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Article

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THE EFFECT OF BACKROOM SIZE ON RETAIL PRODUCT AVAILABILITY – OPERATIONAL AND TECHNOLOGICAL SOLUTIONS

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Abstract

Amid the conditions of increasingly fierce competition, retailers are doing their best to meet the demands of their customers as efficiently as possible. Through the ever-growing level of product availability they raise the quality of service, which is positively reflected not only on the growth in sales, but also customer satisfaction. In the opposite case, the out-of-stock problem emerges, affecting not only customers, but also retailers and their suppliers. Bearing in mind, that the causes of the given problem occur most frequently in the last metres of the supply chain, in this paper we investigated the effect of backroom size on product availability, depending on the retail format. For this purpose, we used moderated regression analysis on the sample of 80 fast moving consumer goods in retail stores located on the territory of the Republic of Serbia. The obtained results pointed to opposite movements in the smallest and the largest format. Whereas in superettes the out-of-stock level lowers with the increase in the backroom size, it tends to drop in hypermarkets. Therefore, we pointed to some in-store problems that cause product stock-outs in different store formats. In addition to indicating the potential causes of analyzed relations, this paper also presents certain operational and technological solutions related to their mitigation.

Keywords: retail, product availability, backroom size, replenishment, Serbia

JEL Classification: M31, M30

Introduction

The process of globalization and advances in information technology have changed market conditions, improving the customer position. Bearing in mind the high share of consumption in Gross Domestic Product (GDP) in most European countries and the importance of an active consumers' policy for good market functioning (Dinu, 2006), customers can be regarded as a real power of the economy (Braşoveanu, Braşoveanu and

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Maşcu, 2014). With higher expectations, they devote an increasing amount of attention to what, where and when to buy, trying to satisfy their needs as cheap as possible.

Amid the growing customer demands, retailers, additionally burdened by ever-rising competition, are forced to place a special accent on their shopping experience, that is, “every point of contact at which the customer interacts with the business, product, or service” (Grewal, Levy and Kumar, 2009, p.1). By means of higher level of service, retail companies are trying to deliver superior customer experience, and thus a higher customer satisfaction which, according to Gomez, McLaughlin and Wittink (2004) plays a key role in a successful business strategy.

Given that customer service is manifested through product availability (Trautrimis et al. 2009), one of the main tasks of retailers is providing its adequate level. A higher level of product on-shelf availability not only increases the likelihood of the customers finding and purchasing the desired product (Ton and Raman, 2010), but also motivates them to do their shopping in well-stocked stores (Dana and Petruzzzi, 2001).

From the S-D (service dominant) logic perspective on-shelf availability represents the key factor in value creation process (Ehrental, Gruen and Hofstetter, 2014). Instead of direct delivering, selling companies (manufacturers and retailers) manage and combine their resources in order to offer value propositions to potential customers. Only after all parties, including customers, have integrated their resources and created preconditions for successful service exchange, does value co-creation start (Vargo, 2011). Retailers play an integrating role in this process, enabling the exchange of services by making manufacturers’ products available to the customers (Ehrental, Gruen and Hofstetter, 2014). However, when out-of-stock (OOS) situation occurs, manufacturer and retailer value proposition to the customer is either altered (if customer substitutes or delays the purchase) or not realized (if customer cancels the purchase).

Out-of-stock situations are one of the most frequent problems faced by customers, both in brick-and-mortar and in online shopping conditions. The situation when they cannot find the product of the desired brand, shape and size at the designated or expected place questions the achievement of their primary goal regarding its purchase and use. Furthermore, in addition to wasted time and energy, it also creates additional costs, which can be transactional, opportunity-related or substitutive by nature, depending on the customers’ response (Campo, Gijsbrechts and Nisol, 2000).

Bearing in mind that shopping goals, as an important element of customer behaviour, influence how customers perceive the retail shopping environment and its individual elements, shopping behaviour, and satisfaction with the shopping experience (Puccinelli et al. 2009), their failure due to out-of-stock problem negatively affects retailers as well. The increase in the OOS rate in retail stores results in decreased customer satisfaction (Angerer, 2005), which may have a negative effect not only on store loyalty (Goldfarb, 2006), but also indirectly on the retailer’s business performance (Musalem et al. 2010). According to Andersen Consulting (1996), the out-of-stock problem costs the average grocery retailer 0.3 to 0.5% of the customer base.

