THE EFFECT OF INVENTORY LEVEL ON PRODUCT AVAILABILITY AND SALE

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Abstract

By increasing inventories, retailers attempt to raise service levels, and thus increase sale. However, in addition to a positive impact on product availability and sale, higher inventory levels may cause problems in performing in-store activities. As poor backroom-to-shelf replenishment process emerges as one of the most common causes of stock-out situations, this article compares store and on-shelf FMCG product availability at SKU level in different stores of a single retailer. In relation to this, besides direct, we have also investigated the indirect effect of inventory level on sale, by using store and shelf out-of-stocks as mediators. The results of the research showing much higher level of shelf- compared to store stock-out rate confirmed the existence of the problem in the realization of internal product flows within retail stores. However, despite the occurrence of this problem, besides direct positive effect of inventory level on sale, its indirect effect was positive as well. Therefore, these results were analysed in the context of other similar studies. In addition to empirical research, the article also discusses certain implications of more efficient organisation of in-store activities.

Keywords: customer service, product availability, inventory level, sales
JEL Classification: M31, M21

1.   Introduction

The increasingly demanding customers tend to place retailers into an unenviable situation, expecting both high quality and cost-efficient offer. The ever-rising competition on the retail market makes this position even more difficult, forcing retailers to constantly search for new, more efficient ways of executing business processes. Consequently, retailers in coordination with other supply chain members (Alaei *et al.*, 2014) devote particular attention to inventory management, so as to achieve certain cost cuts, satisfy their customers, and offer them the right product at the right time at the right place. In particular, Wild (2002) argues that the key objective of inventory control is reflected in attaining the preferred level of product availability as a significant aspect of customer service.

According to Trautrims *et al.* (2009), customer service for retail consumers is manifested by product availability as the fundamental performance indicator of the entire supply chain. Securing the adequate availability level also raises the service quality level

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in retail stores, which can make a positive impact on customer loyalty (Beneke *et al.,* 2012) and the business performance of retailers and their suppliers (Mittal *et al.,* 2005). If, however, the demand cannot be met due to insufficient amounts of products on stock, out-of-stock (OOS) problem emerges, facing all supply chain members, primarily customers.

The fact that an OOS situation represents one of the most common problems encountered by customers in retail stores is confirmed by the results of several studies (Roland Berger Consultants, 2003; Supermarket Consumer Panel, 2011). According to Olofsson (2006), the highest percentage of consumers in France (62%), the UK (59%), Germany, (51%) and Spain (43%) find being faced with frequent stock-outs very frustrating. On the other hand, the percentage of those for whom the problem is not frustrating at all does not exceed 10% (1% in the UK, 2% in France, 4% in Germany and 9% in Spain). A study that covered over 71,000 consumers worldwide has shown that they do not have much patience when they find themselves in an OOS situation, so that more than 40% will opt for substituting a brand or the item, 31% will substitute the retail store, 15% will postpone, and 9% will give up the purchase (Corsten and Gruen, 2004). Depending on the presented responses, the customers are exposed to various costs. While facing transaction and substitution costs in case of opting for alternative solutions, the customers are exposed to opportunity costs if they give up the purchase (Campo *et al*., 2000). On the average, customers lose 21% of their time searching for an OOS product, whereas every 13th product from their shopping list is not located on the designated or labelled position on the shelf (Gruen, 2007).

Stock-out also negatively impacts retailers' business performance (Grewal and Levy, 2007). It can directly lead to sale decrease, most of all when customers give up the purchase, change the retail store or opt for a cheaper substitute (brand or item) (Ehrenthal and Stolzle, 2013). Loss of sales caused by shelf stock-outs is estimated at 3.7% in Europe and 3.8% in the US (Gruen, 2007). Besides direct sales losses, the stock-out can make a negative impact on the effectiveness of purchase and marketing efforts at the retailer and increase inventory holding costs and waste in the supply chain (Ehrenthal *et al*., 2014). According to the previously mentioned authors (2014) this problem also increases the overall costs of the relationship between retailers and manufacturers due to the inaccurate distribution and inventory information. Moreover, frequent stock-outs can endanger store and brand loyalty (Goldfarb, 2006) and lead to customer dissatisfaction and negative financial consequences (Musalem *et al*., 2010).

