# A FRAMEWORK FOR MEASURING SUPPLY CHAIN QUALITY FOR A HEALTHCARE ORGANIZATION

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## ABSTRACT

The objective of this article is to propose a framework that measures supply chain quality in a healthcare organization. The proposed framework considers a dynamic model for crafting better quality metrics that ensure improvement in the performance and makes the health care supply chain more responsive and efficient. In order to build a dynamically improving healthcare supply chain quality measurement system, we have made a set of four enquiries to understand the current situation for an organization and then designing a new set of quality metrics or modifying the existing ones through the use of balanced scorecard concept and a dynamic feedback system. The proposed framework minimizes the weak links and flaws in a healthcare organization's supply chain. It helps the healthcare supply chain managers identifying gaps that cause supply chain inefficiencies and then come up with better quality metrics that incorporate all possible dimensions of quality. This will enable the manager to make decisions in a more balanced way considering all the aspects of the healthcare supply chain.

**Keywords**: Healthcare, Supply chain, Quality measurement metrics, Balance scorecard

## 1. INTRODUCTION

A system's based approach for improving performance with a focus on value creation and achieving satisfaction for the intermediate and final customer by integrating the various supply chain partners and optimizing the opportunities created by upstream and downstream linkages are termed as supply chain quality management (Robinson and Malhotra, 2005). According to this definition, by focusing on performance improvement of a given supply chain, we can ensure quality and enhanced satisfaction to the customers. This is especially true from the healthcare supply chain (HSC) perspective as it helps in improving healthcare quality through enhanced sensitivity towards patients' demands and needs. The introduction of a healthcare supply chain management (HSCM) initiative requires effective linking between the external operation of various supply chain stakeholders viz. suppliers, distributors, group purchasing organization (GPO), manufacturers, etc. and the tightly integrated internal functions pertaining to an organization leading to an overall lower cost, flexibility and improved customer satisfaction (Dean et al. 2013).

Measuring performance is the most important step in performance improvement. For this, we need to define quality metrics. With respect to HSC, the work of Blane (1990) and Kumar et al. (2005) give us two lists of quality metrics for measuring healthcare supply chain quality (HSCQ). Furthermore, Natchmann and Pohl (2009) gave a compilation of quality metrics used to

measure the HSCQ. Smith et al. (2009) made a list of all important quality metrics mentioned in literature and through in-depth interviews of industry experts and then crosschecked these metrics with Garvin's eight dimensions of quality to see which of these are being overly or inadequately represented in the context of US healthcare system. They reported that out of eight dimensions of quality reported by Garvin (1984), only three were being majorly covered, which were performance, conformance, and features. It also mentioned that the healthcare organization's quality metrics are not accessing the reliability, durability, and perceived quality of their supply chain, which clearly highlighted the scope of improvements. More recently, Chofri et al. (2018) gave an integrated performance measurement framework for defining and selecting the most appropriate metric for public HSC. They integrated and consolidated strategies derived from the application of balanced scorecard concept to the nonprofit public healthcare system with the supply chain operations reference model's quality metrics to eventually come up with key performance indicators based on the decision maker's preference to evaluate the HSCQ. Lee et al. (2011) suggest that organizational performance can be improved through supplier cooperation, supply chain efficiency, and quality management practices. They suggested the need to implement innovative ideas for streamlining the organization's operational processes, including those of suppliers, before implementing supply chain management, to ensure the applicability of new technology and resources in it to enhance competitive advantage. According to Aronsonn et al. (2011), the combination of lean and agile supply chain strategies must be applied to HSCM to improve its quality. They suggest that for establishing proper supply chain orientation, the focus must be shifted from functional to process thinking. Concerning the identified sub-processes, the application of lean or agile strategy depends on whether they are aligned upstream or downstream in the supply chain. In upstream the supply chain activities are stochastic in nature and hence requires application of lean whereas in downstream they are detereministically known, i.e. they are visible and hence agile strategy can be applied.