In addition to indirect, stock-out can also directly affect retailers business. If the customers cancel their purchase, change the store or substitute the out-of-stock product with the cheaper brand or item, the retailers will be faced with loss of sale (Ehrental and Stolze, 2013). Gruen and Corsten (2007) assessed these losses on 4% of their annual sales. While

sale losses due to OOS were estimated at 175 million Euros in Netherland, in Germany they were estimated at 1 billion Euros per year in the food retail channel (Verhoef and Sloot, 2006). The fact that even the most successful companies are not immune to stock-outs is testified to by the world's greatest retailer, Wall-Mart, which lost almost \$3 billion in 2013 due to the given problem (Rosenblum, 2014).

Like retailers, manufacturers are also affected by out-of-stocks. According to Gruen and Corsten "lost sales due to OOS items on average cost them \$23 million for every \$1 billion in sales" (2007, p.1). In addition to sale losses, the decrease of brand loyalty (Goldfarb, 2006) and the exchange of inaccurate distribution and inventory information (Ehrenthal Gruen and Hofstetter, 2014) are also some of the problems caused by stock-outs.

Due to the significance of product on-shelf availability and all the effects that stock-out may cause in the supply chain, this paper analysis the OOS problem in the context of backroom size. It is structured as follows. In the literature review section, in addition to main root causes, we devoted special attention to in-store operations such as replenishment and ordering processes. After the methodology section, where we described conceptual model, data and method used for evaluating the impact of backroom size on OOS rate in various retail formats, we presented research results with their discussion. Before the conclusion, for better understanding and solving out-of-stock problems concerned in this research, in implication section we have described several operational and technological solutions that can be used in retail sector.

1. Literature Review

The first publications related to out-of-stock situations in retailing appeared in 1960s and 70s (Walter and Grabner, 1975). Although attention in these was mostly devoted to customers' reactions in OOS situations, they also partly raised some issues related to the root causes of this problem.

According to Gruen, Corsten and Bharadwaj (2002), 72% of out-of-stocks occur as a consequence of retail in-store practices (retail store ordering and replenishing causes), while the remaining 28% are related to supply chain processes (replenishment and planning). With the rate of 47%, problems in ordering and forecasting activities (such as inaccurate inventory, bookkeeping and forecasts) represent major OOS causes. On the other hand, insufficient or busy store staff, infrequent, late or no shelf filling, congested backrooms, bad planogram execution, receiving errors and shrinkage are typical replenishing problems that cause 25% of shelf stock-outs. In addition to these, in their global report, Gruen, Corsten and Bharadwaj (2002) cited several other out-of-stock causes, such as inadequate shelf capacity, inverse effect of inventory, advertising and price changes, new product phase in and out, and manufacturer minimum order sizes.

That the problem of stock-out occurs in the "last 50 metres" of the supply chain has been confirmed by results of other studies as well. According to Roland Berger Consultants (2003), over 85% of all out-of-stocks are caused by retailer in-store operations. By using a common approach in seven different European retail markets, they developed a standardized root cause catalogue that comprises 13 major and 49 sub-root causes. Survey results have shown that all four top root causes are related to retail store practices: store ordering (35%), delisting by store staff (30%), shelf replenishment (12%) and inventory inaccuracy (11%).

McKinnon, Mendes and Nabateh (2007) conducted interviews with supermarket managers in order to identify the reasons for out-of-stocks of three FMCG product categories (Fast Moving Consumer Goods). The results of their study indicated that 65% of all stock-outs were caused at the store. Similar to these results, Aastrup and Kotzab (2009), who analysed OOS situations at 42 retail stores, as Ehrental and Stolzle (2013), whose research included five European retailers, found 98% and 51,5%-94% of stock-outs to have been caused by in-store operations, respectively.

Bearing in mind that top root out-of-stock causes originate from problems in store-related operations, some store characteristics may be considered as important factors of on-shelf availability. The results of several studies (Roland Berger Consultants, 2003; Fernie and Grant, 2008; Aastrup and Kotzab, 2009) have shown that OOS rates differ between retail stores depending on their size or formats which they belong to.

