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Understanding of ERP systems in Chinese SOEs: A Case Study

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Abstract-Enterprises resource planning (ERP) systems are applied by more and more modern companies to manage and support the enterprise-wide business. This paper aimed to investigate the understanding of managers and staffs on ERP systems in Chinese SOE. With a case study approach, chi-square tests are used to analyze the data derived from questionnaires. The test results show that there are no associations between ERP systems implementation and ERP contained management support systems adoption. It is concluded from this contradiction that although the managers and staffs are aware of the situation that ERP systems have been implemented in Chinese SOEs, they do not understand them yet. This situation and all the reasons result in come into being the barriers of successful ERP implementation in Chinese SOEs.

Keywords-ERP; functional information systems; understanding

I. INTRODUCTION

From early 1990s, enterprise resource planning (ERP) systems are already implemented in major enterprises in USA [1]. A survey from AMR research in 2001 shows in total 100 medium to large enterprises, 57 percent of them applied ERP systems in 2000 while this penetration rate grew rapidly to 65% in 2001. The worldwide ERP systems market grew from 16.67 billion dollars to above 21 billion dollars during the period from 2005 to 2010. In China, ERP systems started to be used at the beginning of 1980s [2]. The early implementations were only focused on large state owned enterprises (SOEs) [1]. Until 2002, material requirements planning (MRP), manufacturing resources planning (MRP II) or ERP systems are implemented in nearly 1000 enterprises in China [2]. In recent years, the ERP systems markets are booming with more and more Chinese enterprises apply them for planning coordinating and controlling organization resources. As reported from China center for Information Industry Development, the ERP systems market in mainland China was 226.9 million dollars in 2003, which grew to 652.8 million dollars in 2008, and will develop with a 23.5% growth rate in these following five years. It was estimated in 2006 that the potential ERP

systems implementation markets in China is 7 billion dollars [1]. Although ERP implementation in China is developing rapidly with a high potential, comparing with developed countries, the current situations of ERP systems in Chinese enterprises are still very strange. Only 3.8 percent Chinese enterprises are using ERP systems while at the same time the ERP implementation enterprises account for 68 percent in Europe. To be even worse, in a website survey, none of participants are clear about what ERP systems exactly are. There are even 16 percent of participants show they never heard of "ERP systems" with rest of the respondents just heard about or have a little knowledge of ERP systems [3]. This indicates the necessity to investigate the staffs' understanding of the ERP systems in Chinese enterprises under this rapid development situation. This paper aims to investigate the understanding of users on ERP systems in post implementation enterprises.

II. LITERATURE REVIEW

There are many ways that information technology influence the business processes [4]. Major and traditional way is using information systems to support each business function. Information systems can be categorized based on this business process as sales and marketing systems, purchasing systems, manufacturing systems, finance and accounting systems, as well as human resources systems [4,5]. The main function of sales and marketing systems is to control the process of the products or services selling and also manage the customer relationships. Purchasing systems are in charge of dealing with the relationships with suppliers. Manufacturing and production systems mainly focus on planning manufacturing resources and control manufacturing processes. Finance and accounting systems take responsibilities to manage the financial assets and investment, as well as maintain and manage the financial records of the companies. Human resources systems are mainly used to manage the employees' records and support the activities to attract, develop and maintain the workforce in the organizations [5]. On the other hand, the

information systems can be examined according to the various management and decision support levels, as operational, tactical and strategic levels. Information systems can be grouped as transaction processing systems (TPS), management information systems (MIS), decision support systems (DSS), executive support systems (ESS) based on this. Generally, TPS are used for operational control. MIS and DSS support the management and decisions making in tactical level. EIS are mainly used for strategic planning in top strategic level [6]. Specifically, TPS provide the information of routine transactions and elementary activities in the organizations to the operational managers [5]. Through acquiring information from TPS, MIS are used to produce reports, which help middle managers to monitor and control the business performance as well as make decisions [5]. Furthermore, DSS mainly support decision making on unique or rapid changing situation for middle management [5]. ESS support management and decision making of senior managers on strategic issues based on the information from both inside the organization and external events [7].



