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Research Article

The Role of Physical Distribution in Supply Chain Enterprise and the Accompanying Bottleneck Problems: A Review

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Abstract
Physical distribution is the core component thatdetermines the general performance of supply chain administration because it is thelogistics platform that enables the entire supply chain organization to manage and optimize the movement of productswithin the value chain enterprise. However, there are bottleneck problems attributable to physical distribution that limits the general effectiveness of the value chain. Consequently, the literature appraisal aims to identify and synthesize into adocument the underlying bottleneck problems associated with physical distribution in the supply chain environmentto guide stakeholders in the industry and chart future research direction for effective physical distribution policies to further enhance the supply chain organization. Among the problems identified are, cost, ineffective information technology, transport problem, limited capacity, inventory, regulatory laws, and facility location. Other problems include poor infrastructure, inadequate technical ability, tax, and environmental factors. The identified problems can be used for value stream mapping of physical distribution to identify process improvement opportunities for a more efficient supply chain organization.

***Keywords**: Physical distribution, problem, supply chain management*

1. Introduction

The significance of physical distribution in supply chain enterprisescannot be overemphasized particularly ina production environment because manufacturerslose money when buyers do not find their products to buy when they want to purchase. For instance, stock-outs, additional delivery lead-time, and unpredictable delivery time are indicators of inefficient physical distribution system that leads to loses in the extended enterprise. Physical distribution drives the cost of products, hence, finding a solution to reduced logistics cost results in reduced product cost which is the motivation this appraisal.Supply chain administration is proven to enhance overall production performance in manufacturing settingsbecause it underscores the connections between production,supply, and distribution of products to consumers. Physical distribution channels across the extended enterprisesof manufacturers and thesuppliers are embedded in the value chain administration to enhance the general performance of the value chain. However, the bottleneck problems occasioned by physical distribution limits the overall performance of the supply chain organization.

This review aims to appraise the current efforts on physical distribution function in supply chain administration to identify and document the major problems accompanying physical distributions to enable stakeholders and practitioners gain insight into the problems for improvement to further augmentthe performance of the supply chain administration which in turn will increase the sustainability of the production system. Besides, the review will pose and chart future research direction for an enhanced production system based on the identified problems.
Section one describes the general topic to illustrate the situation while section two briefly reviewed the supply chain system in which physical distribution is embedded. Section three provides a detailed review of physical distribution in the supply chain setting while section four synthesizes the review into a document summarizing the problems of physical distribution and the final section draws conclusions and recommendations for future research direction.

2. Supply chain and the Role of Physical Distribution

Supply chain administration in the production environment plays a key rolein ensuring a smooth flow of materials and information, storage, and distribution through the stages of the manufacturing processes from raw material delivery to manufacturersto physical distribution of the finished products to the final consumers [2]. However, if the processed products are not delivered according to specified conditions it infers inefficiency in the value chain. It is the role of physical distribution to ensure the smooth delivery of information and materials in the extended enterprises.Different definitions of supply chain management have been presented by authors. For instance, [25] stated that supply chain is coordination and integration of activities related to moving products from the raw materials phase through to the end-user of the processed products thereby creating a competitive advantage whose

activities include,organization management, procurement, scheduling, order processing, inventory control, warehousing transportation, and customer service. Likewise, [26] noted that the supply chain is an integrated organization that harmonizesinter-related business activities to satisfy customers' needs for a particular product or service. Also, [32] stated that supply chain management consist of planning, implementing, and control of activities concerning transportation,processing, and storage of raw material, WIP, and finished productsfrom suppliers, through production facilities and otherintermediaries to the final customersto satisfy customer wants.According to [7], the supply chainhighlights connectionsbetween marketing, logistics, and production of which physical distribution is a core component. Furthermore, [7] argued that supply chain activities include, physical distribution, materials organization, and production preparation among other activities.

[7] Criticized that some definitions place boundaries on the scope of supply chainactivities and therefore proposed that supply chain areactionsrelatedto transformation and flow of products and services including information from thepoint of raw materials to the end-users. The supply chain hasa positive and significant impact on product quality and overall production performance [8] argued and [21] described supply chain organizationas the greatestoperations strategy for improving organizationalcompetitiveness particularly in the production environment of which physical distribution plays a core role in achieving the desired competitiveness. [22] Asserted that the supply chainencompasses activitiesconcerningthe integration of fundamental activities across organizational bounds viaenhanced communication, partnerships, and cooperation and emphasizedthat the performance of physical distributionis dependent onIT. [23] Argued that inventory in supply chains isproportional to cycle times that are dependent ondistance, complexity, and uncertainty of thephysicallogistics.