However, although a number of studies point to increasing level of inventories as possibility to reduce OOS problem and to increase level of a customer service and sale (Dana, Petruzzi, 2001; Dubelaar *et al.,* 2001; Cachon, Terwiesch, 2006; Koschat, 2008; Balakrishnan, 2008), there are also studies suggesting the opposite effects of increasing level of inventories dominantly because of its potential negative influence on the efficiency of performing in-store operations (Gruen, Corsten, 2007; Ton, Raman, 2010; Waller *et al.*, 2010; Eroglu *et al*., 2011). Bearing in mind these results and all the losses caused by the stock-out problem, in this article, we devoted attention to both, store and shelf availability of FMCG products. Following recommendations for future research by Ton and Raman (2010) we conducted the analysis at SKU level. The research was realised at different retail stores size from 1,200 to 2,000 square meters, of a single retailer in the Republic of Serbia. The data were obtained from retailer's ERP information platform connected with

stores' POS terminals. Consequently, we investigated the difference between store and shelf FMCG product availability, as well as the effect of inventory level on these two forms of availability and sale. The significant difference between store and shelf availability, as well as the weaker total effect of inventory level on shelf than on store OOS pointed to the existence of the problem in the efficiency of performing in-store operations. On the other hand, both, direct and indirect (mediated by store and shelf OOS) effects of inventory level on sale were positive, causing the need for comparison to other similar studies.

2. Literature Review

2.1 Retail product availability

Securing the optimum retail product availability rates creates the basic prerequisite for its sale, *i.e.* for achieving the desired transaction with the customer. Directly affecting sale (Dubelaar *et al*., 2001), where each reduction by 3% may contribute to 1% turnover decrease (ECR Rus, 2009), product availability draws an increasing attention of large retailers and manufacturers. In relation to this, numerous initiatives have been introduced, including the Efficient Customer Response concept, based on the "Quick Response Strategy". Research results and case studies are published and conferences are organized under the auspices of the ECR organisations.

Product availability in retail stores is often described and analysed through out-of-stock problem (Ettouzani *et al,* 2012), where the OOS rate was also most frequently used as its basic indicator. Attention has been devoted to its measuring (Roland Berger Consultants, 2003; Gruen, Corsten, 2007), identifying (Papakiriakopoulos *et al.,* 2009; Papakiriakopoulos, Doukidis, 2011) main root causes (Fernie, Grant, 2008; Ehrenthal, Stolzle, 2013), effects (Gruen, 2007; Musalem *et al*., 2010), and customer responses in out-of-stock situations (van Woensel *et al*., 2007; Zinn, Liu, 2008).

From the customer's point of view, Roland Berger Consultants (2003, p. 8) define the given problem as "*A product not found in the desired form, flavour or size, not found in saleable condition, or not shelved in the expected location*". Hereby, they distinguish between classic, dual placement and delisting out-of-stocks.

Campo *et al.* (2004) and Sloot (2006) view stock-out from the temporal aspect, where it can be temporary or permanent. If the product is not shelved in the retail store on the designated or labelled place, and the customers suppose that it will be available relatively soon, this stock-out is regarded as temporary. On the other hand, if the stock-out appears as a result of the retailer's deliberate decision to reduce the product assortment (wishing to cut costs, encourage the purchase of other product or limit cooperation with suppliers), it is qualified as permanent.

