COEXISTENCE OF TRADITIONAL SALES CHANNEL AND E-COMMERCE FROM THE POINT OF VIEW OF LOGISTICS COSTS - CALCULATION MODEL

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Abstract

Nowadays competition on the market takes place not only by offering products better tailored to the customer's needs at the lowest possible price, but also by the way in which the product goes the customer. The direction of development of the distribution network organized in the form of omnichannel is clearly perceptible. From the point of view of sales, such solutions allow retail companies to reach customers more easily and offer them sales without risk (easy and free return of purchased goods). This affects the widening of the potential customers and increased sales. On the other hand, omnichannel solutions cause that sales in each channel is not as large as it would be if this channel would function as the only possible one (the phenomenon of cannibalization of sales). Omnichannel solutions also increase logistic costs caused by increased complexity of logistics processes.

The authors in their article describe the developed by them cost model coexistence of traditional sales channel and e-commerce from the point of view of logistics costs. The aim of the publication is to show that the implementation of the e-commerce in a situation where the traditional sales channel already exists is possible from the point of view of logistic costs only when the phenomenon of cannibalization of sales between channels is took into consideration. cannibalization of sales between channels in omnichannel retail is a crucial factor in decision making process about developing distribution channels in way of cross-channel integration. Due to author's model there is possible to assess an influence of introducing online channel on fixed logistics costs and profitability of traditional (offline) distribution channels.

In calculation model only logistics costs and whole demand are take into account. It is a limitation of the paper. Start-up a new sales channel can has an influence on more aspects of trade business. In further research authors want to spread

a range of aspects take into account in calculation model. Calculation model can be used by trade companies in decision making process about developing of sales channels.

Key words: e-commerce, logistics costs, calculation model

1. INTRODUCTION

The development of communication technologies has led to extending distribution channels. The e-commerce development has caused companies, which run sales in traditional canals, to start considering to open new distribution channels. Thereby, the internet channels started interlinking with the traditional ones. It was legally made possible for customers to return goods purchased on the Internet. The differences between the communication and distribution channels are contemporarily observed to be blearing. The customers were enabled to make purchases and returns by means of various distribution channels. The customers were offered a full packet of services independent of the distribution channel of their choice and the ominchannel idea was implemented. On the one hand, this caused a large offer extension and the possibility to get new customers and on the other hand, the logistic processes in the goods distribution phase became complicated. Logistics in omnichannel is crucial to be successful in running business activities as it enables fulfillment of a promise made to the customer. However, the promise fulfillment is related to an additional cost.

The article aims at presenting the significance of the phenomenon of "cannibalising" demand between the distribution channels of the same company in the case of logistic costs and their influence of the conducted business activity profitability. The authors developed a calculation model that makes it feasible to estimate to what demand "cannibalisation" level it is profitable to conduct traditional channels (based on stationary shops) and e-commerce. The authors based their own considerations on their experiences in implementing e-commerce in one of commercial chains from the "furniture" industry.

2. THE THEORY OF DISTRIBUTION CHANNELS – CLASSICS AND CONTEMPORANEITY

A distribution channel is one of the basic terms in logistics and is defined as a set of mutually correlated organisations that co-participate in the process of delivering a product or service to a user or consumer (Cyplik et al., 2008). The distribution channel function is to integrate all participants within the distribution channel of an organisation with all flows between them. All component organisations with their mutual connections need to be appropriately selected and configured so that the channel might correctly play its role. The classical and still existing distribution channels were established as a result of natural evolution but new multi-channel sales

forms keep being formed with the trial-and-error method. As a consequence, there is a great variety of encountered solutions.

According to the classical channel distribution theory, the channels are divided into 3 main categories: consumption goods, industrial goods and services. It is depicted by the vertically performed detailed analysis of particular categories that the structure of existing solutions is largely varied. The situation might be caused by an extensive system of the distribution channel classification criteria. The most frequently cited distribution channel classification criteria include (Czubała, 2001):

- the number of intermediate levels in the channel (short and long channels),
- the number of companies at particular channel levels (broad and narrow channels),
- the type of flowing streams (transactional and item channels),
- the scope of the channel participants' collaboration (conventional and vertically integrated channels - the latter ones are integrated in their full length or only in certain segments),
- the method of the channel participants' action coordination (administrated, contract and corporation channels),
- the channel participants' property law in relations to entities that form a given channel (own, partially own and foreign channels).

