Communication-Based Versus Workflow-Based Redesign: Some Observations From An Experimental Study

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ABSTRACT

Modeling and representation approaches and techniques have been used extensively both in business process improvement and in the design and development of information systems, in order to better understand the processes within organizations. The primary purpose of this study is to investigate the effect of different business process representation approaches and related techniques on business process improvement projects. During the last decade, organizational redesign projects have had a very high rate of failure. We focus on four different research questions by conducting an experiment involving 174 students from a mid-sized university in northeastern United States, and analyzing the corresponding empirical data. The analysis of the data from the experiment indicates that an emphasis on the flow of information and communication in business processes can have a positive impact on the success of business process redesign projects.

BUSINESS PROCESS REDESIGN

Business process redesign is a notion that has been used by researchers and practitioners to reorganize and improve business processes. While its roots originally belong in the field of operational management, the explosion of information systems within organizations has made it critical for the research to be expanded and complemented by researchers in the field of information systems. In order to better understand this connection between the two disciplines, characteristics of an organization and how process redesign has been utilized to enhance its operation will be discussed in the following section.

Organizations typically produce goods, services, or information. In order to employ process redesign or process improvement to improve its operations, the organization should have a clear set of products being produced or delivered in a routine manner. These products are typically produced and delivered to both internal and external customers of the organization through the use of various business processes. Davenport & Short (1990) refer to business process as a set of logically related tasks performed to achieve a defined business outcome. They also analyze a process by defining three characteristics: processes that take place between organizational entities, processes resulting in the manipulation of objects, and processes involving managerial and operational activities.

There are two important views whereby business processes can be looked at and understood. The first refers to the process as the value-adding unit. This view takes into account the primary goal of the process, that is, to take a set of tasks and achieve a defined business outcome. The organization's inputs are provided by suppliers, worked on by agents, and delivered to the customers. Thus, the focus is on the products produced. The second view, often called the workflow view, looks at the process as a set of interrelated activities (White and Fischer, 1994). This implies that if two sets of activities can be done independently then the two sets of activities are not part of the same process; i.e.,

they make up two different processes. Both of these views are important in the understanding of how business processes can be improved (Tapscott and Caston, 1993).

In addition, business processes also present two main distinct, but related, attributes: quality and productivity. Many organizations erroneously focus only on the productivity aspect and fail to recognize that quality is of equal importance to the business process. Quality is inherent in the concept of customer satisfaction, either internal or external to the organization (Deming, 1986; Juran, 1989). Business process quality is also defined as the measure of the business process customers' satisfaction (Crosby, 1984). If there is a rise in the business quality as a consequence of changes in the way activities were performed, then the business process redesign was successful. Business process productivity concerns both production capacity and production cost. Production capacity is the capacity of the process to produce the outputs during a specific time period. Production cost relates to the costs to produce the outputs during a specific time period. Business process productivity can be measured by the ratio between the variables production capacity and production cost. Productivity and quality are clearly interdependent (Drucker, 1993). In fact, improvements in quality will often lead to productivity improvement. Likewise, productivity improvement will be expected to favorably affect quality. Thus, a successful organization must concentrate on both of these aspects in its business.

REVIEW OF MAJOR BPR SCHOOLS OF THOUGHT

Business process redesign is considered to be a very dynamic tool. The primary goal of business process redesign is to improve business processes. The goal typically sought is to improve a business process' quality and productivity (Harrington, 1991; Kock, 1995). Business process redesign can be either an incremental or a radical and rapid approach to improve both quality and productivity in an organization (Davenport and Stoddard, 1994; Kock, McQueen and Baker, 1996). There is a clear distinction between continuous and radical improvements and researchers differentiate between the two approaches. The primary difference between the two is the magnitude of improvement sought (Damampour, 1988; Dewar and Dutton, 1986). This was clearly illustrated by West and Farr (1990, p. 7):

A routine innovation is the introduction of something similar to previous organizational practice, although its specifics are new to the organization. A radical innovation, again new in its specifics for the organization, is also very different from what the organization has done before, thus is more disruptive and requires more change within the organization.

In order to improve organizational productivity and maximize process-related output, researchers have proposed many theories. Those theories and related concepts and ideas, many of which have come from industry practitioners, have formed the basis of the movements relating to business redesign. Three of the primary movements are scientific management, total quality management, and business process reengineering.

