

Supply chain management maturity and performance in SMEs

Lennart Söderberg · Lars Bengtsson

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Abstract Supply chain maturity models attempt to disseminate best practices in supply chain management (SCM). One basic idea behind these models is that increased maturity will lead to improved supply chain performance, which in turn will lead to improved financial performance. There is, however, little empirical evidence about the relationship between supply chain (SC) maturity and financial performance, specifically in SMEs. The results of this study indicate that there is a strong relationship between SCM maturity and SC performance in SMEs, as well as some relationships between SCM maturity and financial performance. One conclusion is that if firms use maturity indicators in the Supply Chain Operations Reference areas to improve their processes, they will most likely achieve positive effects on supply chain performance and probably also on financial performance.

Keywords Supply chain management maturity · Supply chain performance · SMEs · SCM · Maturity models

1 Introduction

Small and medium-sized enterprises (SMEs) of today find themselves confronting new or changing demands and in

many cases even a new type of customer. They are facing customers on a global market with increasing performance demands in terms of service in order fulfilment, delivery consistency, and reduction of lead times. To meet these demands, firms have to develop the corresponding knowledge and abilities exploited in their organizational process (Lockamy III and McCormack 2004b; McCormack et al. 2008). One of these areas is supply chain management.

Outsourcing and specialization have made effective management of supply chains increasingly important for the competitiveness of industrial firms. Firms are thus eager to identify ways to develop their supply chain capability. In recent years, a substantial amount of research has been carried out to define and measure supply chain performance and to investigate maturity models for the strategic management of supply chain processes (Gunasekaran et al. 2001; Morgan 2004; McCormack et al. 2008). Based on the assumption that such a capability is a result of systematic development, there are supply chain maturity models available that try to disseminate best practices in supply chain management (e.g., Lockamy III and McCormack 2004b; Vaidyanathan and Howell 2007).

One basic idea behind these models is that increased maturity will lead to improved supply chain performance, which in turn will lead to improved financial performance. There is, however, scarce empirical evidence on the relationship between supply chain (SC) maturity and performance (Presutti and Mawhinney 2007). The rather few studies that do exist only provide indications that firms with higher SC maturity are more profitable or have better SC performance than firms with lower SC maturity (PRTM 2007; McCormack et al. 2008). Other studies indicate connections between supply chain performance and financial success (Bowersox et al. 2000; D'Avanzo et al. 2003; Christensen et al. 2007). One problem, discussed by Timme

L. Söderberg (✉)
Growth Department, Municipality of Sandviken,
811 80 Sandviken, Sweden
e-mail: lennart.soderberg@sandviken.se

L. Bengtsson
Dept. of Industrial Engineering and Management,
University of Gävle,
801 76 Gävle, Sweden
e-mail: lars.bengtsson@hig.se

and Williams-Timme (2000), is that the managers do not always understand the potential benefit of supply chain management (SCM) for the financial outcome, and that many SCM experts focus more on operational than financial performance indicators.

Another shortcoming is that most studies concern larger firms, while studies on SMEs are lacking. One exception is a recent study of 424 SMEs in Finland (Töyli et al. 2008). The authors could not, however, draw conclusions about the relationship between SCM maturity and financial performance, since most SMEs displayed a very low maturity level. Their study did not include an analysis of SC performance.

The purpose of this paper is to further explore the relationship between supply chain management maturity, supply chain performance, and financial performance in small and medium-sized enterprises. Our study thus replicates the work done by Lockamy III and McCormack (2004b) but in the context of SMEs.

2 Theoretical framework and hypotheses

2.1 The concept of process maturity

Supply chain management maturity is based on the concept of process maturity and derives from the understanding that processes have life cycles or clearly defined stages that can be managed, measured, and controlled. Higher levels of maturity in these business processes will result in better control of results; improved forecasting of goals, costs, and performance; greater effectiveness in reaching defined goals; and an improved ability to propose new and higher targets for performance (Lockamy III and McCormack 2004b).

