

Effect of Multi Echelon Distribution System on Supply Chain Performance in Manufacturing Industry in Rwanda, A Case of Inyange Industries-Rwanda

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Abstract: *Today, most companies have more complex supply chain networks in a more volatile business environment due to global sourcing, outsourcing of production and serving customers all over the world with a complex distribution network that has several facilities linked by various activities. Effective management of material flow across a supply chain is a difficult problem due to the dynamic environment with multiple objectives. The majority of the solution approaches used to solve supply chain problems were based on conventional methods using analytical techniques. In response to the aforementioned challenge, one of the primary objectives of this paper is to determine the effect of multi echelon distribution system on supply chain performance in manufacturing industry in Rwanda and Specific Objectives are: to determine the effect of order size on supply chain performance in manufacturing industry, to analyze the effect of inventory policy on supply chain performance in manufacturing industry, to establish the effect of supplier integration on supply chain performance in manufacturing industry, to assess the effect of Information Communication Technology adoption on supply chain performance manufacturing industry. The study employed the use of questionnaire to collect data. Descriptive research design was used. The study adopted simple random sampling techniques approach to analyze the data. Statistical package for social science (SPSS) version 24 was used to report the descriptive statistics for various variables in the study. The results of this study show that it is important to deploy products in distribution centers with backroom storage to outperform orders that lead to cost reduction and higher profit where primary purpose is retail store order fulfillment and considers the interactions between different unit operations from the outset, rather than optimizing them separately. As conclusion, Manufacturing companies should consider the application of multi echelon distribution systems in both their upstream and downstream distribution systems to achieve benefits such as to stand up to the complexities of retail- and wholesale-specific requirements, to set achievable and clear service level goals, reduced distribution time and stock holding costs, to balance business constraints and financial targets to ensure achievement of improved efficiency and effectiveness and quality outputs. The study recommends that manufacturing companies should have well established distribution systems to ensure efficient and effective supply chains that will assist them achieve their business goals.*

1. Background of the Study

In the last decades, the increasing quality of services requested by the customer, yields to the necessity of optimizing the whole distribution process, this may be achieved through a smart exploitation of existing resources other than a clever planning of the whole distribution process, for doing that, it is necessary to enhance goods consolidation, Mancini (2013). One of the most efficient ways to implement it is to adopt Multi - Echelon distribution systems. Every company has the challenge of matching its supply volume to customer demand. How well the company manages this challenge has a major impact on its profitability. Gonzalez-Feliu (2011), a multi-echelon distribution system is one that relies heavily on layers of suppliers across multiple distribution centers and that is based on outsourced manufacturing; the entire set-up consisting of procedures, methods, equipment, and facilities, designed and interconnected to facilitate and monitor the flow of goods or services from the source to the end use.

According to Carlos A.Méndez. et Al. (2011) multi echelon distribution system breaks with the old approach of treating locations in the supply chain as independent from one another and plans the supply chain as a pool of inventories, which has the added benefit of relocating the best possible quantity of inventory to the appropriate location. A single-

echelon distribution system is one where a single Distribution Center (DC) acts as a central repository between the supplier of the inventory and the customer-facing outlets, the DC is under the control of a single enterprise. Warehouses are at the lowest echelon, responsible for their own stocking policies, independent of each other, which was determine its own single echelon distribution policy, in each decentralized system; each site was typically have its own aggregate full rate constraint or goal.

Shu-Hsien L. et al. (2011) stated that multi echelon is the ability to see the entire supply network and manage the inventory in that network as a pool rather than as a group of independent locations. Henry et al. (2012) stated that new inventory shipments are first stored at a central or regional distribution center (RDC), such systems are considered when products are distributed over large geographical areas, to provide good service, product shipments are first stored at a central facility (warehouse), and these central facilities are the internal suppliers to the customer-facing locations (retailers).

