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# Organizational Culture and the Achievement of ERP Strategic Advantages and BPR Performance Improvements

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# ABSTRACT

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Antonio Kappos

This study looks at the relationship that organizational culture has with the achievement of strategic advantages from implementing Enterprise Resource Planning (ERP) software, and the achievement of performance improvements from performing Business Process Reengineering (BPR). A sample of 22 organizations that implemented ERP and 31 organizations that performed BPR were used to test a number of hypotheses. A competing values approach to measuring organizational culture was used to quantitatively measure an organizations culture profile, and a modified version of the measurement instrument was used to measure the change in that profile due to ERP and/or BPR. Partial least squares (PLS) method of structural equation modeling was then used to determine the relationship that the organization's culture and culture change has with ERP and BPR success. The results show that the organization's culture and the change in that culture is significantly related to the achievement of strategic advantages from implementing ERP and the performance improvements from performing BPR.

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# Table of Contents:

# 1. Introduction

This paper looks at the relationship between Enterprise Resource Planning (ERP), Business Process Reengineering (BPR) and Organizational Culture. ERP has recently taken the business community by storm. ERP represents the implementation of integrated software that carry out business functions. Organizations are currently seeking the ability to integrate many if not all of their processes under a single information system in an effort to capitalise on the strategic advantages offered from implementing ERP. ERP often requires that an organization reengineer its processes in order to bring all of its disparate systems in line. Business Process Reengineering (BPR) can be described as a redesign of an organizations' processes while taking advantage of the level of technology available for the purpose of performance increases (Raymond et al., 1998, Teng et al., 1998). Yet, for all of its promises, BPR has been lacking in its delivery of promised quality, cost, customer satisfaction and productivity improvements. This paper theorises that in order to achieve strategic advantages from ERP and/or performance improvements from BPR, an organization must look to its culture for help. As Parker (1996) states, in order for a BPR to be successful, "the enterprise must create a new culture or face the business consequences." (p. 166)

Organizational culture is an important concept in organizational analysis. Organizational culture can be described as an "abstract composite of assumptions, values, and artifacts shared by its members...[that]...can be reliably represented by the values...which drive its members' attitudes and activities" (Howard, 1998, p. 234). The model proposed in this paper suggests that there is a fundamental link between an organization's culture and the achievement of strategic advantages from ERP, as well as the performance improvements due to BPR. A Competing Values approach to measuring organizational culture is used to provide an empirical measure for an organization's culture (Quinn and Spreitzer, 1991). The competing values approach provides a profile of four cultural archetypes occupied by a particular organization. These archetypes are

group, hierarchical, developmental and rational cultures. The combination of the archetypes describes the organizations culture profile.

ERP and BPR may require and be accompanied by a certain level of culture change. A modified version of the competing values instrument is used to empirically measure the direction change in culture. This study is interested in determining whether the existence of organizational change is related to the strategic advantages from ERP and the performance improvements of BPR.

There are a number of research questions associated with this model. First of all, how does an organization's culture profile affect the achievement of ERP strategic advantages? How does it affect the achievement of BPR performance improvements? Is there a relationship between the change in culture and the achievement of strategic advantages and performance improvements? What roles do assimilation and the elapse time play in changing the organizational culture? In the next section, a literature review of the relevant topics will be presented.

## 2. Literature review:

This section will review the relevant literature touching ERP, BPR and Organizational Culture. It will also touch upon various other areas of importance to these two concepts such as assimilation, IT implementation, and organizational change in relation to the IT implementation. The organizational change literature deals mostly with the concept of assimilation.

### 2.1 Enterprise Resource Planning (ERP)

Enterprise Resource Planning (ERP) is the new topic of conversation for many organizations today. An ERP software system can be described as "a set of integrated business applications, or modules, to carry out most business functions, including inventory control.

general ledger accounting, accounts payable, accounts receivable, material requirements planning, order management and human resources, among others." (Martin et al., 1999).

ERP is a way to bring all of an organization's data and IS/IT resources under a single information system (Oliver, 1999). The author states that "ERP systems evolved to help organizations manage their information through-out the company, from the plant to the back office, and or the front office." (Oliver, 1999, pg. 12)

ERP seeks to align many if not all of an organization's processes under a single ERP system. The processes can be seen in terms of a value chain, which links the suppliers to the organization to the customers. For example, imagine a system where the customer orders a product over the Internet (eCommerce). As soon as the customer places the order, it is automatically sent to the manufacturing department, while at the same time sent to the accounting department for billing. The use of materials by the manufacturing department depletes the stock, therefore a parts order is sent automatically to the supplier when reorder points are reached for replenishment of the stock. In traditional systems, time would be required for the sending of the messages between departments, for the reordering of the parts, and the billing of the customer. ERP seeks to automate all these systems to achieve a number of strategic advantages.

Implementation of ERP software can allow an organization certain strategic advantages (Radding, 1999, Stein 1998). The literature tells us that organizations can benefit from greater flexibility, increased efficiency (Radding, 1999), improved communication, lower operating costs, increased revenue (Oliver, 1999), reduced cycle times, better collaboration and higher profit margins (Stein, 1998). These strategic advantages affect not only the organization, but can affect all members of an organization's value chain. ERP is a system that seeks to unite all of a value chain's disparate processes.

An organization's value chain represents all of the different processes that involve organizational resources and that are needed to support the organization's operations. Porter (1985) developed a model of an organization's value chain. This model of the value chain

contains 9 processes; 5 primary processes, and 4 support processes. The value chain model is shown in figure 1. The organization's primary processes involve the production and delivery of the organization's products to the consumer (Bergeron, 1991). The processes involved in the primary activity are inbound logistics, operations, outbound logistics, marketing and sales, and customer service. The organizations secondary business processes represent the support processes for the primary activities and are, administrative coordination and support, human resource management, technology development, and procurement of resources.

Enterprise Resource Planning often requires the reengineering of the business processes in the value chain. Martin et al. (1999) states that "implementing an ERP system is a way to *force* business process reengineering." (pg. 192, italics theirs) By virtue of the fact that ERP represents the implementation of a type of global organizational system, most of the processes that are affected by the ERP system have consequently required reengineering. Bartholomew (1999) tells us that since the advent of ERP, the call for business process reengineering has increased dramatically.

| | | | | | |
|---|---|---|---|---|---|
| **Support Processes** | Administrative Coordination and Support Services | | | | |
| | Human Resources Management | | | | |
| | Technology Development | | | | |
| | Procurement of resources | | | | |
| **Primary Business Processes** | Inbound Logistics | Operations | Outbound Logistics | Marketing and Sales | Customer Service |

**Figure 1 Porter's Value Chain (adapted from O'Brien, 1999)**

2.2 Business Process Reengineering (BPR)

Since its foundations in the late 1980's and early 1990's, BPR has earned a somewhat controversial rating as the miracle solution to achieving organizational performance increases in a number of areas (Huizing et al., 1997). The controversy stems from the high failure rate of

implementation of BPR. Yet the literature still agrees that BPR will lead to increases in a number of areas including productivity, customer satisfaction, organizational quality, market coverage, cost reductions and defects reduction (see Teng et al., 1998, Raymond et al., 1998, Grover et al., 1995, Kettinger et al., 1997, Davenport and Short, 1990, Hammer, 1990). For all the perceived benefit of BPR, the high failure rate has not as of yet been successfully explained. This (as well as the newness of the topic) has led to a large amount of literature that is of a theoretical nature. Yet there has been some empirical studies done in order to determine what aspects of the organization will lead to BPR success.

BPR has been investigated now for a few years in order to determine what aspects of an organization play an important role in making the BPR effort a success. Huizing, Koster and Bouman (1997) looked at four independent factors that may affect the achievement of BPR performance improvements. To begin with, they looked at organizational fit. The authors state that the organizational fit between the ambition of the BPR project, and four independent factors (breadth, depth, planning, and coordination) must be balanced in order for the project to be a success. Yet, Huizing et al. (1997) state that fit is not easily achieved by organizations. Mismatches in the fit require the organization to rebalance the level of ambition with the independent factors. Interestingly enough, the authors use the reengineering effort as level of analysis while most of the other authors use an organizational level of analysis.

Raymond, Bergeron and Rivard (1998) looked at four independent factors while investigating the BPR process; 1. Compliance with BPR principles, 2. Diversity of the human resources allocated to the project, 3. Methodologicai rigor of the project and 4. Organizational support. Their study also looked at whether benefits are affected by the size of the firm. Raymond et al. (1998) found that the advantages that can occur from implementing a BPR could occur in both large and small to medium size firms. Their Hypotheses were all confirmed for large-scale enterprises.

Teng, Jeong and Grover (1998) looked for changes in roles and responsibilities, measurements and incentives, organizational structure, information technology, shared values, skills and process work flow to correlate with perceived level of success and goal fulfillment of a BPR project. They also studied the importance of the radicalness of the reengineering project. Highlighting the debate between Davenport and Short (1990) and Hammer (1990), Teng et al. (1998) found that the clean slate approach of Hammer (1990) is rarely found in organizations. Most businesses currently emphasize analyzing the current processes before and while implementing a BPR although Teng et al. (1998) found that doing such was not statistically important to the goal fulfillment.

Teng et al. (1998) also looked at the relationship between the BPR implementation success and the reengineering project stage-efforts profile. The reengineering project stage-efforts profile is represented by 8 stages from identification of BPR opportunities to the evaluation process. The model thus presented closely resembles some models of assimilation, which will be discussed below. But, first some concepts related to culture that are presented by the authors, and a review of the culture literature will be presented. Teng et al. (1998) include shared values as an independent factor. Shared values as will be seen below play an important role in an organization's culture and the study of that culture. Unfortunately, the study of culture requires more attention then the total congruence in the shared values of the individual of the firm. Shared values are more closely related to the strength of a culture then to a measure of the culture itself. The authors also included social design as a stage in the project stage effort. Social design is an attempt to change the organizational culture in order to achieve a balance between the engineering effort and the values of the organization. The next section of the literature review will discuss organizational culture.

2.3 Organizational culture:

Culture can be viewed from a number of different levels. Of interest to business are the concepts of national culture and organizational culture. National culture is important due to a more global economy where communication technicalities have begun to evolve. It is also important to the study of information systems technology and management. For example, Watson et al. (1994) looked at national culture as being a dimension in a study looking at Group Support Systems success. This experimental study involved looking at the differences between groups from the U.S. and Singapore. For the majority of the business literature on culture the level of analysis has dropped to the organization. The importance of studying an organization's culture is, like ERP and BPR, a fairly new concept.

An organization's culture can be defined by a number of constructs, such as the symbols, language, ideology, beliefs, rituals, and myths that affect an individuals behavior (Pettigrew, 1979). According to Pettigrew (1979), the culture constructs exist to provide some form of commitment to the established order. Hofstede et al. (1990) proposes a model of culture that is made up of values and practices. The practices reflect member beliefs about symbols, heroes and myths. In an exploratory analysis, Hofstede et al. (1990) found three factors affecting the values, yet, the core of organizational culture was represented by six dimensions of organizational practices. The dimensions represent opposing ideologies as to what constitutes proper practices. Using the dimensions of organizational practices, Hofstede (1998) identified 3 distinct subcultures within 131 different work groups. The three subcultures represented include a professional subculture, an administrative subculture, and a customer interface subculture.

Quinn and Rohrbaugh (1983) developed a quantitative measure of organizational effectiveness, which was later successfully used to study organizational culture (see Kalliath et al., 1999, Howard, 1998, Quinn and Spreitzer, 1991, Zammuto and Krakower, 1991, Yeung et al., 1991). Quinn and Rohrbaugh (1983) exploratory study revealed that organizational effectiveness

can be represented by three distinct dimensions, a focus dimension (internal vs. external point of view), a structure dimension (flexibility vs. control orientation) and a means vs. ends dimensions. The authors call the resulting approach the Competing Values Approach to measuring organizational culture. The model in figure 2 represents the competing values approach.

In figure one, each quadrant represents an ideal type of culture. A particular organization need not be classified exclusively as having one type of culture, but can be considered as containing elements from the four culture types, yet one type may be dominant (Quinn and Spreitzer, 1991, Cameron and Freeman, 1991, Yeung et al., 1991). Each culture type is measured using four items, which are aggregated to achieve a culture profile.

The core values of the Group culture are belonging, trust and participation, which are motivated by factors of attachment, cohesiveness and membership (Denison and Spreitzer, 1991). Like the group culture, the developmental culture also emphasizes flexibility but focuses its attention on the external environment. Productivity, performance, goal fulfillment and achievement are the important factors for the rational culture. These cultures emphasize the pursuit and attainment of well-defined objectives.

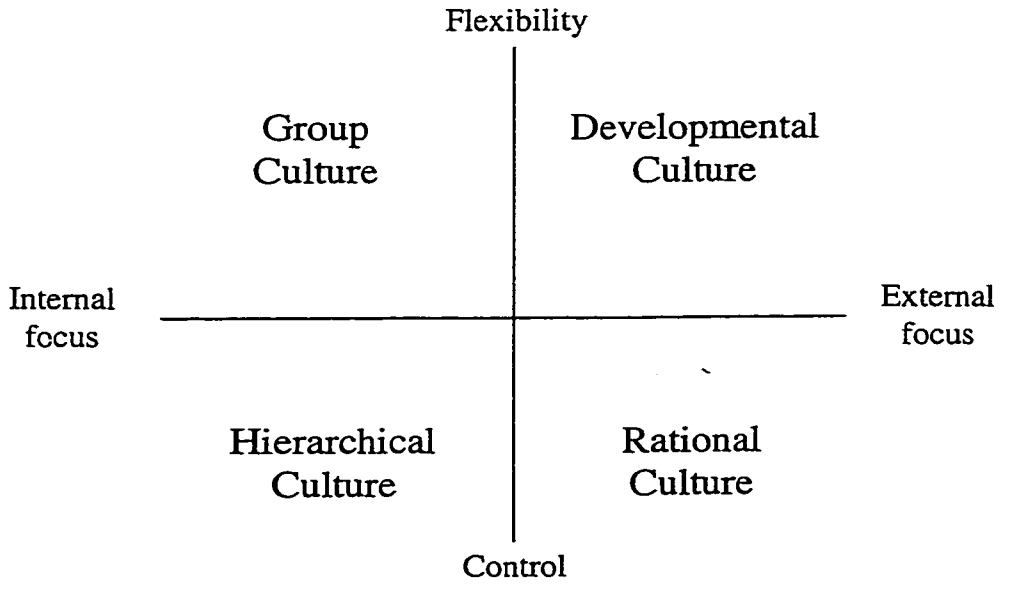


**Figure 2 Competing Values Culture Framework, adapted from Quinn and Rohrbaugh (1983).**

Finally, for the hierarchical culture, the "focus is on the logic of the internal organization and the emphasis is on stability." (Denison and Spreitzer, 1991, pg. 6) As the authors state, the motivating factors for this quadrant include security, order, rules, and regulations.

