

Evaluation of the supply chain network design at UNFPA

Through the development of a performance measurement system

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This article is a summary of the master thesis written by Olof Petersson and Emilia Wiking at the Department of Industrial Management and Logistics, Faculty of Engineering, Lund University. The study was initiated by the United Nations Population Fund (UNFPA) and specified together with the authors. The main objective was to provide UNFPA with a recommendation regarding the suitability of using regional warehouses to pre-position their products. In this article, the background, method and main conclusions are presented.

Introduction

UNFPA is a subsidiary organ to the United Nations (UN) with a primary focus on population and development strategies, sexual and reproductive health and gender equality. The organization was founded in 1967 and began operations in 1969. It has since the start gained more than 30 years of experience in procurement of reproductive health commodities and emergency reproductive health (RH) kits (UNFPA, 2012c). Contraceptives concern mainly subdermal implants, injectable contraceptives and male and female condoms whereas RH kits for example can contain equipment needed for a safe delivery of a baby. Today, UNFPA's Procurement and Service Branch (PSB) is the largest public procurer of contraceptives. PSB has been located in Copenhagen, Denmark since 2006 when this part of the organization was moved from New York (UNFPA, 2012d). Due to that focus for this study will be on PSB's operations, PSB will hereinafter be mentioned instead of UNFPA.

In March 2005 the UNDP/UNFPA Executive Board had realized that for PSB to operate in line with its mission, focus would need to be

directed specifically towards improvements in the areas of procurement, supply and logistics (Steele, 2009). When approaching these areas, challenges such as the; demand situation, the demand planning, long manufacturing lead-times and PSB's history of being an administrative function that could stand in the way for strategic decisions (Andries, 2012; Dupont, 2012; Nielsen, 2012).

In response to the abovementioned challenges, two major studies were conducted. Both studies recommended a pre-positioning of goods in regional warehouses. However, they also recommended further research. The pilot study specifically concluded that in order for a decision to be made regarding regional warehousing, a more quantitative analysis would be necessary. Expected costs and changes in lead-times when implementing regional warehouses are examples of quantitative measures that should be analyzed (Steele & Lkhagva, 2009).

In 2011, PSB once again raised the question of changing its supply chain network design by implementing regional warehouses. The scenario concerned further utilization of the

already existing agreement that allows PSB to store its products in the United Nation's Humanitarian Response Depot's (UNHRD's). There are currently five such depots, situated in Accra, Brindisi, Dubai, Panama and Subang (UNHRD, 2012a).

The purpose of this study is to develop a performance measurement system for PSB's supply chain design to help the organization reach a decision regarding regional warehousing. The purpose has resulted in the following research questions (RQs):

1. *What performance measures need to be considered when developing a performance measurement system for PSB to evaluate the organization's supply chain network design?*
2. *Should PSB keep its current supply chain network design or switch to a supply chain network design with regional warehouses in the UNHRDs?*

Methodology

In order to avoid a sub-optimized solution a holistic view is preferable and a systems approach was taken for this study. PSB approached the authors with a defined problem regarding the suitability for PSB to use regional warehouses. An inductive approach was appropriate because the problem was defined before the study was initiated. During the study the authors found relevant theory that could be used for analyzing the problem at hand. Finally, a case study strategy was chosen for this study because the research questions focus on how PSB's supply chain should be designed and there was no control of the behavioral event. These characteristics were proven suitable for case studies.

To narrow down the purpose and research questions for this study, exploratory interviews were held with employees at PSB.

A literature review was then conducted to create the frame of reference. As a first step of the analysis, the frame of reference was compared to empirical data in a gap analysis. From the gap analysis, appropriate measures were identified and selected into a new performance measurement system for PSB. The proposed measures were discussed with a manager and the two employees who were interviewed regarding the current performance measurement system to secure their suitability. In the next phase, the current supply chain was mapped to get an understanding of the components in the supply chain and how they are linked together. An investigation of the alternative regarding regional warehousing was also performed. Finally, the alternative and current situation was evaluated with respect to the new performance measurement system.

Frame of reference

The literature review for the study included the relevant concepts for this study; supply chain, supply chain strategy, performance measurement system and supply chain network design. The supply chain definition by Mentzer (2001, p. 4), "*a set of entities (e.g. organizations or individuals) directly involved in the supply and distribution flows of goods, services, finances, and information from a source to a destination (customer)*", was chosen. The three aspects that are included in the chosen definition were used as a foundation for the mapping of PSB's first tier supply chain. Hence, PSB's supply chain was mapped with respect to its goods-, financial- and information flow.

Regarding the supply chain strategy, it was found in literature that it should be developed in line with the overall organizational strategy and it should fit to the product or service provided by the organization. Fisher (1997) claims that a supply chain strategy can be

divided into two categories; lean and agile strategies where a lean strategy aims at reducing costs and is suitable for functional products. Contrary, an agile strategy aims at reducing lead-times and requires a supply chain that is responsive to changes in demand.

Supply chain network design concerns questions regarding location of manufacturing, storage or transportation-related facilities and the allocation of capacity for each facility. The decision of where to locate a facility has a long-term impact on the performance of the supply chain as it is very expensive to relocate a facility or even shut it down. It also affects the performance of the supply chain since it sets constraints on how inventory, transportation and information can be used to reduce costs or improve responsiveness towards customers. An increased number of facilities could be desirable in order to reduce response time. (Chopra and Meindl, 2001)

Finally, the area of performance measurement systems was investigated. Beamon (1999) came up with the categorization of dividing performance measures in resources, output and flexibility measures. A good performance measurement system should contain measures from all three categories. Inclusiveness, universality, measurability and consistency are also factors that should be considered when designing a new performance measurement system. (Beamon, 1999)

Result of data collection

A performance measurement system including all three categories of resource, output and flexibility was developed for PSB, see Table 1.