Scientific management dates back to the beginning of the twentieth century when Fredrick Taylor published "The Principles of Scientific Management." Taylor's movement became known as the "Taylor System", which is commonly referred to as scientific management. Scientific management greatly impacted the Industrial Revolution which was primarily concerned with the productivity and efficiency of tasks in assembly lines and manufacturing processes. This theory was based on the premise that the tools used and the activities performed by individuals could be scientifically analyzed and improved in order to produce the maximum amount of output with a minimal input of resources. The system that was designed by Taylor and his associates used a variety of organizational arrangements, tools, and methods to increase the efficiency and speed of production. Furthermore, the system included various bookkeeping and accounting techniques, numerous ways to measure work input, a method of charting work which was designed by Henry Gantt (The Gantt chart is still in widespread use today), a slide rule for the calculation of machine speed by Carl G. Barth, science of motion study by Frank and Lillian Gilbreth, and various other methods to organize storerooms, tool repair, and other potential time wasting elements of the work process (Merkel, 1980).

Another major movement in organizational redesign was the Total Quality Movement (TQM). In contrast to scientific management, total quality management focused on the incremental improvement of current business

processes. This movement started in Japan based upon the work of William Deming, Joseph Juran and Kaoru Ishikawa (Johnson and Chvala, 1996). The main emphasis of this theory was on quality rather than on the productivity needed to improve a manufacturing operation. Deming believed an increase in quality within an organization would result in lower costs, increased customer satisfaction, higher productivity, higher profitability, and greater security for the employees. Many experts credit TQM for Japan's metamorphic change into an economic superpower (Chapman, 1991). Feigenbaum is credited with first bringing TQM to the United States. Later, Crosby promoted the use of TQM in the 1970s (Johnson and Chvala, 1996). A variety of techniques and tools have been used to implement TQM such as: statistical process control, quality costing, Pareto charts and fish bone diagrams, and SWOT analysis with the emphasis on teamwork (Brewer, 2000; Rothman, 1994).

Detractors of the TQM movement believe that it is problematic for organizations attempting to cope with vast changes due to new technological advances. This led to another movement called reengineering in the early 1990s. Reengineering emerged based primarily on the efforts of Michael Hammer and Thomas Davenport who independently worked and developed the idea of business process reengineering. This concept also focuses on reorganizing an organization's processes, rather than its tasks. Reengineering proponents further argue that simply adding technology and automating the old tasks and activities will not create a successful organization. In order to improve the efficiency of an organization, the emphasis must be on radical redesign of processes within the organization (Hammer, 1990). Early reengineering projects had a limited scope and typically were used in invoicing and warehouse management. Today, reengineering is utilized in multiple functional units and processes such as support services and planning (Stalik, 1994).

COMMUNICATION FLOW MODELING

A major step in any process redesign project is to appropriately analyze and represent the current processes in an organization. Since processes are abstract entities, a shared understanding of them becomes difficult without the use of standardized modeling approaches. In order to better understand the processes within organizations, modeling has been historically used extensively both in business process improvement and in the design and development of information systems. Choosing the right modeling approach is an important piece of the redesign process that allows us to depict these abstract concepts. Problematic representation can affect the ease of understanding and ease of solving of future problems. Effective problem solving becomes easier whenever appropriate representation approaches are used (Kaplan and Simmon, 1990).

Historically a variety of modeling approaches have been used in process representation both in information systems development and in organizational redesign projects. One of the most commonly used and widely accepted types of modeling is the workflow or activity flow model. This modeling approach originated from the manufacturing era where the flow of work or materials was an important and integral part of the organization. The workflow model focuses on understanding the interrelated activities, within the organization, that had an exchange of material products.

Another important factor to consider is the evolution from a manufacturing economy to a service economy in developing countries. Most developing countries have witnessed rapid changes since the mid-1970s. As Toffler (1991) suggests, these countries are now information societies with fewer individuals employed in manufacturing jobs. The study done by Kock and McQueen (1996), states that a large percentage of the service sector sales came from companies that sold data products such as software, financial data, and news. And, about seventy percent of the exchanges within the organizations involved information (e.g. faxes, memo, email), as opposed to tangible assets like parts and materials.

