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Effects on Business Process Redesign

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Business process redesign is changing the way corporations do business. Applications of the radical transformations outlined in the seminal essays on the subject ([DAVE90], [DAVE93], [HAMM90], [HAMM93]) have been extremely successful in many cases; however the widely varying results associated with reengineering projects has led researchers and practitioners to study the subject in great detail. Recognizing that no set of process design rules are universally applicable, our research addresses the following broad questions: (I) When is process redesign desirable; (II) How does the optimal design of a process depend on its parameters; (III) What are the interaction effects between and organizational implications of simultaneous changes in information technology, work systems and performance control schemes; (IV) How does the optimal mix of different information systems depend on the nature of the set of tasks they support, and their associated operational and administrative infrastructure.

There are a variety of reengineering approaches and philosophies advocated by both practitioners and researchers alike. Numerous articles e.g. [BALL95], [CHAM95], [DAVE95] have suggested implementation rules and case-based guidelines, while academic studies have focused on strategic [SHOR92], technological [WHIN95], organizational [BRIC95], work system oriented [DENN95], [BUZA95] and informational [SAMP94] aspects of process redesign. However, until now there has been no research that has addressed the question of when processes should and should not be redesigned. There is no clear understanding of how concurrent changes such as the automation of workflows, the extensive sharing of information and the use of output based compensation schemes integrate with the overall organizational structure. Clearly, many of the claims in the original process reengineering articles ignore some of the fundamental trade-offs between old and new job designs. For example, the literature is replete with examples of the successful application and the individual superiority of the IT supported case management approach or of the empowered workgroup approach. The advantages of such designs are evident - however, loss of functional specialization and departmental control can adversely affect costs, timeliness and quality.

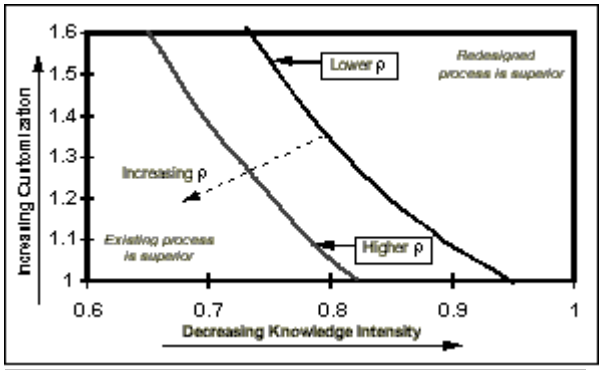
To better understand the technological and administrative dilemmas facing managers when redesigning business processes, and to motivate our models and analysis, we have worked on several process redesign projects with management teams at Xerox Corporation. The result of our work is a rigorous framework in which one can study the optimality of different process designs and information technology choices. The assumptions that we use as a foundation for the framework are based on our participation in these projects and a detailed analysis of some case studies.

The process factors we consider fall into three broad classes. The first consists of the nature of the tasks that comprise the job and the operational design of work systems. The second relates to human resources aspects of the process: compensation, performance measurement and decision rights. The third relates to the information systems and technology support for the process. We compare and contrast the performance of systems before and after process redesign in terms of overall cost, throughput and lead times, quality & error rates and the relative proportions of delay related, control related and technological costs in each case.

We classify the work system factors that describe a process into two broad classes; *process parameters* and *design variables*. Process parameters include those factors that are intrinsic to the job being done; these include relative task sizes, number of tasks, knowledge intensity of tasks, degree of customization of different instances of a job, and range of job sizes. On the other hand, design variables are those factors which can be chosen by the process owner; these include bundling of tasks, sequencing of tasks, scheduling of jobs and allocation of tasks to workers. Varying the process parameters allows us to examine a wide

range of process situations. Analysis of the optimal choice of design variables in each of these situations separates our process space into regions where specific process designs are superior.

