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Article

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ANALYSIS OF RISKS GENERATED BY SUPPLIERS DURING THE PERIOD OF ECONOMIC FLUCTUATIONS

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Abstract

The purpose of this article is to examine one group of supply chain risks, namely the current risks generated by the suppliers and their relations to the position of companies in the supply chain and the current economic fluctuations, as well as to gain the knowledge on how to mitigate these risks, including the cooperation between the partners. The research was conducted in two stages by means of a questionnaire analysis and follow-up of multiple case studies. The surveys used have registered certain signals showing increasing dependence on the suppliers, deepening imbalances in the supply chains and decreasing opportunities of reducing the presence of risks. The surveys have also detected tendencies leading to structural measures strengthening resilience of the supply chain. The areas for further research of supply chains risks and risks management are formulated based on the acquired findings.

Keywords: supplier risks, risks mitigation, supply chain resilience, inbound logistics, case studies, questionnaire searching

JEL Classification: M11, L23, L26, C81

Introduction

Supply chain management is a very complex function facing an enormous scope of inherent risks, ranging from the minor irritation of delays through to the destruction of an entire chain (Waters, 2007). As supply chains become more complex because of global sourcing and the continued trend to 'leaning/down', supply chain risk increases (Christopher and Peck, 2004). The factors increasing the complexity of supply chain management include for example scattering of the chain elements of the large territory, increasing the division of labour and the dependence among companies in the conditions of pressure to provide quick response. Next we can speak about critical fluctuations in the economy, unpredictable changes of demand, frequent changes of legislative rules, natural disaster and many others. Many of these phenomena occur in mutual conjunction.

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The experts, such as Christopher and Holweg (2011), Kotler and Caslione (2009), agree that we are living in the period of turbulences when one must count with unpredictable adverse occurrences and learn to handle them in such a way to make their impact as negligible as possible.

The basic classification of risks in supply chains is usually made according to the boundaries in the supply chain. Waters (2007) uses this perspective to distinguish risks within one organization, risks of mutual relations between organizations in the supply chain and, finally, external risks that come from the supply chain external environment.

This article focuses on one group of these risks - the risks coming from the suppliers. However, it does not examine them in isolation, but it does so in the context of the objectives of a supply chain as a whole. These objectives enable achieving the desired level of supply services at acceptable costs of all the supply chain elements.

According to Cranfield (2003), the supply risk relates to the potential or actual disturbances of the flow of product or information emanating within the network, upstream of the focal company. Therefore, it is risk associated with a company's suppliers, or supplier's suppliers being unable to deliver the materials the company needs to effectively meet its production requirements/demand forecasts.

The consequences of disruptions may spread from suppliers throughout the entire supply chain. Bălan (2008) describes the impacts of these chain effects.

There are numerous sources of risks coming from the supplier's side of the chain. They are related to the ability of a supplier, his responsibility, economic status and location. Also to the number of suppliers of the given item, the organization of supplies, communication method between the supplier and the customer, as well as the variability of the external conditions (natural, legislative, social) that may affect the activities of the supplier and the flow of supplies. The definition of the individual types of supply risks are presented by a number of authors. During the preparation of this article, we used especially the publications by Waters (2007), the methodology by Cranfield University (2003), Faisal (2009), Jüttner, Christopher and Peck (2003), Meredith and Shafer (2007), Slack, Chambers, Johnston and Betts (2006).

Risks coming from the suppliers may manifest themselves as a breach of the agreed delivery time, quantity or quality, incorrect documentation accompanying the delivery, incorrect packaging, delivery to a wrong place, damage to the packaging or the delivery content, etc.

Another common experience of supply side failure is a supplier bankruptcy or its withdrawal from the market (Cranfield, 2003). These events often happen without formal notice, causing considerable disruption; however, they can usually be anticipated with the right intelligence systems in place (Cranfield, 2003).

In some manufacturing branches, the companies are entirely dependent on a small number of dominant or special suppliers, which complicates the situation when there are problems caused by the supplier. Disadvantages of single sourcing are: more vulnerable to disruption if a failure to supply occurs, individual supplier is more affected by volume fluctuations; supplier might exert upward pressure on prices if no alternative supplier is available (Slack, Chambers, Johnston and Betts, 2006). Using more suppliers for one item (multiple-sourcing) enables you to acquire the necessary resources from alternate suppliers, to drive the price down by competitive tendering, to use wide knowledge of numerous suppliers. But it comes hand in hand with disadvantages, and it is (Slack, Chambers, Johnston and Betts, 2006) difficult to encourage commitment from suppliers, more effort is needed to communicate, and it is less easy to develop effective supplier quality assurance.