Most of the business redesign approaches concentrate on the processes in a business as a set of interrelated activities. Not enough attention, however, has been given to analyzing the processes based on information flow (Kock and Murphy, 2001). Knowledge creation and exchange among different parts of an organization is complex. The current business redesign approaches do not take fully into consideration the new communication intensive nature of businesses in today's environment.

The communication flow optimization theory was developed within the last several years based upon actual redesign projects (Kock, 1999; Kock and McQueen, 1996; Kock and Murphy, 2001; Kock, 2003). The theory asserts that the quality of the outcomes of a business process improvement project, particularly in terms of the success of the project, is directly related to the degree of reliance of the project on the communications within the processes, rather than the workflow. This increase in success, according to the theory, is attributable to the proliferation of the communication-intensive processes within today's organization. The communication flow optimization theory states that optimal process configuration can be obtained by redesigning the flow of communication through the application of communication flow-oriented process redesign guidelines.

Process redesign groups have historically thought of processes in terms of chronological sequences of activities or activity flow, rather than in terms of communication flow. Given that most contemporary process redesign projects focus on activity flows (Kock 1999; Katzenstin and Learch, 2000), the following questions were derived for this study supporting an attempt to assess the communication flow optimization theory model:

Question 1: Will process redesign group members perceive communication flow representations to be more difficult to generate than activity flow representations?

Flowcharting and activity flows are routinely used by researchers and practitioners to depict organizational activities. While there has been a variety of computer tools introduced to more expeditiously generate models, the underlying flowchart has remained the foundation of these models. Activity flow charts are easy to conceptualize because they depict the basic actions of the process. When we think about our tasks, we think about the steps that are needed to complete them, not the communication flow throughout the organization. Thus, it is predicted that business process redesign groups will have had experiences with the activity flow representations and therefore will have gained a comfort level with this representation. Therefore, the redesign groups will likely perceive that the communication flow representations are more difficult to generate.

A redesign study done by Kock (2003) states that the redesign groups generated activity flow representations of their targeted processes and then generated communication flow representations based on those initial activity flow representations. The study suggests that a majority of the members of the redesign group favor activity flow over the communication flow because of its intuitive nature. The activity flow model depicts the steps that are followed to perform the task. The interviews conducted in the study suggest that the members of the redesign groups believe a communication model can not depict exactly the step-by-step flow of the tasks that are performed. Thus, the communication model was perceived as being more difficult to conceptualize and more difficult to model.

If a modeling approach is easier to conceptualize and create, there will be less effort required for the redesign group. Therefore, the group will typically utilize the model that it perceives as being easier to understand. If the model provides little difficulty, the users can effortlessly and intuitively generate the organizational model. Modeling business processes is very complex and detailed. It is imperative that the redesign group buy into the new approach. The adoption of the model is strongly influenced by the redesign group's perceptions of the ease of generation and use.

Question 2: Will process redesign group members perceive communication flow representations to be more complete than activity flow representations?

Due to the increase in communications such as emails, faxes, and other electronic transfers of data, it is vital the redesign group understands the communication that takes place within the organization's processes. The communication model provides a more complete representation of the process by better capturing the process activities, the entities involved, and depicting the interrelationships among the various functional units within the organization. This perception of completeness likely results from the extensive exchange of information that is a fundamental aspect of today's organization.

Question 2 flows from the theory's claim that the communication flow model represents a more complete depiction of the business process than activity flow models. Process redesign groups typically think in terms of

chronological sequences of activities. As a result, redesigners have had experience using the activity flow model. Despite the initial preference for the activity flow model, this question predicts members of the business process redesign groups will ultimately conclude that the communication flow model will lead to a more complete process representation.

Question 3: Will process redesign group members perceive communication flow representations to produce a more useful model for designing an information technology solution than activity flow representation?

Question 4: Will communication flow representations be perceived as leading to more successful process redesigns outcomes than activity flow representations?

Questions 3 and 4 follow the model's claim that since the designers utilizing a communication flow based modeling approach have access to a more complete set of process details, they are better able to visualize and identify the relationships among the entities involved. Furthermore, the redesign groups are better able to detect inefficiencies and optimize the process. Because of this access to a better process depiction, the redesign group can more effectively and efficiently map the redesign model into a successful IT solution for the redesign task. Since the activity flow model views the sequences of the activities, it neither properly depicts the location of data nor the flow of information and communication. Consequently, it is more challenging to map the activity model into an IT solution.

