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IT Support for the Goods Reallocation Process in Textiles-Based Fashion Retail

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Abstract
The process of moving goods from locations with the weakest rotation to those with high rotation in order to speed up the process of disposing of inventory in the entire retail network can be described as an assignment of goods. This process is particularly important in the textiles – based fashion industry, where external purchases for the retail network are often made once and the goods have shallow stocks. In order to optimise the stream of materials, the use of an integrated IT system is essential. Therefore, the main purpose of this publication is to show how IT solutions can be used to simplify the automation and optimisation of the process of generating proposals for goods reallocation within the retail network. The study covered selected companies from the textiles-based fashion industry.

Key words: *textiles-based fashion industry, retail, goods assignments, goods transfers.*

Introduction

Managing a modern company is an extremely complex process, with textiles-based fashion retail being one of the most. These companies are under constant pressure from changes in the environment and the delivery time. In the past, there were two seasons in the fashion industry: spring-summer and autumn-winter. In the 1980's, the American textile-based fashion industry applied the Quick Response concept, which led to the fading of the seasonal borders in the creation of collections [19]. This was the basis for the strategy that has been called *Fast Fashion*. The main idea behind it were short collections of clothes and accessories, which allowed for more frequent introduction of newer models. This article focuses on distribution and logistics issues. The introduction of Fast Fashion involves building a more complex distribution chain, as new collections are introduced in small batches, while at the same time increasing the number of deliveries [10]. These factors must be taken into account when efficiently controlling the stream of materials, which can be a challenge. This is not only due to the size and diversity of the streams of goods (such as materials, parts, semi-finished products, finished products, etc.), but also to the corresponding information streams [13]. These streams cross and complete each other. In order to control them as optimally as possible, i.e., to make various decisions (for example. which material to order, when, where and in what quantity), it is necessary to use various information and process it according to different algorithms [22].

Storing and analysing large amounts of data characterised by great diversity and complexity requires an adequate infrastructure [5]. Current market trends are forcing companies to use and improve integrated IT systems. thereby ensuring the correct functionality of the company. From this type of modern software, users require several basic features, which include: integrity, comprehensiveness, user-friendliness, uninterrupted data exchange and additional availability in the cloud [17]. These features are essential in order to obtain a competitive advantage, maintain the desired level of customer service, as well as to reduce the costs of business activity [20].

Organisations operating in the textile industry must fully adapt to the needs of customers, who have specific requirements regarding quality, as well as the way and time of purchase. This is due to, for example, the rapid aging of the product and its specificity [6]. It should also be noted that, with the current level of competition and constantly increasing customer requirements, action at company level is no longer sufficient. Close cooperation throughout the supply chain is becoming necessary to reduce time wastage as well as the costs associated with over-storage [21]. Today, many scientific methods of material stream control are in use which, together with the development of IT facilities, can bring measurable benefits for all participants in the supply chain. The portfolio of the largest IT companies such as Comarch, SAP and Oracle includes software supporting both logistic and financial processes.

Therefore, the main purpose of this publication is to show how IT solutions can be used to facilitate the automation and optimisation of the process of generating proposals for goods reallocation within the retail network. The study covered selected companies from the textile industry. An integral part of the research is to control the material streams, which are also presented in the paper.

Stock management in the textiles-based fashion industry

By definition, stock should be understood as the total quantity of goods in an organisation (enterprise or supply chain) which is not currently used but is intended for further processing or sale [16]. These goods have a precise location and can be expressed in terms of quantity or value.

Proper control of inventory stream processes in an organisation requires making many decisions and analysis of problems related to their structure. The main tasks related to inventory control include optimal structuring of rotating stock, determination of protective stock, as well as elimination of excessive stock. There are several important issues in stock management, namely the selection of stock items to be maintained, determination of the size of an order or production batch, determination of order placement and delivery times, and the choice of a system to control stock levels [14].

It might look like the textiles-based fashion industry does not require special logistical solutions because it deals with non-perishable goods. However, the demand for textiles appears to be fluctuating and difficult to predict, and the industry's business is, to a high degree, determined by the decisions taken by customers.

