LogForum

> Scientific Journal of Logistics <

2018, 14 (3), 315-329

http://dx.doi.org/10.17270/J.LOG.2018.283

http://www.logforum.net p-ISSN 1895-2038 e-ISSN 1734-459X

ORIGINAL PAPER

EXCLUSIONARY CONSTRAINTS IN STORAGE: AN EMPIRICAL STUDY OF LOGISTICS SERVICE PROVIDERS

Arkadiusz Kawa, Marcin Anholcer

Poznan University of Economics and Business, Poznań, **Poland**

ABSTRACT. **Background:** Logistics service providers store very different products which can interact with each other, e.g. in a chemical or physical way. In addition, some manufacturers require logistic companies not to store their products together with competing products. We are therefore faced with exclusionary constraints, thus with the circumstances or conditions under which at least two commodities cannot be stocked in the same warehousing place. In literature, there are no studies on exclusionary constraints in storage, especially findings of empirical research. That is why the main purpose of this paper is to identify and asses the frequency and importance of exclusionary constraints in storage by logistics service providers.
Methods: We have scrutinized a random sample of 300 logistics services providers in Poland in order to capture the managers' assessment of exclusionary constraints, especially their frequency and importance for the activity of the firms.
Results: Our research showed that the approach to the exclusionary constraints in storage is various for the managers of the logistics enterprises. We discovered the correlation between the importance and frequency of exclusionary constraints in storage. The more important a specific exclusionary constraint is, the more often it occurs. The most important and frequent exclusionary constraint for the surveyed enterprises is sensitivity for storage temperature. This study contributes to the theories and practices of logistics enterprises.
Conclusions: This study extends earlier research on exclusionary constraints in logistics, which but do not analyze the real life data. In the future work we will use the results of the quantitative research to develop mathematical models of the storage problems based on the determined exclusionary constraints.

Key words: exclusionary constraints, storage, logistics service providers.

INTRODUCTION

Logistics is undoubtedly an important area of activity for a present-day enterprise.

Apart from supporting the processes of planning, organizing and monitoring the flow of goods and information about them, it fulfils the function of integrating the separate business entities. Due to growing requirements of customers and changing trends related to serving them, logistic processes are becoming more and more complicated and difficult to be completed by a single organization [Pfohl, Müller 2015]. This is particularly noticeable when enterprises produce and sell their products in different places in the world. Most of them do not have appropriate resources or competences, which would facilitate comprehensive logistics service of the customers. Therefore, more and more frequently, managers use external entities specializing in logistics. These entities create a logistics services industry.

Only about a dozen years ago, the tasks of logistics enterprises mainly came down to providing simple services consisting in transporting things from one place to another and in storing them. With time, the scope of their competences has widened and begun to include additional actions, often beyond the primary area of logistics [Cagliano et al. 2017].

Copyright: Wyższa Szkoła Logistyki, Poznań, Polska

Citation: *Kawa A., Anholcer M., 2018. Exclusionary constraints in storage: an empirical study of logistics service providers. LogForum 14 (3), 315-329, http://dx.doi.org/10.17270/J.LOG.2018.283*
Received: 04.03.18, Accepted: 23.05.2018, on-line: 28.06.2018.

Examples may be: product assembly at the customer's premises; cash-on-delivery services; refreshing, repairing or even disposing of products; issuing sales documents on behalf of the consignor; handling returned goods.

Most of these tasks are carried out in the context of storage activities. Over recent years, storage has become one of the key logistics management processes [Lam et al. 2015]. It is needed by businesses to ensure both continuity of sales and storage of products that have not yet found a customer. Generally speaking, storage is a set of activities related to stockpile management or organization of the flow of goods. Products in warehouses are at a relative rest phase because, from the logistical point of view, warehousing is an undesirable interruption in the flow of these products.

In logistics, storage has several essential functions, among which one can mention coordination of supply and demand, required in the case of their significant market fluctuations; the possibility to reduce transport costs by decreasing the frequency of deliveries and at the same time increasing their volume; supporting production processes by ensuring continuity of supply with the necessary raw materials and packaging, as well as ongoing collection of finished products, enrichment of the marketing processes by accumulating the stocks necessary to create sets used in promotional campaigns [Caridade et al. 2017, Gu at el. 2007, Sharif et al. 2016].

Manufacturing, commercial or distribution companies may have their own storage facilities in which they keep stocks. However, this solution requires significant capital and is not flexible in the event of strong fluctuations in demand or a dynamic growth of the company. It can then be more convenient and cheaper to outsource storage operations to a specialist logistics service provider [Kawa 2017]. This is an increasingly common solution. Currently, out of over 13 million sq. meters of warehouse space in Poland, 45% belongs to logistics service providers. According to analysts, Poland's industrial stock rises by 18% year-on-year [Wykrota 2017]. The amount of available warehouse space used by logistics service providers will therefore increase in the near future.

Logistics companies serve many customers from various industries. They store very different products, which can interact with each other, e.g. in a chemical or physical way. In addition, some manufacturers require logistic companies not to store their products together with competing products. We are therefore faced with exclusionary constraints. In literature, there are no studies on exclusionary constraints in storage, especially findings of empirical research.

The purpose of this paper is to identify and asses the frequency and importance of exclusionary constraints in storage by logistics service providers. Our study presents the results of research on exclusionary constraints in storage, which was carried out on a representative sample of 300 logistics companies in Poland. The results of this research, especially the identified importance and frequency of the exclusionary constraints, will be used as a basis to develop the mathematical models of the storage problems existing in reality.

EXCLUSIONARY CONSTRAINTS

Exclusionary constraints in storage are the circumstances or conditions under which at least two commodities cannot be stocked in the same warehousing place. They may be caused by the features of those commodities, in particular their physical and chemical characteristics. Other reasons are the legal issues, mutual agreements and other requirements imposed for example because of the rules of competition.

As aforementioned there is no research on exclusionary constraints in storage. We can base on some experience from the transportation science in which there are several works on transportation problem with exclusionary side constraints [Vancroonenburg et al. 2014, Zachariadis et al. 2017]. The transportation [and, more generally, network] problems with linear side constraints were considered in [Palomo-Martínez et al. 2017]. It

seems that the transportation problem with nonlinear exclusionary side constraints appeared for the first time in [Cao 1992]. Unfortunately, none of this work has considered the minimization of the transportation costs in the networks, which structure is close to the real-life networks and exclusionary constraints are present [Anholcer and Kawa 2015, Ataka, Gen 2008, Cyplik, Hadas, Fertsch M 2009].