In addition to size, on a sample of 84 products in 10 retail stores of a major European retailer, Angerer (2005) analyzed a few more store-related characteristics as work intensity, SKU density, store manager experience and backroom size. According to his research (2005), stores with too many or too few employees per square meter of salesroom, high SKU density and inexperienced store managers have higher out-of-stock rates. In relation to backroom, Angerer (2005) pointed to the existence of a positive correlation between backroom size and out-of-stocks. He explained this relationship through a counterproductive effect of “having too much stock” on shelf availability. Furthermore, besides Gruen and Corsten (2007), who analysed the results of Angerer’s research (2005), a number of other authors (Ton and Raman, 2010; Eroglu, Williams and Waller, 2011) in their own researches elucidated the negative impact of higher inventory levels on shelf availability through poor backroom-to-shelf replenishment process. The negative impact of higher inventory level, Waller et al. (2010) attributed to a „backroom logistics effect”.

2. Methodology Research

Following studies concerning OOS causes, in our research we analyzed the effect of backroom size on shelf availability (expressed with average out-of-stock on a store level). However, as shelf availability varies between different stores sizes, in addition to Angerer’s research (2005), besides backroom size and out-of-stock level, our analysis included store format as moderated variable (moderator) as well.

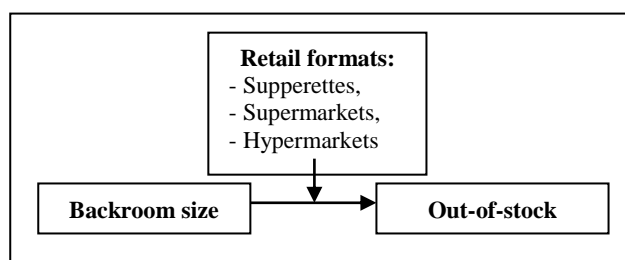


Figure no. 1: Conceptual model

By analysing this model we investigated relations between mentioned variables in different store formats (figure no. 1). Thereby, the emphasis was on the smallest and the largest one.

2.1. Sample Size and Variables

Our sample consisted of 30 retail stores of a retailer that ranges among three top retailers on the Western Balkans. All stores are located on the territory of the Republic of Serbia. In terms of size, they were divided into three groups (Lovreta, Petković and Končar, 2009): 8 superettes (up to 400 square meter salesroom), 12 supermarkets (400 – 2000 square meter) and 10 hypermarkets (over 2000 square meter).

In collaboration with the retailers' supply chain director, we chose 80 FMCG products classified into 10 categories from each store: 6 personal hygiene care products, 6 household care products, 6 soft drinks, 8 products made from sugar (including sugar), 4 edible oils and fats, 12 cereal-based products and flour, 11 spices and aromas, 6 coffee brands, 15 sweets, and 6 salty snacks. In relation to this, attention was dedicated to best-selling as well as products of special importance for customers (difficult to substitute) and all of them were available (listed) in selected stores during the observation period.

In this research we used data obtained from stores POS terminals for 2013. We obtained daily sales and inventory data for all 80 products in each store. They were used for calculating out-of-stock rate (which is most frequently used as product availability indicator), first on product and then on store level. Using POS 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 and real sale:

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

However, as Hausruckinger's approach for estimating expected sales corridor floor can be problematic for FMCG products with high sales volatility, for its calculation we also relied on features proposed by Papakiriakopoulos and Doukidis (2011). After calculating product OOS rates we calculated the mean OOS level for each store (OOS_s).

In addition to out-of-stocks, our analysis included backroom size as a store variable. Following Angerer (2005) we presented it as the ratio of backroom size to sales room.

2.2. Moderated Regression Analysis

As relation between backroom size (BS) and out-of-stock on a store level (OOS_s) may depend on retail format, it can be investigated with the use of moderated regression analysis. Therefore, our model, besides dependent variable (out-of-stock), includes one continuous predictor (backroom size), one categorical moderator (retail format) and their interaction.

According to Frazier, Tix and Barron (2004), both the predictor and the moderator should be analyzed before structuring the equation. While categorical variable needs to be coded, continuous predictor needs to be centred or standardized.