A number of studies have been done, looking at and validating this framework. Quinn and Spreitzer (1991) performed a multitrait-multimethod analysis as well as multidimensional scaling on two competing values' instruments (one using an ipsative scale measure, the other using a likert type scale measure). The authors found evidence for both convergent and discriminant validity. Zammuto and Krakower (1991) looked for relationships between culture and other organizational variables including, centralization, moral, administrator credibility, conflict, strategic orientation and culture strength. Authors state that evidence for construct validity exists due to the correlation of the competing values measure of culture and the other variables stated. Yeung et al. (1991) studied the competing values measure of culture in relation to organizational performance, culture strength and human resource practices. In a cluster analysis, the authors found that organizations from their study could be classified into 5 distinct culture types (or profiles). More recently, the competing values framework was again validated in two more studies (see Howard, 1998, Kalliath, 1999). The next section will look at some of the literature on assimilation and organizational culture change.

## 2.4 Organizational Culture Change

Business Process Reengineering and Enterprise Resource Planning can be seen as organizational changes. There is a relationship between organizational change and organizational culture such that for successful organizational change to occur, the organization's culture must also change. (Parker, 1996, Teng et al., 1998). The question that most organizations ask, is how to successfully implement the change, both at the organizational level as well as at the cultural level. Although the literature on BPR and Organizational change does not present many offerings, there does exist some literature dealing with the change coming in the form of IT or IS

implementation. Assimilation can be defined as a process that "(1) is set in motion when individual organizational members first hear of an innovation's development, (2) can lead to the acquisition of the innovation, and (3) sometimes comes to fruition in the innovation's full acceptance, utilization, and institutionalization." (Meyer and Goes, 1988, p. 897) Assimilation represents the acquisition of skills and knowledge needed to effectively apply some organizational change (Fichman and Kemerer, 1997). Organizations use methodologies to promote successful adoption and assimilation of organizational changes. The literature usually describes assimilation methodologies as having a number of stages that begin with some form of awareness of a potential change, through an evaluation and adoption stage to the implementation of the change (see Raho et al., 1987, Meyer and Goes, 1988, Fichman and Kemerer, 1997). The project stage effort studied by Teng et al. (1998), as mentioned above, closely resembles an assimilation methodology.

Yet, there are other determinants to having successful change. In a historical study of Finnish newspaper companies, Amburgey, Kelly and Barnette (1993) state that organizational change is most disruptive when the change is new. Success occurs with the elapse of time. This will allow the organizational culture the time it needs to adapt itself to its new changes. The next section presents the research methodology for this proposal.

# 3. Research Methodology

## 3.1 Model and Hypotheses

The research model is presented in figure 2. The model shows two dependent variables. Successful ERP is represented by the achievement of strategic advantages (Radding, 1999, Stein, 1998). The majority of the literature identifies of BPR as being the achievement of performance improvements. The organization's culture profile, as well as the change in that culture profile are

linked to successful ERP and BPR. There is also a relationship between the achievement of ERP's strategic advantages and the Achievement of BPR performance improvements.

The organization's culture change is influenced by the organization's ability to assimilate the ERP and BPR and time for the organizational members to get used to the changes. Assimilation is represented by the acquisition of the requisite skills and knowledge needed to effectively apply the organizational change (ERP and or BPR) and the amount of effort given to acquiring the skills and knowledge.

The hypotheses for this model are as follows:

**H1: The Organizational Culture profile will be significantly linked to the achievement of strategic advantages from the implementation of ERP.**

H1a: Flexible cultures will allow a greater achievement of ERP strategic advantages over control cultures.

H1b: External oriented cultures will allow a greater achievement of ERP strategic advantages over internal oriented cultures.

Hypothesis one seeks to determine how an organization's culture can affect the achievement of ERP strategic advantages. It is hypothesized that organizations that have a flexible nature will adapt more easily to the organizational changes that are required for a successful implementation of a particular ERP effort. As ERP arises often as an effort to become more competitive in the market, the model also hypothesizes that cultures with a more external view will also achieve greater success.

**H2: The Organizational Culture profile will be significantly linked to the Achievement of BPR performance improvements.**

H2a: Flexible cultures will allow a greater achievement of BPR performance improvements over control cultures.

H2b: External oriented cultures will allow a greater achievement of BPR performance improvements over internal oriented cultures.

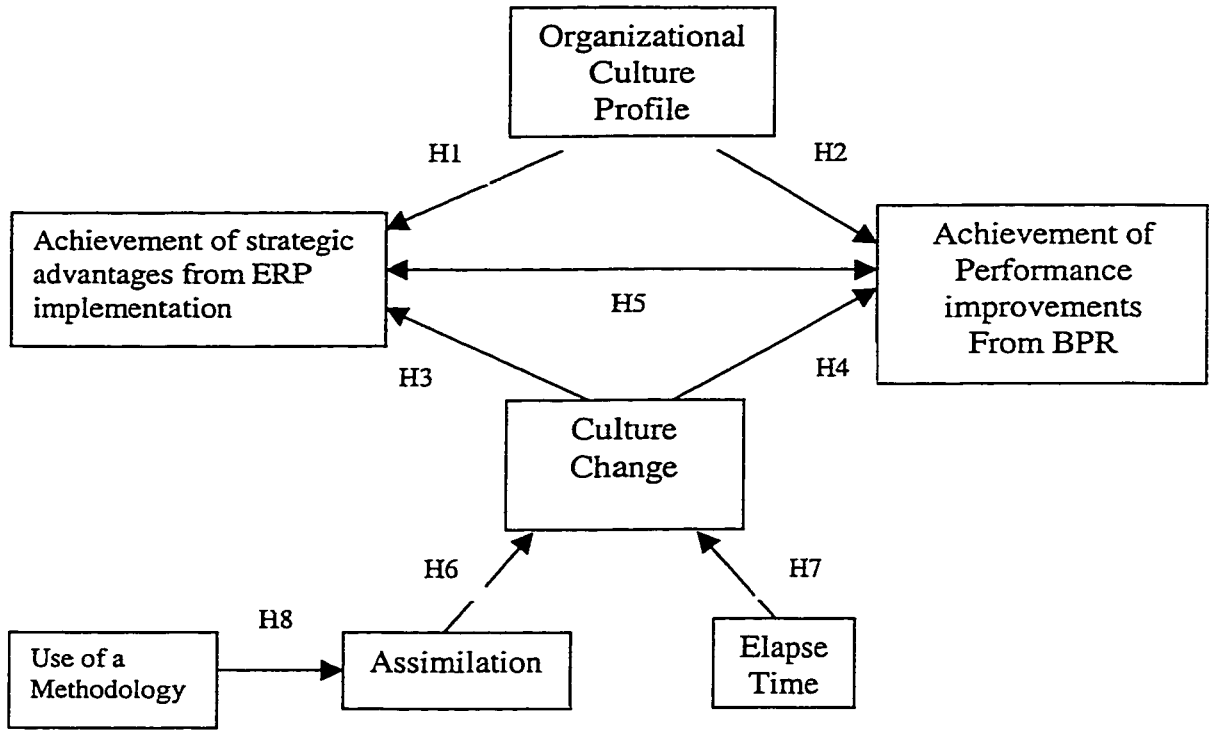


**Figure 3 Research Model (Note, arrows do not necessarily imply causation)**

Like hypothesis one, hypothesis two seeks to determine the relationship between the organization's culture and the achievement of performance improvements from reengineering an organization's processes. In this case, the model hypothesizes that organizations that reengineer their processes will obtain better improvements in performance improvements if the organizational cultures are more flexible and external oriented. Flexibility will allow the organization to adapt quicker and more efficiently to the organizational changes thereby allowing the organization the ability to capitalize on performance improvements. It is further hypothesized that these improvements would affect any and all of the processes along the value chain.

**H3: Culture change will allow organizations to achieve ERP strategic advantages.**

H3a: A general movement toward flexibility will be positively linked to the achievement of ERP strategic advantages.

H3b: A general movement toward an external orientation will be positively linked to the achievement of ERP strategic advantages.

Hypothesis three seeks to identify the affect of an organization's culture change due to the organizational change, and how this change affects the achievement of strategic advantages from an ERP effort. In order for an organization to more easily accommodate an organizational change, it is hypothesized that movements toward flexibility and external view will be positively related to the achievement of strategic advantages. By becoming more flexible, organizations will be more open to potential changes required by performing enterprise resource planning. As enterprise resource planning is often implemented for the purpose of being better able to compete in the market place, a movement toward an external view will be positively linked to the achievement of strategic advantages.

**H4: Culture change will allow organizations to achieve BPR performance improvements.**

H4a: A general movement toward flexibility will be positively linked to the achievement of BPR performance improvements.

H4b: A general movement toward an external orientation will be positively linked to the achievement of BPR performance improvements.

The logic for hypothesis four generally follows that of hypothesis three. A movement toward flexibility will allow the organization to be more open to the changes that are require by a reengineering effort. Furthermore as an organizations value chain includes both an interaction with a supplier and a customer, a movement toward external view will be positively linked to the achievement of performance improvements.

**H5: There is a positive link between the achievement of ERP strategic advantages and the achievement of BPR performance improvements for all processes in the value chain.**

It was stated in the literature review that enterprise resource planning often requires that an organization reengineer their processes. Hypothesis five states that if an organization capitalizes on the strategic advantages that are obtainable from an ERP effort, they will

consequently capitalize on performance improvements obtained from reengineering the organizations processes.

**H6: Assimilation of the organizational change will be significantly linked to the culture change.**

For the model, assimilation represents the acquisition of skills and knowledge required for successful organizational change (BPR and ERP) as well as the effort put into acquiring those skills and knowledge. Hypothesis six states that the assimilation process will be accompanied by a cultural change due to the new skills and knowledge that the organization has acquired. The effort to acquire those skills and knowledge will also be related to the culture change.

**H7: Elapse time of the implementation of BPR and ERP projects will be significantly linked with culture change.**

We can safely say that culture changes over time. This hypothesis states that as time elapses from an ERP and/or a BPR implementation, the organization will experience culture change.

**H8: The use of a methodology will be linked with a more successful assimilation.**

Organizations often use some form of methodology for the implementation of an organizational change. Hypothesis eight states that the use of a methodology will allow the organization to better assimilate the required changes and thereby easing the culture change.

## 3.2 Operationalization of the Constructs

The constructs for this study are defined as follows. There are eight ERP strategic advantage items. These items are, greater flexibility, increased efficiency, improved communication, lower operating costs, increased revenue, reduced cycle times, better collaboration, higher profit margins (see Radding, 1999, Oliver, 1999, Stein, 1998). It must be stated that these items have as of yet to be used in a study to attempt to measure

the strategic advantages of ERP. The items are identified as likely areas to be affected by ERP.

Performance improvements from BPR is measured with 6 items, productivity, customer satisfaction, organizational quality, market coverage, cost reductions and defects reduction (see Teng et al., 1998, Raymond et al., 1998, Grover et al., 1995, Kettinger et al., 1997, Davenport and Short, 1990, Hammer, 1990). Respondents will be asked to rate the improvement for the six items across Porter's (1985) value chain processes (a total of nine processes).

Organizational culture is made up of four cultural archetypes, group culture, developmental culture, hierarchical culture and rational culture . The items that measure the four organizational culture archetypes are presented in Figure 4 (section 4.3.1). These items are directly obtained from the Quinn and Spreizter (1991) article. Culture change uses the same archetypes and items, but the focus is on the change in these items since the implementation of an ERP or BPR.

Assimilation is represented by the acquisition of skills and knowledge needed to apply the changes (Fichman and Kemerer 1997), in this case ERP and/or BPR, and the effort to acquire those skills and knowledge. The respondents will be asked to rate these two items for both the ERP effort, and for the BPR effort. Elapsed time is a single item measure representing the time from the implementation of the organizational change (ERP or BPR). Methodology seeks to simply discover whether the organization uses one, and how many stages does the methodology contain.

### 3.3 Methodology:

A questionnaire survey consisting of four pages was used to collect the data from respondents from companies from across Canada. The questionnaires along with cover letters, reminders can be found in appendices A, B and C respectively. The translations for the above are

also included. The questionnaire was mailed to the CEO's (or high level executive) of a random sample of 1000 organizations from Canada that had at least 200 employees. The database of CEO and company names was acquired from Dun and Bradstreet. Each organization received two questionnaires, one to be answered by the CEO, and the other by the CIO (or the individual in charge of the implementation of the BPR projects). Justification for using the heads of the organization as respondents is that they are in the best position to evaluate the achievement of performance improvements. Furthermore, culture and culture change are often imposed from the top down (Parker, 1996, Howard, 1998). That is, the initiative of imposing culture usually comes from the organization's top management.

### 3.3.1 Questionnaire Survey:

The measurement instrument is comprised of four sections, the first measuring the achievement of ERP strategic advantages, the second measuring the achievement of BPR performance improvements, a third measuring the organizational culture and the culture change and a fourth asking the respondent for some background information. Porter's (1985) value chain processes will be used as the areas in which an organization may affect BPR.

The respondents have been asked if they have implemented ERP software, and to rate whether it has given their organization strategic advantages. They will also be asked to identify which value chain processes have been affected by BPR, and evaluate the achievement of the performance improvements for each affected process. The organizational culture instrument will be the one adapted from Quinn and Spreitzer (1991) and is shown in figure 4 along with the authors reported Cronbach Alphas.

| *Organizational Culture Scale* | *Cronbach Alpha* |
|---|---|
| **Group Culture** | **.84** |
| • Participation, open discussion | |
| • Empowerment of Employees to act | |
| • Assessing employee concerns and ideas | |
| • Human relations, teamwork and cohesion | |
| **Developmental culture** | **.81** |
| • Flexibility, decentralization | |
| • Expansion, growth and development | |
| • Innovation and change | |
| • Creative problem solving process | |
| **Hierarchical Culture** | **.77** |
| • Control, centralization | |
| • Routinization, formalization and structure | |
| • Stability, continuity, order | |
| • Predictable performance outcomes | |
| **Rational Culture** | **.78** |
| • Task focus, accomplishment, goal achievement | |
| • Direction, objective setting, goal clarity | |
| • Efficiency, productivity, profitability | |
| • Outcome excellence, quality | |

**Figure 4 Competing values measurement instrument with cronbach alphas. Source, Quinn and Spreitzer (1991)**

Each culture constructs value (i.e. group, developmental, hierarchical, and rational culture) is obtained by aggregating the value attributes for that culture construct. An organization's culture profile is represented as a combination of the four culture constructs. The respondent will be asked to indicate the value placed on each attribute in their organization on a likert scale response format. The anchors for the likert scale will be "not valued at all" to "Valued a great deal".

