SELECTED ASPECTS OF THE DISRUPTIONS RISK IN THE IMPLEMENTATION OF JIT

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Abstract

In the paper will be presented the way performing the studies, particularly the selection and characterization of the survey sample and the analytical scheme of research. The results of this study will enable to answer the following questions: whether the use of JIT (Just In Time) increases the likelihood and consequences of disruption and whether JIT has been applied in an appropriate way. The main objective of the conducted research was an assessment of the relationship between the use of selected management instrument – JIT and the risk of disruptions in the supply chain. While the scientific aim is to enrich the knowledge of the issues on the risk of disruptions to supply chain management.

Keywords: Disruption risk, just in time, supply chain

1. INTRODUCTION

In modern enterprises searching for a competitive advantage, undertakes to cooperate in the supply chain and an integration of suppliers with buyers, which is expressed in the use of appropriate instruments for managing supply chains. A certain category are instruments whose use as far integrates the supplier and the buyer that follows specific role reversal – the activities and management areas traditionally belonging to the buyer, they shall be transferred to the supplier. These instruments include among others – JIT.

The risk of disruptions, which has been present for a very long time, is currently becoming more meaningful in the context of integration within supply chain defined as "the network of organizations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate consumer" [1]. Not without significance is the fact that supply activities take place on a global scale − in various legal, political and social environments. The literature on the subject stresses the fact that in the last decade there have been several factors which increased the vulnerability of supply chains [2, 3, 5]. These include: natural disasters, terrorist attacks, the rapidly changing and unpredictable demand, shorter product life cycles, a reduction in the number of basic products components, reduced supplier bases, a reduction of buffers, e.g. in store levels and in delivery terms, more integrated and intertwined processes ongoing amongst businesses, more demand for JIT supplies, in shorter time windows, technological changes, cost pressure, the necessity to increase leanness and agility, increased use of outsourcing and off-shoring, dependence on suppliers.

2. RESEARCH PROBLEM

Some authors believe that higher vulnerability of supply chains defined as "exposure to serious disruptions resulting from the risk within the supply chain as well as from internal risks for supply chains" is a consequence of the application of lean supply chains strategies that has been taking place in recent years. In particular, it has become a general practice to keep inventories at extremely low levels which prevents buffering the breaks in the supply flow and causes disruptions. The above is stressed by Handfield, Blackhurst, Elkins and Craighead [5] who notice a conflict between the need to decrease the frequency and minimize the effects of disruptions in supply chains as well as a strive for cost reduction by implementing global economy strategies.

Similarly, Zsidisin, Ragatz and Melnyk [6] point to ”the dark side”, i.e. to the threats for supply chains based on such instruments as TQM (Total Quality Management), Six Sigma, Just-in-Time or lean management. The above results from the fact that on one hand the integration of supply chains and the use of lean management tools brings obvious profits, but on the other it affects such elements of supply chains which are believed to increase the risk of disruptions.

Considering the fact that the evaluation of risk level is based on two elements, i.e. the probability of its occurrence and its effect, following the analysis of literature on supply chain strategies, one conclusion seems to be obvious: perhaps the strategies of lean supply chains - just in time in this - have a positive effect on the probability of disruption, however, if and when it happens, the effects of such disruption might be much more unfavorable than in the situation when the just in time is not applied. To justify the need to take up research into the disruption risk of supply chain instruments an assumption was made that there is a relation between the level of risk and the applied supply chain instrument - for example Just in time.

This manner of formulating the research problem leads to the following thesis that the use of such supply chain management instrument as JIT affects the risk of disruption and 2 hypotheses.

H1. The application of JIT increases the probability of occurrence of disruptions;

H2. The application of JIT increases the negative effects of disruptions.

This research aims to enrich the knowledge of the issues on the risk of disruptions to supply chain management.

In the theoretical aspect, the research aim involves defining the notion of “disruption risk” especially in the contexts of its synonyms such as interruption, delay, deviation. Furthermore there is a need to identify the characteristics of disruptions in supply chains. Another theoretical aim includes defining the fundamental determinants of the selected supply chain strategies.

The research calls for providing answers to the following questions which are relevant to the management of supply chains and the development of knowledge on the subject:

- Does the use of JIT increase the likelihood and consequences of disruption?
- Has JIT been applied appropriately?

3. METHODOLOGICAL BASES AND LITERATURE REVIEW

The methodological aim includes operationalization of variables used in the analytical scheme and defining the method of measurement of the variables related to the disruption risk in supply chains. The finally aim is to verify hypotheses formulated based on a constructed simulation model and the performed simulations to research methods with which achieved the answers for this questions and verification of hypotheses, include: literature studies, empirical research with the use of statistical methods.

The source data for statistical analysis was obtained from questionnaires as it is impossible to use exclusively the data from secondary sources. The sample consisted of 195 enterprises, the use of JIT was declared by 84 companies (43.3%).

