ERP System Implementation in Make-to-Order SMEs: An Exploratory Case Study

Ondrej Zach  
Department of Information Systems  
University of Agder  
Serviceboks 422  
4604 Kristiansand, Norway  
ondrej.zach@uia.no

Dag Håkon Olsen  
Department of Information Systems  
University of Agder  
Serviceboks 422  
4604 Kristiansand, Norway  
dag.h.olsen@uia.no

Abstract

The purpose of this paper is to investigate the issue of Enterprise Resource Planning (ERP) system implementation in the context of Make-To-Order (MTO) Small and Medium-size Enterprises (SMEs). No prior study has investigated the whole ERP implementation process in MTO SMEs. Because of the special requirements of both the SME and the MTO context, ERP implementations under these conditions are challenging. We investigate how these organizational characteristics influence the implementation of an ERP system. This study is part of a larger research project to investigate ERP implementation issue in SMEs. We present the empirical findings from an exploratory case study of an ERP implementation in a manufacturing MTO SME. The study provides a valuable insight into issue of ERP implementation in MTO SME sector. The findings are further discussed in a broader context and propositions for further research are presented.

1. Introduction

Enterprise Resource Planning (ERP) systems have become one of the most widespread IT solutions in organizations [1]. Since the large enterprise market is close to saturation, the ERP vendors have begun focusing on Small and Medium Sized Enterprises (SMEs). However, even though the main ERP vendors offer pre-configured low cost solutions designed especially for SMEs, ERP investments are still significant for these companies [2]. Because of limited resources and other constrains, such as lower level of experience with IT, and lack of Information Systems (IS) management in general, investment into new IT is a critical issue for SMEs. Wrong IT investment decisions can have a huge impact on the enterprise’s business results. This applies particularly to an ERP system due to its complex implementation process and high resource requirements.

Organizational size plays an important role in relation to ERP implementation [3]. SMEs represent a significant proportion of the economy in European countries. In 2007 SMEs constituted 98.8 % of the almost 19 million enterprises in the EU-27 countries’ non-financial business economy [4]. Thus, SMEs represent a huge potential market for ERP systems.

SMEs are forced to replace their obsolete legacy systems to be capable of competing with large enterprises. The information requirements of their supply chain partners are another factor forcing SMEs to upgrade their systems [2]. Usually large companies, already using an ERP system, require their business partners to follow suit to make the business exchange more efficient.

Research on IT innovation implementation within SMEs is still limited [5]. Although a number of researchers have focused on the ERP implementation process, most of the ERP literature is based on findings from large organizations [6, 7]. Prior studies argue that findings from large companies cannot be applied to SMEs since they represent a fundamentally different environment [3, 8]. It is argued that SMEs are not smaller versions of large enterprises [9]. A number of important aspects likely to affect ERP implementation differentiate SMEs from large companies, such as lack of leadership and planning, lack of defined structure, and lack of procedures formalization [10, 11].

This is particularly relevant for companies operating in a make-to-order (MTO) environment. In recent years, many manufacturers have switched to MTO production. This phenomenon is caused by increased demand for specialized products [12]. Almost all MTO companies are SMEs [12-14]. MTOs are characterized by low production volume, wide product variety, and unstable production schedule [15]. The requirements of MTOs are also very different from...
a typical make-to-stock (MTS) manufacturer. Their competitive priorities are associated with volume flexibility and product customization [15].

It is imperative for MTO SMEs to maintain their flexibility, as it is a core competitive competence. They need to be able to conform their products according to customer requirements. When implementing a standardized solution as an ERP system, the flexibility and thus competitiveness may be threatened [16]. The standardized systems employ embedded standard business processes. That may be in conflict with a need for idiosyncratic business processes. We conjecture that given these limiting factors, MTO SMEs become more vulnerable to ERP implementation failure.

Hence, the production strategy is likely to significantly affect the ERP implementation. However, little attention has been given to research on ERP implementation in MTOs [10, 12, 13]. It remains unclear whether ERP systems can meet the needs of MTO companies [13].