Insufficient communication about problems of a supplier brings another risk, which makes it difficult to respond quickly to the situation, because the customer is unable to take attenuating measures in advance. Among other factors related to this issue, Waters (2007) analysis the risks related to a decision of supplier outsourcing, particularly the loss of control and too much reliance on a single partner. Outsourcing needs an organization to switch to new type of operations – thereby replacing a set of relatively familiar and well-known risks with new ones that are less understood.

Location of suppliers in remote territories is one of the risks. Craighead and Blackhurst (2007) examined the influence of the supply chain density, the complexity of the network and how critical the individual nodes are to the significance of the supply chain disruption. Also concluded that practices such as supplier base reduction, which increases critical importance of a node, global sourcing, which increases the complexity, and sourcing from supply clusters, which increases the density, leaves the companies exposed to severe supply chain disruptions.

Excessive synchronization of supplies also leads to such a high dependence on the supplier that the customer is left with little room for manoeuvring (Wagner and Bode, 2008). This risk escalates when natural disasters, such as floods, tsunamis, earthquakes (recently more frequent) disrupt the possibility of supply for a longer time. Faisal (2009) points out to risks associated with ignoring the rules of corporate social responsibility.

This article is focused on identifying the current risks coming from the suppliers and their relations with certain attributes of organization of the supply chain and with the current economic fluctuations. Its aim is to determine whether these risks are currently changing, to what extent they can be avoided, what impact they have on other supply chain elements and what options the companies have to mitigate their impacts. The article presents the process and results of two consecutive surveys carried out in industrial enterprises of different branches. The form of a questionnaire survey was used in 2010 when most of the surveyed companies were affected by a significant decline of demand, and the form of multiple case studies was used in 2011 when a demand recovery was witnessed in many fields. The survey conclusions will be used to deepen the understanding of the changes in the supply chains and they will be used to guide further research in the area of supply chain risk management as a whole.

1. Methodology description

The preparation process of this article involves several steps. Firstly, a preliminary survey of the risk factors in logistics was conducted, taking into account both the factors within the organization and the factors related to the relationships with the suppliers and customers, and the factors coming from the environment outside the supply chain. This survey was carried out in 2010 using a questionnaire form on a sample of companies operating in the Czech Republic in order to identify the significance of the individual groups of risk factors according to the feelings of the respondents during the ongoing economic crisis. This article will provide a more detailed analysis of the data related to the supply risks. The follow-up survey covered only the supply risks and was conducted as a quality research using six detailed case studies performed in selected companies. These studies looked at the causes and demonstrations of the supply risks in the conditions of 2011, when companies were not so severely hit by the critical decline of orders.

1.1 Procedure of the questionnaire survey related to the supply risks

A survey of the risk factors was part of a wider investigation consisting of five parts: A - Survey of the occurrence and impact of risk events in logistics, B - A survey of the risk factors in logistics, C – The expected development of the risk factors, D - Risk Management, E-Improvement in logistics.

In Part B, which investigated the sources of risk, the risk factors were divided into five groups: B1 – demand risks, B2 – supply risks, B3 - risks of internal implementing processes, B4 – management risks within the organization and between organizations, B5 - environmental risks. A list of potential individual risks was created thanks to a team brainstorming of the resolvers. 46 partial risk factors were defined in total, 10 of which were the supply factors. The individual risks were identified by codes:

- B2.1 - Dependence on a small number of dominant or special suppliers,
- B2.2 - The risk of bankruptcy of suppliers,
- B2.3 - Long delivery times from suppliers,
- B2.4 – Problems of suppliers with quality, reliability of delivery time, keeping the quantity, level of accompanying documents,
- B2.5 - Lack of purchased items in the market leading to high price,
- B2.6 - Suppliers do not provide timely information on pending problems,
- B2.7 - Suppliers are located in remote and hard to access territory,
- B2.8 - Complexity of chain because of many interfaces,
- B2.9 - Dependence of the supplies on the type of transport
- B2.10 - Risk of damage to the supply caused by another subject (the carrier, third party).

The respondents expressed their opinions on the question, to what extent the factor is typical for their company. The following scale was used: 1 - not at all typical, 2 - negligible, irregular, 3 - negligible, regular, 4 - partial (sometimes), 5 - prevailing, 6 - fully typical.