It is just caused by the variety of forms that it is exceptionally difficult and complicated to design the distribution channels adequate to the contemporary customer-dominated market requirements and make them function. The occurrence of such new multi-channel sales forms as multichannel, crosschannel and omnichannel results in making attempts to form new structures of the distribution channels which additionally complicates the situation. The multi-channel sales development phases come up step by step, as follows (Marketer+, 2018):

- one channel - customers start interacting with only one brand by means of only one channel,
- multichannel - customers have an opportunity to select a channel dependent on their own preferences, there are numerous simultaneous channels that function independently of each other, their integration is not required;
- crosschannel- its customer has an experience of numerous channels that are part of the same brand, the customer starts being perceived as an individual but gets various brand-related experiences dependent on the channel;
- omnichannel - the customer stops perceiving differences between the channels (blearing differences), the customer is treated as an individual and the customer's experiences are identical in all points of contact with the brand.

Multichannel is characterised by a no communication and logistic integration in the distribution channel. The communication barrier is admittedly removed by crosschannel but goods logistics is still a problem. Only omnichannel is breaking through the logistic barrier as it is the most advanced solution and the option searched for by a contemporary customer (Domański & Adamczak, 2016).

Whereas multi-channel was in vogue in the last decade in retailing, we now observe a move to so-called omnichannel retailing. Omnichannel retailing is taking a broader perspective on channels and how shoppers are influenced and move through channels in their search and buying process. We discuss this development

conceptually and subsequently discuss existing research in this multi-channel retailing (Verhoef et al.).

Omnichannel (OC) retailing has an integrated perspective, with seamless interactions between online and bricks-and-mortar channels. comprehensively analyze the logistical development options open to retailers for integrated fulfillment. The authors discuss the conceptual development options and formulate propositions for an advanced OC fulfillment approach. OC retailers aim to pool their organizational units for fulfillment via different channels. Retailers with multiple channels develop their warehouse systems toward channel-integrated inventory enabling flexible and demand-driven inventory allocation. Retailers with channel-integrated inventory also organize their picking procedures in one common zone. The higher the outlet density, the more it becomes beneficial for retailers to introduce pick-up services. The findings provide an insight into designing OC fulfillment and distribution structures. The concepts themselves, archetypes, challenges and development paths are analyzed. Identified logistics levers can be adjusted to pinpoint the steps required to advance integration. The authors contribute by deriving propositions and a framework for transitioning from basic MC to integrated, extended OC logistics. Because this research area is still comparatively young, the authors take a more comprehensive, exploratory view of OC fulfillment (Hubner et al.). The customers of companies are offered large possibilities – selection elasticity by the synergy of managing numerous channels – selection elasticity (Verhoef et al., 2015).

Omnichannel has the following features[1]:

- puts its customer at the heart of action,
- leads to the undisturbed action of all points of contact independently of the time of day or a device operated by the customer,
- causes the customer to perceive all points of contact with the brand not as a set of separate channels but as an integrated offer of one brand,
- makes it feasible for the customers to select another contact channel at each purchasing or non-purchasing process stage,
- makes it possible for the customers to purchase products on the Internet and to receive them in a stationary shop or reversely - to purchase products in the stationary shop and to have them delivered home,
- ensures the possibility to use the same prices and promotions in various sales channels.

To develop an omnichannel framework in the context of sales and sales management related to six areas: sales contexts, impact of technology, stages in the sales process, impact on relationships, impact on firm performance and the role of various communication tools and platforms (Cummins et al., 2016).

How omnichannel retailing should be structured to create a supply chain that is both cost effective and responsive to customer needs. Given the complementary strengths of the physical and online channels, hybrid structures should be designed to use both channels. The physical channel should be used to serve frequent and predictable needs and the online channel should be used to provide variety and serve sporadic needs. The physical channel can also serve as a showroom and pickup

[1] https://marketerplus.pl/teksty/artykuly/kilka-slow-o-strategii-omnichannel/ (access: March 20, 2018)

location for the online channel. This hybrid structure can be particularly effective in emerging markets where new online players can partner with existing local retailers to benefit both parties and the consumer (Chopra, 2016).

As referred to the removed barriers, the omnichannel sales success is conditioned by the following factors: communication and logistics. On the one hand, there is no purchasing comfort (saving the customers' time, the ease of their transaction performance) with no effective and efficient communication between the company and its customers based on advanced Internet and mobile technologies. On the other hand, it is the deliverers' efficient logistic systems that will seal the omnichannel sales success. The systems flawlessly fulfil supplies and returns (flows forwards and backwards) within a short period of time.

