

Supply Chain Management Maturity and Performance in SME

Lennart Söderberg¹ and Lars Bengtsson²

1) *Corresponding author,*

Growth Department, Municipality of Sandviken, Sweden

Odengatan 37, 811 80 Sandviken, Sweden

lennart.soderberg@sandviken.se

2) *Dept. of Industrial Engineering and Management, University of Gävle, Sweden*

lars.bengtsson@hig.se

Abstract

Maturity models for supply chain management (SCM) are used to disseminate best practices in organizations. There is, however, scarce empirical evidence of the performance outcomes, specifically in small and medium-sized enterprises (SMEs). The purpose of this paper is to analyze the relationship between SCM maturity, SC performance and financial performance in SMEs. The results confirm a close relationship between different aspects of SCM maturity and SC performance and explore the relations between SCM maturity and financial performance.

Keywords: supply chain management maturity, supply chain performance, SME

Introduction

Small and medium-sized enterprises (SMEs) of today are finding 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 and McCormack, 2004; McCormack, Ladeira, and Valderes de Oliveira, 2008). One of these areas concerns 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, Patel, and Tirtirouglu, 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 and McCormack, 2004; 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 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, von Lewinski, and Van Wassenhove, 2003; Christensen, Germain, and Birou, 2007). One problem, discussed by Timme 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 small and medium companies (SMEs) are lacking. One exception is a recent study on 424 SMEs in Finland (Töyli *et al.*, 2008). This study could, however, not draw conclusions about the relationship between SCM maturity and financial performance because most SMEs displayed a very low maturity level. They 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 (SMEs).

Theoretical framework and hypotheses

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 improved ability to propose new and higher targets for performance (Lockamy and McCormack, 2004).

A maturity model represents 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 Figure 1. Achieving each level of maturity establishes a higher level of process capability for an organization, such as predictability, control, effectiveness, and efficiency (Lockamy and McCormack, 2004; McCormack *et al.*, 2008).

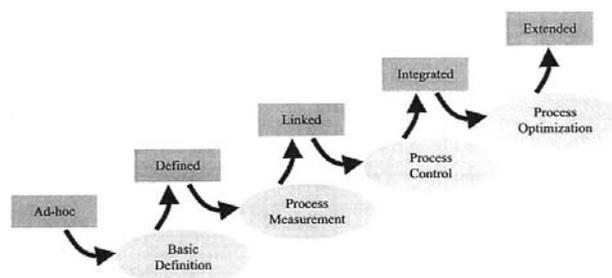


Figure 1. Process maturity development stages. Source: McCormack *et al.*, 2008.

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 and McCormack, 2004).

Over the years, maturity models have been used in many industries. The most famous of them is the Capability Maturity model developed by the Software Engineering Institute of Carnegie Mellon University (2002) and used by the software industry. The Lean Aerospace Initiative developed the Lean Enterprise Transformation Maturity model to guide the aerospace industry toward their “degree” of 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.

The Supply Chain Management Maturity model

The Supply Chain Management Maturity model (SCMM) developed by Lockamy and McCormack (2004) takes consideration to 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 SCCM model as illustrated in Figure 2, 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 and McCormack, 2004; 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.
- *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.
- *Linked* – Broad SCM jobs and structures are put in place outside and in addition to traditional functions. Cooperation between 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.
- *Integrated* – The company, as well as its vendors and suppliers, take 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.
- *Extended* – Competition is based on multifirm supply chains. Multifirm SCM teams with common processes, goals, and broad authority take shape.