A maturity model uses a methodology very similar to the concepts of Business Process Reengineering. The concept is founded on components related to the definition, measurement, management, and control of business processes (McCormack et al. 2008). The Business Process Orientation (BPO) model indicates five stages of process maturity, shown in Fig. 1. Achieving each level of maturity establishes a higher level of process capability for an organization, such as predictability, control, effectiveness, and efficiency (Lockamy III and McCormack 2004b; McCormack et al. 2008).

Any attempt to skip maturity levels is counterproductive, since each level builds a foundation from which to achieve the next level. An organization must evolve through these levels to establish a culture of process excellence (Lockamy III and McCormack 2004b).

Over the years, maturity models have been used in many industries. One of the most well known is the Capability Maturity model (CMM) developed by the Software

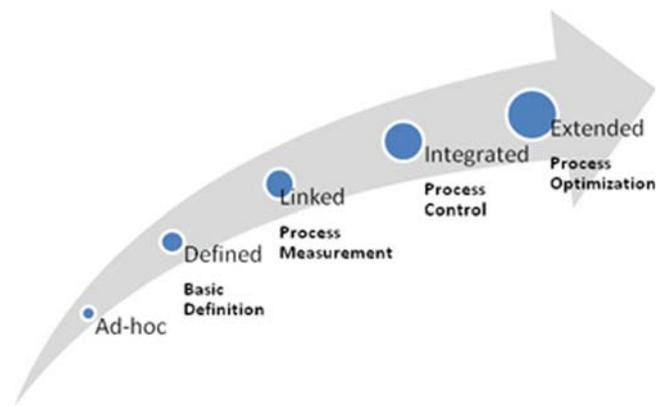


Fig. 1 Process maturity development stages. Source: McCormack et al. (2008)

Engineering Institute of Carnegie Mellon University for the software engineering process (Vaidyanathan and Howell 2007). The Lean Aerospace Initiative developed the Lean Enterprise Transformation Maturity model to guide the aerospace industry toward leanness (Nightingale and Mize 2002). All the maturity models have the concept of BPO in common.

While the maturity model did not directly originate with supply chain processes, it can be used to analyze the activities of supply chains based on key performance indicators.

2.2 The supply chain management maturity model

The Supply Chain Management Maturity model (SCMM) developed by Lockamy III and McCormack (2004a, b) takes into consideration both the BPO concept and the cross-industry supply chain management approach from the Supply Chain Operations Reference model (SCOR) developed by the Supply Chain Council.

The SCOR framework conceptualizes the SCMM model, owing to its process orientation and wide adoption by the supply chain academic and practitioner communities. The five stages of maturity show the progression of activities toward effective SCM and process maturity (Lockamy III and McCormack 2004b; Johnson and McCormack 2003).

The following is a short description of each SCM maturity level:

- *Ad hoc*—The supply chain and its practices are unstructured and ill-defined. Process measures are not in place. Jobs and organizational structures are not based on horizontal supply chain processes. On this level there are few structured practices and there is a lack of competencies. Success is based on individual heroics and “working around the system.” Frustration

and burnouts are often present in the organization and among the employees.

- *Defined*—Basic SCM processes are defined and documented. Jobs and organization basically remain traditional. Process performance is more predictable. Targets are defined but still missed more often than not. The organization practices collaboration among representatives from sales, manufacturing, and transportation to coordinate with each other, but only as representatives of their ordinary functions. There is a need for knowledge and understanding of process management.
- *Linked*—Broad SCM jobs and structures are put in place outside and in addition to traditional functions. Cooperation among intra-company functions, vendors, and customers takes the form of teams that share common SCM measures and goals that reach horizontally across the supply chain. There is a need for continuous improvements and a broad understanding of how to deal with root cause elimination and performance improvements. The organization has to include their customers in process improvement efforts.
- *Integrated*—The company, together with its vendors and suppliers, takes cooperation to the process level. Organizational structures and jobs are based on SCM procedures. SCM measures and management systems are deeply imbedded in the organization. Advanced SCM practices, such as collaborative forecasting and planning with customers and suppliers, take shape. The organization uses teams when they set process goals.
- *Extended*—Competition is based on multifirm supply chains. Multifirm SCM teams with common processes, goals, and broad authority take shape.