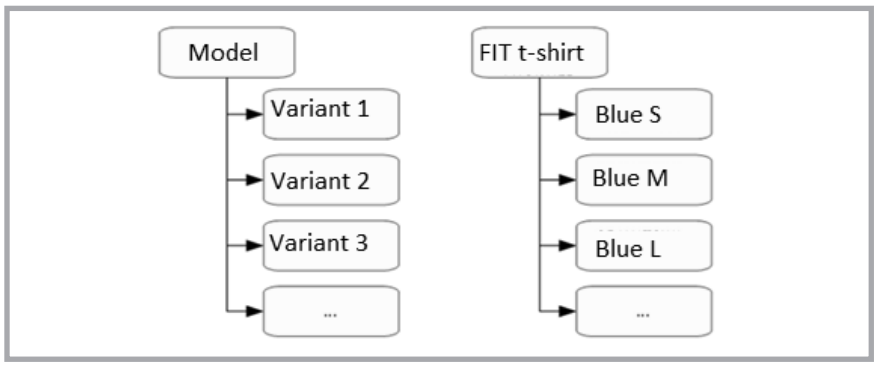

Figure 1. *Structure of goods data, divided into models and variants.* ***Source:*** *own research.*

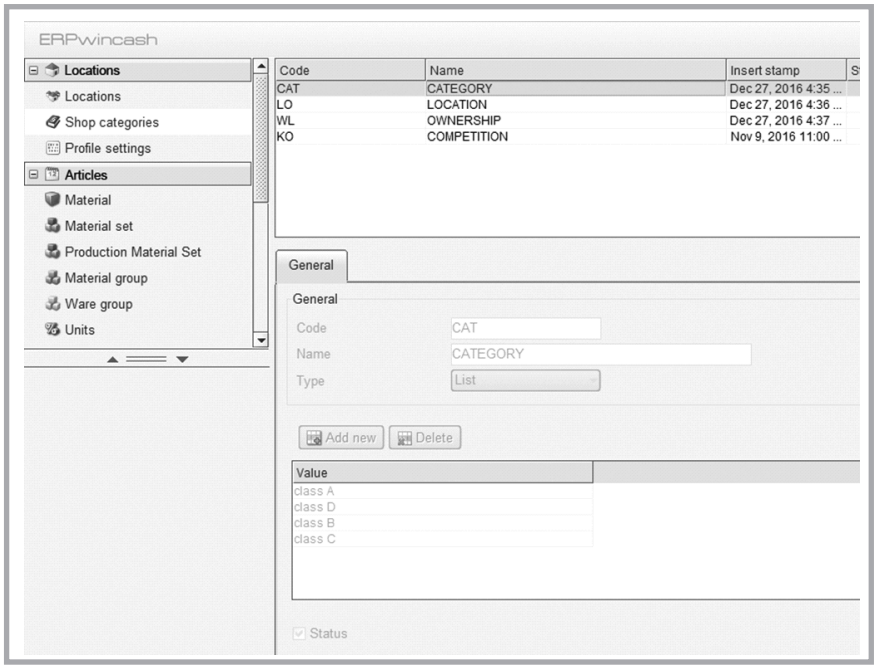

Figure 2. *Assignment of categories.* ***Source:*** *own research.*

It should be noted that consumer behaviour continuously evaluates [18, 1]. Over time, customers expect more diversified offers in terms of colours, cuts and design. In addition, the difficult task of market research concerns the adjustment of offers both in terms of prices and assortment according to the needs of the population of a given region. Global company activities should be flexibly adjusted to local needs [2]. Differences may occur between large agglomerations and the surrounding area, or even rural areas. Retail networks focus their attention mainly on large cities, where universities and most high schools are located, and where a significant percentage of the population works. These people have a higher need to buy clothing, which means they have a higher frequency of purchases of this type of goods [4].

Another issue to be addressed is the complex system of the supply chain that is typical of this sector. The specificity of the textile industry means that clothing production takes place in different countries and factories. Introducing a new product on the market involves activities such as design, selection of the manufacturer, selection and purchase of materials, and the creation of specifications and samples. In addition, the clothing industry is characterised by a short product life cycle, associated with seasonality and fashion trends. Although there are repetitive collections (referring to classic trends), there are usually changes in design, colour or size.