FIGURE I. DIVISION OF ORGANISATIONAL LEVELS AND FUNCTIONAL AREAS (MODIFIED FROM FIGURE 2.1 IN LAUDON AND LAUDON [5])

Managing all the information in all of these different types of information systems are complicated and challenging work in an organization. ERP systems, which cover all of these functional areas and execute business process in all levels of management, are used to integrate all of these systems and make them communication and share information together.

Enterprise resource planning (ERP) is a “cross-functional enterprise system driven by an integrated suite of software modules that supports the basic internal business processes of a company” [4]. Moreover, ERP systems operate as gathering data from all the key functional areas including sale and marketing, manufacturing and production, finance and accounting, human resource to a central data warehouse so as to make the information fragmenting in various separated systems integrated and can be shared enterprise wide for different business process [5].

ERP systems can bring a lot significant benefits to the organizations. Firstly, the adoption of ERP will improve the quality of the production and service, as well as efficiency and effectiveness through coordinating the business process from all the functional areas in every management support level [4, 5]. Secondly, the maintenance costs of the isolated legacy IS are very high. The transaction processing costs, hardware, software as well as the number of IT support staffs are reduced according to the reports from many companies after ERP adoption [4, 5]. Thirdly, because of the integration, ERP can provide cross-functional information for management, which facilitates the managers’ decision making [4]. Fourthly, ERP systems adoption helps organization cross the barriers among different departments or functional business units. Therefore, management, organizational structures, and roles of work in the organization are more flexible to meet the fast changing environment and new business opportunities [4].

Although there are many benefits of ERP implementation, the costs are also considerable [4]. A research in 2010 showed that the average costs of ERP implementation were around 5.48 million dollars and the average durations were 14.3 months [8]. Business process reengineering, employees training and change management take main parts of the costs [4]. Despite these huge financial costs and time consuming, the risks of failure in ERP implementation are substantial. The major cause of failed ERP project is underestimation of the complexity of ERP implementation preparations. Other typical causes contain uninvolved affected employees in planning and developing stages, insufficient training for the users, and data conversion and testing failures [4]. Furthermore, reference [9] identified organizational barriers, such as inefficient collaboration and communication between functional department, short-term behavior of top managers, low user involvement, low-skilled and ill-trained users are main triggers of the occurrence of other ERP post-implementation risks in China. This paper aimed to test the understanding of managers and users on ERP system in post-implementation stage in a typical SOE group, moreover, the main organizational barriers are explored.

In order to carry out the test, the ERP functions in different business process discussed above are used to formulate the hypotheses. The hypotheses test, when staffs in companies think ERP systems are implemented, whether they think:

H1: TPS functions are used in all the business process areas

H2: MIS functions are used in all the business process areas

H3: DSS functions are used in all the business process areas

H4: ESS functions are used in all the business process areas

III. METHODOLOGY

The hypotheses listed above were tested based on a case study. The case study is the most appropriate approach when the research aims to investigate a phenomenon or situation within the specific context, “especially when the boundaries between phenomenon and context are not clearly evident” [10, 11]. Obviously, the understanding of the staffs on ERP systems is heavily influenced by the context of ERP usage in the organization. On the contrary, their understandings also have impact on the ERP adoption success in enterprises. Therefore, case study was used in the research.

A typical manufacturing Chinese SOE group was selected as the case enterprises. This SOE group operates in Aluminum industry and had more than 208,000 employees in 2006. Moreover, 9 branches and 1 research institute are contained in this group, with geographical dispersing in different provinces in China. In order to reach this large SOE group on geographically dispersed with relative low cost, questionnaires were used as the data collection techniques in the research. The questionnaires were designed base on a systematic literature review, and the questions are designed to investigate:

1) Whether the ERP systems have been adopted in the enterprise;

2) Whether information systems have been adopted in sales and marketing area in the enterprises;

If so, whether TPS/MIS/DSS/ESS functions are contained in the sales and marketing systems;

3) Whether information systems have been adopted in purchasing area in the enterprises;

If so, whether TPS/MIS/DSS/ESS functions are contained in the purchasing systems;

4) Whether the information systems have been adopted in manufacturing and production area in the enterprises;

If so, whether TPS/MIS/DSS/ESS functions are contained in the manufacturing and production systems;

5) Whether the information systems have been adopted in finance and accounting area in the enterprises;

If so, whether TPS/MIS/DSS/ESS functions are contained in the finance and accounting systems;

6) Whether the information systems have been adopted in human resources area in the enterprises;

If so, whether TPS/MIS/DSS/ESS functions are contained in the human resources systems.