Bearing in mind that retail format as categorical variable has $G = 3$ levels (superette, supermarket and hypermarket), according to West, Aiken and Krull (1996) two code variables ($G - 1$) must be built into our regression model (C_1 and C_2). We used dummy variable coding system to represent them.

Table no. 1: Dummy coding system

Base	superette		supermarket		hypermarket	
dummy codes	C ₁	C ₂	C ₁	C ₂	C ₁	C ₂
superette	0	0	1	0	1	0
supermarket	1	0	0	0	0	1
hypermarket	0	1	0	1	0	0

Among three versions of dummy coding system (presented in table no. 1), we have chosen the first one with superette as a comparison group (in which both code variables have 0 values). In the two remaining groups a value of 1 is alternately given to code variables (C₁ in supermarket group and C₂ in hypermarket group) for contrasting with comparison group.

Although not a necessary requirement for moderator regression analysis (Whisman and McClelland, 2005), on the recommendation of many authors (Aiken and West, 1991; West, Aiken and Krull, 1996; Cohen et al. 2003) we centred continuous predictor (backroom size), i.e. converted it to deviation score form (West, Aiken and Krull, 1996). In this regard we replaced the predictor BS with BS' (Whisman and McClelland, 2005):

$$BS' = BS - \text{mean}(BS) \quad (2)$$

Not only that centring reduces multicollinearity problems (Whisman and McClelland, 2005), but according to West, Aiken and Krull it also “yields the regression model that is most analogous to the familiar ANOVA model” (1996, p. 14). In addition to this operation, similar effects could be obtained from standardizing continuous predictors, i.e. converting them to “z scores” (Frazier, Tix and Barron, 2004).

In many studies (West, Aiken and Krull, 1996; Frazier, Tix and Barron, 2004; Cohen et al. 2003), interaction term was presented as the product of predictor and moderator variables using the newly centred/standardized continuous variables or coded categorical variables. As our analysis included two coded variables (C₁ and C₂) we created two interaction terms, one for each coded variable (BS'C₁ and BS'C₂). Opposite to continuous predictor, these product terms, as dependent variable and coded variables as well, do not need to be centred or standardized (Fraizer, Tix and Barron, 2004). After all variables were prepared, we structured the regression model, presented with the following equation:

$$OOS_s = b_0 + b_1BS' + b_2C_1 + b_3C_2 + b_4(BS'C_1) + b_5(BS'C_2) \quad (3)$$

Our full regression model is consisted of one centred predictor, two coded variables and two product terms. According to Whisman and McClelland the simple rule in forming the moderated regression model is “that the components of any products must always be included when testing the moderator effect” (2005, p. 113). For testing auto-correlation and multicollinearity, we used Durbin-Watson test and variance inflation factors.

3. Results and Discussion

For testing the interaction effects, hierarchical multiple regression was conducted in two steps. According to Frazier, Tix and Barron (2004) in the first step we entered centred continuous variable and coded variables (as predictor and moderator variables), followed by interaction terms in the second step. Then, we compared the reduced regression model (without interaction terms) with full regression model given in equation 3.

Table no. 2: Hierarchical multiple regression

Mod.	R	R ²	Adj. R ²	Std. E.	Change Statistics					Durbin-Watson
					R ²	F	df 1	df 2	Sig. F	
1*	0.856	0.732	0.701	0.010	0.732	23.701	3	26	0.000	
2**	0.904	0.817	0.779	0.009	0.085	5.577	2	24	0.010	1.743
* OOS _s = b ₀ + b ₁ BS' + b ₂ C ₁ + b ₃ C ₂										
**OOS _s = b ₀ + b ₁ BS' + b ₂ C ₁ + b ₃ C ₂ + b ₄ (BS'C ₁) + b ₅ (BS'C ₂)										

Comparing to the reduced model, the R² change related to the interaction terms was 0.085 (table no. 3). It means that the interaction between backroom size and retail formats explained an additional 8.5% of the variance in out-of-stocks. The results of F test (F(2,24) = 5.577, p<0.05) also confirmed that adding interaction terms to the model resulted in accounting for statistically significant more variance in shelf stock-outs. Following Durbin-Watson statistic (1.743), there is no auto-correlation in a regression analysis. In addition, values of the variance inflation factor (VIF), which are lower than 10, indicate that there are no potential problems of multicollinearity for variables.