Commercial companies in the national and global economy need to master how to evaluate their opportunities and threats. Each company should closely monitor its surroundings, draw conclusions and take decisions relating to the centralisation or decentralisation of the supply chain [12]. The ability to work together throughout the supply chain leads to good reputation and business success. It is difficult for an individual company to survive on the market without constant proper relations with the environment in which the relationship is interdependent. In the case of a retail chain, the short product life cycle forces numerous movements between individual points of sale. Goods assignment is the process of moving goods from the least rotating locations to those with high rotation, the aim of which being to better tailor the product range to the local customer. In addition, this process accelerates stock run-off across the entire retail network, reducing the amount of post-seasonal returns. It is also often the case that damaged products are returned that were sent back in the complaint process [23]. This is why the harmonisation of streams between individual cells is complicated. In such a case, it is advisable to run professional IT systems which provide the possibility of solving all logistical difficulties and allow the implementation of complex business tasks.

Optymalisation of goods transfers within textiles--based fashion retail

The aim of the research was to determine the parameters that can be used in an algorithm supporting the automation of the allocation process as well as to determine the algorithm itself. In the company surveyed, an IT solution was used which significantly facilitates the automation and optimisation of the process of generating proposals for goods reallocation within the whole retail network. In order to prepare the assignment of goods, the dictionary of the goods was supplemented with several additional parameters, such as the minimum, recommended and optimal stock levels – separately for the model and for each variant – including seasonality. The availability of goods within a specific shop category was also determined (***Figure 1***).

In this context, a correct categorisation of the retail network seems extremely important. This allows the network to be divided into one or more dynamic and time – varying categories according to priority, location, store size, ownership and other parameters. For individual stores, secondary parameters have also been defined, such as the volume of goods per square metre or capacity (***Figure 2***).

The system collects operational data that can be used in the process of preparing the

assignment of goods. The most important of them are the current stock (separate for the model and variant), the current quantity of ordered goods, current reservations on a given index (e.g., for the online store), the current level of goods on the way, sales turnover in a given period (period entered manually by users or as a parameter in the case of automation of the shifting process), stock turnover in a selected period (with the possibility to configure which warehouse documents are taken into account in calculations), average sales per day, and seasonality. On the basis of these parameters, it is possible to prepare proposals for moving goods within selected stores of the retail network. In the first step, several indexes can be chosen for initial analysis of rotation, with the possibility of indicating both the product range to be analysed and the entire product groups (***Figure 3***).

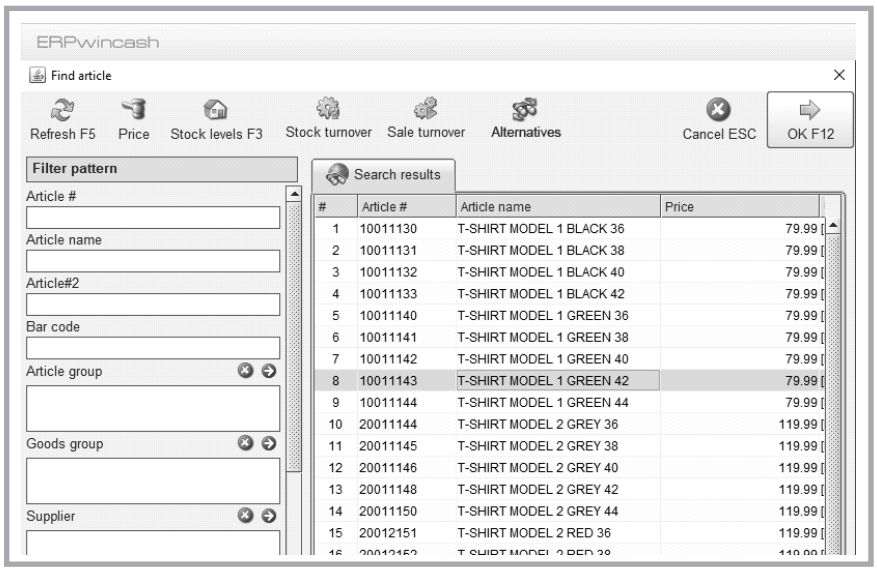

Figure 3. *Selection of goods for initial analysis.* ***Source:*** *own research.*

