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이 재 정[1)]

Factors Influencing BPR Implementation : An Empirical Study of Critical Success Factors and Resistance Management

The Objective of this study is empirically investigating organizational/managerial factors affecting BPR implementation. The contributions of this research project are two-fold.

First, this research project provides empirically tested CSFs and CFF of BPR implementation. Especially, the influence of the organizational culture, structure, and managerial support on BPR implementation were thoroughly investigated.

Second, this research found the combined effects of CSF and CFF. Top management commitment, leadership style, and collaborative work environment were found to negate employee resistance to a reengineered process and lead to a successful BPR implementation, especially when the level of employee resistance is high.

1) 부경대학교 경영정보학과

I. INTRODUCTION

As we enter the era of global economic systems, the role of information technology in organizations has changed. According to researchers in the area of technology management, productivity declined during the 1980s despite the proliferation of personal computers and advanced information technology in the workplace[Bowen, 1986 ; Davenport, 1993 ; Hammer and Champy, 1992 ; Scott Morton, 1991]. These researchers point out that getting results from information technology requires changing the way business is done. They propose that organizations can redesign their business processes by using powerful information technology. The combination of strategic planning and business process reengineering(BPR) based on modern information technology will be a powerful synergy for enhancing organizational competitiveness. Now BPR is regarded not only as a tool for survival in the global market, but it is also accepted as a new corporate paradigm that can replace old bureaucratic methods of doing business.

Numerous organizations have reported success from their BPR efforts. For example, Ford Motor Co. and AT&T have reported increased productivity with less employees. IBM Credit, Eastman Kodak, Mutual Benefit Life Insurance, and Hallmark Cards Inc. have also reported increases in productivity with reduced process time.

However, not all organizations that undertake BPR efforts achieve their intended results. A survey by CSC Consulting reveals that more than seventy percent of BPR projects fail. Hammer and Champy [1992] state that as many as fifty to seventy percent of organizations that undertake BPR projects do not achieve the dramatic results they seek. Cyrus F. Gibson, a former Harvard Business School professor and now vice president of CSC Consulting, states that only one out of ten BPR projects can be evaluated as successful.

The high failure rates of BPR make implementation issues especially important. BPR has great potential for increasing productivity through reduced process time and cost, improved quality and greater customer satisfaction. However, to attain these benefits it must be implemented and managed in the best interests of customers, employees, and the organization. To improve the prospect of successful BPR implementation, factors such as organizational culture, structure, resistance, and managerial/administrative support should

be thoroughly investigated, and methods for managing them must be developed.

BPR is not simply "a redesign of business processes to eliminate that which adds no value to the output of the process."[Kevin, 1992]. As Goll[1992] defines it, BPR is a total organizational transformation including organizational culture, structure, and management style. Most reengineering studies emphasize the technological and strategic aspects of BPR efforts and overlook the organizational/managerial aspects. Thus, the role of management for smooth organizational change such as resistance management, reward systems, communication, roles and responsibility of employees, organizational structure, shared value, skills and knowledge required to adapt to the new processes has often been ignored.

Since the concept of BPR is new, research on this subject is not yet firmly established or well-structured. Most studies on this subject take the form of case studies that are descriptive and do not conform to standards of scientific research. Those case studies usually describe the success of BPR efforts in situations where variables are not defined.

The objective of this study is empirically investigating organizational/managerial factors affecting BPR implementation. As a pioneering study of BPR, this research project is mainly concerned with two issues of BPR.

First, this study examined organizational/managerial factors that make BPR implementation successful. The organizational/managerial factors that will be investigated in this research project include organizational structure, culture, leadership style, resistance management issue, and management support which include top management commitment and change in management systems to support BPR implementation.

Second, the other objective of this research project is to find ways how to negate employee resistance which is primary failure factors of BPR using the above identified CSFs of BPR implementation.

II. REVIEW OF FACTORS AFFECTING BPR IMPLEMENTATION

There have been many studies from different perspectives that identify success factors of BPR. Numerous researchers and practitioners[Champy and Arnoudse, 1992 ; Randall, 1993 ; Janson, 1993 ; Davenport, 1993] say that top management

commitment is the most important factor for a successful BPR effort. They argue that BPR never happens bottom up and a reengineered process alone will not change the way people work. Champy and Arnoudse[1992] identify the role, attitude, vision, and skill or knowledge of leaders as necessary for the successful BPR. Especially, they state that BPR must be more top-down driven than a quality improvement plan because of its radical change requirement.