In addition, Question 4 suggests that the focus on the communication flow will be meaningful only if it leads to increased process redesign success. If the communication model leads to no improvements to the outcomes produced, then the model was not successful.

METHOD

As discussed in the previous sections, the literature on empirical research of process redesign distinctly identifies the benefits of understanding the current processes in an organization as an important factor in a redesign project. Despite this known benefit, there has been very limited empirical research that identifies and defines how the various functional units work, communicate, and interrelate within an organization. This study evaluated the communication flow optimization theory by examining activity flow and communication flow modeling approaches in a redesign project using two different groups consisting of university students.

Data was collected through a questionnaire, which included twelve questions, each using a Likert-type scale. The original questionnaire was designed based upon a review of the relevant literature. To further refine the questionnaire, four system analysts and one database administrator were interviewed. Participants were provided with a copy of the initial questionnaire and were informed that they were participating in a pilot study and that their comments and recommendations would be used to develop a revised questionnaire for the purpose of evaluating various modeling approaches in an experiment. A short description of the proposed experiment was provided to each participant. This included a brief description of the modeling techniques to be utilized and process redesign techniques. The participants then reviewed the questionnaire and provided their insights. In order to further refine the instrument and test its reliability and construct validity, a pre-test was also conducted on a group of thirty-eight students. The results were used to perform exploratory factor analysis to test the construct validity and categorize items under different constructs. To ensure the internal consistency of the variables, reliability assessment was performed using Cronbach's alpha. After analyzing the results of the pre-test, the final questionnaire was developed. The final questionnaire contained three constructs and twelve items. The variable items in the questionnaire were used to measure the ease of generation, completeness, and usefulness in the development of IT solutions. In addition, the questionnaire was revised based upon the questions and comments made by the pre-test participants.

POPULATION AND SAMPLE

The subjects in this study were 174 students from a mid-sized university in the northeastern United States. Each of the students was enrolled in a system analysis course at the university. Data collection was conducted over a period of three semesters. In each of the classes, the students were randomly assigned to two separate groups. Each group was given a short training session focusing on one of the two specific process modeling and redesign

approaches: (a) a communication flow-oriented approach proposed by Kock (1999), which employed a variation to the standard Gane-Sarson data flow diagram (Davis,1983; Dennis and Wixom, 2000); and (b) an activity flow approach that employed the general flowcharting and process redesign techniques proposed in connection with functional timeline flowcharting by Harrington et al. (1998).

The procedures and implementation of the training were conducted in detail and in such a way as to make certain that all students in each group were consistently provided with the same information. The training included a brief description of each of the two main modeling approaches, the symbols used, and a simple example using the model. Handouts were provided which described the notations with an example. The training also included an overview of the process redesign guidelines which were compiled from a large body of literature on process redesign. A summary of these guidelines is presented in (Table 1) and are further discussed in detail by Kock (1999). To minimize any bias effect, special care was taken to provide guidelines containing elements from both activity and communication flow approaches. As seen in Table 1, the guidelines *foster asynchronous communication, eliminate duplication of information,* and *reduce information flow* are geared more toward an communication flow approach; while *execute activities concurrently, group interrelated activities,* and *break complex business processes into simpler ones* are related to an activity based approach. *Reducing the control activities* and the *number of contact points* are more neutral and can be utilized in both approaches.

