# ERP systems' capabilites for supply chain performance management


## ABSTRACT

**Purpose:** The first purpose of this article is to describe the demands from supply chain performance management (PM) on ERP systems. The second purpose is to evaluate the corresponding capabilities of common ERP systems.

**Methodology/approach:** The first purpose was handled conceptually; by a literature review, a framework for the demand on ERP systems from supply chain PM was developed. The second purpose was handled with an empirical study, based on the framework. Respondents for twelve common ERP systems on the Swedish market were interviewed.

**Findings:** A framework for the demand on ERP systems from supply chain PM was developed containing ten demands; a theoretical contribution. The studied ERP systems were found to overall have good supply chain PM capabilities, where the most supporting systems in this sense were Oracle and iScala.

**Research limitations/implications:** The findings imply that future research on supply chain PM could focus less on ERP systems' capabilities and more on how ERP systems are applied.

**Practical implications:** The findings can give two types of input to companies purchasing or upgrading ERP systems; a "checklist" of demands from supply chain PM to consider and an evaluation of the corresponding capabilities for common ERP systems.

**Originality/value of paper:** Even though investments in ERP systems represent significant costs for companies, few studies in the area of ERP systems and supply chain PM were identified.



**Type of paper:** Research paper

**Keywords:** ERP systems, capabilities, performance management, supply chain management

## Introduction

Any company would strive for enhancing revenue, control costs, increase asset utilization and improve customer satisfaction. In supply chain management the emphasis is on how well a chain or group of companies performs in these terms, in order to create value for the final customer (Brewer and Speh, 2001).There are several ways of describing the performance in a supply chain. One way of structuring performance in the supply chain was provided by Krajewski *et al.* (2007), who distinguished between inventory measures, process measures and financial measures. Inventory measures could be inventory value, weeks of supply and inventory turnover. Process measures are mainly related to customer relationship, order fulfilment and supplier relationship processes and could be a number of measures per process, such as customer satisfaction, on-time delivery or lead times. Financial measures could be return on assets or cost of goods sold (ibid).

Another way of structuring supply chain performance can be found in the Supply Chain Operation Reference (SCOR) model. Based on five standard supply chain processes; plan, source, make, deliver and return, a terminology and a framework of standard process performance metrics were developed (Lockamy and McGormack, 2004). The SCOR model describes supply chains in five dimensions or performance attributes, namely reliability, responsiveness, flexibility, cost and efficiency in asset utilization (Stephens, 2001). These attributes are then transformed into defined performance metrics such as delivery performance, order fulfilment lead times and cash-to-cash cycle, which allow for performance measurement across the supply chain. Altogether, it can be seen that measuring supply chain performance is a complex issue, containing an abundance of possible metrics that in many cases also are interrelated (Basu, 2001).

The issue of how to measure supply chain performance was illustrated by Forslund and Jonsson (2007a). Performance management (PM) is one approach for measuring and improving performance in the supply chain, and can be seen as a process. The PM process between customer and supplier consists of the activities selecting performance variables, defining metrics, setting targets, measuring and analysing. Supply chain PM is referring to a PM process taking place between actors in the supply chain (ibid). This article studies a focal customer company, which manages performance from suppliers and inbound logistics service providers; the studied supply chain hence encompasses three actors.

The importance of measuring performance in the supply chain is emphasized by many scholars; at the same time many studies have revealed obstacles for supply chain PM (e.g. Bourne *et al.*, 2000; Brewer and Speh, 2001; Busi and Bititci, 2006; Forslund and Jonsson, 2007a). Obstacles such as supply chain partners having different goals and objectives, lack of standardized performance metrics, problems with control and problems with trust, were pointed out. One major obstacle was found to be the Enterprise Resource Planning (ERP) systems (e.g. Brewer and Speh, 2001; Busi and Bititci, 2006; Fawcett *et al.*, 2008; Phusavat *et al.*, 2009; Forslund and Jonsson, 2009). An ERP system can be described as a modularised suite of business software applications that are seamlessly integrated to provide automated interactions and a common source of data for a firm (APICS, 2007).

The PM process between supplier and customer has been stated a challenging task in practice. Some demand from supply chain PM seems not to be supported by the ERP systems. One practical problem is the difficulties for suppliers and customers to adapt to differing needs for metrics definitions, and hence defining supply chain metrics in the ERP system in differentiated ways (Hofmann, 2008). Also the fact that companies, according to Forslund and Jonsson (2007a), had to rely on manual performance data capturing and manual report

generation, due to lacking capabilities in their ERP systems, is problematic. Are companies aware about what is required from the ERP system to support supply chain PM? No identified study provided a systematic framework for the demand from supply chain PM on ERP systems. The need for systematic knowledge in this area is especially critical as studies have shown positive relationships between well-functioning supply chain PM and high on-time delivery performance. Manual performance data capturing and report generation was the issue that most significantly differed between companies with high and low on-time delivery performance (Forslund and Jonsson, 2007b). Also Knolmayer *et al.* (2009) related well integrated ERP systems in the supply chain to performance advantages. Hence, the ERP systems' capabilities to support supply chain PM seem to be a practical problem for both the work with supply chain PM and the supply chain performance in itself.

