

SUPPLY CHAIN PERFORMANCE MEASUREMENT: A CASE STUDY ABOUT APPLICABILITY OF SCOR MODEL IN A MANUFACTURING INDUSTRY FIRM

Turan Erman ERKAN

Atılım University Ankara/TÜRKİYE

Atılım Üniversitesi Endüstri Mühendisliği Bölümü C-212 İncek 06836

Ankara/TÜRKİYE

E-mail: ermanerk@atilim.edu.tr

Uğur BAÇ

Atılım University Ankara/TÜRKİYE

Atılım Üniversitesi Endüstri Mühendisliği Bölümü C-216 İncek 06836

Ankara/TÜRKİYE

E-mail: ubac@atilim.edu.tr

—Abstract —

The Supply Chain Operations Reference model (SCOR) is the product of the Supply Chain Council. The supply chain operations reference model (SCOR) is a management tool used to address, improve, and communicate supply chain management decisions within a company and with suppliers and customers of a company. The model describes the business processes required to satisfy a customer's demands. It also helps to explain the processes along the entire supply chain and provides a basis for how to improve those processes. The model integrates business concepts of process reengineering, benchmarking, and measurement into its framework. This framework focuses on five areas of the supply chain: plan, source, make, deliver, and return. These areas repeat again and again along the supply chain in order to satisfy continuous improvement. This study is about determining the limitations of SCOR model in a manufacturing industry firm in Turkey. All the steps of SCOR model considered and adaptability, compatibility and sustainability of the model analyzed among all of its steps as and plan, source, make, deliver, and return.

Key Words: *Supply Chain Management (SCM), SCOR Model, Organizational fit*

JEL Classification: L23, L25

1. INTRODUCTION

In the modern world competition is no longer between organizations, but among supply chains (SCs) (Trkman et.al. 2010). Enterprises must compete against one another in order to survive. As the global economy continues to grow, enterprises are no longer competing independently but to rely on their supply chain systems. Effective supply chain management (SCM) has therefore become a potentially valuable way of securing a competitive advantage and improving organizational performance (Li et.al. 2006; Trkman et.al. 2007).

Foster (2008) defined supply chain quality management as a systems-based approach to performance improvement that leverages opportunities created by upstream and downstream linkages with suppliers and customers. Lockamy and McCormack (2004) indicated in their research that there were only a small number of studies attempting to empirically link specific supply chain management practices such as quality assurance to supply chain performance. Additionally, the conceptualization of a supply chain quality assurance system is incomplete, leaving out the important central link of supply chain process decisions and performance metrics (Reichardt and Nichols 2003; Liu 2009). Various performance metrics have been developed to measure, evaluate, and monitor the operation of the entire supply chain. The appropriate performance metrics can be used to evaluate the probability of success in achieving the target, to provide advice or corrective suggestions to the organization, to provide a feedback system to the manager and to evaluate the internal input and output (Tesoro and Tootson 2000). However, if the metrics within a supply chain lack consistency, it is difficult for managers to take the appropriate actions based on the performance evaluation (Hwang et.al. 2008).

The Supply Chain Operations Reference (SCOR) model was introduced by the Supply Chain Council (SCC), an independent, not-for-profit, global corporation interested in applying and advancing the state-of-the-art in supply-chain management systems and practices. SCC was established in 1997, when 69 visionary supply chain practitioners from a variety of industry segments formed a cross-industry forum to discuss the issues related to supply chain management. The Supply Chain Operations Reference (SCOR) model is a reference model with standardized terminology and processes (Meyr et al. 2002) which benchmarks operational measurement to create a prioritized improvement portfolio tied directly to a company's balance sheet for improving quality performance and profitability. SCOR model provides a methodology for managing supply chain

activities and processes, which can be used as a set of practical guidelines for analyzing supply chain management practices. Figure-1 presents a schematic framework that illustrates supply chain interrelationship. According to SCC, the SCOR-model integrates the concept of business process re-engineering, benchmarking, and process measurement into a cross-functional framework. The model spans all customer interactions, from order entry to paid invoice; spans all product transactions, from your supplier's supplier to your customer's customer; and spans all market interactions, from the understanding of aggregate demand to the fulfillment of each order. Once an effective management process is captured in standard process reference model form, it can be implemented effectively to achieve competitive advantages, and to be tuned and retuned to a specific purpose.

Figure-1: Supply chain decision categories at level 1



Source: SCC, 2009.