The purpose of this paper is to explore the issue of ERP implementation in the context of an MTO SMEs. This study is part of a larger research project aiming to investigate how specific organizational characteristics of SMEs influence implementation of an ERP system. The remainder of the paper is organized as follows. First, we review ERP literature to identify prior research. We then describe the research method including the data collection and the case company. Next, the data analysis and findings are presented. Then, we discuss the research results and present propositions. Finally, we elaborate on the propositions’ implications and provide some alternative routes.

2. Literature review

A substantial number of researchers has studied ERP systems. ERP literature has become extensive over the last decade, covering a wide range of ERP issues. Based on a comprehensive review of ERP literature, Moon [17] demonstrated that the main body of ERP articles (40%) investigated the implementation theme. However, despite the research effort to understand the issue of ERP implementation in organizations, the proportion of ERP system implementation that has failed in recent years is astonishingly high. A recent ERP report found that out of nearly 1600 ERP implementation projects conducted in the last four years, 57% took longer time than expected, 54% went over budget, and 41% of companies failed to realize at least half of the expected business benefits [18]. The high failure rate calls for further research to improve our understanding of ERP implementation processes in organizations.

A possible way to improve our ability to investigate implementation processes is to focus on more specific organizational issues. For example, Moon [17] presented that out of 313 articles they reviewed, only seven focused on a particular sector. These articles are particularly interesting since common attributes and unique features can be analyzed in a particular sector [17]. Another way may be to distinguish between different organizational sizes. Base on a review of ERP literature, Shehab et al. [2] concluded that there is a need for further research investigating the differences in ERP implementation between large enterprises and SMEs.

The influence of company size on ERP implementation has been recognized in recent research literature [3, 8, 19]. Some studies have investigated critical success factors (CSFs) in SMEs [7, 20]. Buonanno et al. [19] conducted a comparative study between SMEs and large companies, investigating factors affecting ERP system adoption. A study conducted by Muscatello et al. [6] applied a broader view of ERP implementation, covering planning, selection and installation activities. The study focuses on implementation activities that affect successful ERP installation. The authors investigated implementation processes in four manufacturing SMEs. They found a strong relationship between manufacturing strategy and ERP implementation success. Unfortunately, this issue has not been further elaborated.

Recent research literature emphasizes the need to address the specific requirements of the MTO production strategy [10, 12, 13]. Typically, prior research on ERP has treated all the enterprises as make-to-stock (MTS), neglecting the needs of the MTO sector.

An exceptional study has been conducted by Aslan et al. [13] who assessed applicability of ERP systems in MTO sector. The literature review revealed a gap between the requirements of MTO companies and ERP functionality. The authors conclude that a greater body of knowledge should be developed about the issue of ERP in the MTO companies. In particular, there is a need for empirical studies exploring MTO sector and industry-specific issues of ERP system adoption [13].

Stevenson et al. [12] provide an assessment of production planning and control (PPC) concepts from a MTO viewpoint. The applicability of ERP systems in MTO companies has been recognized as limited. However, the applicability of the concepts is not supported by empirical data. The findings are derived based on prior studies on ERP implementations. Moreover, the study provides an assessment for the right selection choice between various PPC concepts. Thus, it employs a more general point of view, not particularly aiming at ERP systems.
A valuable research on ERP implementation in MTO SMEs has been done by Olsen et al. [16, 21]. Even though the authors do not recognize the affect of production strategy explicitly, the research is based on cases of MTO and engineer-to-order (ETO) enterprises. The companies are described as niche-oriented SMEs characterized by idiosyncratic business processes, customer-orientated production, and need for flexibility. The findings indicated that proprietary software developed in-house is a suitable solution for niche companies. It enables organizations to keep their idiosyncratic business processes and thus leverage their competitive advantage. The presented approach acknowledges the specific needs of MTO SMEs. However, this solution may not be suitable for all SMEs. Because of a lack of IT competence, SMEs are usually not capable of software in-house development.

The only empirical study on ERP focusing on specific conditions of MTO SMEs sector has been conducted by Deep et al. [10]. The study investigated factors affecting selection of ERP systems. The authors developed a framework for ERP system selection. While valuable, the study investigated only the selection phase. No prior study has investigated the whole implementation process, including the later implementation process phases.