On a theoretical level, van Donk (2008) claimed that we still know little about the use of ERP systems in the supply chain. Huge amounts of money are spent in purchasing, implementing, running and updating such systems whereas these aspects are hardly researched at all. In 2003, Akkermans *et al.* found that ERP systems would only have a modest role, if any, in improving supply chain performance. One reason would be that ERP systems were developed to integrate the functions within one firm rather than to integrate with multiple partners. Still in 2005, a similar conclusion was made by Kelle and Akbulut, who claimed that ERP systems provide tools that can support and obstruct supply chain integration in the same time. Fawcett *et al.* (2008) pointed out both the hard issues (technology, information, measurement systems) and the soft issues (culture, trust, willingness to collaborate) as barriers for supply chain management.

Problems in ERP systems can be caused by the systems themselves or by the way they are applied (Botta-Genoulaz *et al.*, 2005). So, is this a problem in ERP systems' capabilities – to what extent do they actually support the demands from supply chain PM? Are some ERP systems more supporting for supply chain PM than others? Practitioners need guidelines when ERP systems should be purchased or upgraded (APICS, 2007; Karsak and Özogul, 2009), as selecting the appropriate ERP system is a critical success factor for ERP implementation (Dezdar and Sulaiman, 2009). There is lacking knowledge when it comes to how the capabilities of the ERP systems can support or hinder supply chain PM. Hence, a study that evaluates the capabilities of common ERP systems to support supply chain PM, would be valuable both theoretically and practically.

The first purpose of this article is to describe the demands from supply chain PM on ERP systems. The second purpose is to evaluate the corresponding capabilities of the most common ERP systems.

The article is organised as follows: in the following section, a theory review on ERP systems are conducted. This is followed by a section where a framework for the demand on ERP systems from supply chain PM is developed, in order to fulfil the first purpose. The methodology is then presented, followed by a description of empirical data – the capabilities of common ERP systems. The capabilities are evaluated and discussed to fulfil the second purpose. Conclusions, implications, further research and limitations are finally presented.

## Enterprise Resource Planning systems

ERP is a business management system made up from a collection of applications or modules that integrates company functions such as marketing, finance, manufacturing and logistics (Helo and Szekely, 2005). ERP uses database technology to control and integrate information related to a company's business including data related to customers, suppliers, employees and finance. Ideally all business transactions, such as inventory management, customer order

management, production planning and distribution are entered, recorded, processed, monitored and reported (Helo *et al*., 2008). A single comprehensive database collects data and feeds data into the various modules (Krajewski *et al*., 2007). ERP systems are hence very complex.

Typical modules in an ERP system can be master production schedules, material requirements planning, inventory statuses and financial control (Helo and Szekely, 2005). ERP system capabilities have developed fast during the late years (Akkermans *et al.*, 2003), although many SMEs still use technically obsolete applications developed in the 1980s, such as MRP systems (APICS, 2007). Swedish companies tend to change ERP systems each 12 years (ComputerSweden, 2007). Advanced ERP versions and modules have shifted the focus from internal optimisation to external relationships. There is now functionality for global on-demand access to operational data, enabling external collaboration, data sharing and additional transaction ability through expansions into functionality such as customer relationship management (CRM), supplier relationship management (SRM), built-in-portals, and collaborative tools for joint planning. What is included in an ERP system is continuously changing as ERP vendors buy best-of-breed vendors to add functionality (APICS, 2007).

Evaluating ERP systems is a complex assignment, which can be referred to as multi-criteria decision making (Karsak and Özogul, 2009). This article simplifies and focuses on those parts or modules of the ERP systems that are related to handling of the activities in the supply chain PM process; no complete evaluation of the ERP systems' capabilities is hence done.

Based on the structure of Helo *et al.*, (2008), data should be entered, recorded/processed and monitored/reported in the ERP system. Measurement data should somehow be entered, which might be seen as something partly outside the ERP system. Anyway, the ERP system must have interfaces for inbound data entering or capturing, internally, from suppliers and logistics service providers (LSP). Data is preferably entered by automatic identification and data capture (AIDC), by the use of e.g. barcodes or RFID (APICS, 2007). After being entered, data should be electronically communicated inbound into the ERP system, known as electronic data transfer (EDT), e.g. using traditional or web-based EDI, XML or Web services (APICS, 2007). Core capabilities of the ERP system would be to record measurement data in its database and to process measurement data. The ERP system should also have capabilities for monitoring/reporting measurement results, which also might be seen as something partly outside the ERP system. Anyway, the ERP system must have capabilities or interfaces for outbound data communication and visualising results internally, to suppliers and LSPs. Data can be presented as different graphical user interfaces, e.g. in a web portal (APICS, 2007). These three capabilities of ERP systems are from here named data capturing, recording/processing and reporting. This is visualized in Figure 1, together with the studied actors in the supply chain, customer, supplier and LSP (shown in italics).