Table no. 3: Regression coefficients (full model)

Model	Variables	Unstandardized		Stand.		t	Sig.	VIF
		B	Std. E.	Beta				
1	Intercept	0.066	0.004		16.944	0.000		
	BS'	-0.004	0.012	-0.032	-0.304	0.763	1.104	
	C ₁	-0.021	0.005	-0.530	-4.244	0.000	1.514	
	C ₂	-0.044	0.005	-1.055	-8.113	0.000	1.642	
2	Intercept	0.068	0.003		19.973	0.000		
	BS'	-0.033	0.014	-0.295	-2.423	0.023	1.943	
	C ₁	-0.024	0.004	-0.591	-5.405	0.000	1.571	
	C ₂	-0.042	0.005	-1.009	-8.589	0.000	1.813	
	BS'C ₁	0.061	0.024	0.271	2.537	0.018	1.501	
	BS'C ₂	0.081	0.029	0.307	2.768	0.011	1.612	

As presented in Table no. 3, values of regression coefficients changed after adding interaction terms. While the coefficient of backroom size variable had negative values in both models, it was statistically significant only in the second one (full regression model), with p = 0.023. So, without interaction terms, we would have concluded that backroom size did not have significant relation with shelf-out-of-stock.

In addition, in full regression model, coded variables and interaction terms also had significant t-tests. Opposite to regression coefficients of coded variables, which were negative, regression coefficients for interaction terms had positive values.

The facts that the increment in the squared multiple correlation (R²) is significantly greater than zero and that the regression coefficients of interaction terms significantly differ from zero, support the thesis that relationship between backroom size and out-of-stock level differs among different store formats. In order to test these relations within each store format, following Whisman and McClelland (2005) we rearranged the equation 3 into:

$$OOS_s = (b_0 + b_2C_1 + b_3C_2) + (b_1 + b_4C_1 + b_5C_2)BS' \quad (4)$$

The obtained equation represents the relationship between OOS_s and BS' , where the term in the first set of brackets ($b_0 + b_2C_1 + b_3C_2$) represents the intercept and the term in the second set of brackets ($b_1 + b_4C_1 + b_5C_2$) represents the regression slope. Bearing in mind that our categorical variable consists of three groups, after substituting the values of the dummy codes, we simplified the equation 4 for each group:

- $OOS_s = b_0 + b_1BS'$, for superettes ($C_1 = 0; C_2 = 0$), (5)

- $OOS_s = (b_0 + b_2) + (b_1 + b_4)BS'$, for supermarkets ($C_1 = 1; C_2 = 0$), (6)

- $OOS_s = (b_0 + b_3) + (b_1 + b_5)BS'$, for hypermarkets ($C_1 = 0; C_2 = 1$), (7)

The equations 5, 6 and 7 are simple regression equations that show the regression of out-of-stock (dependent variable) on the backroom size (continuous predictor) for three different retail formats (signified with code variables). For superettes, the regression coefficient b_1 gives the regression of OOS_s on BS' . For supermarkets the regression of OOS_s on BS' is $(b_1 + b_4)$ and for hypermarkets the regression of OOS_s on BS' is given as $(b_1 + b_5)$.

For the regression of OOS_s on BS' for three retail format groups, b_1 , $(b_1 + b_4)$ and $(b_1 + b_5)$ represent simple slopes, that according to West, Aiken and Krull (1996) are completely comparable to the ANOVA simple effects. On the other hand, b_0 , $(b_0 + b_2)$ and $(b_0 + b_3)$ are intercepts for superette, supermarket and hypermarket groups respectively. After using values of regression unstandardised coefficients presented in table no. 4, we calculated intercepts and simple slopes for all three groups:

- $OOS_s = 0.068 - 0.033BS'$, for superettes, (8)

- $OOS_s = 0.044 + 0.028BS'$, for supermarkets, (9)

- $OOS_s = 0.026 + 0.048BS'$, for hypermarkets. (10)