Bashein and her associates state that top management commitment, their realistic expectations, and empowered and collaborative workers are important factors [Bashein et. al, 1994]. Especially, they emphasized that a strategic context of growth and expansion is a positive precondition of BPR success since growth and expansion reduce resistance of employees caused by job security.

If BPR represents the future of the business, then the real challenge is how to motivate employees to encourage and support the BPR effort. To do this, Kanin-Lover and Keilty[1993] propose that a program of career development alternatives and promotions as well as rewards and recognition for the desired behavior is required. They suggest existing reward systems combined with special incentive award funds and gain-sharing will be an important approach to successful BPR.

Hammer and Champy[1993] also emphasize the importance of measurement and rewards for reengineered process performance. They argue that paying employees based on their position is inconsistent with the principles of BPR. They must be paid based on their performance and ability.

Since BPR pushes decision point down to the lower levels of the hierarchy, employee empowerment is another important factor for BPR success. Having employees assume more authority and responsibility as well as developing a high level of skill is an important outcome of BPR, and it is a critical step in creating a culture in which workers at all levels feel more accountable [Rohm, 1993].

Clear, honest, and frequent communication is also important for successful BPR implementation. Sharing information with employee can help minimize resistance [Janson,1993].

Hall and his associates[1993] found that the successful redesign of a broad process requires the complete restructuring of the key drivers of behavior. Depth of BPR means how many and how much six depth

levers–roles and responsibilities, measurement and incentives, organizational structure, IT, shared value, and skills–change as a result of BPR. Their study on the depth of BPR showed that companies that manipulate all six depth levers to bring about behavioral change show the most dramatic process cost reduction.

Harrison and Pratt[1993] emphasize that change implementation should start as soon as the project starts. They argue that employee involvement in projects and their empowerment should be assured for the success of BPR project. User readiness can be improved by their involvement in project and extensive communication. Therefore, user involvement and communication can reduce the resistance in an organization[Bashein et. al, 1994 ; Johansson et. al, 1993].

Furly[1993] states that BPR must be initiated based on customer needs. He identifies customer satisfaction measurement and customer involvement as other critical success factors of BPR efforts.

Although Rogers[1983] stated that the correlation of organizational structure with innovativeness of organizations is rather low, a variety of structural dimensions of organizations have been identified and measured by past researchers. In innovation research, three structural variables are seen as having an effect on the innovation implementation process–centralization, formalization, and complexity[Marshall, 1985].

Centralization refers to the degree of participation of organizational members in decision making[Marshall, 1985 ; Zmud, 1982]. Formalization refers to the extent to which job duties are codified in written description, rules and regulations, and employees are evaluated according to highly codified and specific procedures[Beyer and Trice, 1978]. Other concept used to describe organizational structure is the integration of tasks. Integration is the most basic and common feature of reengineered processes. Throughout the industrial age, organizations have sought efficiencies through the detailed functional specialization of jobs, or so–called division of labor. However, many formerly distinct jobs or tasks are integrated and compressed into one as a result of BPR efforts. Having individuals or a small team perform a series of tasks is a process that could lead to higher quality output, less process time, and reduced process cost[Hammer, 1992 ; Morris and Brandon,1992]. One term for such an individual responsible for an end–to–end process is case worker or case man-

ager[Hammer, 1992 ; Davenport and Nohria,1994].

The primary reason for BPR failure is resistance from key persons who would be affected by a BPR effort[Stanton et al., 1992]. Managers generally put the needs of their own function ahead of the business as a whole. BPR is an attempt to erase this type of thinking. A team-based organizational structure dissolves functional boundaries and dilutes functional responsibilities, while flattening organizational hierarchy[Woofe,1993]. As a result of BPR implementation, some people may lose their power, while others may be afraid of losing even their jobs. Another source of resistance may be fear and skepticism about BPR results. Since a reengineered process often requires new skills for operating advanced information technology, some people may feel uncomfortable with a newly reengineered process. Thus, failure to manage those key persons influenced by BPR can cause its implementation failure.

It is inevitable that such radical change as BPR provokes resistance from employees. Indeed, if there is no resistance, the organization is probably not conducting right BPR project. While resistance can cause BPR failure, it can be managed. Management and project leaders must know who will be affected by implementing a redesigned process, must understand what their reactions might be, and must gain intellectual and emotional buy-in from the users and managers. By managing sources of resistance(rationality, fear, discomfort, and skepticism), we can successfully implement the redesigned process.