Take in Figure 1 about here

## Developing a framework for the demand from supply chain PM on ERP systems

In the following description of demands on the ERP systems, each supply chain PM demand is followed by a suggestion on how to categorize it into those three capabilities. This is done based on previous studies which have had a focus on tactical and operational levels in the company; such as the demands of purchasing managers, purchasers, logistics managers and material planners. The demands from supply chain PM can be general for any supply chain metric. In order to go more into detail, the specific focus of this framework development is laid on some often applied logistics metrics; on-time delivery and lead time (e.g. Forslund and Jonsson, 2007a). They can be categorized as process metrics according to Krajewski *et al.* (2007), or as reliability metrics according to the SCOR model (Stephens, 2001). These metrics are critical in today's lean supply chains, where e.g. deficient on-time delivery have consequences that can propagate through the supply chain. The supply chain PM process can here be described as consisting of four activities; defining metrics, target setting, measuring and analysing (Forslund and Jonsson, 2007a), as the performance variables on-time delivery and lead time already are selected.

In the defining metrics activity, it is important that the ERP systems efficiently **enable detailed metrics definitions** so that customer, LSP and supplier can define in the same way (e.g. Knolmayer *et al.*, 2009). The detailed metrics definition of on-time delivery was found to require agreement on at least four issues, measurement object, time unit, measurement point and comparison time (Forslund and Jonsson, 2007a, Hofmann, 2008). Measurement point requires an extra consideration; the ERP system must be fed with measurement data from different measurement points in the supply chain; internal within the company or from suppliers and LSPs. The ERP system should support various measurement points – it is acknowledged that some kind of relation-specific integration with the supply chain partners' ERP system is necessary. This aspect can be related to data entering and recording/processing capabilities. Another problem in this activity, pointed out by Hofmann (2008) was the lacking possibilities to **enable differentiated definitions** in the ERP systems in order to adapt to differing supplier demand (e. g. to measure performance of complete orders for some suppliers and for complete order lines for others). An important capability of the ERP systems is hence to give the possibility no to be forced to measure e.g. all suppliers' performance by order line, but rather the possibility to switch between definitions. This issue seems to be related to recording/processing capabilities. One way of avoiding the detailed discussions on metrics definitions can be to refer to use an ERP system's **availability of standard metrics**. Pre-defined or standardized metrics could be found in the SCOR model (Lockamy and McCormack, 2004) or in Materials Management Operations Guidelines/Logistics Evaluation used in the automotive industry (Odette, 2007). This aspect seems also to be related to recording/processing capabilities.

When setting performance targets, specific performance targets would accurately reflect each actor's individual needs (e.g. Holmberg, 2000). However, Forslund and Jonsson (2007a) found that many companies were forced by their ERP system to set the same performance target level for all suppliers without the possibility to differentiate. Hence, **differentiated target setting** possibilities are demanded from the ERP system. This aspect can be related to recording/processing capabilities.

In the measuring activity, there is a need for the ERP system to capture measurement data from different points in the supply chain. Measurement data collection was found to be done manually to a large extent (Forslund and Jonsson, 2007b). The ERP systems **supporting AIDC of measurement data** in different ways would be important. Data should be collected

at each point where the goods are handled, both internal and external to the company (ibid). This aspect can be related to data entering capabilities. After being registered, measurement data should be electronically communicated inbound into the ERP system using EDT. The **support of inbound EDT** is demanded. Again, it is acknowledged that some kind of relation-specific integration with the supply chain partners' ERP system is necessary. This requires data entering capabilities as well as recording/processing capabilities. In order to build the basis for joint improvement work in each supply chain relation, measurement results must be generated for each individual relation. Forslund and Jonsson (2007a) found that many companies were forced by their ERP system to measure performance as averages for many suppliers rather than **generating differentiated measurement results** for each relation. This aspect implies needs on recording/processing capabilities.

In the analysing activity, **efficient measurement reports** should be created. Forslund and Jonsson (2007a) found that many companies had to move data to Excel in order to produce usable performance reports, something that has also been mentioned by e.g. Bourne *et al.* (2000) and Busi and Bititci (2006). Reports can be done directly in the ERP system, which can have advantages such as less need for investments in additional software and no need for moving data. They can also be done in report generators, like in Business Intelligence tools, Clickview or Excel, which can have advantages such as being more powerful analysis tools (ComputerSweden, 2007), enable more tailor-made reports and the possibilities to use data from many sources (APICS, 2007). Forslund and Jonsson (2007b) found that companies with automatic report generation had higher on-time delivery performance than companies that had to move data and create reports in other systems. It could also be related to that companies that prioritize PM tend to invest in automatic report generation. Efficient measurement reports involve demand on recording/processing and reporting capabilities.