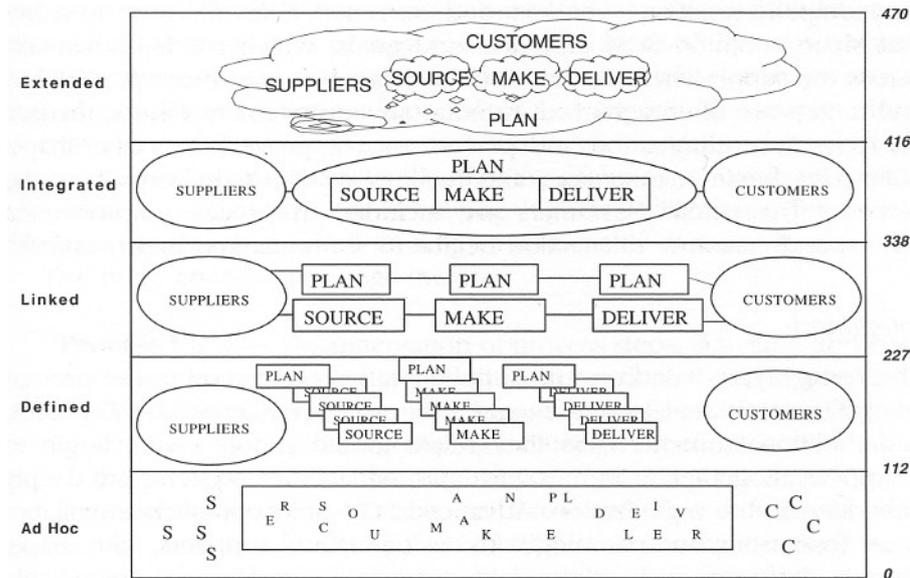


Figure 2. The Supply Chain Management Maturity model overview. Source: Johnson and McCormack (2003); Lockamy and McCormack (2004).

Drawing on the literature presented above, the conceptual model and hypotheses on the relationships between supply chain maturity, supply chain management performance and financial performance are illustrated in Figure 3. We propose three hypotheses:

- H1: Firms with higher-level SCM maturity will improve SC performance.
- H2: Higher levels of SCM maturity lead to better financial performance.
- H3: Improvements in SC performance lead to better financial performance.

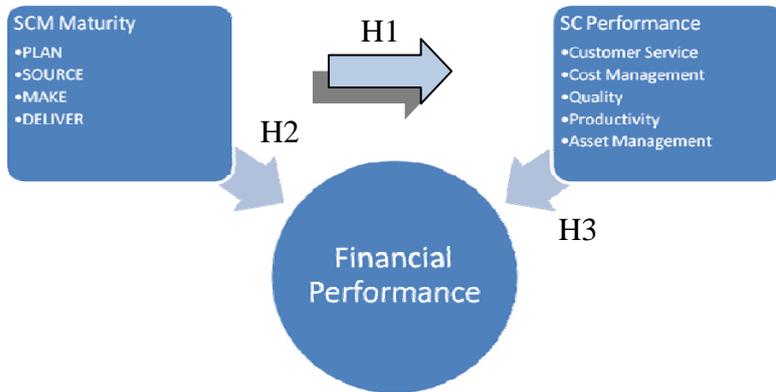


Figure 3. Conceptual model and hypotheses.

Methodology

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 larger steel companies as their main customers. 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).

The analysis was done in three steps. First, we established the SC performance and SC maturity by interviewing the plant and/or logistics manager in each firm. Eleven of the 15 were the firm owners. In this study we used the performance metrics suggested

by Bowersox *et al.* (2000) and Bowersox, Closs and Cooper (2007) to describe the supply chain performance in each firm in terms of five key dimensions of logistics parameters (see Table 1). Each metric was captured by having each manager judge his own performance and answer each question in relation to his competitors in a five-point Likert scale (ranging from 1 = very poor, 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 of performance: laggards, average, leaders, and front-runners. Only one of the firms could be classified as a front-runner, while 12 were leaders, one was ranked as average and one as a laggard.

Table 1. SC performance metrics used

Supply Chain Performance metrics used				
<i>Customer Service</i>	<i>Cost Management</i>	<i>Quality</i>	<i>Productivity</i>	<i>Asset Management</i>
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		

Source: Adapted from Bowersox, Closs, and Cooper (2007).

We used the SCMM model from McCormack (2003) and Lockamy and McCormack (2004) to define the firm's supply chain maturity. With a foundation in business process orientation (BPO), the model conceptualizes how process maturity relates to the well-known SCOR framework developed by the Supply-Chain Council (2009).

Lockamy and McCormack's model used the SCOR model for the purpose of evaluation of four areas (Plan, Source, Make, and Deliver), on a scale of 1 (never exists) to 5 (always exists). The 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. This maturity model was selected because it already had been tested and validated (Lockamy and MacCormack, 2004; 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 had to be considered. First, the plant management, in the most cases the owner of the firm, has 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 ensure results from the respondents. This approach resulted in a response rate of 100% and no missing data.

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*	40*	51*	76*	258*	linked*
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	
*sample mean							

The maturity of each firm's supply chain management (SCMM) was examined and the sample had a mean of 249 (i.e., level 2, so-called *linked* maturity) and 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) but there were no one at level 4 (extended, greater than 416 points), which is consistent with earlier research using the model (McCormack *et al.*, 2008).

The second 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 concerned both internal facing metrics (e.g., costs 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 financial outcome of each SME was also compared to the mean financial performance of a randomized and representative sample (57 firms) of the same industry to see if the outcome of the financial analysis was reliable.