Based on above literature review, possible success factors and failure factors of BPR implementation are suggested. Six possible success factors are labeled as follows : (1) leadership style, (2) top management commitment, (3) formalization of task, (4) change in management systems, (5) participation in decision making, and (6) collaborative work environment. Two of the failure factors are labeled

(1) employee resistance and (2) lack of resources.

These success factors and failure factors of BPR implementation suggests eight specific hypotheses that is open to empirical testing :

Hypothesis(S) : Each success factor is positively associated with successful implementation of BPR.

Hypothesis(F) : Each failure factor is negatively associated with successful BPR implementation.

To investigate combined effects of each CSF and CFF, following hypotheses are developed :

Hypothesis(Hi) : At a high level of a CFF, the mean score of each CSF of the successful implementation group is significantly higher than that of failed group.

Hypothesis(Lo) : At a low level of a CFF, the mean score of each CSF of the successful implementation group is significantly higher than that of failed group.

III. METHOD

3.1 Variables

Independent Variable :

Top management commitment is one of the the most important factors for successful BPR implementation[Hammer and Champy, 1990 ; Bashein et al., 1994 ; Stanton et al. ; 1993]. To exert their leadership in implementing a reengineered process : (1) they must have sufficient knowledge, (2) they must have realistic expectation of BPR results, (3) they must communicate with employees in the reengineered process, and (4) they must have the ability to coordinate the different interests of functional units involved in the reengineered process.

The major components of an egalitarian leadership style include (1) shared vision/information, (2) open communication, (3) supportive behavior, and (4) confidence and trust in subordinates (Lee, 1993, 1994).

Collaborative work environment include (1) friendly interaction among people, (2) substantial amount of team work, (3) high level of confidence and trust among people.

Another important issue in management support for successful BPR implementation is in change management systems. BPR is a total transformation of a business[Goll, 1992] or a major part of business. BPR requires a radical change in business processes to achieve dramatic improvement in performance [Hammer, 1990]. To support these total transformation, radical change in a business must be planned and managed. In this study, the extent of change in reward systems, education/training, communication, employee empowerment, performance measurement, and organizational structure are investigated to support BPR implementation.

Formalization in the reengineered process was measured by (1) the existence of

written rules, procedures, or policies, (2) the extent of written guidelines for the tasks in the redesigned process, and (3) the relationship between observation of these written rules or procedures and employee performance.

Participation in decision making include (1) degree of participation in decision making, (2) knowledge and skill level of employee, and (3) the degree of group-based operation in the redesigned process.

Employee resistance to the redesigned process is widely recognized as a critical reason for the failure of BPR implementation[Stanton et al., 1993]. In this study, the resistance caused by (1) job security, (2) loss of power, (3) skill/knowledge requirement, (4) skepticism about results, (5) functional unit's interests, and (6) resistance of customers were investigated.

Resource management is another important issue in a successful BPR effort. Some BPR projects have failed because of their lack of such resources as time, finance, human, and technical knowledge. BPR may be viewed simply as another program with too many improvement projects already under way. Diverse improvement projects may be poorly planned, badly integrated, and even mutually self-defeating. When many projects are competing for scarce resources, the effectiveness of the redesigned process may be diluted and breakthrough improvement may become impossible.

Dependent Variable :

Six items were examined to measure BPR implementation success with a five-point scale. Successful BPR implementation usually results in internal operational excellence as well as external strategic achievement. Internal operational excellence includes (1) process time reduction, (2) process cost reduction, (3) user learning, (4) output quality, (5) quality of work life, and external strategic achievement mainly related to (6) responsiveness to customer need.

Process time reduction can be achieved by eliminating redundant or non-value added activity. BPR efforts usually simplify or streamline business processes. BPR also encourages employees to learn many tasks in the redesigned process. When a process is reengineered, jobs evolve from narrow and task-oriented to multidimensional. One of important purposes of BPR efforts is improving the quality of work life. Especially important is an egalitarian climate in the workplace, employee empowerment, flat organizational structure,

and a team-based working environment. These outcomes can be the result of BPR efforts to improve quality of work life in the redesigned process[Davenport and Short, 1990]. Quality improvement is the most likely objective of BPR efforts to be attained[Davenport and Short, 1990]. BPR efforts usually start with the needs of the process customer. According to the customer-based view, quality is fitness for use[Juran, 1974]. With reduced process cost, time, and improved skill, the redesigned process provides improved output quality to the process customer. Increasingly, customers are the impetus for reengineering efforts. A quick response to customer needs or change of needs is an important way of doing business in today's competitive market.