Furthermore, supply chain partners need to easily have access to the same performance data for analysis (APICS, 2007). This implies that the ERP system should **support outbound report EDT** in the supply chain; internally, to suppliers and to LSPs. Data can be presented as different graphical user interfaces. Demand on recording/processing and reporting capabilities appear. The analysis should be input to monitoring and following up past performance for making reactive decisions, as well as to improvement projects and proactive decision making (Forslund and Jonsson, 2007a). The ERP system should then **enable efficient analyses.** Examples of analyses here can be deviations from targets and trend analysis (Forslund and Jonsson, 2007a)**.** This implies demand on recording/processing and on reporting capabilities.

In Table 1, supply chain PM activities, their ten demands on the ERP systems and the three ERP system capabilities are illustrated. It can be seen that the main amount of demands are related to ERP systems' recording/processing capabilities; they are related to all activities in the PM process. A number of demands are related also to data entering capabilities and reporting capabilities; these are also important aspects when selecting an ERP system. Table 1, based on Figure 1, fulfils the first purpose of this paper.

## Methodology

This section describes the methodology for the empirical study. Based on Table 1 and the framework behind it, an interview guide was developed; which in an abbreviated form is presented in the left column of Table 3. It was pre-tested on some ERP system consultants, which lead to minor adjustments in wording. The interview guide was structured by supply chain PM activity, where defining metrics contains three demands and 16 operationalized sub-demands. Target setting contains just one demand, measuring contains three demands and three operationalized sub-demands, and analysing three demands and five operationalized sub-demands. Altogether 25 operationalized sub-demands implying 25 questions were included. The scale applied was nominal with three response alternatives; (1) that the demand/sub-demand is supported within the standard version or by configuration. Configuration refers to setting of parameters (Hedman, 2003) within the standard system without re-programming (APICS, 2007), (2) that the demand is supported with customer-specific adaptations, known as customization (ibid) or (3) that the demand can not be supported.

The wish was to evaluate common ERP systems provided by vendors represented on the Swedish market. It was difficult to find an objective "gross list" describing the Swedish market for ERP systems, due to the fact that there are many ways of measuring it (e.g. by number of installations or by installed license value). Information was collected from www.dpu.se, from a special issue in the industry magazine ComputerSweden (2007) and from a Swedish study (Olhager and Selldin, 2003). Including the large international ERP systems (from SAP down to iScala in Table 2) was straightforward as seen in the mentioned information sources. All respondents were exposed to the list of evaluated ERP systems in order to identify more systems to include; the last three ERP systems were included in that way. The selected twelve ERP systems and their studied versions can be seen in Table 2, followed by brief motivations of the choice of each system. A convenience sampling (Bass, 1990) of respondents was used; by the help of PLAN, ERP system websites and consultants, one respondent with knowledge in supply chain PM for each ERP system were sought for. The respondents' positions can be seen in Table 2. The respondents received the interview guide in advance; personal or telephone interviews were then conducted during early 2009.

Take in Table 2 about here

## How ERP systems support supply chain PM

This is the empirical chapter, containing an overview of the responses. In Table 3, the capabilities of the different ERP systems concerning how they support supply chain PM are shown. The table is structured by demands and sub-demands for each supply chain PM activity. The sub-demands are seen as the indented rows in the table. A "X" indicates that the demand is supported within the standard version or by configuration. A "(X)" indicates that the demand is supported with customer-specific adaptations, known as customization (ibid). An empty box indicates that the demand can not be supported.

Take in Table 3 about here

## Evaluating ERP systems' capabilities for supply chain PM

This section contains the analysis of the second purpose of the article. The analysis follows the activities of the supply chain PM process.

### Evaluating ERP systems' capabilities in defining metrics

Defining on-time delivery and lead time is the most complex activity containing 16 sub-demands. The first demand is that the ERP system should **enable detailed definition** of metrics, which means that measurement object, time unit, measurement point and comparison time should be captured (Forslund and Jonsson, 2007a). All systems, except for MS Dynamics NAV and Monitor, support different measurement objects, such as order, order line or item. Monitor has a special logic, capturing each delivery, no matter if it is an order or an order line. Day is the standard time unit in all studied ERP systems. Week is also supported in most systems, but hour and window are more seldom supported. Window can for many systems better be created in separate report generators. SAP/R3, Oracle, Lawson M3, iScala and Jeeves support all time units. Measurement points can be captured along the supply chain in all ERP systems except for Pyramid and Monitor that only contains one, internal, measurement point. When measurement points external to the company are wanted, this must be customized and integrated with a way of capturing data. All studied ERP systems allow for different comparison times; both wished and acknowledged time can be used.

