STUDY ON THE USAGE OF ENTERPRISE RESOURCE PLANNING IN THE CURRENT MANUFACTURING SCENARIO

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ABSTRACT

The objective of this study is to determine the factors affecting the adoption decision and implementation of new technology, particularly Enterprise Resource Planning (ERP), in discrete manufacturing companies. It aims to answer the question whether or not there is any relationship between production characteristics and the decision to adopt ERP. Using a sample of 30 discrete manufacturing companies, selected from a larger population that have selected from Ministry of Trade and Industry database, the results suggest that ERP is likely to be adopted if the production characteristics are compatible with the characteristics of the technology. However, statistical analysis shows that the decision-maker’s computer knowledge is more important than other factors, including production characteristics. The result of investigation of factors associated with level of implementation is not cut. It may be due to the reason that level of implementation is affected by other factors not covered in this study. Contrary to the general expectation, manufacturing method does not appear to be a significant factor in this sample.

Key words: Adoption, Implementation, ERP.

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1. INTRODUCTION

Users of technology play an important role in developing new technology. They can influence emerging techno-economic trajectories, initiate search for a new technological solution to a radical new need, establish a precise set of user requirements and serve as a source of invention, of solicited on new/evolving needs
and information on post-launch improvement (Rothwel 1994). However, since most new technologies are invented in developed countries, the role of users in the developing countries is very minimal. They can only accept the new technology “spill-over” in selecting and adopting those that meet their needs. This study discusses the adoption of Enterprise Resource Planning (ERP) by manufacturing companies in India. One technology (in this case ERP) and one country (India) were chosen to eliminate the effect of different technologies and environmental characteristics. This study aims at understanding the factors that affect the adoption decision, and hopes to expand the literature on technology adoption, especially in manufacturing companies. The focus is the adoption of technology developed outside the company. If ERP is compatible with manufacturing characteristics of the company, ERP should easily infuse into the manufacturing activity. This study hopes to contribute to the identification of significant constructs concerning the implementation of advanced manufacturing technology.

Ideally, the sample of this study would be randomly selected from population composed of all Indonesian discrete manufacturing companies. Since not all companies made their complete addresses available, the population of this study is limited to those companies with complete listed address only.

Most of the data were gathered through the mailed questionnaire, and follow-up calls were made in cases of inconsistencies in the answers. Questions were chosen and formulated in a way that can be easily understood by respondents.

Since the questionnaire was self-administered, some problem of measurement might exist. For example, in measuring the decision-maker’s knowledge of computer software, he/she was merely asked to state the number of software he/she is familiar with. No probing of the extent of familiarity/knowledge was done. For instance, the term 'familiarity' may be understood in different ways. Thus, one respondent with 4 listed software may not be as skillful in the software as another with only 2 listed ones. This variable may not have been measured as accurately as desired.

2. LITERATURE REVIEW
At this point it must be stressed that the discussion is limited to manufacturing companies who produce discrete product, since this kind of product allows for the use of ERP. In terms of production systems, it can be job-shop or mass production, and in term of materials flow, it can be intermittent or line.

The objective areas of production/operation are: cost, quality, delivery and flexibility (Schroeder 1989). Based on the characteristics of their business, companies can choose any of these objectives to stress since it is difficult (and not always necessary) to achieve all of them at the same time. For example: lowest cost and highest flexibility are difficult to achieve simultaneously since, to reduce cost, the company needs to produce large volumes which, in turn, reduces flexibility. However, the most recent technologies and management practices facilitate the above goals without sacrificing one or another. Among these are Advance Manufacturing Technology (AMT), Flexible Manufacturing System (FMS), Computer Integrated Manufacturing (CIM), and Just in Time (JIT).

Small company’s especially small and medium enterprises (SME’s) could also benefit from using new manufacturing technology. The prices of hardware and software are falling quickly. Extended ERP (e-ERP) has permitted the small manufacturer to import electronic drawing from clients, revise the model of
manufacturability, lay tool paths, and drive the computer-numerical controlled machines that cut the desired parts (Puttre 1993).

3. ERP IN MANUFACTURING

As much as 70% of the production cost of a manufactured part is determined during the engineering design process. For complex machines, 80% of the cost is committed by the time the preliminary design is complete. Therefore, only small percentage of part's cost is subject to money saving efforts during the manufacturing planning stage. This shows the importance of the design stage and suggests clear that computer assistance during the design stage can be a major help in assuring proper function and reasonable product cost. It is at this design stage ERP is needed in manufacturing companies.

The early development of ERP was aimed at improving the efficiency of the design process (Primrose 1991). It has now been found, however, that the major financial benefit of ERP comes from its use as an integral part of a company's overall management control and information system. ERP offer the potential for substantial gains over the traditional blueprint drafting method of design in the following areas: (i) product flexibility: new product can be designed and therefore introduced much more quickly; (ii) modification flexibility: existing designs can easily be altered to meet particular customer needs; (iii) design access: designs can be stored and accessed far more easily on a computer than on paper; (iv) quality: designs can be tested for performance before being run, and any required changes to upgrade the quality of the product can be easily made; and (v) productivity: with technology flexibility and information-storage capability, the productivity of design engineers is enhanced significantly.

4. FACTORS THAT INFLUENCE ADOPTION

Bessant (1982) distinguishes adoption factors among characteristics of (i) the innovation itself, (ii) those responsible for providing it, (iii) users, and (iv) the general environment in which innovations take place. After reviewing 17 research on technology adoption, Bessant concludes that the combination of factors are more important in adopting decision than single element. Furthermore, the exact presence and relationship of these factors will vary over time with a given set of company circumstances.