Culture change will use the same measurement instrument, but here the respondents will be asked to evaluate the change in value of the attributes. The likert scale will run from negative two to positive two. The anchors will be "Much Less Valued", "No Value Change" and "Much More Valued". For these questions, a five point likert scale will be used to allow the respondent to select in between anchors if they so desire.

The questionnaire will assess whether the organization uses an assimilation methodology. It will also assess the amount of effort put into assimilation for both an ERP software and the individual reengineering within the value chain processes. Finally the elapse time since the implementation of ERP software and BPR will be assessed.

### 3.3.2 Pretest:

A set of questions was developed to pretest the questionnaire. The pretest and pretest results are presented in Appendix D1. The Questionnaire was pretested with a total of 8 business executives. Six were given and responded to the pretest questionnaire. Two were interviewed. Appendix D2 contains the comments that were raised during the pretest, as well as the resolution of those comments. From the results of the pretest, the final version of the questionnaire was developed (as presented in Appendices A1 and A2).

### 3.3.3 Sample Size:

Unfortunately, the questionnaire survey did not result in a good response rate. The tabulation of responses are as follows. A total of 998 packages containing two questionnaires each was mailed to the respondents at the beginning of April 2000. The reminder was sent to the respondents one month after the questionnaires were sent. Of the 998 packages, 32 were returned as undelivered (3.2%), which left us with 966 potential respondents to receive the questionnaires. A total of 30 respondents sent messages stating that they would be unable to respond to the questionnaire. Reasons that were given were that they were either too busy at the moment, or that the organizations did not complete an ERP or BPR project. Forty-eight questionnaire responses were received representing 46 companies (two companies followed the instructions to include both the CEO's and the CIO's response). Of the 48 questionnaires that were returned, 31 (3%) were usable for analysis of the BPR dependent variable, and 22 (2%) were usable for the analysis of the ERP dependent variable. The ERP sample form a subset of the BPR sample.

## 3.4 Data Analysis

### 3.4.1 SEM and PLS

The method of analysis in this study was limited in its choices due to the resulting sample sizes of the ERP and BPR samples. Furthermore, histograms and normal probability plots showed skewed distributions and raised doubts as to the normality of the samples' distribution. A number of different transformations were tried on the data but none was found to transform the data to near normality. A structural equation modeling method, PLS (partial least squares) was used due to its distribution free methodology (Croteau and Bergeron, 2000). PLS is a variance based approach to structural equation modeling. PLS allows for relatively small sample sizes with a strong rule of thumb of having a sample size that is ten times the size of the number of indicators

for the largest construct. Yet this restriction can often be relaxed to 5 time the number of items in the largest construct (Chin, 1997).

### 3.4.2 Sample Frequencies:

There were 22 usable ERP cases, and 31 usable BPR cases. Table 1 shows the distribution of the cases among the different provinces. As we can see, respondents from only five provinces responded to the questionnaire. Ontario provided the highest number of usable questionnaires followed by Quebec for both the ERP and BPR samples. The number of packages that were sent to these provinces are as follows; Nova Scotia received 18, Quebec received 269, Ontario received 458, Alberta received 83, and BC received 89.

| ERP Province Frequencies | N |
|---|---|
| Nova Scotia | 2 |
| Quebec | 6 |
| Ontario | 10 |
| Alberta | 3 |
| BC | 1 |

| BPR Province Frequencies | N |
|---|---|
| Nova Scotia | 2 |
| Quebec | 7 |
| Ontario | 15 |
| Alberta | 5 |
| BC | 2 |

**Table 1 ERP and BPR province frequencies.**

Industry frequencies are shown in Table 2. As noted, Two case from the ERP sample, and three from the BPR sample listed more then two primary industries. The highest number of ERP and BPR projects occurred in the manufacturing industry, followed by the service industry.

| ERP Primary Industry | N |
|---|---|
| Manufacturing | 9 |
| Wholesale | 2 |
| Retail Trade | 2 |
| Service | 5 |
| Mining | 1 |
| Distribution | 1 |
| Consulting | 2 |
| Energy and Oil | 2 |
| Engineering | 1 |
| Aerospace | 1 |

Note: Two cases listed two primary industries

| BPR Primary Industry | N |
|---|---|
| Manufacturing | 12 |
| Wholesale | 2 |
| Retail Trade | 3 |
| Finance, Insurance and real estate | 3 |
| Service | 5 |
| Mining | 1 |
| Health | 1 |
| Distribution | 1 |
| Consulting | 2 |
| Energy and Oil | 2 |
| Engineering | 1 |
| Aerospace | 1 |

Note: Three cases listed two primary industries

**Table 2 ERP and BPR industry frequencies.**

ERP software vendor frequencies are shown in table 3. As can be seen, there is a fairly large range of ERP software that was used by the respondents. In this sample SAP was the most popular choice, yet the small sample size makes it difficult to make assumptions on the population trend.

| ERP Software Vendor | N |
|---|---|
| SAP | 4 |
| BaaN | 2 |
| JD Edwards | 2 |
| Oracle | 2 |
| SMGC | 1 |
| Mincron | 1 |
| QAD | 3 |
| ROI Systems | 1 |
| Peartree | 1 |
| Marcam | 1 |
| Mapics | 1 |
| BST | 1 |
| Nxtrend | 1 |
| Other | 1 |

**Table 3 ERP software vendor frequencies.**

### 3.4.3 Descriptive Statistics

Before continuing with the presentation of the descriptive statistics, a description of the steps taken to build the research constructs will be discussed. These steps included an exploratory and confirmatory factor analysis on the BPR performance area constructs (i.e. Productivity, Customer Satisfaction, Market Coverage, Organizational Quality, Cost Reductions and Defects Reduction). Exploratory factor analysis was performed for each of these constructs to try to identify a trend within Porter's (1985) processes. This was followed by a confirmatory factor analysis forcing two factors to see if the processes converged into the primary and secondary processes described by Porter (1985). The result was that for all of the performance area constructs no evident pattern was identified. This is to say that the iterations converged into different patterns for most of the different performance areas. Reliability analysis was then performed on the performance area construct items to determine the most reliable combination of

the items. Then the mean was taken of these items to form the BPR performance improvement area indicators. The descriptive statistics along with the results of the reliability analysis for these constructs are shown in table four. The initial number of items for the performance area indicators were nine, representing the nine processes of Porter's (1985) model.

| Performance Areas | Final # of items | α | Mean | Min | Max | Std. Deviation |
|---|---|---|---|---|---|---|
| Productivity | 6 | 0.79 | 3.5697 | 2.33 | 4.33 | .4433 |
| Customer Satisfaction | 6 | 0.84 | 3.5722 | 2.17 | 4.33 | .3627 |
| Market Coverage | 7 | 0.83 | 3.6257 | 3.00 | 4.57 | .3057 |
| Organizational Quality | 7 | 0.91 | 3.7604 | 3.00 | 5.00 | .3876 |
| Cost Reductions | 9 | 0.87 | 3.1901 | 1.00 | 4.11 | .5774 |
| Defects Reduction | 9 | 0.93 | 3.1900 | 1.00 | 4.00 | .5319 |

N = 31

**Table 4 Descriptive statistics and Cronbach alpha's for BPR performance area constructs.**

Another second order construct was created, namely the assimilation item "acquisition of skills and knowledge". A factor analysis of the nine organizational processes revealed two latent constructs following Porter's (1985) model such that the acquisition of skills and knowledge could be divided into skills and knowledge acquired for reengineering of the primary processes and skills and knowledge acquired for Porter's (1985) support processes. Descriptive statistics for this construct is shown in table 5.

| Skills and knowledge | Initial # of items | Final # of items | α | Mean | Min | Max | Std. Deviation |
|---|---|---|---|---|---|---|---|
| Primary Skills | 5 | 4 | 0.71 | 3.5132 | 2.00 | 4.00 | .4404 |
| Secondary Skills | 4 | 3 | 0.78 | 3.5818 | 2.00 | 4.33 | .4476 |

N = 31

**Table 5 Descriptive statistics and Cronbach alpha's for BPR Skills and Knowledge acquisition constructs.**

The descriptive statistics for the ERP sample are shown in table 6a. The ERP sample posed some trouble due to its small sample size. As was stated above, PLS requires at the least a sample that is five times the number of items belonging to a construct, or five times the number

of relationships directed to a construct. Factor analysis concluded that the 8 items representing the achievement of ERP strategic advantages converged into a single factor. This was supported by the fact that the Cronbach alpha for these items (all eight included) was 0.915. Therefore the mean of the eight items was taken to represent this dependent variable. In the ERP sample case, a single item represents acquisition of skills and knowledge construct, as does the elapsed time construct.

| ERP Culture Descriptive Statistics | Mean | Min | Max | Stdev |
|---|---|---|---|---|
| Organizational Culture | | | | |
| Group culture | 4.05 | 2.33 | 5.00 | 0.68 |
| Developmental culture | 3.97 | 2.25 | 5.00 | 0.69 |
| Hierarchical culture | 3.30 | 2.00 | 4.33 | 0.67 |
| Rational culture | 3.98 | 2.00 | 5.00 | 0.84 |
| Culture Change | | | | |
| Group change | 3.98 | 3.00 | 5.00 | 0.76 |
| Developmental change | 3.66 | 2.50 | 5.00 | 0.82 |
| Hierarchical change | 3.33 | 2.25 | 5.00 | 0.63 |
| Rational change | 3.70 | 3.00 | 5.00 | 0.73 |
| BPR assimilation | | | | |
| Acq. Skills and Knowledge | 3.05 | 1.00 | 4.00 | 0.90 |
| Effort to acquire | 3.18 | 1.00 | 4.00 | 0.96 |
| Elapsed time | 27.95 | 2.00 | 96.00 | 24.70 |
| ERP Strategic Advantages | 3.03 | 1.00 | 5.00 | 0.90 |
| N = 22 | | | | |

**Table 6a Descriptive statistics for ERP sample constructs.**

The descriptive statistics for the BPR sample constructs are presented in table 6b. For both the BPR performance area constructs and the BPR skills and knowledge acquisition constructs, a mean was taken of the reliable processes in order to create the second order constructs that were used as the items in the PLS path analysis. The BPR performance area constructs became the items explaining the "BPR Performance Improvements" construct, and the acquisition of skills and knowledge constructs became the items explaining the "Acquisition of

skills and knowledge" construct. The next section will look at the validity and the reliability of the constructs used in PLS study.

| BPR Culture Descriptive Statistics | | Mean | Min | Max | Stdev |
|---|---|---|---|---|---|
| Organizational Culture | | | | | |
| | Group culture | 4.15 | 2.33 | 5.00 | 0.67 |
| | Developmental culture | 4.10 | 2.00 | 5.00 | 0.69 |
| | Hierarchical culture | 3.46 | 1.75 | 5.00 | 0.70 |
| | Rational culture | 4.30 | 2.75 | 5.00 | 0.59 |
| Culture Change | | | | | |
| | Group change | 4.05 | 3.00 | 5.00 | 0.76 |
| | Developmental change | 3.71 | 2.50 | 5.00 | 0.79 |
| | Hierarchical change | 3.40 | 2.00 | 5.00 | 0.64 |
| | Rational change | 3.82 | 3.00 | 5.00 | 0.74 |
| BPR performance improvements | | 3.48 | 2.08 | 4.30 | 0.36 |
| BPR assimilation | | | | | |
| | Acq. Skills and Knowledge | 3.55 | 2.42 | 4.00 | 0.36 |
| | Effort to acquire | 3.61 | 2.44 | 4.63 | 0.42 |
| Elapsed Time | | 22.46 | 5.77 | 87.15 | 14.62 |
| N = 31 | | | | | |

**Table 6b Descriptive statistics for BPR sample constructs.**

### 3.4.4 Validity and reliability of the constructs

Croteau and Bergeron (2000) state that in order to have item reliability in the measurement model, only indicators with factor loadings of 0.500 should be kept. This was done for all constructs in the measurement model. Evidence for convergent validity was obtained for the measurement models by using the construct Rho's. Rho is a value that represents how much of the variability of the construct is due to the factor loadings of the construct's indicators as opposed to error. Croteau and Bergeron (2000) state that to have evidence of construct validity, Rho's for a construct should be greater then 0.7. Evidence of construct validity for ERP sample exists as most of the constructs'

Rho values are very high (See Table 7a). Rho values for the ERP culture constructs range from 0.79 to 0.93 (which belonged to the hierarchical change construct). As with the ERP sample, evidence of convergent validity for the BPR Culture and Culture Change sample exists. Table 7b shows the convergent validity for the BPR Culture and Culture change sample. The rho's vary from 0.75 to 0.92 with a majority in the .80s. Developmental change and rational change kept their initial number of indicators and had Rho's of 0.90 and 0.92 respectively.

| **ERP Culture Construct Validity** | **Initial # of Items** | **Final # of Items** | **Rho** |
|---|---|---|---|
| Organizational Culture | | | |
| Group culture | 4 | 3 | 0.82 |
| Developmental culture | 4 | 4 | 0.83 |
| Hierarchical culture | 4 | 4 | 0.81 |
| Rational culture | 4 | 2 | 0.79 |
| Culture Change | | | |
| Group change | 4 | 4 | 0.90 |
| Developmental change | 4 | 4 | 0.93 |
| Hierarchical change | 4 | 4 | 0.80 |
| Rational change | 4 | 4 | 0.90 |
| ERP assimilation | | | |
| Acq. Skills and Knowledge | | 1 | |
| Effort to acquire | | 1 | |
| Elapsed time | | | |
| ERP Strategic Advantages | (Mean ERP strategic advantages) | | |
| N = 22 | | | |

**Table 7a Convergent Validity for the ERP Culture and Culture change sample.**

Discriminant validity can be represented by the ability of a construct to discriminate itself from another construct. Examining the variance extracted from a particular construct, and comparing it to the shared variance of the other constructs in the model can obtain evidence of discriminant validity. Croteau and Bergeron (2000) states that the average variance extracted

(AVE) for a particular construct need be higher then 0.5, which was the case for both the ERP and BPR samples.

| BPR Culture Construct Validity | Initial # of Items | Final # of Items | Rho |
|---|---|---|---|
| Organizational Culture | | | |
| Group culture | 4 | 3 | 0.85 |
| Developmental culture | 4 | 2 | 0.75 |
| Hierarchical culture | 4 | 4 | 0.85 |
| Rational culture | 4 | 3 | 0.83 |
| Culture Change | | | |
| Group change | 4 | 3 | 0.88 |
| Developmental change | 4 | 4 | 0.92 |
| Hierarchical change | 4 | 3 | 0.81 |
| Rational change | 4 | 4 | 0.90 |
| BPR performance improvements | 6 | 6 | 0.92 |
| BPR assimilation | | | |
| Acq. Skills and Knowledge | | 2 | 0.80 |
| Effort to acquire | (all nine effort items factored together) | | |
| Elapsed Time (Mean elapsed time for org) | | | |
| N = 31 | | | |

**Table 7b Convergent Validity for the BPR Culture and Culture change sample.**

Table 8a contains the AVEs and shared variances for the ERP sample. As can be seen from the table, the AVEs for this sample range from 0.508 to 0.772. Furthermore, the AVEs for these constructs are greater than the shared variances between the constructs for all of the constructs (excluding the constructs containing a single indicator). For the ERP sample, the construct "ERP strategic advantages" contains an AVE of 1. This is due to the need to use the mean of the 8 ERP strategic advantage questionnaire items as a single indicator. The reason for this is due to the small sample size of organizations that implemented ERP software, using all eight items as indicators to the construct would have rendered the model unstable.