Ambrose et al. (2010), basing on global competition in supply chain, there are several tactics brands like Nike, Toyota and McDonald's Supply chain employs to increase efficiency, ensuring they tackle supply chain issues and meet

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rising consumer demand, Yung-Hsiang C. and Yi-LingT. (2009), Matching supplier production with deliveries to meet schedules and distribution centers requirements, centralized distribution centers emphasis is on economies of scale, High storage volumes, strong quality focus and prevention of faults to deliver exceptional customer service experiences from suppliers to distribution centers to dealers.

For example, Nike's distribution network consists of 7 RDCs and more than 300,000 DCs; and these DCs serve end customers. Here, the DC and RDC both are under the control of a single enterprise- Nike, Kulkarni, et Al. (2009). As stated by Ambrose smith, (2016), McDonald has centralized distribution centers at Mumbai, Delhi and Kochi, McDonald uses three types of Distribution strategy – Franchising – Licensing – Joint ventures. McDonald has quicker connections that allow them to track purchases and offer customer loyalty programs, this also connect headquarters with stores. A Savitz , et Al. (2013) argued that Toyota has managed to gain the reputation of being the world's biggest automaker; their distribution system is large and depends on the Toyota brand and service namely Toyota, Toyopet, Corolla and Netz to give great sales and services that was maintain the reputation of Toyota and its dealer body.

Few non-agricultural products are produced in Rwanda, which leaves most distribution and sales channels reliant on import-export partners. Construction of the Kigali Free Trade Zone K-FTZ was designed to serve as a distribution platform to the entire Great Lakes region. Goods shipped by rail are transferred to trucks in Isaka for the remaining journey to Kigali, adding to the time and cost of goods shipped to and from Rwanda, Ben Gasore (2013). Multi echelon distribution system is similar to other distribution system, it only differs from their implementation; and in Rwanda, distribution system is increasingly being implemented especially in the health-related field.

Ministry of Health-Rwanda has integrated new distribution systems that facilitate the distribution of drugs to all health centers across the country. This new electronic system of delivering drugs is enhancing efficiency and speed of the distribution, the method has a tracking system which monitors the transportation of drug consignments from the central medical store to various destinations countrywide, thus minimizing cases of fraud or loss and having a system that enables timely deliveries, planning and adaptability, is a key milestone in the quest for providing quality healthcare to citizens, Gene Trousil (2015).

Diego C. and Jaime C. (2010) discussed the distribution network from how products enter to final destination, including reliability and condition of distribution mechanisms, major distribution centers, ports, etc. Delays in delivery of imports and exports are common and manufacturers in Rwanda in time-sensitive industries often rely on expensive air transport to ensure timely receipt of inputs and timely export of finished goods. Alexander O. et Al. (2014), manufacturers have established a wide, independent and fully operational distribution system to ensure that they are able to get products available at any shop closer to the end consumers. This requires a huge investment in multi echelon distribution systems to speed up

the operations so that they can have a competitive edge in the market in Rwanda and worldwide. This study looked into how they can use multi echelon distribution systems to increase their supply chain performance.

2. Statement of the Problem

Increased competition, globalization in today's market, companies spanning a wide spectrum of industries have been focusing their competitive strategies on leveraging the competencies and innovative capabilities to be found in the clusters of customers and suppliers constituting their business supply chains. Much effort had been invested in quality management models, the application of information technologies, and process and organizational reengineering, Kevin P. et Al. (2016). Today, most companies source globally, produce in various plants and serve customers dispersed over a large geography with a complex distribution network which has several stock points linked by various activities. Keyvan S. et Al. (2015). Although managing information and material flow in a global supply chain can be challenging, companies that learn how to design and manage their complex distribution network was have a substantial competitive advantage in their markets, Daniel P. et Al. (2016).