Not only is there demand for detailed definition possibilities; also the capability to **enable differentiated definitions** for different supply chain partners is a demand. All ERP systems except for MS Dynamics NAV and Pyramid can handle this. A third issue within defining metrics concerns the **availability of standard metrics**. Here there are larger differences between the systems. Oracle, Lawson M3 and iScala contain both SCOR and Odette metrics. A majority of the studied systems do not support standard metrics. This accord to the findings of Forslund and Jonsson (2007b) who found scarce use of standard metrics in Swedish manufacturing companies.

Overall, the defining metrics activity is well handled in most ERP systems. When it comes to all details, Oracle, Lawson M3 and iScala seem to be the most supporting ERP systems.

### Evaluating ERP systems' capabilities in target setting

The target setting activity contains just one demand; enabling **differentiated target setting**. MS Dynamics AX, Lawson M3 and Jeeves do not handle targets in their standard version and require customer-specific adaptations for the support of this demand. MS Dynamics NAV and Monitor do not support target setting. The remaining ERP systems support this demand. Differentiated target setting between supply chain actors should be important when improvement is in focus (Holmberg, 2000).

SAP/R3, Oracle, JD Edwards, IFS, IBS and iScala seem to be the most supporting ERP systems in the target setting activity.

### Evaluating ERP systems' capabilities in measuring

The first demand in the measuring activity is to **support AIDC of measurement data**; all studied ERP systems support AIDC with barcodes. At the same time, it is recognized that capturing data requires a relation-specific integration solution. Forslund and Jonsson (2007b) found that companies with AIDC had higher on-time delivery performance than companies that had to capture data manually; a similar conclusion was made by Knolmayer *et al.* (2009). The **support of inbound EDT** by EDI or XML exists in all studied systems; again, a relation-

specific integration must be added. The capability of the ERP systems to **generate differentiated measurement results** can be found in all studied system.

Measuring issues seem to be perfectly supported in all studied ERP systems.

### Evaluating ERP system capabilities in analysing

Firstly, the demand to **create efficient measurement reports** splits the ERP systems into two groups; the larger group with SAP/R3, Oracle, JD Edwards, Lawson M3, IFS, IBS, Pyramid, iScala and Monitor that contain possibilities to create reports in the system, and the smaller group with MS Dynamics AX, MS Dynamics NAV and Jeeves that do not. Forslund and Jonsson (2007b) found that companies with automatic report generation had higher on-time delivery performance than companies that had to move data and create reports in other systems The **support of outbound report EDT** by EDI/XML can be found in SAP/R3, Oracle, MS Dynamics AX and NAV, Lawson M3, IFS, IBS, Jeeves and iScala. JD Edwards, Pyramid and Monitor instead support report communication via e-mail, claiming EDI to be un-necessary. EDT by web portals can be handled in all studied systems except for Pyramid. Customer-specific adaptations are though necessary in IBS and Monitor.

Finally the ERP systems **enabling efficient analyses** were studied. Deviations from targets can be analysed in SAP/R3, Oracle, JD Edwards, Lawson M3, IFS, IBS, Pyramid and iScala. Trend analysis can be conducted in all studied ERP systems except for MS Dynamics AX and NAV and Jeeves.

Altogether, analysing issues are completely supported in SAP/R3, Oracle, Lawson M3, IFS and iScala.

### Discussion

No identified study provided a systematic framework for the demands from supply chain PM on the ERP systems, even though many scholars call for guidelines for practitioners when ERP systems should be upgraded or purchased (APICS, 2007; Karsak and Özogul, 2009). As these purchases represent large investments for companies, more research is required (van Donk, 2008). Selecting an adequate ERP system was found to be a critical success factor for ERP implementation by Dezdar and Sulaiman (2009). Based on a theory review, a framework or a “checklist” identifying ten demands on the ERP systems from supply chain PM was developed. It was seen that the main amount of demands were related to ERP systems’ processing/recording capabilities; however a number of demands were related also to data entering and reporting capabilities, which also should be important aspects when selecting an ERP system. The current study has provided a general framework for the demands from supply chain PM, and a more operationalized framework for on-time delivery and lead time. This can guide practitioners in one aspect of selecting ERP system.

No identified study evaluated to what extent ERP systems support supply chain PM. Table 4 provides an aggregate view of how the studied ERP systems support the demand from each supply chain PM activity, and shows the percentage of support (directly or with configuration, the “X” in Table 3). For example, SAP/R3 supports 14 out of 16 sub-demands = 88% in defining metrics. Defining metrics is, in all its details, supported to differing degrees in the studied ERP systems. Target setting demands is supported in the half of the studied systems. Measuring, the core activity of PM, is perfectly supported in all systems. Finally analysing has lacking capabilities in many systems; however analysing is often intended to be done in completing systems. It should be said that for many companies, not all detailed demands should be necessary; then Table 3 can offer the detailed information on which demands and sub-demands that are supported for the respective ERP system. The most supporting ERP

systems for supply chain PM are Oracle and iScala. It is maybe not surprising that one of the largest systems is on that list. More interesting is to see that iScala, which is a smaller system measured as license value, also supports supply chain PM in a complete way.