In this research, 1 headquarter and 5 branches in SOE group were set as the research subjects. Furthermore, in each of these 6 enterprises, 1 manager and 4 system users were selected as the target respondents. In total 30 questionnaires are sent out by email with the support of the CIO of the SOE group. Finally all of these 30 responses were collected and valid for the research.

The aim of the study was to explore if the respondents in the enterprises realize there are relationships among the ERP implementation and related functions (TPS, MIS, DSS, ESS)

implementation so as to find out the understanding of the staffs on ERP systems. As (Andy) pointed out, Pearson’s chi-square test is used to investigate “whether there’s a relationship between two categorical variables” [12]. According to the research aims and the characteristics of the variables from the questionnaire results, Pearson’s chi-square test is used as data analysis techniques. All the collected data is analyzed using SPSS software.

IV. FINDINGS AND DISCUSSIONS

For each hypothesis, five tests are carried out in sales, purchasing, manufacturing, accounting and human resources areas respectively based on the literature review to investigate if there are associations on different types’ systems implementation. For each test, one cross-tabulation table and one chi-square test table are produced by SPSS. If no significant difference was found in the test, the proposed association was rejected. In this case, if the significant value is less than 0.05, then the variables are related in some way. Otherwise, we can conclude the variables are not related thereby the proposed hypotheses are rejected.

Results of the chi-square tests for each hypothesis are summarized below.

Hypothesis H1: Respondents consider ERP systems are used in enterprises and they also think TPS functions are used in all the business process.

The chi-square test results are summarized below. In total 30 respondents, 24 of them consider ERP systems are implemented in the company, while for these 24 positive responses to ERP adoption, only 2, 6, 5, 13, 6 of them think TPS functions are used in sales, purchasing, manufacturing, accounting and human resources areas respectively.

TABLE I. TABLE 1 TESTS ON ERP IMPLEMENTATION AND TPS FUNCTION

| Summary of Cross-tabulation table | | | |
|-----------------------------------|-----|-----|----|
| | | ERP | |
| | | Yes | No |
| TPS sales area | Yes | 2 | 1 |
| | No | 22 | 5 |
| TPS purchasing area | Yes | 6 | 2 |
| | No | 18 | 4 |
| TPS manufacturing area | Yes | 5 | 1 |
| | No | 19 | 5 |
| TPS accounting area | Yes | 13 | 4 |
| | No | 11 | 2 |
| TPS human resources area | Yes | 6 | 3 |
| | No | 18 | 3 |

| Summary of Chi-square tests | | | | |
|-----------------------------|-------|-----|-----------------------|----------------------|
| | Value | d f | Asymp. Sig. (2-sided) | Exact Sig. (2-sided) |
| TPS sales area | .370 | 1 | .543 | 1.000 |
| TPS purchasing area | .170 | 1 | .680 | 1.000 |
| TPS manufacturing area | .052 | 1 | .819 | 1.000 |
| TPS accounting area | .305 | 1 | .580 | .672 |
| TPS human resources area | 1.429 | 1 | .232 | .329 |

The hypothesis is rejected for all the significance values are above .05.

Conclusion: From the respondents' opinions, ERP implementation is not associated with TPS function in all the business process.

Hypothesis H2: Respondents consider ERP systems are used in enterprises and they also think MIS functions are used in all the business process.

From the test results, 24 out of 30 respondents are positive to ERP adoption, however, only 9,9,8 and 11 of them consider MIS is used respectively in sales, purchasing, manufacturing, accounting and human resources areas.

