# ADOPTION OF OPEN SOURCE AND CONVENTIONAL ERP SOLUTIONS FOR SMALL AND MEDIUM ENTERPRISES IN MANUFACTURING

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## ABSTRACT

Many studies on the Enterprise Resource Planning (ERP) market have indicated that very few ERPs have succeeded to fully meet the expectations of an organisation in particularly the Small and Medium Enterprises (SMEs). This is usually due to commercial reasons, because most of the ERP systems are primarily designed and developed for large corporations which is not suitable for simplified and rapidly changing SMEs. With the arrival of licence free open source ERPs and at an affordable price, the problem of capital shortage in SMEs is partially resolved while flexibility remains a problem. In order to solve the flexibility issue, this paper presents methods of (a) an industrial survey and (b) a multistage initiation model to compare open source ERPs and the advantages of conventional ERP's modular structure to propose an alternative ERP platform. The finding concludes that this alternative platform is feasible to be developed by users as well as flexible enough for growing SMEs in manufacturing.

**Keywords:** Open Source ERPs; Small and Medium Enterprises; SMEs; Manufacturing

## 1 INTRODUCTION

An ERP system is an information system which manages and automates the flow of information in an enterprise in order to increase its performance and productivities (Hendricksa et al. 2007). Therefore, the key advantage of an ERP system is to integrate data and information which generates by an enterprise's daily activities such as Supply Chain Management, Warehouse Management, Production Planning, Quality Management, Customer Relationship Management, Finance and Human Resources (Altekar. 2006). However, conventional ERP systems are built for large enterprises and SMEs have to adjust their business model to adopt conventional ERP solutions. In addition to this, conventional ERPs are too expensive and complicated to implement in SMEs. In terms of business processes, SMEs are much simpler; changing is one of the key natures of these companies. SMEs processes can adapt to new ways of a business process where standardization is much faster with higher probability of success than large enterprises. This is why many experts recommended that it is better to fit an SME's organisation processes to ERP standards rather than customise ERP systems to fit an organisation because customisation of ERP software could lead to system instabilities (Gupta, 2000, Cheung et al. 2008).

Since the emerging of the open source ERP Systems in the early 2000s, its market share has increased considerably among SMEs. However there is no specific study has been carried out to compare the tech-

nical aspects of open source and conventional ERP systems (Sobh, 2010). In order to have a comprehensive understanding of open source and conventional ERP systems with specific requirements from SME in manufacturing, this research conducted a survey and a technical evaluation of open source and conventional ERP systems. The aim of this evaluation is to understand where open source ERP systems stand in the current market but also how it relates to other successful conventional ERP systems. The results of this investigation have identified the future opportunities of open source ERP systems and the gaps that open source ERPs must fulfil for SME market. This technical evaluation is focused on covering organisations' process, feature and the functions of ERP interfaces. Therefore, the remainder of this paper presents the findings based on the following:

- An industrial survey to reveal users' viewpoint towards ERP systems.
- The methods of analysing different conventional and open source ERP systems through the most common enterprise functions. This will be achieved through an investigation into the selection of open source and conventional ERPs based on the requirements of SMEs in particularly from the perspectives of the manufacturing industry.
- A combination of mathematical and experimental evaluations will be used to analysis the outcome of the survey and the identified common ERP functionalities.

As a result, the foundation of an ERP platform explicitly for SMEs in manufacturing is proposed.

## 2 METHODOLOGY

To understand the role of open source and conventional ERP systems within an enterprise and the requirements for SMEs, a mixture of survey and statistical methods have been used to reveal users' expectations and their attitudes toward ERP systems. The reason for this approach so that qualitative data obtained in the survey can be analysed quantitatively using statistical methods. The survey was carried out mainly on automotive and textile manufacturing. The survey was conducted in two stages. The first stage was a pre-evaluation of the questions to ensure a full coverage of the objectives was met. In the trial run, the questionnaire was sent to a group of experts and the questionnaire was modified based on their feedbacks. The second stage was to send the questionnaire using an online tool to a number of selected companies, overall more than seventy companies responded. The survey was divided into two parts; (i) to investigate the cultural aspect of SMEs in using information system; and (ii) to find out the expectations of SMEs on ERP systems. In addition to the survey, the research also carried out a study on the features and functionalities of selected open source and conventional ERP systems. These include:

- the backend of ERP systems which support organization processes; and
- the frontend of ERP systems such as their features and functions for system interfaces and integration issues.