3. Research method

The literature review suggests that there are major gaps in our knowledge of ERP implementations in MTO SMEs. While Deep et al. [10] investigated the ERP selection process in a MTO SME, no prior study has investigated the implementation process as a whole. Single case studies are useful to represent unique cases when there is lack of theory [22]. While a single case has limited generalizability to the population, it can give important propositions for future research. We have therefore chosen an exploratory case study methodology. This would allow us to collect rich descriptive data on an ERP implementation project in a MTO SME in its natural setting. The purpose of this study is thus to increase our knowledge of the factors which influence the implementation process in MTO SMEs. The questions that this study addresses are:

- How do characteristics of MTO SME sector affect ERP system implementation?
- Which ERP implementation practices are affected by these characteristics?

The data were collected through 14 qualitative interviews. All interviews were face-to-face involving one interviewee, except an introductory interview where the project leader and his assistant were both present. We gathered data from employees representing various positions within the company. We interviewed 13 different respondents, among them the project leader, project leader assistant, middle and top management (including CEO), key users, end user, and IT staff. The respondent variety yielded different perspectives to enrich the findings though data triangulation [23].

13 of the interviews were recorded. On average the interviews lasted for approximately one hour, varying between 20 up to 90 minutes. All interviews were conducted by one researcher, thus ensuring equal conditions during the data collection process. The data collection took place within one week (5 working days) and all interviews were carried out inside the company (in meeting rooms). All recorded interviews were carefully listened to and analyzed. The important parts and supporting quotes were transcribed.

The interviews were semi-structured, and employed an interview guide with open-ended questions following Myers & Newman’s [24] guidelines for conducting qualitative interviews. The questions covered various issues of the ERP implementation project, diverging in a level of abstraction (from general to very concrete). The interviewees were asked about their personal experiences and opinions about the implementation project and the ERP system itself, about its outcomes and limitations, specific issues regarding the company characteristics, etc.

In addition, we collected information from the vendor. We conducted a telephone interview with the vendor’s CEO. The telephone interview lasted for approximately 20 minutes focusing on questions regarding specificity of the implementation project in the case company. Another supplementary telephone interviews was also conducted with the project leader and sales manager. Furthermore, emails and documents provided by the company were utilized as additional data sources.

4. The case company

The case company is a manufacturing SME with approximately 220 employees engaged in fiberoptic equipment production. The company manufactures a variety of products in six product divisions. The divisions include planar and fused components, monitoring line systems, fiberoptic connectors, and optoelectronic components. The company is a dynamically developing organization cooperating with international partners and customers. It is located at one location, without any subsidiaries and branches. This company was selected because of its characteristics meeting the focus of the study, offering a case of ERP system implementation in a MTO SME.
The company is presently moving towards MTO production. It predominantly manufactures high-variety bespoke products. The company also comprises a technological center providing development and design of new products and production technologies.

In the middle of 2007 the company decided to invest in a new ERP. The main reason was an unsatisfactory legacy system. The outdated system became significantly limiting. The legacy system used a technique for creation of predicative product codes based on alphabetic and number combinations. The company was running out of the possible combinations and it was therefore impossible to continue the use of the system. Beside the fact that the system was not user friendly and did not provide any analytical tools, the DOS-based technology created a number of problems (e.g. very slow response time, break downs). It did not provide sufficient data security or user rights regulation.

Moreover, the company was using other separate systems including an accounting system, attendance system, and software for production control. A number of Excel spreadsheets and other tools were used in addition. Since all these applications worked separately, data export and import between them were complicated, and were often solved by manual data transcription. As the company has expanded through the years this has become very time consuming and inefficient.

In the very beginning of 2008 an ERP system selection was initiated. A small local IT company operating as a certified agent of the biggest domestic ERP vendor was selected. However, right after the system selection, the implementation project was discontinued by top management. The reason was the market uncertainty resulting from the financial crisis in 2008. The project was refreshed in mid-November, one and half month before the planned start of the system. However, as a consequence the project was launched in a reduced version. An accounting module was implemented in the beginning of January and the full system was launched by mid-April.

