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QUALITY IN SUPPLY CHAINS AND DESIGNING PERFORMANCE MEASUREMENT SYSTEM

***Abstract:** Supply Chain Management became a philosophy make companies operate inter-organizationally, and merge both strategic initiatives and upstream and downstream processes in order to achieve business excellence. Quality is an important factor in the value-adding process involved in the production and delivery of products along the supply chain. Traditional quality programs must now transform to a supply chain (SC) perspective. The complexity of SC depends on the number of links in the chain and the different capacities of each link. This affects the selection of appropriate performances for assessing the quality of the SC and methodology of their determination. The questions in quality assessment of the SC are what and how supply chain performances should be measured and what results we should take as a base for the action plans and improvements implementation. This paper describes a strategic framework for the development of supply chain quality management (SCQM), a system perspective on supply chain measurement and introduces a different measurement approaches and key performance selection needed for the SCQM assessment.*

***Keywords:** Supply Chain Management, Quality, Performances, Measurement*

1. INTRODUCTION

Global chain management needs more commitment and care since it should be understand as a holistic and strategic approach to demand, operations, procurement and logistics process management. Activities among the organizations from different countries exist in reality are often under the influence of social and technical supply chain components.

The specific functions, like purchasing, production and delivery are not anymore in the focus of supply chain. In competitive environment of 21st century

the organizations within the supply chain have to provide efficiency, high service levels, rapid response, and high quality of products and services.

The supply chain management fundamentally changes the nature of organizations. Control is no longer based on direct control of business processes in individual companies, but rather on control of all processes among the organizations integrated within the supply chain. The coordination among the organizations in supply chain is a key to its effective implementation. It is necessary that the organizations understand their activities in the supply chain and the fact that their

performances have an impact on the performances of other members of the chain.

The challenge for the organizations is to manage supply chain performances through the gain and differentiation of cost and services in order to achieve competitive edge.

2. SUPPLY CHAIN MANAGEMENT

In the past, most organizations have not been so orientated on supply chain management. Instead, they had the focus on their own suppliers and operations. Some of the main factors influenced on more active companies engagement in supply chain management are: operations improvement needs, freight costs increase, competitors pressure, growing globalization and e- trade significance, supply chain complexity, inventories control, etc.

Supply Chain Management (*SCM*) implies design, maintenance and functioning of all processes within the chain in order to meet customer satisfaction.

Christopher defines supply chain management as “management of relations between organizations precedes and/ or follows a parent company in the supply chain.”[4]

Bowersox, Closs and *Cooper* identify supply chain management as “a process of collective action of more organizations in order to achieve a certain level of strategic position and operation efficiency improvement”.[1]

Simchi- Levi and *Kaminsky* define it as follow: “Supply chain management represents the set of coordinated approaches in integration of suppliers, producers, warehouses and shops in sense that ordered quantity of products should be produced and delivered on right locations, just on time, minimizing costs in delivery system and meet customer requirements

while providing a certain level of services”.[22]

For Harrison-a and *Van Hoek-a* “supply chain management represents planning and control of all processes connect the partners within the supply chain in order to satisfy final customers needs”. [10]

According the authors, all organizations in the supply chain are partners. They also emphasize that there are individual, as well as collective roles during the conversion from primary goods to the final products in every supply chain. For the first time, in the process of supply chain definition, the authors introduce a stream becomes more important from day to day- a stream of products return to the recycling system.

Supply chain management includes all activities related with resources purchasing, conversion of the resources and logistics in whole. It implies coordination and cooperation between the partners in supply chain such as suppliers, mediators, logistics providers and customers. Finally, supply chain management integrates and harmonizes supply and demand within the organization and all members of the supply chain.

A supply chain concept philosophy, based on responsibility of each function, is that it's represent an integrator of main business functions within one organization and between all in the chain, in to cohesive business model with the highest performances.