Six ERP systems have been selected for the evaluation process, including among these are three open source on Open Bravo, Compier and Open ERP; and three conventional solutions on SAP, Sage and Microsoft Dynamics. A comparative study was performed in order to prioritise a SME's needs in conventional and open source ERP solutions. The overall approach of quantifying the results is shown in Figure 1, and the steps of the approach are:

1. Download row data to a spreadsheet.
2. Convert qualitative data into a quantitative form.
3. Transfer quantitative data into a database.
4. Select and filter data.
5. Transfer the query results to spreadsheet for further analysis.
6. Conduct correlation analyses.
7. Transfer the query results.
8. Calculating P-value.
9. Transfer the findings into a graph.

In the final stage of the investigation, the results of the highest ranked ERP functionalities along with the survey results have been evaluated so that a conceptual platform for the future of ERP systems specifically for SMEs in manufacturing is proposed.

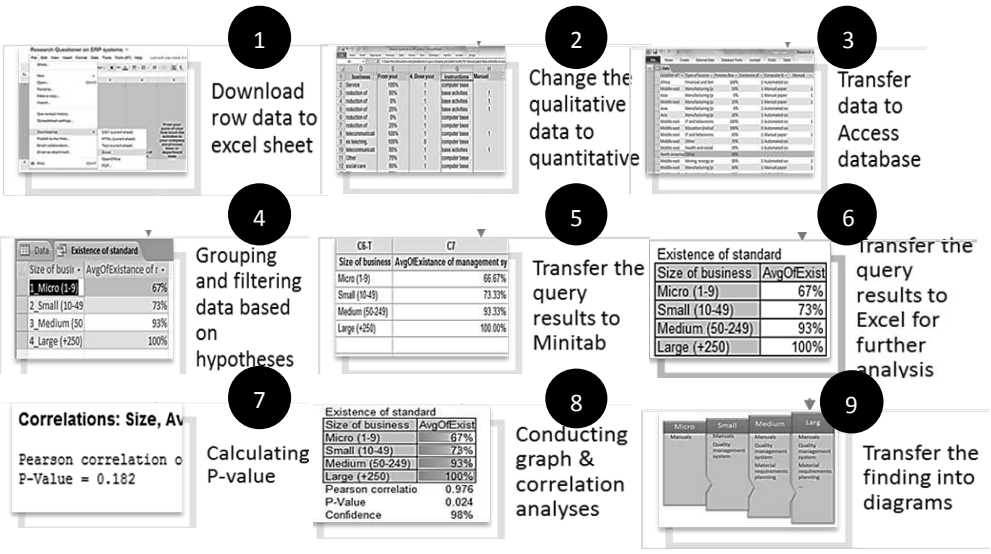


Figure 1: The overall methodology

## 2.1 Industrial Survey

An industrial survey was conducted to investigate SMEs' behaviour for adopting ERP solutions based on enterprises' cultural attitudes and their needs.

### 2.1.1 Enterprise Culture

To investigate cultural attitudes of small enterprises toward information systems, several questions are considered in order to find out how an ERP system can best be implemented within a SME, they are:

1) Does the size of an enterprise matter in supporting information systems implementation?
2) How confidence is the staff on using different components of an information system? The response could affect the growth of an enterprise and how the introduction of a new ERP being implemented.
3) If there is a correlation, then how other alternative factors, such as standardisation can affect an organisation?

To understand how standardization can be implemented during the growth of an enterprise, two further questions are needed in order to understand: (i) which organisation's process, and (ii) why the process is being standardized. These are:

4) Does their company have any management systems, if so, what type?
5) How business processes matured throughout an enterprise's growth?
6) Is there any correlation between the growth of an enterprise and their business processes?
7) How much process level of an enterprise affects the amount of usage on computerised-based activities?

For example: "If the enterprise size increases, the number of standard processes will increase" and "If the enterprise is more process-based, then their activities will become more computerised-based". To gather data for these scenarios, two further questions have been asked. The first question is:

8) What processes and functions in your company are using management systems?" And the answers are categorised into six main processes which are supported by ERP systems, such as finance, human resource, manufacturing engineering, supply chain management and customer relationship management. The second question is:
9) From your point of view, how much are the processes within your company being automated with the help of software?" The answers are categorised into 25%, 50%, 75% and 100%.