In order to distinguish the exclusionary constraints in storage we conducted research with the use of secondary sources. On the basis of scientific papers, industry materials, market reports, we have identified exclusionary constraints that were subject to primary research [Goossens, Spieksma 2009]. We verified them during several individual interviews with managers of logistics service providers having warehouses. Thanks to that we might distinguish at least over a dozen of common reasons that may cause the exclusions. The most frequent are:

- Sensitivity for duration of storage [Firoozi et al. 2013],
- Sensitivity for storage conditions [Tolesa et al. 2017],
- Sensitivity for storage temperature [Lam et al. 2013],
- Sensitivity for humidity [Brenner et al. 2014; Lam et al.. 2013],
- Sensitivity for light [Saurette et al. 2017],
- Sensitivity for fragrances [Ashayeri, Selen 2013],
- High-value goods [Goldstein 2010],
- Perishable goods [Postan, 2016; Lu et al. 2013],
- Dangerous goods [Muncke et al. 2017],
- Animals [Overesch, Kuhnert 2017],
- Competitive products [Chandukala et al. 2017],
- Over-sized load [Goldstein 2010].

EMPIRICAL RESEARCH DESIGN

For the needs of this paper we carried out the quantitative research with the use of the Computer-Assisted Web Interview (CAWI) and Computer-Assisted Telephone Interview (CATI). These techniques of the data collection are characterized by a relatively low cost of reaching respondents and a possibility to constantly monitor the progress and results of the research.

The main assumptions of this empirical research are as follows:

- The objective of the research: to identify the most common exclusions emerging in storage;
- Method of collecting information: direct structured individual interview using questionnaires;
- General population: logistics companies operating in Poland;
- Respondents: managers responsible for storage;
- The sampling method: random sampling from the group of logistics companies operating in Poland will be selected;
- Sample size: 300 entities.

The questionnaire was tested in a pilot, in which 7 respondents participated; these were representatives of the logistics services industry, experts and researchers investigating logistics.

In the study, random sampling was applied. The database of companies operating in the field of logistics services in Poland was used as the sample. It included data from the Regon database kept by the Central Statistical Office in Poland. It is often used as the sampling frame by researchers preoccupied with management sciences. This database contains data about the type of business the entities do, but it does not include valid contact details. Accordingly, the missing data were supplemented from polish commercial databases, such as Infobrokering or Bisnode.

The research project did not assume any restrictions on the size of the researched entity. According to Eurostat [2016] approximatively 140 thousand transport and warehousing companies were operating in Poland in 2014. After removing firms involved in pipeline and passenger transport, which are not part of logistics services industry, the number of firms in our target population tops 94 thousands.

With the assumed measurement error of 5% and the confidence level of 0.95%, the sample

size was set at N = 383 subjects [Raosoft 2017]. In the design of the sample size the lack of storage services of the logistics companies and the lack of awareness of the exclusionary constraints in storage were taken into account. Next, the intensity of research projects is currently high and managers do not have time or simply do not want to participate in studies. Finally, an e-mail or call with a request to take part in a study may be unnoticed among the numerous messages employees receive every day. In order to compensate for this eventuality the survey was sent to approx. 23 thousand persons – managers with knowledge of the storage. A total of 58 questionnaires were received, giving only a yield of approx. 0.25%. Such a low percentage could have been affected by, except for the above-mentioned lack of awareness of the exclusionary constraints in storage, quite a large size of the questionnaire and its complexity.

In the next step the CATI was used in order to collect more data. Approx. 30 thousand persons were interviewed by telephone. In this case a total of 248 questionnaires were received, giving only a yield of approx. 0.82%. Due to errors and incomplete information, some surveys were rejected. In the end, 300 correctly completed questionnaires were qualified for further analysis, which, assuming the same level of confidence, gives an acceptable measurement error of 5.6%. It should be emphasized that according to the literature [Bazarnik et al. 1992], 300 observations are sufficient to be able to come to conclusions about a population consisting of about 94k entities.

The managers who participated in the study and completed the questionnaire represented (taking into account the size of employment) mostly micro (49.7%) and small (36.7%) enterprises (see Table 1). In terms of the legal form the largest group consisted of sole-traders (54.3%) and limited liability companies (25.3%). The majority of the surveyed companies provided services for customers from the construction (41,7%) and food (29%) industry.

In our research we have adopted a five-point Likert-type scale to capture our respondents evaluation of how important and frequent the exclusionary constraints in their companies was: 1 meant respectively "completely unimportant" and “not at all”, and 5 respectively "very important” and “very frequently” with 3 as the „neutral” indication.

Table 1. Sample characteristics

Characteristics	Share in the sample
Employment	
1-9 emoployees	49.7%
10-49 emoployees	36.7%
50-249 emoployees	9.0%
250-999 emoployees	2.0%
1000-4999 emoployees	0.7%
More than 5000 emoployees	0.0%
No data available	2.0%
Legal form	
Sole-trader	54.3%
Civil law partnership	7.7%
Registered partnership	3.7%
Professional partnership	0.7%
Limited partnership	2.6%
Limited liability company	25.3%
Joint stock company	1.7%
Cooperative	0.0%
Others	2.0%
No data available	2.0%
Serviced industry	
Food	29.0%
Electric	13.0%
Construction	41.7%
Textile	8.0%
Paper	13.3%
Chemical	15.3%
Agricultural	13.7%
Telecommunications	4.0%
Medical	6.3%
Furniture	15.3%
Financial	1.3%
Logistic	14.0%

DISCUSSION OF RESULTS

The first part of the study concerned the importance of the exclusionary constraints for the activity of the firm. The respondents had to determine the particular types of the exclusionary constraints importance, by selecting the answer on a scale from 1 to 5. The most important exclusionary constraint for the surveyed enterprises is “sensitivity for storage temperature” (Fig. 1). The average rating of this factor is 2.88. This value is slightly below 3.0 – „neutral” indication. It shows that the exclusionary constraints problem in storage is not significant for the managers of the logistics enterprises. However, when we look at the details of the research results (Fig 2-25), we can notice that this issue is important and very important for some part of companies. For example, “sensitivity

for storage temperature" is important for 17.5% and very important for 27.5% respondents (see Fig. 2). It means that this factor is at least important for 45% managers. This may be due to increasing demand for products that require controlled storage.