2.3 Hypotheses

Drawing on the literature presented on the relationships between supply chain maturity, supply chain management performance, and financial performance, we propose two hypotheses:

- H1: Higher levels of SCM maturity lead to better supply chain performance.
- H2: Higher levels of SCM maturity lead to better financial performance.

3 Research methodology

This study is a replication of the work of Lockamy III and McCormack (2004b) in the context of SMEs. Lockamy III and McCormack propose the Supply Chain Management Maturity model to analyze the maturity and then examine the relationship between supply chain

management maturity and performance. They show a very strong correlation between maturity and performance. We aimed to investigate that connection even in rather small SMEs. We could find no studies conducted on small SMEs in Sweden or outside Sweden except Finland—the study by Töyli et al. (2008).

The paper is based on a study of 15 SMEs within the Swedish engineering industry. The SMEs together form a regional supplier network of metal cutting firms that have large steel companies as their main customers. The selection of cases from a single industrial sector limits generalizing to other sectors, but the situation where clusters of SMEs depend on one or a few customers is not uncommon in other industries. Sweden has a rather homogenous and stable economy, political structure, and context, which makes the regional bias of the studied firms less critical for the findings. Even though the number of companies is rather small, the study meets the standard of good credibility, according to the criteria presented by Forza (2002).

In order to collect valid and reliable data, we chose personal interviews (with plant managers and/or the logistics manager) instead of a conducting a mail survey. There are several arguments for this approach. The rather small population makes the results sensitive to a lack of data. Through interviews we could ensure that all data needed were in place. Another justification for using personal interviews was that the knowledge and the maturity in the area of supply chain management seems to be low in many SMEs. This is also what we found in our study, in line with other studies of SMEs (see Töyli et al. 2008). With interviewing we could be sure that the respondents understood the questions, so the data based on wrong assumptions could be kept to a minimum. Our approach also allowed us to explain the concept of supply chain maturity, making it easier for the respondents to understand the criteria for evaluating the firm's maturity.

The questionnaire behind the model was designed to answer how the companies work with their processes, how they define and document them, and how they measure and link them horizontally. The questions can apply to small companies as well as big organizations.

The analysis was done in four steps. First, we established the level of SC performance by interviewing the plant and/or logistics manager in each firm. Eleven of the respondents were the firm owners. In this study we used the performance metrics suggested by Bowersox et al. (2000) and Bowersox et al. (2007) to describe the supply chain performance in each firm in terms of five key dimensions of logistics parameters (see Table 1).

We used these performance metrics because they had a clear, logistic approach and were easy for the respondents

Table 1 Supply chain performance metrics used

Customer service	Cost management	Quality	Productivity	Asset management
Customer satisfaction	Logistics cost	Delivery dependability	Information systems support	Inventory turn
Delivery speed		Responsiveness	Order fill capacity	
Product flexibility		Order flexibility	Advanced shipment notification	
		Delivery flexibility		

Adapted from Bowersox et al. (2007)

to understand, even without much knowledge of SCM maturity and process management. Each manager judged his own performance and answered each question in relation to his competitors on a five-point Likert scale (ranging from 1 = very poor and 3 = equal to 5 = very superior). Most of the respondents ranked themselves as equal or superior compared to their competitors. In some cases they ranked themselves as poor, but in no case as very poor or very superior compared to their competitors. The distribution of the studied firms is displayed in Table 3. Overall performance estimated from the firm's individual results of the metrics used, yielded four groups by performance: laggards, average, leaders, and front-runners. Four of the firms could be classified as front-runners, while nine were leaders, one was ranked as average, and one as a laggard.

In the second step we used the SCMM model from McCormack (2001); Johnson and McCormack (2003) and Lockamy III and McCormack (2004b) to define the firm's supply chain maturity. The data was collected during the same interviews that established the firm's SC performance. With a foundation in business process orientation, the model conceptualizes how process maturity relates to the well-known SCOR framework developed by the Supply Chain Council (2009). Lockamy III and McCormack's model used the SCOR model to evaluate four areas (Plan, Source, Make, and Deliver) on a scale of 1 (never exists) to 5 (always exists). Our model does not include the "Return" area of the SCOR, since in these SMEs reverse logistics are not a significant factor in their supply chain. The model weights nine variables differently due to their appearance in different constructs in a set of 94 questions, using a Likert five-point scale. The work behind definitions of variables and validation of questions is well described by Johnson and McCormack (2003). The maturity model was selected because it already had been tested and validated in previous studies (Lockamy III and McCormack 2004b; Johnson and McCormack 2003; and McCormack et al. 2008).