**ERP Culture Construct Validity**

**ERP Culture**

| | ERP | Group | Develop | Hierarch | Rational |
|---|---|---|---|---|---|
| **ERP Strategic Advantages** | 1 | | | | |
| **Group Culture** | 0.164 | 0.620 | | | |
| **Develop Culture** | 0.072 | 0.182 | 0.555 | | |
| **Hierarch Culture** | 0.224 | 0.033 | 0.032 | 0.586 | |
| **Rational Culture** | 0.078 | 0.075 | 0.069 | 0.013 | 0.661 |

**ERP Culture Change**

| | ERP | Group | Develop | Hierarch | Rational | Skills | Effort | Elapsed time |
|---|---|---|---|---|---|---|---|---|
| **ERP Strategic Advantages** | 1 | | | | | | | |
| **Group change** | 0.097 | 0.704 | | | | | | |
| **Develop change** | 0.110 | 0.523 | 0.772 | | | | | |
| **Hierarch change** | 0.000 | 0.128 | 0.122 | 0.508 | | | | |
| **Rational change** | 0.225 | 0.378 | 0.669 | 0.114 | 0.686 | | | |
| **Skills and knowledge** | 0.000 | 0.041 | 0.000 | 0.064 | 0.010 | 1 | | |
| **Effort to acquire** | 0.001 | 0.000 | 0.027 | 0.097 | 0.001 | 0.484 | 1 | |
| **Elapsed time** | 0.088 | 0.013 | 0.000 | 0.291 | 0.048 | 0.002 | 0.020 | 1 |

N = 31. Underlined values represent the constructs' AVE.

**Table 8a Evidence of discriminant validity. Average variance extracted – shared variance table for ERP sample.**

The average variance extracted for the BPR sample, excluding constructs that had a single indicator, were from 0.54 to 0.69 (see Table 8b, the diagonal underlined matrices represent the AVEs). Some of the constructs have AVEs equal to 1. This is due to the fact that these constructs have only one indicator (which leaves a factor loading of 1 and no room for error). There is only one case here that may cast doubt onto the discriminant validity of a particular construct, and that is the skills and knowledge construct. The shared variance between "acquisition of skills and knowledge" and "effort to acquire skills and knowledge" is higher than the AVE of the former. Yet the effort required applies to the skills and knowledge that is to be acquired. Having a high relationship between these two constructs is understandable since if the

generally speaking the more effort put into acquiring the skill and knowledge, the greater the skills and knowledge which would explain the high shared variance.

**BPR Culture AVE Shared variance tables**

**BPR Culture**

| | BPR | Group | Develop | Hierarch | Rational |
|---|---|---|---|---|---|
| **BPR performance Improvements** | 0.659 | | | | |
| **Group Culture** | 0.082 | 0.655 | | | |
| **Develop Culture** | 0.032 | 0.196 | 0.618 | | |
| **Hierarch Culture** | 0.204 | 0.043 | 0.086 | 0.543 | |
| **Rational Culture** | 0.049 | 0.193 | 0.238 | 0.132 | 0.548 |

**BPR Culture Change**

| | BPR perf | Group | Develop | Hierarch | Rational | Skills | Effort | Elapsed time |
|---|---|---|---|---|---|---|---|---|
| **BPR performance Improvements** | 0.659 | | | | | | | |
| **Group change** | 0.000 | 0.715 | | | | | | |
| **Develop change** | 0.028 | 0.366 | 0.733 | | | | | |
| **Hierarch change** | 0.007 | 0.130 | 0.197 | 0.591 | | | | |
| **Rational change** | 0.147 | 0.239 | 0.638 | 0.209 | 0.690 | | | |
| **Skills and knowledge** | 0.023 | 0.052 | 0.028 | 0.063 | 0.013 | 0.669 | | |
| **Effort to acquire** | 0.001 | 0.003 | 0.000 | 0.027 | 0.020 | **0.743** | 1 | |
| **Elapsed time** | 0.165 | 0.054 | 0.010 | 0.071 | 0.117 | 0.085 | 0.162 | 1 |

N = 31. Underlined values represent the constructs' AVE.

**Table 8b Evidence of discriminant validity. Average variance extracted – shared variance table for BPR sample.**

The next section will present the results of the study. The hypotheses will be tested and the research model evaluated. Following this, a discussion section will be presented looking at culture, BPR and ERP in light of the presented results.

# 4. Presentation of Results

## 4.1 Introduction

Before presenting the results of the hypothesis testing, it should be noted that a necessary split had to be made in the research model due to the sample size restriction. Unfortunately due to the small number of organizations that performed ERP, BPR could not be examined within the same context (BPR contains 6 indicators which requires a minimum of 30 cases according to Chin's (1997) rule of thumb). Therefore two samples were created, one with organizations that performed BPR and the other with organizations that implement ERP software. The second point that needs to be discussed is the need to look at culture and culture change separately with the dependent variable. This is also due to the sample size restrictions mentioned above. If all eight culture and culture change variables were to be included in the model, a sample size greater then 40 would have been needed.

It should also be noted that this study is a semi-exploratory study. This is the first study that looks more closely at the relationship between the organization's culture and BPR or ERP performance measures. Finally, this study uses an original measure for the achievement of ERP strategic advantages. The next subsection will present the structural equation models that were developed using PLS. This will be followed by a summary of the test of hypotheses using the PLS models.

## 4.2 Organizational Culture.

### 4.2.1 ERP strategic advantages and organizational culture

The research model presented in this paper (see figure1) hypothesizes a link between the organizations culture profile made up of the four culture archetypes and the achievement of strategic advantages from the implementation of an ERP software. The path analysis presented in figure 5 describes the relationship between the organization's culture and ERP strategic

advantages. The values that appear over the arrows represent the path coefficients, the size and sign of which determines the magnitude and its type of its relationship with the dependent variable. The value beneath the independent variable (ERP strategic advantages) represents the proportion of its variance that is explained by the relationships directed toward it. As we can see from the figure 5, the organization's culture is significantly linked with the achievement of ERP strategic advantages. The T-Statistics for all the models can be found in Appendix E. Hypothesis 1 can be accepted since the path between ERP strategic advantages is significantly related to some of the culture profile archetypes.

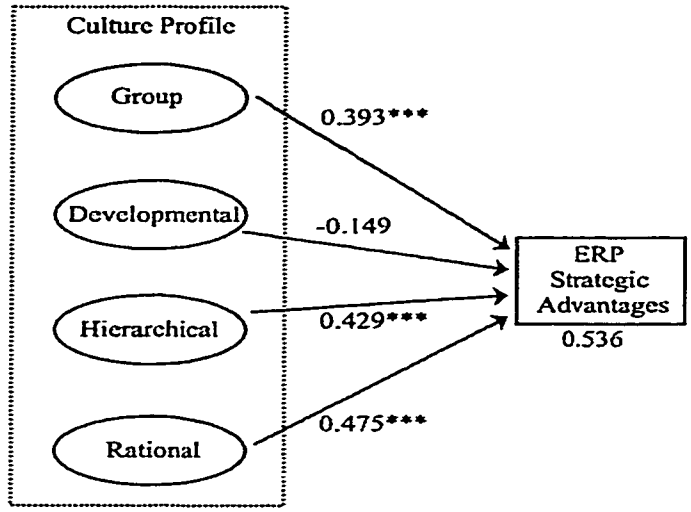


**Figure 5 Relationship between the organizational culture profile and ERP strategic advantages. *** $p \leq 0.001$.**

From figure 5 we see that group culture and hierarchical culture are positively linked with the ERP strategic advantages. Rational culture's factor loading were in fact negative, therefore rational culture is negatively linked to ERP strategic advantages. If we recall from the literature review, the four culture archetypes belong to a two by two matrix with a featuring two dimensions representing an internal view vs. external focus as well as control vs. flexibility orientation (see figure 2). Group and Hierarchical cultures are both internal cultures, but group is flexible whereas hierarchical is control oriented. Figure 5 tells us that internal oriented cultures are more significantly related to the achievement of ERP strategic advantages then are external

cultures. The fact that the magnitudes of the relationships are fairly close tells us that the flexibility vs. control dimension may not play a part. Although the rational culture is negatively related to the dependent variable, the fact that there are only two indicators in stead of the original four makes it difficult to interpret whether the negative influence is from being an external culture or a control culture. We would therefore reject hypothesis 1a and say that the result is inconclusive. We also reject hypothesis 1b but say that internal cultures not external ones are positively related to ERP strategic advantages. The results will be further discussed in the discussion section

### 4.2.2 BPR performance improvements and Organizational culture.

Like the previous case, the research model hypothesizes a relationship between the organizations culture and the achievement of BPR performance improvements. Figure 6 shows the PLS relationship between these constructs.

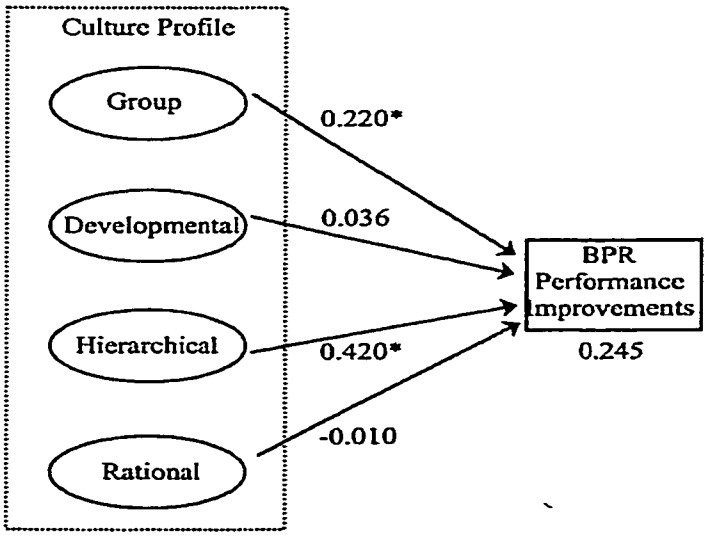


**Figure 6 Relationship between the organizational culture profile and BPR performance improvements. * $p \leq 0.05$.**

Like the case above, here we can see that there is a relationship between the organizations culture and the achievement of BPR performance improvements. Hypothesis 2 can therefore be accepted.

The culture profile explained 24.5% of BPR Performance Improvements variance. The factor loadings for developmental culture were negative. Group culture and hierarchical culture are again significant in their relationship with the dependent variable. This gives evidence that cultures with an internal view will achieve higher BPR performance improvements then cultures with an external view. The path coefficients are fairly high for the internal cultures (group and hierarchical). But in this case Hierarchical is twice as high as group. This may mean that control cultures have greater improvement than flexible cultures. The results of this model indicate that we should reject hypothesis 2a and say that flexible cultures do not improve performance where as control cultures may. Like the case above, Hypothesis 2b should be rejected and say that external cultures do not improve performance whereas internal cultures do. We will now look at the relationship between culture change and the dependent variables.

## 4.3 Culture change

In the next subsections we look at the relationship between Culture change and ERP strategic advantages (H3 in Figure 1). Included in the models that will be presented are the relationships between culture change and assimilation and the elapsed time (H6 and H7 respectively in Figure 1). Since it is necessary to examine the dependent constructs independently of each other, evaluating evidence from the models of both dependent constructs will resolve hypotheses 6 and 7. Figures 7 and 8 below show the relationship between the dependent variables, culture change, assimilation and elapsed time.

### 4.3.1 ERP strategic advantages and culture change

Figure seven shows the relationship between culture change and ERP strategic advantages. For the sake of visual clarity, the path coefficients that were not significant were left out of Figure 8. They can be found in Table E1 in Appendix E. We can see from Figure 8 that there does not seem to be a significant relationship between the culture change archetypes and

ERP strategic advantages. Hypothesis 3 would therefore have to be rejected. It so follows that Hypotheses 3a and 3b also have to be rejected and say that the relationship between culture movement and ERP strategic advantages is inconclusive.