From the spatial aspect, Gruen, Corsten (2007) distinguish between store and shelf stock-outs. Whereas in the former, the product is physically absent from the retail store, in the latter it is unavailable on the designated or labelled point of sale (*i.e.* shelf), but there is a possibility that it is already in the retail store (in the backroom storage space). The average OOS rate of FMCG products amounts to 8.4% on the global level, 8.6% in Europe, and 7.9% in the US (Gruen, 2007). It varies between European countries as well, where its average value in Western and Northern Europe (Norway, Denmark, Sweden, France, Belgium, the Netherlands, Germany, Switzerland and Austria) is 3.6%

lower (7.2% compared to 10.8%) than in the Southern and Eastern countries (Portugal, Spain, Greece, Poland, Hungary, the Czech Republic and Slovakia (Gruen *et al.*, 2002). However, Holman and Buzek (2008) point out in their study that the presented rates do not reflect the real state of affairs on retail markets. Their research results point to the presence of much higher stock-out rates (exceeding 17%), implying at the same time the size of the problem faced by all supply chain members.

2.2 Inventory/Sales relationship

The relationship between inventory levels and sales has been examined in numerous researches. Although the first study of this issue dates back to the 1950s (Whitin, 1957), today there can still be identified many different studies focusing that topic. There are studies in line with these early articles which gave evidence on the existence of positive correlation between these variables. However, there are studies pointing out to some negative effects of high inventory levels.

Cachon, Terwiesch (2006) state that increase of the retail inventory levels also increases service levels, and, consequently, results in increased sales levels. Dubelaar *et al.* (2001) quantified the given correlations, representing the service level through product availability. A higher number of available products in a retail store increases the probability that the customer will find and purchase the desired product (Ton, Raman, 2010). The positive effect of inventories on sales through product availability is referred as availability effect by Koschat (2008).

Besides improving service levels, higher inventories can increase sales through stimulating customer demand by serving as a promotional tool (Balakrishnan, 2008). According to Dana and Petruzzi (2001), customers are more willing to visit the store where they expect higher service levels.

On the other hand, there are studies pointing to the fact that higher inventory levels can also make a negative impact on customer service by causing problems in performing in-store logistics activities. In order to analyse the effects of overstocking, British retailer Marks and Spencer (M&S) conducted the pilot project in one of its stores (ECR UK, 2007). During the four-week trial period inventories were increased in a selected store and the effects were benchmarked against the remainder of M&S stores within the same depot area. At the beginning, because of the reduction in customer requests for products, it was assumed that their satisfaction was increased. However, after some days, higher inventories caused additional handling and waste disposal problems, while the number of customer complaints about product freshness increased. Having in mind that these issues negatively affected not only the store profitability but the customer satisfaction as well, the M&S pilot project has shown that higher inventory level does not automatically lead to a higher service level and more customer satisfaction (Trautrims *et al.*, 2009).

Conducting the research at the store level and by using data from a single retailer, Ton and Raman (2010) pointed to the existence of indirect (negative) effect of inventory levels on retail store sales in addition to direct (positive) impact. According to these authors (2010), increasing inventory levels increases the complexity and confusion in the operating environment, resulting in higher percentage of "phantom products". As these products, despite their physical presence at the store are not available to customers

on designated or labelled places, their increase leads to a decrease in store sales. In addition to named variables, the authors included additional store related variables, such as store unemployment rate, payroll expenses, employee turnover, store manager turnover *etc*.

Negative impact of inventory level on sale was explained by Waller *et al*. (2010) in the context of case pack quantity. Following them, products that have larger pack quantity are more likely to be stored in the backroom since they all do not fit on the shelf when arriving to the store. Thus, their increased inventory level can lead to higher stock-outs, due to poor shelf replenishment from the storage area. This "backroom logistics effect" was identified in the research within RTE cereal category.

In addition to case pack size Eroglu *et al*. (2011) considered the consumer demand variable, as well. These authors suggest that in the case of the products with the same case pack size, more units of a slow moving SKU must be moved to the backroom, thus increasing shelf stock-outs due to the unreliable nature of backroom-to-shelf replenishment and *vice versa*. This relation was investigated within the discrete-event simulation that consisted of a supplier, a retailer and consumers who purchased a single SKU.