3. IMPLEMENTING SUPPLY CHAIN QUALITY MANAGEMENT

The quality represents a very important factor in value adding process from the production to the deliveries along the supply chain. The authors as *Casadesus & Castrao, 2005; Chin et al. 2006; Flynn & Flynn, 2005; Joyce et al. 2006; Kuei & Madu, 2001; Kuei et al.,*

2002, 2005; Levy, 1998; Lin et al., 2005; Madu & Kuei, 2004; Robinson & Malhotra, 2005, Flynn and Flynn (2005), Levy (1998), Liker (2004), Lin et al. (2005), Robinson i Malhotra (2005) i Shin et al. (2000) also indicate on this.

Kuei and Madu (2001) indicate that focus of quality-based paradigm has been moved from individual organization to the complete supply chains. [165]

Levy (1998) referred to the phenomenon of total quality relationship in the supply chain as a paradigm shift. According traditional paradigm, the organization engages with the issues like price, product quality and delivery time, while in a new paradigm of supply chain quality relation customer- supplier and collective development of good quality product exist as a main issues.[15]

In order to better understand a role quality has in the supply chain it is necessary to define supply chain quality management (SCQM) on the first place.

Kuei and Madu (2008) define SCQM as follows:

- SC=a production-distribution network;
- Q = meeting market demands correctly, and achieving customer satisfaction rapidly; and
- M = enabling conditions and enhancing trust for supply chain quality.[17]

A structured quality approach needs to be implies: (1) design quality into a supply network, (2) optimize the receipt, production and shipping of materials, (3) stabilize the SC quality system, and (4) maximize Enterprise Resource Planning systems.

Robinson and Malhotra (2005) start on the process approach and define a SCQM as formal coordination and integration of business processes between all organizations- partners within the supply chain pipeline. Such process includes measurement, analyzing and continuous improvement of products, services and processes. [21]

Chen and Paulraj (2004) have defined eight following segments of SCM: environmental uncertainty, customer focus, top management support, supply strategy, information technology, supply network structure, managing buyer–supplier relationships and logistics integration. They need to be managed effectively to have positive impacts on supply chain performances.[3]

Robinson and Malhotra consider that succesful supply chain and quality management strongly depends on supply chain quality context, which includes: (1) externally focused process integration, management and strategy; (2) communication and partnership; (3) supply chain quality leadership; and (4) quality and supply chain practices.

C.-H.Kuei et al. [17] have developed a conceptual framework of SCQM implementation and identified potential gaps can arise during SCQM implementation, as well as the drivers of supply chain quality.

Their conceptual framework includes five significant themes as follows:

- the competence required to enhance a SC's competitive position as perceived by other SC members,
- the competence required to enhance a SC's competitive position as perceived by a focal firm's leaders,
- the plan of SCQM,
- implementation of SCQM initiatives, and
- the competence required to enhance a SC's competitive position.

These five themes need to be managed along four distinctive dimensions in reducing the implementation gaps: SC competence, critical success factors (CSF), strategic components and SCQ practices/activities/programs. These four dimensions can be described as four possible countermeasures, or drivers of SCQ.