5. Data analysis and findings

In order to organize the data analysis, we structured the findings into implementation phases. We adopted the enterprise systems implementation process life-cycle model developed by Markus and Tanis’ [26]. It consists of four phases: project chartering, the project, shakedown, and onward and upward phases. Organizing the analysis in this manner provided better overview and logical structure. Although a number of ERP implementation process models exists in literature [e.g. 25], however, Markus and Tanis’ model is one of the most recognized and cited in ERP literature. In our investigated case, the model was well applicable, as the project did follow the implementation phases, and we were able to classify and fit the implementation processes into the model.

5.1. Project chartering

Project chartering includes all activities before the project officially starts. These involve an organizational decision about investment into new IS solution, mapping currents business processes, analyzing potential benefits and limitations, specification of needed functionality, and in the final the system selection.

As mentioned above, the main goal of the implementation project in the case company was to replace the legacy system. From the very beginning the company knew that they wanted an ERP system. The unsustainable situation with the existing IT solutions became a strong driver for implementing a new ERP system. Another driver for a new ERP was the company reputation among customers. These are usually big international enterprises and presenting them outputs from DOS-based system became inconvenient. To sum up, there existed a strong need and motivation for the implementation project, which significantly contributed to its procedure and a successful implementation in the end.

The system selection was conducted by an internal team of five persons (project leader and his assistant, two IT staff, and one key user). The selection documentation involved a detailed specification of requirements and needs, both on a system and a vendor, including technical, security, maintenance, hardware, and financial considerations. Seven selection criteria with different weights were defined. The selection was run in two rounds. Vendor presentations took place in the company during the first round. Visits by the final two vendors and reference companies were conducted in the second round.

The system selection fully relied on the team members’ experiences, no external consultant was used. The project leader stated that “regarding the knowledge and experience the team members had about information system implementation, we decided that we were able to select and decide about the system ourselves.” This was corroborated by statements from other interviewees and by the vendor. The company knew exactly their needs and requirements for the system. Therefore, the selection was appropriate and well done.

One of the main requirements was a need for system customization. The company decided that it was necessary to apply a high level of system
customization. Many interviewees also expressed the system customization as one of the factors which contributed to the successful implementation. The project leader stated that “we knew that our processes are not standard and the system had to be customized a lot to suit our processes.” The company selected a vendor who was willing to adjust the system based on the company’s customization requirements. The project leader assistant commented that “we did not want a software nor a vendor who would force us into their standardized solution. We […] really needed […] some software and somebody who would help us with that and would adjust it towards our [processes].”

5.2. The project

This phase encompasses all activities between the system selection and its “going live” [26]. It involves activities such as project team building, business process modeling and reengineering, system customization and configuration, end users training, data conversion, testing and debugging, and in the end, rollout.

The implementation project was governed by an implementation team. The implementation team consisted of 10 key internal users. In addition to the project leader, his assistant, and two IT staff, there were six more key users representing various departments within the company. The key users were chosen based on their experience and attitude to the old system, their interest in the project, and good knowledge of business processes. Not only department managers were assigned as the key users. Particular key users were responsible for the collection of requirements from their field of competence. These were then discussed and analyzed during implementation team meetings.

Despite the complicated situation caused by the financial crisis, the project was renewed. “With the old system we could not live any more,” the project leader stated. However, the costs were reduced by two thirds compared to the original project. Only the most necessary functionalities were left. They did not consider the integration of the legacy systems, except the accounting system. Human resources (HR) and material requirements planning (MRP) modules were excluded from the implementation. Furthermore, planned hardware innovations, training time, and the number of licenses were reduced. As one of the interviewees commented, “it was a minimalist variant of the system which functionally corresponds to the old system.”