We can see that the organizations acquisition of skills and knowledge necessary for effective ERP software utilization is negatively related to group change whereas effort to acquire the skills and knowledge is positively related to group change. This shows some evidence for supporting hypothesis 6 stating that there is a significant between assimilation and the culture

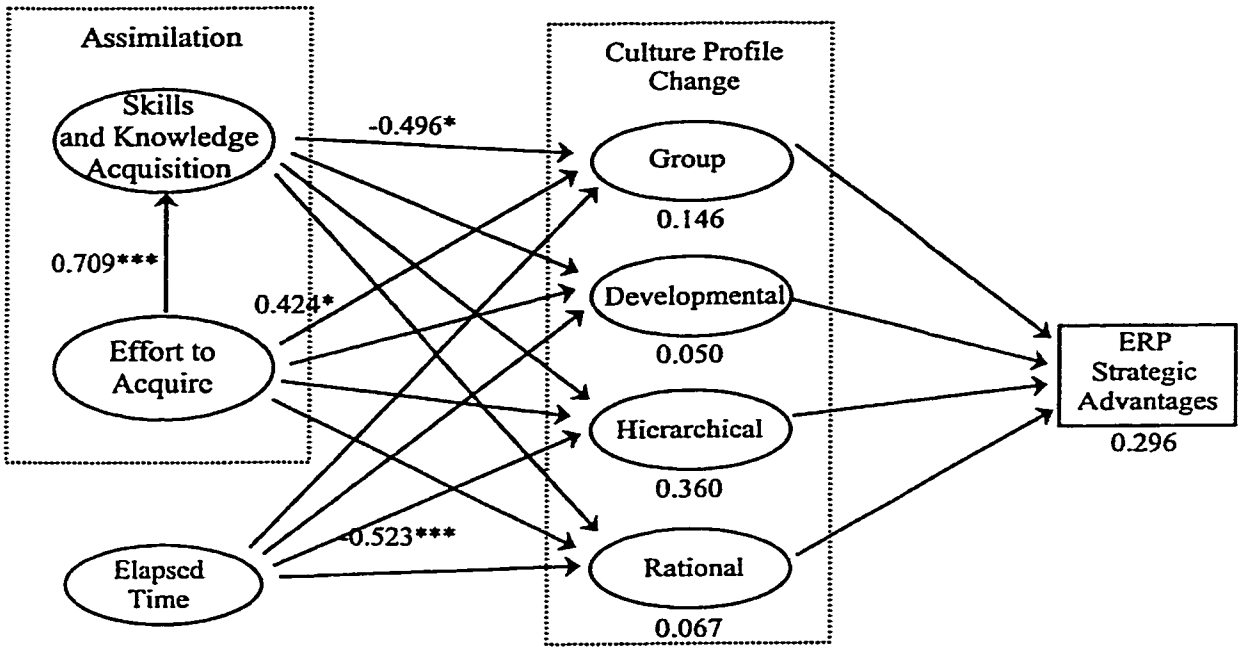


**Figure 7 The relationship between ERP strategic advantages, culture change, assimilation and elapsed time. * P ≤ 0.05. ***P ≤ 0.001.**

profile change. Finally, the elapsed time from the implementation of the ERP software is negatively linked with hierarchical change. This is to say that as the time elapsed from the implementation increases, the organizations tend to become less hierarchical. We would thus have to accept hypothesis 7 stating that there is evidence that the time elapsed is significantly related to the culture change.

### 4.3.2 BPR performance improvements and culture change

The relationship between BPR performance improvements and the change in culture is represented by hypothesis 4 and can be seen in Figure 8. As was explained above, the path coefficients that were not significant were left out of the model but can be found in Table E2 in Appendix E. Group culture from Figure 8 contained negative factor loadings. There is a strong positive relationship between rational culture and BPR performance improvements. We can therefore accept H4 and state that there is a relationship between the change in culture and BPR performance improvements. Rational culture is described as a control culture that has an external view. Yet, it is difficult to make the assumption that becoming more control oriented and supporting a more external view will improve performance improvements. There exists some evidence that control cultures enjoy greater BPR performance improvements from the BPR culture model (see Figure 6). The model in figure 8 tends to support this evidence therefore we will reject hypothesis 4a and say that flexible culture change is not related to BPR performance improvements but that control culture change may be related.

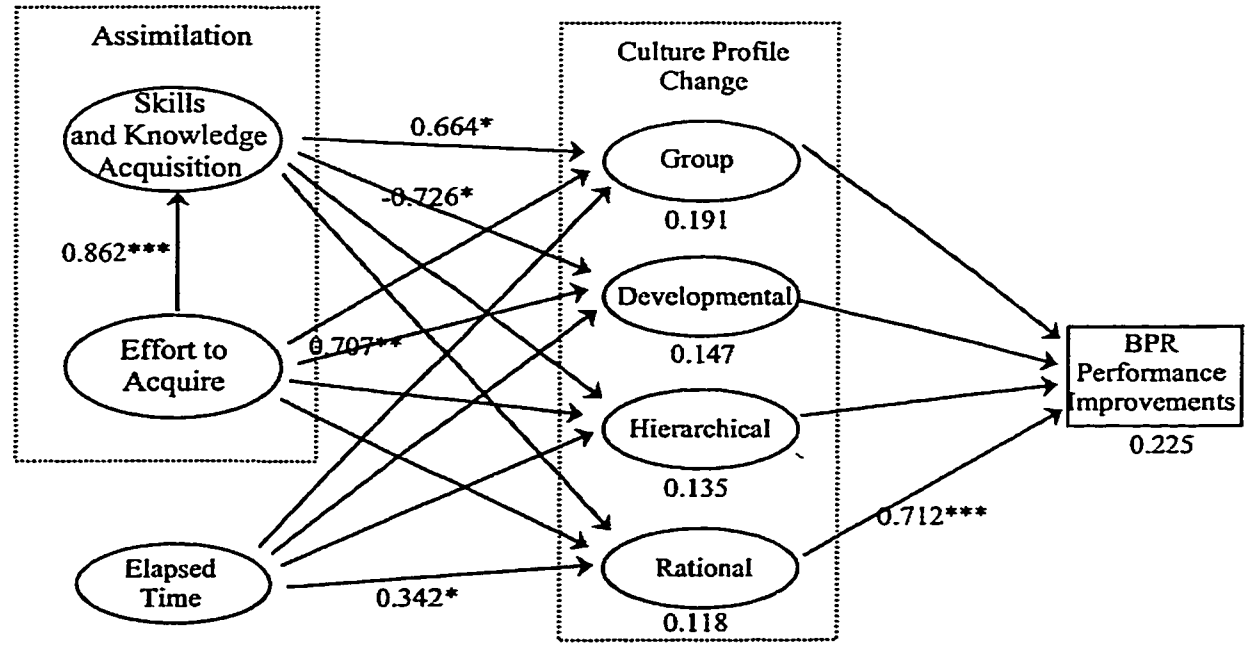


**Figure 8 The relationship between BPR performance improvements, culture change, assimilation and elapsed time. * P ≤ 0.05. ** P ≤ 0.01. ***P ≤ 0.001.**

Hypothesis 4b must be rejected stating that the link between BPR performance improvements and becoming more external oriented remains inconclusive given the evidence provided in Figure 8.

Figure 8 reveals that skills and knowledge acquisition is negatively related to group change (due to the negative loadings of the group change construct loadings) and developmental change. Effort to acquire the skills and knowledge is positively related to developmental change. As a relationship exists between the assimilation constructs and both dependent variables, hypothesis 6 will be accepted and say that there is a significant link between assimilation and culture change.

Elapsed time in Figure 8 seems to be significantly related to rational change. In this case we will accept H7 again and say that the elapsed time of a BPR effort is significantly related to culture change.

It should be noted that the hypothesis 5 (relationship between the two dependent variables, see Figure 1) cannot be tested due to the sample size restrictions that were mentioned above. Furthermore, hypothesis 8 (representing the relationship between the use of a methodology and assimilation) cannot be tested due to the fact that only 8 usable cases used a methodology to implement ERP sample and 10 usable cases for the BPR sample. The next section will present a summary of the hypothesis testing result.

## 4.4 Summary of hypothesis testing results

This section will present a summary of the hypothesis testing results. For a quick view, a list of the results is presented in Table 9. Hypothesis 1 tested the relationship between the organization's culture and the achievement of ERP strategic advantages. The results found that group and hierarchical cultures were positively linked to ERP strategic advantages, and that rational culture was negatively linked to ERP strategic advantages. Hypothesis 1 was thus accepted. Hypothesis 1a was rejected as there was no specific evidence that flexible cultures enjoy greater ERP strategic advantages. Hypothesis 1b was also rejected due to the lack of

relationship between external cultures and ERP strategic advantages whereas the results actually showed a relationship between internal cultures and the dependent variable.

| Hypo's | Status | Comments |
|---|---|---|
| H1 | Accepted | Group, hierarchical and rational culture significantly related to ERP strat. adv. |
| H1a | Rejected | Inconclusive relationship between flexible cultures and ERP strat. adv. |
| H1b | Rejected | Evidence of relationship between internal culture and ERP strat. adv. |
| H2 | Accepted | Group and hierarchical change significantly related to BPR perf. imp. |
| H2a | Rejected | Possible relationship between Control culture and the BPR perf. imp. |
| H2b | Rejected | Evidence of relationship between internal culture and BPR perf. imp. |
| H3 | Rejected | No evidence of relationship between culture change and ERP strat. adv. |
| H4 | Accepted | Rational change significantly related to BPR performance improvements. |
| H4a | Rejected | No evidence of a relationship between flexible change and BPR perf. imp. |
| H4b | Rejected | Inconclusive evidence. |
| H5 | - | Not testable due to sample size restrictions. |
| H6 | Accepted | Assimilation constructs significant in both ERP and BPR samples |
| H7 | Accepted | Elapsed time is significant in both ERP and BPR samples |
| H8 | - | Not testable due to sample size restrictions. |

**Table 9 Summary of hypothesis testing results.**

Hypothesis 2 tested the relationship between the organization's culture and the achievement of BPR performance improvements. The results showed that group culture and hierarchical culture were significantly and positively linked with BPR performance improvements. Hypothesis 2 was therefore accepted. Hypothesis 2a was rejected as there was no evidence that flexible cultures enjoy greater BPR performance improvements over control cultures. In fact, since the path coefficient for hierarchical culture is nearly twice that of group culture, there is some evidence that control cultures may enjoy greater performance improvements. Hypothesis H2b is also rejected since internal cultures are positively related to BPR performance improvements and not external ones.

Hypothesis 3 was rejected due to the lack of any relationships between culture change and ERP strategic advantages. It so follows that H3a and b are also rejected. Hypothesis 4 was accepted due to a relationship between rational change and BPR performance improvements. Yet H4a and b remain inconclusive. Even though rational culture is represented by being external oriented, there is not enough evidence to say that becoming more externally oriented is related to BPR performance improvements.

Hypothesis 5 remained un-testable. Hypotheses 6 and 7, dealing with the relationship between assimilation and culture change was accepted due to the various relationships that existed among the constructs. Finally hypothesis 8 also remained un-testable due to the limited number of organizations that used methodologies for implementation. Including the methodology construct in the models thus rendered the models unstable. In the next section, a discussion of the results of this study are presented.

# 5. Discussion

This section will discuss the presentation of the results and the implications that there may be. First we will discuss topics on the culture profile and its relationship with the dependent constructs. Then implications for the relationship between culture change and the dependent variables will be discussed. Finally we will discuss how assimilation and elapsed time impacts the model.

## 5.1 Organizational culture and the dependent constructs

In the presentation of results section, hypothesis 1 was accepted, that there was a relationship between the organizations culture and the achievement of ERP strategic advantages. Yet hypotheses 1a and 1b were both rejected. The assumed hypothetical dynamics of the relationship between organizational culture and ERP strategic advantages was not present (i.e. the importance of flexibility and an external view). What was seen instead was that internal cultures play a large role in achieving ERP strategic advantages, and the beginning of evidence showing that control cultures also play a role. We also saw that internal cultures played a large role in the achievement of BPR performance improvements.

One of the goals of ERP is to electronically and technologically align the members of a value chain. Thus it was assumed that an external view would be more beneficial to the organization in its implementation of an ERP. Yet we cannot forget that the implementation of an ERP software also represents the implementation of software that will affect the organization internally. BPR often involves the reengineering of processes that are internal to the organization. Perhaps what the results say is that organizations need to focus on the internal environment if the changes that are made internally are to be successful.

We also saw in the relationship between the culture profile and ERP strategic advantages a strong showing of the control cultures (Hierarchical and Rational vs. the flexible ones of group

and developmental). This also goes against the original assumptions that were made based on the literature. It was assumed that flexibility would be more of an asset than would be control in the implementation of organizational change. Yet the results allude to the opposite in relation to ERP strategic advantages. Furthermore, the strength of the path coefficient found between hierarchical culture and BPR performance improvements in comparison to the weaker one with the group culture constructs support the interpretation that control cultures may achieve greater success with organizational changes such as BPR and ERP. We will now look at the relationship between culture change and the dependent variable.

## 5.2 Culture Change and the Dependent variable

The presentation of the results showed us that there was no relationship between culture change and ERP strategic advantages leading to the rejection of H3, and a single significant relationship between culture change and BPR performance improvements leading to the acceptance of H4 (see Figures 7 and 8). The significant relationship that existed was that a large portion of the variation in rational culture change was positively and significantly related to BPR performance improvements. Although, according to the culture model presented by Quinn and Rohrbaugh (1983, See figure 2), rational cultures are said to be control oriented and have an external view, it is difficult to interpret where the change occurred, and therefore which dimension is significantly related to BPR performance improvements. Corroborative evidence would be needed in order to determine whether a movement toward an external and/or control culture is related to the dependent construct. We will now look at the relationship between the elapsed time, assimilation and culture change.

## 5.3 Culture change and assimilation

The first thing that is noticed when looking at the models including the relationship between assimilation and culture change is a paradox (see Figure 7 and 8). In the cases of both

dependent constructs, the shared variance between skills and knowledge acquisition and effort to acquire skills and knowledge is very high. But for both models, the two assimilation constructs affect one of the culture change constructs in a nearly exact opposite manner. For example, in the BPR sample (represented by the model in Figure 8), the path coefficient for the relationship between effort to acquire skills and knowledge and the acquisition of those skills and knowledge is 0.862 (which explains 74.3% of the variance in skills and knowledge acquisition). Yet effort to acquire has a positive relationship with developmental change, whereas acquisition of skills and knowledge has a negative one on of the same magnitude. It is as if the model were trying to say: (1) the more effort put into acquiring skills and knowledge, the more skills and knowledge will be acquired, (2) the more effort put into acquiring those skills and knowledge, the greater the increase in developmental change will occur, and (3) the more skills and knowledge that is acquired, the greater the decrease from developmental change will occur.

Generally, a result of this type may have been explained by chance (the probability that some error in the model will occur). Yet the phenomenon occurs for both models (yet the paradox occurs with group culture change in the ERP model). One potential resolution to the model is that there is a time dependence within the data (i.e. when the construct occurred in relation to each other). For example perhaps we can say that at the beginning of the change, a great effort was put into acquiring skills and knowledge. Perhaps such an effort created a culture change toward more flexibility and an external orientation in the culture. As time went on and acquisition of skills and knowledge increased, and no improvements to BPR performance was seen, the culture change began to revert toward an internal orientation (to find the problem) and toward a control culture (to control the output). Looking at the ERP model (see Figure 7), perhaps a similar phenomenon occurred with group change. The acquisition of skills and knowledge affect group change in the same way for both culture change models (remember that the factor scores for group change in the BPR sample were negative). The pattern that emerges is that as skills and knowledge acquisition increases, and there is no corresponding response from

the dependent variable, more control is implemented in the organizations causing the movements seen in culture change models. The culture change seems to be a movement toward control due to the negative impact of the acquisition of skills and knowledge on group change from one model, and developmental change from the other. As both are flexible cultures, but group an internal one and developmental and external one, movement away from these two cultures would thus be toward control (see Figure 2).