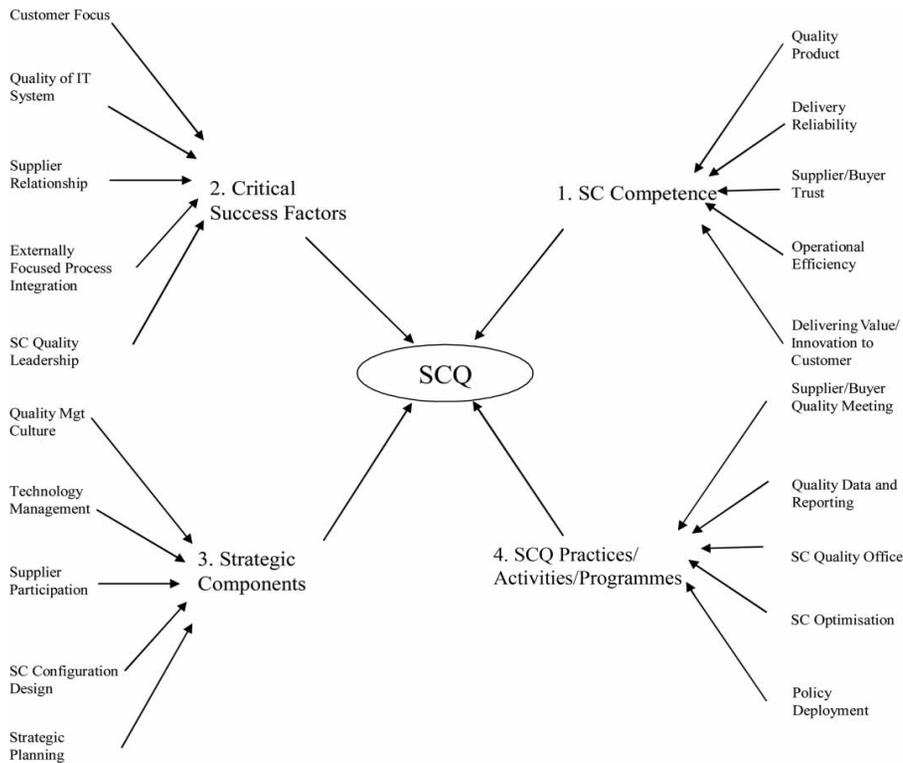


Figure 1 –Supply chain quality [17]

Potential gaps should be eliminated through four phases. In the first phase, emphasize should be put on different advantages among the competitors on the market. However, this should be embraced by both, the organization and all partners in the supply chain. In the second phase, a critical success factors need to be identified in order to set responsibilities in the supply chain. In the third phase, the stress is on the strategic possibilities like supply chain infrastructure, climate, etc. The fourth phase emphasizes the importance of continuous improvement by learning through the practice (Figure 1).

4. SUPPLY CHAIN PERFORMANCE MEASUREMENT

SCM is a wide dimensions concept and it is hard to measure. The question is:

Why to measure the supply chain? The main purpose is to get information for the top management, but a few types of measurements are necessary for the other levels of management. We could say that SCM need to be measured in order to learn about supply chain efficiency.

Development of SCM request qualified performance measurement system. Performance measurement systems provide the information to the management necessary for monitoring, control, assessment and feedback. It can be a driver for motivation, management action, continuous improvement and the achievement of strategic objectives. [6,13,18,19,23]

Supply Chain Performance Measurement system represents a formal definition of supply chain performance model established on mutually agreed goals, measures, measurement methods that specify procedures, responsibilities

and accountability of supply chain participants and the regulation of the measurement system by supply chain participants. [8, 11].

Author	Framework / Performance measures/ Performance Measurement System	Category Of Measure	Author	Framework / Performance measures / Performance Measurement System	Category of Measure
Beamon (1999)	Resources, output and flexibility	QN	Changrui Ren, Yueting Chai, Yi Liu, (2004)	Active performance management system	QN, QL
Holmberg,S. (2000)	Performance model with system perspective, cost, speed and customer service level, agility	C, A, Q	Archie Lockamy III, Kevin McCormack	SCOR model	QN
Suwignjo, U.S Bititci, and AS Came, (2000)	Quantitative model	QN	David J. Parsons, Robin J. Clark, Kevin L. Payette, (2004)	Relationship between productions run lengths and overall supply chain performance	QN, Q
Gunasekaran.A, Patel C and Tittiroglu E (2001)	Strategic, operational and tactical focus	QN, QL	Schonsleben (2004)	Quality, cost, delivery and flexibility	Q, C, D, F
Stephens, (2001)	Measures based on process	C,R, QN	Gunasekaran A, Williams, H.J and Mcgaughey R. E. (2005)	Framework for measuring costs and performance	C, NF
De Toni and Tonchia (2001)	Cost and non cost	C, NF	Li, S., Rao, S., Ragu-Nathan, T. S., & Ragu-Nathan, B.(2005)	Strategic supplier partnership, CRM, information sharing, quality, internal lean practices and postponement	QL,Q N, Q, C
Hieber (2002)	Supply chain collaboration efficiency; coordination efficiency and configuration	Q, QN	Liwen Wu, Yutao Song (2005)	Finance, business processes, customer, environment, core enterprise ability	C, QN
Chan (2003)	Cost, quality, resource utilization, flexibility, visibility, trust and innovativeness	C, Q, QN, F, A	Fynes,B., Voss,C., Búrca,S.D.,(2005)	Quality, framework incorporating dimensions of SC relationships and quality performance	Q, QN
Chan and Qi (2003)	Input, output and composite measures, processes of supply chain	QN, QL	Abhijeet K. Digalwar, Bhimaraya A. Metri (2005)	Theoretical framework for the performance measures of World Class Manufacturing	QN, Q, C
Chunhua Tian, Yueting Chai, Yi Liu, Shouju Ren (2003)	Quality, cost, delivery and flexibility perspective performance measures at department, enterprise and supply chain level	C, Q, QN, F, A	MAO Zhaofang et al.(2006)	Supporting evaluation level (HITSHuman, Institution, Technology, Surroundings) and operational evaluation level (TQFS –Time, quality, Finance and service)	QL, T, Q, C
Felix T S Chan, H J Qi, H K Chan, Henry C W Lau, and Ralph W L, (2003)	Innovative Performance Measurement Method	Q, QN, QL	Z., Li, X. Xu, & Arun kumar (2007)	Supply chain performance measurement approach which evaluates a supply chain from both structural and operational levels	QN, C, Q
Stefan Tangen, (2003)	Financial, time based measures, non cost	C, T, NF	Tong Ren, (2008)	Supply Chain Performance Measurement Based on SCOR Model	QN