Fig. 1. The importance of the exclusionary constraints for the activity of the firms

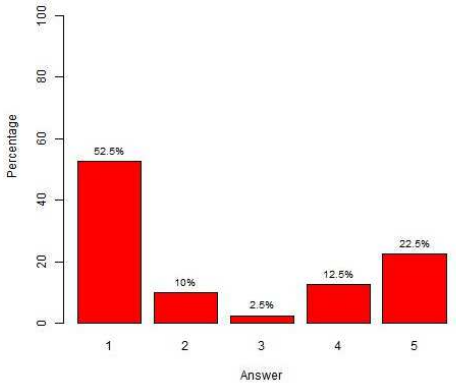

Fig. 2. The importance of the "sensitivity for duration of storage" factor

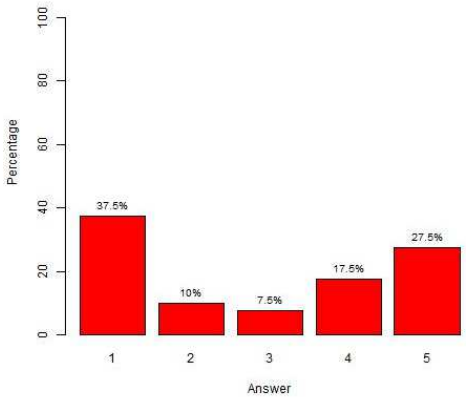

Fig. 4. The importance of the "sensitivity for storage temperature" factor

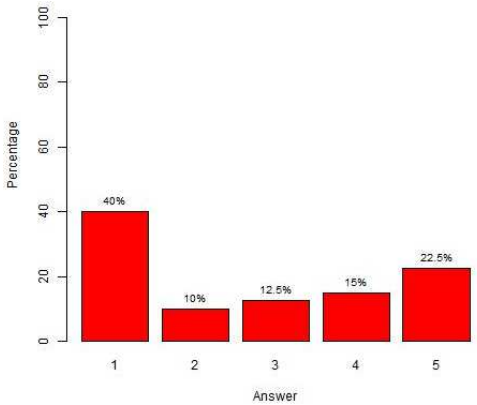

Fig. 3. The importance of the "sensitivity for storage conditions" factor

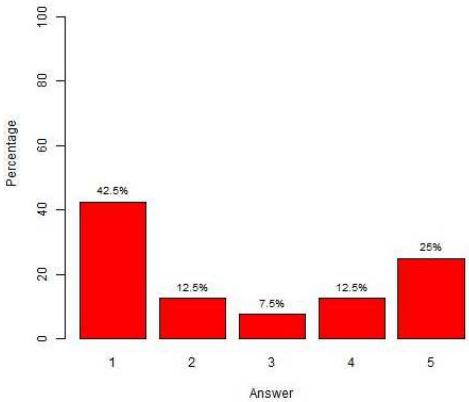

Fig.5. The importance of the "sensitivity for humidity" factor

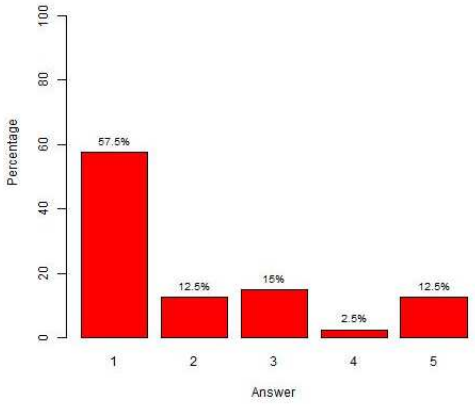

Fig. 6. The importance of the "sensitivity of light" factor

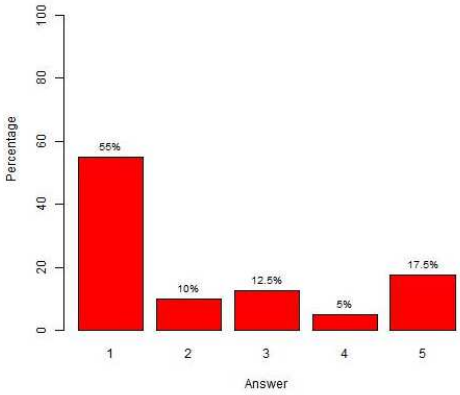

Fig. 7. The importance of the "sensitivity for fragrances" factor

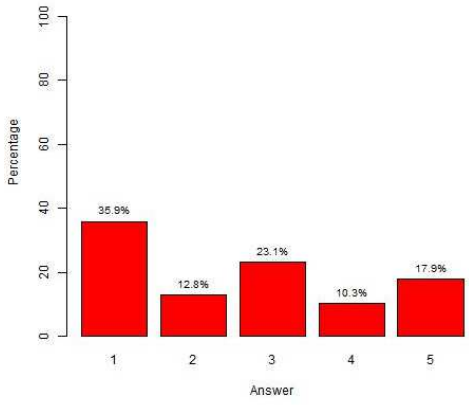

Fig. 8. The importance of the "high-value goods" factor

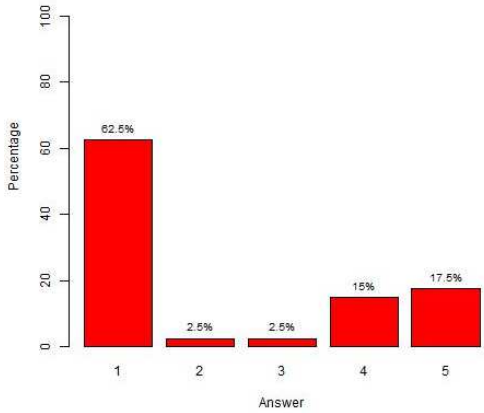

Fig. 9. The importance of the "perishable goods" factor

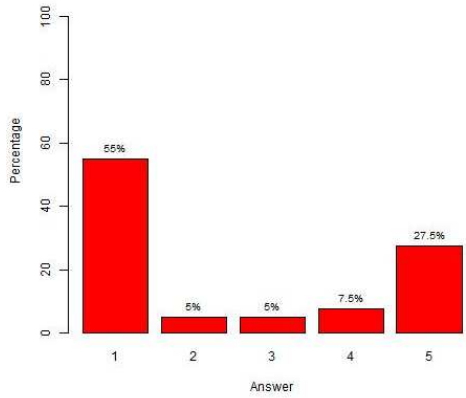

Fig. 10. The importance of the "dangerous goods" factor

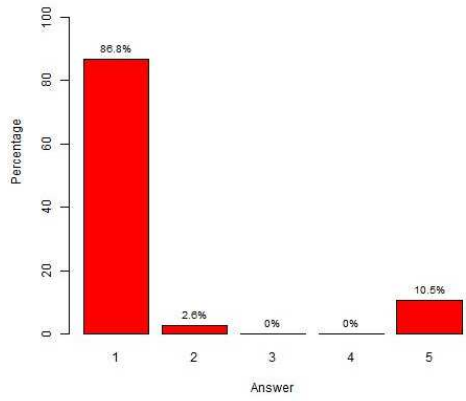

Fig. 11. The importance of the "animals" factor

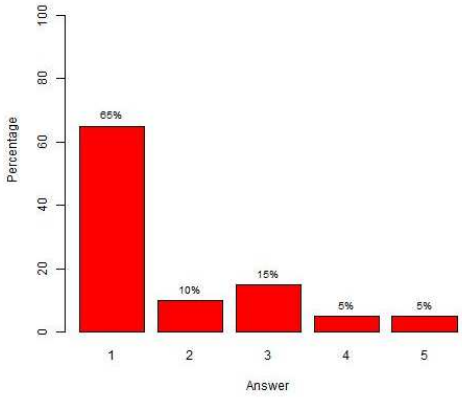

Fig. 12. The importance of the "competitive products" factor

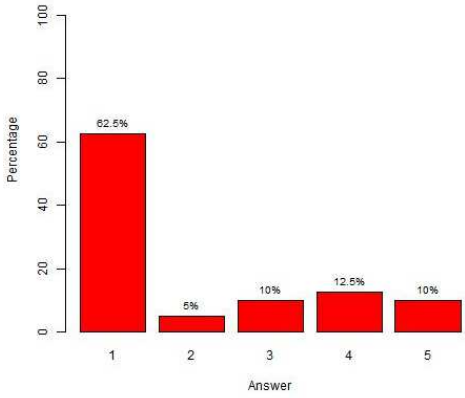

Fig. 13. The importance of the "over-sized load" factor

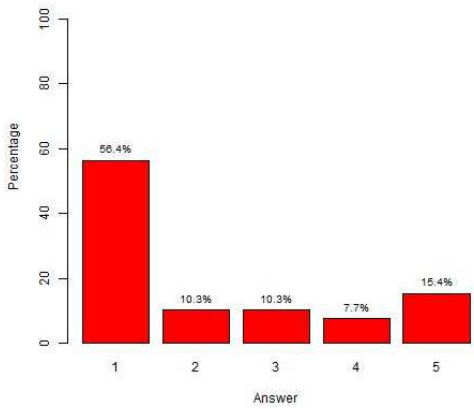

Fig. 14. The frequency of the "sensitivity for duration of storage" factor

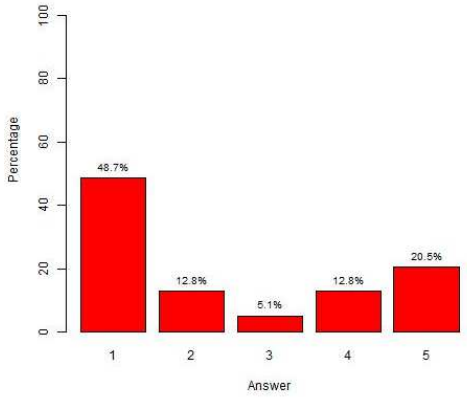

Fig. 15. The frequency of the "sensitivity for storage conditions" factor