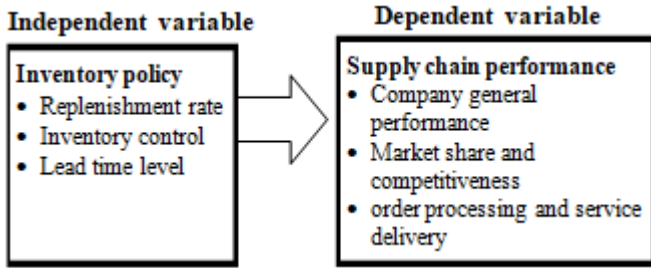
Many manufacturers' supply chains struggle to face the modern challenges of volatile demand, globalization, and increasingly personalized, differentiated, and complex products. Inventory planners and distribution managers are constantly battling to balance maintaining desired customer service levels while keeping inventories in check, Annika A. et Al. (2015). Neglecting the importance of multi echelon distribution system in any organization can lead to the closing down of the company, especially if the factors of production are not well managed to meet customers' needs. The distribution problem consists of having inadequate allocation of raw material, finished goods and parts components. The stock of items must be reasonable, meaning that it should not be too much far from the end consumers, Shuangyan L. et Al. (2017).

In Rwanda, very few studies have been intended to analyze the effect of multi echelon distribution system on supply chain performance, and especially in the manufacturing industry. This study, therefore, sets to bridge this gap by analyzing the effect of multi echelon distribution system on supply chain performance in manufacturing industry, in Rwanda.

3. Objective of the study

To analyze the role of inventory policy on supply chain performance in manufacturing industry in Rwanda.

4. Conceptual framework



5. Research Design

This study was adopted a descriptive survey design. A descriptive survey design enables the researcher to keep track of the research activities and ensures that the ultimate research objectives are achieved Alan Bryman (2016). Uma S.& Roger B. (2016) pointed out that descriptive studies are only restricted to fact finding but may often result in the formulation of important principles of knowledge and solutions to significant problems.

This method was therefore integrated by the researcher for it gave room for an in-depth analysis of the case under investigation. Quantitative research was employed under this study, as argued by Babbie, Earl R. (2010) quantitative research focuses on gathering numerical data and generalizing it across groups of people or to explain a particular phenomenon.

6. Population of the Study

According to Martyn Denscombe (2014) a population refers to the entire group of persons or elements that have at least one thing in common. Target population is defined as all members of a real or hypothetical set of people, events or objects to which a study wishes to generalize the results of the research study, RK Yin (2017).

In this case, the target population consisted of the different employees in INYANGE Industries. The unit of observation was comprise Operational and production, procurement and supply chain, Finance, Distribution centers/ stores and ICT departments. The target population (N) was 98 employees who were randomly picked. Random sampling technique was adopted by the researcher following the homogeneity of the target population Ilker Etikan (2016).

7. Sampling Technique

A sample is a set of observations drawn from a population by a defined procedure. The sample represents a subset of manageable size. Samples were collected, and statistics calculated from the samples so that one can make inferences or extrapolations from the sample to the population, Steven G. H et Al. (2017). The sample was drawn from the population that represented the employees of Inyange Industries.

The study employed purposive and simple random sampling technique in coming up with a sample size of 49 respondents by use of Slovin's formula: $n = \frac{N}{1 + e^2}$ where $e = 0.1$, whereas questionnaires were the main data collection instruments, Wolfgang Viechtbauer, et Al. (2015). The use

of sample enables the researcher to save time and costs associated with studying the entire population, this also involved random selection of respondents from each stratum.

Table 1: Target Population and sample population

Department	Target population	Sample Size
Procurement and Supply chain	20	n=N/ (1+e ²)
ICT	6	
Operational and production	20	
Distribution centers/Stores	40	
Finance	12	
Total	98	49

8. Data Collection Instruments

The primary data was collected using questionnaires that were administered by the researcher herself. In this case, the questionnaires were adopted by the researcher following their simplicity in administration, scoring of items and analysis of data, Gary Thomas (2017). The questionnaires comprised of closed-ended questions in relation to the study objectives.

The open-ended questions were adopted since they provide alternative answers to the respondents. Closed ended questions are easier to analyze and economical in terms of time. The open ended questions on the other hand was used for they give the respondents a chance to provide an insight into their feelings, interests and the backgrounds of the study, Alan Bryman (2017).