Factors affecting adoption do not necessarily have the same effect upon implementation. In their research on MRP (Material Requirement Planning) implementation, Cooper and Zmud (1990) finds that although task technology compatibility affects MRP adoption, it does not seem to significantly affect MRP infusion. This finding supports that rational models of implementation behavior are most relevant for early implementation stages. In the later stages, political and learning models are likely to be more relevant.

5. FRAMEWORK

According to Penings (1987), the diffusion of new technology can be depicted as a clash between existing and novel routines. When the novel routines cannot be viewed as replications of previous routines, the firm might seek to imitate, that is, to obtain new routines from elsewhere. If the firm already possesses pocket of knowledge about the new technology, or if there is already some awareness among the key decision
makers, the new technology is more likely to be defined as evolutionary, and hence quite replicable. In such organization, adoption is more likely to succeed.

Based on the flow of materials, production process can be classified into three types: project, intermittent and line (Schroeder 1989). Project-flow process is used to make single unique product, usually a large task made up a set of activities that must be performed subject to precedence requirement. The typical example of project-flow is building construction. Project-flow companies are excluded from the study because the discussion is limited to manufacturing companies. Line-flow process is designed for high volume and low variety of products. They are usually capital intensive and consist of a set of dedicated machines.

Intermittent flow (or job-shops) process is the design for low-volume production of highly customized products. They are usually labor intensive and require a relatively high skilled work force. Job-shops utilize a production layout that is more process oriented.

6. HYPOTHESES

Hypothesis-1: ERP is more likely to be adopted in job-shop (intermittent flow) manufacturing companies rather than line flow ones.

Based on the type of customer order, manufacturing companies can also be classified into make-to-stock (MTS) and make-to-order (MTO). In make-to-order manufacturing companies, product specifications are made by customers and sometimes customers are involved in the design process. ERP can be useful in this design process which needs the interaction from customer and producer. This leads to the second hypothesis:

Hypothesis-2: ERP is more likely to be adopted by make-to-order manufacturing companies rather than make-to-stock ones.

Since the main benefit of CAD is in making the product design, the higher the product variety is, the higher the possibility that the company will adopt CAD. But even if the product variety is high, CAD may not be worthwhile if the product price is low.

7. RESEARCH DESIGN

The objective of this study is to investigate the effect of the compatibility between technology and production characteristics on the adoption and the level of implementation of new technology. For the first problem we use dichotomous (adopt/not-adopt) dependent variable analysis. Adoption decision usually refers to the point in the innovation process where the users start to initiate innovation. However, this can be defined in various ways. ERP is a combination of hardware and software, and the most observable fact to differentiate adopters from non-adopters is whether ERP is available for use in their manufacturing facilities.

The main independent variables are: manufacturing method (assembly line or job-shops), types of customer order (make-to-stock or make-to-order), product variety (number of product type per year), product type (consumer good or industrial good), and price of the product.

8. SAMPLE AND DATA COLLECTION

This study starts by finding out whether ERP is really used by manufacturing industry in India. To do this, a simple questionnaire was sent to 100 manufacturing companies,
asking whether ERP is utilized in their manufacturing facility. Those companies were chosen from Ministry of Trade and Industry database based on their market capitalization. To be included in the respondent list, the firms should be able to be identified as discrete product manufacturers based on their advertisement.

9. FINDINGS AND ANALYSIS

9.1. DESCRIPTIVE STATISTICS
Respondents of this study vary in size, location and types of business. But all of them are discrete manufacturing companies that have the potential to adopt CAD. Thirty (30) of sixty-five (65) companies covered in this study have adopted CAD. The implementation level in the adopting companies varies from 5 to 100%.

With the exception of market share, all of continuous independent variables are skewed to the right. This suggests that the majority of the sample comes from the small and middle size companies.

10. STATISTICAL MODEL BUILDING
Logistic Regression on CAD Adoption. Following HosmerLemeshow (1989 p.83) this model building starts with uni-variate logistic regressions for each independent variable.

Variables with p < 0.25 can be considered as candidate variables for the final model. Based on this uni-variate logistic regression, only five variables meet this requirement. If a smaller significance level is used, 0.05 for example, only decision maker familiarity with computer is eventually retained in the model, with $R^2_L = 0.16$. This indicates the importance of the decision-makers computer background in the decision to adopt ERP.

11. SUMMARY AND CONCLUSION

11.1. SUMMARY
Not all the two hypotheses investigated in this study were supported for Indian manufacturing companies. Three hypotheses were supported, however.

<table>
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<th>HYPOTHESIS</th>
<th>RESULT</th>
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<tr>
<td>ERP is more likely to be adopted in job-shop (intermittent flow) manufacturing companies rather than line flow ones</td>
<td>Not Supported</td>
</tr>
<tr>
<td>ERP is more likely to be adopted by make-to-order manufacturing companies rather than make-to-stock ones.</td>
<td>Supported</td>
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Among the control variables considered in the study, only computer knowledge of the decision maker appears in the first fitted model. In fact, this variable had the lowest p-value, indicating it is highly significant. It would appear that, at this stage of Indonesian technological development, computer knowledge of the decision maker is the most crucial factor in the decision to adopt new technology, CAD in particular. This factor seems to have greater impact than the production characteristics of the company.
12. CONCLUSION
Compatibility as the degree to which an innovation is perceived as consistent with existing values, past experiences, and needs of potential adopters. An idea that is more compatible is less uncertain to the potential adopter.

The most important finding of this study is the particular importance of computer knowledge of the decision makers in adopting new technology. It appears, therefore, that in the case of Indian manufacturing companies, availability of suitable technical experience and expertise may have a greater impact on the technology adoption decision than other factors such as production characteristics.

Although this study focused on discrete manufacturing companies, the companies may still be too heterogeneous. The sample covered firms that differ widely in technological sophistication. Even among the ERP adopters, the range in technological sophistication is great.

REFERENCES