The items selected and their groups can be displayed in the form of a table, where the user additionally enters the time period for which the average sales will be calculated. After selecting the time interval, the process of initial analysis of the selected assortment in relation to the turnover in this interval is started. The result of the initial analysis of the goods selected in the retail network will be a list of products in the form of a table containing basic details about the article and the model. The table contains the following data:

- article number (model),
- article name,
- total amount of goods in the network,
- stock of the central warehouse,
- stock of the online store,
- average sales in the retail chain per day,
- average sales in the central office and online store,
- expected time to complete sale (***Figure 4***).

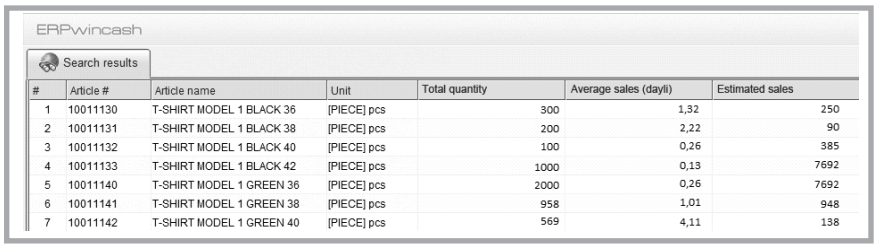

Figure 4. *List of products determined on the basis of an initial analysis.* ***Source:*** *own research.*

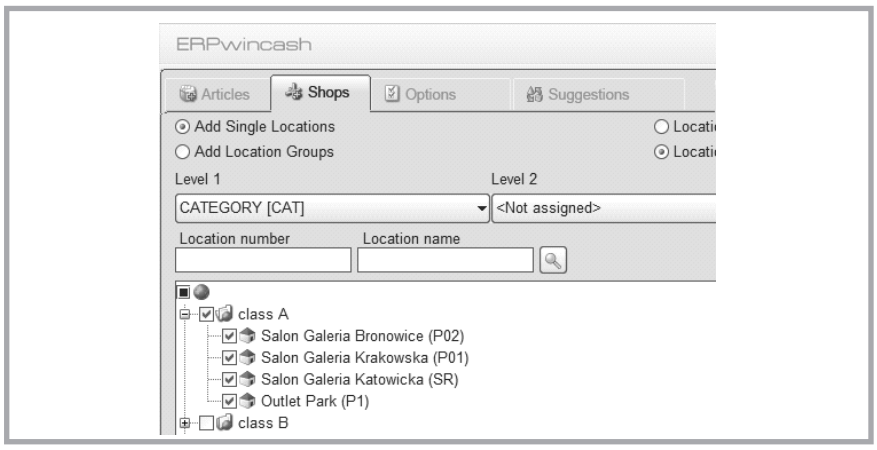

Figure 5. *Choice of shops.* ***Source:*** *own research.*

In the next step, it is possible to select products that will be included in the analysis of commodity assignments. The user can also select shops, which will be taken into account in the process of generating proposals for moving the previously selected assortment. In order to improve the process, shops can be presented by location or category (***Figure 5***).

Once the selection has been approved, the system generates an order proposal based on the assortment selected and location list, and it is possible to define if the goods are to be taken first from the central warehouse or from shops with a low turnover. The process of generating transfer proposals will analyse each item selected in the previous step (variants belonging to the model, e.g., size). The principle of its operation will be presented in an example of one article, which will be analysed by the system for eight shops. Parameters used and calculated by the system in the example calculation are as follows:

- Shop stock – current stock, including deliveries, orders, reservations, etc.
- Sales volume – sales turnover in a given period – here it is possible to use the period set in the first step or another system parameter (in the example, a period of 14 days was analysed).
- Average sales per day in the store for the period analysed.
- Days to sell – a value indicating how many days it takes to sell the current stock, taking into account the average sales per day in a given period and store.
- Average number of days to sell in the chain of selected stores.