Tabla 1- Supply Chain Measure [20]

Literature in the field of supply chain performance measurement systems: showed seven distinct supply chain Function based measurement system

(FBMS), Dimension based measurement system (DBMS), Supply chain operations reference model (SCOR), Supply chain balanced scorecard (SCBS), Hierarchical based measurement system (HBMS), Interface based measurement system (IBMS), and Perspective based measurement system (PBMS).[20].

The literature also revealed a various measures of supply chain. Table 1 lists the various measures, which can be categorize into nine categories: Quality (Q) Cost (C) Delivery (D) Flexibility (F) Agility (A) Responsiveness (R) Non financial (NF) Qualitative (QL) Quantitative (QN).

5. A SYSTEM PERSPECTIVE ON SUPPLY CHAIN MEASUREMENT

Increasing competition and belief that cooperation within the supply chain can create a competitive advantage, gain organizational interest on supply chain management. Organizations are forced to abandon the old antagonistic business approach and adopt more integrated management style implies coordination of activities through the supply chain in order to achieve competitive advantage. However, it is not easy to coordinate activities in supply chain due to existence of large number of related and interdependent activities in it. For example, if it is known that there are approximately 15000 parts needed for one vehicle assembly, and that the producers and suppliers are located all over the world, and that every supplier has more than one customer, it can be imagine the complexity of the supply chain. Therefore, the understanding of interdependence and complexity of relations in supply chain is essential for the activities successful management.

A systems thinking offer a method suitable for decryption and analyzing of complex and dynamic socio- economic problems emerges in such circumstances.

Organizations in the supply chain should be understand as a components of a larger system, rather than independent entities ignore the wideness and volume of interdependences among the others in the chain. However, analyzing the problems of many organizations, it is clear that systems thinking is not properly evolved so far. The lack of systems thinking affects another, very important field- how to design performance measurement systems in the supply chains. This field has strategic meaning but it hasn't be understood properly and completely. [14,24,7].

Holmberg states typical problems arising during the measurements: strategy and measurements are not connected, a biased focus on financial metrics, too many isolated and incompatible measures and the problems in a supply chain context. [11]

Systems analysis helps us depict real world systems by using a structured way of building models. The general approach is to define components, make decision which one should be a part of the system and define relations among them.