This may be one of the first times this model has been proved and used in a Swedish context and with small SME firms as respondents, so a few special circumstances must be considered. First, the plant management, in the most cases the firm owners, have very little knowledge about

SCM practices, so there would be no use sending them a survey to return. Therefore we went to visit them and discussed the questionnaires together, to give the respondent enough background information about SCM to answer the questions properly. Second, we could not afford to miss any answers when the population of the study was so small. It was necessary for the first author to go out to the firms to be sure of results from the respondents. This approach resulted in a response rate of 100% and no missing data. The maturity of each firm's supply chain management (SCM) is displayed in Table 2.

The sample as a whole has a mean value of 249, indicating so-called *linked* maturity, and a median of 261 points. This means that most firms end up as level 2 (linked, greater than 227 points), but firms are also represented at level 3 maturity (integrated, greater than 338 points). There are no companies at level 4 (extended, greater than 416 points), which is consistent with earlier research using the model (McCormack et al. 2008).

The third step of the analysis concerned the establishment of the firm's financial performance and was based on official financial reports obtained from a nationwide database. The financial metrics chosen include both internal-facing metrics (e.g., cost of sold goods) and shareholder-facing metrics (e.g., net margin and ROA), as suggested by Bowersox et al. (2007) and Bolstorff and Rosenbaum (2003).

The set of performance metrics differs from those used by Lockamy III and McCormack. But because we used the set of parameters for SC performance suggested by Bowersox et al. (2007) and Bolstorff and Rosenbaum (2003), we chose to use their set of parameters for financial performance as well. Furthermore, these are easy to obtain from the public database used. The values of the variables were calculated from the firm's annual reports. The firms were grouped into four different levels according to their financial outcome in the key variables. Most of the firms were at level 2 (called parity) but all levels were represented.

We used a statistical sample of 5% of the overall number of the Swedish companies in the chosen industry to verify that the method of grouping the companies according to their financial outcomes was accurate for this purpose.

Table 2 Distribution by company for SCM maturity variables

Company	Employees	Maturity variable				Maturity points	Maturity level
		Plan (pts.)	Source (pts.)	Make (pts.)	Deliver (pts.)		
Metal company 1	13	61	27	28	60	176	defined
Metal company 2	13	34	22	27	53	136	defined
Industry service company 1	101	82	31	47	72	232	linked
Manufacturing company	58	118	57	63	113	351	integrated
Steel cutting company 1	45	114	42	63	86	305	linked
Steel cutting company 2	18	58	35	33	61	187	defined
Steel cutting company 3	56	107	48	61	83	299	linked
Industry service company 2	37	106	44	48	64	262	linked
Steel cutting company 4	46	103	39	60	81	283	linked
Steel company	8	87	36	56	82	261	linked
Steel cutting company 5	16	85	38	57	72	252	linked
Steel cutting company 6	77	121	56	69	94	340	integrated
Steel cutting company 7	72	117	45	57	80	299	linked
Steel cutting company 8	3	91 ^a	40 ^a	51 ^a	76 ^a	258 ^a	linked ^a
Industry service company 3	56	75	39	41	62	21	defined
Mean value		91	40	51	76	249	linked
Standard deviation		25.5	9.5	13.2	15.3	60.1	
Median value		91.0	39.0	56.0	76.0	261.0	

^a Sample mean (We used the values from sample means if we could not reach the company in time for the study.)

When we put our 15 companies into the statistic sample of companies, none changed its position in the group. Therefore, we consider the method of grouping the companies by their financial outcomes valid. We also used the four-digit industry code (given by Statistics Sweden,

SCB) to be sure that a company belonged to a specific industry. The distribution of financial performance is shown in Table 3.