In this study, we wish to understand the various strategies for HSCQ improvement and measurement for the public healthcare setup and eventually give a generalized framework for the same. This framework, when applied to any healthcare system, in any geography, would help healthcare managers to pinpoint flaws in the existing system and strategize the changes required for quality improvement.

## 2. PROPOSED FRAMEWORK

In this section, we propose a framework for measuring supply chain quality in a healthcare organization. We have followed three steps for developing the framework. In the first step, we have raised four different enquiries to find out the answer to why the HSCM system is important for an HCO. Next, we have identified the dimensions of quality that need more attention in the context of HSCM and quality metrics that can measure the performance of an HSCM system. Finally, we have proposed the healthcare supply chain quality measurement framework.

Step 1: Understanding the HSCM system being adopted by the HCO under consideration.

In order to understand the HSCM system of an HCO, a quick survey can be done seeking information regarding the various supply chain activities being undertaken and the associated awareness regarding the same, purpose served by these activities, challenges faced during the execution of these activities, and level of collaboration between the various supply chains partners involved in these activities. Let us briefly look at the suggested enquiries and probable outcomes to understand the purpose of this step. The outcome of this step is tabulated in Table 1.

Enquiry 1: Is there a separate functional unit dedicated to SCM in the given HCO?

Generally, all HCOs have a certain section of manpower dedicated to monitoring the

various upstream and downstream supply chain activities. This entire process of monitoring is either formally systematized or being undertaken informally. In order to get a better outcome of such a monitoring system, it is necessary that people involved in various stages of the supply chain have adequate strategic information about the processes involved and the role they need to play in it.

Healthcare personnel operating at various levels in an HCO should be enquired about their awareness of the organization's SCM activities. The result of this enquiry will highlight as to what extent has the organization adopted SCM concepts. Generally, it might be the case that the HCO has adopted SCM concepts in parts to include the area of inventory control, manufacturing and GPOs cooperation, managing transportation, logistics, facilities, information systems, and outsourcing. It will also give us an idea to what extent healthcare providers at different strata in an HCO are aware of the SCM initiatives.

Enquiry 2: What is the purpose of various SCM activities in an HCO?

The purpose of any supply chain activity must be clear so that its performance could be measured against the desired expected outcomes. This process of performance measurement is also termed as quality control. Hence, we define a set of quality metrics to measure the performance of a supply chain. In order to understand the SCM system of an HCO, we must keep track of all the associated activities and quality metrics being used to measure their performances.

The general objectives for implementation of SCM activities are to achieve cost savings, improve product traceability, enhance customer responsiveness and services. It also increases productivity and profitability, maintains sufficient flexibility, improves invoice accuracy, reduces cycle time, and provide a better evolution of supplies and vendors' performance. All these objectives have already been discussed in SCM literature (Shumaker, 2006; Mantone, 2007; Smith, Lacy, & Justice, 2008; Burns & Lee, 2008; Buntin & Cutler, 2009).

The result of this enquiry should highlight which objectives are being achieved with the current SCM activities being undertaken in the HCO. At the same time, what quality metrics are being used to measure the performance of the SCM activities can be observed and recorded.

Enquiry 3: What are the challenges associated with any HSCM activities?

We know from literature (McKons-Sweet et al., 2009; Nachtmann & Pohl, 2009; Burns & Lee, 2008; Buntin & Cutler, 2009) that the HCSM activities face certain challenges. Some of them are:

- Unstandardized data collection which causes redundancy and reduces compatibility
- Several stakeholders involved in an HSCM system have conflicting goals.
- Inaccurate data collection
- Replication of various elements of core activities at various levels due to poor coordination
- Poor and inefficient adaptation and implementation in information technology and related resources

The outcome of this enquiry should highlight the challenges being faced in the execution of a certain SCM activity as well as its impact on other related activities, and hence modification can be accordingly planned.