In addition, the delay caused a reconsideration about the project feasibility. The financial manager required that the transition to the new system should be at the beginning of a new year. “We were [discussing] either to manage it in one and half month or wait one more year,” the project leader said. The sharp deadline and the lack of time created a pressure. Since there was only one and half month before the system start, it became very hectic. The project leader assistant expressed: “We were pressed already in November,…we had planned [to use] one year for that, and suddenly we had just one month.” Consequently the implementation strategy was changed. Instead of implementing all modules at once, it was decided to implement only the accounting module by January 1. The rest of the system was planned to be implemented by the end of February.

As can be observed, the financial crisis had significant implications for the implementation process. Under such uncertain conditions any planning or predictions become very inaccurate. The EPR implementation project was initially carefully planned and a detailed time schedule had been developed. However, the financial crisis significantly changed the market conditions for the company and in consequence the whole project.

The lack of time caused further problems after the accounting module implementation. The tight time schedule of the renewed project led to an insufficient analysis. The ambition was to implement the rest of the system by end of February. “Then the problems occurred,” the project leader assistant stated. “The things that should have been detected by longer analysis, […] were not,” he further explained. The project leader seconded that. He expressed that the fact that it had been postponed was mainly caused by the lack of time for a proper analysis earlier. “There were many last-time changes resulting from that there was not enough time for the process model design,” he added. Most of the interviewees corroborated that the little time for proper analysis was the most significant complication in the implementation.

The analysis was further complicated by the production complexity in the case company. As commented above, the company has six product divisions which differ in the manufactured product as well as the employed technology. This diversity made it challenging to map and define the business processes. “Every production division is a little unique, so it demanded time,” the project leader expressed. The system requirements specification had to be done separately for each product division.

The requirement specification had to be done in very detail because of the high level of system customization. A complication mentioned during the interviews was that the vendor underestimated the production complexity. One of the interviewees said that “the production was more complicated than the
vendor expected.” They were not able to absorb all the processes. “We knew that our processes are not standard,” one of the interviewees stated. Also, it took a long time to debug the system because the production was very complicated.

The production complexity is related to the production strategy issue. The MTO strategy offers high-variety products, which implies frequent changes in the production structure. Moreover, MTO companies must have an ability to react to frequent changes quickly. The interviews indicated that a standardized ERP system would be inappropriate for the case company. Therefore it was imperative that the company had access to system development competence to make appropriate changes to the system. The internal programmer was seen as crucial in this respect, and was evaluated as the second most important factor for the successful implementation.

The implementation team was evaluated as the most important factor for the successful implementation. Many of the interviewees expressed that the composition of the implementation team was crucial. The project leader stated that “it is the main aspect which made the [implementation successful].” However, all the implementation team work had to be done in addition to the regular work duties, and no extra time resources were assigned for the project. Therefore the project seriously strained key personnel resources. The project leader expressed that the team spent a huge number of hours and “nights” there during the implementation. It was evident that the requirements identification and analysis was constrained by the limited personnel resources. The project leader expressed that the fact that processes were poorly mapped complicated the implementation, and that it was related to the lack of well defined responsibilities.

The MTO environment had an effect on the implementation process. The company was not convinced about the applicability of an MRP module. The requirements analysis indicated that the MRP module was unable to meet the specific needs of the company. Based on requirements analysis and reference visits in companies with similar conditions and experiences with ERP implementation, the MRP module was disregarded from the project.

Many interviewees expressed their concern about the applicability of an MRP module and questioned its benefit for the company. “It is possible that it would not be such a contribution, because we are make-to-order production, we are not series production,” the project leader assistant argued. In general, the interviewees expressed that MRP is more suitable for MTS production companies. Production planning under MTO conditions was seen as more complicated.

“If this [MTO] was not here, it [the ERP implementation] would be much easier,” one of the interviewees commented on MTO production strategy. A minimum of the company’s products and technologies is repeatable. MRP was expected to be less effective in MTO than in MTS where there normally are just a few changes in the production. Long time forecasts of material purchases were expressed to be very difficult. Another concern was regarding embedded changes. “It [the MRP] would be connected to many changes, in all the processes,” the project leader assistant stated. Therefore, MRP was found to not be an effective solution for the case company.