The research was conducted using a questionnaire survey form during a period from June to October 2010. The respondents were represented by persons from production or production-distribution companies based in two heavily industrialized regions of the Czech Republic. The selection of the companies - respondents was a combination of random selection from a public database of companies and a deliberate selection from the sphere of enterprises, which had cooperated with us in the past. Companies of all sizes were roughly equally represented.

The questionnaire survey was conducted in three phases using electronic forms of the questionnaire, created in Excel and sent upon addressing the respondents by telephone or e-mail. The completed questionnaires in Excel were converted to SPSS, ordinal variables were introduced and databases were created.

The processing of descriptive statistics, identification of the absolute and relative frequencies, creations of bar charts and box plots were carried out in SPSS. The principle of box plot is shown in figure nr. 1.

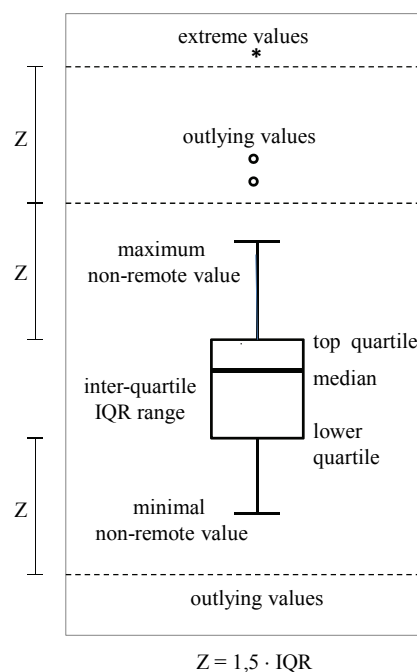


Figure no. 1: The principle of box plot

A box plot consists of a box and whiskers. The thicker line shows the median (x_{50}). The top and bottom border of the box represents the upper and lower quartile, i.e. x_{75} and x_{25} . The top, respectively bottom barriers represent the maximum, respectively minimum value that is not outlying yet (adjacent to observation). The symbol „o“ means outlying observations at a distance of 1.5 to 3 times the quartile range IQR ($IQR = x_{75} - x_{25}$) from the bottom, respectively upper border of the box. The analogical symbol „*“ represents the extreme

values exceeding 3IQR. For the symbols „o“ and „*“, it is possible to use numbers that mean the codes of the observations, thus identifying the given respondents.

The supply risk factors were organized into groups according to their typicality for the respondents' company, on the basis of the analysis of box plots.

1.2 Procedure of supply risk case studies

The causes and effects of the risks coming from the first level of suppliers and their links with the organization of the supply chain were investigated during the second stage. The aim of the research was to obtain data necessary for the consideration of improved organization of the incoming logistics in order to reduce the occurrence and impact of risks.

A qualitative research taking advantage of multiple case studies was applied. In general, the research using case studies focuses on a detailed description and analysis of one or several cases (Hendl, 2005). The aim of the case study is to capture the complexity of the case and to describe the relationships in their entirety. It is assumed that a thorough investigation of one case will allow us to acquire better understanding of other similar cases. At the end of the study, the examined case is incorporated into a broader context and can be compared with other cases.

The so called triangulation is one of the tools used to ensure the validity of the case studies, which means that more acceptable methods of data collection or more observers or a greater number of surveyed people are used to verify the findings, or the examination is performed in various local and time circumstances. A more detailed description of the ways used to ensure the validity are provided by Karlsson (2009), Lin and Zhou (2011), Silverman (2005), Hendl (2005).

The presented multiple case study used manufacturing companies as the focal organizations and the research was narrowed to the risks associated with securing essential raw materials and material inputs from the first level suppliers. The focal organizations were represented by 6 companies from different industrial branches, which had been chosen on the basis of previous cooperation. Particular attention was paid to selecting various company positions within the supply chain and enterprises with different types of owners. There were no mutual relations among the examined companies.

Semi-structured controlled interviews were applied for the data collection. A protocol of the case studies was prepared, including the purpose and objectives of the survey, definition of the types of respondents, sets of questions and sub-questions, the types of identification data about the respondents, the method of collecting and recording data, and the general procedure used for the data evaluation.