Enquiry 4: What is the level of collaboration amongst the HSC partners associated with any SCM activity?

All stakeholders in a supply chain tend to seek maximum information so as to exercise better control overflow of goods minimize their risk. At the same time, they are reluctant to share the set of information that they have exclusively for the same reason. In order to optimize this situation, the flow of information should be strategized in a collaborative manner to enhance the

supply chain efficiency and hence reduce the risk for all stakeholders adequately.

Mcknos-Sweet et at. (2005) shows that when a customer can identify common products being offered by various competing suppliers, the process of price comparison becomes easy. Hence, HCOs with poor information system capabilities, which depend on GPOs and distributors for data used in decision making and planning, are generally at a disadvantage as sharing information with other supply chain partners would not go in line with GPOs or distributors incentives. Likewise, conflicting goals prevent the flow of critical information, thereby rendering the supply chain inefficient. By establishing communication with the various stakeholders in a supply chain, we can do a perception analysis to know what the various grievances are that some of them have. Until and unless we ensure that all the stakeholders have adequate access to strategic information, we cannot expect the HSC to be functioning effectively and efficiently. The outcome of this enquiry should highlight HSC partners who indict the SCM system to be non-collaborative in nature, thereby helping us identify the weak link in the supply chain.

**Table 1.** Enquiries that were posed to understand the HCO's supply chain system and their outcomes

| Enquiries | Outcome |
|---|---|
| 1. Awareness about the SCM system in healthcare employees | • Various supply chain concepts that are used in an organization<br>• Kind of awareness and training the employees working at different levels of the HCO possess about the supply chain activities |
| 2. Purpose of the supply chain activities | • The objectives being achieved by a given supply chain activity<br>• Quality metrics being used to quantify the extent up to which the objective is being met |
| 3. Challenges in the execution of the supply chain activity | • Issues or weaknesses which prevents the progress desired to be achieved in a specific part of the supply chain system<br>• The impact of these shortcomings on other related supply chain activities |
| 4. Level of collaboration amongst the supply chain partners | • It will help us to know the HSC partner who has a perception of improper collaboration in HCO's supply chain. |

Step 2: Identifying the dimensions of quality that needs more attention

As an outcome of the enquiries in step 1, we will know about the different quality metrics being currently used to assess the performance of the various supply chain activities being performed. Smith et al. (2011) give the adaptation of the Garvin's (1984) eight dimensions of quality in the healthcare setup, and it has been shown in **Table 2**. As per the taxonomy suggested by Smith et al. (2011), we can classify the various obtained quality metrics being used by the given HCO. Researchers have used different subsets of Garvin's eight dimensions to evaluate the

quality management strategy of companies. Several quality managers were surveyed, and they reported that each of these eight dimensions could have varying degrees of importance based on situation and environment (Sebastianelli and Tamimi 2002). As HSC spans over a broad spectrum of activities, managing HSCQ would require to delve into multiple dimensions of quality. The eight dimensions of quality are given by Garvin (1984) provides a good base for such an exercise. As a result of this classification, we can propose the direction in which future efforts are to be made in quality metrics development for HSCQ measurement.

**Table 2.** Eight dimensions of healthcare supply chain quality (as adapted by Smith et al., 2011)

| Dimension | Definition |
|---|---|
| Performance | Major modus operandi characteristics of an HSC |
| Features | Auxiliary characteristics to further improve the basic functioning of the HSC by allowing a better understanding of it |
| Reliability | The probability that an HSC will perform as desired during a predefined tenure |
| Conformance | The amount of standardization has been applied to HSC's design and associated operating characteristics |
| Durability | Maximum service that can be extracted from an HSC before it breaks down to the extent that alternative service is preferred over taking corrective actions |
| Serviceability | Easy applicability and performance-enhancing capabilities of corrective action |
| Aesthetics | The way a particular individual views the HSC |
| Perceived Quality | Personal assessment of quality based on indirect exposure to a system |