[25] Described supply chain administration as the integration ofbusinessactivitiesacross the value chain and emphasizes the decrease in the stock of materials both within and across organizations. Also, [25] noted that to implement SCM, there should be some degree of synchronizationacross administrativeborders which includeintegrationofactivitiesandfunctions within organizationsandthe supply chain system. The supplychain is a network of firms connected through upstream and downstream relationships in different processes that provides value in the form of goods and service to the final consumer.The part information technology plays in the supply chain setting cannot be overemphasized. For instance, [29] asserted that technology created an opportunity for low cost,efficient, electronic web between buyers, sellers, and their parties in thechain channels. It is evident from the foregoing that supply chain administration enhances production performance but physical distribution is the core component that determines the general performance of the entire supply chain system.

3. Physical Distribution and the Accompanying Bottlenecks in Supply Chain Setting

Production is incomplete until semi or finished products are delivered to the final consumers which is the primary function of physical distribution in the supply chain environment.Products meanlittle or no value for the buyer unless it is put in the setting that provides the buyer the chance to enjoy the benefits of the attributes associated with the possession [1] argued. It requires moving the product from where it is purchased to where it is required to be used through physical distribution. It is the function of the physical distribution component of the supply chain system to move products from one point to another in the extended enterprise. It is intuitive that where the physical distribution fails to perform effectively, the entire supply chain system fails that is why it is imperative to ensure that physical distribution is well integrated and efficient.

The significance of physical distribution and the nature of services expected from supply chain managementin a production setting has evolved over the years.As economic development grows from the rural economy to an industrialized urban economy, the growing complexity of physical distribution services is increasingly recognized in related literature [1] stated.Also, [1] stated that owing to the advancement of the society from rural primitive to urban industrialization, manufacturers and consumers become more widely separated and physical distribution becomes very significant in the exchange of products between the parties.[3] Pointed out that physical distribution is separated into transportation and storage functions with the level of services expected by customers. Thus, some of the bottleneck problems arising in physical distribution is the supply chain setting include, transportation, storage capacity, and level of services offered. [4] Highlighted that efficient physical distribution system will result in minimized out-of-stock problems and shorter customer order periods thereby improving the performance of the supply chain administration.According to [1], physical distribution performance measuresinclude delivery time, consistency and delivery reliability, and physical condition of goods, order cycle time variability, and cooperation among others.

National Council of Physical Distribution Management (NCPDM) stated that physical distribution is a vocabulary used in manufacturing and other business situationsto describe activities related toeffective mobility of products from the downstream of theproduction line to the consumer, and sometimes includes the movement of raw materialsfrom the source of supply to the upstream of the production line [7]. However, the revised definition provided by NCPDM states that "Physical distribution describesintegrationamong the broader set of processesfor planning, executing and regulatingthe well-organized flow of raw materials, work-in-process (WIP)inventory and finished products from originto point of consumption". However, bottleneck problems arising from physical distribution constitute impediments in supply chain administration. Progresses in information technology and product flow channels occasioned by global operationsof companies, and amplified customer demands for branded products with rapid delivery reaction caused by competition have motivated strategies in terms of product flow channels that integrate several enterprisesof suppliers, customers, and carriers [7].
Figure 1 depicts physical distribution as a central framework for supply chain systen connecting the functional units of the enterprise.