Bearing in mind backroom-to-shelf inefficiencies and that high inventories impede replenishment systems, in a research with a major European retailer, Angerer (2005) analysed the relationship between the backroom size and stock-outs. According to this author, a positive correlation between these variables in 10 retailer stores, pointed that having too much inventories can be counterproductive to on-shelf availability.

As it was presented, poor backroom-to-shelf replenishment process (or "backroom logistics effect" according to Waller *et al.*, 2010) was identified as one of the most common reasons for the negative impact of inventory levels on shelf availability, and thus the sale. In addition, the results of several other studies showed that most on-shelf stock-outs were caused in the store (Gruen *et al.,* 2002; Ehrenthal, Stolzle, 2013), where shelf replenishment ranged among the three top root causes (Roland Berger Consultants, 2003). Unlike stores without backroom storage, where store and shelf replenishment feature as a single operation (with products placed on shelves directly from the transporting vehicle), in stores with backroom storage space (typically larger stores), store replenishment is separated from shelf replenishment (Gruen and Corsten, 2007). According to Waller *et al.* (2010) replenishing shelves from backroom areas tends to be less reliable than direct shelf replenishing process. The main reason for this occurs when inventories are misplaced in storage (Raman *et al*., 2001); thus employees may not be able to find the product in the storage area (Eroglu *et al*. 2011). Besides this, problems can appear even when inventories are properly located in the backroom area. No out-of-stock checks, lack of shelf-edge label (Roland Berger Consultants, 2003), insufficient or busy store employee (Waller *et al*., 2010) are also common shelf-replenishment issues that negatively affect on-shelf availability.

3. Conceptual Model and Hypotheses Development

Following reviewed literature, we investigated relations between four variables: inventory level, store and shelf out-of-stocks (as product availability indicators) and sales. Besides direct we examined indirect effects as well. For this analysis we have used multiplestep multiple mediated model presented in Figure 1.

Figure 1 | Conceptual Model
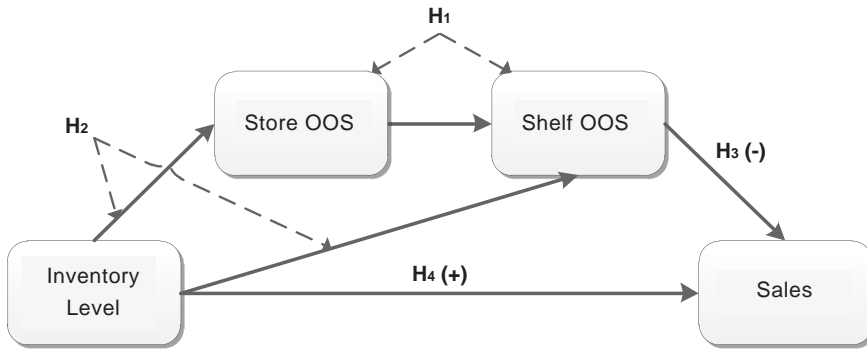
Source: Authors

Given all the in-store problems related to shelf replenishment (Waller *et al*., 2010; Eroglu *et al*., 2011), we first analysed the distinction between store and shelf out-of-stocks. As on the context of our research shelf stock-outs may also occur when the products are available in backroom storage areas, the existence of significant difference between these variables points to poor backroom-to-shelf replenishment process. The efficiency of executing these operations can also be investigated by comparing the effect of inventory levels on both forms of stock-out occurrence. Hereby, a much higher effect of inventory on store stock-outs compared to shelf stock-outs points to the existence of problems in shelf-replenishment process. Concerning this, we tested the following hypotheses:

H_1: *Shelf out-of-stock is significantly higher than store out-of-stock.*
H_2: *The total effect of inventory level on shelf out-of-stock is weaker than on store out-of-stock.*