Table 1. *First iteration.*

POS#	Sold	Average sales/day	Days to sell	Aberrance	Potential to give/take	Plus/ minus	Stock before	Stock aftur	MAX
S1	17.00	1.21	12.35	22.43	27	0.00	15.00	15.00	60.00
S2	12.00	0.86	23.33	11.45	9	0.00	20.00	20.00	60.00
S3	4.00	0.29	122.50	-87.72	-25	-25.00	35.00	10.00	60.00
S4	35.00	2.50	16.00	18.78	46	0.00	40.00	40.00	60.00
S5	65.00	4.64	5.38	29.40	136	25.00	25.00	50.00	60.00
S6	11.00	0.79	31.82	2.96	2	0.00	25.00	25.00	60.00
S7	38.00	2.71	21.37	13.41	36	0.00	58.00	58.00	70.00
S8	4.00	0.29	45.50	-10.72	-3	0.00	13.00	13.00	60.00

Table 2. *Second iteration.*

POS#	Sold	AV sale/day	Days to sell	Aberrance	To give/take	Plus/ minus	START Quantity	END Quantity	MAX
S1	17.00	1.21	12.35	12.16	14	0.00	15.00	15.00	60.00
S2	12.00	0.86	23.33	1.18	1	0.00	20.00	20.00	60.00
S3	4.00	0.29	35.00	-10.48	-2	0.00	10.00	10.00	60.00
S4	35.00	2.50	16.00	8.52	21	0.00	40.00	40.00	60.00
S5	65.00	4.64	10.77	13.75	63	5.00	50.00	55.00	60.00
S6	11.00	0.79	31.82	-7.30	-5	0.00	25.00	25.00	60.00
S7	38.00	2.71	21.37	3.15	8	0.00	58.00	58.00	70.00
S8	4.00	0.29	45.50	-20.98	-5	-5.00	13.00	8.00	60.00

Table 3. *Last iteration.*

POS#	Sold	AV sale/day	Days to sell	Aberrance	To give/take	Plus/ minus	START Quantity	END Quantity	MAX
S1	17.00	1.21	18.94	1.24	1	0.00	23.00	23.00	60.00
S2	12.00	0.86	21.00	-0.82	0	0.00	18.00	18.00	60.00
S3	4.00	0.29	21.00	-0.82	0	0.00	6.00	6.00	60.00
S4	35.00	2.50	17.60	2.58	6	3.00	44.00	47.00	60.00
S6	11.00	0.79	20.36	-0.18	0	0.00	16.00	16.00	60.00
S7	38.00	2.71	21.37	-1.19	-3	-3.00	58.00	55.00	70.00
S8	4.00	0.29	21.00	-0.82	0	0.00	6.00	6.00	60.00

Table 4. *Proposals for transfers.*

Iteration	Order to	Order from	Quantity	Recipient stock before	Recipient stock after	Recipient stock MAX
4	S1	S6	8.00	15.00	23.00	60.00
6	S4	S3	1.00	40.00	41.00	60.00
7	S4	S2	2.00	41.00	43.00	60.00
8	S4	S6	1.00	43.00	44.00	60.00
9	S4	S7	3.00	44.00	47.00	70.00
1.3	S5	S3	28.00	25.00	48.00	60.00
2.5	S5	S8	7.00	48.00	60.00	60.00

- Aberration – in days to average the selling time in the whole retail chain.
- To be given/taken away – value specifying how many units of a given assortment a store should receive or give away in order to optimise sales. A negative value means that the store should return the goods, while a positive one means that the store can receive the goods.
- MAX – maximum level of the shop's warehouse for goods.

The initial state of the article and eight shops taken for analysis is presented in the table below. Initial values were calculated for all parameters required in the estimation, and the average number of days to sell the goods for the whole group examined is 35. It should be noted that the best store should sell the goods in five days, while the worst one will need over 122 days (***Table 1***).

