Use of the Distribution Center in the Ukrainian Distribution System

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Abstract

With the increase of companies’ sustainable turnover, most companies are thinking about creating a distribution center. The consumers should obtain the necessary quality and quantity level of the goods at the right time in the right place, etc., from a reliable supplier, with a sufficient level of service and a minimum level of total costs. Failure to comply with any of these requirements can lead to loss of customers or market share.

The research study of the Ukrainian distribution system was made on the example of one of the national companies which sells building materials.

The article defines irregularity in functioning of existing distribution channels. At the same time, the authors determine inefficiency of various distribution channels used by the participants of the retailers’ network in one region. To solve this problem, combining several material flows has been proposed. Serving clients together allows avoiding seasonality and makes goods volumes more sustainable. In this case, the use of the distribution center is rational. Applying a DC in customers consolidation areas allows increasing productivity and efficiency of the distribution system and improving logistics indicators.

Obtained results are based on: scientific and practical analysis of irregular services of material flows; integrated and system approaches to data processing; an experimental method for implementing the distribution center in the distribution system; methods of project analysis evaluating the distribution system effectiveness.

Keywords: Logistics; cities; parameters; distribution; retail; indicators; channel,

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1. Introduction

Expansion of retail networks inevitably raises the question of uninterrupted supply of commodities. The easiest solution for retailers is an option where vendors bring their goods to stores; put them on shelves and monitor current balances themselves. But, unfortunately, the majority of suppliers are not able to provide such services, or their price is too high. The analysis shows that maximum 40% of modern store suppliers are in compliance with full obligations due to their contract when delivering goods (Johnson and Johnson, 1999). Only a few of them, in addition to the delivery, can do extra services. All the others are small wholesale brokers, who can’t provide stable supply of products to the market in right time, place, quantity, etc. So, their unclaimed reserve will automatically increase the costs. This situation forced retailers to search direct links with producers and organize their own supply department.

On the other hand, due to the falling purchase power of customers, retailers start to reduce their own number of orders and their size. In such conditions each of distribution channels is unstable or episodic. Influence of these factors provides negative impact on logistics systems functioning.

Many specialists and scientists agree with the idea to centralize flows that use distribution center (DC) or central warehouse, which can accumulate stock in a short time spent, is necessary for supply chain. Using of DC ensures that the customers receive the exactly ordered range of goods of the corresponding quality and clients are not burdened with the “logistics problems” (Hadjinsky, 2013). However, these actions will have effect on the final price of the finished products (Shapiro, 2006) in distribution channel.

Based on the existing analysis of the up-to-date functioning of the logistics system (instability and periodicity), the influence of its external participants, and rising requirements for environmental protection, it has been assumed that there is a possibility of rational organization of the distribution channel scheme which would ensure DC channels effective functioning.

This article is aimed at finding efficient ways for making stable flows from irregular orders at separate distribution channels in the current economic situation in Ukraine, on the one hand, and evaluates the efficiency of such decision for logistics system, on the other.

The best project solutions serve as indicators of effectiveness of functioning of the logistics channel. Every company has its own indicators that can demonstrate the quality and quantity of their work. For example, for online shop this can be an indicator of “Average time of order processing” or “order processing time”. If a certain value of efficiency indicator can be defined, it is possible to analyze, set the index values for the next period and strive to implement them. Proper goal setting can provide up to 50% success rate (Hadjinsky, 2013). At the same time the efficiency of distribution system should be based on project analysis methods and indicators which are based on the long-term profit (Roslavtsev, 2010; Kuznetsov, 2012, Vorkut, 2002). In this paper, technological changes in distribution systems, which lead to economic and ecological efficiency shifts, have been considered. The results from the conducted experiments on the use of the distribution center have been evaluated.