As one of the most frequently stated negative effects of stock-outs is loss of sales (Gruen, Corsten, 2007), the subject of analysis in the research included the relation between on-shelf OOS (as the place of direct contact with customers in the retail store) and sales levels. It was researched through the hypothesis:

H_3: *Shelf out-of-stock has negative effect on sale.*

Besides shelf OOS, we investigated the impact of inventory level on sale. A number of studies (Dubelaar *et al*., 2001; Cachon, Terwiesch, 2006; Koschat, 2008) point to the existence of a positive correlation between the above mentioned variables. However, according to some authors (Ton, Raman, 2010; Eroglu *et al.*, 2011), as an increase in inventories may cause out-of-stock problems, and consequently sale losses, along with direct (through store and shelf stock-outs), we investigated the indirect effect of inventory level on sale. According to this, we developed hypotheses:

H_4: *Inventory level has positive direct effect on sale.*
H_5: *Inventory level has negative indirect effect on sale.*

The last hypothesis implies that higher levels of store and shelf out-of-stocks mediate the negative effect of inventory level on sale.

4. Research Methodology

4.1 Sample and data

We tested our hypotheses using data from a FMCG retailer, ranging among three top retail chains on the Western Balkans. The research was conducted in 16 of its retail stores, size from 1,200 to 2,000 square meters, located in the Republic of Serbia. Furthermore, each store includes storage areas, where products are first stored before shelf replenishment. In addition to avoiding unobservable across-unit heterogeneity, reliance on the facilities of a single retailer, allows us to have consistent measures in empirical study (Ton, Raman, 2010).

The same sample was taken from each retail store, comprising nine FMCG categories that make up more than 60% of total retailer's offer. In collaboration with its supply chain director we selected 70 FMCG products: 6 personal hygiene care products, 6 household care products, 4 soft drinks, 4 edible oils and fats, 12 cereal-based products and flour, 11 spices and aromas, 6 coffee brands, 15 sweets, and 6 salty snacks. The attention was dedicated to the top-selling products as well as products of special interest for customers (those hard to substitute), whereby some of them comprised about 80% of total category sale. All the sampled products were available (listed in) in the selected stores in the observation period.

Using retailer's ERP information platform connected with stores' POS terminals we obtained the required data for 2013. In addition to daily sales for each product in each store, our analysis also used the data related to the inventory levels and changes in the individual stores, also on a daily basis.

4.2 Measures and research methods

Analysing the obtained data, we first calculated the store and shelf stock-outs. Both variables can be expressed by means of separate OOS rates. Using POS sales estimation method (Hausruckinger, 2005; Gruen and Corsten, 2007) out-of-stock rate (OOS index) for item *i* in store *s* produces the ratio of lost (LS) and expected sales (ES) in units, over a given period of time, where the lost sale is the difference between the average[1] and real sale:

$$OOS_{is} = LS_{is} * 100 / ES_{is} \qquad (1)$$

Under the auspices of ECR Europe, by analysing the data on daily sales, Hausruckinger (2005) set the principles for calculating the boundaries within which the expected sales ranges. However, as his approach can only be applied to a small number of FMCG products with low sales volatility (Papakiriakopoulos *et al*., 2009), for calculations in this study we also relied on features proposed by Papakiriakopoulos, Doukidis (2011).

Formula (1) can be used for calculating rates for both types of stock-outs, with the difference that, unlike shelf, store stock-outs occur only when products are not present in the store. As the analysis of POS data can also identify such situations (by monitoring the position and changes of inventories), store (as well as shelf) OOS rates can be calculated for all the sampled products in the selected stores.

In addition to the presented forms of stock-out, using POS data, we also calculated the remaining variables: inventory and sales level. The values taken were their average values over the observation period: average inventories and average sales (in units) of item *i* in store *s*.

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1   The average sales figure is used as the "expected sales" figure.

Various methods were used for calculating ratios of the above mentioned variables. Given the sample size and the fact that store and shelf stock-out are calculated for each product, *i.e.* item, the existence of difference between these two forms of stock-outs (as well as hypothesis H_1) were tested by Paired-Samples T test. All other hypotheses in the study were tested using Structural Equation Model (SEM), with data analysis conducted in AMOS 20.0 statistical package.