TABLE II. TABLE 2 TESTS ON ERP IMPLEMENTATION AND MIS FUNCTION

Summary of Cross-tabulation table

| | | ERP | |
|--------------------------|-----|-----|----|
| | | Yes | No |
| MIS sales area | Yes | 9 | 2 |
| | No | 15 | 4 |
| MIS purchasing area | Yes | 9 | 2 |
| | No | 15 | 4 |
| MIS manufacturing area | Yes | 8 | 2 |
| | No | 16 | 4 |
| MIS accounting area | Yes | 8 | 1 |
| | No | 16 | 5 |
| MIS human resources area | Yes | 11 | 2 |
| | No | 13 | 4 |

Summary of Chi-square tests

| | Value | df | Asymp. Sig. (2-sided) | Exact Sig. (2-sided) |
|--------------------------|-------|----|-----------------------|----------------------|
| MIS sales area | .036 | 1 | .850 | 1.000 |
| MIS purchasing area | .036 | 1 | .850 | 1.000 |
| MIS manufacturing area | .000 | 1 | 1.000 | 1.000 |
| MIS accounting area | .635 | 1 | .426 | .637 |
| MIS human resources area | .305 | 1 | .580 | .672 |

The hypothesis is rejected for all the significance values are above .05.

Conclusion: From the respondents' opinions, ERP implementation is not associated with MIS function in all the business process.

Hypothesis H3: Respondents consider ERP systems are used in enterprises and they also think DSS functions are used in all the business process.

The chi-square test results are shown below. From the results, the similar situation happened here. For the 24 respondents agree with they used ERP systems, the numbers of the positive responses on DSS adoption are 12, 6, 9, 12, 9 in sales, purchasing, manufacturing, accounting and human resources areas respectively.

TABLE III. TABLE 3 TESTS ON ERP IMPLEMENTATION AND DSS FUNCTION

Summary of Cross-tabulation table

| | | ERP | |
|--------------------------|-----|-----|----|
| | | Yes | No |
| DSS sales area | Yes | 12 | 1 |
| | No | 12 | 5 |
| DSS purchasing area | Yes | 6 | 2 |
| | No | 18 | 4 |
| DSS manufacturing area | Yes | 9 | 2 |
| | No | 15 | 4 |
| DSS accounting area | Yes | 12 | 1 |
| | No | 12 | 5 |
| DSS human resources area | Yes | 9 | 2 |
| | No | 15 | 4 |

Summary of Chi-square tests

| | Value | df | Asymp. Sig. (2-sided) | Exact Sig. (2-sided) |
|--------------------------|-------|----|-----------------------|----------------------|
| DSS sales area | 2.172 | 1 | .141 | .196 |
| DSS purchasing area | .170 | 1 | .680 | 1.000 |
| DSS manufacturing area | 0.036 | 1 | .850 | 1.000 |
| DSS accounting area | 2.172 | 1 | .141 | .196 |
| DSS human resources area | 0.036 | 1 | .850 | 1.000 |

The hypothesis is rejected for all the significance values are above .05.

Conclusion: From the respondents' opinions, ERP implementation is not associated with DSS function in all the business process.

Hypothesis H4: Respondents consider ERP systems are used in enterprises and they also think ESS functions are used in all the business process.

From the chi-square tests summary below, the results in ESS functions are similar. For 24 respondents who think ERP systems are applied in the companies, minority of them (5, 3, 10, 10, 10) are positive on ESS adoption in all the business units including sales, purchasing manufacturing, accounting and human resources areas.

TABLE IV. TABLE 4 TESTS ON ERP IMPLEMENTATION AND ESS FUNCTION

Summary of Cross-tabulation table

| | | ERP | |
|--------------------------|-----|-----|----|
| | | Yes | No |
| ESS sales area | Yes | 5 | 0 |
| | No | 19 | 6 |
| ESS purchasing area | Yes | 3 | 0 |
| | No | 21 | 6 |
| ESS manufacturing area | Yes | 10 | 2 |
| | No | 14 | 4 |
| ESS accounting area | Yes | 10 | 2 |
| | No | 14 | 4 |
| ESS human resources area | Yes | 10 | 1 |
| | No | 14 | 5 |

Summary of Chi-square tests

| | Value | df | Asymp. Sig. (2-sided) | Exact Sig. (2-sided) |
|--------------------------|-------|----|-----------------------|----------------------|
| ESS sales area | 1.500 | 1 | .221 | .553 |
| ESS purchasing area | .833 | 1 | .361 | .592 |
| ESS manufacturing area | .139 | 1 | .709 | 1.000 |
| ESS accounting area | .139 | 1 | .709 | 1.000 |
| ESS human resources area | 1.292 | 1 | .256 | .372 |

The hypothesis is rejected for all the significance values are above .05.