In the fourth step we tested the hypotheses about the relationships between SC maturity and performance using

Table 3 SC performance and financial performance in the studied firms ($N=15$)

Performance (max. value)	Mean value	Standard deviation	Median value
Supply chain performance			
Customer service (15)	11.7	1.2	12
Cost management (20)	13.1	2.2	13
Asset management (4)	2.7	1.2	3
Quality (20)	14.2	1.8	14
Productivity (15)	11.2	2.4	12
Sum, SC performance (74)	52.9	3.8	52
Financial performance			
Sales growth	0.2	0.2	0.2
Cash flow	0.4	0.3	0.4
Inventory turn	29.4	39.5	16.7
COGS (Cost of goods sold)	0.4	0.2	0.4
Gross margin	0.1	0.1	0.1
Operation margin	0.1	0.1	0.1
Net margin	0.1	0.1	0.1
ROA	0.2	0.1	0.2
ROI	0.4	0.8	0.4
Financial performance (levels 1–4)	2.3	0.8	2.0

Table 4 SCOR area maturity vs. SC performance (Correlation Analysis)

SC performance	Supply chain management maturity				
	Plan	Source	Make	Deliver	SCMM
Customer service	0.37	0.34	0.22	0.58	0.40
Logistics costs	-0.16	-0.22	0.02	-0.12	-0.13
Asset management	-0.25	-0.35	-0.24	-0.26	-0.28
Quality	<u>0.72</u>	<u>0.66</u>	0.58	0.52	<u>0.67</u>
Productivity	<u>0.83</u>	<u>0.78</u>	<u>0.89</u>	<u>0.71</u>	<u>0.85</u>
SC performance	<u>0.74</u>	<u>0.63</u>	<u>0.65</u>	0.48	<u>0.68</u>

$N=15$; bold means $p<0.05$, bold and underlined means $p<0.01$

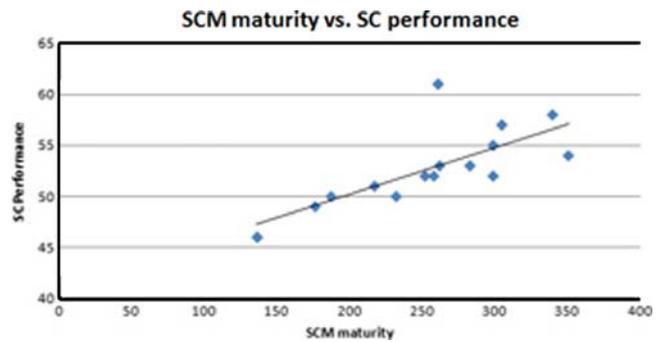
both clustering of firms into four groups (Bolstorff and Rosenbaum 2003) and correlation analysis using Pearson's.

4 Results

4.1 Correlation analysis between SCM maturity and SC performance

Table 4 shows a positive and strong correlation between SCM maturity (SCMM) and quality variables such as delivery performance and productivity, which includes order fulfilment capacity and information system support. Figure 2 shows the correlation.

The outcome for logistics costs is lacking. Also, asset management seems to be negatively correlated to SCMM. Almost all parts of SCM maturity do, however, strongly correlate to overall SC performance (0.68–0.74). The results thus mostly support Hypothesis 1.

**Fig. 2** SCM maturity vs. SC performance

4.2 Correlation analysis between SCM maturity and financial performance

We can see indications of correlations between SCM maturity and financial performance (Table 5). Maturity seems to have the greatest impact on profitability. This is, however, the only significant correlation. This means that the study does not provide full support for hypothesis 2.

5 Discussion

This study contributes to the rather sparse set of empirical studies on the relationship between supply chain management maturity and performance (Presutti and Mawhinney 2007).

The first hypothesis was mostly supported. This means that our results confirm the relationship between SCM maturity and SC performance claimed in earlier studies (PRTM 2007; McCormack et al. 2008; Lockamy III and McCormack 2004b; Johnson and McCormack 2003). In addition to previous studies, the results from the current study further

Table 5 SCOR area maturity vs. financial performance (Correlation Analysis)