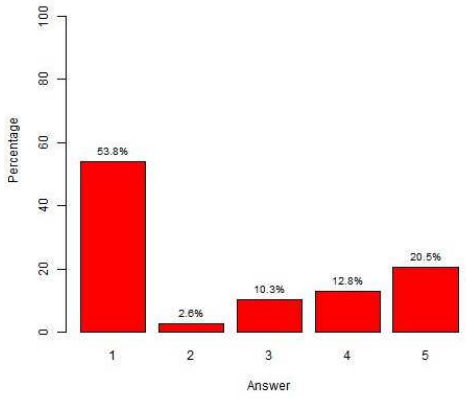

Fig. 16. The frequency of the "sensitivity for storage temperature" factor

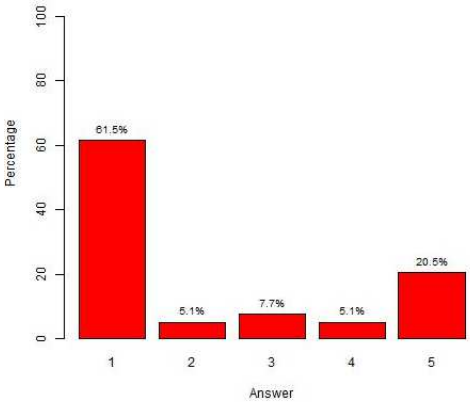

Fig. 17. The frequency of the "sensitivity for humidity" factor

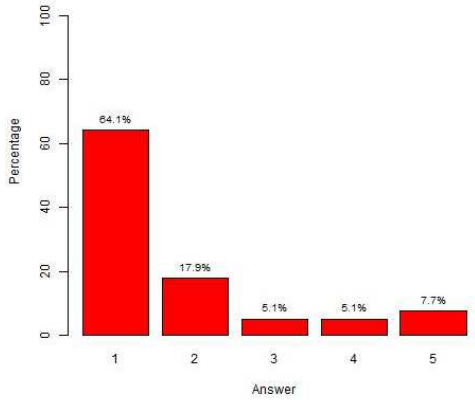

Fig. 18. The frequency of the "sensitivity of light" factor

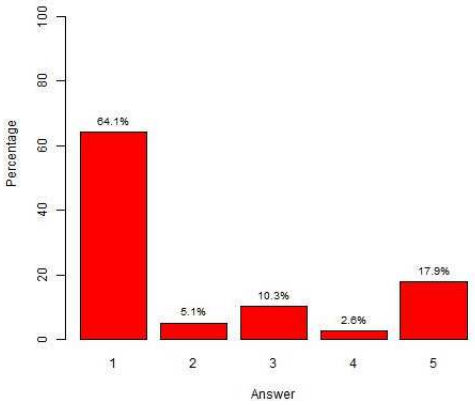

Fig. 21. The frequency of the "perishable goods" factor

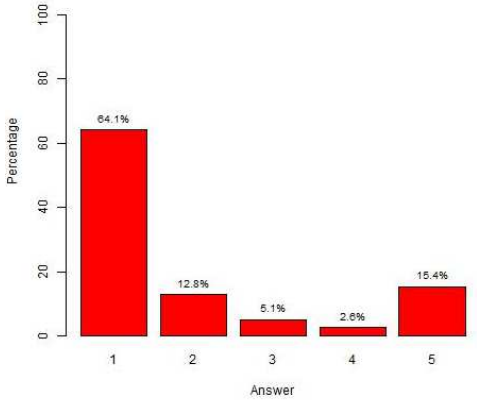

Fig. 19. The frequency of the "sensitivity for fragrances" factor

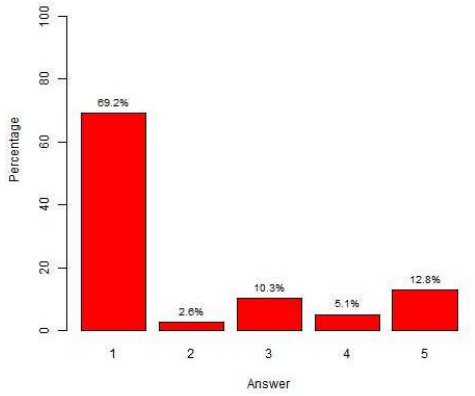

Fig. 22. The frequency of the "dangerous goods" factor

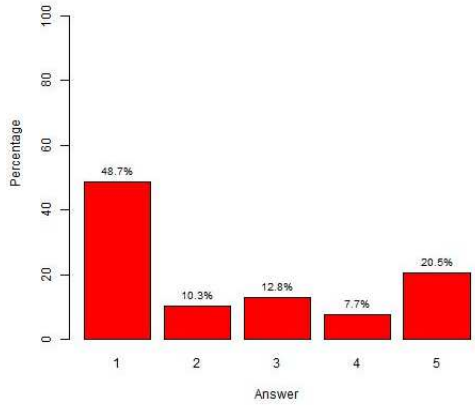

Fig. 20. The frequency of the "high-value goods" factor

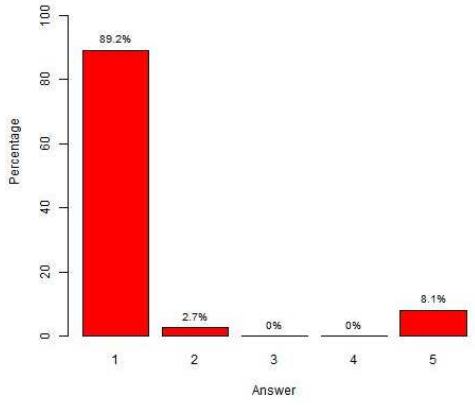

Fig. 23. The frequency of the "animals" factor

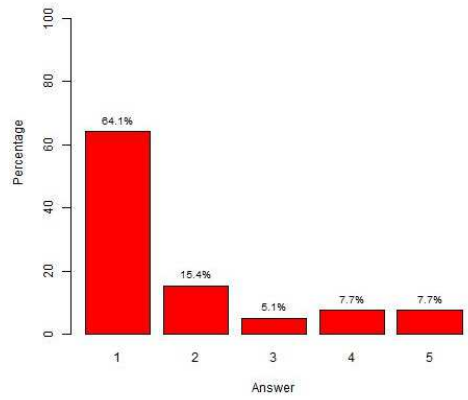

Fig. 24. The frequency of the "competitive products" factor

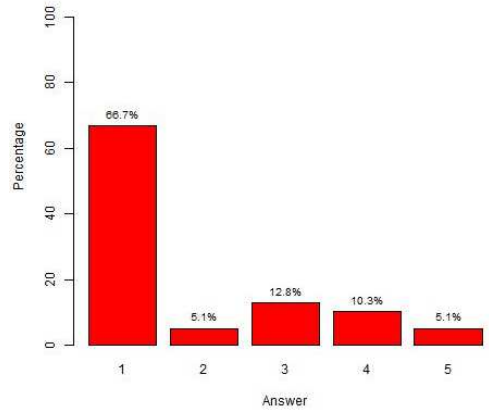

Fig. 25. The frequency of the "over-sized load" factor

"Sensitivity for storage conditions" (2.70) and "sensitivity for humidity" (2.65) are at the similar level as the "sensitivity for storage temperature". Both types of the exclusionary constraints are least important for 37.5% managers (Fig. 3, 5).

The factor "Animals" obtained the lowest value. Almost 87% of respondents answered that it is the completely unimportant exclusionary constraint (Fig. 11).