While there was a negative simple slope (-0.033) for superettes, for other two groups they were positive. Thereby, positive correlation is much stronger in hypermarkets (0.048) than in supermarkets (0.028). In addition, we tested the statistical significances of these slopes. According to Cohen et al. (2003), instead of centred continuous predictor (BS'), we added three variables (BS'_1 for superettes, BS'_2 for supermarkets and BS'_3 for hypermarkets) in the full model (presented in equation 3, representing the backroom size effect for each of the three retail format groups. In them, each group's BS' values were coded on a variable for which all other groups were coded 0. Regression coefficients for these variables reflect the slopes of out-of-stock on backroom size for each retail format group. In table no. 4, we presented the reproduced full regression model.

Table no. 4: Regression coefficients (reproduced model)

Variables	Unstandardized		Stand.	t	Sig.	VIF
	B	Std. E.	Beta			
Intercept	0.068	0.003		19.973	0.000	
C_1	-0.024	0.004	-0.591	-5.405	0.000	1.571
C_2	-0.042	0.005	-1.009	-8.589	0.000	1.813
BS'_1	-0.033	0.014	-0.216	-2.423	0.023	1.046
BS'_2	0.028	0.020	0.124	1.408	0.172	1.014
BS'_3	0.048	0.026	0.181	1.851	0.077	1.260
$R^2 = 0.817$, $p < 0.01$, Durbin-Watson 1.743						

Bearing in mind that negative simple slope for variable BS'_1 (-0.033) is statistically significant with $p < 0.05$, we can confirm that there is a negative relationship between backroom size and out-of-stock level in superettes. On the other hand, simple slope for supermarket group (0.028) is statistically insignificant ($p = 0.172$), while one for hypermarket group (0.048) is statistically significant, but with p value lower than 0.1. Thus, with confidence interval of 92.3% we can confirm that backroom size in hypermarkets is positively related with out-of-stock level. All these relations are presented in figure no. 2.

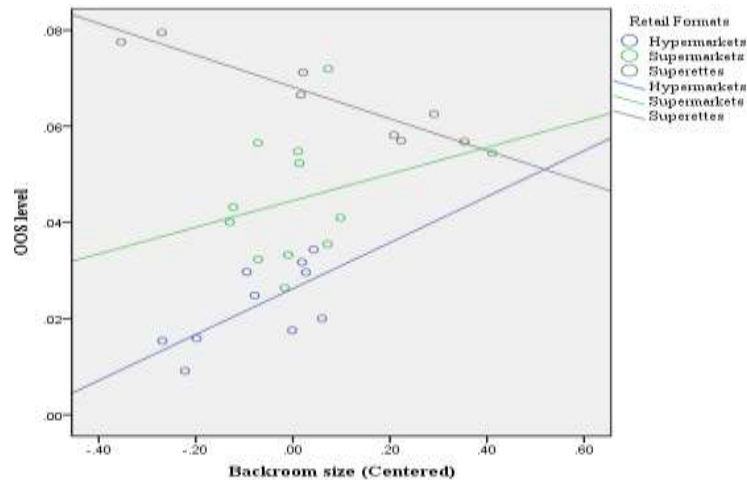


Figure no. 2: Relations between backroom size and OOS level

Unlike large retail formats, possibilities to allocate space and give more facings to both products with high and lower turnover are much smaller in smaller stores (Aastrub and Kotzab, 2009). In addition, according to Ehrental and Stolzle (2013), insufficient shelf place represents one of the major out-of-stock root causes. Bearing in mind that for superettes space is the limited factor, larger backrooms provide certain reliability in ordering and allocation operations, and consequently lower OOS levels.

Contrary, in large retail formats (hypermarkets), characterised by much wider and deeper product range and assortment, and a higher level of inventories, larger backrooms can have a negative impact on product availability. Negative relation between backroom size and product availability was confirmed by Angerer (2005), who conducted the similar empirical research with a major European retailer. The reason to this may occur in poor backroom-to-shelf replenishment process, which is, at the same time, one of the most frequent root causes of stock-outs. According to Gruen and Corsten (2007), overflow goods in larger stores are often randomly assigned in backroom storage area, which negatively affects their visibility. Because inventories have been lost or misplaced, store staff may spend a lot of time searching or may not be even able to find the right product and replenish the shelf (Raman, DeHoratius and Ton, 2001; Eroglu, Williams and Waller, 2011). In addition, most store managers do not pay an adequate attention to the backroom, which usually is not treated as an asset (Gruen and Corsten, 2007).

