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MANAGING THE FLOW COMPONENTS IN SUPPLY CHAINS

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Identification and evaluation of the frequency and the power of influence as well as effects of disruptions, are essential problems noticed both by practitioners and theoreticians of the management of flows in supply chains. They are a widely discussed problem of the resilience of the supply chain. This paper considers the strategy of strengthening the resilience by production postponement and constructing network relations with subcontractors and participants of distribution channels. The study took into account two locations of the material decoupling point in supply chains of metallurgic products. Due to the aim of the research, attention was focused on the material decoupling point of the supply chain: assembly to order.

Key words: metallurgical products, managing, supply chain, cooperation climate, postponement production

INTRODUCTION

Supply chains, sensitive to disruptions, realize flows in a turbulent environment. The network structure of supply chains favours not only generating disruptions but also transferring them along the stream of the value added. Consequently, research into strategies of strengthening the resilience of supply chains are important and current. The authors considered two variants of this strategy and evidenced their limitations. The study took into account two locations of the material decoupling point in supply chains of metallurgic products. The adopted research procedure consists of the following stages: identification and analysis of disruptions (the diary method, a statistical analysis of the obtained results), identification of factors which determine establishing network relations and developing a construct of cooperation climate (a statistical analysis of the initial data) and a sensitivity analysis of the supply chain to changes in cooperation climate (simulation modelling in the system dynamics technology). The research findings indicate limitations of the applied strategy of strengthening the resilience of the supply chain of metallurgic products.

MANAGING FLOWS DIRECTED ON REILIENCE SUPPLY CHAIN

The organization of material flows in supply chains depends on a number of factors, including a description of demand, the degree of the complexity of a product, the production and logistic cycle, the lead time accepted by the customer. The determinants mentioned together affect the location of the material decoupling point in the supply chain [1] and consequently the location of resources in the supply chain, which are crucial for synchronization of material flows. The literature most frequently mentions three main material decoupling point: make-to-stock (MTS), assembly-to-order (ATO), make-to-order (MTO). The material decoupling point (or Customer Order Decoupling Point) is investigated in the context of the supplies management but also touches a number of other issues connected with the organization of flows, including integration of the supply chain, resilience of the system and subcontracting [2]. Kramarz, Kramarz (2015) indicate risk factors which involve disruptions in the flow of metallurgic products differentiated in the service centre in accordance with the production postponement strategy.

The personalization of products in supply chains, which on one hand is a response to the uncertainty of the environment and limits the costs connected with lost sales, requires formation of new network relations and a different approach towards managing flows, which can generate disruptions in material flows. Consequently, the organization cooperating in the supply chain must reconfigure their operations directed on strengthening the resilience of the supply chain [4]. The resilience of the supply chain is understood as a property (attribute) of the organization / system expressing the rules, the procedures, the method and the management techniques and the strategy protecting the organization against negative results of deviations occurring because of disruptions [5].

THE CONCEPTION OF RESEARCH MODEL

Supply chains of metallurgic products are differentiated and complex with regard not only to a wide choice but also to heterogeneous customers. This research separated the flows which concern components, the same customer is an institutional recipient, who execute further manufacturing operations. In this understanding a

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component involves a supply of the customer's manufacturing system. Adopting this assumption has its consequences in the established service standards. Institutional customers have large bargaining power and simultaneously demand reliable order fulfilment. Reliability, understood as completeness and punctuality is a dimension of assessment adopted in further analysis. The assumptions adopted to the research took into account formation of network relations for the service centre at the level of execution of postponed manufacturing tasks, however, for the distribution centre at the level of execution of transport processes. Another adopted assumption is the dynamic character of the distribution network shaped by the service centre. It is so because the constructed network relations are strongly addicted to the climate of cooperation in the network.

The context of the analysis of variants of formation of the resilience of the supply chain - the climate of network collaboration, proposed in this paper, is a new construct, however, it is strongly embedded in the previous research into collaboration in interorganizational networks and determinants of this collaboration. Czakon, Klimas (2017) [6] noticed that the theoretical frames of networking cooperation provide discriminants of co-ordination of activities in an interorganizational space: 1) adaptation of expectations, skills and aims of the participating organizations; 2) designing routines of collaboration and rules of communication; 3) designing rules of behaviour binding the cooperating organizations. Empirical research into the collaboration between tourist enterprises selected: confidence, inclination to collaboration and experience in collaboration. The conceptualization of dimensions of the climate of interorganizational collaboration adopted by Czakon, Klimas 2017 [6], justifies adopting a three-dimensional approach towards this construct, i.e.: confidence, inclination to collaboration, the experience in collaboration. However, these three dimensions do not exhaust the collection of factors which could have influence on establishing network relations.

Therefore we propose a wider look on the construct of the climate of network cooperation. The interpretation of the climate of network cooperation was proposed by Kramarz (2012) as the total of phenomena affecting decision making about formation of network relations. Consequently, according to the assumptions adopted in this paper, and the logic of research, the climate of network cooperation can be, for the flag enterprise of the distribution network (including both the service centre and the distribution centre). a factor limiting formation of the resilience through the variant of an increase in network relations.

In the research into the climate of network cooperation, a decision was made about widening the range of factors by elements of the nearer and further environment of cooperating enterprises. The collection of relation determinants in distribution networks of products was developed in 2010-2012. The final result involved the following stages: literature research, pilot studies, expert research, actual survey. Climate-forming factors were evaluated as regards the direction of the influence on decision making about formation of network relations (inhibitory or favourable ones), and regarding the power of influence on the undertaken decisions. In the research in the metallurgic industry, the scale (-5;5) was adopted. Simultaneously, respondents gave ranks to climate-forming factors. Due to the number of significant climate-forming factors in the metallurgic industry, determined by experts, the total sum of ranks was determined as 100.