The dominant situation related with performance measurement in the supply chain is that each organization from the supply chain has a different organizational culture, rules, routines, etc, and performance measurement system of their own. (Figure 2)

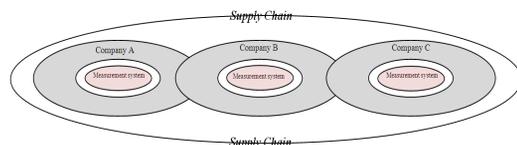


Figure 2 - Fragmented measurement activities

Most organizations are not ready to extend their own measurement activities and staying on the internal level without understanding of whole chain miss opportunity to contribute performance

improvement of the supply chain in whole based on appropriate measurement system.

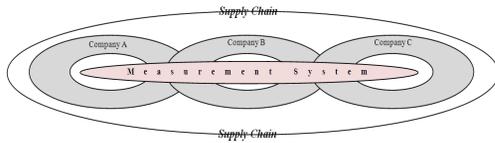


Figure 3 - The new way of looking at supply chain measurement

The obstacle in clear understanding what is going on in the organization or in the supply chain is limited information flow fragmented within the organization (internal fragmentation) or among the organizations (external fragmentation). This means that there is a very poor information interchange between the organizations. Such selfish position and unwillingness to look over the walls of their own yards disable them in performance improvement. The figure 4 shows very common situation when there is no or very restrictive and poor key performance indicators (KPI) information flow in direction from customer to the supplier.

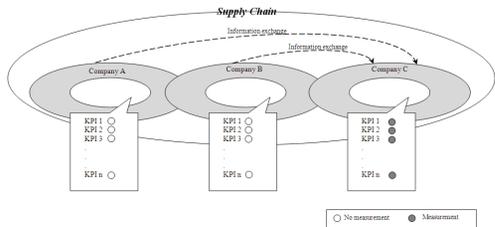


Figure 4 - No or very restrictive and poor KPI information flow in direction from customer to the supplier

With the carefully selected information provided from measurement system the organizations will be in position to understanding what is going on and what will happened. Based on it they can plan and take corrective actions if necessary in order to reduce negative effects. So, information interchange is absolutely necessary for supply chain

success.

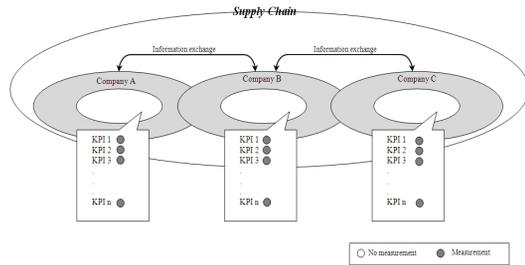


Figure 5 - Measures used in collaborative measurement activities

Performance measurement system implies existing of metrics, harmonized measurement methods across the organizations and developed performances models.

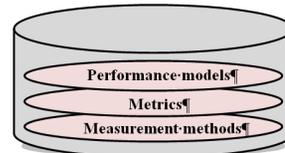


Figure 6 - A structural view of a measurement system

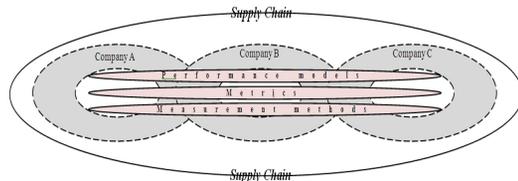


Figure 7 - A structural view of a measurement system in SCM

Understanding of the supply chain as a whole implies that unique measurement system has to be set up through the entire chain, too.

6. CONCLUSIONS

Everything mentioned above lead us to conclusion that performance measurement should be set up within the

frame of holistic system perspective beyond the organizational boundaries. All the participants of the supply chain should be partners sharing mutual customer focused goals and cooperate in order to provide products and services that satisfy customers' requirements and gain competitiveness of the supply chain in whole. Performance of supply chains needs to be assessed across the chain and

optimizations have to encourage global optimization along the supply chain. So, in the focus of measures should be put supply chain perspectives covering the overall performance rather than only the local entity, while researching performance measurement system in a holistic context and applying to all aspects of the manufacturing business.

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Acknowledgment: Research presented in this paper was supported by Ministry of Science and Technological Development of Republic of Serbia, Grant III-44010, Title: Intelligent Systems for Software Product Development and Business Support based on Models.