The process of calculating the quantity and indicating the stores for transfers takes place in two steps:

- selection of the shop with the greatest negative aberration (donor, in our case shop S3) and the greatest positive aberration (recipient, in our case shop S5),
- check if the amount available in the donor's shop is less than or equal to the amount expected by the recipient and if the maximum amount will not be exceeded after the transfer. If the condition is fulfilled, the system saves the proposal of transfer and corrects the quantities to be given and received. If the condition is not met, the quantity taken from the donor is adjusted to the maximum quantity that can be accepted by the recipient resulting from the MAX parameter.

In the case analysed, the S3 shop can offer 25 items, while the S5 shop can theoretically accept 136 items (without considering the maximum levels; if they are taken into account, the maximum number of items will be 35). The first transfer will, therefore, take place from the S3 store (donor) to the S5 store (recipient) with a quantity of 25 items. In the new situation, the best store should sell the goods within 10 days, while the worst one will need 45 days, and the average number of days to sell the goods for the whole group surveyed drops to 24 (***Table 2***).

It is important to note that all parameters are recalculated after each movement. If a specific shop reaches the maximum stock level allowed, it will be excluded from further analysis, as is the case for the S5 shop, which in the fifth iteration reaches the amount corresponding to the assumed MAX parameter. The operation is repeated until the list of donors or recipients is exhausted. In the example, after nine iterations, the best store should sell the goods in 17 days, while the worst one will need only 21 days, and the average number of days to sell the goods for the whole group surveyed will be 20 (***Table 3***).

Cyclical recalculation will be terminated if the amount to be transferred in donors or recipients is less than one. In the example presented, the average time of sale of goods in the network has been optimised to 20 days, and the discrepancy between the worst and best store has been reduced from 117 days to 4 days. After the calculation of transfers for stores selected as donors is completed, the condition of left-over merchandise will be verified in relation to the recommended level for the model. If the quantity of the left-over goods is less than the recommended minimum, the whole model stock is added to

the largest planned transfer for this model (***Table 4***).

After completing the process of generating transfer proposals, the system presents the results together with the effects generated by other algorithms in tabular form, with the header containing information about the donor and recipient, while the bottom table presents the items proposed for transfer between a selected pair of stores. While browsing the list of transfers proposed, the user can correct each item in terms of the quantity, removal or addition of items to be transferred, as well as resign from the entire movement between the stores selected.

After analysing the list of transfer proposals and making the required corrections, the user can approve the modified list. After approval, the system triggers a procedure that converts the proposed movements into real transfers between locations. The creation of such transfers will have a direct impact on the preparation of proposals for orders for the same set of goods and locations in the future, as it will update the number of active orders. If the transfer proposal is, in the user's opinion, too large to be realised, the system will allow splitting to be performed. The user can also view and print the orders generated.

Conclusions

The article describes software and its application for planning the distribution of textile products in the textile-based fashion industry, where the fast fashion system is implemented. With a market worth about USD 10-12 billion, Poland currently ranks in the first tenth among EU countries and in the third tenth among all countries of the world. The textile industry is rapidly transforming into fast fashion, which results in up to eight collections per year. By adding countless colours, patterns and expanded size grids, we get a very large number of highly rotating goods with a very short life cycle. According to the PMR report, Polish textile retail will reach 43.2 billion PLN in 2022 [8].

For this reason, it seems to be fundamental to trace stock levels throughout the whole retail network and to introduce a system to optimise stocks. One of the most important synchronisation principles is that all elements of the chain act as a whole [3]. Companies operating in the textiles-based fashion industry should adapt their business models to the current market conditions, with particular attention to the needs indicated by local customers [15]. This involves constant monitoring of their needs and quick response to any changes in these requirements [1]. Manufacturers and service providers are spending more and more time exploring information about buyers and their shopping preferences [19]. In order to continuously increase customer satisfaction, companies implement a number of logistics, marketing and quality-related solutions, whose aim is to provide businesses with a higher level of service [11]. The implementation and use of modern IT systems in companies is an essential solution for solving all logistics tasks and problems within the entire supply chain.