Previous studies (e.g. Brewer and Speh, 2001; Busi and Bititci, 2006, Fawcett *et al.*, 2008, Phusavat *et al.*, 2009; Forslund and Jonsson, 2009) have found ERP systems to be obstacles to supply chain PM. This study could in several ways show a different view. The capability to enable differentiated definitions was found in almost every studied system. This contradicts the results of Hofmann (2008), who found companies to have problems in creating differentiated definitions. Half of the studied ERP systems handle differentiated target setting, which differs from the study of Forslund and Jonsson (2007a). They found that many companies had ERP systems which did not support this demand. The capability of the ERP systems to generate differentiated measurement results could be found in all studied system, contrary to the results of Forslund and Jonsson (2007b), who found companies that had no possibilities to measure one supplier at a time and were hence forced to measure averages for all suppliers.This does not necessarily mean that the previous studies were wrong. Many respondents have mentioned that ERP systems' capabilities for supply chain PM have developed a lot the last years, which indicate an awareness of demand on supply chain PM. This trend is also supported by APICS (2007). It is also acknowledged that Swedish companies on average change their ERP system each 12 years (ComputerSweden, 2007), which implies that many companies will improve their possibilities to work with supply chain PM once they change or upgrade their ERP system. According to Knolmayer *et al.* (2009) and Forslund and Jonsson (2007b), supply chain PM capabilities should also lead to higher performance levels. This could in turn imply competitive advantages.

## Conclusions, implications, further research and limitations

The first purpose of this article was to describe the demands from supply chain PM on ERP systems. This was shown in Table 1 as a theoretical contribution to the combined area of supply chain PM and ERP systems. The practical implications from this framework are to give practitioners input when selecting ERP system¸ a "checklist" of demands from supply chain PM to consider. It could also imply that ERP system developers and vendors are made aware of supply chain PM demands. Little explicit evaluation of this framework was done, other than the fact that the respondents of this study were confronted with it. These respondents represented vendors of ERP systems. It would be valuable to validate the framework by companies that have invested in ERP systems, questions such as: are these the demands that they face? What is missing and what is surplus? Which are the practical experiences from evaluating ERP systems? What was easy to fulfil and what was difficult? are left for further, case-based research. Such a study would also generate valuable practical contribution for companies and ERP system developers and vendors.

The second purpose was to evaluate the corresponding capabilities of common ERP systems. This study found that ERP systems overall have good capabilities for supply chain PM. The most supporting ERP systems for supply chain PM seem to be Oracle and iScala. The detailed evaluation of the ERP systems offers some practical implications as companies can use it as a starting point for their own evaluation. However, the results could also have a theoretical contribution. The outcome of an ERP system is both related to the system in itself and how it is applied (Botta-Genoulaz *et al.*, 2005). The results of this study can theoretically imply that research in supply chain PM could focus less on the ERP systems' capabilities and more on how the systems are applied. Not only which ERP system that is selected, but also how it is configurated or customized, how the staff is educated, how the ERP system actually is used,

and how parameters are updated should affect supply chain PM. It would be interesting to conduct such a study, based on case studies.

The study was directed to supply chain performance in general, and more specifically to on-time delivery and lead time. The results would be valid also for other metrics, especially those that affect more than one supply chain partner. Further research could study other supply chain metrics more specifically. The study has focused on common ERP systems on the Swedish market, although most ERP systems are "international" and can be found globally. Companies operate in global contexts with global demand, why the results of the empirical study also should be applicable outside Sweden. Country-specific ERP systems could be added to complete the evaluation in further studies.

Some limitations of the study should be mentioned; methodological decisions were made which might affect the results. The selection of ERP systems to include is the first; as no complete and objective gross list existed, the selection is somehow subjective. However, many sources were consulted and the respondents were asked to comment on the selection, which implied that three additional ERP systems were included. This is one validation of the selection. Second; the selection of respondents might have affected the results. They should be skilled in both supply chain PM and the respective ERP system. In some cases, up to four persons had to be contacted until the "right" respondent was found. There might further be a risk that the respondents have interpreted the questions differently, e.g. what is included in a standard version of an ERP system and what is configuration as compared to customization. To avoid this, the article was validated by the respondents. The respondents read and validated their own response, then they read and validated the final version of the paper, both times with possibilities to change misunderstandings. This procedure meant that all respondents were "satisfied" with how their respective ERP system had been evaluated. This would be an important component in the scientific quality of the paper. The scientific quality of the paper was, considering the mentioned limitations, still judged to be satisfactory.