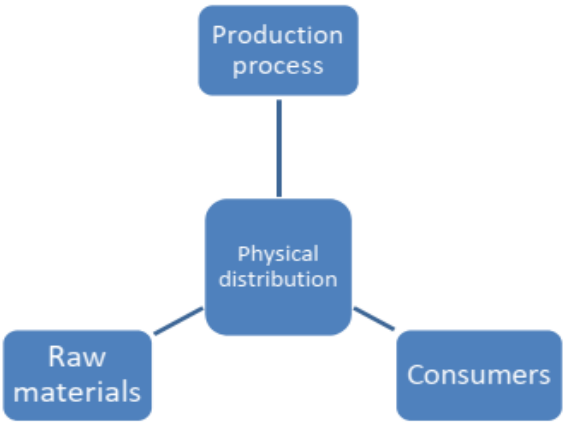

Figure 1. A Typical Physical Distribution Framework

[10] Emphasized that logistics is an essential component of business strategy but the complexity of logistics increased as organizations moved from centralized and vertically integrated production facilities to geographically separated networks of resources that cooperatively create value for the customers. However, [9] argued that vertical integration is a tool that guarantees product quality and consistency of supply though outsourcing is an option with a caveat.Based on definitions in the literature, logistics and physical distribution can be used interchangeably. [11] Noted that among the logistics functions, distribution is a fundamentalfunction in the system and the mainconnection between manufacturers and customers in a supply chain. [14] Stressed that distribution is a key driver of productivity in organizations because it has a proportional impact on logistics cost and the customer expectation. A good design of a distribution network can achieve numerous logistics and supply chain aims, such as low operational cost and high customer service [11]. Physical distribution is a cost reduction tool in the production environment if it is well managed compared with reducing the cost of raw materials and labor.

[18] Claimed that reasons for physical distribution include, short-order economy to minimize inventory, rapid expansion in stock keeping unit, a revolution in marketing, pricing flexibility, a tool for competitive marketing among other reasons. The issuesto consider for the design of a physical distribution system include, cost, quality of service, delivery reliability, delivery lead time, product availability, and technical ability among others [1] stated. [16] Argued that essentials of logistics include storage, information, and management of materials, manufacturing design, and effective transportation which is central to the integrated logistics system. Although transportation systems differ with the product type and geographical location of the market for raw materials, spare parts, and finished products, there is a fundamental objective of the various strategies [16] stated. Again, [17] describe physical distribution as a business activity involving transporting finished product or raw materials to arrive at the desired place needed in useable condition and integrated physical distribution provides a productive avenue for cost reduction in manufacturing. Also, physical distribution is a key to improved volume and profit and a frontier of cost reduction in the manufacturing environment [18]. Despite all the benefits attributable to physical distributions, if the processes are not properly harnessed and well integrated, it can cause huge economic losses.Physical distribution is a source of competitive advantage in a production setting, despite this potential, it is shown in the literature that the necessary infrastructure to support and streamlined productflows are inadequate compare with the rapid developments in informationtechnology [23] stated. The Council of LogisticsManagement (CLM) in 1986

describedit as the procedure of organizing, executing, and governing cost-effective flow and storage of raw materials, WIP inventory, finished products, and associated information flow from origin to point-of-consumption to meet customer demands [25].

Transport and logistics form a huge part of the international economy and the demand for supporting services have emerged due to expansion in international trade which is connected to increased outsourcing of manufacturing support activities and businesses now face an evolving dependence on knowledgeable and cultured transport and logistics systems to operate uninterrupted supply chains [18]. Physical distribution is an inter-related activity such as transportation, inventory, and storage of goods and information, and order processing which involves the physical mobility of finished goods from manufacturers to consumers, directly or through intermediaries [15]. The areas portraying physical distribution include internal and external materials movement, information system, facilities planning, and traffic management [30].

Bottleneck problemfrom time-to-time cause delay or stoppage of the entire system which result inoutput variability and loses in production and operations environments [31] asserted. It determines the capacity of a system and thus, the performance of the physical distributions systemunder bottleneck condition determines the overall efficiency of the supply chain administration which makes it imperative to identify and treat the problems for higher productivity. Situations such as stock-outs, excess delivery lead-time, and unnecessary delivery time variability as indicators of inefficient physical distribution leads to lost sales [5]. [15] Noted that physical distribution is influenced by an increase in the costof transportation occasioned by poor roads, the cost of vehicles, and components.