Subjects and Procedure

This study employs a survey approach using key informants as well as respondents. Key informants are used to determine whether or not an organization undertook a BPR project. Key informants are those individuals who are knowledgeable about a specific subject in an organization. In this study, key informants are those who are directly involved in the BPR projects such as information system managers, human resource managers, or CAs (change agents). The differences between informants and respondent are significant. An informant is asked to assist the researcher by summarizing or evaluating the various aspects of the organization. Thus, the major role of key informants for this study was helping the researcher determine whether or not an organization implemented a reengineered process. By employing key informants, the researcher was able to obtain information about organizational structure, IT used, and process redesigned which are the basis for the determination of BPR implementation.

Respondents are those who are working in the reengineered processes and actually provide data for this study. Using the respondents, the researcher was able to obtain information concerning each of the reengineered unit of the organization. Of the forty-six respondents who specified his /her positions, thirty-four(74 percent) are managers and twelve(26 percent) are users.

A total of twenty-one organizations located in the Midwest region of the United States are participated in this study. Of the 144 questionnaires distributed, fifty-

three were returned, a return rate of 36.8 percent. Two of the returned questionnaires were deemed invalid because too many values were missing. Thus, fifty-one reengineered processes are examined in this study. Of the fifty-one processes examined, public sector organizations account for 40 percent of the total data used in this study. The public sector includes state government, Department of Defence (DOD), and public utilities. The private sector, which includes nine different industries, accounts for the remainder of the sample.

The types of redesigned processes analyzed in this study are listed in Table 1. Among the eight types of redesigned processes examined, seventeen were customer services processes(33 percent), and fourteen were production processes(27 percent). This concentration of processes in the two primary areas reflects the fact that the most important objectives of BPR efforts are : (1) external excellence in the competitive market, which is directly related to "customer satisfaction," and (2) internal operational efficiency, which is related to "production process." Other types of reengineered processes included the new product development process (6), purchasing process (5), order management process (5), quality process (2), training process (1), and recruitment process (1).

Table 1. Types of Processes Examined in the Study

Types of Processes	Frequency	Percent
Customer Service Process	17	33
Production Process	14	27
New Product Development Process	6	12
Order Management Process	5	10
Purchasing Process	5	10
Quality Process	2	4
Training/Education Process	1	2
Recruitment Process	1	2
Total	51	100

Ⅳ. DATA ANALYSIS AND RESULTS

4.1 CSFs and CFFs of BPR Implementation

The investigation of CSFs and CFFs of BPR implementation was conducted by examining the relationship between the selected variables and success measure. Eight hypotheses to identify CSFs and CFFs are tested using correlation analysis [Blau, 1988 ; Mckinley, 1987]. The variable names that were used in this study are defined as follows :

SUCCESS : BPR Implementation Success
LEADER : Leadership Style
COLLAB : Collaborative Work Environment
PARTIC : Employee Participation in Decision Making
FORMAL : Formalization
COMMIT : Top Management Commitment
CHANGE : Change in Management Sys-tems
RESIST : Employee Resistance
LACKRES : Lack of Resources

Table 2 shows a correlation matrix of variables examined in this study. Of the organizational culture variables, leadership style(H1) and collaborative work environment(H2) were significantly positively correlated with success of BPR implementation($p < .01$). The correlation coefficient of egalitarian leadership is .39 at the significance level of .0061, while that of collaborative work environment is .67 at the significance level of .0000. However, participation in decision making(H3) was not significantly correlated with success of BPR implementation. Formalization of tasks(H4) and change in management systems(H6) were also positively correlated with success of BPR implementation($p < .05$). The correlation coefficient of formalization is .33 at the significance level of .0229, while that of change in management systems is .38 at the significance level of .0183. Top management commitment(H5) is positively correlated with success of BPR implementation ($p < .01$). Its correlation coefficient is .38 at the significance level of .0073. Therefore, identified critical success factors are egalitarian leadership style (H1), collaborative work environment (H2), formalization(H4), top management commitment(H5), and change in management systems(H6).

