



The Effects of an Enterprise Resource Planning System (ERP) Implementation on Job Characteristics: A Study Using the Hackman and Oldham Job Characteristics Model

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ABSTRACT

Many organizations have implemented Enterprise Resource Planning (ERP) systems to replace their legacy systems. ERP implementation changes the roles, responsibilities, and job characteristics of organizational participants. This study examined two issues. To what extent does enterprise resource planning implementation lead to work redesign and what is the impact of ERP initiated work redesign on employee job satisfaction? The sample frame for this research was made up of nine government organizations located in the Ottawa, Canada area, which have implemented the SAP R/3 enterprise resource system. The Job Characteristic model proposed by Hackman and Oldham was used to analyze the work redesign. The research found that ERP implementation brought significant structural and cultural changes to these organizations.

INTRODUCTION

An enterprise resource planning system (ERP) is, in essence, an integrative mechanism connecting diverse departments through a shared database and compatible software modules (Hammer and Stanton, 1999). Enterprise resource planning systems developed by companies such as People Soft, SAP, Oracle, and Baan are widely used in businesses to provide a platform for integrating functional and operational processes across the entire enterprise. A report from industry analysts, Advanced Manufacturing Research (AMR) found that in the mid - 1990's vendors of Enterprise Resource Planning (ERP) software experienced unprecedented global expansion (Logistics Management, September 1997). Although growth in this sector has slowed since then, many companies continue to view ERP systems as necessary for integrating core business processes.

Typically, ERP systems are implemented by large and medium sized companies, government departments, and related organizations to increase operational efficiency and support business growth. Survey results based on data collected from 186 companies from a broad cross section of industries where SAP implementation had taken place highlighted eight important reasons why organizations initially chose to implement SAP. These reasons were: to standardize company processes, integrate operations or data, reengineer business processes, optimize supply chain, increase business flexibility, increase productivity, support globalization and help solve year 2000 problems (Cooke and Peterson, 1998).

When an integrated system is implemented, organizational and management structures have to be changed in fundamental ways (Hammer and Stanton, 1999). A new, more collaborative organizational culture is needed for the functional units to work with the integrated system. When the organizational structure changes, people have to be moved from some jobs to jobs with different roles and responsibilities. Reaping the benefits afforded by enterprise systems requires a change in the basic nature of work and the restructuring of jobs to provide challenging, meaningful work for every employee who was now interacting with the systems (Davenport, 1998).

Researchers argue that a healthy organizational setting is created for an enterprise resource planning system only when the employees have a positive relationship with their work, a relationship that will make them efficient and give them a sense of job satisfaction (Davenport, 1998; Hammer and Stanton, 1999). They further state that

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matching the human resources with the process system is a critical issue in the whole implementation process. The ultimate success of an enterprise system lies in how the employees accept and adapt to the new process system.

Government organizations that have implemented ERP systems have had to redesign work in their functional units in order to accommodate process and infrastructure changes. This meant that jobs and skills had to be thoroughly analyzed and re-engineered to suit the new environment.

This paper reports on exploratory research carried out in nine Canadian Federal Government organizations that have undergone an ERP implementation. The research attempts to answer two questions. To what extent does ERP implementation lead to work redesign and what is the impact of ERP initiated work redesign on employee job satisfaction?

THEORIES OF JOB REDESIGN

Work redesign occurs whenever a job is changed. Whether it occurs because of new technology, internal reorganization or a whim of management, it can be said that work redesign has taken place (Hackman and Oldham, 1975). In the 1970's redesign of work was considered the solution for motivating employees at work. Some work redesign theories put forward by behavioral scientists are shown in Table 1.

The theorems presented in Table 1 examine the factors that would increase employee motivation at work. In 1975 Hackman and Oldham proposed a comprehensive job characteristics model for work redesign in modern organizations.