Conclusion: From the respondents' opinions, ERP implementation is not associated with ESS function in all the business process.

From the questionnaire results, it is surprising to find that in case SOE group, although the respondents are aware of the ERP systems are in post implementation stage, they consider the TPS, MIS, DSS and EIS functions which are actually contained in ERP package are not used yet in any of business units. This finding indicates a situation in Chinese SOE that ERP systems are applied according to the government plan, however, the understanding of managers and staffs on them are very poor.

Considering the special context of Chinese SOE, this strange situation is resulted from various reasons. In operational level, the workers are not clear about ERP implementation. The nature of SOE decides they are not allowed to lay off the unskilled or redundant workers. Therefore, the staffs in SOE are normally less technological than other types of enterprises in average. This means they face more difficulties when they learn new information systems technologies. In addition to this, in Chinese SOE, influenced by the collectivist culture, workers are used to follow the organizations' decision. Trainings for the staffs mainly focus on the specific operation. Fewer resources are used to entuse the staffs to change their behaviors. Therefore, workers in SOE just accept the information systems implementation passively. They are not really interested in or have paid enough attention learning it. These are the reasons in Chinese SOE, the information systems are applied already, but the staffs do not really understand it yet.

In tactical and strategic levels, although managers have more power in Chinese SOE, they don't have enough knowledge of ERP implementation. Firstly, one reason that managers in Chinese SOE understand ERP systems in very low level can be concluded as they are not involved in the ERP implementation effectively. Chinese SOEs are still in vertical management modes with centralized structures. Western countries conducted informatization after industrialization while in China, informatization and industrialization are carried out together in the state-owned enterprises.

A standard management regulation has not been formed, which results in although the systems are applied, the management modes haven't changed with it. The vertical modes make it very difficult to exchange the information from works to managers as well as from middle managers to senior managers. Therefore, managers may feel inconvenient for ERP implementation. They are used to the traditional management methods and not positive on applying information systems to conduct management activities. Secondly, managers in Chinese SOE are designated by government and they are not under much pressure to create benefits. Therefore, facing the ERP implementation plan proposed by government they are not able to find enough motivations to learn the related knowledge or be trained for the information systems implementation skills. They only execute commands from government as a role of supervising the implementation and sending orders to subordinates rather than learn the knowledge and use the information systems for operation themselves. Considering top managers have large amount of privileges in the organizations and enjoy great respects from subordinates in Chinese SOE, this is a critical barrier of information systems implementation success in China. Thirdly, Chinese government paid much more attention to hardware and software investment just for achieving the goal of computerization. The management issues or problems, which are significant factors for ERP implementation, draw very little attention from them.

To sum up, the research findings show an obvious situation that the managers and staffs don't have enough knowledge on ERP in the case SOE enterprises although ERP systems have been implemented. This strange situation and all the reasons result in it comprise of major organizational barriers for successful information systems implementation in Chinese SOE.

V. CONCLUSIONS

This paper explores the understanding of managers and staffs on ERP systems in Chinese SOE through a case study. From the literature review, the researchers identified ERP systems covers all the support functions containing TPS, MIS, DSS and ESS in all the sales, purchasing, manufacturing, accounting and human resources areas. The findings show that although the respondents are aware of the ERP implementation in the enterprises, they consider neither of the TPS, MIS, DSS and ESS is applied, which indicate a very strange situation that managers and staffs don't understand ERP systems in ERP post implementation enterprises. Furthermore, the reasons to the insufficient understandings are analyzed. All of these factors have negative impacts on the successful ERP implementation. It is suggested that Chinese government should pay more attention on human resources issues such as manager and staffs training in the ERP

implementation and post-implementation phases to ensure that the SOEs can acquire sufficient benefits from large investment on ERP systems.

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