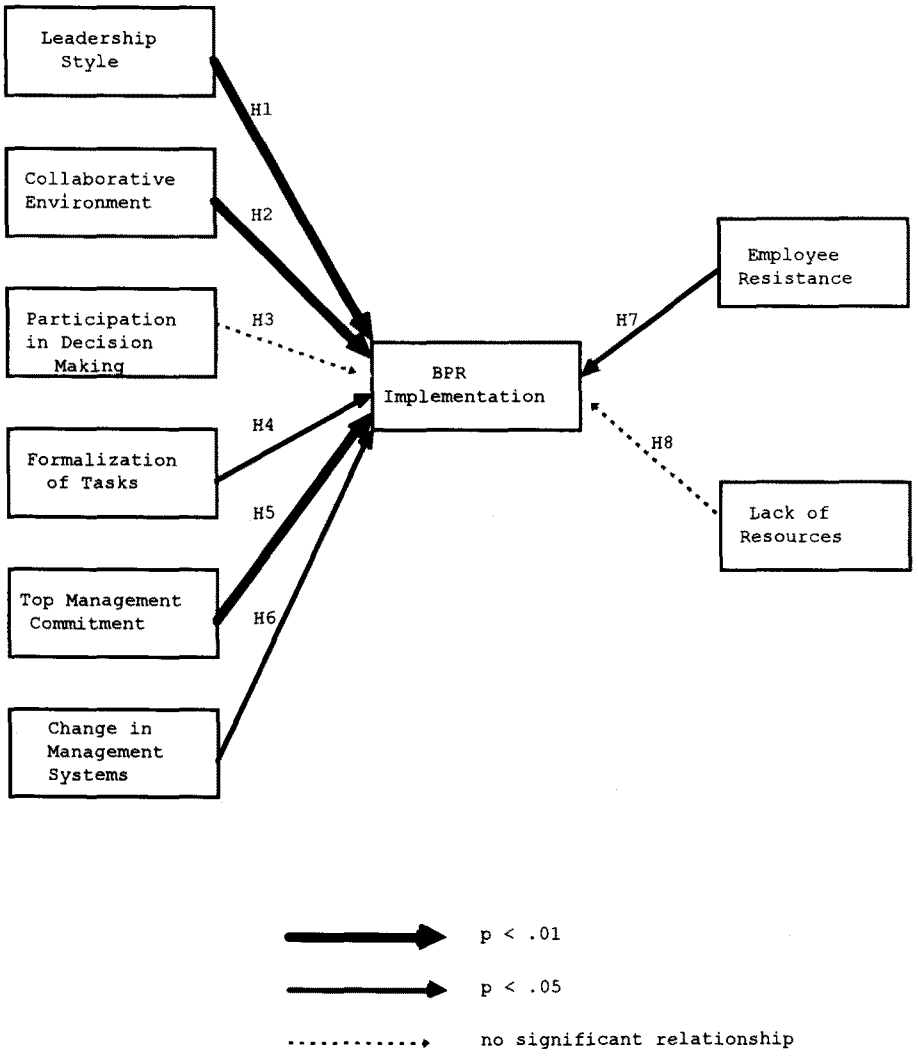
Table 2. Correlation Matrix

	SUCCESS	LEADER	COLLAB	PARTIC	FORMAL	COMMIT	CHANGE	RESIST	LACKRES
SUCCESS	1.00	.39**	.67**	.25	.33*	.38**	.34*	-.30*	.01
LEADER	.39**	1.00	.38**	.54**	.23	.54**	.38**	-.24	.14
COLLAB	.67**	.38**	1.00	.44**	.30*	.24	.30*	-.12	.08
PARTIC	.25	.54**	.44**	1.00	.29	.38**	.34*	-.14	.10
FORMAL	.33*	.23	.30*	.29*	1.00	.17	.09	-.20	-.06
COMMIT	.38**	.54**	.24	.38**	.17	1.00	.38**	-.24	-.23
CHANGE	.34*	.38**	.30*	.34*	.09	38**	1.00	.01	-.16
RESIST	-.30*	-.24	-.12	-.14	-.20	-.24	.01	1.00	-.15
LACKRES	.01	.13	.07	.10	-.06	-.23	-.15	-.15	1.00