Financial performance	Supply chain management maturity				
	Plan	Source	Make	Deliver	SCMM
Sales growth	0.15	0.24	-0.02	0.05	0.11
Cash flow	0.07	0.02	-0.05	0.06	0.04
Inventory turn	-0.31	-0.36	-0.16	-0.15	-0.26
COGS	0.34	0.50	0.26	0.38	0.38
Gross margin	0.21	0.23	0.17	0.29	0.24
Operation margin	0.23	0.26	0.13	0.32	0.25
Net margin	0.20	0.24	0.09	0.30	0.22
ROA	0.11	0.18	0.00	0.24	0.14
ROI	-0.03	0.19	-0.08	0.14	0.04
Financial performance	0.12	0.21	-0.01	0.14	0.12

$N=15$; bold means $p<0.05$, bold and underlined means $p<0.01$

indicate that all four areas of the SCOR model have a great impact on such performance variables as quality and productivity, as well as on overall SC performance. The delivery process has a moderately strong correlation to customer service. Why logistics costs do not correlate to SCM maturity is an open question subject to further research.

The second hypothesis concerned the impact of SCM maturity on financial performance. The results showed a few correlations, which indicate a positive relationship between maturity and financial outcome. The source area has the strongest relation to the COGS variable in financial performance. Our study is thus one of a few that can show a relationship between SCM maturity and financial performance, a relationship that has only been suggested in previous studies (Bowersox et al. 2000; D'Avanzo et al. 2003; Christensen et al. 2007). The hypothesis was, however, not fully supported, because there were too few significant correlations. There are two possible interpretations of this result. One is that the lack of correlation is an effect of an insufficient number of observations. While the study by Töyli et al. (2008) could not confirm this relationship due to a low level of maturity in the SMEs, our study would instead suffer from too few cases. Another explanation might be that financial performance is more likely influenced by a number of factors outside the area of SCM. Indicators like the gross margin, ROA, and ROI are influenced by a number of factors including market trend, the structural configuration of the firms, etc. Both explanations imply the need for further research with a large-scale survey approach.

Lastly, the results tell us that the study's SMEs are more mature in their supply chain management than we expected, with none of the respondents at the lowest, ad hoc level. This could be an indication that even smaller firms have begun to more fully realize the potential of SCM and process management for performance outcome, as discussed by Timme and Williams-Timme (2000).

6 Conclusions and managerial implications

This study is one of the first in a Swedish context with small and medium-sized enterprises as respondents. Most previous research has been done in larger international or global organizations. Therefore, this study contributes to understanding the impacts of SCM, particularly in smaller firms. The empirical basis is narrow, but practical lessons learned can still be translated into know-how when it comes to how to develop, define, measure, and manage the processes for a successful supply chain.

The results of this study indicate that there is a strong relationship between SCM maturity and SC performance in SMEs and some relationships between SCM maturity and

financial performance. This means that if firms, even SMEs, use maturity indicators in the SCOR areas to improve their processes, they will most likely achieve a positive effect on supply chain performance.

This study is a replication of the work of Lockamy III and McCormack (2004b), but in the SME context. Since the study confirms their results, it finally confirms the robustness of this approach and the Lockamy III and McCormack (2004b) maturity model as a reliable tool for this purpose, even in small firms.

One implication is that it is effective for a company to focus on its own processes, define and document them, set up process goals and measure them, and manage them for higher maturity. Such an approach is more effective than trying to find activities that are focused directly on higher performance. For instance, the company can always increase the customer satisfaction by decreasing delivery time, but this could easily lead to increased logistic costs, which in turn make overall SC performance the same or even worse. But as Fig. 2 shows, increased maturity mostly leads to higher overall SC performance. To gain higher maturity in supply chain management, the understanding of the impact of process management and especially the knowledge of horizontal process integration must be taken to a higher level. Understanding continuous improvements is vital to making companies advance to a higher maturity level. Realizing this is a crucial issue for managers of SMEs.

Starting such a journey also presents several challenges. Many SMEs lack knowledge and any empirical evidence that SCM development is a valuable path for SMEs to embark on. Small companies often do not have enough knowledge in house, and therefore have to buy it from consultants (which can be expensive). If the knowledge about SCM and process management remains with consultants outside SMEs, it may also be harder to adopt this as a method for improvements. The results from this study, however, provide SME managers with arguments and incentive to invest in SCM, and to see the benefits from a long-term point of view instead of the short-term costs, while simultaneously giving them a tool and a method to do that.

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