Table 1: Process Redesign Guidelines Used In The Study

Foster asynchronous communication
Synchronous communication refers to the exchange of information at the same time whether in a same place or at different places. Examples are face-to-face, virtual meetings, or telephone conversation. A meeting of a customer and a sales representative is an example of synchronous communication. Asynchronous communication refers to communication done at different times when the parties are not engaged at the same time. Examples include email, faxes, and bulletin boards. A customer placing an order on a web site is an example of asynchronous communication. Experience has shown the majority of business communications is synchronous communications. This type of communication, however, is both costly and time consuming. Also, this type is often less objective and the set up time is greater. Asynchronous communication has proven to be more efficient in the majority of business communications. This type of communication has a much lower set up cost and is more objective. Thus, organizations should focus on their processes to determine which synchronous communications can be eliminated to increase productivity.
Group interrelated activities
Activities that have similar characteristics and utilize the same resources could be grouped together in time and space. Organizations that group interrelated activities may determine there is a duplication of efforts for the same task. Grouping the interrelated activities will result in cost savings and will increase productivity. Furthermore, it will likely increase customer satisfaction. Customers appreciate having an issue solved on the first call, rather than having to call several departments to resolve an issue.
Break complex business processes into simpler ones
A complex business process that includes numerous activities should be separated down into a finite set of simpler business processes. Most individuals cannot retain more than seven, plus or minus two, steps. Thus, breaking down complex processes into more simplified processes will facilitate in reduction of the required training time for associates. Furthermore, there are fewer mistakes made when the processes are understood. It is easier for workers to grasp several smaller business processes than one large complex process. This will also result in a reduction in mistakes that will lead to an increase in productivity and a reduction in costs to detect and correct the errors.
Eliminate duplication of information
Data repositories can be either static or dynamic. Static repositories hold data on a more permanent basis and can be either manual or electronic storage devices. Duplication of information has historically been an obstacle for organizations. When various storage repositories are kept, there is a potential to have inconsistencies. This problem can exist in different electronic files and databases throughout an organization. Further, the duplication of data is extremely expensive due to maintenance time and storage costs. These inconsistencies may adversely affect the organization's productivity and quality.

Reduce information flow
Organizations often could have an excessive and unnecessary amount of information exchange. Companies striving for efficiency sometimes fail to understand the negative implications that excess information has on effectiveness. This excess information often requires middle management to become information filters. Further these managers often take on the role of messengers to lower management. This excess information requires the manager to focus on these roles rather than performing the vital and more important functions of his or her job. This excess information can be reduced by eliminating all information that is not important to the business processes. This can be facilitated by using database management systems and support groups.
Reduce control
Organizations implement control activities to improve efficiency. The controls help to eliminate or alleviate problems resulting from human error. These controls, however, may provide workers with a "safety net" that will result in a reduction in productivity. Thus there is no accountability or repercussions to the employee. An employee who knows his mistakes will be reviewed and corrected may not be as careful in performing his work. Also, the cost of implementing the control may outweigh the benefit achieved from the control. For example, some companies routinely pay out small amounts of money for slip and fall cases. The cost to settle the case is often times less expensive than investigating the claim and hiring counsel. Therefore, organizations should evaluate controls to determine if the control is cost effective.
Reduce the number of contact points
A contact point occurs when there is a communication between two or more individuals. Each time a customer has to contact or meet with individuals within an organization it creates a contact point. In a process, contacts can also occur within functional units of the organization and among functions and customers. Excess contact points can lead to inconsistencies and delays. This will ultimately lead to customer dissatisfaction. A goal of an organization should be to reduce the number of contact points. Reducing the contact points will also make it easier to improve business quality. The key to the success of self-service restaurants, gasoline stations, and stores, is the minimum number of contact points.
Execute activities concurrently
Traditionally organizations have performed their tasks in a sequential manner. Most individuals think in terms of doing one step at a time. Historically this methodology has been used on most assembly-line activities. However, many of these tasks could be performed concurrently which would result in the reduction of costs (elimination of unnecessary labor) and an increase in productivity. Thus, organizations should identify which activities can be performed concurrently. The identification of these tasks is made easier when the business process flowchart is utilized.

At the end of the training, the same task, which was adapted from a case study about an order fulfillment process in a medium size organization, was given to each of the groups. Each group was asked to generate three sets of diagrams. First, the group was to generate a model for the current (i.e., pre-redesign) business process described in the case study based upon their assigned modeling technique. Second, the group was asked to complete a business redesign exercise using the redesign guidelines previously provided, and generate another model for the redesigned processes using the same modeling approach. Last, the groups were required to generate a generic IT solution using their redesigned processes diagram.

A questionnaire was administered to each group after the completion of the task, whereby quantitative data was gathered. Identical questionnaires were given to the two types of groups – one employing the communication flow-oriented approach; the other employing the activity flow-oriented approach. The results of the survey were gathered and analysis of variance (ANOVA) was applied using SPSS software.