The next part of our research was to recognize the frequency of the exclusionary constraints in the firms. The respondents were asked how often the particular types of the exclusionary constraints appear, by selecting the answer on a scale from 1 to 5. The results are very similar to the findings from the analysis of the previous question (Fig 26). This value is much less than 3.0 – „neutral" indication. It means that the exclusionary constraint is a rare problem. The most frequent exclusionary constraint for the surveyed enterprises is "sensitivity for storage temperature". The average rating of this factor is only 2.38. For one third of the managers is a frequently or very frequently appearing issue (Fig. 16). At the same and similar level there are respectively "sensitivity for storage conditions" and "high-value goods".

The factor "animals" obtained the lowest value. For almost 90% of respondents this exclusionary constraint never occurs (Fig. 23).

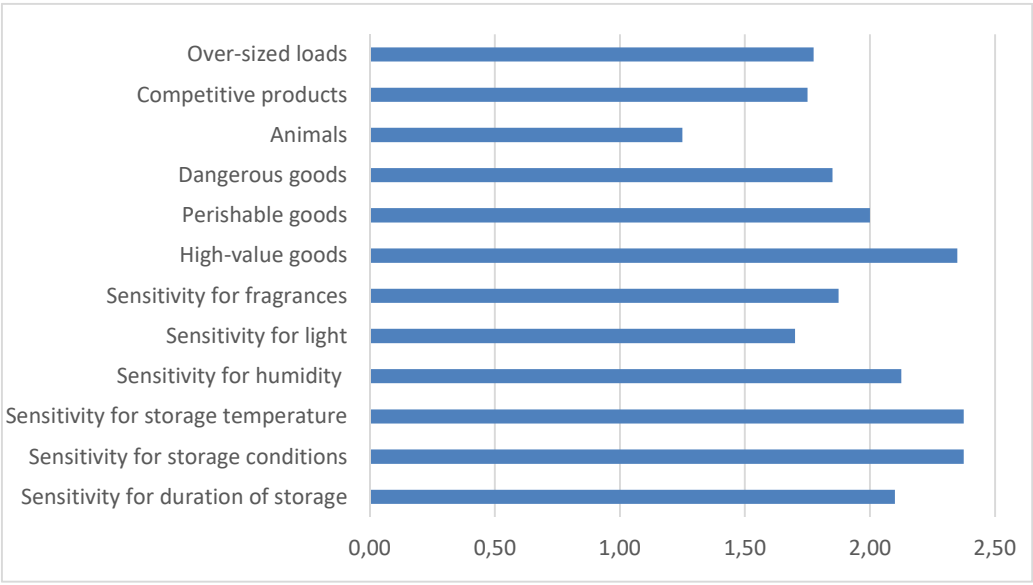

Fig. 26. The frequency of the exclusionary constraints in the firms

Due to existing links between the importance and frequency (Fig. 27) of exclusionary constraints, it is worth to compare them. We run a series of Pearson's Chi-squared tests for all types of exclusionary constraints in pairs (Table 2) to determine whether the correlation between them was statistically significant. All relations between the importance and frequency of the exclusionary constraints are statistically significant and correlation coefficient is high (greater than or equal to 0.6) . This means that specific types of exclusionary constraint are interdependent. An increase in one gives rise to at least a significant increase in the other.