10) How different organisation structures are supported and distributed in the global market?

To find out the response of this question, the location of participants and the structure of their organisations are used for this investigation.

### 2.1.2 Enterprise Needs

To evaluate the importance of different features and processes that supporting by the ERP modules, the second part of the survey was focused on the functionalities of ERPs. Overall, there are eighty functions across a typical ERP system, and these have been examined in order to define the importance of how such functions were linked to a SME's business need.

## 2.2 Multistage Initiation Model for Comparisons of Open source and Conventional ERPs

The aim of the evaluation on ERP systems was to understand the differences between open source and conventional ERP systems to compliant with their features, functions and business processes supportability. This phase was focused on the technical aspect of ERP products for SME end users in manufacturing. Different mathematical decision making methods were investigated and a combination of these methods was used. As shown in Figure 2, in order to perform a technical evaluation of ERP systems, two criterions must be considered.

- The first criterion is ERP features and functions of interfaces (FFI) which shows how the ERP interfaces use data from the core of the ERP system.
- The second criterion is organisation process coverage (OPC) which is supported by the core of ERP systems.

Data for the third level was collected from the second part of the question. For each sub criterion, six different ERP systems (three open sources and three conventional) were evaluated and ranked with an Analytical Hierarchy Process (AHP) model (Saaty. 2008). The reason for using an AHP model rather than other decision making models was that AHP is capable to connect to a decision tree model as it follows the same hierarchical structure. The accuracy of the ERP comparison results can be evaluated by the consistency ratio in an AHP model as proposed by Saaty (2008).

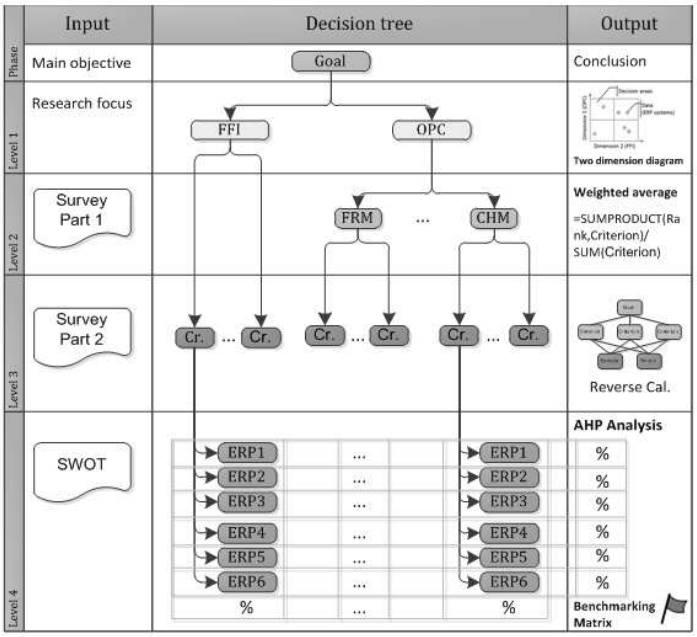


Figure 2: Multistage Initiation Model for Open source and Conventional ERPs Comparsion

## 3 RESULT OF ANALYSIS

The result of this investigation is shown in Figure 3; the highest ranking in terms of organisation process coverage is SAP, while Microsoft Dynamic has achieved the highest classification in features and functionalities. This shows that the technical advantage is still dominated by conventional ERP systems. Therefore, before investing on any ERP system, these differences must be taken into account. Although conventional ERPs can cover an organisation process far better than open source solutions, but open source ERP user interfaces are just as advanced as conventional ERP systems. In essence, as long as a SME do not intend to become a large enterprise there is no need to implement conventional ERP solutions.