[6] Emphasized that the significance of appointing a supply chain partner is based on quality performance measured by delivery reliability, flexibility, and speed. This rank physical distribution as the core component of supply chain administration without which the chain system cannot perform effectively. Logistics costconstitutesa large portion of GDP in the economy which is estimated at 30% of the cost of the products sold [12]. For example, [19] noted that the primary challenge in physical distribution is cost.Similarly, [13] asserted that in a logistics setting, physical distribution cost takes the maximum share of expense in the logistics system and it drives the cost of products. Limited capacity significantly affects the overall logistics performance [11]. Similarly, [15] statedthat increased cost of transport and poor infrastructure enforcesstress on physical distribution. The transportation industry relies on information technology which enables customers to sustain a very low stock of materials. Similarly, cost is reduced in freight management services to improve delivery times and reduce costs through Electronic Data Interchange (EDI) [16] noted. Hence, absence or inadequate IT in physical distribution services contributes to poor integration of the extended enterprise which results in poor performance. For instance, some transportation companies still need additional IT to support JIT processes otherwise the process wouldn't be effective [16]. Also, [16] emphasized the importance of IT as a tool that connects suppliers and manufacturers with the transporterto enhance delivery schedules and reduce the costs of excessive inventories.

In transportation, logistics information alternates for inventory, and information technology has fuelled the logistics by connecting shippers andcustomers through information flow. Logistics reduces inventory and eradicates shipment problems anddelays in delivery schedules which saves time and cost to the supply chain partners [16]. Physical distribution setting is a network consisting of one or more storage points connected by a sequence of transportation relations, therefore, integration of stocks of goods must be attained in terms of geographical location for timely delivery [17].[20] Noted that terrorism is a threat to physical distribution which causesdisruptions to the flow of materials to assembly plants and consumers. Also, [23] stated that the major problems of physical distributions include, disjointed regulatory laws(different trade laws), insufficient intermediaries(global shipments are required to involve 27 separate parties to complete), difficulties in costs(random variations in duties and taxes between countries).
The summary of the problems accompanying physical distributions in the supply chain is presented in table 1.

Table 1 References of Physical Distribution Bottlenecks in Supply Chain Enterprise

No.	Authors	Physical Distribution Problems
1	[22, 29, 23, 16].	Information technology inadequacy
2	[23, 25]	Inventory
3	[23]	Distance
4	[23]	Uncertainty
5	[23]	Complexity
6	[3, 17],	Transportation
7	[3]	Storage capacity
8	[1, 15, 12, 13, 16, 19, 23, 24, 29, 11]	Cost
9	[1]	Technical ability
10	[5]	Delivery lead-time and variability
11	[11, 24, 27]	Limited capacity
12	[15]	Infrastructure
13	[20]	Terrorism
14	[23, 27]	Regulatory laws
14	[23]	Inadequate intermediaries
15	[23, 24]	Distribution centers
16	[23, 24]	Facility location decision
17	[24]	Tax
18	[24]	Product design
19	[24]	Environmental factors
20	[12, 15]	Ineffective integration of functional units

Besides, [23] emphasized thatthe physical distribution of products is influenced bydistribution points and facility location. [24] Stated that the key decision standards for the design of an outgoing logistics network are: the number ofdistribution pointsand where they are to be sited, proceduresof distribution and capacity of each location, customers to be served by each center and the type of demand. Furthermore, [24] stated that other general problemsinclude,taxand duty, the location of customers and suppliers, transit time and cost of different transportation options, and the design of products. Other challenges affecting logistics areinfrastructure and laws [27] stated. Also, [29] recognized the issue of the rising cost of physical distribution in the supply chain setting and emphasized the need for analysis for cost trade-offs. [11] Asserted that logistics costs constituted a huge percentage of the cost of the products sold in the market.

It is demonstrated from the literature assessment that problems associated with physical distributions in supply chain administration are fragmentally documented, the gap which the review bridged by generating a comprehensive and holistic document on the problems. The outcome of this review chartsthe future research direction on how to improve the overall performance of the supply chain system by addressing the identified problems particularly cost.

4. **Conclusion**

Bottleneck problems associated with physical distribution in supply chain management have been identified and comprehensively documented. Among the identified problems are, cost, ineffective information technology, transport problem, limited capacity, inventory, regulatory laws, and facility location. Other problems include poor infrastructure, technical ability, tax, and environmental factors. It is expected that if these problems are properly addressed, it will result in a more efficient supply chain system.

5. Recommendation

We recommend further research based on the identified problems to improve the general performance of the physical distribution system. For instance, value stream mapping can be used to map a physical distribution system in terms of time and cost using the identified problem variables to identify process improvement opportunities for enhanced performance of the supply chain system.

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