Step 3: Strategic development of quality measurement metrics

Based on the results obtained in step 1, and in step 2, in step 3, we can address the outcomes of the various HSCM related enquiries to resolve the shortcomings. The different proposed methods are backed with prior research mentioned in published literature. Here we suggest the extensive use of the balanced scorecard (BSC) to develop measurement metrics. Kaplan and Norton developed the BSC as a management tool in 1992. The mission and the strategies adopted by the firm are to accomplish the tasks that are streamlined into objectives and measures by the BSC. According to the concepts of the BSC, we need to design the new quality metrics for the HSC from the perspective of internal business, patients, financial and social aspects, and learning and growth aspects (Chofri et al., 2018). They also define the various objectives to be studied under these different perspectives related to HSC. They proposed it for the overall public HSC. They explained it in the context of the Moroccan healthcare system by taking motivation from the BSC framework given by Kaplan (2001) for nonprofit organizations.

We propose the implementation of the concepts of BSC to a single HCO and observe the entire process of HSCQ metrics designing under the ambit of the four perspectives of BSC. The results that it achieves for the organization can then be studied and reported. The four views of the

BSC, associated objectives, and functional aspects of these objectives, as defined for the public HSC has been shown in Table 3.

**Table 3.** Four perspectives of the BSC for the public HSC (Chofri et al., 2018)

| Perspectives | Objectives | Functions |
|---|---|---|
| 1. Internal business perspective | Achieve operational excellence | • The process of procuring and distributing pharma products to HCOs must be made more effective, efficient, and flexible<br>• The chain of warehouses must be improved dynamically for enhancing efficiency and effectiveness<br>• Manage risks effectively |
| | | • Implementing advanced information systems |
| 2. Patient perspective | Increase patient satisfaction | • Availability<br>• Accessibility<br>• Quality and reliability<br>• Trust |
| 3. Financial and social perspective | Create long-term social and economic impact | • Taking care of the health financing constraints<br>• Social perks to the public must be increased<br>• Manage expenses |
| 4. Learning and growth perspective | Innovation, culture, resources | • Effective execution of changes brought by innovation<br>• Preparing a prompt, active, and mutually inspiring human resource for strategy execution<br>• The process being governed internally need technical support and dynamically modifying infrastructure<br>• Providing adequate strategic information to all the employees<br>• Collaborating with partners strategically at an external and internal level |

The outcome of enquiry 1 highlights the scope of improvements in the training and communication of supply chain activities amongst the employees operating at different levels in an HCO. Since the HCO are generally nonprofit in nature or if we put it otherwise, profit maximization is not the primary objective of an HCO. We can apply the adaptation of BSC framework to the nonprofit organization given by Kaplan (2001), where its first step gives

direction to better communication and an enhanced learning process for achieving the vision of the organization.

Actually, the initiation of any performance measurement system should be done with a clear strategy statement. If the performance measures are so designed that they can quantify the achievements of strategy, we can, to a great extent, eliminate the ambiguity associated with objectives and methods amongst the different stakeholders with respect to that strategy. Hence, the problem of miscommunication or no communication amongst the employees of an HCO, with respect to its HSCM activities, can be resolved by the adaptation of a BSC for the given HSCM system.

The currently used quality metrics in an HCO that were obtained as an outcome of enquiry two can be classified under the various perspective depending on the kind of functional objectives they are measuring. Once this is done, those metrics can be improved, or new metrics can be defined to accommodate more functions and thereby to make the overall HSCQ measurement process more holistic in its approach. In that when the existing and newly defined quality metrics are also classified simultaneously into a process-based, structure-based, or outcome-based, it will further add clarity to the interdependence of these quality metrics. This understanding will help us in optimizing the limits of quality improvements that can be achieved in various individual segments of the HSCM system so that its' overall efficiency is high.

