Developing Performance Measurement Tool for Slow-Onset Humanitarian Supply Chain Operation

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Abstract

The aim of this paper is to propose a conceptual performance measurement framework that can efficiently assess and evaluate the supply chain operation of school-meal programs (i.e. one of the focused slow-onset humanitarian aid operations by large humanitarian organizations). Such framework is derived from the well-known Supply Chain Operational Reference (SCOR) model. Numerous studies have applied the SCOR models to evaluate and enhance the performances of sudden-onset humanitarian relief operations, while application of the SCOR model on slow-onset humanitarian supply chain operation is scarce. Since the designs for operations of the sudden-onset and slow-onset disasters differ from one another, the SCOR application needs to be adapted. This paper is among the first to explore the applicability of the SCOR model on slow-onset humanitarian supply chains. The proposed conceptual framework identifies the scope and content of the school-meal supply chain. It also visualizes process configuration, where different stakeholders, processes, and flows are comprised. The conceptual framework serves as an initial stage of our full development of the SCOR model and its detailed performance metrics to evaluate the school-meal supply chain. Over the long-run, we aim at delivering a practical performance measurement tool to assist humanitarian logisticians in improving their supply chains.

Keywords
Humanitarian Logistics, Slow-Onset Disaster, School-Meal Program, Performance Measurement and SCOR

1. Introduction

Many researchers and practitioners in the humanitarian context have recently focused their attention to effective methods that can successfully assess and evaluate their humanitarian supply chains. Such an assessment (i.e. the so-called performance measurement) is as equally important as other activities since it is a basis for developing further actions to improve the supply chain operation. More precise policies and strategic plans can accordingly be adjusted (Banomyong et al. 2019). The supply chain has been proven to be a backbone of humanitarian operation to tackle disaster (Stegemann and Stumpf 2018, Van Wassenhove 2006). Thus, enhancing the supply chain can result directly in a successful operation that can save more lives and effectively alleviate the vulnerability and suffering of beneficiaries. One of the most recognized and frequently used supply chain performance measurement tools is the Supply Chain Operational Reference (SCOR) model (Abidi et al. 2014, Huang et al. 2005, Qing et al. 2016). The advantages of employing the SCOR model include the possibility of benchmarking the current supply chain performance against the previous one as well as the best practices (Banomyong et al. 2019). The application of the SCOR model is also user-friendly and practical, which suit the nature of work of humanitarian logisticians. Comprehensive details of the SCOR model can be found in SCC (2010).

According to Van Wassenhove (2006), disasters can be classified into sudden-onset and slow-onset disasters, and these two disaster types require different humanitarian operations to achieve the purposes. The occurrence of the sudden-onset disaster is unexpected, quick, and possibly random (FAO, n.d.). Examples of sudden-onset disasters include earthquake, tsunami, flood, landslide, chemical leak, and so on. The design for sudden-onset humanitarian
relief operation must satisfy the objectives of being agile and responsive (Dubey et al. 2020, Lamenza et al. 2019). From the past, many efforts have been devoted to improving humanitarian relief supply chain operations through the applications of the SCOR models (see examples in Blecken 2010, Bölsche 2012, Tatham and Spens 2011) as the effective relief operation could mean a huge difference between life and death.

Even though it could generate negative impacts as significant and severe as the sudden-onset disaster, little attention has been paid to the slow-onset disaster and its humanitarian supply chain operation. Examples of the slow-onset disasters include ones resulting from crop and natural failure (e.g. drought, famine, and poverty), political and violent situation (e.g. refugee and displaced population), disease spreading (e.g. outbreak and pandemic), and a mixture of them (FAO, n.d.). Figure 1 illustrates a global hunger issue as a consequence of the slow-onset disasters. As many as 821 million people around the world were undernourished and required humanitarian assistance.


Figure 1. A global hunger issue

According to Food and Agriculture Organization of the United Nations or FAO (FAO, n.d.), the occurrences of the slow-onset disaster and its consequences are gradual and progressive over time. Thus, the design for slow-onset humanitarian supply chain operations must take efficiency (i.e. cost), effectiveness and reliability (i.e. on-schedule), and resilience (i.e. flexibility and quick recovery) into consideration in order to support long-term humanitarian assistance.