5.3. Shakedown & onward and upward

Project shakedown is a period between “going live” and when the operations are in routine use. During this period the system performance is tuned, bugs are fixed, and additional training is conducted if needed. The end users are getting used to work with the system and operations are becoming “normal.” The onward and upward phase is defined as a period from “normal” operations until the system is replaced with an upgrade or a different system. Characteristic activities of this phase are additional user skill building, continuous business improvement, and benefits assessment. Moreover, organizations may also decide about the success of the project [26].

We found it difficult to distinguish between these two phases in the presented case. Therefore we present them together. It was hard to determine when the operations had become “normal.” It is an ongoing process and we were not able to recognize such boundary.

The company did not define explicit success definitions or measures. The ERP system implementation project was interpreted as successful by all the interviewees, although perceptions of a success differed. The success was most often cited as the fact that the production was not stopped. “I think a huge success is that we managed to shift, de facto from day to day, from one system to another one without stopping the production,” one of the interviewees expressed. The company core business was certainly the main concern regarding the success perception.

Another often expressed perception of the success was the user acceptance of the system. Employees have taken the system into use without any serious trouble. They also learned to work with the system in quite a short time. “We have used to work and live with it quite fast,” one of the interviewees said. In general the system has been accepted well. Some minor negative opinions occurred, but they were purely individual
problems. As the project leader noted, “some people are not satisfied from the reason that they must learn something new, and they must do something differently then what they were used to do before.” The project leader assistant further added, “of course, information system implementation is nothing easy, it is a change and people do not like changes […] but as a whole it works fine and I see it as 100% success.” To conclude, system acceptance is highly individual and human factor plays an important role.

However, no evaluation of the system benefits or outcomes has been carried out in the case company. No parameters for ERP outcome assessment were specified a priori. There existed some general expectations from the system (e.g. increased responsiveness to the customers, faster delivery), but they were not evaluated retrospectively after the implementation. Actually, these parameters were identified as inappropriate because of higher system requirements as discussed above.

Another problem is the lack of use monitoring in the old system. This limits any comparison. The project leader was not happy about the lack of outcome assessment parameters. “When there are no data, it is not possible to compare the outcomes,” the project leader explained. Moreover, it was stated that it is not possible to use general parameters (e.g. overall turnover, number of reclamations) because the external changes have more significant influence than the system implementation. In addition, since the company is dynamically developing, it was seen as difficult to isolate the effects of the system. The project leader assistant noted that “the effect of the system contribution would need somehow to be highlighted.” However these criteria were found to be difficult to quantify. “Nevertheless numbers would be the best, preferably in money,” he further added. A desire for the visibility of outcomes was also expressed by the CEO.

As already stated, flexible business processes was an important characteristic of this company. Its core competence lies in the ability to reconfigure business processes quickly in response to the dynamic business environment. Changing business processes implies changing systems support. The project leader explained: “we must be very flexible towards both customer demands and changes of external environment. The changes must be done quickly.” He further expressed that the business environment is difficult to predict. The changes can be radical. The business environment can become totally different. He further added “If we say today it is like this, it can be totally different in 14 days.” A number of other interviewees also corroborated this view, and stated that one of the most important aspects of the system was that it should be a “platform for further development.” The IT manager stated that “possibility of own further development” was the most important criterion for his satisfaction with the system. The vendor expressed that the company had a very specific environment. He characterized it as a private, small, dynamic, agile company.

6. Discussion

We found that six issues were particularly important in this case: ERP system customization, system and process flexibility, inappropriateness of MRP module, implementation team composition, ERP system evaluation and external events. We conjecture that these issues would be important for other MTO SMEs planning ERP implementations. We discuss each of these issues below.

**ERP system customization.** The ability to reconfigure the system with the business processes was a key issue in the ERP system selection. The ERP system customization was crucial for achieving flexibility in the business processes.

These findings diverge from ERP literature on large enterprises [27-29], and even research on ERP implementation in SMEs in general [7], which argue that minimal customization is one of the crucial factors for successful ERP implementations. Our findings suggest that we need to take the organizational context into consideration. Particularly, based on our study, we have identified production strategy as an important factor influencing ERP implementations.