By solving logistics problems in larger, as well as in smaller stores, retailers can increase business efficiency and provide higher customer service. These tasks are very important,

especially bearing in mind the consequences of the recent global financial and economic crisis, which affected not only the retail sector, but, according to Mencinger, Aristovnik and Verbič (2014), whole economies by moving them into debt traps.

4. Implications – Operational and Technological Solutions

Analysing the impact of backroom size on out-of-stock at the store level, we pointed to the existence of problems related to ordering and replenishing processes. For their minimizing, several operational and technological solutions can be used for smaller (superettes) and larger retail formats (hypermarkets).

The lack of backroom space in smaller stores forces retailers to organize frequent deliveries. Consequently, in order to increase their product availability, they need to synchronize information and product flows between stores, distribution centres and suppliers. In this regard, retailers, usually in cooperation with their suppliers, can implement sophisticated information and ordering systems. Therefore, besides customers, they focus their marketing activities on the relationship with suppliers as well (Dumitru and Căescu, 2013)

Aiming to enhance the efficiency of ordering and replenishment processes, Tesco developed the Tesco Information Exchange system (TIE), based on EPOS and internet technologies (Harrison and van Hoek, 2008). Its implementation enabled automated information flow between the retailer (including stores and distribution centres) and suppliers, creating a precondition for implementing the Vendor Managed Inventory (VMI) system. Thus, suppliers can use the TIE extranet to directly monitor sales and inventory levels of their products both in distribution centres and in retail stores. The ordering system itself is also automated where the optimum order quantity and reorder point are established for each product in the store. If store inventory drops under the foreseen level, the order is automatically forwarded to the distribution centre, in which the same method is used for ordering goods from the supplier. By direct inclusion of suppliers in the ordering process and automation of most operations, store deliveries have become more synchronised with the retailer's real needs, which later on contributed to reduced inventory costs and increasing product availability.

That the implementation of collaborative ordering system contributes to reducing out-of-stocks was also shown by the results of a study by Pramateri and Miliotis (2008). In the field experiment that included a major retailer and several suppliers in Greece, they tested the use of automatic ordering and replenishment process, supported by daily information sharing over an internet platform. After conducting pre- and post- measurements, results have shown the reduction in out-of-stocks by more than 50%.

Higher on-shelf availability level can also be achieved by the cooperation between retailers and their suppliers in planning and forecasting activities. Cooperation at this level gains special significance bearing in mind that forecasting inaccuracy is one of the main root causes of OOS situations. Thereby, with the implementation of Collaborative Planning Forecasting and Replenishment (CPFR) model, besides retailers, manufacturers (suppliers) would also be included in sharing and synchronizing their plans and forecasts. As a result, the forecasting, production and replenishment cycle would become ever closer to the actual demand, i. e. customers (Fernie and Sparks, 2009).

Unlike smaller retail formats, hypermarkets with larger backroom storage spaces, additionally burdened by high inventory levels, are faced with higher out-of-stock rates. In order to diminish the complexity and confusion caused by increasing inventory levels, Ton and Raman (2010) suggested the reduction of storage areas. In this regard, store operations should be organized at the principles of “one-touch replenishment” policies (Cooper, Browne and Peters, 1994) or following the model of lean production system (Ton and Raman, 2010).

However, because of many advantages of backroom area (notably reflected in reduced uncertainty) instead of its reduction, retailers should dedicate more attention to organizing backroom-to-shelf processes. Among them, emphasizes should be placed on shelf replenishment and inventory monitoring operations.

In order to ensure their greater efficiency, according to ECR UK (2007) backroom storage areas should be divided into departments, sections and lines, where fast moving and promotion lines should be kept near to the shop floor. Retailers should also monitor shelf and backroom stocks, keeping the records on a daily basis. For this, besides periodical checks of store staff, they can use various technological solutions.