Table 1. Performance measurement developed for the analysis of PSB's supply chain network design
R=resource, O=output, F=flexibility

New performance measurement system	R	O	F
Transportation cost	X		
Inventory cost	X		
Inventory turnover ratio	X		
Inventory obsolescence	X		
Tied-up capital	X		
Customer Satisfaction		X	
On-time delivery		X	
Target fill rate achievement		X	
Freight Performance		X	
Share of transportation mode		X	
Volume flexibility			X
Responsiveness to urgent deliveries			X
Stock capacity			X

The two supply chain designs were also analyzed with respect to PSB's supply chain strategy and the characteristics of their suitability for handling contraceptives and RH kits.

Conclusions

In Table 2, the performance of the alternative supply chain network design is compared to the current situation.

Table 2. Comparison of the supply chain network designs

Comparison of the two supply chain network designs	
Performance measure	Relative performance of the alternative supply chain network design compared to current supply chain
Transportation cost	\$1230
Inventory cost	No difference
Inventory turnover ratio	No difference
Inventory obsolescence	Advantage for the current supply chain
Tied-up capital	In average \$ 6 300 000 more in tied-up capital for the alternative supply chain
Customer Satisfaction	Advantage for the alternative supply chain
On-time delivery	Advantage for the alternative supply chain
Target fill rate achievement	Higher fill rate for alternative supply chain
Freight Performance	5.1 days shorter with air and 32.8 days shorter with ocean for the alternative supply chain
Share of transportation mode	45% more air transport and 45% less air transport with current supply chain
Volume flexibility	No difference
Responsiveness to urgent deliveries	Better for alternative supply chain due to facilitated customs process
Stock capacity	No difference

From the analysis it was concluded that the alternative supply chain with network design would perform better in transportation cost,

customer satisfaction, on-time delivery, freight performance, share of transportation mode and responsiveness to urgent deliveries. Especially the customer satisfaction, responsiveness and on-time deliveries were factors that PSB expressed as important to achieve and they are all in favor of the alternative supply chain network design and the design was also found to be in line with PSB's supply chain strategy. Therefore, the authors recommend PSB to start using the UNHRD's. However, it was found that the Brindisi warehouse would be unsuitable for PSB due to the low material flow through this warehouse as well as the higher transportation costs. Therefore it is recommended that PSB uses the remaining four warehouses and allocate the countries that should have been served from Brindisi to their closest UNHRD. For the majority of the countries, the closest UNHRD would be in Dubai.

All contraceptives were found suitable for regional warehousing and it is therefore recommended to store them in the different warehouses. The analysis showed that male condoms would be more expensive to transport compared to the current supply chain. However, the increased performance in on-time deliveries, customer satisfaction and freight performance are considered to outweigh the extra cost of transportation.

The analysis also showed that there would be a priority issue between inventory obsolescence and the ability to reach the target fill rate for RH kits in an alternative supply chain network design. There are two options if PSB decides that the target fill rate should be prioritized. Either the inventory levels could be increased in all four warehouses which would increase the risk of inventory obsolescence. The second option would be to consolidate the RH kits in two of the warehouses, for example Dubai and

Panama, to mitigate the risk of obsolete products by gathering the uncertainties in demand. This would reduce the savings in transportation cost due to increased distances to the beneficiary countries. The increased distances would also increase the delivery lead-times. The authors will leave this decision of priority to PSB.

Future research

PSB's current performance measurement system does not measure all aspects of the organization. A performance measurement system was developed for the purpose of evaluating the alternative of regional warehousing. The system was adjusted to reflect aspects regarding regional warehousing. However, the performance measurement system could be modified as a future research project by applying the approach used to develop the performance measurement system in this study. A modified performance measurement system could for example be designed to measure PSB's continuous performance or to evaluate other alternatives for the supply chain network design. Another research possibility for PSB would be to investigate the advantages and disadvantages of only utilizing one or two of the UNHRDs as regional warehouses. In this study, the investigation focused on utilizing all the UNHRDs. Brindisi was not found to be suitable due to its low demand but there could be benefits of restricting the number of warehouses such as lower risk of obsolete products. It has been discussed in this thesis that the use of regional warehouses in the UNHRDs could open up increased opportunities for PSB with respect to consolidation of orders from different suppliers. What has not been discussed is the opportunity for PSB to consolidate the orders with other humanitarian organizations. Such

collaboration could further reduce the transportation costs but further research is required to determine the potential savings and risks.

The conclusions presented in this thesis are a result of a study made specifically for PSB. Further research would therefore be needed in order to determine the applicability of the result on other organizations. However, the performance measurement system that was the foundation for the analysis was developed with measures found in literature. Due to their non-specificity, it is assumed that even though the result might not be applicable to all organizations, the performance measurement system could be used to measure the performance of other organizations as well.

Another aspect that was not included in the analysis for this thesis is the effect of environmental aspects such as regulations and increased fuel prices. A potential future research project could be to investigate current environmental trends with respect to transportation and what effects this would have on a recommendation to store goods in regional warehouses.

Finally, it would be interesting to see a benchmarking of performance measurement systems within different humanitarian organizations. Benchmarking could provide a platform for a discussion regarding what measures that should be included for different purposes and the possibility for the organizations to learn from each other.

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