Hackman and Oldham proposed that individuals would be motivated towards their job and feel job satisfaction only when they experience certain psychological states. They identified these critical psychological states as experienced meaningfulness of work, experienced responsibility for outcomes of the work, and knowledge of actual results of the work activities. The positive effect created by the presence of these psychological states is believed to be reinforcing and serves as an incentive for continuing to do the task. In order to provide these psychological states, a job should have certain core characteristics. Hackman and Oldham found that the experienced meaningfulness at work is facilitated by skill variety, task identity and task significance. The level of autonomy in a job increases the feeling of

Table 1: Theories on motivation and work redesign

Researchers	Theory	Basic Assumptions
Frederick Herzberg (1959)	Two Factor Theory	Hygiene factors are necessary to maintain a reasonable level of satisfaction in employees, which are extrinsic and are related to the job context. They are pay, benefits, job security, physical working conditions, supervision policies, company policies and relationships with co-workers. Motivating factors are intrinsic to the content of the job itself. These are factors, such as achievement, advancement, recognition and responsibility. It is these factors that bring job satisfaction and improvement in performance.
Douglas McGregor (1960)	Theory X and Theory Y	McGregor's Theory X assumes that employees are lazy and unwilling to produce above the minimum requirements. By contrast, Theory Y assumes that people are not by nature passive or resistant to organizational objectives. The essential task of management is to arrange organizational operations in such a way that employees achieve their own goals by directing their efforts towards organizational objectives.
Researchers	Theory	Basic Assumptions
Turner and Lawrence (1965)	Requisite Task Attributes Model	They used six requisite task attributes such as variety, required interaction, knowledge and skill, autonomy, optional interaction and responsibility to calculate a requisite task attribute index (RTA). They found strong links between attendance, worker's involvement and attributes of the work.
William Scott (1966)	Activation Theory	When jobs are dull or repetitive it leads to low levels of performance because dull jobs fail to activate the brain. However, when jobs are enriched, it leads to a state of activation and enhances productivity.

personal responsibilities for work outcomes. They also found that when a job has good feedback, it provides the employee with increased knowledge of the actual results of the work activities. The job characteristics model suggested that growth need strength (GNS) is a moderator, which affects the employees' reactions to their work. Hackman and Oldham used a job diagnostic survey (JDS) to test their job characteristics model. Data was obtained from 658 employees working on 62 different jobs in seven organizations.