Risk has recently become the subject of Polish publications not only in the area of finances and insurance, but also logistics and supply chains. The risk of disruptions is a particularly meaningful and frequently stressed category of risk in supply chains. The issues of risk of disruptions are discussed by such authors as Świerczek [7], Kramarz [8]. Świerczek [7] pointed to the transmission of disruptions, i.e. the expansion of the negative effects of risk to a higher number of supply chain participants in the contexts of becoming mutually dependent on the companies which act within supply chains. Kramarz [8] built a model of strengthening resilience of supply chains from the point of view of material division within the supply chain of steel products. The literature

on the subject of disruptions on the world scale written in English primarily includes articles and scientific publications [9].

Marley [9] pointed to lean management, integration complexity, and their relationship with respect to the effects of disruptions and that the use of lean tools can create problems in the supply chain that have not occurred on such a large scale. Closer cooperation within a single supplier, while reducing the level of buffer stock and flow times, causes more frequent occurrence of disruptions. Sinha et al. [11] - the need to control the effects of disruption in the process of planning, controlling and monitoring the relationship between the organization and its partners. Zsidsin [6] − lean process should lead to a reduction in losses and in inventory levels, which in turn reduces costs, but these activities - regardless of the positive conditions for the application - can increase the risk of disruptions as well as their severity. Handfield and McCormack [5] saw a conflict between the need to take action to reduce the frequency and impact of disruptions in supply chains and the aspirations to reduce costs by the strategies of the global economy. Hendricks and Singhal [12] - an increase in the number of large and costly supply chain disruptions resulting from the introduction of lean management. Moreover, there is no publication that contains an analysis of the just in time in view of the risk of disruption.

Secondary research carried out in economic environments points to the fact that the managers approach the eventuality of supply chain disruptions as one of the most important threats for businesses. The industry data prove that 85% of global supply chains suffered from at least one disruption in one year. The negative effect of supply chain disruptions on the price of shares was also confirmed in a report published by PricewaterhouseCoopers [13]. The research carried out in 2005 [14] pertaining to risk management in Polish organizations (250 most dynamically developing companies) concludes that the most threatening factors for companies are disruptions in supply chains (34% respondents) and strengthening of the competitors (43% respondents). Also the result of the companies' own research on risk factors in supply chains showed disruptions to be a valid factor in everyday practice.

Viewing strategies in the context of single organizations, however, shall not be adequate as complete supply chains compete with each other on the market. When considering the tendencies in the development of supply chains, it is advisable to study supply chain strategies in the contexts of possible risk of disruptions. The current knowledge points to the fact that the subject of research itself, i.e. the risk of disruptions, is a new research area. The studies of the subject become even more innovative if the risk of disruptions is viewed in the contexts of the applied supply chain strategy.

Based on a literature review the concept of disruption in the supply chain was defined as unplanned event leading to a break in the normal flow of goods and information, which has a negative impact on the supply chain. The most general notion is a disruption in the supply chain. Considering the problem of disruption from the perspective of the company and not the entire supply chain, we are talking about disruption of supplies. On the other hand, when we estimate the probability of occurrence of an identified potential disruption and its possible effects, then we can talk about the risk of disruption.

4. THE ASSESSMENT OF THE IMPACT OF JIT ON THE PROBABLILTY AND EFFECTS OF SUPPLY CHAIN DISRUPTIONS

JIT impact on the likelihood and consequences of disruptions, rated on the basis of the results of quantitative analyzes responses given to the question:... "Do you think that the use of a JIT, as opposed to the situation that this instrument is not used, causes: [...]„

- a higher likelihood of a supply disruption,
- a situation when a disruption that occurs at our supplier's end would affect us sooner,
- a situation that if the source of risk was external (e.g. a natural disaster) and it affected our supplier, it would be more difficult for us to deal with its consequences etc.(see **Table 1**)

Each of these questions contain the same set of statements respondent could agree with them or not. By checking in accordance with their feelings - on a scale of 1-5: 1 - "definitely not" 2 - "probably not", 3 - "neither, nor so", 4 - "rather yes", 5 - "definitely yes". Given the questions, which used a five-point Likert scale, benefited from higher statistics measurement. The mean, standard deviation, and median.

When analyzing the JIT instrument and considering a question whether the probability of a supply disruption is greater when JIT is applied, one cannot see any prevalence of either - "yes" or "no" answers. The average of indications amounts to 3.13, and the standard deviation is 1.14. Thus, the use of JIT does not increase the likelihood of disruption. When assessing the increase in potential impact of disruptions, it may occasionally be seen - when analyzing the median - that half of the respondents agreed with certain statements. This was the case in the following variables: disruption that occurred at our suppliers' end, would affect us sooner if the source of risk was external (e.g. a natural disaster) and if it affected our supplier, it would be more difficult for us to deal with its consequences, if there were a supply disruption, the sales losses would increase. In the case of the use of JIT the average of all potential negative effects is higher than 3, therefore the respondents tend to answer: 4 - "rather yes", 5 - "definitely yes"."

Table 1 The answers for the question: Why did you decide to implement the JIT in your organization?