It seems as the future looks bright for supply chain PM; the ERP system have developed fast during the years and when companies upgrade their ERP systems, they have good possibilities to acquire the supply chain PM capabilities they need. This could also imply higher supply chain performance levels. This is illustrated with a quotation "While supply chain management is enabled by modern information technology, supply chain management success is founded on people" (Fawcett *et al.*, 2008, p. 45).

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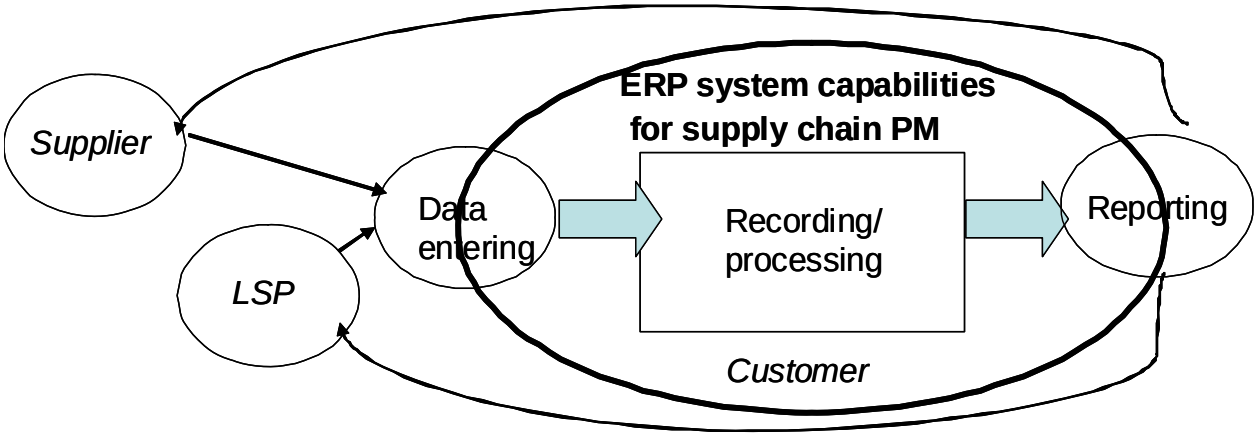
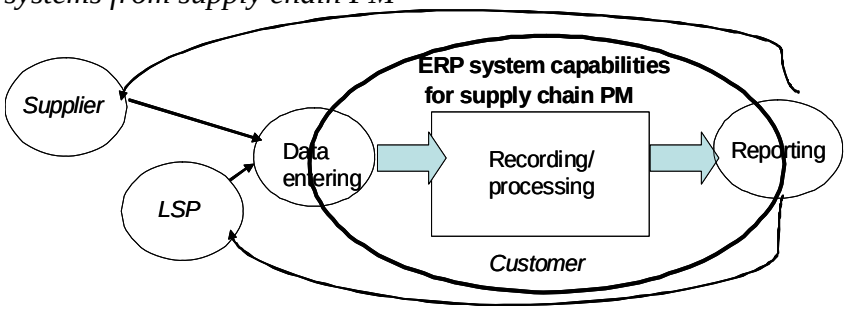



*Figure 1. ERP system capabilities for supply chain PM*

*Table 1. Demand on the ERP systems from supply chain PM*




| PM activities | Demand on the ERP systems | Data entering capabilities | Recording/ processing capabilities | Reporting capabilities |
|---|---|---|---|---|
| **Defining metrics** | Enable detailed definitions (of measurement object, time unit, measurement point, comparison time) | X | X | |
| | Enable differentiated definitions | | X | |
| | Availability of standard metrics | | X | |
| **Target setting** | Enable differentiated target setting | | X | |
| **Measu-ring** | Support AIDC of measurement data | X | | |
| | Support inbound EDT | X | | |
| | Generate differentiated measurement results | | X | |
| **Analy-sing** | Create efficient measurement reports | | X | X |
| | Support outbound report EDT | | X | X |
| | Enable efficient analyses | | X | X |