2. Methods of distribution

Material Flow movement can be seen as a variety of sources – the source of raw materials, finished products, semi-finished products, return of containers, packaging, damaged goods. One of the main logistics problems and tasks is effective distribution of products. The solutions played the main role in design and management of logistics chains (distribution channels, sales channels) (Dybskaya etc, 2008). Organizational structure of logistics chains can be varied and depends on (Dybskaya etc, 2008, Larina, 2005; Hadjinsky, 2013; Galkin, 2015): 1) the size of enterprises; 2) the scope of their activities; 3) the concept of governance; 4) material consumption; 5) fields of industry, etc.

Historically, distribution channels represent an group of independent companies. Each of these companies seeks to maximize their profits, not worrying about the overall profits of the channel. These traditional channels of distribution have poor management and low efficiency of system functioning. Emerging channels with such conflicts have a devastating effect on all the system.

In the simplest case, when the logistics system is characterized as a system with direct links, logistics chain consists of suppliers and consumers. Forms of bringing the goods to the consumers are determined primarily by the nature of the goods, place and conditions of its production, consumption and transport capabilities. This form is used
when a large consignment of goods is purchased or for buying unique products. It allows minimizing transportation costs and costs of temporary goods storage (Fig. 1).

**Producer / Seller ----> Carrier -----> User / Buyer**

Fig. 1. Example of a simple supply chain (Larina, 2005).

Fig. 1 shows an example of simple supply chain direct sales, which includes such links: Producer (seller) of the finished product, the User (buyer) and logistics intermediary who deliver the goods to the buyer (Dybskaya etc, 2008, Larina, 2005).

The current approach is valid for one particular market. In a market environment, there are many markets and for each of them separate logistics channels should be used (Fig. 2). It is necessary to consider the DC to consumers located in a certain area, city, region, country. This does not prevent the use of facilities and logistics infrastructure (warehouses, DC, transport, retail network) serving several areas.

Current channels are not well organized on the Ukrainian market (Belovodskaya, 2011; Krykavsk, 1999). Development of distribution systems is moving straightforward to the establishment of an integrated supply chain (Krykavsky, 1999; Dybskaya etc, 2008). Unlike traditional channel, a vertical marketing system consists of manufacturers, wholesalers and retail network, functioning as a single system.

Another form of bringing goods to the consumers is to use the services of whole-sale intermediaries in DC functioning. This form is mainly used to expand markets and reduce cost, if necessary, to create extra value in channel of the same product in different markets when delivering a large number of products, etc.

The basic idea of the effective use of transportation technologies is consolidation of goods to deliver them in large lots on a long distance (Dolia, Grigorov and Usatov, 2008). Therefore, the future of customer service is the ability to reorganize the routes from pendulum to delivery van, allowing to use a better capacity of vehicles and to reduce the transportation service cost (TSC). Also, it can lead to decreasing the ecological component in distribution. Increasing productivity and efficiency of the distribution system is possible by using warehouses (or DC) in consolidation areas of clients. The basic idea for DC technology use is reducing stock level at retailers (Johnson and Johnson, 1999) simultaneously increasing the assortments of products.

In more complex cases, the echelon system can be provided. Such chains have a tree structure or flexible logistics system (Larina, 2005; Laktyonova, 2002). Logistics models are used for solving the problem of material flows distribution (Belovodskaya, 2011; Krykavsk, 1999): linear programming, game theory, queuing theory, simulation, inventory management, network models.

Thus, one can distinguish traditional, vertical, horizontal and combined system of distribution channels (Dybskaya etc, 2008; Kotler. & Keller, 2012; Feng, and Huang, 2003). Systems are often developed to match the capabilities and requirements of certain markets, mainly on the basis of internal factors and the intentions of the
company: the financial condition, stage of life cycle of the company and product (Fig. 3) (Oklander, 2005; Anykyna, 2003; Kal'chenko, 2003; Hadjinsky, 2013; Johnson and Johnson, 1999; Kotler & Keller, 2012).

Fig. 3. Material flow distribution channels scheme (based on Galkin, 2015): X – logistic channel under certain conditions not exists

Selection of channel directly affects the speed, time, efficiency of movement and safety of products during delivery from the manufacturer to the end consumer. Specificity of modern logistics channel functioning are their irregularity and seasonality due to different reasons. It has a negative effect on all logistics and non-logistics processes.