The growing importance of the online channel and the increased deployment of new technologies such as smart mobile devices and social networks create new opportunities and challenges for traditional retailers. The retailing industry is moving to a new phase, in which the distinctions between traditional and online channels disappear, namely omnichannel retailing. The new challenge is to understand how multiple channels can be synergistically managed to provide a seamless customer experience. In OC retailing, logistics represents a key success factor due to its impact on both customer service and total costs. Retailers need to define the distribution configuration for serving the online demand, making decisions on the integration level between online and traditional channels. Companies can set an ad hoc network for the online channel or use the same network for both online and traditional channels at warehouse and/or transport levels. In this paper, we developed an assessment model of the operational costs for three distribution configurations in OC retailing. Results highlighted that the search for synergies between online and traditional flows in both warehouse and transport activities is important for the economic sustainability of OC systems (Marchet et al., 2017).

Logistics is crucial to be successful in business as it fulfills the promise made to the customer. Logistically perceived, the basic omnichannel strategy feature is the increase in the number of order sources. The management in the omnichannel strategy conditions relies on designing and using process-equipment patches within the existing logistic structure that are dedicated to serving new channels (Antonowicz 2017). The distribution strategy complexity causes logistics to face numerous difficult challenges, for instance business elasticity and scalability. The same day delivery, return service and trans-border sales[2] will be forced by the omnichannel development. New business conduct conditions need to be included in trade companies' strategies, e.g. bulk level - one of the solutions should be to implement the multi-channel sales concept (Strojny & Chromińska, 2016).

Due to the above situation, contemporary logistics with its formation of distribution channels has a resurgence. What is significant nowadays, is not the company presence in its numerous sales channels but the full communication and logistic integration which is defined as informational and physical availability of goods searched for. According to consumers, the communication and trade offer

[2]http://www.jll.pl/poland/pl-pl/Research/Logistyka_e_commerce_w_Polsce_przetarte_szlaki_dla_rozwoju_sektora_raport.pdf (access: March 27, 2018)

customisation is the future of trade[3]. It is widely thought that the omnichannel strategy is necessary to be successful in the future[4]. There is observed that technology supports development of business concepts of trade. Shortening delivery of goods to customers is possible thanks to good communication between partners in supply chain and in distribution networks. There is many standards which allow quick response on a demand in distribution networks. An example of such standard is Global Location Number (GLN) (Dujak et al., 2017). Flow of information is a one factor in quick response on customers demand. Second factor is speed of flow of goods. Nowadays there is possible to find in literature many conceptions of improving speed of goods movement in distribution network. One of these conceptions is Physical Internet (PI) (Domański et al., 2018).

3. DISTRIBUTION COSTS

It is more and more frequent for companies to pay attention to distribution costs that might be from 30% to 40% of the total product costs. Such data based on the research performed among Polish companies are quoted by Dohn, Matusek, Odlanecka-Poczobutt (Dohn et al., 2012) in their work. In Kotler's view, the total distribution cost components are: transport 37%, stock financing 22%, warehousing 21%, customer service and distribution administration 20% (Kotler, 2009). The distribution costs contribute to increasing the product prices and diminishing the offer value as perceived by purchasers.

A customer's purchasing decision is a kind of compromise between the costs to be beard in the purchasing transaction and the benefits implied by obtaining a product or service. In other words, the customer tends to minimise the purchasing risk and will prefer the purchases in the channel where they might obtain a goods/service with the possibly lowest risk.

The costs might be divided into 2 basic categories: monetary and non-monetary costs. The first category includes the purchase process and transport costs. The latter category includes, among others, information query costs and purchasing risk. The latter group of costs of no financial type is rather abstract and difficult to be measured and valuated. The purchasing price is undoubtedly a key component in the cost classification because it is the most visible purchasing element. Nevertheless, one should not forget the significance of seemingly invisible costs (second group). As part of the purchasing decision, one sums monetary and non-monetary costs (Snoj et al., 2014) whereas the price is considered to the iceberg top of the purchasing cost (Best, 2013).

Two price components are traditionally (Zeithaml, 1988) indicated: – an objective one – real price and a perceived one – price projection in the customer's mind. In the work by Funkhouser & Parker (Funkhouser & Parker, 1986), functions performed in the distribution channel were adopted to be the point of departure in the

[3] https://www.accademiaretail.it/wp-content/uploads/2017/10/Comarch_TNS_survey_future_of_retail-1.pdf (access: March 27, 2018)
[4] http://www.dhl.com/content/dam/downloads/g0/about_us/logistics_insights/dhl_trendreport_omnichannel.pdf (access: March 27, 2018)

matrix of total costs beard by the consumer. The first matrix dimension is various cost categories that might occur during the purchasing process. The second matrix dimension is related to the type (character) of the costs. The accidental cost configuration is a combination of a purchaser, seller, exchange subject, buy-sell transaction conditions (among others distribution channel – communication and logistics). More information on consumers' price perception is presented in the work by Franjkovic, Dujak and Sebalj (Franjkovic et al., 2017)