As seen on Figure 1, the SCOR model version 9 comprises five components: Plan, Source, Make, Deliver and Return. Plan includes processes that balance resources to establish plans that best meet the requirements of a supply chain and its sourcing, production, delivery, and return activities. Source includes processes that manage the procurement, delivery, receipt, and transfer of raw material items, subassemblies, products, and services. Make includes processes that transform products to a finished state. Deliver includes processes that provide finished goods and services, including order management, transportation management, and distribution management. Return includes post-delivery customer support and processes that are associated with returning or receiving returned products. Each of these components is considered both an important intra-organizational function and a critical inter-organization process. This framework can be viewed as a strategic tool for describing, communicating, implementing, controlling, and measuring complex supply chain processes to achieve good performance. The

SCOR modeling framework provides a systematic approach to describe, characterize, and evaluate complex supply chain processes.

The SCOR-model specifies five performance metrics in two categories: customer-facing metrics that include reliability, responsiveness, and flexibility, and the internal-facing metrics that include cost and assets. Each of the performance attributes contains a set of metrics. As an example, the customer facing attribute named Flexibility is measured by the three metrics: Upside Supply Chain Flexibility, Upside Supply Chain Adaptability, and Downside Supply Chain Adaptability. Upside refers to an increase in delivered quantities in the supply chain while downside refers to a decrease in deliveries. Flexibility is defined as the number of days required achieving an unplanned sustainable 20% increase in delivered quantities whereas adaptability is defined as the maximum sustainable percentage increase in delivered quantities that can be achieved in 30 days (SCOR, 2008). Each metric can be broken down to the lower levels (levels 2 and 3) and aggregated from the lower levels up to the top level (level 1). The customer facing metric Perfect Order can work as an example.

Case studies are applied either to extend the SCOR-model to the service sector or to emphasize a specific decision area (Cavalieri et al. 2007; Naesens et al. 2007, 2009; Soffer and Wand 2007; Xu 2007). For example, Cavalieri et al. (2007) followed three Italian companies during their implementation of the SCOR-model in after-sales services. The SCOR-model was extended to both external processes (that includes customer care, marketing and pricing, network certification, service and order fulfillment) and internal processes (such as maintenance and warehousing). Naesens et al. (2007) used the SCOR-model to measure the strategic fit of inventory pooling in a horizontal collaborated supply chain. Additionally, Soffer and Wand (2007) focused on a single decision area of the SCOR-model, delivery decisions. By analyzing delivery activities for the make-to-order manufacturing strategy, they found that customer order, payment schedule, product, shipping documentation, product receiving and verification were key performance metrics.

2. CASE STUDY

Case study in this research is about applicability of SCOR Model in a manufacturing industry firm. A company from steel industry had chosen. Its main field is manufacturing of welded industrial and commercial steel structures. Currently available procedures are; manufacturing preparation, pre-erection, welding, surface protection with hot dip galvanization and painting.

In fact this study is a monographic one. All the processes from; plan, source, make, deliver and return were examined and metrics from SCOR model that could be calculated were analyzed. The company has a sophisticated Enterprise Resource Planning (ERP) tool in order to define, store and calculate metrics, because of confidentiality authors would just call ERP instead of its vendor. Therefore, a SCOR model and ready to calculate metrics were checked that if it is possible to measure them from the current ERP system.

Figure-2: SCOR Performance Attributes and Level 1 Metrics

Level 1 Strategic Metrics	Performance Attributes				
	Customer-Facing			Internal-Facing	
	Reliability	Responsiveness	Agility	Costs	Assets
Perfect Order Fulfillment	✓				
Order Fulfillment Cycle Time		✓			
Upside Supply Chain Flexibility			✓		
Upside Supply Chain Adaptability			✓		
Downside Supply Chain Adaptability			✓		
Supply Chain Management Cost				✓	
Cost of Goods Sold				✓	
Cash-To-Cash Cycle Time					✓
Return on Supply Chain Fixed Assets					✓
Return on Working Capital					✓

Source: SCC, 2009.

As seen from Figure 2 there are both performance attributes and strategic metrics. Actually all of the Level 1 Strategic Metrics that are distributed according to the customer-facing (reliability, responsiveness and agility) and internal-facing (costs and assets) performance attributes could be calculated from the ERP system data.

In this monographic study, an assumption was made that “it would be better to take the flexibility metrics in order to evaluate the performance of the supply chain in that company”. Therefore all the flexibility metrics from SCOR model were determined and selected.