To the best of our knowledge, no existence of application of the performance measurement on slow-onset humanitarian supply chain operation has been found. Our aim is devoted to the development of such a performance measurement tool to assist humanitarian logisticians in enhancing their supply chain operations to effectively fight against hunger and other impacts.
1.1 Objectives
In particular, our work focuses on a school-meal program or school-feeding program (SMP) — one of the major humanitarian assistance programs in the fight against slow-onset disaster and the consequent hunger issue. The SMP is a program that aims at coping with problems of health, education, hunger, and poverty of children. The purposes of the SMP are to encourage class attendance, improve cognition and learning capacity, and mitigate the malnourishment of students (Jomaa et al. 2011) through pro-bono distribution of nutritious lunch-meals to students at schools on school days. The SMP could widely be found in several regions and countries such as Bhutan, Cambodia, Nepal, Timor-Leste, Bolivia, Columbia, Algeria, Egypt, and so on (see examples in figures 2 and 3). Annual budgets to operate the SMP range from few million to hundreds of millions of US dollars depending upon the geography, size, and scale of the program in each country.

Figure 2. School-meal program in Asia
Source: The authors

Figure 3. WFP school-meal program coverage
Source: World Food Programme (WFP)

The design for the SMP supply chain must be able to support the distribution of nutritious (i.e. following the predefined menu) lunch meals at minimal costs on every school day. Since its first program launched in the 20th century, the SMPs in various countries have experienced their supply chain shortcomings. To overcome these shortcomings by
conducting precise capacity strengthening and further action plans, the performance measurement tool plays a vital role.

The objective of this paper is to propose a conceptual performance measurement framework by drawing upon the SCOR process reference model. The scope and content of the SMP are discussed and identified. The conceptual framework also visualizes all stakeholders and their relationships through the process configuration of the SCOR model. This conceptual framework serves as an initial stage of our full development of a practical performance measurement tool with detailed performance metrics that could assist humanitarian logisticians in assessing and enhancing the supply chain operation of the SMP. Application of the proposed SCOR model can also be a foundation (AS-IS) of process and flow re-engineering and redesign (TO-BE).

The organization of this paper is as follows. Section 2 reviews relevant literature on the SCOR model and its application in the humanitarian context. Section 3 describes research methodology, while section 4 discusses the proposed conceptual SCOR framework. Section 5 concludes the paper and provides future steps of our work.

2. Literature Review

The SCOR model is organized around five primary supply chain management processes including Plan, Source, Make, Deliver, and Return (SCC 2010). By using these process building blocks, the model can be used to describe and explain any supply chain operation. Supply Chain Council (SCC 2010) identifies different levels of the SCOR model. It provides a framework that integrates strategic goals, supply chain processes, and metrics at different levels into one structure (Huan et al. 2004, Qing et al. 2016). Qing et al. (2016) also mention that there are four levels of supply chain processes under SCOR model (i.e. three main levels and one additional level). Level 1 is the strategic level for an organization to establish strategic goals. Level 2 includes core process categories that are generic components of a typical supply chain operation such as make-to-order, make-to-stock, and engineer-to-order. Level 3 dives into the operational details of the processes in the Level 2, and Level 4 is additionally industry-specific for an organization to measure the operational performance of particular processes. Under the SCOR model, there are five generic performance attributes including reliability, responsiveness, agility, cost, and asset management (SCC 2010). In addition, the SCOR model allows us to identify opportunities for process and performance enhancement (Qing et al. 2016).

While the SCOR model has been criticized for being too rigid in performance measurement in the context of humanitarian supply chain (Davidson 2006), it has been successfully implemented in large humanitarian organizations such as World Food Programme or WFP (Bölsche 2012). Noting the differences between humanitarian and commercial supply chains in terms of objectives, processes, and operating environments, Qing et al. (2006) further applied the SCOR framework to the context of humanitarian emergency supply chains (i.e. the sudden-onset) and proposed a hierarchical benchmarking framework with identification of a set of 26 metrics. The authors also suggested the automation of key logistics processes, which would significantly increase the number of implementable metrics to 14. The adoption of SCOR model agrees with the suggestion of Tatham and Spens (2011), who propose the SCOR framework as the first step for a unified reference source for the humanitarian organizations.