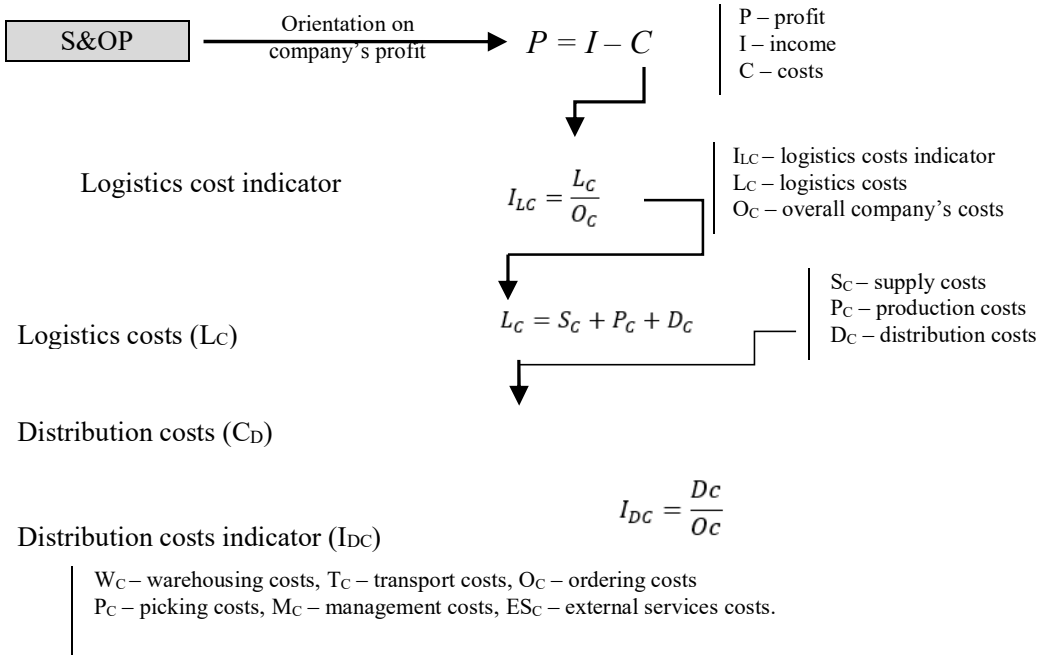
The customers are offered goods and services at a given price and this is mainly implied by the factors: costs of obtaining goods (or manufacturing products) and the margin which a company wants to perform on sales. The price specification might be conducted based on costs and the specified margin and then, the price is a result of such a prepared calculation or the price is specified in advance (e.g. if the company wants to take a given competitive position on the market) and in this case, the margin is a result if the costs are specified. The company profit is conditioned by the margin height and therefore, it is so significant to keep its value positive. If the competition on the market is strong, the prices offered to customers are forced in some ways to be used by the companies and as a consequence, the margin maximisation might be conducted only by minimising costs. As regards to the authors' comparative analysis, the distribution channels will be thoroughly investigated in terms of downstream logistic costs (from the analysed company to the customers). The material costs, costs of obtaining materials/resources are unchangeable in the case of various organization variants. Therefore, it is so essential to recognise the downstream logistic costs that might have a significant impact on sales margin where there are a number of distribution channels functioning.

Total logistics costs can be broken into the fallowing cost type (Jonsson, 2008):

- transportation and handling costs, which a are related to the moving of goods originate from internal and external freight transportation, packaging and damages to goods during handling;
- packaging costs include all costs related to packaging materials and the processes of packing and marking goods;
- inventory-carrying costs are costs for keeping good in stock;
- administrative costs include all costs which are associated with long-term planning and operative management of material flow;
- ordering costs can be attributed to the processing of purchase and manufacture orders;
- capacity-related costs are annual depreciation and cost for maintenance;
- shortage and delay costs;
- environmental costs.

The localisation of the distribution logistics costs in the structure of the company costs and their influence on the company result is presented in Figure 1.

Figure 1. Company result transposition on distribution costs



Source: Koliński, A. (2017). 'Analiza wpływu działań operacyjnych na efektywność procesów dystrybucji' [Analysis of influence of operations on distribution processes efficiency], (unpublished report of scientific project - KCiSI1/17).

When planning the company result at the strategic level (SOP level), one searches for an income excess over the costs necessary to obtain the income. The costs are created as a result of using resources in logistic processes or involving financial resources. In general, one investigates the share of logistics costs in the company total costs (LCI indicator). One might draw a conclusion that the efficiency of the total logistic processes performed by the company is investigated at the strategic level. In this case, the efficiency is defined as a component of two variables: effectiveness – the objective achievement level (achieved/unachieved) and effectivity – the size of resources needed to achieve an objective (smaller/larger). The action, which offers the same effectiveness with a smaller effectivity degree (resource involvement), will be considered to be more efficient. The above dependencies should be treated as the strategic level guidelines for the sake of fulfilling objectives at lower (operational) levels. At lower logistics management levels, there is a subsequent decomposition of costs in the phase layout (procurement, production and distribution) in the first place and then, each phase is continuously developed in terms of costs in the processual layout (in the case of distribution: transport, order preparation, dispatch performance, management of the flow of information, service, etc.)