Q: Why did you decide to implement the JIT in your organization?	Average	Median	Standard deviation	Min.	Max
Our competitors enforced the implementation of JIT on us.	3.1205	3.0000	1.17284	1.00	5.00
JIT was imposed upon us by our client (we did not want to lose them).	2.9036	3.0000	1.15415	1.00	5.00
The use of JIT was our idea, we imposed certain conditions for the good of both parties.	3.3704	4.0000	1.03010	1.00	5.00
We would not have implemented the JIT, if there had been no trust between us with respect to information sharing.	2.7284	3.0000	1.16203	1.00	5.00
We would not have implemented JIT without the support of integrated IT systems.	3.2410	3.0000	1.13256	1.00	5.00
We have successfully implemented the JIT because the supplier fulfills their quality management duties.	3.3494	4.0000	1.17321	1.00	5.00
Long term financial profits from using the JIT are higher that possible losses that might be caused by disruptions.	3.4699	3.0000	0.95429	1.00	5.00
Before we implemented the JIT deliveries we had considered the threat of increased risk of disruptions.	3.5663	4.0000	1.09536	1.00	5.00
We had protected ourselves against the effects of disruptions within the JIT by introducing penalties for failing to meet the terms of deliveries.	3.0602	3.0000	1.17234	1.00	5.00
Thanks to the application of JIT we cope much better than our competitors with external disruptions.	3.6024	4.0000	1.02338	1.00	5.00
Since the time, we have been relying on the supplier within the JIT, the disruptions in their deliveries occur less frequently.	3.5293	4.0000	0.98200	1.00	5.00
We apply the JIT but we simultaneously monitor our supplier and support them in case external disruptions occured.	3.3614	4.0000	1.00703	1.00	5.00
JIT is used only for the goods in regular and continually controlled demand.	3.2289	3.0000	1.02797	1.00	5.00
We use the JIT if the scale of flow from the supplier is substantial enough.	3.4819	4.0000	1.02839	1.00	5.00
We have not decided to use the JIT without standardization.	3.1446	3.0000	1.06075	1.00	5.00

Q: Why did you decide to implement the JIT in your organization? (continue)	Average	Median	Standard deviation	Min.	Max
Within the JIT we plan the purchase of product ranges with no guarantee of their quality.	2.8554	3.0000	1.19074	1.00	5.00
We would not be using the JI if we could not be sure that we could eliminate the possible disruptions.	3.5060	4.0000	1.05198	1.00	5.00
In order to ensure the demand, we have set up a warehouse in the vicinity of our recipient so that we could meet their JIT requirements.	3.3049	3.0000	1.00233	1.00	5.00
Whenever there were disruptions within the JIT deliveries, it caused substantial financial losses to our organization.	3.3614	4.0000	1.03096	1.00	5.00
If we use the JIT deliveries, it is only for the standard components for which replacements may easily be found.	2.9398	3.0000	1.16189	1.00	5.00

However, the deviations from these values are large enough (about 1.0), thus a conclusion that the use of JIT increases the negative effects of potential disruptions would be an overstatement.

5. CONCLUSION

Based on the statistical analyzes, the hypotheses have not been confirmed. The present studies show that the use of JIT which is one of the basic tools of lean management does not increase the risk of disruptions in the supply chain. The analysis of the median suggests that a representative sample might prove that the use of this instrument increases the negative effects, yet it does not affect the increase in the likelihood of disruptions. The analysis should be based on conditions of the application of lean tools as well as on the correctness of their implementation. Therefore, it is suggested that risk analysis should constitute the starting point for the implementation of lean tools. Despite the falsification of hypotheses, achieving it is a contribution to enhancing knowledge of the disruptions risk in supply chain management.

The above data undoubtedly prove the relevance of supply chain disruptions and thus the relevance of theoretical studies on such disruptions. What is missing is a theoretical basis for the analysis of disruption risk. There is literature which points to theories that can be applied to explain the operation of companies within a supply chain, among others the theory of agency, the theory of transactional costs, the theory of key competencies, Porter's cluster theory, the theory of branch structure and the chain of value as well as the chain approach. As risk is a notion that is discussed by many types of sciences, especially the social science, mathematics, natural science or technology, the contemporary knowledge on the risk is cross-disciplinary, although each type of science only uses its part, one may point to certain theories or concepts which create a common foundation to all of them. In the economic sciences, the first elaboration on risk was presented by Willet in The Economic Theory of Risk and Insurance, which was followed by the expected utility hypothesis or the prospect theory. However, most analytic work on the risk of disruption itself includes the reports of consulting companies or standards defined by practitioners. Thus the lack of theoretical foundations with respect to the risk of disruptions of supply chains is an area that needs to be tackled upon by scientific research. Based on preliminary survey, there are a couple of theories which might be used in this area. These include the dynamic theories and follow the leader traffic flow models, loose coupling, normal accident theory, reliability theory, or the theory of black swan events. These theories, however, call for a detailed discussion, and their exact applicability for explaining the phenomena related to the risk of disruptions of supply chains is yet to be defined.

The current knowledge points to the fact that the subject of research itself, i.e. the risk of disruptions, is a new research area. Needless to say, this notion must not be simplified down to the phenomenon of demand

acceleration or to the notion of bottle neck. The studies of the subject become even more innovative if the risk of disruptions is viewed in the contexts of the applied supply chain strategy.

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