A significant reserve for increasing the efficiency of logistics processes is the presence of a large number of market participants and therefore channel choices for distribution (Laktyonova, 2002; Hesse & Rodrigue, 2004). As a result, on the one hand, the participants are quickly changed in channels, if they don’t match the requirements (especially transport companies or n-PL providers), on the other, due to constant changes – the quality is reduced: increased delivery time, TSC, material flow cost. A good practice in Ukraine is that wholesalers and manufacturers take part of retailers’ operation for better services to avoid changes and seasonality for them.

3. Methods of DC technology

Today in Ukraine, DC is understood mostly like a controlled unit of one certain logistics system its channel for one retailer. It’s providing and maintaining the necessary range of goods in the structural units of the enterprise (or parts of the network stores) in accordance with the order policy and directly to the organization so that they meet their demands (Dybskaya etc, 2008; Shapiro, 2006). Using traditional regional warehouses, a company “freezes” its stocks – a greater share of current assets. These stocks which is in logistics chain are frozen on way from the supplier (producer) to the regional warehouses, from warehouse to store, stock level in stores. Inventory poor management leads to the fact that DC and store shelves are occupied by non-liquid products and the desired position is not available (Kotler & Keller, 2012; Skjoett-Larsen T., 2010).

Centralized replenishment through the DC allows company to (Dybskaya etc, 2008; Shapiro, 2006):
1) order items in bulk, which is beneficial and the supplier, thereby reducing TSC;
2) often order goods from the supplier (producer);
3) efficient use of vehicles for the delivery of goods in the region;
4) increase the turnover of funds;
5) reduce the amount of cash balances of the company.

Each participant of the channel is a separate entity, seeking to secure its maximum profit. This personal optimization leads to non-rational systems functioning as whole. Development of modern distribution systems is aimed at integration process, effective interaction of all participants and maximum profit for the logistics system. Each technology has its own peculiarities of delivery. Many factors have influence on the choice of technology choice:

1) The parameter MF (MF structure, transport and storage conditions, etc.) (Dybskaya etc, 2008; Hadjinsky, 2013; Shapiro, 2006);
2) The parameters of market infrastructure (national and international legislation; the total number of industrial, commercial and intermediary firms, the commercial banking system, etc.) (Kuznetsov, 2012; Kotler & Keller, 2012).

3) Consumers parameters. Consumer behaviour study is based on consumer buying behaviour, with the customer playing the three distinct roles of user, payer and buyer. Research has shown that consumer behaviour is difficult to predict, even for experts in the field (Armstrong, 1991).

Specialists in logistics put delivery’s deadlines first from the list of service quality characteristics (Dybskaya et al., 2008). Direct links obligate stores to give up to half of their shop total area to allocate the stocks (Dybskaya et al., 2008). DC allows expanding the shopping area and improves the quality of supply, ensures completeness of the range in any of the stores. Assortment provision can reach up to 95% or higher, while DC is in use. In comparison with the option without this figure does not exceed 60-70 % (Krykavsky, 1999).

There are four ways of DC or warehouse development (Shapiro, 2006; Kuznetsov, 2012):
1) selection of the finished building and establishment of warehouse logistics processes with known limitations;
2) design and construction to suit your needs;
3) modernisation of existing warehouses;
4) outsourcing.

Distribution of MF requires many resources on one hand and on the other hand it’s important to serve all users in time. The process of stocks distribution requires consistent implementation of the management traditional functions – planning, organization and control of distribution – adapted to the specific processes in Ukrainian DC.