The distribution system financial efficiency assessment tools are, among others, (Frankowska & Jedliński):

- model of profit strategy (D.J. Bowersox or L. Stern),
- Economic Value Added – EVA,
- Residual Income – RI,
- Activity Based Costing – ABC,

- Direct Product Profit – DPP,
- Total Cost of Ownership – TCO,
- Supply Chain Costing – SCC.

In practice, attention is paid to the problem of correct input data that are used to calculate costs in the case of a given method, this problem is also raised both in the sphere of distribution and in the entire supply chain. Therefore, the real problem is not a fulfillment of a specified cost calculation procedure but no confidence about the accuracy of the obtained calculation results. Assistance might be gained from the systems of recording and reporting the activities in logistic processes with the use of wide IT support – computer software, automatic identification system mobile technologies – GPS and Internet.

A dilemma, which the distribution system faces, is, as follows: to guarantee the service level as required by the customer (possibly the largest) in relation to minimising the logistic distribution costs (possibly the smallest). Very generally regarded, the logistics distribution costs might be globally divided into: transport, warehousing, resource management and lost sales. It should be beard in mind that the mentioned categories are mutually dependable which means the change of one cost category influences the change in the category of other costs – therefore, decisions should be made with respect to the total distribution cost (sum of particular cost categories).

To identify the realignment of the physical distribution process for store-based retailers in their efforts to integrate the online channel into their business model. Retailers are developing a consistent omnichannel physical distribution process in which stores undertake a bigger role in order fulfillment and delivery. Level of online sales, size of distribution network, number of sales associates at a store, and number of years engaged in the online channel are identified as having strong associations with the type of order fulfillment method used by omnichannel retailers. The study of R. Ishfaq and team finds that retailers are focussed on integrating their store and DC inventories and have the benefit of scale with a large store network. A better understanding of the requirements of physical distribution in an omni-channel setting will guide retailers in developing requisite operational capabilities (Ishfaq et al., 2016).

Literature about omnichannel is full of analysis from a customer point of view (Li et al., 2018; Yim et al., 2016; Du et al., 2018; Ovezmyradov & Kurata, 2018). There is a lot of research about influence of omnichannel introduction on inventory management too (Gallino et al., 2017; Morenza-Cinos et al., 2017; Ovezmyradov & Kurata, 2018). In literature there is a lack of analysis of dependencies of logistics cost in omnichannel distribution. That gap is covered by model described in next chapter.

4. CALCULATION MODEL

4.1. Model Assumptions

The authors adopted a number of assumptions while developing a calculation model of distribution logistic costs in the condition of the coexistence of traditional

sales channel and e-commerce. According to the first assumption, the distribution system objective is to obtain the assumed conducted business activity efficiency.

It is specified by the second assumption what the distribution system efficiency components are. The efficiency is a function of 3 variables:

- customer service level in the distribution network (related both to the deadline, quantity and quality compliance and customers' special requirements),
- trade sales growth (quantitatively or valuably determined by income),
- generated distribution costs.

The first two variables define the postulated objective (action effect) but the third one defines the objective achievement method (outlay necessary to achieve the objective). In the calculation model under construction, one will analyse distribution costs, i.e. efficiency outlay prospect.

The third assumption is related to the method of settling logistic costs in distribution. There are 2 basic models of approaching to calculating the distribution costs:

- assignment of costs to a single product,
-joint consideration of all costs with a periodic settlement at the end of the reporting period.

In the model under construction, one used the second approach that jointly considers the distribution costs of all products (without dividing them into particular products).

The fourth assumption regards the description of a distribution network for which the model will be developed. The distribution network offers products for consumers, has its own shops and the central warehouse. The model will be constructed in the case of conditions in which the traditional sales network is completed by e-commerce.

The fifth assumption regards the distribution process costs to be included in the calculation model:

− costs of the product flow in the distribution network to the final customer by the central warehouse, retail shops, order service costs, handling, transport and salary costs,

− reception and storage of materials in the central warehouse and ready-made goods shops, handling costs, costs of packaging final products, warehousing and salary costs

− organisation of the material flow from the central warehouse to the final consumer – costs of serving information streams that control the physical processes of the ready-made goods distribution, handling, transport and salary costs.

In the consecutive subchapters, there is a solution based on the above assumptions.