For efficient shelf stocks tracking, Smart Shelf system, based on Radio Frequency Identification (RFID) technology, can be used. According to Newave Sensors Solutions (2013), with the implementation of this system retailers can reduce out-of-stocks, increase order accuracy and improve shelf-space utilization. Smart Shelves are equipped with sensors that can detect every product movement. If an item leaves the shelf, this data is transmitted wirelessly to the Smart Shelf controller. After the level of shelf inventory lowers to its determined limit, store personnel will be alerted via text message, email or public address system, while the video of the shelf area will be recorded (Newave Sensors Solutions, 2013).

However, bearing in mind that Smart Shelf system can only be used for monitoring shelf, and not backroom stocks, RFID technology can also be used in the context of in-store processes (Szmerekovsky, Tilson and Zhang, 2011). Radio waves enable automated monitoring of products with incorporated RFID tags from the backroom area to the shelves. According to Condea, Thiesse and Fleisch, compared to traditional backroom-to-shelf replenishment process based on periodic inspections of product availability, the RFID-enabled redesign of in-store processes can increase operation efficiency in terms of total cost and service levels (2012, p. 847). Thereby, besides expensive, the RFID tagging of cheap products (i.e., those that cost less than an RFID tag) can also generate significant benefits to the retailer as well (Piramuthu, Wochner and Grunow, 2014).

Hardgrave, Waller and Miller (2006) in a pilot project at Wall-Mart analysed the implementation of RFID technology in the replenishment process. In 12 stores, more than 4.500 products were tagged and monitored between the backroom area and the shelf. After 8 months, their average stock-out rate was 16% lower compared to another control group of 12 stores.

Besides RFID technology, for more efficient backroom operations retailers can implement pick-to-light (PTL) and pick-to-voice (PTV) systems. The PTL systems utilize visible lights (numeric or alphanumeric displays) located directly on the storage slot to indicate which and how many items need to be picked (Dematic, 2014). On the other hand, with the use of

PTV systems, replenishment and picking operations are directed by voice instructions, where employees use headsets and portable belt-fitted devices (Swisslog, 2013).

In addition to operational and technological solutions, higher efficiency of in-store logistics activities and consequently lower out-of-stocks can be achieved by improving people engagement. Bearing in mind that “store stockers” usually do not have a system for shelf replenishment and that they often would not bother searching items in large and crowded backrooms (Gruen and Corsten, 2007), in order to increase product availability, retailers can implement different learning, motivation, communication and career models (ECR UK, 2007).

Conclusions

Bearing in mind higher customer expectations, retailers are trying to minimize their purchasing efforts and provide an adequate level of on-shelf availability. On contrary, the occurrence of an out-of-stock situation would not only affect customers, but retailers and their suppliers as well. Therefore, this problem was analysed from many aspects.

Besides presenting main OOS causes, in our research we have analysed the effect of backroom size on product availability. To our knowledge, we are the first one who investigated this relation among different retail formats. While in superettes, with the increase of backroom size, out-of-stock on a store level decreases, in hypermarkets the opposite trend has been observed, with the increase of backroom size, out-of-stock increases as well. Therefore, these results opened several issues concerning smaller and larger stores.

In superettes, problems concerning limited backroom space and smaller shelf allocation possibilities could be mitigated by better synchronization of information and product flows between stores, distribution centres and suppliers. This can be achieved by the implementation of sophisticated information and ordering systems, based on close cooperation between business partners. In addition, their cooperation can be extended on planning, forecasting and marketing activities, by applying CPFR model.

On the other hand, in hypermarkets with larger backrooms, problems related to poor backroom to shelf replenishment process occur. Consequently, special attention should be dedicated to shelf replenishment and inventory monitoring operations. Shelf and backroom stocks should be monitored on a daily basis, and all in-store activities should be organized at the principles of “one-touch replenishment” policies. In this regard, retailers can use different technological solutions as RFID, smart shelves, pick-to-light and pick-to-voice systems.

Bearing in mind that most in-store processes are labour intensive activities, future researches could include some human factors (e.g. work intensity and store manager experience) as well. Consequently, the limitation of the paper could be overcome by extending our research model.

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