5. Results

In our model we investigated relations between four variables. Their descriptive statistics are presented in Table 1.

Table 1 | Means and Standard Deviations

	Variables	N	Mean	SD
1.	Shelf OOS$_{is}$	1120	0.0568	0.091
2.	Store OOS$_{is}$	1120	0.0457	0.087
3.	Inventory$_{is}$	1120	102.581	184.370
4.	Sales$_{is}$	1120	9.087	19.179

Source: Authors

As the occurrence of store stock-out is followed by shelf stock-out, these variables are interdependent. This is confirmed by the existence of a very strong statistically significant correlation of 0.963 ($p < 0.01$) between them.

The difference between their average rates amounts to 0.0111 in favour of shelf stock-out. It is statistically significant with *p* value under 0.01 (see Table 2). This also confirms hypothesis H_1, that shelf out-of-stock is significantly higher than store out-of-stock.

Table 2 | Paired Samples Test

	Mean	Std. Deviation	Std. Error Mean	t	df	Sig. (2-tailed)
Store OOS – Shelf OOS	-0.0111	0.02443	0.00073	-15.214	1119	0.000

Source: Authors

The remaining four hypotheses were tested by examining relations in conceptual model with SEM (Path analysis). Following Kline (2010) for determining the fit of the model to the data we used several indices: $\chi^2(1) = 1.282$, p = 0.257; RMSEA = 0.016; SRMR = 0.0021 and CFI = 1.000. These results indicate very good model fit as RMSEA value is below 0.025 (MacCallum *et al.*, 2001), SRMR value below 0.05 (Kelloway, 1998) and CFI value exceeds 0.90 (Hu, Bentler, 1999). Results regarding direct effects are shown in Table 3.

Table 3 | SEM Analysis Results (Standardized Effects)

Independent variables	Dependent variables		
	Store OOS	Shelf OOS	Sales
Inventory Level	-0.159 (0.006)	0.019 (0.255)	0.651 (0.004)
Store OOS	-	0.966 (0.002)	-
Shelf OOS	-	-	-0.064 (0.021)

Source: Authors

Besides presented SEM analysis, in our model we have investigated three indirect relations, which are presented in Table 4. In addition to indirect, total and direct effects are shown as well.

Table 4 | Mediation Analysis (Standardized Effects)

Relations	Effects		
	Total	Direct	Indirect
Inventory Level → Shelf OOS	-0.135 (0.033)	0.019 (0.255)	-0.154 (0.005)
Store OOS → Sales	-0.062 (0.020)	-	-0.062 (0.020)
Inventory Level → Sales	0.660 (0.004)	0.651 (0.004)	0.009 (0.002)

Source: Authors

Starting from hypothesis H2, we first analysed the relations between inventory level and stock-out categories (store and shelf OOS). A negative total effect occurs in both cases, with the difference that it is weaker in the case of shelf (β = -0.135, p = 0.014) compared to store out-of-stock (β = -0.159, p = 0.010). This confirms hypothesis H2. Hereby, in contrast to the relation between inventory level and store OOS which is only direct, the relation between inventory level and shelf OOS is both direct and indirect (through store OOS). Consequently, the former total effect is established immediately, while the latter is derived as sum of direct and indirect effects.

Consistent with H3, shelf stock-out was found to be negatively associated with sales (β = -0.064, p = 0.019). Opposite to this relationship, inventory level has positive total, direct and indirect effects on sales. All these relations are statistically significant with p values lower than 0.05. However, even if indirect effect (β = 0.009) is much weaker then direct (β = 0.651), they are both positive, so while hypothesis H4 is confirmed, hypothesis H5 stays unsupported.