** $p < .01$, * $p < .05$

Table 3. Summary of Correlation Analysis

Hypotheses	Variable	Correlation Coefficient	Level of Significance	Result
H1	Leadership Style	.39	.0061	Accept
H2	Collaborative Work Environment	.67	.0000	Accept
H3	Participation in Decision Making	.25	.0828	Reject
H4	Formalization of Task	.33	.0229	Accept
H5	Top Management Commitment	.38	.0073	Accept
H6	Change in Management Systems	.34	.0183	Accept
H7	Employee Resistance	−.30	.0366	Accept
H8	Lack of Resources	.01	.93	Reject



〈Figure 1〉 Summary of Hypothesis Test

3.2 The Combined Effects of CSF and CFF

The primary reason for BPR failure is employee resistance to change[Davenport, 1992 ; Hammer and Champy, 1992 ; Stanton et al., 1993]. The results of correlation analysis also support this statement(H7). This part of the study attempts to find the difference between the successful and failed BPR implementation with different levels of that critical failure factor.

Mean scores of previously identified

CSFs of successful BPR implementation sample data were compared with that of data from a sample of failed BPR implementation. This comparison was made using ANOVA test.

Sample data were divided into two subgroups based on the mean score of the "success" variable. The subgroup with success scores above the median(=3.714) is labeled "SUCCESS", while the subgroup whose success score is below the median is labeled "FAILURE". "SUCCESS" and "FAILURE" were then further divided into the "HiResistance" and "LoResistance" subgroups based on the mean score of resistance variable. The reengineered processes with an employee resistance mean score above the median(2.90) are labeled "HiResistance" ; those below the median are labeled "LoResistance."

Using scores above the median versus below the median to create subgroups is a common research procedure(e.g., Sims and Szillagyi, 1976 ; Blau, 1988). 〈Figure 2〉 shows the design of this comparative study of CSFs with different levels of resistance.

The mean scores of previously identified CSFs of Cell a and Cell b were compared to ascertain which factor makes the BPR implementation successful in spite of a high level of resistance. Mean scores of Cell c and Cell d were also compared to find CSFs that make BPR implementation to fail under the circumstance of lower level of resistance.

〈Fig 2〉 Combined Effects of CSFs and CFFs

	SUCCESS	FAILURE
HiResist	Cell a	Cell b
LowResist	Cell c	Cell d

V. FINDINGS AND DISCUSSION

The correlation analysis showed the relationship between critical success factors and the success measure of BPR implementation. CSFs identified in this study are leadership style, collaborative work environment, top management commitment, change in management systems, and formalization of tasks. Employee resistance is identified as a critical failure factor of

BPR implementation. The ANOVA test showed which CSFs can lead to successful implementation of reengineered processes with different levels of employee resistance. Among the five CSFs, three–leadership style, collaborative work environment, and top management commitment–can negate employee resistance.

Table 4 showed that the mean score of egalitarian leadership style of the successful implementation group is significantly higher than that of the failed implementation group when the level of employee resistance is high. This finding can be interpreted to mean strong egalitarian leadership negates a high level of employee resistance. However, the role of egalitarian leadership is not as important when the level of employee resistance is low.