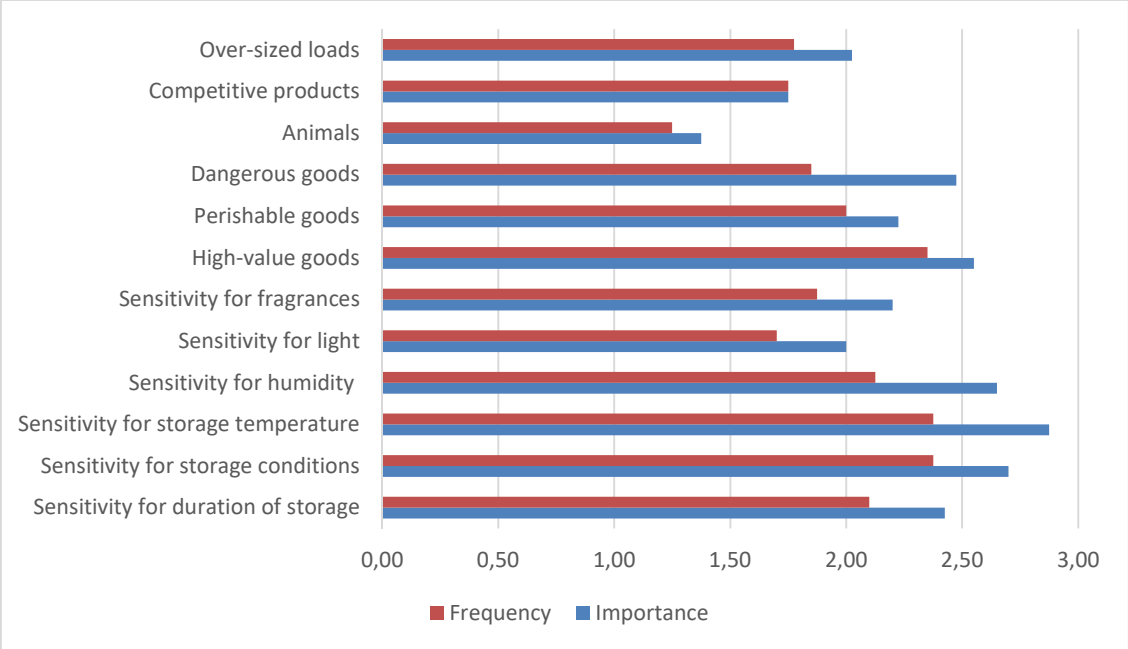

Fig. 27. The importance and frequency of the exclusionary constraints in the firms

Table 2. Statistical parameters for the importance and frequency of exclusionary constraints types

Type of exclusionary constraint	Importance (a)		Frequency (b)		Correlation coefficient between (a) and (b)
	Mean	Standard deviation	Mean	Standard deviation	
Sensitivity for duration of storage	2.43	1.72	2.10	1.57	0.72**
Sensitivity for storage conditions	2.70	1.65	2.38	1.69	0.65*
Sensitivity for storage temperature	2.88	1.71	2.38	1.72	0.70**
Sensitivity for humidity	2.65	1.70	2.13	1.68	0.72**
Sensitivity of light	2.00	1.41	1.70	1.26	0.80**
Sensitivity for fragrances	2.20	1.57	1.88	1.51	0.84**
High-value goods	2.55	1.55	2.35	1.66	0.75**
Perishable goods	2.23	1.69	2.00	1.60	0.71**
Dangerous goods	2.48	1.80	1.85	1.49	0.60**
Animals	1.38	1.25	1.25	1.13	0.64**
Competitive products	1.75	1.19	1.75	1.32	0.67**
Over-sized load	2.03	1.48	1.78	1.31	0.44**

** Correlation is significant at the level of 0.01 [two-tailed].
* Correlation is significant at the level of 0.05 [two-tailed].
(a) 1 = „completely unimportant"; 5 = „very important"
(b) 1 = „not at all"; 5 = „ very frequently"

In the last step of our study we asked the respondents to give some examples of product pairs that are in parallel storage under the certain exclusionary constraints. Food, groceries, fruits are the most frequently mentioned (Table 3).

Table 3. Examples of product pairs depending on types of exclusionary constraints

Type of exclusionary constraint	**Examples**
Sensitivity for duration of storage	animals – others grains – others blueberries – others groceries – household appliances groceries – others food – others
Sensitivity for storage conditions	household appliances – specialized equipment food – paper grains – others
Sensitivity for storage temperature	meat – vegetables food – cosmetics grains – others frozen goods: meat, fruit, dairy products grains – others blueberries – others
Sensitivity for humidity	wood panels – others dry goods – others grains – others fruits – others nappa cabagge – others
Sensitivity for light	grains – others fruits – others
Sensitivity for fragrances	paper – others grains – agricultural crops groceries – others
High-value goods	car seats – others machines – others computer memories – others electronics – others alcohol – electronics
Perishable goods	food – others grains – others groceries – others fruits – vegetables
Dangerous goods	fireworks – fuels fuels – spirit lighters – fireworks raw materials – chemicals ADR – others paper – building materials
Animals	animals – meat
Competitive products	bicycles – others agricultural crops – others chemicals – others fertilisers – coal fertilisers – grains
Over-sized load	engines – others agricultural crops – others agricultural machines – others machines – others structural elements – building elements

CONCLUSIONS

For the needs of this paper we have scrutinized a random sample of 300 logistics services providers in Poland in order to capture the managers' assessment of exclusionary constraints, especially their frequency and importance for the activity of the firms. We have identified 12 exclusionary constraints which can be imposed in storage.

Our research showed that the approach to the exclusionary constraints in storage is various for the managers of the logistics enterprises. Depending on the factor, the

distributions of the frequency and importance are different. Moreover, we have noticed the quite extreme evaluations. The specific exclusionary constraint is very important for some managers and it is completely unimportant for the others (e.g. sensitivity for storage temperature, sensitivity for storage conditions, sensitivity for humidity). Moreover, in comparison to the exclusionary constraints in transportation they are less significant and frequent [Anholcer, Kawa 2018].

We discovered the correlation between the importance and frequency of exclusionary constraints in storage. The more important a specific exclusionary constraint is, the more often it occurs. The most important and frequent exclusionary constraint for the surveyed enterprises is sensitivity for storage temperature. This may be due to increasing demand for products that require controlled storage.

Our study offers a pioneering insight into exclusionary constraints in storage. The empirical research on exclusionary constraints of logistics companies, to the best of the authors' knowledge, has not been conducted. This study extends earlier research on exclusionary constraints in transportation which but do not analyze the real life data. Moreover, it contributes to the theories and practices of logistics enterprises.

Of course, we plan further research in this area. In the future work we will use the results of the quantitative research to develop mathematical models of the storage problems based on the determined exclusionary constraints. This model will aim to plan and organize stocking of different products in the place. Consequently, it will allow to minimize the cost of warehouse management. It is very important because stocks represent on average 20 to 80% of the total assets of industrial enterprises [Duicu 2017] and their costs are estimated to contribute about 10% to 25% of the sale [Firoozi et al. 2013].

FUNDING SOURCE DECLARATION

The paper was written with financial support from the National Center of Science (Narodowe Centrum Nauki) – the grant no. DEC-2014/13/B/HS4/01552.