Table-1: SCOR Flexibility Metric that can be calculated by using ERP Data

SCOR Flexibility Metrics	Exists in ERP
Re-plan Cycle Time,	YES
Cumulative Source/Make Cycle Times,	YES
Intra-Manufacturing Replan Cycle Time,	NO
Total Supply Chain Response Time,	YES
Source Flexibility (the time required to achieve a sustained increase in volume by 20%),	NO
Order Management Cycle Time (% Overtime Labor),	YES
Ability to augment RETURN capacity rapidly,	NO
Time and Cost related to Expediting the Sourcing Processes of Procurement, Delivery, Receiving and Transfer,	NO
Average Days per Schedule Change,	NO
Average Days per Engineering Change,	NO
% Receipts Received without Item and Quantity Verification,	YES
% Receipts Received Without Quality Verification,	YES
Time and Cost Reduction related to Expediting the Transfer Process,	NO
X% Invoice Receipts and Payments Generated via EDI,	YES
Time and/or Cost Reduction related to Expediting the Transfer Process,	NO
% Single and/or Sole Source Selections,	NO
End to End Cycle Time for Business Processes,	YES
RP-PO Cycle Time,	NO
Approval Cycle Time,	NO
Policy Documentation & Approval Cycle Time,	YES
Time to access supplier/source data as required to respond to need,	NO
The degree of flexibility to access, collect, sort, update and analyze source data to enable rapid business decisions,	NO
Cycle Time required to move product to point of use,	YES
Mean Time to Repair Asset (Tooling & Equipment),	NO
Speed at which parameters (e.g., rates) are updated,	NO
Dock-to-Dock times (lane specific),	NO
Create and maintain multiple suppliers and multiple supplier sites to record information about individuals and companies from whom you want to purchase catalogue goods and services,	NO
Total Source Lead Time,	NO
Total Delivery Time,	YES
Terms and Conditions,	NO
Customs clearance cycle time,	NO
Export shipment processing time,	NO
Degree and frequency that purchase orders/contract can be altered,	NO
Average length of contracts,	NO
Item/Product/Grade changeover time,	NO
Schedule Interval,	NO
Upside Production Flexibility,	NO

Downside Production Flexibility,	NO
Intra-Manufacturing Re-Plan Cycle,	NO
ECO cycle time,	NO
Production Rules Preparation Cycle Time (PRPCT),	NO
Time interval between a Performance Standard request and availability,	YES
Time from occurrence of an event to dissemination of the information,	NO
Mean Time to Repair Asset,	NO
% of New or Modified Equipment & Facilities Available when and where needed,	NO
Time for network re-design,	NO
Time to Comply with regulatory changes,	NO
Upside Delivery Flexibility (number of days required to achieve an unplanned sustainable 20% increase in deliveries),	NO
Downside Delivery Flexibility (percentage delivery reduction sustainable at 30 days prior to delivery with no inventory or cost penalties),	NO
Upside Order Flexibility,	NO
Downside Order Flexibility,	NO
Upside Shipment Flexibility,	NO
Downside Shipment Flexibility,	NO
Upside Installation Flexibility,	NO
Downside Installation Flexibility (percentage installation reduction sustainable at 30 days prior to installing with no inventory or cost penalties),	NO
Service Levels / Accuracy,	YES
Cost efficiency/elasticity of shipping schedules,	NO
Rain check %,	NO
Adoption rates,	NO
Cycle Time And Cost To Implement New Or Modify Existing Return Criteria, Scheduling Rules, Delivering Or Transferring Rules,	NO
Cycle Time To Change Condition Criteria,	NO
Time and Cost Related To Expediting The Disposition,	NO
Time and Cost Related To Responding To An Increase In Disposition Demand,	NO
Cycle Time To Incorporate Changes In Return Authorization Processing,	NO
Cycle time to update changes to shipment schedule,	NO
Time and Cost To Exercise The Transfer	NO

As seen from Table 1 that; 12 out of 66 flexibility metrics are kept in the ERP system, therefore only those metrics could be calculated. In order to take out that query from ERP system, authors study on the database structure of that ERP and try so many times for queries. After plenty of hours spend on that, they manage to take the result.