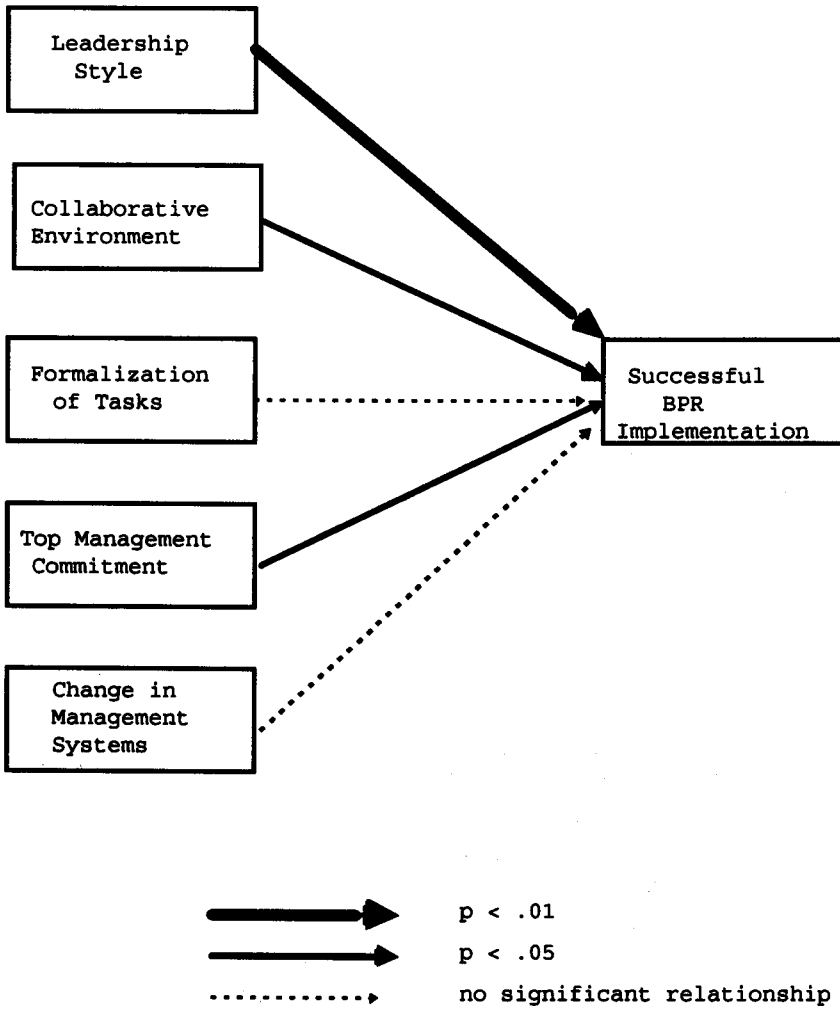
The effect of collaborative work environment in combination with the different levels of employee resistance on BPR implementation is the same as the effect of leadership style. Table 4 showed that the mean score of collaborative work environment of the successful implementation group is significantly higher than that of the failed implementation group when the level of employee resistance is high. This finding can be interpreted to mean strong collaborative work environment negates high level of employee resistance. However, the role of collaborative work environment is not as important when the level of employee resistance is low.

The effect of top management commitment in combination with different levels of employee resistance on BPR implementation is the same as the effect of leadership style. Table 4 showed that the mean score of top management commitment of the success implementation group is significantly higher than that of the failure implementation group when the level of employee resistance is high. This finding can be interpreted to mean strong top management commitment negates high level of employee resistance. This result supports the statements of Stanton and his colleagues[1993], which argue that employee resistance must be managed by top management communication, intervention, and force.

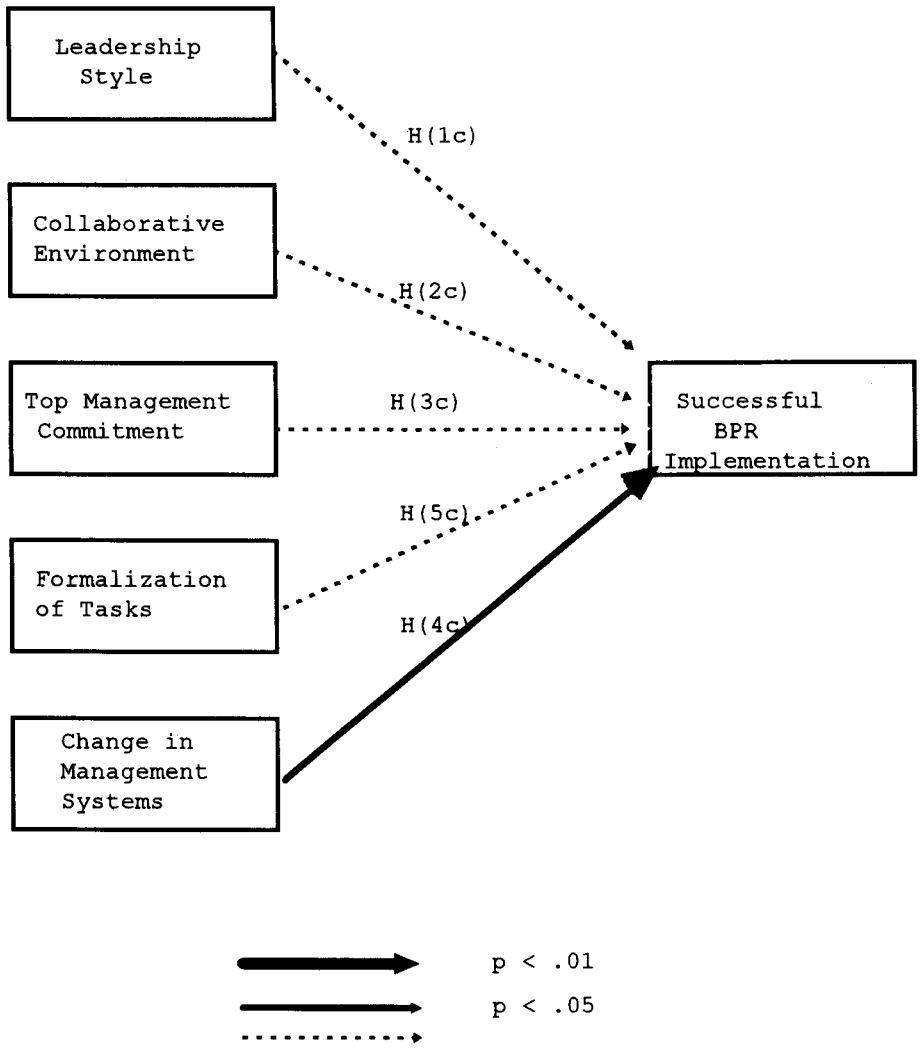
However, the role of top management commitment is not as important when the level of employee resistance is low.