4.2 Demand Cannibalization

While omnichannel is implemented, the basic issue is the phenomenon of demand „cannibalisation" between sales channels. This phenomenon relies in dividing demand into the sales channels. Demand might decrease in the below example, in which the functioning traditional sales channel (with the use of retail shop

networks) is completed by an e-commerce channel. Some customers, who have so far made purchases in the traditional channel, will transpose their purchasing activity to the Internet. Obviously, it is possible to get new customers who started making purchases in a given network only because of the fact they might use e-commerce. There will be very likely an increase in the total demand (quantitatively calculated as a sum of income from all the channels) after e-commerce is implemented. This does not mean that there will be a decrease in sales in the traditional channel. Having traditionally implemented e-commerce, this particular decrease in the sales value in the traditional channel is called demand "cannibalisation". The calculation formula applicable to calculate the demand "cannibalisation" degree is as follows:

$$CI = \left(1 - \frac{Its_{with\ e-c}}{Its_{before\ e-c} \cdot (1+t)}\right) \quad (1)$$

where:
$CI - 'canibalization' indicator$
$Its_{with\ e-c} - Income\ in\ tradicional\ channel\ after\ indroduction\ e-commerce$
$Its_{before\ e-c} - Income\ in\ tradicional\ channel\ before\ indroduction\ e-commerce$
$t - trend\ in\ analyzed\ period\ of\ time$

The above formula enables approximate demand „cannibalisation" calculation. The indicator is based on the total income value quotient (for all assortment items). It was decided to adopt such a solution in the model due to its implementation ease in practical conditions. Obviously, it is possible to search for more precise solutions and to separately calculate the indicator value in the case of each assortment item. Nevertheless, such a solution is much more labour-intensive in the implementation and one very frequently needs to update the values of indicators to gain benefits from this solution. Demand "cannibalisation" is of key significance for the sake of understanding logistics costs in the omnichannel functioning conditions. This has a special significance for fixed logistics costs. The division of logistic costs into fixed and variable ones in the distribution area is presented in the next subchapter.

4.3. Distribution Logistics Costs

In the calculation model under construction, it is adopted in assumptions that the logistic costs in the distribution phase will consist of partial costs as presented in Figure 1. The most significant costs division within the channel coexistence analysis is the division of costs into variable and fixed:

- variable costs are costs proportional to the sales growth. Therefore, they are beyond the analysis in the case of traditional sales channel and e-commerce,
- fixed costs are costs which growth does not depend on the sales growth. Thus, the smaller sales (caused for instance by demand "cannibalisation"), fixed costs will have a stronger influence on the margin decrease.

The next criterion of dividing fixed costs might be their appurtenance to the distribution channel (traditional and/or e-commerce). According to this criterion, the costs might be divided into:

-non-shared – assigned only to one distribution channel traditional channel or e-commerce (e.g. depreciation of the warehouse equipment used to packing courier services in the e-commerce channel)

- shared – costs that keep a record of actions undertaken both in the distribution processes in traditional channel and e-commerce (e.g. depreciation cost of the storage warehouse equipment where one stores goods distributed in both channels at the same time)

A precise identification of fixed costs in logistics distribution was presented in Table 1.

Table 1. Logistics distribution costs classification

Logistics distribution fixed costs in traditional channel (TC)		Logistics distribution fixed costs in e-commerce (EC)	
Non-shared (N)	Shared (S)		Non-shared (N)
Warehousing costs (WC)			
WC_{TC_N}	WC_{TC_S}	WC_{EC_S}	WC_{EC_N}
Transport costs (TC)			
TC_{TC_N}	TC_{TC_S}	TC_{EC_S}	TC_{EC_N}
Ordering costs (OC)			
OC_{TC_N}	OC_{TC_S}	OC_{EC_S}	OC_{EC_N}
Picking costs (PC)			
PC_{TC_N}	PC_{TC_S}	PC_{EC_S}	PC_{EC_N}
Management costs (MC)			
MC_{TC_N}	MC_{TC_S}	MC_{EC_S}	MC_{EC_N}
Logistics distribution fixed costs in traditional channel (TC)		Logistics distribution fixed costs in e-commerce (EC)	
External services costs (ESC)			
ESC_{TC_N}	ESC_{TC_S}	ESC_{EC_S}	ESC_{EC_N}
Logistics distribution fixed costs (DCf)			
DCf_{TC_N}	DCf_{TC_S}	DCf_{EC_S}	DCf_{EC_N}