The outcome of enquiry 3 helps us to know the issues at hand at executing a designed HSCM system and its impact on the performance of the overall supply chain. Lee et al. (2011) suggest innovative designing of the HSC has a significant impact on the selection of and cooperation with best suppliers, increased supply chain efficiency, and enhancement of quality management practice, which subsequently will improve organizational performance. All the stakeholders in the HSCM system should consider themselves as partners and should come up with innovative plans or tools that can be used by all. Innovation in supply chain activities should be aimed at standardization of required materials and supply chain practices for ensuring a lean HSC, which can improve service and reduce cost. Lee et al. (2011) further suggest that supply chain innovation can be achieved through technological intervention, implementation of better information systems.

The outcome to enquiry 4 provides us with a perception analysis that clearly outlines those stakeholders of the HSC who feel there is a need to increase mutual collaboration. Here, the policy and environment play a crucial role in this purpose. We know that healthcare is a service sector that can't solely operate with the motivation of profit. Hence, regularity authorities should implement regulations to ensure proper collaboration amongst the various stakeholders of the HSC. This will influence the supplier's willingness to collaborate and eventually improve the contribution of the HSC in the overall value chain. Such influence can either be made directly through rules and norms or indirectly through moral suasion. (Dimitri et al., 2006).

From an organization's perspective, generally, a public HCOs have an advantage to private ones. Public healthcare organizations are expected to collaborate and share their knowledge and practices, which in turn improves the scope of collaborative purchasing and network creation within the HCO (Hchotanus and Telgen, 2007).

Other than this, private HCO can implement benchmarking to improve collaboration in the HSC system. They can study processes such as procurements, as is being done in public HCOs. A public goal like equity, accountability, and legality can be accomplished by the respect of laws and regulations. Better collaboration would improve the HSC efficiency and hence the value-added to the customer. So, any HCO must keep track of attempts made by individual players in a supply chain who try to impeding organizational goals for personal benefits.

Addressing the outcomes of enquiry 3 and 4 will provide us with continuous feedback about the functioning of the HSCM system at hand. A dedicated team can be arranged for proposing innovative ideas backed with technology to resolve exécution challenges with respect to the HSC activities and for managing the issues and grievances of unhappy stakeholders in the HSC. The suggested improvements based on the feedback will help modify the quality metrics at the place for HSCQ measurement. In Figure 1, we propose a framework for measuring supply chain quality for a healthcare organization.

