired an easy-to-use computer-aided flowcharting tool, and this tool was used in the early stages of process redesign. However, those who used the tool came to see it as not having a positive impact on either the redesign process or the outcome.

The business process redesign at MANCO was accomplished through an iterative process lasting several months in which the redesign team brainstormed, discussed, and agreed upon different aspects of the future processes and the organizational environment for the processes. Despite the flowcharting tool being used at the beginning of the redesign effort, the evolving redesign came to exist primarily in the minds of the redesigners in the form of a shared body of unwritten knowledge. In other words, they all knew the redesigns "in their heads," without using the computerized flowcharting tool. This rendered the tool useless from the perspective of the redesigners. On some occasions, especially for clarification purposes, flowcharts were spontaneously hand drawn in redesign sessions, but *at no point was there any conscious attempt to create computer-drawn process diagrams representing the team's then current view of any business process, even though MANCO had flowcharting software readily available*. Toward the end of the redesign effort, the first author asked the MIS manager why the process redesigns were not being represented/ documented using the flowcharting package. She replied:

> *I had tried to do that…it just worked out to be an exercise for me… basically. If you look in my book that I put together before the project started, I had...two chapters…"business as it is" and "business as it will be," and the "will be" is still blank. The vision that we have right now is kind of a high level and it hasn't really come to fruition yet…we will write [draw] it after we do it.*

Overall, she was convinced that the use of computerized flowcharting tools would not contribute to a more effective redesign, especially in light of the iterative approach to process redesign that the reengineering team had adopted. According to the MIS manager, one advantage of this approach was that the design remained very flexible, and could be continuously challenged and modified by the team members, who thought of different concerns as they learned more about the envisioned process and process-enabling software options. When asked if she would use the computerized tools in a larger company, the MIS manager indicated that she probably would, although not because such tools would *inherently* enhance the effectiveness of the process redesigns, but because they could help generate the "professional documents" and contribute to the legitimacy of the redesigners in larger organizations:

> *In a larger company you have to justify things a lot more….And you have to get sign-offs and go through the levels of approval and all this stuff…but here, it's not like that*.

Our observations during the redesign sessions also supported the team members' shared view that the absence of computerized graphical tools helped the team operate flexibly without getting bogged down on details and diagramming conventions. In fact, absence of computerized tools appeared to help the team concentrate on developing a *shared understanding of the redesign* rather than on merely creating a *uniform representation* of the vision.

Based on this evidence, we conclude that computerized tools did not enhance the redesign effectiveness of order processing process flow at MANCO. Hence, we reject statement **TS3**.[30]

[30]We would like to point out that, through the falsification of TS3, we do not wish to imply that computerized BPR tools should not be used. What we hope to have proven to the readers is that BPR tools do not necessarily enhance redesign effectiveness (for all organizational contexts) as portrayed unequivocally in the practitioner-oriented literature.

The Sociocentric Theory-in-Use

***SS1**: Effective redesign of processes can be accomplished only if the redesign is driven by leadership's "vision" regarding the reengineered processes.*

As in testing the technocentric statements, we consider the two phases of the initiative: first, the redesign of the organizational structure and culture, which was conducted by the CEO with some assistance from members of the management, and second, the redesign of the business processes (e.g., order processing) that was accomplished by the redesign team without the intervention or active participation of the BPR initiative's leaders (the CEO and the senior VP). In this (second) phase, top management provided two broad guidelines to the redesign team: (1) the reengineered MANCO needed to be an agile enterprise and (2) processes should be redesigned keeping in mind that significant customization would not be authorized for the process-enabling software that was finally selected by the team. Staying within these two guidelines, the process vision was developed bottom-up by the redesign team through an iterative process, as described by the MIS manager:

> There is nothing as of yet cast in stone about how we want to be when we come out of this…it's like prototyping really.

Also, in an interview, the CEO clearly indicated his lack of involvement in the formulation of the process visions:

> *To be candid with you...I am not personally following the process closely at all. I'm taking it on faith that our management information systems people and our operating people and our outside consultants are approaching things carefully and consistently. But I won't be able to judge that until we've either won or lost on it. Partly, because I don't choose to get into details...and secondly, because they know about what they're doing.*

Even the senior VP, who was seen as the champion of the entire initiative by the redesign team members, was not a major source of ideas regarding the process vision, which (in the second phase) evolved through the interaction of the redesign

team members with the vendors as well as the software package (BASYS) that was finally selected. Thus, while the leader(s) of the initiative did articulate the goal of "enterprise agility," and did recognize the need for (and made) changes to the structure and culture of MANCO, certainly the redesigned process configurations or their effectiveness cannot be attributed to *their* vision. In other words, the evidence in the case is not consistent with SS1, given that effective redesign occurred even though the redesign was not based on the leadership's vision of the process flows. We, therefore, reject SS1.

***SS2**: Effective redesign of processes can be accomplished only if a balanced team undertakes redesign.*

In the first phase of the initiative, redesign was not undertaken by any team. The CEO himself engineered the changes in the top management as well as part of the organizational structure. Thereafter, he did involve some members of the management such as the senior VP, the Quality manager, and the Production Planning manager, although these individuals were not working collaboratively as a team but rather under the direct supervision of the CEO, to rethink and implement appropriate changes in the organization's structure and culture. Also, this collection of individuals could not be described as balanced since many functional areas and hierarchical levels in the organization remained without representation.