6. Discussion and Conclusions

Starting from the results of several studies (Gruen, Corsten, 2007; Ton, Raman, 2010; Waller *et al.,* 2010) as well as following recommendations for future research (Ton and Raman, 2010) we analysed the effects of inventory level on FMCG product availability

and sale at the SKU level. In addition, this paper investigated the existence of problems in backroom-to-shelf operations, which are identified as one of the key reasons for stock-outs in retailing (Eroglu *et al.*, 2011).

A higher level of store product availability compared to shelf product availability (both measured by stock-out rates) implies the inefficient execution of the replenishment process. The shelf stock-out rate is for 1.11% higher than the store stock-out rate, which represents a significant percentage of "phantom products". In this respect, almost one-fifth of shelf stock-outs were caused by problems related to in-store operations.

The lower total effect of inventories on shelf, compared to store out-of-stock also indicates the presence of these problems. The inventory level makes a negative impact on shelf OOS indirectly through store OOS. Despite its direct positive, but statistically insignificant impact on shelf out-of-stock, total effect of inventories on shelf out-of-stock is negative. Its lower value compared to total effect of inventory level on store out-of-stock shows that inventory increase contributes to product availability more at store than at shelf level.

Consistent with previous research (Gruen, Corsten, 2007; ECR Rus, 2009; Ehrenthal *et al.*, 2014), both stock-out categories (shelf out-of-stock directly and store out-of-stock indirectly) negatively impact product sales. In this respect, despite being positive, the indirect impact of inventory level on sale (where store and shelf out-of-stocks are mediators) is much weaker in comparison with its direct impact on sale. Thus, out-of-stock situations diminish the effect of inventories on sales, which could be at a significantly higher level. However, positive indirect effect of inventory level on sale can be explained in the context of the design and variables of our study in comparison to others. While studies with partly different implications were conducted either from store level aspect, thus involving variables that can be related to certain store, or from a single product category aspect, our study was designed at SKU level, comprising nine different FMCG categories with top-selling products.

Therefore, in order to better understand these problems, additional researches can be conducted. Future analyses can include certain characteristics of stores (such as store unemployment rate, employee turnover, store manager turnover *etc.*) and/or products (such as SKUs turnover, case pack size, shelf life, price *etc.*). The relations between inventory levels, product availability and sale can also be investigated from the financial aspect, so the business decision making process could be facilitated through cost optimisation.

Bearing in mind all effects of poor backroom-to-shelf operations on product availability and sale, retailers and their suppliers can take a variety of measures to reduce them. Cooperating in the areas of category management (CM), assortment planning and space allocation, they can improve buying, replenishment, merchandising and pricing activities within different product categories. While Roland Berger Consultants (2003) propose the implementation of "Shelf Availability Management Model" (based on CM principles), Gruen and Corsten (2007), for more efficient in-store activities, suggest the implementation of demand-based planogrammes. As all these activities depend on accurate and reliable information exchange, sophisticated information technology and product monitoring systems are very important for their successful realization. According to IDTechEX Web Journal (2005) Smart Shelves represent the technology that captures and delivers real-time data of shelf stocks. Based on wireless sensors (mounted in the shelves) and cloud reporting applications (for managing alerts), this system helps retailers to reduce or eliminate shelf out-of-stocks, increase order accuracy and improve

re-stocking efficiency and shelf-space utilization (Newave Sensors Solutons, 2013). However, as Smart Shelves are unable to monitor warehouse inventories, for identifying and tracing products before they get to the shelves, Radio frequency technology (RFID) can be used (Grünblatt *et al.*, 2006).

Ton and Raman (2010) see a temporary solution of the problem related to in-store operations in reducing storage areas, which could help to reduce phantom products and improve inventory and assortment planning. In their opinion, store operations should be organised following the model of lean production systems, so the complexity and confusion caused by increasing inventory levels could be diminished. As these problems can increase employees' errors, special attention should be dedicated to their training, learning and motivation. Higher engagement of store personnel and teamwork can reflect positively on product availability in retailing (ECR UK, 2007).

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