However, as mentioned earlier, many of these studies have focused on sudden-onset emergencies and associated humanitarian emergency response and relief operations. The objectives of response operations are to minimize loss of life. Therefore, effective response operation must be quick and responsive (service-driven). Lead time to source relief items until getting them delivered must be as minimized as possible (Van Wassenhove 2006). There seem to be fewer studies that focus on slow-onset disasters and protracted crises that require development intervention with multiple objectives and goals such as the SMP. The ultimate objectives of the supply chain operations to cope with slow-onset disasters must be efficient (i.e. cost-driven), reliable (i.e. on-schedule), and also sustainable. This is confirmed by the recent rethinking of large humanitarian organizations to shift their focuses toward long-term and sustainable program which would rely more upon local capacities and engagements (Kretschmer et al. 2014). The achievement of effectiveness and sustainability of the SMP depends on supply chain operation and management. This has demonstrated the importance and significance of the development of a performance measurement tool to assist in improving the performance of the SMP supply chain.
3. Research Methodology

The scope of this paper is to develop a conceptual framework, which is derived from the SCOR model layers (or levels) 1 and 2. A case of the existing SMP is chosen for this development. Understanding the supply chain processes as well as stakeholder behavior and relationship is first conducted through interviewing and qualitative research. This is a common step of in-depth analysis and information examination of a case study based method (Baxter and Jack 2008).

The construction of the SCOR model layer 1 is made according to the case study analysis. Main SCOR supply chain processes of stakeholders involved are defined. Then, a detailed supply chain and its commodity flow is drawn through the process configuration at the SCOR layer 2. Note that we limit the scope and content of the conceptual framework up to layer 2 as the framework requires preliminary validation before further processing in details at layer 3. Also, for the sake of being manageable in the initial stage, information and financial flows, which are also important for performance measurement, are excluded and will later be added.

4. Discussion on a Conceptual SCOR Framework for the SMP

As mentioned, information on the existing SMP operated in one country in Asia is used as an initial case for developing the conceptual framework. The mapping of the SMP and its supply chain operation can be illustrated in figure 4. This SMP can be seen as a decentralized system, where municipalities (i.e. local government) over the country play important roles in connecting schools with central governments. Information flows upstream from schools, where the total number of students is ultimately consolidated at the Ministry of Education (MoE) via municipalities. This total number of students is required at the beginning of every fiscal year in order for the MoE to plan and calculate the annual budget. The planned budget is then submitted to the Ministry of Finance (MoF) for approval and execution.

Once approved and executed, the whole annual budget is first delivered to municipalities over the country. The budget is then later shared to each school on a quarterly basis, where each school needs to submit the expenditure spend report of the previous period as well as the planned spending for the next period. Otherwise, the budget cannot be approved by the municipality. This is how expenditure is monitored and controlled. The annual budget is used for purchasing ingredients for school-meals (i.e. commodities) including 1) rice and 2) meats and vegetables.