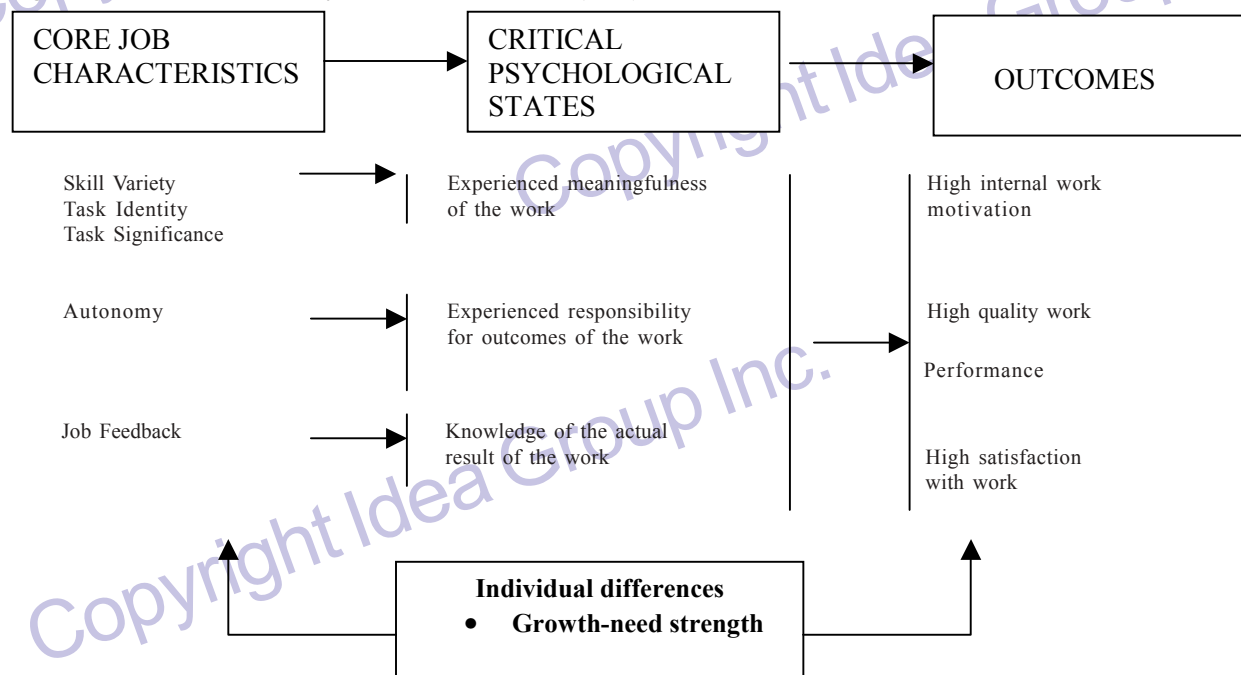
METHODOLOGY

This research used the job characteristics model as a tool for understanding the work redesign initiated in organizations where an ERP system was implemented. However, JDS was not used to collect data. The JDS is not appropriate for use in diagnosing jobs of single individuals. Five or more individuals who work in the same job are averaged, and the scale reliabilities are only valid for such grouped items. JDS scores for single individuals are not sufficient to substantiate work redesign for individuals (Hackman and Oldham, 1975). A large amount of cooperation is required from participants and management for the successful administration of a JDS since it requires a job rating form filled out by the supervisors of the participants. The following steps were taken to collect data for this research.

Findings and Discussion

The research found that 75 percent of the respondents agreed that they used

Figure 1: Hackman and Oldham job characteristics model (1975)



Source: J. R. Hackman and G. R. Oldman, work redesign (Reading, MA: Addison-Wesley Publishing Co., 1980)

Table 2: Steps taken to collect data

Ethics clearance	A draft of the research proposal was submitted to the Carleton University ethics clearance committee and approval was obtained.
Pretest	A pre-test was conducted at a prominent government organization in Ottawa, which implemented the ERP system in 1998. A set of questionnaires was given and feedback was obtained. After reviewing the pretest results, three additional questions were added to the final questionnaire.
Sampling Instrument One Questionnaire	The final questionnaire had twenty-eight questions. The questions were similar to the once asked in the JDS. In order to clearly understand the respondent's view on job characteristics, these questions were asked in two different ways. Seventeen questions were on the components of the job characteristics model (nine were on job dimensions, four on psychological states, three on personal and work outcomes and one on the growth need strength of the individual). Four were on the ERP system and five questions on the demographic details of the respondent. The questionnaire used five point Likert scales to collect responses. In addition, the questionnaire had two open ended questions. The first question was geared to understanding what other organizational changes (e.g. organizational restructuring, a change in organizational policies, mergers, downsizing), had taken place during the SAP implementation. The second open question asked the respondents about other significant influences (e.g. change in work supervisor, a change in work location, personal issues) on the work environment of the respondent prior to or during the implementation. By asking these two questions we were able to get some insight into the change processes that had taken place in these organizations when the process system was introduced. This allowed us to distinguish between the changes initiated by the process system and those brought about by other organizational factors.
Sampling Instrument Two Interviews	Interviews were held with five middle and senior managers. Three interviewees were from the finance department and the others were from production, operations and computer system support. The interview process was guided by an open-ended questionnaire, based on the previous questionnaire.
Data Collection	Over a period of three months more than one hundred questionnaires were sent through emails and by personal delivery to employees from the human resources, logistics and finance departments. Their participation was voluntary. These departments were chosen mainly because SAP produces popular modules for these functional departments. Forty-seven SAP users from nine government organizations responded to the questionnaire.
Data Analysis	The responses from the questionnaires were coded into an SPSS file to facilitate statistical analysis. In addition to frequencies, correlations and <i>t</i> tests, some of same analyses carried out in the original Hackman and Oldham (1976) study were also done. The interviews were recorded with the permission of the respondents and later transcribed. A content analysis was done on the interview transcriptions.