The direction of the influence on the undertaken decisions allows dividing climate-forming factors into stimulators and destimulators of formation of network relations. In the next phase of determining the climate of network cooperation, it is postulated to determine weighted assessment of stimulators (SWO) and weighted assessment of destimulators (DWO). The sum of weighted grades of stimulators and destimulators determines the climate of the cooperation (CC).

$$CC = SWO + DWO.$$

The interviews were carried out in 27 organizations (2012), 27 organizations (2014), 31 organizations (2016). The investigated distribution sector of metallurgic products was dominated by factors favouring formation of network relations.

CC 2012 = 233; CC 2014=248,5; CC 2016= 256,5

The cooperation climate changes proportionally to changes in demand for Polish metallurgic products. After the period caused by the lengthening crisis, which was difficult for metallurgy, in 2014 the economic situation improved, and thanks continuation of infrastructural investments and positive legal changes the demand for steelwork in Poland was rebuilt. Both the market and the production of steel increased significantly attaining the highest dynamics in the European Union. In 2017 the domestic consumption of steel reached the record level of over 13,5 million tonnes - according to the data of the Polish Steel Association (HIPH) in Katowice. The domestic production of steel increased by almost 15 percent.

STRATEGIES OF STRENGTHENING RESILIENCE

The further stages of the research took into account strengthening the resilience by building network relations with subcontractors of postponed manufacturing tasks and network relations with logistic organizations, which allow obtaining the effect of flexible transport networks. Simultaneously, the empirical research took into account two points of product differentiation in the supply chain: the service centre, which is a commercial enterprise executing complex postponed manufacturing tasks (3 different operations on the metallurgic product), and the distribution centre, which is a logistic enterprise and executing solely one postponed manufacturing operation. The service centre sells the product in different variants. This organization forms strong relations in supply chains and simultaneously both formal and informal relations with subcontractors of postponed manufacturing tasks, with substitutional resources at its disposal. The distribution centre offers services involving storing

and delivering the base product or one variant of the differentiated product to the customer. This organization performed services for one segment of recipients and builds strongly formalized relations both in the supply chain with industrial and commercial enterprises, and in the logistic network with transport enterprises.

Measuring disruptions in flows of components for the following industry lines: motor, building and steel processing was conducted for one year. Disruptions were measured by means of the method of continuous participating observation with the use of the technique of diary studies and a questionnaire for measuring disruptions.

The methodology for measuring disruptions and analysing resilience variants went in the same manner in each organization: daily identification of disruptions (diary studies), a cause-and-effect analysis of disruptions (Ishikawa's diagram), simulaton analysis in the system dynamics technology in Vensim DSS tool. The interrelations provided the basis for operationalization of the simulation model. The authors carried out simulation experiments for the variant of stable demand for the service centre and the distribution centre, in a favouring climate, then the authors changed climate parameters to the climate unfavourable for establishing network relations in the variant of subcontracting of postponed manufacturing tasks. The next experiments involved increasing demand fluctuations over 20 % in the conditions of climate favouring network cooperation and then in the conditions of climate unfavourable for network cooperation.

This research indicates a higher resilience of the distribution system configured on the basis of the model with the service centre despite its bigger complexity. As regards demand with slight fluctuations, both the first and the second model, at all product variants, maintain the determined reliability standard, without falling below 75 % of orders fulfilled completely and on time. In the conditions of worsening the climate of cooperation, there are no changes in the resilience of the model with the distribution centre, however, there is a considerable decrease in the indicator of the reliability of fulfilled orders through the service centre. Resource sharing for manufacturing different product variants without any possibility of commissioning parts of the operation to subcontractors, and without any possibility of compensating disruptions through the flexible transport variant, indicates a large sensibility of the model with the service centre to changes in the climate of network cooperation. Increasing demand fluctuations for the favouring climate of network cooperation shows a large resilience of the system with the service centre, and an insufficient resilience of the system with the distribution centre. The worsening climate of cooperation again increases the results of disruptions in the system with the service centre.

CONCLUSION

Strategies of strengthening the resilience proposed by the two investigated subjects are different and result from the network maturity of those organizations in the distribution sector of metallurgic products. The centre service, which is a commercial enterprise involved in selling metallurgic products, participated in changes in the distribution sector of metallurgic products from the beginning of the restructuring of the Polish metallurgy. This organization strengthens the resilience through flexible resources allowing combination of different postponed manufacturing tasks and formation of relations with subcontractors of postponed manufacturing tasks. Network relations are unusually essential for this organization. This fact causes a large sensibility of the distribution system with participation of the service centre to changes in the climate of network cooperation. A decidedly weak aspect indicated in this particular case are relations with transport enterprises because disruptions which arise at the last stage of product delivery to the customer result directly in worsening the customer satisfaction because there are no chances for suppressing their effects. The strategy adopted in this way increases the flexibility of the system and allows responding to exogenous disruptions. Disruptions in flows between the service centre and the subcontractors are not dominant and are compensated by the service centre. The distribution centre realizes the strategy of the surplus of the base product and simultaneously shapes network relations with transport enterprises. This variant is compatible with one of the strategies of strengthening the resilience - flexible transport networks. The strategy adopted in this manner allows compensating very well disruptions in the variant of selling the product which is not personalized (in the organization under research such orders constitute above 70 % of all orders). For products personalized through cut, flexible transport networks do not sufficiently compensate disruptions in the conditions of strong demand fluctuations.

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Note: The responsible for English language is lector from University.