Sourcing and purchasing rice can be undertaken by schools (i.e. purchasing directly from local suppliers). However, municipalities can also support schools in sourcing and purchasing rice from available suppliers and producers in regional and local markets (i.e. with the purpose of achieving economy-of-scale purchases) and also from international suppliers (i.e. when exceeding the capacities of local suppliers). In such a case, rice is first distributed to municipalities for storing, and municipalities later distribute rice to schools. Both municipalities and schools have limited capacities to store rice. Note that meats and vegetables are purchased daily by schools with local suppliers as most schools do not have cold-chain storage facilities (i.e. refrigerators). School-meals are prepared and cooked at schools on each school day by hired cooks.
Layer 1 of the SCOR model can be constructed according to the SMP supply chain mapping. Figure 5 depicts the SCOR layer 1, which defines the scope and content of the concerned supply chain and stakeholders involved. Local governments or municipalities are involved in the processes of Plan (P), Source (S), and Deliver (D). No existence of Make process is defined for municipalities in the scope of the SMP. Furthermore, in the context of the SMP or any other humanitarian supply chain operation, the Return process is less important and thus is excluded (Peretti et al. 2015). In addition, the storing processes have implications on the cost and lead time that can influence the supply chain performance. Thus, Store (ST) process should be highlighted (Qing et al. 2016). The SCOR processes at layer 1 for schools are Plan (P), Source (S), Store (ST), Make (M), and Deliver (D). Note that Source (S) process of student describes the activity to obtain and receive school-meal from school and immediately consume after receiving.
In the SCOR conceptual framework layer 2, we further denote P1 as Plan Supply Chain, P2 as Plan Source, P3 as Plan Make, P4 as Plan Store, P5 as Plan Deliver, S1 as Source for products intended for storage (Qing et al. 2016), S2 as Source for products intended for immediate use or delivery (Qing et al. 2016), M1 as Make-to-Stock, M2 as Make-to-Order (i.e. in this case it is “Make” for products intended for immediate use, consumption or delivery), ST1 as Storing, D1 as Delivery for products intended for storage, and D2 as Delivery for products intended for immediate use or next delivery, the SCOR layer 2 and its commodity flow is illustrated in Figure 6.

![Figure 6. SCOR Conceptual Framework Layer 2 (commodity flow)](Source: The authors)

5. Conclusion

This paper describes the application of the SCOR model on the SMP. The SMP is a long-term humanitarian aid operation to alleviate the suffering from slow-onset disasters. Since the design for humanitarian operations of slow-onset disasters is different from those of sudden-onset disasters, the SCOR framework and its applications need to be reconstructed. Over the long-run, we aim at developing the practical performance measurements based on SCOR process reference model to assist humanitarian logisticians in evaluating the current supply chain performance (AS-IS) and redesigning/strengthening for operational enhancement (TO-BE). As an initial stage, this paper discusses and constructs layers 1 and 2 of the SCOR conceptual model. These two layers are considered as the bases for further development as they define the scope and content of the model. Furthermore, all stakeholders and their relationships can also be visualized and mapped.

The next steps of our work will be to validate the proposed SCOR layers 1 and 2 with various practitioners who operate the SMPs as we would like to develop a generic performance measurement tool that is applicable regardless of country, region, and geography. After the validation phase, the complete SCOR model including layer 3 and the relevant detailed performance metrics over different layers will be constructed. Considering that the performance metrics must be able to measure the highlighted performances of long-term humanitarian supply chain operations including efficiency, effectiveness, resilience, and possibly green supply chain, a set of potential performance indicators is proposed in Table 1.
Table 1. Potential performance indicators

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<th>SCOR Attribute</th>
<th>Description</th>
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| Reliability    | 1) Percentage of on-schedule school-meal delivery  
2) Percentage of perfect school-meal delivery in terms of quantity (i.e. matching the number of students) and quality (i.e. matching the predefine menu) of the meal |
| Responsiveness | 1) Cycle time  
2) Lead time |
| Agility        | 1) Supply flexibility  
2) Distribution flexibility |
| Cost           | 1) Total supply chain costs (including fixed expenses and operational expenses)  
2) Environmental costs |

It is worth mentioning that reliability is one of the compulsory requirements to be measured in any supply chain operation. It is stated how reliable (or perfect) the supply chain is. Reliability of the SMP is measured by the percentage of on-schedule/on-time school-meal delivery over the year (i.e. the delivery is expected to take place on every school day). The SMP supply chain, which is a long-term operation, must also be able to cope with sudden changes such as border closer, shortage of supply, and so on. This is measured by agility or flexibility indicator.

Last but not least, in order to have a more comprehensive measurement of the SMP, financial and information flows should also be captured in the model as they also influence the overall performance of the school-meal supply chain.

References


**Biographies**

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