Compared to a typical MTS manufactures, competitive priorities of MTOs are associated with volume flexibility and product customization. Therefore, it is imperative for MTOs to maintain their idiosyncratic business processes and thereby their competitiveness in the market. The findings corroborate the research by Olsen et al. [16, 21], who also investigated cases of MTO SMEs. They recognized the inability of commercial ERP solutions to meet MTOs’ business requirements. Thus we propose that:

*P1: MTO SMEs need a high degree of ERP customization.*

**Process and system flexibility.** We found that the ability to quickly reconfigure both the business processes and the system support was a core competitive capability in this company. Many business processes needed to be changed on a dynamic basis. We argue that the ability to quickly and effectively change business processes is in fact a competitive necessity for most MTOs. Such companies need
flexible business processes that can be adapted to changing customer requirements as well as external market changes. It should therefore be possible to perform system modifications quickly and efficiently and provide add-ons when needed at later stages. Deep et al. [10] also defined the need for flexibility in system modification as one of the desired outcomes of the effective selection process. This leads us to our second proposition:

**P2:** MTO SMEs need to be able to develop the system further after the implementation to allow for dynamically changing business processes.

In this company, an internal employee was highly capable of developing the implemented system further. This was a critical issue in this implementation, and makes it likely that the company will be able to further maintain and develop the system when needed. They will therefore also be able to do system development independently of the vendor. However, the company will be vulnerable to this employee leaving the company. They should make sure that they have access to this competence either by training more employees or by hiring new IT staff. We propose that system development competence will be crucial:

**P3:** ERP system development skills are crucial for MTO SMEs.

**Manufacturing resource planning (MRP) module.** The company found that the MRP module would constrain the manufacturing flexibility. Production planning was seen as complicated because of the dynamic character of MTO environment. Forecasting material purchase in the long terms was deemed to be very difficult. Therefore, MRP was seen as an ineffective and the company decided not to implement it.

This indicates that MRP modules incorporated in ERP systems may not be appropriate and not yield enough manufacturing flexibility for MTO companies. This finding is consistent with Aslan et al. [13] who questioned whether MRP is feasible in today’s manufacturing conditions. Furthermore, Deep et al. [10] noted that traditional MRP or old ERP systems are limited in their applicability to the MTO context. We forward the following proposition:

**P4:** Traditional MRP modules do not allow enough manufacturing flexibility and are inappropriate for MTOs.

**Implementation team composition.** The implementation team played a key role during the project. In particular, the composition of the team turned to be crucial. Mapping the business processes is an important activity to achieve a good fit between the system and business processes. However, it requires the involvement and time from many employees, and strains the limited SME resources.

Poorly described business processes in SMEs leads to imprecise definition of employees’ roles and responsibilities. Therefore, clear responsibilities and tasks need to be granted in the very beginning of the implementation project. The SMEs usually do not have personnel resources to dedicate full-time to the implementation project. In contrast to large companies, employees in SMEs often perform unique work duties and cannot easily be replaced by other employees. Thus, the implementation team members must deal with ERP system implementation in parallel with their day-to-day work duties. Work overload and the lack of time can affect the quality of requirements identification and analysis.

**P5:** Requirements identification and analysis is constrained by SMEs’ limited personnel resources.

**ERP system outcomes evaluation.** We saw in the previous chapter that the company was unable to perform ERP system outcome evaluation. Compared to any other IS, the outcome evaluation of ERP systems requires a more complex approach. Since ERP systems are organization-wide systems encompassing processes from whole organizations, a careful thorough analysis is needed.

Moreover, the MTO environment implies additional constrains in conducting ERP system outcomes evaluation. MTO companies face a dynamically evolving environment. Therefore the assessment of general business parameters (such as cost reduction, overall productivity, increased capacity, business process change) in relation to ERP system implementation are considered to have limited validity. In such environment, conditions change repeatedly and fast. The case company found that the effect of other, usually external forces, on the measured parameters was more significant than the implementation of an ERP system. Therefore we conclude that:

**P6:** ERP outcome evaluation is difficult to perform in MTO SMEs.

**External events.** The financial crisis led to the rejection of the initial implementation plan, and eventually to a scaled down version that was implemented in a rush. This illustrates how SMEs may be very vulnerable to economic macro events such as recessions. Especially MTOs may be subject to dramatic falls in orders as major customers cut production to protect their own financial positions. ERP implementations in MTO SMEs would likely be adversely affected in such scenarios.
P7: ERP implementations in MTO SMEs are vulnerable to economic macro conditions.