Figure 6. *Presentation of algorithm results.* ***Source:*** *own research.*

References

1. Chen J, Reilly R R, Lynn G S. New Product Development Speed: too much of a Good Thing? *Journal of Product Innovation Management* 2012, 29(2): 288-303.
2. Chiou J S, Droge C, Hanvanich S. Does Customer Knowledge Affect how Loyalty is Formed? *Journal of Service Research* 2002, 5(2): 113-124.
3. Christopher M. Logistics and Supply Chain Management, Creating Value-Adding Networks. Pearson Education Limited, London 2005: 187.
4. Figler M. Jak branża odzieżowa dostosowuje się do warunków koniunktury gospodarczej w Polsce. *Roczniki Ekonomiczne Kujawsko-Pomorskiej Szkoły Wyższej w Bydgoszczy* 2015, 8: 422-434.
5. Hofmann E, Rüsch M. Industry 4.0 and the Current Status as well as Future Prospects on Logistics. *Computers in Industry* 2017; 89: 23-34.
6. Huang H, Liu Q. An Intelligent Retail Forecasting System for New Clothing Products Considering Stock-out. *FIBRES & TEXTILES in Eastern Europe* 2017, 25, 1(121): 10-16.
7. Jung J H, Yoo J J. Customer-To-Customer Interactions on Customer Citizenship Behaviour. *Service Business* 2017; 11(1): 117-139.
8. Kołata D. Pełna paleta usług to już niemal konieczność. *TSL Biznes* 2018; 2(88): 6-10.
9. Kruczek M. Modele struktur łańcuchów dostaw przemysłu odzieżowego – publikacja na stronie internetowej http://www.ue.katowice.pl/images/user/File/katedra_ekonomii, data 01.12.2011.
10. Macchion LA, Moretto F, Caniato M, Caridi Danese P, Vinelli A. Production and Supply Network Strategies within the Fashion Industry. *Int. J. Prod. Econ*. 2015; 163: 173-188.
11. Malindžák D. The Basic Principle of Logistic Theory. *Applied Mechanics and Materials* 2015, 708: 47-52.
12. Marian Al. Some aspects of Supply Chain Risk Management Global Risks Map and Apple's Approach to Risk Management. *Quality-Access to Success* 2017, 18(160): 64-67.
13. Mishra S, Modi S B, Animesh A. The Relationship between Information Technology Capability, Inventory Efficiency and Shareholder Wealth: A Firm-Level Empirical Analysis. *Journal of Operations Management* 2013; 31(6): 298-312.
14. Pisz I, Sęk T, Zielecki W. *Logistyka w przedsiębiorstwie*, PWE 2013: 80- 81.
15. Santouridis I, Veraki A. Customer Relationship Management and Customer Satisfaction: the Mediating Role of Relationship Quality. *Total Quality Management & Business Excellence* 2017: 1-12.
16. *Słownik terminologii logistycznej*, Fertsch M. (red.), Instytut Logistyki i Magazynowania, Poznań, 2006.
17. Vaidya S. Industry 4.0 – A Glimpse. *Procedia Manufacturing* 2018, 20: 233-238.
18. Wolniak R. The Assessment of Significance of Benefits Gained from the Improvement of Quality Management Systems in Polish Organizations. *Quality & Quantity* 2013, 41(1): 515-528.
19. Yang D, Qi E, Li Y. Quick response and supply chain structure with strategic consumers, *Omega* 2015; 52: 1-14.
20. Zhong RY, et al., Intelligent manufacturing in the context of industry 4.0: *Engineering* 2017; 3(5): 616-630.
21. Zimon D, Malindžák D. Impact of Implementation of Standardized Quality Management Systems on the Functioning of Organizations in the Textile Industry. FIBRES & TEXTILES in Eastern Europe 2017; 25, 6(126): 19-24. DOI: 10.5604/01.3001.0010.5362.
22. Zimon D, Domingues P. Proposal of a Concept for Improving the Sustainable Management of Supply Chains in the Textile Industry. FIBRES & TEXTILES in Eastern Europe 2018; 26, 2(128): 8-12. DOI: 10.5604/01.3001.0011.5732.
23. Żabicki D. Odzieżowe wymagania. *TSL Biznes* 2012; 2: 17.

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