RESULTS

The first set of data in this study was obtained from three independent judges who evaluated and scored the final IT solution of each redesign project for the groups who used the communication and activity flow models. Each judge used a scoring scale of one to ten (ten being the highest score) to grade the final design, based upon

predetermined criteria provided by the authors. The scores of the judges were averaged and a final score was produced for each redesign project. Cronbagh alpha reliability for the judges' scores was 0.89.

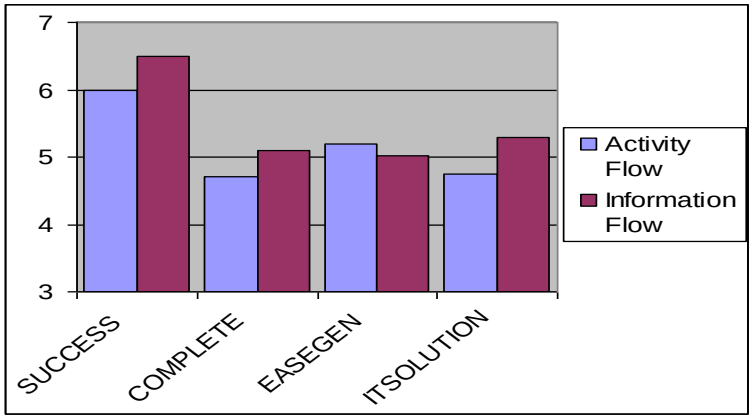
An analysis of the scores generated by the judges suggested the use of the communication flow-based modeling approach, when compared to the activity-based modeling approach employed, led to an approximately 6.5% higher success rate. Analysis of variance was also used to examine differences among the average scores given by the judges, which were found to be statistically significant at $p < .01$.

The next phase of the analysis was performed on the data gathered from the post-task questionnaire. Factor analysis was performed on the data from the responses to the questionnaire. Using data reduction and summarization, factor analysis allows for the analysis of complex multidimensional problems, and provides the facility to combine a large number of variables into smaller sets of new factors or constructs while minimizing the chance of losing information during the reduction process (Hair et. al, 1994).

At the end of the factor analysis, the variables were loaded under three common factors. The three prominent variables were: perceived ease of generation of the model (EASEGENE); perceived completeness (COMPLETE); and perceived usefulness in generation of an IT solution (ITSOLUTION). The variables with lower Cumulative Percent Value (CPV) of .7 were eliminated. Following the factor analysis, a reliability test was performed for the extracted factors. The Cronbagh alpha values for the extracted factors were .81 for perceived ease of generation, .75 for perceived completeness, and .87 for perceived usefulness in generation of an IT solution.

In the next phase of data analysis, analysis of variance (ANOVA) was used to examine the differences of the means between the communication flow-oriented and activity flow-oriented groups with respect to different constructs in the study. While the mean for the ease of generation for the activity flow condition was 4% higher than the communication flow modeling, the result of the ANOVA analysis showed no significant difference between the two. On the other hand, the differences between the means were found to be statistically significant for perceived completeness and usefulness in the generation of an IT solution. The results suggested the use of a communication flow-based approach, when compared to an activity flow-based one, had over a 5.8% higher result in the perceived completeness, and an 11.2% increase in generation for IT solution.

Figure 1: Data Analysis Result



SUCCESS Judges scores for the redesign
COMPLETE Perceived completeness
EASEGEN Perceived ease of generation of the approach
ITSOLUTION Perceived usefulness in generation of IT Solution

CONCLUSION

Historically modeling methodologies have contributed to the successful outcome of process redesign projects. An important component of a redesign project is the understanding of the organizations' processes through an appropriate modeling approach. While there are various modeling approaches available in the redesign area, a review of literature suggests there is a significant reliance, by the majority of operational level process redesign projects, on depicting processes by using the flow of materials and activities. This focus is often seen as inherited from the manufacturing era. The depiction of the workflows has undoubtedly been effective at a time when most of the wealth generated in developed and developing nations came from manufacturing operations, which is not the case since at least the mid 1980s for most of those nations. The modern organization is communication flow-intensive, not activity-intensive.