more skills with SAP than they did before. The interview participants also generally felt that the SAP system allowed the employees to use their skills and talents more. With the legacy systems they had only to understand a limited number of processes and perform them repetitively. With SAP they had to be very analytical and clearly understand their part in the whole process. SAP users employ their skills and talents when they try new processes and deal with the software. However, some managers said that using more skills and talents largely depended on the set of skills the employees possessed. Employees who

have more computer skills would use them much more than employees who do not have them.

With regard to task identity 55 percent of the sample agreed that they knew their work outcomes in the process system. Every transaction that is entered into SAP has a nametag attached to it. If a person is working with the accounting module and is in charge of the general ledger, that individual will be responsible for doing the ledgers, making changes and maintaining them. When this is fed into the process system, employees can identify their part of work interacting with the whole organization. Therefore, individuals know who is doing what and whether data is being processed correctly. The system will also detect errors made by individuals. However, there are security features that prevent employees from accessing all information. Some managers argue that these features considerably reduce task identity for employees.

More than 80 percent of the respondents who answered the questionnaires agreed that the process system provided employees with autonomy and independence at work. An integrated system provides the users with all the necessary information to perform their work. When a new transaction takes place the information is instantly available company wide. Once the data is in the system, it is an easy matter for an employee to retrieve it. Managers prepare reports and allow their employees to do their own queries. It is up to individual employees to retrieve appropriate data. However, because of the complex nature of SAP, some managers raised doubts about whether the process system provided employees with autonomy. They considered SAP to be a highly standardized system and expected individual employees to work within a given framework. Once the process system was set up, it provided little flexibility. For example, a receiver must immediately enter relevant data when products are received. The employee cannot wait until the next because that would cause many mismatches in the system. In an integrated system every interaction becomes important. Small transactions can have a large impact on the organization. This may be the reason over 55 percent of the respondents felt that their work with the SAP was more significant to the organization than it was before. With the SAP system, individuals need to know what is driving the system and where it is being driven because it depends on individuals to provide accurate and timely data. For example, before the integrated system, a payroll clerk counted the time for each employee and passed the information to the compensation section clerk. However, in a process system, this data drives the whole system. This makes the payroll clerk's task more significant than before. A majority of the interviewees felt that the system provided task identity and task significance to employees. However, when it came to whether the SAP system provided independence or autonomy to individuals, the response was negative. The participants also felt that the system did not provide users with feedback either from the job itself or from the supervisor. This differs from the results collected from the SAP users.

With regard to feedback from the job itself, more than 60 percent of the sample said that they often received feedback from their job. However, the feedback appeared to be more from individual to individual rather than directly from the system. A view held by some was, that when you deal with the system on a day-to-day basis with different people doing different activities, and an individual makes a mistake it will be identified by another individual who will let the first individual know about the error. Being an integrated system, SAP system facilitates this quick error detection. While working on the SAP system individuals do not often get feedback from their supervisors. In this study only 40 percent of the sample indicated that they received such feedback. Managers set the task parameters, but it was up to individual employees to complete the job. Employees did not report back to their supervisors because the transactions were all entered into the process system. Everyone who was involved in getting the job done knew who was doing what and the progress of the task. Thus, there was no formal feedback system in place with the SAP system. Organizations are working on setting up a formal feedback channels as employees adapt to the process system.

On average, 60 percent of the sample agreed that the process system provided them with an enriched job that provides autonomy, task identity, task significance, skill variety, and feedback from both the job and the supervisor. Some job characteristics, specifically autonomy, task identity and task significance were stronger than others.

In this research more than 80 percent of the sample showed that they experienced meaningfulness in their work with the SAP system. This sense of accomplishment came when individuals overcame the challenges presented by the process system and learned to work around the constraints of the system. The process system also allowed users to work along with peers from other departments. SAP users were able to compare what they were doing and learn from each other, discovering correct functionality and developing the necessary solutions for problems. This experience was meaningful and employees felt satisfied with their work performance.