Source: Own study

In the last row of table 1, there are total costs according to the criterion of the appurtenance to the distribution channel. And for instance distribution fixed costs

non-shared in traditional channel (DCf_{TC_N}) are calculated according following formula:

$$DCf_{TC_N} = WC_{TC_N} + TC_{TC_N} + OC_{TC_N} + PC_{TC_N} + MC_{TC_N} + ESC_{TC_N} \quad (2)$$

where:
$WC_{TC_N} - Warehousing\ fixed\ costs\ non-shared\ in\ traditional\ channel$
$TC_{TC_N} - Transport\ fixed\ costs\ non-shared\ in\ traditional\ channel$
$OC_{TC_N} - Ordering\ fixed\ costs\ non-shared\ in\ traditional\ channel$
$PC_{TC_N} - Picking\ fixed\ costs\ non-shared\ in\ traditional\ channel$
$MC_{TC_N} - Management\ fixed\ costs\ non-shared\ in\ traditional\ channel$
$ESC_{TC_N} - External\ services\ fixed\ costs\ non-shared\ in\ traditional\ channel$

In line with the adopted cost calculation scheme, logistics distribution fixed costs (DCf) are callculated accordng following formula:

$$DCf = DCf_{TC_N} + DCf_{TC_S} + DCf_{EC_S} + DCf_{EC_N} \quad (3)$$

where:
DCf_{TC_N} – distribution fixed costs non – shared in traditional channel
DCf_{TC_S} – distribution fixed costs shared in traditional channel
DCf_{EC_S} – distribution fixed costs shared in e – commerce
DCf_{EC_N} – distribution fixed costs non – shared in e – commerce

When one knows the shared and non-shared costs between distribution channel, it is possible to calculate the shared index (SI) that shows what percent of the distribution logistics fixed costs are costs that are shared between the distribution channels.

$$SI = \frac{DCf_{TC_S} + DCf_{EC_S}}{DCf} \cdot 100\% \quad (4)$$

In the case of the shared costs, it is necessary to specify the proportion that shows which part of the shared fixed costs should be calculated to e-commerce and which part should be calculated to traditional channel. To perform it, one will use the e-commerce index (ECI) as calculated according to the below formula:

$$ECI = \frac{I_{EC}}{I_{TC}} \cdot 100\% \quad (5)$$

where:
$I_{EC} - income\ in\ e-commerce$
$I_{TC} - income\ in\ traditional\ channel$

ECI is calculated based on income which is a simplification. Obviously, it is possible to make the input data more detailed and present them in quantitative, volumetric units, etc.

4.4. Demand „Cannibalisation" Influence on Distribution Costs

The demand „cannibalisation" influence on distribution costs and the company result will be presented in this chapter based on the indicators as calculated in the previous chapters. The analysis starting point will be the formula "per company result".

$$P = I - \frac{(DCf + DCv)}{I_{DC}} \tag{6}$$

where:
$P - profit$
$I - income$
$DCf - fixed\ distribution\ costs$
$DCv - variable\ distribution\ costs$
$I_{DC} - distribution\ costs\ indicator\ (see\ fig.1)$

Distribution fixed costs before introduction e-commerce (DCf_1) according previous part of analysis (presented in chapter 4.3.) could be calculated as:

$$DCf_1 = DCf_{S_1} + DCf_{N_1} \tag{7}$$

where:
$DCf_{S_1} - shared\ fixed\ distribution\ costs\ before\ introducing\ e-commerce$
$DCf_{S_1} - non-shared\ fixed\ distribution\ costs\ before\ introducing\ e-commerce$

By analogy to formula 7, one might calculate distribution fixed costs after introduction e-commerce (DCf_2). The formula per (DCf_2) was presented below:

$$DCf_2 = DCf_{S_2} + DCf_{N_2} \tag{8}$$

Shared fixed distribution costs after introduction e-commerce (DCf_{S_2}) might also be calculated based on the values of distribution fixed costs before introduction e-commerce (DCf_1) and the indicators calculated in chapter 4.3 (formula 1, 4 and 5).

$$DCf_{S_2} = DCf_1 \cdot SI \cdot (1 - ECI) \cdot (1 + CI) \tag{9}$$

where:
$SI - shared\ indicator$
$ECI - e-commerce\ indicator$
$CI - 'canibalization'\ indicator$

By analogy to formula 9, one might calculate non-shared fixed distribution costs after introduction e-commerce (DCf_{N_2}):

$$DCf_{N_2} = DCf_1 \cdot (1 - SI) \cdot (1 + CI) \tag{10}$$

One might obtain the formula per distribution fixed costs after introduction e-commerce by referring to formula 8 and substituting formula 9 and 10 results to formula 8 and then performing a mathematical simplification.

$$DCf_2 = DCf_1 \cdot (1 + CI) \cdot (1 - ECI \cdot SI) \quad (11)$$

Having performed a kind of simplification based on formula 11, it is possible to state to some extent that it is necessary to fulfil the condition in formula 12 in order not to make distribution fixed costs increase after implementation of e-commerce

$$CI < ECI \cdot SI \quad (12)$$

While interpreting the condition presented in formula 12, attention should be paid to the fact that distribution fixed costs for traditional channel will not rise if the demand "cannibalisation" effect is compensated by the allocation of part of fixed costs to the e-commerce channel. The fixed costs, which have so far been exclusively dedicated to the traditional channel, will be shared with the e-commerce channel.