There has been a vast amount of research on information systems design and organizational process redesign. Introducing technology to optimize or redesign organization processes has had an inordinately high rate of failure. This research attempted to analyze this shortcoming by building upon the communication flow optimization theory and setting forth the hypothesis that some failures are partly attributable to the lack of understanding of the organizational processes, primarily because the workflow modeling methodologies used are not well-suited for the hyper-communicative environment that exists in the current business environment. Recent trends suggest that with the emergence of e-business and other virtual communications, the requirement to refocus and realign process redesign will continue to intensify.

There is a definite and necessary requirement that the redesign process must account for this fundamental organizational change. Currently, there is little consideration directed to the investigation of the communication flow within the organization. The result of this study suggests that this reliance should be shifted toward depicting the information and the communication aspects of the process. The findings conclude that the communication model allows redesign groups to more easily visualize and identify business process inefficiencies. These communication interactions can then be eliminated or improved. Focusing on the communication flow will likely lead to a better process redesign outcome.

The findings in this research should contribute to a variety of groups. The information system developers and designers should be able to acknowledge and better align information systems design with business processes techniques. Utilizing communication flow methodologies in the analysis stage should significantly help the design processes. The second group that will benefit from this research should be the managers of organizations who embark on the challenging and sometimes disappointing areas of business redesign and reengineering. Explicitly in very complex and large redesign projects, any minimal improvement can produce enormous savings. This research can help decision makers with the insight necessary to establish a strategic plan when success and return on investment remain the focal points. The findings here can also contribute to academic research across many different disciplines as the area of business redesign permeates many fields. Specifically, researchers in information systems should utilize the vast body of research that has already been completed in organizational redesign.

Many theoretical issues remain to be resolved and much more research is needed to further test and refine the communication flow optimization model. The extension and refinement of different aspects of the communication flow optimization theory should also be pursued. Further research and the possible proposal of new modeling approaches, by combining and utilizing different modeling methodologies, would be useful. In particular, the development of a model that combines the positive aspects of both the activity flow and communication flow theories that are supported by the hypothesis of this research would be extremely beneficial.

The participants in this study were not redesign team members in an actual organizational redesign project. Future studies should focus on the characteristics of the designers. A study using actual redesign teams in various organizational environments may have a differing effect on the results. Although the task used for the experiment was from a mid-size organization, the results provide important guidelines for conducting process redesign projects. Another limitation, however, is that the results cannot be generalized to all business enterprises. This is particularly

true in terms of the size of the organization. Studies using either very large organizations or small organizations could have specific characteristics that would need to be considered.