## 5.4 Culture change and elapsed time

The relationship between elapsed time of implementation of ERP software is negatively related to hierarchical change (See Figure 7). Hierarchical cultures are described as those with an internal perspective along with a control orientation. In this case, we would say that as the time elapsed from the implementation of ERP software, the less hierarchical we become. Organizational changes often require a certain amount of flexibility. Yet this may not be so due to the positive relationship between the elapsed time of BPR implementation and rational change (see Figure 8). As mentioned previously, rational culture is a control oriented and external perspective culture. Here the model states that as the elapsed time from a BPR effort increase, the more rational a culture will become, which is not in the direction of flexibility. Here, the path analysis suggests that with the negative relation between hierarchical culture and the elapsed time from the ERP sample, along with the positive relation between rational culture and the elapsed time in the BPR sample, the net effect of elapsed time on the culture change due to the organizational change was a movement toward an external prospective. Yet as mentioned above, the interpretation of the effect of this move on the dependent construct is debatable. This is apparent in the significant relationship between rational change and BPR performance improvements.

As stated in the results section, unfortunately the methodology construct hypothesis remained untested, as was the relationship between the two dependent constructs. The following

section will conclude with a few points, some limitations to the study and some directions for further research.

## 6. Conclusion

To begin the conclusion section, it must be stated that to make interpretations on the results of the analysis of this data is somewhat problematic due to the small sample sizes. Some doubt is cast upon the generalization of these results upon the population of large size Canadian organizations. Yet there is some consensus within the results between the ERP models and the BPR models. This perhaps defends the validity of the data somewhat against the doubt cast by the small sample sizes.

We will say that a replication study should be performed to confirm the validity of these results before they can be generalized to the greater population of Canadian organizations. The major limitation that existed was the limited sample sizes. A possible reason for such a small sample size was that the questionnaire was sent to the CEOs of the organizations. It has been suggested that CEO's are difficult target respondents due to their busy schedules and heavy considerations. Further research should investigate the possibility that targeting members of the organization other then the CEO. The small sample size can also be the result of some sort of non-response bias. Due to the young and important nature of the study, perhaps organizations are not willing to report on their successes and/or failures. If this is the case it is unfortunate for the realm of academia and we may expect a number of years to pass before a really significant study can be found. Of course, we need not be so pessimistic and say that perhaps this study was performed to soon. Many of the organizations in the sample responded saying that they were unable to respond as they have either just implemented an ERP software, or are planning on it for the near future. Although it is unfortunate that these respondents did not respond to the sections that may have pertained to their present status (the questionnaire contained instructions for such a

case, i.e. to continue to the section on BPR). Finally, the low response rate may be due to the fact that the reminder was sent too late (one month after the questionnaires were sent).

Future research in examining ERP should perhaps look at a limited set of ERP solutions. There is a wide variety of enterprise software that accomplishes a wide variety of tasks. For example, a study can look at specifically E-Commerce solutions and its relationship with the organization's culture and culture change. Furthermore, the study could also look at the investment in implementing the infrastructure and its relationship with both ERP and culture and culture change. Future research should also perhaps choose a more selective data set. Not all industries and/or organizations implement ERP nor do they perform BPR. Selecting a few promising industries would perhaps improve the response rate. Finally, the organizational culture instrument is fairly remarkable and versatile in the number of research domains to which it can be applied. An interesting study could be a longitudinal study of a number of firms that are scheduled to enter a merger or acquisition. The goal is to determine the dynamics of the culture change that occurs during a merger or acquisition.

This paper concludes by saying that cultures that espouse more control-oriented values and have a more internal perspective enjoy ERP strategic advantages and BPR performance improvements. The relationship between culture change and the dependent variables will necessarily for the moment remain indeterminable. Finally, this paper showed that assimilation and elapsed time are significantly related to culture change.

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# Appendix A1: ERP, BPR and Culture Questionnaire

# ERP, BPR and Culture Questionnaire

I am currently doing a study on the relationship between the achievement of performance improvements of **Enterprise Resource Planning (ERP)** and **Business Process Reengineering (BPR)** from an organizational culture perspective. This study will attempt to measure your organization's culture using a cultural values questionnaire, then find the link between your organization's culture and the achievement of the performance improvements of the implemented ERP and/or BPR projects.

## Part A: Achievement of ERP Strategic Advantages.

Enterprise Resource Planning (ERP) represents the integration of front office and back office software solutions under a single information system. ERP software can usually be acquired through software vendors (ex. Peoplesoft, SAP, Baan, etc...) as individual software modules. It is understood that organizations can acquire modules produced by more than one software vendor according to organizational needs. If your company did not implement ERP software, continue with Part B.

1. Please indicate which software vendor(s) supplied your ERP software, how satisfied you are with the software, and the time that has elapsed (in months) since the implementation of the software?

| | | Unsatisfied | | | | Satisfied | |
|---|---|---|---|---|---|---|---|
| a. | Peoplesoft | 1 | 2 | 3 | 4 | 5 | _____months |
| b. | SAP | 1 | 2 | 3 | 4 | 5 | _____months |
| c. | BaaN | 1 | 2 | 3 | 4 | 5 | _____months |
| d. | J.D. Edwards | 1 | 2 | 3 | 4 | 5 | _____months |
| e. | Oracle | 1 | 2 | 3 | 4 | 5 | _____months |
| f. | | 1 | 2 | 3 | 4 | 5 | _____months |
| g. | | 1 | 2 | 3 | 4 | 5 | _____months |
| h. | | 1 | 2 | 3 | 4 | 5 | _____months |

2. Do you agree that ERP software has given your organization the following strategic advantages?

| | | Do not agree at all | Agree slightly | Agree moderately | Agree very much | Agree completely |
|---|---|---|---|---|---|---|
| a. | Lower Operating Costs | 1 | 2 | 3 | 4 | 5 |
| b. | Better Collaboration | 1 | 2 | 3 | 4 | 5 |
| c. | Greater Flexibility | 1 | 2 | 3 | 4 | 5 |
| d. | Increased Efficiency | 1 | 2 | 3 | 4 | 5 |
| e. | Reduced Cycle Times | 1 | 2 | 3 | 4 | 5 |
| f. | Improved Communication | 1 | 2 | 3 | 4 | 5 |
| g. | Increased Revenue | 1 | 2 | 3 | 4 | 5 |
| h. | Higher Profit Margins | 1 | 2 | 3 | 4 | 5 |

| | Negligible | | | | Excellent |
|---|---|---|---|---|---|
| 3. Please rate your organization's acquisition of the skills and knowledge necessary for effective ERP software utilization. | 1 | 2 | 3 | 4 | 5 |
| 4. Please rate the effort that was given to the acquisition of the skills and knowledge necessary for the ERP software implementation. | 1 | 2 | 3 | 4 | 5 |

## Part B: Achievement of BPR Performance improvements.

**Business Process Reengineering (BPR)** is the transformation and redesign of organizational processes by using Information Technologies for the purpose of achieving performance breakthroughs in productivity, customer satisfaction, organizational quality, market coverage, cost reduction and defects reduction. **Acquisition of skills and knowledge** represents the skills and knowledge that has been acquired by the organization for effective application of the reengineered organizational process. **Effort to acquire skills and knowledge** represents the percentage effort given to obtain the required skills and knowledge. **Elapsed Time** represents the time that has passed since BPR occurred within the reengineered organizational process. This response should be given in months.

5. For each of the organizational processes listed below (inbound logistics, operations, etc...), rate the **improvement** in the performance areas (productivity, customer satisfaction, etc...) due to BPR using the scale provided just below: (See following example.)

> In the hypothetical example, we can see that there were good improvements in productivity, organizational quality, market coverage, and defects reduction, accompanied by a passable improvement in customer satisfaction, and an excellent one in cost reduction. There was a passable acquisition of the needed skills and knowledge, along with a good effort to acquire those skills and knowledge. It has been 14 months since this process has been reengineered.

| Negligible 1 | Inferior 2 | Passable 3 | Good 4 | Excellent 5 | Not Applicable N/A |
|---|---|---|---|---|---|

| **Organizational Process** / **Performance Areas** | Productivity | Customer Satisfaction | Organizational Quality | Market Coverage | Cost Reductions | Defects Reduction | Acquisition of skills and knowledge | Effort to acquire skills & knowledge | Elapsed Time (in months) |
|---|---|---|---|---|---|---|---|---|---|
| **Example:** Customer Service | 4 | 3 | 4 | 4 | 5 | 4 | 3 | 4 | 14 |
| a. Inbound Logistics | | | | | | | | | |
| b. Operations | | | | | | | | | |
| c. Outbound Logistics | | | | | | | | | |
| d. Marketing and Sales | | | | | | | | | |
| e. Customer Service | | | | | | | | | |
| f. Administrative Coordination and Support Services | | | | | | | | | |
| g. Human Resources Management | | | | | | | | | |
| h. Technology Development | | | | | | | | | |
| i. Procurement of Resources | | | | | | | | | |

## Part C: Organizational Culture

**6.** Please indicate the importance of the following attributes for your organization. Please try to value all the attributes

| | | Not Important | | Moderately Important | | Very Important |
|---|---|---|---|---|---|---|
| a. | Participation, open discussion | 1 | 2 | 3 | 4 | 5 |
| b. | Empowerment of employees to act | 1 | 2 | 3 | 4 | 5 |
| c. | Assessing employee concerns and ideas | 1 | 2 | 3 | 4 | 5 |
| d. | Human relations, teamwork and cohesion | 1 | 2 | 3 | 4 | 5 |
| e. | Flexibility, decentralization | 1 | 2 | 3 | 4 | 5 |
| f. | Expansion, growth and development | 1 | 2 | 3 | 4 | 5 |
| g. | Innovation and change | 1 | 2 | 3 | 4 | 5 |
| h. | Creative problem solving process | 1 | 2 | 3 | 4 | 5 |
| i. | Control, centralization | 1 | 2 | 3 | 4 | 5 |
| j. | Routinization, formalization and structure | 1 | 2 | 3 | 4 | 5 |
| k. | Stability, continuity, order | 1 | 2 | 3 | 4 | 5 |
| l. | Predictable performance outcomes | 1 | 2 | 3 | 4 | 5 |
| m. | Task focus, accomplishment, goal achievement | 1 | 2 | 3 | 4 | 5 |
| n. | Direction, objective setting, goal clarity | 1 | 2 | 3 | 4 | 5 |
| o. | Efficiency, productivity, profitability | 1 | 2 | 3 | 4 | 5 |
| p. | Outcome excellence, quality | 1 | 2 | 3 | 4 | 5 |

**7.** Please indicate if the attributes are more important, less important or unchanged for your organization since it began reengineering its processes.

| | | Less Important | | No Change | | More Important |
|---|---|---|---|---|---|---|
| a. | Participation, open discussion | -2 | -1 | 0 | 1 | 2 |
| b. | Empowerment of employees to act | -2 | -1 | 0 | 1 | 2 |
| c. | Assessing employee concerns and ideas | -2 | -1 | 0 | 1 | 2 |
| d. | Human relations, teamwork and cohesion | -2 | -1 | 0 | 1 | 2 |
| e. | Flexibility, decentralization | -2 | -1 | 0 | 1 | 2 |
| f. | Expansion, growth and development | -2 | -1 | 0 | 1 | 2 |
| g. | Innovation and change | -2 | -1 | 0 | 1 | 2 |
| h. | Creative problem solving process | -2 | -1 | 0 | 1 | 2 |
| i. | Control, centralization | -2 | -1 | 0 | 1 | 2 |
| j. | Routinization, formalization and structure | -2 | -1 | 0 | 1 | 2 |
| k. | Stability, continuity, order | -2 | -1 | 0 | 1 | 2 |
| l. | Predictable performance outcomes | -2 | -1 | 0 | 1 | 2 |
| m. | Task focus, accomplishment, goal achievement | -2 | -1 | 0 | 1 | 2 |
| n. | Direction, objective setting, goal clarity | -2 | -1 | 0 | 1 | 2 |
| o. | Efficiency, productivity, profitability | -2 | -1 | 0 | 1 | 2 |
| p. | Outcome excellence, quality | -2 | -1 | 0 | 1 | 2 |

## Part D: Background Information.

**8.** Does your organization use some specific plan of action to promote the successful adoption of organizational changes? ☐ Yes ☐ No

**9.** If yes to 8, how many major stages does this plan of action contain? _____Stages

**10.** What is your title? _____

**11.** How long have you occupied this position? _____ Years

**12.** How long have you worked for this firm? _____ Years

**13.** How many individuals does your organization employ? _____

**14.** What is your organization's annual revenue? _____

**15.** What is your primary industry?

| | |
|---|---|
| Manufacturing | Agriculture, forests and fisheries |
| Wholesale | Mining |
| Retail Trade | Construction |
| Finance, insurance and real-estate | Health |
| Service | Transport |
| Communications | Other: _____ |

**Please return the questionnaire using the attached envelope.**
**Thank you for your time and collaboration.**

If you wish to obtain a summary of the results of this study, please enclose your business card in the return envelope. Please feel free to contact us for any reason.

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# Appendix A2: Translation of ERP, BPR and Culture Questionnaire

## Questionnaire sur la GIR, la RPA et la culture organisationelle

Je mène actuellement une étude sur la relation entre l'atteinte des objectifs de performance de la **gestion intégrée des ressources (GIR)** et de la **réingénierie des processus d'affaires (RPA)** dans la perspective de culture organisationnelle. Cette étude tente de mesurer la culture de votre organisation à l'aide d'un questionnaire sur les valeurs culturelles pour ensuite établir un lien entre la culture de votre organisation et l'atteinte des objectifs de performance de l'implémentation de projets de GIR et/ou de RPA.

### Section A : Atteinte des avantages stratégiques de la gestion intégrée des ressources

La gestion intégrée des ressources (GIR) est l'intégration des solutions logicielles du bureau de direction et du bureau administratif dans un même système d'information. Vous pouvez obtenir les logiciels de GIR en modules individuels par le biais d'un fournisseur de logiciels (ex. Peoplesoft, SAP, Baan, etc.). Il est entendu que les organisations peuvent se procurer des modules produits par différents fournisseurs et ce, selon leurs besoins. Si votre entreprise n'a pas procédé à l'implémentation d'un logiciel de GIR, passez à la section B.