REFERENCES

Anholcer M., Kawa A., 2015. Optimization of transportation decisions under exclusionary side constraints in food supply chain, International Food Operations and Processing Simulation Workshop, FoodOPS 2015, 28-33.

Anholcer M., Kawa A., 2018. Exclusionary constraints in transportation – results of quantitative research (preprint).

Ashayeri J., Selen W., 2013. A storage assignment model for batch preparation in process industries, Journal of Manufacturing Technology Management, 24[6], 830-849, http://dx.doi.org/10.1108/JMTM-12-2011-0115.

Ataka S., Gen M., 2008. The study for transportation planning considered the inventory using hybrid genetic algorithm, Proceedings of the 10th Annual Conference on Genetic and Evolutionary Computation 2008, 1689-1690, http://dx.doi.org/10.1145/1389095.1389411

Bazarnik J., Grabiński T., Kąciak E., Mynarski S., Sagan A., 1992. Badania Marketingowe. Metody i Oprogramowanie Komputerowe [Marketing Research, Methods and Computer Software], Canadian Consortium of Management Schools, Warszawa – Kraków: Akademia Ekonomiczna w Krakowie.

Brenner V., Hülsmann M., Cordes-Berszinn P., 2014. Improving Flexibility in Autonomous Cooperating Food Chains, In: Nandakumar M., Jharkharia S., Nair A., eds. Organisational Flexibility and Competitiveness. Flexible Systems Management. Springer, New Delhi, http://dx.doi.org/10.1007/978-81-322-1668-1_20.

Cagliano A. C., De Marco A., Mangano G., Zenezini G., 2017. Levers of logistics service providers' efficiency in urban distribution, Operations Management Research, 10[3-4], 104-117, http://dx.doi.org/10.1007/s12063-017-0125-4.

Chandukala S. R., Dotson J. P., Liu Q., 2017. An assessment of when, where and under what conditions in-store sampling is most effective, Journal of Retailing, 93[4], 493-506, http://dx.doi.org/10.1016/j.jretai.2017.07.002

Cao B., 1992. Transportation problem with nonlinear side constraints a branch and bound approach, Mathematical Methods of Operations Research, ZOR. 36, 185–197, http://dx.doi.org/10.1007/BF01417216.

Caridade R., Pereira T., Pinto Ferreira L., Silva F. J. G., 2017. Analysis and optimisation of a logistic warehouse in the automotive industry, Procedia Manufacturing, 13, 1096-1103, http://dx.doi.org/10.1016/j.promfg.2017.09.170.

Cyplik P., Hadas L., Fertsch M., 2009. Production planning model with simultaneous production of spare parts, Conference: 19th International Conference on Production Research Location: Pontifical Catholic Univ Valparaiso, Valparaiso, Chile, Jul 29- Aug 02, 2007. International Journal Of Production Research, 47, 8, 2091-2108. PII 909137867.

Dalalah D., 2016. LSP-constrained supply chains: A discrete event simulation model, RAIRO - Operations Research, 50(1), 1-17, http://dx.doi.org/10.1051/ro/2015008.

Duicu S., 2017. Stage Decisions of Stochastic Model in Production Processes, WSEAS Transactions on Business and Economics, 14.

Eurostat 2016. Transportation and storage statistics – NACE Rev. 2, http://ec.europa.eu/eurostat/statistics-explained/.

Firoozi Z., Ismail N., Ariafar S., Tang S. H., Ariffin M. K. A. M., Memariani A., 2013. Distribution network design for fixed lifetime perishable products: A model and solution approach, Journal of Applied Mathematics, 2013, http://dx.doi.org/10.1155/2013/891409.

Goldstein S., 2010. Pallet firms push global ops, Packaging News, 32-33.

Goossens D., Spieksma F. C. R., 2009. The transportation problem with exclusionary side constraints, 4OR, A Quarterly Journal of Operations Research, 7, 51–60. http://dx.doi.org/10.1007/s10288-007-0067-z.

Gu J., Goetschalckx M., McGinnis L. F., 2007. Research on warehouse operation: A comprehensive review, European Journal of Operational Research, 177(1), 1-21, http://dx.doi.org/10.1016/j.ejor.2006.02.025

Kawa A., 2017. Fulfillment service in e-commerce logistics. LogForum 13, 4, 429-438, http://dx.doi.org/10.17270/J.LOG.2017.4.4.

Lam H. Y., Choy K. L., Ho G. T. S., Cheng S. W. Y., Lee C. K. M., 2015. A knowledge-based logistics operations planning system for mitigating risk in warehouse order fulfillment, International Journal of Production Economics, 170, 763-779, http://dx.doi.org/10.1016/j.ijpe.2015.01.005

Lam H. Y., Choy K. L., Ho G. T. S., Kwong C. K., Lee C. K. M., 2013. A real-time risk control and monitoring system for incident handling in wine storage, Expert Systems with Applications, 40[9], 3665-3678, http://dx.doi.org/10.1016/j.eswa.2012.12.071.

Muncke J., Backhaus T., Geueke B., Maffini M. V., Martin O. V., Myers J. P., Scheringer M., 2017. Scientific challenges in the risk assessment of food contact materials, Environmental Health Perspectives, 125[9], http://dx.doi.org/10.1289/EHP644.

Overesch G., Kuhnert P., 2017. Persistence of mycoplasma hyopneumoniae sequence types in spite of a control program for enzootic pneumonia in pigs, Preventive Veterinary Medicine, 145, 67-72, http://dx.doi.org/10.1016/j.prevetmed.2017.06.007.

Palomo-Martínez P. J., Salazar-Aguilar M. A., Albornoz V. M., 2017, Formulations for the orienteering problem with additional constraints, Annals of Operations Research, 258(2), 503-545, http://dx.doi.org/10.1007/s10479-017-2408-4.

Pfohl H.-C., Müller K., 2015. Collaboration and communication in a networked economy. LogForum 11, 2, 139-149, http://dx.doi.org/10.17270/J.LOG.2015.2.2.

Raosoft, 2017. Available from Internet: http://www.raosoft.com/samplesize.html.

Saurette E. M., Groza L. G., Blowes D. W., Ptacek C. J., 2017. Storage and preservation of artificial sweeteners in groundwater samples, Groundwater Monitoring and Remediation, 37[4], http://dx.doi.org/doi.org/10.1111/gwmr.12249.

Soinio J., Tanskanen K., Finne M.,, 2012, How logistics-service providers can develop value-added services for SMEs: a dyadic perspective, The International Journal of Logistics Management, 23, 1, 31–49, http://dx.doi.org/10.1108/09574091211226911.

Tolesa G. N., Workneh T. S., Melesse S. F., 2017, Logistic regression analysis of marketability of tomato fruit harvested at different maturity stages and subjected to disinfection, storage condition and storage period treatments, Biological Agriculture and Horticulture, 1-13, http://dx.doi.org/10.1080/01448765.2017.1368414.