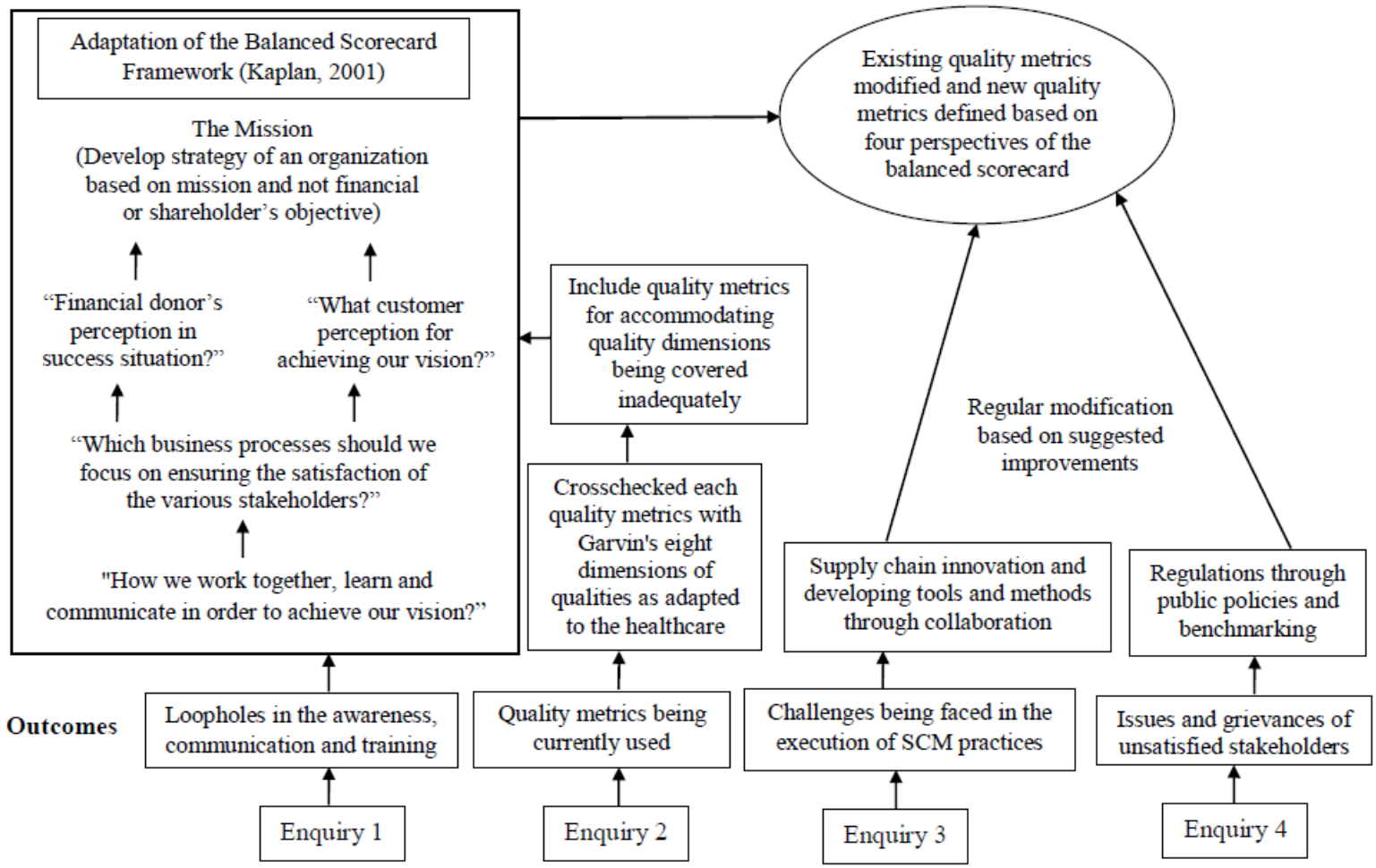


**Figure 1.** Propose framework for measuring supply chain quality for a healthcare organization

## 3. CONCLUSION

Through this study, we have proposed a framework for measuring supply chain quality based on balanced scorecard concepts after understanding the existing supply chain quality measurement processes for an HCO.

For understanding the current situation of the HSCQ measurement system employed in an HCO, we propose a set of enquiries. The outcome to these enquiries would give us a clear idea about the level of awareness pertaining to HSC activities amongst the employees of the HCO, quality metrics being currently used to measure the performance of the HSC, challenges that HSC managers come across while executing the HSC activities and the level of collaboration amongst the various stakeholders in the HSC. We then propose to drive in further to identify the dimensions of quality that are being ignored in the current quality measurement system.

Having known all this, we propose to improve the HSCQ measurement system by using a continuous feedback system and strategies, as suggested by the balanced scorecard management tools. The proposed strategy will help the HSC managers to come up with new quality metrics that will be designed based on the balanced scorecard concept as adapted for nonprofit organizations (Kaplan, 2001), keeping in mind the existing drawbacks in the current quality measurement systems. Hence, the set of newly developed quality metrics will be more responsive in capturing the performance of HSC. The dynamic feedback system introduced into the framework will enable continuous improvement of the HSCQ measurement system.

## 4. FUTURE WORK

In the future, we plan to verify the proposed framework on the field with a bunch of HCOs situated in both urban and rural setups to check for its practical applicability. We also plan to work on coming up with a generalized decision-making approach that will help the HSC managers to design their supply chain quality metrics, which suits the best in a given environment and situation.

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