3. CONCLUSION

The supply chain operations reference model (SCOR) is a management tool used to address, improve, and communicate supply chain management decisions within a company and with suppliers and customers of a company. The model describes the business processes required to satisfy a customer's demands. It also helps to explain the processes along the entire supply chain and provides a basis for how to improve those processes. The model integrates business concepts of process reengineering, benchmarking, and measurement into its framework. Therefore it is a complete model for corporate's; inbound/out bound logistics, manufacturing, distribution and after sales operations. ERP is a cross-functional enterprise system that integrates and automates many of the internal business processes of a company, particularly those within the manufacturing, logistics, distribution, accounting, finance, and human resource functions of the business. In fact SCOR and ERP seem as good complements. However, ERP implementations are usually lack of future planning that is why there are always too much problems for evaluation of SCM. It is generally lack of unplanned and registered process in ERP project

In this research, researchers try to catch up how many of the SCOR metrics about flexibility could be measured in an existing ERP. After a long, time costly and tiresome work they manage to realize that. They determined 66 metrics in SCOR about flexibility and could only find 12 of them ready in ERP. It is some how 20% percent of the whole.

As a further study; SCOR metrics determination from ERP could be analyzed and a road map for project implementation could be realized

ACKNOWLEDGEMENTS

This research paper is an outcome of BAP (Scientific Research Project) which is funded by Atilim University, Ankara, Turkey

BIBLIOGRAPHY

Cavalieri, S., Gaiardelli, P., and Ierace, S. (2007), "Aligning strategic profiles with operational metrics in after-sales service", *International Journal of Productivity and Performance Management*, Vol. 56, No. 5–6, pp. 436–455.

Foster Jr, S.T. (2008), "Towards an understanding of supply chain quality management", *Journal of Operations Management*, Vol. 26, No. 4, pp. 461–467.

Gunasekaran A., Patel C., Tirtiroglu E. (2001), "Performance measures and metrics in a supply chain environment", *International Journal of Operational Production Management*, Vol. 21, No. 1, pp. 71–87.

Hwang Y., Lin Y., Lyu J. (2008), "The performance evaluation of SCOR sourcing process-The case study of Taiwan's TFT-LCD industry", *International Journal of Production Economics*, Vol. 115, No. pp. 411– 423.

Li S., Ragu-Nathan B., Ragu-Nathan T.S., Subba Rao S. (2006), "The impact of supply chain management practices on competitive advantage and organizational performance", *Omega*, Vol. 34, No. 2, pp. 107–124.

Liu, C.H. (2009), "The effect of a quality management system on supply chain performance: an empirical study in Taiwan", *International Journal of Management*, Vol. 26, No. 2, pp. 285–295.

Lockamy III, A. and McCormack, K. (2004), "Linking SCOR planning practices to supply chain performance: an exploratory study", *International Journal of Operations & Production Management*, Vol. 24, No. 11–12, pp. 1192–1218.

Meyr, H., Rohde, J., Stadler, H. (2002), Basics for modelling. In: Stadler, H., Kilger, C. (Eds.), *Supply Chain Management and Advanced Planning*, second ed. Springer, Berlin, pp. 45–70.

Millet, P., Schmitt, P., and Botta-Genoulaz, V. (2009), "The SCOR model for the alignment of business processes and information systems", *Enterprise Information Systems*, Vol. 3, No. 4, pp. 393–407.

Naesens, K., Gelders, L., and Pintelon, L. (2007), "A swift response tool for measuring the strategic fit for resource pooling: a case study", *Management Decision*, Vol. 45, No. 3, pp. 434–449.

Naesens, K., Gelders, L., and Pintelon, L. (2009), "A swift response framework for measuring the strategic fit for a horizontal collaborative initiative", *International Journal of Production Economics*, Vol. 121, No. 2, pp. 550–561.

Reichardt, E. and Nichols, L.J. (2003), "SCOR your ISO certification", *Quality*, Vol. 42, No. 2, pp. 44–47.

Soffer, P. and Wand, Y. (2007), "Goal-driven multi-process analysis", *Journal of the Association for Information Systems*, Vol. 8, No. 3, pp. 175–204.

Supply-Chain Council (SCC) (2008), *Supply-chain operations reference (SCOR) model, version 9.0*, <http://supply-chain.org>, [Accessed 14.12.2008].

Tesoro, F., Tootson, J. (2000), *Implementing Global Performance Measurement Systems-A Cookbook Approach*. Jossey-Bass, San Francisco.

Trkman P., McCormack K., Valadares de Oliveira M.P., Ladeira M.B. (2010), "The impact of business analytics on supply chain performance", *Decision Support Systems*, Vol. 49, pp. 318–327.

Trkman P., Indihar Štemberger M., Jaklič J., Groznik A. (2007), "Process approach to supply chain integration", *Supply Chain Management-An International Journal*, Vol. 12, No. 2, pp. 116–128.

Xu, L. (2007), "Editorial", *Enterprise Information Systems*, Vol. 1, No. 1, pp. 1–2.