9. Research findings and discussion

9.1 Effect of Inventory policy on supply chain performance

Table 2: Percentages distribution of respondents' perception on Inventory policy

	5-Strongly agree	4-Agree	3-Neutral	2-disagree	1-strongly disagree
Replenishment rate is important to the overall company's performance	31%	69%	0%	0%	0%
Inventory control affects supply chain effectiveness	41%	53%	6%	0%	0%
The length of lead- time influences supply chain performance	37%	53%	10%	0%	0%
The process of receiving, issuing, accounting and storing responsibilities are properly segregated	33%	63%	4%	0%	0%

Source: Primary data, 2018

The study sought to establish the significance of inventory policy on supply chain performance in manufacturing industry in Rwanda. Majority of the respondents agreed to the fact that the levels of inventory policy impacts supply chain performance. This is evident from the table where 69% agreed to the fact that replenishment rate has an effect on supply chain performance, followed by 31% who

strongly agreed that replenishment rate has an effect on supply chain performance. A percentage of 53% agreed that Inventory control affects supply chain performance and 41% of respondents strongly agreed respectively that the Inventory control has an effect on supply chain performance and only 6% preferred to stay neutral on the statement.

When the respondents were asked whether the length of lead- time influences supply chain performance, 53 % agreed on the statement, 37% strongly agreed that the length of lead- time influences supply chain performance, only 10 % remained neutral to the statement. All the respondents were in agreement that process of receiving, issuing, accounting and storing responsibilities properly segregated has an effect on supply chain performance with 63% agreed on the statement, 33% strongly agreeing while only 4% were neutral that the process of receiving, issuing, accounting and storing responsibilities properly segregated has an effect on supply chain performance.

The findings are in agreement with Kannan Govindan (2015) who stated that inventory policy establishes the optimal inventory levels that must be maintained to meet expected service levels for demand fulfillment. Reordering or replenishment process needs to define review period for reordering, and an ordering quantity. Then it needs the inventory parameters to determine whether an order for replenishment should be placed at the time of review or not. Based on how the review period and order quantities are defined, there are a few options to drive the reordering and determine the variability of the historic data to determine the optimal inventory levels. Inventory policy pre-processes the time-series data for demand, supplies, and supply lead-time to compute the mean and standard deviation of these series. It then computes the optimal inventory level (safety stocks) that was enough to guarantee the target service levels.

10. Conclusion

Following the results of the study, it is worthwhile to conclude that there is a positive relationship between multi echelon distribution systems and supply chain performance. Through Inventory Policy. Inyange Industry has been able to achieve optimum supply chain performance. It is therefore clearer that the application of multi echelon distribution systems in the manufacturing industry can be used to achieve more benefits than the previously forecasted to achieve. It provides means for achieving coordinated process and reduced costs. Manufacturing industry use multi echelon distribution systems to achieve benefits such as to stand up to the complexities of retail- and wholesale-specific requirements, to set achievable and clear service level goals for meeting customer needs, to balance business constraints and financial targets for the first time, to reduced distribution time and stock holding costs in the purchase and transportation of raw materials and finished goods through its production processes to ensure achievement of improved efficiency and effectiveness and quality outputs both at reduced operational costs.

11. Recommendations

Given the effect of multi echelon distribution systems have on supply chain performance, it is imperative that

manufacturing firms start to view multi echelon distribution systems as a strategy to ensure efficiency and effectiveness of their operations. This involves strong capability to increase the inventory turnover through properly established and right-sized safety stock buffers across the entire supply chain, taking into account the complex interdependencies between stages, as well as variables that cause chronic excess inventory, such as long lead times, demand uncertainty, and supply volatility. Since most respondents agreed that multi echelon distribution systems have led to increasing the level of supply chain performance, manufacturing companies should be encouraged to adopt multi echelon distribution systems since it will assist them achieve their business goals. The applications of inventory Policy contribute to the performance to the performance of manufacturing company.

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