In the second phase, the envisioning of the business processes in MANCO was primarily done by the members of the redesign team. Careful attention was given to the selection of the team, reflecting the fact that the leaders of the initiative recognized the importance of creating a well-balanced team with competent members. The selection of team members was carried out in two phases: first, the MIS manager obtained nominations for potential team members from each functional area; and second, the nominees were evaluated, according to the MIS manager, based on their understanding of their areas' functions, the inter-relationships among different functional areas, their ability to work constructively as a group, and their ability to represent their areas' special interests.

As a participant observer in redesign sessions, the first author could see the importance of bringing together a group of people from different functional areas with an objective of improving the business processes of MANCO as a whole. It was obvious, in many cases, that the absence of a team member of any functional area from the redesign session would have resulted in the envisioning of a process that was not acceptable to different stakeholder groups in MANCO. Such a business process was likely to violate some fundamental assumptions of the functional area that was not represented, that team members belonging to other functional areas would not be aware of or sensitive to. It is also worth highlighting that the redesign team was not just a symbolic entity acting as a façade, but actually, the team members' recommendations regarding process, procedures, and technology were respected and actually acted upon by the leadership of the initiative.

To summarize, in the second phase, MANCO's business process redesign was formulated by a "balanced" team consisting of representatives from different functional units (e.g. MIS, Sales, Production Planning, Engineering, Manufacturing, etc.), as well as an external consultant. The team also had representatives from different levels in the organization (e.g., a foreman, who represented the interests of the shopfloor workers, middle managers such as the Production Planning manager, and the Plant manager who had overall responsibility of the operations), again showing it was quite balanced. However, if we consider the fact that early stages in the redesign were undertaken by the CEO and a few members of the management up-front in order to set stage for the redesign team to work effectively, we are not able to demonstrate that the entire redesign was undertaken by a balanced team. Thus, we invalidate SS2, or at best, can claim partial support.

Sociotechnical Theory-in-Use

STS1*:* *Effective redesign of processes can be accomplished only if an understanding of both the business processes within the social context and IT is used during redesign.*

The evidence in MANCO is consistent with this statement. The entire redesign effort involved a sequential-recursive design process, as described by Markus and Robey (1995). First, the CEO and selected members of management, recognizing that no system would work in the absence of an appropriate social climate, engineered changes to the top management team as well as to the organizational structure, culture, and reward systems. Many remarks by the CEO during an interview showed his understanding of the relationship between the social and the technical. For example, he said that starting off the initiative with changes in the technology "gives technology too high a rating," and given that he had reached the conclusion that the existing organization and management group could not achieve high performance on a consistent basis, "that became the primary thing that needed [to be] changed." In his opinion, because "the social change was itself critical and time consuming and not risk free...doing them [technical after social] consecutively made sense….Because juggling two balls however good you are is tougher than juggling one."

Once the social dimension was fixed, the redesign team took over the responsibility of developing the detailed process vision by iteratively revising the design of the business process as the members came to be exposed to the different technologies available for enabling the processes that they had in their minds. A more detailed account of the recursive redesign process has been provided in the context of testing TS1 earlier. Based on the above evidence gathered from MANCO, we fail to falsify the statement STS1.

***STS2**:* *Effective redesign of a process can occur only if the redesigners seek to enhance the functional coupling in the business process through the use of technological as well as social enablers.*

The evidence in MANCO is consistent with this statement. As described earlier, the redesign in MANCO consisted of two separate phases: in the first phase, the CEO with the aid of a few managers envisioned how structural and cultural

changes could dismantle the territorial walls between different functional areas; and in the second phase, the reengineering team members envisioned improved business processes that were to be enabled through the use of an integrated database system. Thus, it is clear that the MANCO reengineering team (and others spearheading the reengineering initiative) attempted to use social as well as technical enablers to make business processes (especially order processing) in their organization more efficient and effective.

An examination of the diagram (Figure 3) showing information and paper flows pertaining to order processing reveals that, prior to the reengineering initiative, there was a very low level of functional coupling among functional units such as Sales, Accounting, Engineering, and Production Planning. This low level of functional coupling resulted from the high level of physical coupling and the low level of information coupling among departments.

As mentioned earlier in the case background, resolving any cross-functional issue, such as committing to an agreeable delivery date, involved a lot of memo exchanges ("memoing each other to death"), contributing to the high physical coupling among the different functional units. Additionally, in almost all instances, activities in departments were triggered by the arrival of a physical document from another department, again indicating a high level of physical coupling that led to a sequential (and often inefficient) flow of work. For example, the Production Planning department would not start processing an order until it physically received a credit-approved shipper from Accounting.

The existence of territorial walls (prior to the first phase of the initiative) among the different functional departments strongly suggests that there was a very low degree of inter-functional collaboration through information sharing, which further indicates that there was a low degree of information coupling among the functional units.