REFERENCES

1. Brewer, P.D., Brewer V.L., and Hawksley, M. (2000). Strategic Planning for Continuous Improvement in a College Business, *The Mid-Atlantic Journal of Business*, Vol. 36, No. 2, pp. 123-132.
2. Chapman, W. (1991). *Inventing Japan*: *The Making of a Postwar Civilization*, Prentice Hall, New York, NY.
3. Crosby, P.B. (1984). *Quality Without Tears: The Art of Hassle-Free Management*, McGraw-Hill, New York, NY.
4. Damampour, F. (1988). Innovation Type, Radicalness, and the Adoption Process, *Communication Research*, Vol. 15, pp. 545-567.
5. Davenport, T.H. (1993). *Process Innovation*, Harvard Business Press, Boston, MA.
6. Davenport, T.H. and Stoddard, D.B. (1994). Reengineering: Business Change of Mythic Proportions?, *MIS Quarterly*, Vol. 18, No. 2.
7. Davenport, T.H. and Short, J.E. (1990). The New Industrial Engineering: Information Technology and Business Process Redesign, *Sloan Management Review*, Summer 1990.
8. Davis, W.S. (1983). *System Analysis and Design: A Structured Approach*, Addison-Wesley, Reading, MA.
9. Deming, W.E. (1986). Out of the Crisis, MIT, Center for Advanced Engineering Study, Cambridge, MA.
10. Dennis, A. and Wixom, B. (2000). *System Analysis and Design: An Applied Approach*, John Wiley & Sons, New York, NY.
11. Dewar, R.D. and Dutton, J.E. (1986). The Adoption of Radical and Incremental Innovations: An Empirical Analysis, INFORMS, Linthicum, MD.
12. Drucker, P.F. (1993). *Post-capitalist Society* , HarperCollins Publishers, New York, NY
13. Hair, J., Anderson, R., Tatham, R.L., and Black, W.C. (1994). *Multivariate Data Analysis with Readings*, 4th Ed., McMillan Publishing Company, New York, NY.
14. Hammer, M., (1990). Reengineering Work: Don't Automate, Obliterate, *Harvard Business Review*, Vol.68, No. 4, pp. 104-114.
15. Hammer, M. (1996). *Beyond Reengineering*, HarperCollins Publishers, New York, NY.
16. Harrington, H.J. (1991). *Business Process Improvement*, McGraw-Hill, New York, NY.
17. Harrington, J.H., Esseling, K.C., and Van Nimwegen, H. (1998). *Business Process Improvement Workbook: Documentation, Analysis, Design and Management of Business Process Improvement*, McGraw-Hill, New York, NY.
18. Johnson, W.C. and Chvala, R.J. (1996). *Total Quality in Marketing*, St. Lucie Press, Delray Beach, FL.
19. Juran, J.M. (1989). *Juran on Leadership for Quality: An Executive Handbook*, Free Press, New York and London.
20. Kaplan, C. A. and Simmon, H. A. (1990). In Search of Insight, *Cognitive Psychology* Vol. 22, pp. 374-419.
21. Katzenstein, G. and Lerch, F. (2000). Beneath the Surface of Organizational Processes: A Social Representation Framework for Business Process Redesign, *ACM Transactions on Information Systems*, Vol. 18, No. 4, pp. 383-422.
22. Kock, N. (1995). MetaProi: A Group Process for Business Process Improvement, Project Report GP-G-1995-R5, Dept. of Management Systems, University of Waikato, Hamilton, New Zealand.
23. Kock, N. and McQueen, R.J. (1996). Product Flow, Breath and Complexity of Business Processes: An Empirical Study of Fifteen Business Processes in Three Organizations, *Re-engineering & Management*, Vol. 2, No. 2.
24. Kock, N., McQueen, R.J. and Baker, M. (1996). Learning and Process Improvement in Knowledge Organizations: A Critical Analysis of Four Contemporary Myths, *The Learning Organization*, Vol. 3, No.1, pp. 31-41, MCB Press, Bradford, England.
25. Kock, N. (1999). *Process Improvement and Organizational Learning: The Role of Collaboration Technologies*, Idea Group Publishing, Hershey, PA.
26. Kock, N., Loch, K.D., Clarke, R., and Davison, R.M.(2001). Research Ethics in Information Systems: Would a Code of Practice Help*?, Communications of the AIS*, Vol. 7, No. 4, pp. 1-39.

27. Kock, N. and Murphy, F. (2001). *Redesigning Acquisition Processes: A New Methodology Based on the Flow of Knowledge and Information*, Defense Acquisition University Press, Fort Belvoir, VA.
28. Kock, N. (2003). Communication-focused Business Process Redesign: Assessing a Communication Flow Optimization Model Through an Action Research Study at a Defense Contractor, *IEEE Transactions on Professional Communication*, Vol. 46, No.1, pp. 35-54.
29. Merkel, J.A., (1980). *Management and Ideology*, University of California Press, Berkeley and Los Angeles, CA.
30. Rothman, H. (1994). Quality's Link to Productivity, *Nation's Business*, Vol. 82, No. 2, pp. 33-34.
31. Stalik, S.K. and Andrews, D.C. (1994). *Business Reengineering: The Survival Guide*, Prentice Hall, Englewood Cliffs, NJ.
32. Strauss, A. L. and Corbin, J.M. (1990). *Basics of Qualitative Research: Grounded Theory Procedures and Techniques*. Sage, Newbury Park, CA.
33. Tapscott, D. and Caston, A. (1993). *Paradigm Shift: The New Promise of Information Technology*, McGraw-Hill, New York, NY.
34. Toffler, A., (1991). *Powershift*, Bantam Books, New York, NY.
35. West, M. and Farr, J.L. (1990). *Innovation and Creativity at Work: Psychological and Organizational Strategies*, Wiley, Chichester, England and New York
36. White, T.E. and Fischer, L. (1994). *The Workflow Paradigm, Future Strategies*, Alameda, CA.

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