Vancroonenburg W., Della Croce F., Goossens D., Spieksma F.C.R., 2014, The Red–Blue transportation problem, European Journal of Operational Research 237, 814–823, http://dx.doi.org/0.1016/j.ejor.2014.02.055.

Sharif K. I., Ibrahim J. A., Udin Z. M., Othman A. A., 2016, Decision making of spare parts inventory based on risk quantification, International Journal of Supply Chain Management, 5(3), 96-99.

Wykrota K., 2017. The Polish industrial market sets new highs, Available from Internet: http://www.cushmanwakefield.pl/en-gb/research-and-insight/2017/warehouse-market-in-in-poland/.

Zachariadis E. E., Tarantilis C. D., Kiranoudis C. T., 2017. Vehicle routing strategies for pick-up and delivery service under two dimensional loading constraints, Operational Research, 17(1), 115-143, http://dx.doi.org/10.1007/s12351-015-0218-5.

OGRANICZENIA WYKLUCZAJĄCE W MAGAZYNOWANIU: BADANIE EMPIRYCZNE DOSTAWCÓW USŁUG LOGISTYCZNYCH

STRESZCZENIE. **Wstęp:** Dostawcy usług logistycznych magazynuje bardzo różne produkty, które mogą współdziałać ze sobą, np. poprzez reakcje chemiczne lub fizyczne. Ponadto niektórzy producenci wymagają, aby firmy logistyczne nie składowały ich produktów razem z produktami konkurencyjnymi. Mamy zatem do czynienia z ograniczeniami wykluczającymi, a więc z okolicznościami lub warunkami, w których co najmniej dwa towary nie mogą być składowane w tym samym miejscu. W literaturze nie ma badań dotyczących ograniczeń wykluczających w magazynowaniu, zwłaszcza wyników badań empirycznych. Z tego powodu głównym celem artykułu jest identyfikacja i ocena częstotliwości oraz znaczenia ograniczeń o charakterze wykluczającym w zakresie magazynowania przez dostawców usług logistycznych.
Metody: Zbadana została próba 300 losowo wybranych dostawców usług logistycznych w Polsce w celu otrzymania dokonanej przez menedżerów oceny ograniczeń wykluczających, w szczególności ich częstotliwości i znaczenia dla działalności firm.
Wyniki: Badania wykazały, że podejście do ograniczeń wykluczających w magazynowaniu jest zróżnicowane w zależności od menedżerów przedsiębiorstw logistycznych. Istnieje jednak korelacja pomiędzy znaczeniem i częstotliwością ograniczeń wykluczających w składowaniu. Im ważniejsze jest konkretne ograniczenie wykluczające, tym częściej ono występuje. Najważniejszym i najczęstszym ograniczeniem wykluczającym dla badanych przedsiębiorstw jest wrażliwość na temperaturę składowania.

Wnioski: Badanie to poszerza wcześniejsze eksploracje nad ograniczeniami wykluczającymi w logistyce, w których nie analizowano jeszcze danych rzeczywistych. W przyszłości wykorzystamy wyniki badań ilościowych do opracowania matematycznych modeli problemów składowania w oparciu o zidentyfikowane ograniczenia wykluczające.

Słowa kluczowe: ograniczenia wykluczające, magazynowanie, dostawcy usług logistycznych

EINSCHRÄNKUNGEN, DIE EINE GEMEINSAME LAGERUNG VON LAGERGUT AUSSCHLIESSEN: EINE EMPIRISCHE UNTERSUCHUNG VON LOGISTIKDIENSTLEISTERN

ZUSAMMENFASSUNG. Einleitung: Die Anbieter von logistischen Dienstleistungen bewahren lagermäßig verschiedenartige Produkte auf, die sich, z.B. durch chemische und physikalische Reaktionen, gegenseitig beeinflussen können. Darüber hinaus verlangen manche Produzenten, dass ihre Produkte nicht gemeinsam mit den Erzeugnissen ihrer Konkurrenten gelagert werden. Es liegen daher die ausschließenden Einschränkungen, also Gegebenheiten oder Voraussetzungen, bei denen mindestens zwei Produkte nebeneinander oder an demselben Standort nicht gelagert werden dürfen, vor. In der Fachliteratur findet man kaum Forschungen, die die betreffenden Einschränkungen, insbesondere die Ergebnisse von empirischen Untersuchungen, anbetreffen. Angesichts dieser Tatsache ist das Ziel der vorliegenden Arbeit es, die Intensität des Auftretens und die Bedeutung der Einschränkungen, die einen ausschließenden Charakter in Lagerprozessen besitzen, zu ermitteln und zu beurteilen.
Methoden: Für die Zwecke der vorliegenden Erforschung wurde eine Losgröße von 300 Logistikdienstleistern in Polen ausgewählt. Deren Geschäftsführer nahmen eine Beurteilung der vorkommenden, ausschließenden Einschränkungen, insbesondere deren Intensität und Bedeutung für eine erfolgreiche Betätigung der betreffenden Firmen, vor.
Ergebnisse: Die Untersuchungen haben ergeben, dass das Herangehen an die Fragen der die gemeinsame Lagerung von bestimmten Produkten ausschließenden Einschränkungen seitens der untersuchten Logistikdienstleister unterschiedlich sei. Es besteht jedoch eine Korrelation zwischen der Bedeutung und der Intensität des Auftretens der bei der Lagerung ausschließenden Einschränkungen. Je belangvoller eine konkrete ausschließende Einschränkung bleibt, desto häufiger tritt sie auf. Zu den wichtigsten und am häufigsten auftretenden Einschränkungen, die für die betreffenden Logistikdienstleister belangvoll sind, ist die Empfindlichkeit der Lagerwaren gegen die Lagerungstemperatur.
Fazit: Die vorliegende Erforschung erweitert frühere Forschungen zu den in der Logistik auftretenden, ausschließenden Einschränkungen, in denen bisher keine Ist-Werte analysiert wurden. In Zukunft werden Ergebnisse von quantitativen Untersuchungsmethoden für die Ausarbeitung der mathematischen, die Lagerungsprobleme wiederspiegelnden Modelle anhand der ermittelten, ausschließenden Einschränkungen in Anspruch genommen werden.

Codewörter: ausschließende Einschränkungen, Lagerung, Logistikdienstleister

Arkadiusz Kawa
Poznan University of Economics and Business
Faculty of Management
Department of Logistics and Transportation
al. Niepodległości 10, 61-875 Poznań, **Poland**
e-mail: arkadiusz.kawa@ue.poznan.pl

Marcin Anholcer
Poznan University of Economics and Business
Faculty of Informatics and Electronic Economy
Department of Operations Research
al. Niepodległości 10, 61-875 Poznań, **Poland**
e-mail: marcin.anholcer@ue.poznan.pl