**1.** Veuillez indiquer de quel(s) fournisseur(s) vous avez acheté votre logiciel de GIR, votre degré de satisfaction ainsi que le temps écoulé (en mois) depuis l'implémentation du logiciel

| | | Insatisfait | | | | Satisfait | |
|---|---|---|---|---|---|---|---|
| a. | Peoplesoft | 1 | 2 | 3 | 4 | 5 | _____mois |
| b. | SAP | 1 | 2 | 3 | 4 | 5 | _____mois |
| c. | BaaN | 1 | 2 | 3 | 4 | 5 | _____mois |
| d. | J.D. Edwards | 1 | 2 | 3 | 4 | 5 | _____mois |
| e. | Oracle | 1 | 2 | 3 | 4 | 5 | _____mois |
| f. | | 1 | 2 | 3 | 4 | 5 | _____mois |
| g. | | 1 | 2 | 3 | 4 | 5 | _____mois |
| h. | | 1 | 2 | 3 | 4 | 5 | _____mois |

**2.** Êtes-vous d'accord que le logiciel de GIR a procuré les avantages stratégiques suivants à votre organisation ?

| | | Pas d'accord du tout | Légèrement d'accord | Modérément d'accord | Très en accord | Totalement d'accord |
|---|---|---|---|---|---|---|
| a. | Frais d'exploitationplus bas | 1 | 2 | 3 | 4 | 5 |
| b. | Meilleure collaboration | 1 | 2 | 3 | 4 | 5 |
| c. | Flexibilité accrue | 1 | 2 | 3 | 4 | 5 |
| d. | Efficacité augmentée | 1 | 2 | 3 | 4 | 5 |
| e. | Durée du temps de cycle réduite | 1 | 2 | 3 | 4 | 5 |
| f. | Communication améliorée | 1 | 2 | 3 | 4 | 5 |
| g. | Revenu augmenté | 1 | 2 | 3 | 4 | 5 |
| h. | Ratio de marge bénéficiaire plus élevé | 1 | 2 | 3 | 4 | 5 |

| | Négligeable | | | | Excellente |
|---|---|---|---|---|---|
| **3.** Veuillez évaluer l'acquisition des aptitudes et des connaissances nécessaires à l'utilisation efficace du logiciel de GIR. | 1 | 2 | 3 | 4 | 5 |
| **4.** Veuillez évaluer l'effort accordé à l'acquisition des aptitudes et des connaissances nécessaires à l'implémentation du logiciel de GIR. | 1 | 2 | 3 | 4 | 5 |

## Section B: Atteinte des objectifs de performance de la RPA

**La réingénierie des processus d'affaires (RPA)** est le résultat de la transformation et du remaniement des processus organisationnels au moyen des technologies de l'information et ce, dans le but d'accroître de façon significative la productivité, la satisfaction du consommateur, la qualité organisationnelle, l'étendue du marché ainsi que la réduction des coûts et des défauts. **Acquisition des compétences et des connaissances** représente les compétences et les connaissances, acquises par l'organisation, nécessaires à l'application efficace des processus remaniés. **Effort accordé à l'acquisition des compétences et des connaissances** représente l'effort accordé pour l'obtention des compétences et des connaissances requises. **Temps écoulé** représente le temps écoulé depuis la réingénierie des processus organisationnels suivants. Veuillez répondre en termes de mois.

5. Pour chacun des processus organisationnels ci-dessous (logistique interne, opérations, etc.), évaluez **l'amélioration** dans les secteurs de performance (productivité, satisfaction de la clientèle, etc.) depuis l'implémentation du logiciel de RPA. (Voir l'example suivant.)

   Dans cet exemple, nous pouvons observer de bonnes améliorations dans la productivité, la qualité organisationnelle, l'étendue du marché, la réduction des défauts ainsi qu'une amélioration acceptable de la satisfaction de la clientèle et une réduction significative des coûts. Il y a eu une acquisition passable des aptitudes et des connaissances requises ainsi qu'un bon effort fourni pour les acquérir. Quatorze mois se sont écoulés depuis la réingénierie de ce processus.

| Négligeable 1 | Inférieure 2 | Passable 3 | Bonne 4 | Excellente 5 | Sans-objet S.O. |
|---|---|---|---|---|---|

| **Processus organisationnels** / **Secteurs de performance** | Productivité | Satisfaction de la clientèle | Qualité organisationnelle | Étendue du marché | Réduction des coûts | Réduction des défauts | Acquisition des compétences et des connaissances | Effort accordé à l'acquisition des compétences et des connaissances | Temps écoulé (en mois) |
|---|---|---|---|---|---|---|---|---|---|
| **Exemple : Service après-vente** | 4 | 3 | 4 | 4 | 5 | 4 | 3 | 4 | 14 |
| a. Logistique interne | | | | | | | | | |
| b. Opérations | | | | | | | | | |
| c. Logistique externe | | | | | | | | | |
| d. Marketing et ventes | | | | | | | | | |
| e. Service après-vente | | | | | | | | | |
| f. Coordination administrative et service de soutien | | | | | | | | | |
| g. Gestion des ressources humaines | | | | | | | | | |
| h. Développement technologique | | | | | | | | | |
| i. Approvisionnement des ressources | | | | | | | | | |

## Section C : Culture organisationnelle

**6.** Veuillez indiquer l'importance que votre organisation accorde aux attributs suivants :

| | | Pas important | | Plutôt important | | Très important |
|---|---|---|---|---|---|---|
| a. | Participation et discussion libre | 1 | 2 | 3 | 4 | 5 |
| b. | Liberté d'action du personnel | 1 | 2 | 3 | 4 | 5 |
| c. | Considération des inquiétudes et des idées du personnel | 1 | 2 | 3 | 4 | 5 |
| d. | Relations humaines, travail d'équipe et cohésion | 1 | 2 | 3 | 4 | 5 |
| e. | Flexibilité et décentralisation | 1 | 2 | 3 | 4 | 5 |
| f. | Expansion, croissance et développement | 1 | 2 | 3 | 4 | 5 |
| g. | Innovation et changement | 1 | 2 | 3 | 4 | 5 |
| h. | Méthode créative de résolution de problèmes | 1 | 2 | 3 | 4 | 5 |
| i. | Contrôle et centralisation | 1 | 2 | 3 | 4 | 5 |
| j. | Uniformisation, élaboration et structure | 1 | 2 | 3 | 4 | 5 |
| k. | Stabilité, continuité et commande | 1 | 2 | 3 | 4 | 5 |
| l. | Performances anticipées | 1 | 2 | 3 | 4 | 5 |
| m. | Souci de la tâche, accomplissement et atteinte des objectifs | 1 | 2 | 3 | 4 | 5 |
| n. | Direction, établissement de objectifs et clarté des buts | 1 | 2 | 3 | 4 | 5 |
| o. | Efficacité, productivité et rentabilité | 1 | 2 | 3 | 4 | 5 |
| p. | Excellence des résultats et qualité | 1 | 2 | 3 | 4 | 5 |

**7.** Veuillez indiquer si les attributs sont plus importants, moins importants ou s'ils sont demeurés inchangés pour votre organisation depuis la réingénierie des processus d'affaires.

| | | Moins important | | Pas de changement | | Plus important |
|---|---|---|---|---|---|---|
| a. | Participation et discussion libre | -2 | -1 | 0 | 1 | 2 |
| b. | Liberté d'action du personnel | -2 | -1 | 0 | 1 | 2 |
| c. | Considération des inquiétudes et des idées du personnel | -2 | -1 | 0 | 1 | 2 |
| d. | Relations humaines, travail d'équipe et cohésion | -2 | -1 | 0 | 1 | 2 |
| e. | Flexibilité et décentralisation | -2 | -1 | 0 | 1 | 2 |
| f. | Expansion, croissance et développement | -2 | -1 | 0 | 1 | 2 |
| g. | Innovation et changement | -2 | -1 | 0 | 1 | 2 |
| h. | Méthode créative de résolution de problèmes | -2 | -1 | 0 | 1 | 2 |
| i. | Contrôle et centralisation | -2 | -1 | 0 | 1 | 2 |
| j. | Uniformisation, élaboration et structure | -2 | -1 | 0 | 1 | 2 |
| k. | Stabilité, continuité et commande | -2 | -1 | 0 | 1 | 2 |
| l. | Performances anticipées | -2 | -1 | 0 | 1 | 2 |
| m. | Souci de la tâche, accomplissement et atteinte des objectifs | -2 | -1 | 0 | 1 | 2 |
| n. | Direction, établissement de objectifs et clarté des buts | -2 | -1 | 0 | 1 | 2 |
| o. | Efficacité, productivité et rentabilité | -2 | -1 | 0 | 1 | 2 |
| p. | Excellence des résultats et qualité | -2 | -1 | 0 | 1 | 2 |

## Section D : Renseignements généraux.

**8.** Votre organisation a-t-elle employé un plan d'action spécifique afin de favoriser la réussite de l'adoption des changements organisationnels ? ☐ Oui ☐ Non

**9.** Si vous avez répondu oui à la question 8, combien de phases majeures ce plan d'action comprend-il ? _____ phases

**10.** Quel poste occupez-vous ? _____

**11.** Depuis combien de temps occupez-vous ce poste ? _____an(s)

**12.** Depuis combien de temps êtes-vous au service de votre organisation ? _____an(s)

**13.** Quel est le nombre total d'employé(e)s travaillant au sein de votre entreprise ? _____

**14.** Quel est le chiffre d'affaires de votre entreprise ? _____

**15.** Quel est le principal secteur d'activités de votre entreprise ?

| | |
|---|---|
| Industries manufacturières | Agriculture, forêts et pêcheries |
| Commerce de gros | Exploitation minière |
| Commerce de détail | Construction |
| Finances, assurances et immobilier | Transport |
| Communications | Santé |
| Services | Autres :_____ |

**Veuillez retourner ce questionnaire dans l'enveloppe ci-jointe.**
**Merci de votre précieuse collaboration.**

Si vous désirez obtenir une copie du sommaire exécutif de cette étude, veuillez insérer votre carte professionnelle dans l'enveloppe-retour. N'hésitez pas à communiquer avec nous pour toutes questions ou commentaires.

Antonio Kappos
Étudiant à la maîtrise en Science et Administration
Université Concordia
1455 boul. de Maisonneuve O.
GM 209-13
Montréal, Québec, Canada H3G 1M8
Tél. (514) 728-8657
Courriel : lefebvre.kappos@sympatico.ca

Anne-Marie Croteau, Ph.D.
Professeur adjoint
Université Concordia
Department of Decision Sciences & MIS
1455 boul. de Maisonneuve O.
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Montréal, Québec, Canada H3G 1M8
Tél.: (514) 848-2983
Fax: (514) 848-2824
Courriel : croteau@alcor.concordia.ca

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Nous n'utilisons ce numéro qu'à titre de référence. _____

# Appendix B1: English CEO and CIO cover letters

*Date*

*Top Management*
*Title*
*Company*
*Address*
*City (Province)*
*Postal Code*

**Subject: Organizational Culture and the Achievement of ERP and BPR Performance improvements Questionnaire.**

*Prefix Name,*

I am a graduate student at Concordia University, Montreal, completing a Masters of Science degree in Administration. I am currently doing a study on the relationship between the achievement of performance improvements of **Enterprise Resource Planning (ERP)** and **Business Process Reengineering (BPR)** from an organizational culture perspective. This study will attempt to measure your organization's culture using a cultural values questionnaire, then find the link between your organization's culture and the achievement of the performance improvements of the implemented ERP and/or BPR projects. My study is supervised by Dr. Anne-Marie Croteau.

Since we do not know the name of your chief information officer (or upper level manager responsible for software and systems implementation), would you be kind enough to forward to this individual the second questionnaire. The input of this individual is also important to us.

I would ask you for your help by answering this carefully designed questionnaire. Responding should not take more than fifteen (15) minutes. All the information you provide while responding will be kept strictly confidential. Your participation in this study is completely voluntary.

Sincerely,

Antonio Kappos
MScA in MIS/DS,
Concordia University
Tel.: (514) 728-8657
e-mail: lefebvre.kappos@sympatico.ca

*Date*

**Subject: Organizational Culture and the Achievement of ERP and BPR Performance improvements Questionnaire.**

Dear Sir or Madam:

I am a graduate student at Concordia University, Montreal, completing a Masters of Science degree in Administration. I am currently doing a study on the relationship between the achievement of performance improvements of **Enterprise Resource Planning (ERP)** and **Business Process Reengineering (BPR)** from an organizational culture perspective. This study will attempt to measure your organization's culture using a cultural values questionnaire, then find the link between your organization's culture and the achievement of the performance improvements of the implemented ERP and/or BPR projects. My study is supervised by Dr. Anne-Marie Croteau.

I would ask you for your help by answering this carefully designed questionnaire. Responding should not take more than fifteen (15) minutes. All the information you provide while responding will be kept strictly confidential. Your participation in this study is completely voluntary.

Sincerely,

Antonio Kappos
MScA in MIS/DS,
Concordia University
Tel.: (514) 728-8657
e-mail: lefebvre.kappos@sympatico.ca

# Appendix B2: French CEO and CIO cover letters

*Date*

*Top Management*
*Title*
*Company*
*Address*
*City (Province)*
*Postal Code*

**Object : Questionnaire sur la culture organisationnelle et sur l'atteinte des objectifs de performance de la gestion intégrée des ressources et de la réingénierie des processus d'affaires**

*Prefix Name,*

Je suis un étudiant diplômé de l'université Concordia de Montréal qui termine une maîtrise en Science et Administration. Je mène actuellement une étude sur la relation entre l'atteinte des objectifs de performances de la gestion intégrée des ressources (GIR) et de la réingénierie des processus d'affaires (RPA) dans la perspective de culture organisationnelle. Cette étude tente de mesurer la culture de votre organisation à l'aide d'un questionnaire sur les valeurs culturelles pour ensuite établir un lien entre la culture de votre organisation et l'atteinte des objectifs de performance de l'implémentation de projets de GIR et de RPA. Mon étude est supervisée par Anne-Marie Croteau Ph. D.

Puisque nous ne connaissons pas le nom de votre chef du service de l'information (ou du cadre supérieur responsable de l'implémentation des systèmes informatiques et de logiciels, auriez-vous l'obligeance de lui faire suivre le deuxième questionnaire. La contribution de cette personne est également très importante pour nous.