We enhance this modeling framework using economic concepts from agency theory. This enhancement allows us to study the issue of individual performance measurement and control, and enables us to examine the critical effect of *information asymmetry* on the design of



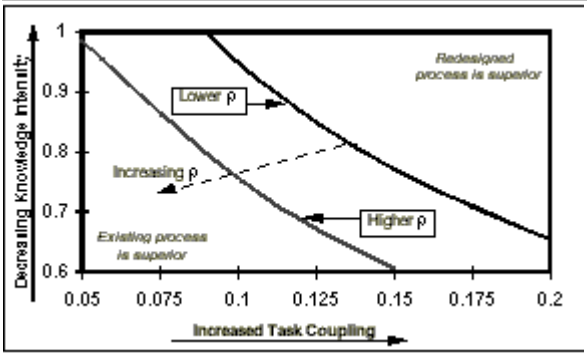


Figure 1 Effect of Knowledge Intensity & Customization Figure 2: Effect of Knowledge Intensity and Task Coupling

business processes. This asymmetry is of two kinds; among different workers, and between workers and management. Each of these forms of asymmetry have different implications on organizational costs, and therefore, process design. Some of our preliminary results ([SEID95], [SEID96a], [SEID96b]) have indicated that process redesign is more desirable when there are a large number of tasks in a job, high variability in task times, information asymmetries and a greater need for customization. On the other hand, process redesign is less desirable when jobs are knowledge intensive, tasks are fewer and uniform, and there is symmetry of information or low returns from information sharing.

In conjunction with our work system and performance control models, we analyze the effect of three technology concepts. The first form of information systems support we examine is technology that *enhances productivity*. This productivity enhancement could come about through improved decision

making with the help of decision support systems, increased speed of work flows through various computer based productivity tools, or quicker access to job-related information facilitated by a workflow automation system. The second effect of technology support that we study is *job scope expansion*; technology that expands the skill set that a worker possesses, and enables the worker to widen the scope of tasks that he or she can perform. There are a wide variety of information systems that have this effect; expert systems and decision support systems are two examples. The third effect of technology we model is its enabling role in *information sharing*. For instance, groupware or similar intranet based systems are designed to provide consolidated access to cross-functional information from different organizational entities, and enable a workgroup to share information more effectively. Evidently, many information systems may be beneficial in more than one aspect discussed above.

We study the tradeoffs between investments in different forms of technology support in the context of a 'traditional' work system and in a reengineered work system. Our initial findings are:

- The impact of information technology is *enhanced* by the redesign of work systems, and the optimal level of technology investment tends to be *higher* when processes are redesigned
- The optimal mix of technology support within the space defined by these three dimensions depends critically on the parameters of the process; in particular, degree of job-to-job customization, knowledge intensity, task coupling and information asymmetry among employees. Figure 1 and 2 illustrate some examples of our results, and indicate the effects of some of these parameters on process redesign.
- Information technology and performance based incentives tend to be *substitutable* (rather than complementary) drivers of performance enhancement; however, the redesign of work systems could be *complemented* by both enhanced technology support, and a shift towards incentive compensation schemes.

Our study clearly reveals the structure of the indifference curves that separate the regions of optimality of different process designs and information technology choices. These results provide a solid basis selecting the optimal portfolio mix of work system designs, performance control schemes and information systems, depending on the nature of the process.

Our work contributes to the design and analysis of business processes in many ways. We provide a sound theoretical basis for the study of process design, and outline a formal methodology of selecting the appropriate design to use in a particular situation; though our work was initially aimed at addressing reengineering, it suggests new directions for the optimal internal structure of an organization. Our analytical tools draw from operations research, information theory, microeconomics and queuing theory. We also examine and identify the interaction effects and direction of complementarity between the simultaneous technological, operational and organizational changes that accompany reengineering. Most importantly, the managerial implications of our conclusions and results are of significant consequence; given, a process description, a manager can use our framework to make technological, administrative and operational design choices. Since our framework explicitly models and provides solutions for a variety of job and technology related factors, it allows superior design decisions in a broad variety of organizational settings.

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