7. Conclusion

This exploratory case study has highlighted a number of critical ERP implementation issues for MTO SMEs. We saw that this ERP implementation was troubled by several issues. These issues were rooted mainly in two underlying causes: the particular challenges of MTO production environment, and the resource poverty that characterizes SMEs in general.

The standardized ERP systems force companies to employ embedded standard business processes. That may be in conflict with a need of MTOs for idiosyncratic business processes. Implementing an ERP system may threaten the flexibility and thus competitiveness of MTO SMEs. Therefore, ERP implementations in MTOs require a high degree of customization, and the organizations are more likely to experience problems during the implementations.

We argue that it is imperative for MTO SMEs to maintain their flexibility, as it is a core competitive competence. They need to be able to customize their products based on customer requirements. MTO companies, most of them SMEs, play an important role in the facilitation of the just-in-time supply chains of large manufacturing companies. The MTOs’ business agility and manufacturing flexibility are therefore important for an agile and competitive economy. That also means that MTOs must accommodate a significant portion of the impacts of market corrections.

ERP acquisition and implementation was a challenging task for this company even though they have quite competent IS personnel. On the contrary, most SMEs may not have the appropriate system development competence. An alternative is to establish a closer relationship with a competent external vendor, such as an ERP vendor or a consulting company. There may be need for radical changes in the MTO processes, and one can conceive that not all system development can be done internally. Then quick response from a competent provider may be necessary. A close long term relationship may be essential for the external party to invest in and maintain the appropriate competence.

Based on the findings we propose that traditional MRP modules are not appropriate for MTOs. We further argue that Advanced Planning and Scheduling (APS) systems may yield enough manufacturing flexibility and be appropriate for MTOs. ASP is the next generation of MRP and is more accurate than the classic MRP systems [10]. However, the case company decided not to implement the MRP module, and we cannot conclude that it would not have worked. The finding indicates a problem, but it is not possible to assess MRP module applicability. Therefore, further research should explore this issue.

The adoption of process modeling methods has been very slow among SMEs, and few of them map the business processes. If a company decide not to map the business processes, team members need to be knowledgeable about business processes. They also need to understand the business requirements on an ERP system. Therefore, the team members should not be selected based only on their position, but based on their potential contribution for implementation project success. Moreover, they should be able to communicate and influence other employees at their department. Personal interest and self motivation are also important aspects for the selection of team members.

SMEs usually do not have resources for a proper ERP outcome evaluation. Moreover, the ability to evaluate the ERP outcomes in SMEs can be limited due to the lack of comparable historical data. Developed measurements tools such as by Gable et al. [30] or Ifinedo [31] could be helpful for MTO SMEs to assess the outcomes of ERP implementation. A demonstration of the contributions and outcomes would increase the motivation for further system utilization and development. However, we are aware that SMEs in general, restricted by limited resources, will not give such evaluations high priority. It would be a comprehensive task that would take resources away from more pressing tasks, such as getting the system up on time without any stops in the business.

This article is intended to emphasize effect of the production strategy on ERP implementation, as it is not recognized in extant literature. Very few studies have considered this aspect. Based on the presented study we have identified production strategy as a key influencing factor on the ERP implementation. Therefore, we argue that the research on ERP in manufacturing SMEs should consider production strategies as an important factor.

This is a case study of a single company, and thus the findings can not be generalized to a larger population of MTO SMEs. This context is, however, an area with little empirical knowledge, and it needs cumulative empirical studies. We forward seven propositions that should be further investigated in subsequent research. Furthermore, the results may have practical value to other MTO SMEs which are about to acquire an ERP system. Our findings and propositions can help such companies to identify key issues for the implementation success.
8. References