Je requiers donc votre aide et vous demande de bien vouloir répondre à ce questionnaire. Le temps de réponse ne devrait pas excéder quinze (15) minutes. Tous les renseignements divulgués dans ce questionnaire sont strictement confidentiels. Votre participation à cette étude se fait sur une base volontaire.

Je vous prie d'agréer, Monsieur, l'expression de mes salutations distinguées,

Antonio Kappos
Étudiant et Science et Administration
Université Concordia
Tel. : (514) 728-8657
Courriel : lefebvre.kappos@sympatico.ca

*Date*

**Object : Questionnaire sur la culture organisationnelle et sur l'atteinte des objectifs de performance de la gestion intégrée des ressources et de la réingénierie des processus d'affaires.**

Madame, Monsieur,

Je suis un étudiant diplômé de l'université Concordia de Montréal qui termine une maîtrise en Science et Administration. Je mène actuellement une étude sur la relation entre l'atteinte des objectifs de performances de la gestion intégrée des ressources (GIR) et de la réingénierie des processus d'affaires (RPA) dans la perspective de culture organisationnelle. Cette étude tente de mesurer la culture de votre organisation à l'aide d'un questionnaire sur les valeurs culturelles pour ensuite établir un lien entre la culture de votre organisation et l'atteinte des objectifs de performance de l'implémentation de projets de GIR et de RPA. Mon étude est supervisée par Anne-Marie Croteau Ph. D.

Je requiers donc votre aide et vous demande de bien vouloir répondre à ce questionnaire. Le temps de réponse ne devrait pas excéder quinze (15) minutes. Tous les renseignements divulgués dans ce questionnaire sont strictement confidentiels. Votre participation à cette étude se fait sur une base volontaire.

Je vous prie d'agréer, Madame, Monsieur, l'expression de mes salutations distinguées,

Antonio Kappos
Étudiant et Science et Administration
Université Concordia
Tel. : (514) 728-8657
Courriel : lefebvre.kappos@sympatico.ca

# Appendix C: English and French Reminders

*Date*

**Reminder**

Dear Sir or Madam:

At the beginning of April, I sent you a questionnaire on Enterprise Resource Planning (ERP) and Business Process Reengineering (BPR) from an organizational culture perspective. If you have already responded to this questionnaire, thank you and please disregard this reminder. If you have not already answered the questionnaire, I invite you and your chief information officer to answer the questionnaire and return it as soon as possible. If your organization has not implemented ERP software, your response to the rest of the questionnaire would still remain invaluable to my study.

Your collaboration in this study will help us identify the benefits of implementing an ERP software, identify productivity increases in performing BPR, and identify which culture characteristics are most related to successful ERP and BPR projects. If you have not received the questionnaire, or have since misplaced it, do not hesitate to contact me at (514) 728-8657. You can mail the questionnaire to the address shown below.

Sincerely,

Antonio Kappos
M.Sc. Student
Concordia University
Department of Decision Sciences & MIS
1455 de Maisonneuve Blvd. W. GM 209-13
Montreal, Quebec, Canada H3G 1M8
lefebvre.kappos@sympatico.ca

*Date*

**Rappel**

Madame, Monsieur,

Au début du mois d'avril, je vous ai fait parvenir un questionnaire sur la gestion intégrée des ressources (GIR) et la réingénierie des processus d'affaires (RPA) dans la perspective de culture organisationnelle. Si vous avez déjà répondu à ce questionnaire, je vous remercie et vous prie de ne pas tenir compte de ce rappel. Si vous n'avez toujours pas répondu à ce questionnaire, je vous invite, vous et votre directeur(trice) du département des systèmes d'information, à répondre à ce questionnaire et à me le faire parvenir dès que possible. Si votre organisation n'a pas procédé à l'implémentation d'un logiciel de GIR, vous pouvez répondre aux autres sections car ces réponses constituent de précieuses données pour mon étude.

Votre collaboration à cette étude nous aidera à identifier les avantages qui découlent de l'implémentation d'un logiciel de GIR, l'augmentation de la productivité liée à la RPA et à déterminer quelles caractéristiques culturelles profitent le plus de l'implémentation réussie de projets de GIR et de RPA. Si vous n'avez toujours pas reçu le questionnaire ou si vous l'avez égaré depuis, n'hésitez pas à communiquer avec moi au (514) 728-8657. Vous pouvez également me retourner le questionnaire à l'adresse indiquée ci-dessus.

Je vous prie d'agréer, Madame, Monsieur, l'expression de mes salutations distinguées,

Antonio Kappos
Étudiant à la maîtrise en Science et Administration
Université Concordia
1455 boul. de Maisonneuve O. GM 209-13
Montréal, Québec, Canada H3G 1M8
lefebvre.kappos@sympatico.ca

# Appendix D1: English and French pretest questions and resolutions

1. How long did it take you to respond to the questionnaire?_____

2. Was the vocabulary used clear?
   Comments (if needed for all questions):

3. Do you think that the vocabulary was appropriate?
   Comments:

4. Were the directions for responding clear?
   Comments:

5. Did you find any of the questions to be leading you to respond other than you feel?
   Comments:

6. Did you understand what was being asked of you?
   Comments:

7. Did you find offense with anything at all in the questionnaire?
   Comments:

1. Combien de temps avez-vous accordé pour répondre à ce questionnaire ?_____

2. Est-ce que le vocabulaire employé est clair ?
   Commentaires : (pour toutes les questions si tel est le cas):

3. Croyez-vous que le vocabulaire employé est approprié ?
Commentaires :

4. Est-ce que les instructions sont claires ?
Commentaires :

5. Did you find any of the questions to be leading you to respond other than you feel????
Commentaires :

6. Avez-vos bien compris ce qu'on vous a demandé ?
Commentaires :

7. Avez-vous été offensé(e) par quoi que ce soit dans ce questionnaire ?
Commentaires :

# Appendix D2: Pretest concerns and resolutions

A. q7. Not sure what was meant under 'Market Coverage'
This term is provided by Porter's value chain, and may not be possible to changed.

B. q4. Should start with 'If Yes to # 3,'
Accepted

C. q7. Not all respondents will be knowledgeable on all Organizational Processes. This question should have a bullet to state that the respondent should only answer the Organizational Processes that they are familiar with.
It is of course understandable that that some organizations will not be knowledgeable about some of the processes listed. Suggest that I include as a possible response for the CEO's to be N/A = Not Applicable.

D. q8. Si le but de la question 8 est de définir la culture d'entreprise, la liste des attributs me semble incomplète.
Organizational culture can of course be more complicated then what is described in the questionnaire. Under other circumstances, I would have perhaps found a more comprehensive measurement for organizational culture. I understand that organizational culture should perhaps usually be studied qualitatively, yet time and budget do not allow for this unfortunately.

E. q9. J'aurais tendance à préciser à quel niveau de l'organisation on fait référence quand on demande s'il y a eu changement dans l'importance accordé aux différents attributs (changement au niveau de la direction ou plus grande adhésion des employés la culture)
Noted, and I suggest emphasizing the organization as a whole.

F. q8. Les aspects culturels est posée de façon directe et risque d'influencer le répondant dans le sens où on risque de recevoir des réponses notées beaucoup plus en borne supérieur qu'inférieur. Peu de gestionnaires avoueront d'emblée les déficiences de leur culture d'entreprise, à moins d'être un nouvel arrivant de l'organisation. Le véritable diagnostic sur la culture organisationnelle de l'organisation vient presque à tout coup de la base et non des gestionnaires qui ont normalement tendance à penser que leur style de gestion est toujours le plus approprié et qu'il rencontre tous les critères énoncés à la question 8.
This is usually acceptable as long as the questionnaire has that potential effect on all the respondents (i.e. responses follow a normal distribution). The result will be a smaller range of variation, but statistical tests should sufficiently tell us whether there is a pattern to be seen in the data. This is to say that perhaps the max and min values will be closer together, but as long as there is variation in the responses, then bias can be ruled out.

G. q7. Ma principale difficulté à la lecture du questionnaire se situe principalement au niveau de la définition de la RPA et du peu de distinction que l'on semble faire entre les processus d'affaires et les processus de support. Je ne me lancerai pas ici dans un exposé sur les deux faits suivants :

- qu'une vision de la réingénierie comme étant un remaniement essentiellement technologique des processus est réductrice,
- et qu'il y a une différentiation importante entre processus d'affaires et processus de support,

mais je me contenterai de dire que cette définition m'indispose. Je crois qu'ici on tombe dans le piège de la réduction informatique de la perspective de ce que doit être la réingénierie des processus qui doit s'appuyer d'abord sur l'identification de concept de fonctionnement (au niveau des cinq ressources de toute organisation, soit : les ressources humaines, matérielles, informationnelles, technologiques et financières) répondant à la finalité des processus et des objectifs de performance qu'une organisation se fixe en fonction de ladite finalité.

H. q5, q6. Need to elaborate on what is meant by percentage.
For this question, I changed the response format to use a 1 to 5 likert scale with the same anchors that are found in q7.

I. Part B. Is the BPR performance improvements obtained via ERP solutions?
In an interview with one executive, the executive did not have the same concern, and understood that performing BPR may be independent of ERP.

J. q7 What is meant by inbound, outbound logistics and by the procurement of resources.
Some respondents may not understand these organizational processes due to them not forming an integral part of the everyday operations of the organization. Suggested in concern three that I include as response format N/A=Not Applicable.

K. q15. Select one or more.
Noted

L. Part A: Definition of ERP needs some work. Suggests that we explain better with reference to front and back office. Many organizations do not do or are unaware of the front office aspect of ERP.
Suggest definition as follows:
**Enterprise Resource Planning (ERP)** represents the integration of front office and back office software solutions under a single information systems.

M. q2. Should include option for N/A.
In this case, I believe that it is not necessary to include a response N/A for this question since if the respondents believe that the strategic advantage is not applicable, then they do not agree that there exists some strategic advantage in the specified area.

N. q5, q6. Need new measurement scale.
Suggest using the same scale that is found in Part B (i.e. likert scale 1 to 5).

O. q7. Acquisition of skills and knowledge and effort to acquire skills and knowledge should use the same scale as other measurements (Productivity to Defects Reduction).
OK

P. q7. Maybe use inbound logistics as example instead of Customer Service
OK

Q. q7. May need to define inbound and outbound logistics.
See concern J.

# Appendix E: T-Statistics for the Model Testing.

T-Statistic for ERP culture model (See Figure 5)

| | Group Change | Developm Change | Hierarch Change | Rational Change |
|---|---|---|---|---|
| **ERP strategic advantages** | 3.3459 | 0.9465 | 4.4602 | 3.1445 |

T-Statistics for BPR Culture Model (See Figure 6)

| | Group Change | Developm Change | Hierarch Change | Rational Change |
|---|---|---|---|---|
| **BPR perf. imp** | 2.1799 | 1.5942 | 1.7530 | -0.4065 |

T-Statistic for ERP Culture change model (With assimilation and Elapsed time constructs, see Figure 7)

| | Group Change | Developm Change | Hierarch Change | Rational Change | Skills & Knowledge | Effort | Elapsed time |
|---|---|---|---|---|---|---|---|
| **ERP strategic advantages** | 0.9604 | -0.4904 | -0.9151 | 1.4377 | 0.0000 | 0.0000 | 0.0000 |
| **Group Change** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | -2.0711 | 1.8499 | -0.6089 |
| **Developmental ch.** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | -0.8743 | 1.0630 | 0.0074 |
| **Hierarchical change** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | -0.9411 | -0.4083 | -3.3437 |
| **Rational change** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | -0.5928 | 0.1623 | 0.8770 |
| **Skills & Know.** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 4.3796 | 0.0000 |

T-Statistic for BPR Culture change model (With assimilation and Elapsed time constructs, See Figure 8)

| | Group Change | Developm Change | Hierarch Change | Rational Change | Skills & Knowledge | Effort | Elapsed time |
|---|---|---|---|---|---|---|---|
| **BPR perf. Imp** | 0.3455 | -1.3761 | -0.2764 | 3.3371 | 0.0000 | 0.0000 | 0.0000 |
| **Group change** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 2.2360 | -1.2021 | 0.6441 |
| **Developmental ch.** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | -1.8426 | 2.6684 | 0.7903 |
| **Hierarchical change** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 1.2352 | -0.9090 | -1.0916 |
| **Rational** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | -0.3327 | 0.3012 | 1.7695 |
| **Skills a** | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 9.8106 | 0.0000 |

T-Statistic for ERP Culture change model (Without Assimilation and Elapsed time constructs, See Figure 9)

| | Group Change | Developm Change | Hierarch Change | Rational Change |
|---|---|---|---|---|
| **ERP strategic advantages** | 0.7124 | -1.1405 | -0.7266 | 2.2309 |

T-Statistic for BPR Culture change model (Without Assimilation and Elapsed time constructs, See Figure 9)

| | Group Change | Developm Change | Hierarch Change | Rational Change |
|---|---|---|---|---|
| **BPR perf. imp** | -0.8204 | -1.9130 | 0.2748 | 2.5937 |

# Appendix F: Path coefficient tables for culture change models.

| | Group Change | Developm Change | Hierarch Change | Rational Change | Skills & Knowledge | Effort | Elapsed time |
|---|---|---|---|---|---|---|---|
| ERP strategic advantages | 0.264 | -0.32 | -0.217 | 0.642 | | | |
| Group Change | | | | | -0.496* | 0.424* | -0.181 |
| Developmental ch. | | | | | -0.242 | 0.318 | -0.022 |
| Hierarchical change | | | | | -0.11 | -0.152 | -0.523*** |
| Rational change | | | | | -0.123 | 0.01 | 0.236 |
| Skills & Know. | | | | | | 0.709*** | |

**Table E1 Path coefficients for Figure 7: ERP strategic advantages, culture change, assimilation and elapsed time. * $P \leq 0.05$. *** $P \leq 0.001$.**

| | Group Change | Developm Change | Hierarch Change | Rational Change | Skills & Knowledge | Effort | Elapsed time |
|---|---|---|---|---|---|---|---|
| BPR perf. imp | 0.174 | -0.27 | -0.06 | 0.712*** | | | |
| Group change | | | | | 0.664* | -0.419 | 0.258 |
| Developmental ch. | | | | | -0.726* | 0.707** | 0.175 |
| Hierarchical change | | | | | 0.485 | -0.364 | -0.273 |
| Rational | | | | | -0.043 | 0.032 | 0.342* |
| Skills a | | | | | | 0.862*** | |

**Table E2 Path coefficients for Figure 8: BPR performance improvements, culture change, assimilation and elapsed time. * $P \leq 0.05$. ** $P \leq 0.01$. *** $P \leq 0.001$.**