In the model under construction, one also included the difference between distribution fixed cost after and before introducing e-commerce. The formula 12 (formula 14) result might be substituted to the simplest formula on calculating the difference (formula 13) and perform a mathematical simplification (formula 15):

$$\Delta DCf = DCf_2 - DCf_1 \quad (13)$$

$$\Delta DCf = DCf_1 \cdot (1 + CI) \cdot (1 - ECI \cdot SI) - DCf_1 \quad (14)$$

$$\Delta DCf = DCf_1 \cdot [(1 + CI) \cdot (1 - ECI \cdot SI)] - 1 \quad (15)$$

What is the most significant to a company, is to make the e-commerce channel not cause such a large increase in distribution fixed cost which would eliminate the previously gained profit. Therefore, the difference between the distribution fixed cost should be smaller than the last recorded profit. This condition is presented in formula 16:

$$\Delta DCf < P \quad (16)$$

Moving on to the quotient approach, profitability might be calculated as a ratio of profit to income:

$$P[\%] = \frac{I - \frac{(DCf + DCv)}{I_{DC}}}{I} \cdot 100\% \quad (17)$$

In the next analysis step, one calculates the change ratio of distribution fixed cost to the values of distribution fixed cost before intruducing e-commerce. Formula 15 was used to develop formula 18. Formula 19 is a mathematical simplification of formula 18.

$$\frac{\Delta DCf}{DCf_1} = \frac{DCf_1 \cdot [(1+CI) \cdot (1-ECI \cdot SI)] - 1}{DCf_1} \quad (18)$$

$$\frac{\Delta DCf}{DCf_1} = (1 + CI) \cdot (1 - ECI \cdot SI) - 1 \quad (19)$$

Having put the condition in formula 16 together with the change of values of distribution fixed cost after intruducing e-commerce (formula 17), it is possible to indicate a boundary condition in which a company stops gaining profit from sales in the traditional channel. This condition was presented in formula 20.

$$(1 + CI) \cdot (1 - ECI \cdot SI) - 1 > \frac{P[\%] \cdot I}{DCf} \quad (20)$$

In conclusion of modelling the "cannibalisation" effect influence of demand between the distribution channels on the company result in the traditional channel, attention should be paid to the fact that this phenomenon is influenced not only by the demand "cannibalisation" indicator but also the possibility to share fixed costs between the distribution channels (SI) and ratio between income in e-commers and traditional channel (ECI).

5. CONCLUSION

Described in article model makes it feasible to perform a more thorough analysis of where it makes sense to start online distribution channels and perform omnichannel. As implied by the performed analysis, 3 indicators have a key significance with respect to the possibility of the coexistence of traditional sales channel and e-commerce:

- "canibalization" index – CI;
- shared index – SI;
- ratio of distribution logistics fixed costs to the income value.

Thanks to developed cost model there is possible to assess influence of introducing e-commerce on profitability of existing traditional distribution channel. From a scientific point of view it is new approach to analyse functioning of distribution channels. Such possibility is an important to practitioners because it gives a chance to reduce a risk in decision making process about developing distribution channels.

The practical application of the analysis results makes it possible to recommend the distribution design in the omnichannel conditions. The two most significant recommendations are:

- increase in the share costs contribution, particularly in the traditional channel case, for instance by using the same infrastructure to the possibly highest level for the sake of conducting logistic operations in favour of sales in the traditional channel and e-commerce;
- decreasing the share of fixed costs in traditional channel in favour of variable costs, for instance by increasing in using outsourcing.

The companies, which consider the implementation of omnichannel solutions in their simplest formula, might estimate the influence of developing distribution channels on the traditional channel profitability. These companies start with completing the traditional channel with e-commerce.

In further research, the authors are intended to make the calculation model more detailed in 2 areas:

- assignment of the calculation model to particular assortment items but not to the entire assortment
- indicator values – by their calculation not based on valuable data but quantitative data that reflect their respective process characteristics.

The presently existing simplifications aimed at facilitating the model implementation to business practice. In the test phase, the applied simplifications were successful and gave satisfactory results. However, the detailed work analyses cannot be revealed and therefore, the focus was put on presenting the model concept and not their implementation results.

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