*Table 2. Studied ERP systems and respondents*

| ERP system/version | Motivation | Respondent |
|---|---|---|
| SAP/R3 ECC 6.0 | SAP/R3 is the largest ERP system on the Swedish market (in licence value) | Project leader |
| Oracle EBS R12/BI EE R10.1.3.4 | Oracle is the second largest ERP system on the Swedish market (licence value) | Principal sales consultant |
| JD Edwards EnterpriseOne 9.0 | JD Edwards is among the larger systems (license value) | System consultant |
| Microsoft Dynamics Axapta (AX) 4.0 | Axapta is among the newer ERP systems and is large (number of installations) | System consultant |
| Microsoft Dynamics Navision (NAV) 5.01 | Navision is still among the smaller actors but have grown considerably the last years | Business consultant |
| Lawson M3 Ver 7.1 | Lawson M3, formerly Intentia/Movex, is the largest "Swedish" ERP system (licence value) | Business consultant |
| IFS Applications 7.5 | IFS is large (licence value ) | Business solution consultant |
| IBS Enterprise 6.00 | IBS is among the larger ERP systems (number of installations) | Research/development manager |
| iScala 2.3 SR2 | Scala is among the largest ERP systems ( number of installations) | Product marketing manager |
| Jeeves Ver 10. 0.1.0 | Jeeves is large (number of installations, licence value) and is a Swedish ERP system | Support responsible |
| Pyramid Business Studio Ver 3.40A | Pyramid is a Swedish ERP system (number of installations) | Development manager |
| Monitor Ver 7.1 | Monitor is one of the largest Swedish ERP systems (number of installations) | Development manager |

*Table 3. ERP systems' capabilities related to demands from supply chain PM*

| Supply chain PM activities | ERP systems / Demand from supply chain PM | SAP / R3 | Oracle | JD Edwards | MS Dyn AX | MS Dyn NAV | Lawson M3 | IFS | IBS | iScala | Jeeves | Pyramid | Monitor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Defining metrics** | Enable definition of measurem object | | | | | | | | | | | | |
| | Order | X | X | X | X | (X) | X | X | X | X | X | X | (X) |
| | Order line | X | X | X | X | X | X | X | X | X | X | X | (X) |
| | Item | X | X | X | X | (X) | X | X | X | X | X | X | X |
| | Enable definition of time unit | | | | | | | | | | | | |
| | Hour | X | X | X | | (X) | X | X | | X | X | (X) | |
| | Day | X | X | X | X | X | X | X | X | X | X | X | X |
| | Week | X | X | X | X | (X) | X | X | (X) | X | X | X | X |
| | Window (+/– days) | X | X | (X) | | (X) | X | (X) | X | X | X | (X) | X |
| | Enable definition of measurem point | | | | | | | | | | | | |
| | Accessible at supplier | (X) | (X) | (X) | (X) | (X) | (X) | (X) | (X) | (X) | (X) | | (X) |
| | Available at customer | X | X | X | X | X | X | X | X | X | X | X | X |
| | In stock at customer | X | X | X | X | (X) | X | X | X | X | X | | |
| | Available at point of use | X | X | X | X | (X) | X | X | X | X | X | | |
| | Enable definition of comparison time | | | | | | | | | | | | |
| | Wished time | X | X | X | X | X | X | X | X | X | X | X | X |
| | Acknowledged time | X | X | X | X | X | X | X | X | X | X | X | X |
| | Enable differentiated definitions | X | X | X | X | (X) | X | X | X | X | X | (X) | X |
| | Availability of standard metrics | | | | | | | | | | | | |
| | SCOR | X | X | | | | X | (X) | (X) | X | | | |
| | Odette | | X | | | | X | (X) | (X) | X | | | |
| **Target setting** | Enable differentiated target setting | X | X | X | (X) | | (X) | X | X | X | (X) | (X) | |
| **Measuring** | Support AIDC of measurement data | | | | | | | | | | | | |
| | By bar code | X | X | X | X | X | X | X | X | X | X | X | X |
| | Support inbound EDT | | | | | | | | | | | | |
| | By EDI/XML | X | X | X | X | X | X | X | X | X | X | X | X |
| | Generate differentiated measurement results | X | X | X | X | X | X | X | X | X | X | X | X |
| **Analysing** | Create efficient measurement reports | | | | | | | | | | | | |
| | In the ERP system | X | X | X | | | X | X | X | X | | X | X |
| | Support outbound report EDT | | | | | | | | | | | | |
| | By EDI/XML | X | X | | X | X | X | X | X | X | X | | |
| | By a web portal | X | X | X | X | X | X | X | (X) | X | X | | (X) |
| | Enable efficient analyses | | | | | | | | | | | | |
| | Deviations from target | X | X | X | (X) | | X | X | X | X | | X | |
| | Trend analysis | X | X | X | (X) | | X | X | X | X | | X | X |

*Table 4. The percentage of support per ERP system and supply chain PM activity*

| ERP systems / Supply chain PM activities | SAP / R3 | Oracle | JD Edwards | MS Dynamics AX | MS Dynamics NAV | Lawson M3 | IFS | IBS | iScala | Jeeves | Pyramid | Monitor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Defining metrics** | 88 | 94 | 75 | 69 | 31 | 94 | 75 | 69 | 94 | 81 | 50 | 50 |
| **Target setting** | 100 | 100 | 100 | 0 | 0 | 0 | 100 | 100 | 100 | 0 | 0 | 0 |
| **Measuring** | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| **Analysing** | 100 | 100 | 80 | 40 | 40 | 100 | 100 | 80 | 100 | 40 | 60 | 40 |