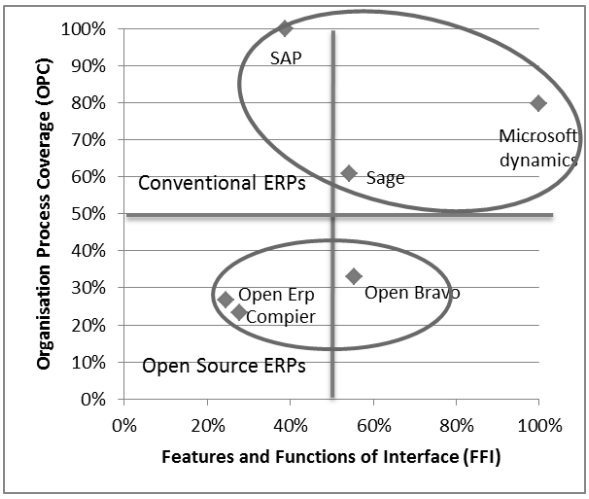


Figure 3: ERP Comparisons

## 4 FUTURE OF ERP IMPLEMENTATION FOR SMES IN MANUFACTURING

Unlike the one-off implementation methods of conventional ERP solutions, the result of this research suggests that a new approach for implementing ERPs which support multi-stage implementations of an ERP system during the growth of an SME in manufacturing. This approach can enhance the success rate of implementing ERP solutions as well as the potential to achieve a higher Return-on-Investment for SMEs.

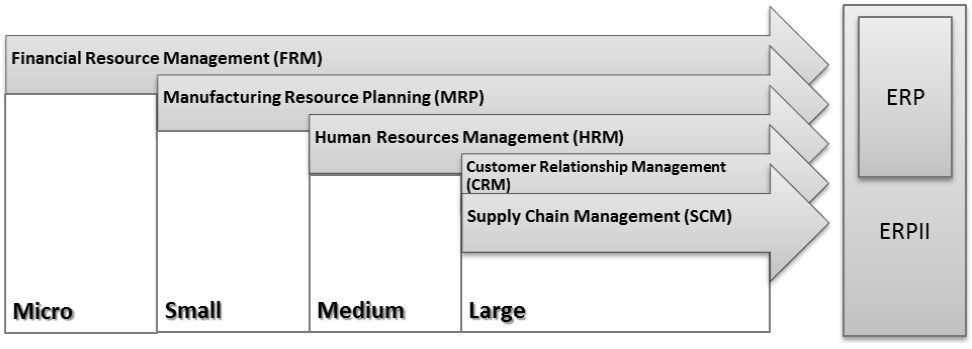


Figure 4: Phases of ERP systems implementation through SMEs growth

As illustrated in Figure 4, the components of an ERP system should not be implemented at the same time, they can be implemented at different stages. Based on the need of a company and the rate of its growth, each of the components can be implemented as an add-on. Furthermore, despite the size of an enterprise,

finance and accounting processes have to follow standard procedures as defined by national law (Kastantin. 1998). In light of this, financial management is the key element in any new SME's success. Therefore, the first and the only information system that can implement by a micro size company is the Financial Resource Management (FRM) component.

As macro size companies grow into small size enterprises, in order to manage the manufacturing processes, most of this type of companies will implement management standards, such as quality management system. At this stage it is possible to combine managerial standards with computer-based Manufacturing Resource Planning (MRP) information system rather than using paper-based procedures in order to minimise additional cost to readopting the procedures in future. When the number of employee increased to a medium size enterprise level, it is feasible to automate human resource processes with a Human Resources Management (HRM) information system. At this stage the company is powered by an integrated information system known as Enterprise Resource Planning system. Finally, when an enterprise turns into a large organisation, it will be more appropriate to transform the ERP system into ERP-II by adding Customer Relation Management (CRM) and Supply Chain Management (SCM) components to fully automate the sales and procurement processes.

## 5 CONCLUSIONS AND FURTHER WORK

In conclusive, a new ERP system should have a structural platform and this should be represented as a standard ERP template for SMEs implementation. The platform should contain features and functionalities that develop with open source in mind i.e. to adopt the advantages of source code accessibility and affordability. The ERP template should support the standards of conventional ERP solutions, for example, using HTML5 programming to integrate web applications within the proposed ERP platform. The dynamic field database structure will potentially capable of storing any type of files in the system. This means that not only the databases can be integrated within the proposed ERP platform but software packages too. The other advantage of software integration is the concept of files and folders can be replaced by unified data sources. As the development of this ERP system can be incorporated on the web, their server can be stored online or locally in a SME. Further investigation should focus on how this proposed platform could affect manufacturing practices, for example, if a SME decide to implement lean manufacturing, a quality programme, how will the proposed ERP platform overcomes these changes or vice versa.

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