4. Research and data analysis

The research study was based on PJSC “Smegnik” (Ukraine) and its brand name “PLEST” (“PLEST”, 2015). PJSC “Smegnik” is large industrial enterprise manufacturing building and construction materials: facades, roofing, decking, composite materials, ventilation systems, ventilated facades, solvents, bituminous mastic. The first production line was put into operation in 1993. Manufacturing is based in the industrial zone of Kharkiv. Products of PJSC “Smegnik” are sold in almost all regions of Ukraine, as well in foreign countries. The enterprise’s logistic system consists of manufacturing; transport participants; DC – where materials and finished products are stored; consignees (retailers) which have separate business entities and have their own warehouses and sales areas. Clients of the company are building companies, hardware stores and end-users. The enterprise also has two vehicles with the carrying capacity of 2 and 20 tons. There could also be direct sales with self-delivery. The enterprise also makes construction and installation works of its own products (Fig 4).

The distribution of mastics was selected for research. A set of products that includes: Germabutil 2M Plest (sealant), hermetic bitumen (mastic hothouse), butyl rubber mastic “Butislan-K” (sealing waterproofing), bituminous-butyI rubber “MGBB” (waterproofing roofing), Bitumen Primer (waterproofing roofing), Water-based mastic “BiEM”, Construction bitumen BN 70/30, Construction bitumen BN 90/10.

![Fig. 4. MF distribution channels scheme on PJSC “Smegnik” (made by authors according to PJSC “Smegnik”): logistics channels](image)
Raw materials for the production of bitumen are obtained from the two oil refineries of Ukraine: Kremenchug and Lisichansk. The latter is working irregularly because of the military conflict and antiterrorist operation in the East of the country.

The company carried out the following ways of packaging and shipping of the products (Fig. 5) with compatible serving of several MF in the same time period (Dolia, Kush and Galkin, 2014). Mastics are packed in tins of 4 sizes: 3 liters, 5 liters, 10 liters, 20 liters. The unified packaging give opportunity to serve several materials flows together. Shipping is made by rail, road and self-delivery of products (EXW incoterms). Cargo refers to first and second class of carrying capacity – from 1 to 0.8 depending on MF.

Fig. 5. Scheme of material flows movement in supply chain of the PJSC “Smegnik” (made by authors)

Change of the existing logistics channels on the market in time, affects as a change in distribution of MF through different distribution channels for the period of time in Fig. 6 on PJSC “Smegnik” example.
The manufacturer fulfills customer orders for the formation and sending deliveries by separate vehicles by pendulum routes in almost 76% of cases. As the range and number of orders are variable in time (Fig. 7) and most of the orders are from 2 to 4.9 tons, the use of light-duty vehicles becomes ineffective in terms of long distance transport from producer to consumer by pendulum routes with reverse empty run.

If goods are delivered from the manufacturer to retailers, unloading the truck and the paperwork would take a long time. At the same time it requires significant work of the staff. Using the light-duty vehicle increases the one ton cost of transporting (average TSC was 4.2 UAH/ton-km), which affects price of the product. Frequency of supply and low stocks level in retailer networks do not make the product competitive.

Direct links were replaced by DC one for whole clients. The decision to use DC was made in Kiev. Kiev DC serves Kiev region, as well as neighboring regions: Chernihiv, Cherkasy, Zhytomyr. Applying of DC in customers’ consolidation areas allowed to increase productivity and efficiency of the distribution system. Finished products will be delivered in large quantities to the DC (20-22 tons), the items will be sorted into quantity packaging required for each retailer’s participant (usually a set of pallets). Customers are served by collecting-delivery van routes. In one direction they carry goods, in opposite – containers and pallets. This allows more efficient use of vehicles. It reduces the costs of 1 ton delivery to 1.25 UAH/ton-km on the route “Manufacturer – DC” and to 2.25 UAH/ton-km in the route “DC – Retailers” (total 3.5 UAH/ton-km). Time of loading and unloading operations value is increased
threefold to the whole system, because of increasing extra operations of reloading. But at the same time there is no need to have large size of warehouses and a lot of staff at the manufacturer and retail shop. Also, the period of goods storage is reduced there. Applying the logistics approach allows for improving service of customers with irregular demand by implementing supply to the distribution center. As a result, total costs for single lots (batches) of supplies were reduced by 25% and delivery time to store was reduced by 40%.

The circuit distribution system will have the following form (Fig. 8). As a provider of DC services LTD “UVK” Company was selected. It has suitable DC in any region of Ukraine (LTD “Uvk”, 2015).