The financial performance was estimated from some key variables as suggested by Bowersox *et al.* (2007) and Bolstorff and Rosenbaum (2003). The value of the variables was transformed 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 (parity) but all levels were represented. The distribution of financial performance is shown in Table 3.

Table 3. SC performance and financial performance in the studied firms

Performance (max. value)	Mean value	Standard deviation	Median value
<i>Supply chain performance</i>			
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 (73)	52.9	3.8	52
<i>Financial performance</i>			
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
N = 15			

In the third step we tested the hypotheses on the relationships between SC maturity and performance using both clustering of firms in four groups (Bolstorff and Rosenbaum, 2003) and correlations analysis using Pearson's.

Results

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. The outcome for logistics costs is lacking and 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.

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>

Note: N = 15. Bold means <0.05, bold and underlined means <0.01

Correlation analysis between SCM maturity and financial performance

Table 5 shows a number of correlations between SCM maturity and financial performance. Maturity seems to have the greatest impact on profitability, as the maturity in the source process can answer for in some cases up to 50% of the variation in the cost of goods sold (cogs). This is, however, the only one significant correlation, probably due to variations in the limited number of observations. This means that the study cannot lend full support to hypothesis 2.

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

Note: N = 15. Bold means <0.05, bold and underlined means <0.01

Correlation analysis between SC performance and financial performance

Finally, Table 6 shows several relationships between SC performance and financial performance. In this material it was predominantly customer service that displayed positive significant correlations with four financial performance variables. The third hypothesis can thus be regarded as partly supported.

Table 6. SC performance variables vs. financial performance (correlation analysis)

Financial performance	Supply Chain performance					
	Customer service	Logistics costs	Asset Mgmt.	Quality	Productivity	SC perform.
Sales growth	0.22	0.21	-0.08	0.39	0.02	0.15
Cash flow	0.48	-0.01	-0.21	0.19	0.00	0.27
Inventory turn	-0.06	0.22	0.79	0.14	-0.22	-0.04
Cogs (Cost of sold goods)	0.33	-0.14	-0.57	-0.01	0.35	-0.09
Gross margin	0.52	-0.05	-0.27	0.32	0.23	0.38
Operation margin	0.64	-0.09	-0.31	0.29	0.12	0.29
Net margin	0.61	-0.06	-0.30	0.27	0.06	0.25
ROA	0.62	-0.12	-0.29	0.23	0.03	0.21
ROI	0.29	-0.03	-0.15	0.21	-0.13	0.04
Financial performance	0.42	-0.29	-0.13	0.29	-0.04	0.36

Note: N = 15. Bold means <0.05, bold and underlined means <0.01

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 that was claimed in earlier

studies (PRTM, 2007; McCormack *et al.*, 2008; Lockamy and McCormack, 2004; Johnson and McCormack, 2003). In addition to previous studies, the results from this study 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 relate 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 number of correlations, which indicates a positive relationship between maturity and financial outcome. The source area has the strongest relation to the cost of sold goods (cogs) variable in the financial performance attribute. 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 could, however, not be supported, because there were too few significant correlations. This is probably an effect of an insufficient number of observations. While the study of Töyli *et al.* (2008) could not confirm this relationship due to a low level of maturity in the SMEs, our study mainly suffers from too few cases.

When testing the third hypothesis, we found several correlations between SC performance and financial performance, even though only a few were significant. This indicates that if firms succeed in boosting their SC performance by SCM, additional activities are also likely to experience financial improvements.

Lastly, the results tell us that the study's SMEs are more mature in their supply chain management than we expected, with no one of the respondents at the ad hoc level. This is an indication that even smaller firms have begun their journey toward higher performance through a higher level of maturity in their supply chains. If so, this means that SMEs to a larger extent have begun to realize the potential of SCM for performance outcome, as discussed by Timme and Williams-Timme (2000).

Conclusions

The results of this study indicate that there is a strong relationship between SCM maturity and SC performance in SMEs, some relationships between SCM maturity and financial performance, as well as some relationships between SC performance and financial performance. This means that if firms use maturity indicators in the SCOR areas to improve their processes, they will most likely achieve a positive effect on supply chain performance and probably also on financial performance. While this study is based on a rather small number of participating firms, it would be valuable to further test the significance of the indicated correlations between SCM maturity and performance in a large-scale survey.

This study is one of the first in a Swedish context and with small and medium-sized enterprises as respondents. Most of the research has been done in larger international or global organizations. Therefore, this study contributes to understanding the impacts of SCM, particularly in smaller firms. This study finally confirms the Lockamy and McCormack (2004) maturity model as a very reliable tool for this purpose, even in extremely small firms.

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