The first phase of reengineering was targeted toward dismantling the inter-departmental territorial walls by using social enablers, thereby opening up infor-

mation exchanges among the departments, and also eliminating the need for formal memo exchanges in many cases, and consequently enhancing the level of information coupling and reducing the level of physical coupling among the functional units involved (see Figure 5). For example, the decision to eliminate the practice of relying on the receipt of the credit-approved shipper from Accounting as a trigger to initiate order processing activities in Production Planning (which represented a reduction in physical coupling), and the opening of informal communication channels between Production Planning and the Accounting department for discussing the status of the shipper (which represented an increase in the level of information coupling), was expected to (and actually did) create greater parallelism and collaboration in order processing, thereby contributing to a greater level of coupling among functional areas in the company.

The second phase involved the use of primarily technological (but also social) enablers to enhance functional coupling. The BASYS database was expected to be the medium for sharing data among functional units, consequently eliminating paper handoffs among departments in many cases, thus increasing parallelism in the business processes through a reduction in the level of physical coupling among the concerned units (see Figure 5). The redesign team, for example, had envisioned that, on receiving a sales order, the Sales department would enter relevant order-related information into the system. Thus, without even sending physical copies of the order, Production Planning would start examining the feasibility of the proposed delivery dates, and indicate in the database itself if such a date was feasible. If negotiations between Sales and Production Planning were necessary regarding target dates, they would be conducted over the telephone in a spirit reflecting trust and cooperation arising as a consequence of the social enablers of cooperative organizational structure and culture in the first phase. Working in parallel, Accounting would initiate the credit approval process and update the database when a decision was made. For large orders, and for cases where the Accounting department had a reason to doubt the credit worthiness of the

client, Accounting personnel would be in constant touch with the members of the Production Planning department (as in a cross-functional team), thus enabling a parallelism between credit-checking and manufacturing planning activities through collaborative communication.

To summarize, the discussion shows that without the proposed use of both the technical (e.g., BASYS and the add-on configurator) and the social enablers (organizational culture and structure supportive of cross-functional cooperation, one process owner for order processing, reward systems reinforcing cooperation, etc.), albeit sequentially, those involved in creating the process vision at MANCO would not have been able to formulate an effective redesign. Thus, we fail to reject the statement STS2.

VI. CONCLUSION

The major ramification of our case study for IS researchers is that it successfully challenges the technocentric theory regarding business process redesign. By subjecting practitioner beliefs "about how to act effectively…to the most rigorous tests available" consistent with Argyris's view of good science, we find that statements of the dominant practitioner theory-in-use are logical (i.e., consistent with one another), but not empirical (i.e., they do not portray the "real world").[31] In the process of challenging the technocentric view, our case study also invalidates the sociocentric theory-in-use, another competing practitioner perspective evidenced in the BPR literature, thereby demonstrating the lack of survivability of both the perspectives.

For researchers and practitioners wary of the functionalist and instrumental nature of some BPR philosophies, our case study serves the purpose of providing

[31]While a majority of IS practitioners and IS researchers might be knowledgeable, at some level, of the fact that the technocentric or the sociocentric approach does not work, it is remarkable that, for many of them, their preference for a technology-driven theory of redesign in the context of BPR, ERP implementation, e-business design is readily apparent (from the literature as well as from first-hand observations/interactions). We hope that this case study demonstrates that such approaches are fundamentally problematic.

concrete evidence that confirms their suspicions and exposes the invalidity of a technologically deterministic as well as socially deterministic orientation to business process redesign. Indeed, our case study is useful for invoking the following parallel: just as IS researchers interested in information systems development (ISD) have long been moving away from just a functionalist and instrumental view (c.f. Hirschheim and Klein 1989), IS researchers interested in business process redesign should consider doing the same. Specifically, future research on redesign might look to the past and current research on ISD for suggesting analogies of how to proceed.

Along the same lines, the major ramification for practitioners, including consultants and senior management, is that it could turn out that BPR, just as ISD, can be more successful in the situation where interactions between the social and technological dimensions are anticipated and acted upon, than the situation where one of the two dimensions (technological or social) is given all the attention.

Indeed, for critical researchers and skeptical practitioners, the overarching lesson of our case study could be that BPR is but the latest arena in which researchers and practitioners are relearning old lessons by repeating past mistakes. For newly emerging arenas, such as design/implementation intranets, virtual organizations, and, especially enterprise resource planning systems, all of which draw on the body of knowledge on business process redesign, this means that it would be prudent for researchers and practitioners to adopt, *from the beginning*, an orientation that is neither technocentric nor sociocentric, but instead gives equal consideration to technical and social dimensions, and their interactions.

Our single case study is analogous to a single experiment. As for any scientific experiment, we believe that follow up studies (case studies, surveys, ethnographies, action research, additional experiments, and so forth) are in order, whether to replicate, challenge, or otherwise build on our case study and its findings. Positivist case studies, as our intensive examination of MANCO illustrates, are a viable method for contributing to this research stream, and we believe that this

paper can serve as a valuable guide for future researchers interested in deductively testing scientific theories or practitioner theories using case research.

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