Redistribution (delegation) functions of packaging and distribution of products from manufacturer to DC provides an opportunity to reduce costs for all logistic system by 10%. Projects solutions decrease time on preparation and execution of orders, delivery time, reduce costs on stock for retailers’ stores by 15-30 %, contributes stable demand in a particular distribution area. The costs associated with the reorganization of the distribution channel will be paid off in six months.

Fig 8. Project logistics channel (made by authors)

The project solutions that have been described have reduced fuel consumption through the use of light load capacity vehicles. This will reduce the payment of ecological fee by 8.5 %, comparing to the current situation (in Ukraine the ecological fee depends on the amount of fuel used). It also increases the efficiency of the transport process. Entrance of heavy trucks to town urban core is possible only from 9 pm to 8 am compared to the previous variant, which leads to an increase of working hours of unloading retailer areas and hence to additional costs. Using trucks with light load capacity allows serving the retail network at any convenient time during the day.

5. Discussion and conclusions

The benefits for companies when working through the DC are obvious. First, the material flows delivered in quantity exactly needed by retailers in short-term period of demand and not freezing financial capital for stocks maintaining. Secondly, irregularity and seasonality of different material flows for different regions could be served together through the DC. It has a positive effect on whole system. Thirdly, the delivery through DC decreases the size of the retail and manufacturer zone for stock and stock level:

- projects solutions reduce the time on preparation and execution of orders, delivery time, reduce costs on stock for retailers’ stores by 15-30 %, contributes to stable demand in a particular distribution area, simultaneously increasing the assortments of products by 10-20%);
- it also increases the efficiency of the transport process. Entrance of heavy trucks into urban core, is possible only from 9 pm to 8 am. Using trucks with light load capacity allowed serving the retail network at any fit time during the day;
- reduction of staff’s number and storage place at manufacturer’s.
Fourthly, redistribution (delegation) functions of packaging and distribution of products from manufacturer to DC provides an opportunity to reduce costs for all logistic system by 10%:
- reduce total transportation service costs by 16.6 %;
- the suggested variant allows reducing total costs for single party supplies by 25%, and also waiting time was reduced by 40%;
- proposed options enabled to use transport more efficiently and allowed to reduce full costs by 10 %, reduced stock level of these goods in retailers' network on 15-30 % comparing without DC;
- The costs associated with the reorganization of the distribution channel will be paid off in six months.

Fifthly, the establishment of DC improved the quality of logistics services participants:
- improved quality of service due to a closer location of the regional transportation and DC for customers
- due to regular replenishment of goods, DC allows to serve with smaller margin on their stock, and as a consequence, increase customer satisfaction.

At least ecological component of every delivery will be improved for joint servicing of multiple irregular material flows via DC use:
- project decisions have reduced fuel consumption through the use of light load capacity vehicles;
- this will reduce the ecological fee payments by 8.5 % comparing to the current situation (in Ukraine ecological fee depends on the amount of fuel used);
- reduce pollution of CO₂ by 68.79%; CH₄ by 7.66%; NOₓ by 7.19% (According to the method of calculating emissions of pollutants and greenhouse gases into the atmosphere from vehicles, 2008).

Other research shows that using light load capacity vehicles can reduce the average network speed and make transportation faster (Ponkratov D. et al., 2015). Also this solution increases road congestion in a city.

Future research should examine the effectiveness of using the solution, considering influence of consumers’ parameters or examining manufacturing and demand volumes and their influence on logistics channel functioning. Other changes in technology of distribution still need updating. This will determine not only the effectiveness of the logistics system and also social benefits in general. The question of influence of parameters of the region, territory or city on the technology of its logistics services is still relevant.

Acknowledgements

This paper has been completed according to the research profile of the Department of Transport and Logistics O. M. Beketov National University of Urban Economy in Kharkiv, in particular within the department research topics: “System Tools of technological design, organization, logistics and transport processes ergonomic support of the city” (state registration 0107U0000252).

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