The effect of change in management systems combined with different levels of employee resistance on BPR implementation is quite different from that of leadoership style, collaborative work environment and top management commit-

ment. Even though the mean score of change in management systems of the success group is significantly higher than that of the failure group, there is no significant difference between the mean scores of the success group and the failure group when the level of employee resistance is high. However, when the level of employee resistance is low, the mean score of change in management systems of the success group is significantly higher than that of the failure group. Thus, change in management systems seems to be an effective way of implementing a reengi-neered process especially when the level of employee resistance is low. But, Change in manage-



〈Figure 3〉 Effects of CSF When Employee Resistance is High



〈Figure 4〉 Effects CSF When Employee Resistance is low

ment systems can not lead to successful BPR implementation in the presence of high level of employee resistance.

The mean score of formalization between the success group and the failure group is not significantly different at either the higher level(Sig of F=.510) or the lower level of resistance(Sig. of F=.304). These results are contradictory to those of the correlation analysis that identified formalization as a CSF.

The reasons for these conflicting results can be summarized as follows. First, although formalization is considered as a

critical success factor for BPR implementation, the correlation coefficient(.33) between formalization and success is the smallest among that of the five proven CSFs. Second, even though using scores above or below the median to create subgroups is a common research procedure(e. g., Blau, 1988 ; Sims and Szilagyi, 1976), the "SUCCESS" and the "FAILURE" subgroups created by median of success measure may cause these conflicting results. Third, data from public sector organizations account for forty percent of the total data used in this study. This heavy portion of public sector organizations, which generally have higher levels of formalization, in the sample data might cause these conflicting results. The results of the combined effects of each CSF and employee resistance are summarized in Table 4.

Table 4. Summary of Combined Effects of CSF and CFF

	CSF	Hypothesis	Level of Significance	Result
H(1b)	LEADER	HiResist : Xs > Xf	.001	Accept
H(1c)		LoResist : Xs > Xf	.199	Reject
H(2b)	COLLAB	HiResist : Xs > Xf	.011	Accept
H2(c)		LoResist : Xs > Xf	.104	Reject
H(3b)	COMMIT	HiResist : Xs > Xf	.014	Accept
H(3c)		LoResist : Xs > Xf	.121	Reject
H(4b)	CHANGE	HiResist : Xs > Xf	.169	Reject
H(4c)		LoResist : Xs > Xf	.009	Accept
H(5b)	FORMAL	HiResist : Xs > Xf	.510	Reject
H(5c)		LoResist : Xs > Xf	.304	Reject

Xs : Mean Score of CSF of Successful Implementation
Xf : Mean score of CSF of Failed Implementation

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◇ 저자소개 ◇

이재정 교수는 서강대학교 경영학과를 졸업하고 Louisiana 공과대학에서 경영석사학위를 취득하였으며 University of Nebraska에서 MIS로 박사학위를 취득하였다. 현재 부경대학교 경영정보학과에 재직하고 있으며, 주요 관심분야는 경영혁신기법, 정보자원의 전략적 이용, Strategic Business Reengineering, World-Class Organization 등이고, Journal of Management Information Systems(JMIS) 등에 논문을 발표한 바 있다.