Of all the variables suggested by the job characteristics model, only task significance had significant correlation with experienced meaningfulness. This points out that, for this group of SAP users, meaningfulness was experienced when they felt that their job was significant to the whole organization. On the other hand, feedback from the job and supervisor had a moderate rating individually but correlated significantly with experienced meaningfulness (although not predicted by the model). From this, we concluded that, for this particular sample of SAP users, task significance led to experienced meaningfulness and that, even when they received moderate levels of feedback from job and supervisor, they still experienced meaningfulness.

According to the model, autonomy leads to the psychological states of experienced responsibility. The correlation between these two variables was very poor in this study and not as predicted by the job characteristics model. However, there were other job dimensions that correlated more strongly with this psychological state. Task identity and task significance correlated significantly. The conclusion that we drew from this was that, for this group of SAP users, experienced responsibility did not come from the level of independence they had, but from job dimensions such as task significance and task identity.

Job and supervisor feedback provide employees with knowledge of task outcome. In this research, the correlation between knowledge of results and feedback from the job was significant. This is the only job dimension that predicted the given psychological state as suggested by the job characteristic model. The system provided users with periodic feedback of transactions. Knowing the actual outcome of their work lets SAP users do things faster and better. One interviewee described the SAP system as "idiot proof". Employees immediately know the results of their work. However, there was no significant correlation between knowledge of results and feedback from the supervisor. This finding further supported the low rating indicated for feedback from supervisor. Although not predicted by the model, other job dimension variables such as skills variety and task identity had strong relationships with knowledge of outcomes. These findings suggest that, for this particular sample of SAP users, skill variety and task identity provided them with knowledge of their work outcome as much as feedback from the job. Nevertheless, the nature of the ERP system does not provide direct results from work. It only contains and provides updated information about the many transactions that take place within an organization.

The majority of the interviewees interacted with the system for more than 60% of their work with the SAP system. They agreed that they experienced the three critical psychological states while interacting with the system. They indicated that they felt an increase in internal motivation, general satisfaction and growth satisfaction in their jobs after the implementation of the SAP system.

In theory, growth need strength plays a mediating role between job dimensions and the affective outcomes. This moderating effect was not found in this research.

CONCLUSION

Many researchers have tried to develop frameworks for the factors that create internal work motivation and work effectiveness in

employees. Redesigning work in organizations is a very challenging undertaking because every individual needs to be given a job profile that matches his or her skills and knowledge. Even if one job is changed in an organization, many of the interfaces between that job and the related ones need to be changed also, causing a chain of changes.

The "People Factor" has been identified as critical in determining the success of an enterprise system. The two research questions, "To what extent does enterprise resource planning implementation lead to work redesign?" and "What is the impact of ERP initiated work redesign on employees job satisfaction?" tried to capture the impact of SAP implementation on individual employees. The five core job characteristics and the three critical psychological states allow us to analyze the work redesign from many different perspectives. Initially, working with the SAP system was not motivating for employees in these organizations. Employees did not understand how their jobs were going to change and could not perform their tasks effectively. They struggled to carry out their responsibilities with the process system. When work units went "live" with the system, the error rates were high. However, as time passed and SAP users became more comfortable with the integrated system and got to know their exact roles and responsibilities, they became more internally motivated in their jobs. The whole work environment forced employees to change their behavior towards work. The legacy systems disappeared as the new system took over. Work redesign initiated by the process system provides employees with opportunities for personal growth. It provides employees with an opportunity to work with globally popular integrated systems and acquire skills that increase their value in the labor market. Managers who took part in the research reported that after a year of SAP adoption, employees were happier with the system and complaints had reduced tremendously. As employees successfully overcame the constraints of the process system, they experienced more satisfaction at work. Overall, the findings of this research lead us to conclude that the effect of work redesign initiated by SAP implementation was moderate.

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