The sets of questions were formulated in order to carry out the interviews, and they were related to disruptions of deliveries from the suppliers and their solutions, the number of suppliers per one item, the method and criteria for the selection of suppliers, the location of

the suppliers, continuous evaluation of the suppliers, the forms of cooperation with the suppliers, as well as the considered inbound logistics organization changes.

Each of the sets of questions was elaborated on separate cards and was divided into sub-questions. Open questions prevailed, but *yes - no* questions and selective type of questions occurred as well.

To ensure the validity of the data collection, it was decided that, whenever possible, two survey team members will take part in each interview and two people in the company will be questioned simultaneously (usually the head of purchasing and the logistics department head).

An overview of the six examined cases is shown in table nr. 1.

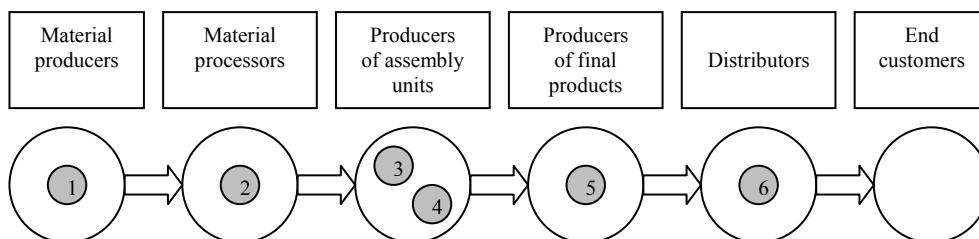
Table no. 1: Overview of the performed case studies

Seq. no of stud	Branch	Position in the supply chain	Number of employees	Production repetitiveness	Company ownership
1.	Chemistry	Producer of material and components	50-250	Batch, partly custom-made	Foreign owners
2.	Metallurgical secondary manufacturing	Material processor	50-250	Custom-made	Foreign owners
3.	Rubber industry	Supplier of parts and assembly	over 250	Batch	Czech owners
4.	Plastic manufacturing	Supplier of parts and assembly	over 250	Batch and custom-made	Czech owners
5.	Automotive industry	Final assembly	over 250	Batch	Foreign owners
6.	Electronics	Final product treatment and wholesale	50-250	Custom-made	Czech owners

The companies with foreign owners were a part of trans-national corporations.

The position of the individual companies in the supply chain in terms of the stages of the final product processing is clearly illustrated in figure no. 2.

Figure no. 2: Position of the examined companies in the supply chain



Studies 1-5 had a common feature of being involved in the automotive industry chains. Enterprises no. 3 and 4 delivered most of their supplies to the automotive industry. Enterprises no. 1 and 2 supplied a wide range of customer sectors and only a small portion of their supplies went to automotive industry chain. Company No. 5 was focused on the final assembly of cars.

The answers and comments were recorded on the spot and by hand into the individual record cards. After that, the collected data on each case were put together according to the examined categories and they were arranged in a table with the following sections: identifying information of companies, the features of organization and input logistics management, the main problems of inbound logistics (and their causes and consequences), the existing ways of preventing and solving problems.

The data analysis consisted of two steps:

- detailed analysis of the identified phenomena and relations within the scope of one study,
- cross-section analysis among the studies (detection of similarities and curiosities according to branches, according to the position in the supply chain and according to the owners).

The combination methods based on a pattern and methods of depth penetration into the text were applied during the analysis.

2. The analysis of the survey results

This part of the article summarizes the most important results of the analyzes of risks coming from suppliers.

2.1 Results of the questionnaire survey

The recoverability of the questionnaires was 33.4%, the basis of the data consisted of 82 respondents' answers. The sample of the respondents included logistics managers (27.4%), top management members and company owners (also 27.4%), while the remaining 45.2% were managers or specialists focused on various logistic functions. According to the position of the enterprises in the supply chain, 47% of companies were in the position of suppliers (materials, components or assembly units), 44% in the position of final producers, and the remaining 9% were distributors.

Table no. 2 provides an overview of eight identified most important risk factors out of the set of 46 surveyed ones, six of demand type, ten supply ones, six risks of internal performance processes, fifteen management risks and nine external environment risks. We are not presenting the data here due to their large scale, this table serves for orientation only.

Table no. 2: The sequence of the most significant risk factors identified by the questionnaire survey in 2010

Order of significance	Name of the factor	Groups of risk factors
1.	Dependence on a small number of large customers	Demand
2.	Increase of prices and fees	Supply + External environment
3.	Dependence on a small number of dominant or special suppliers	Supply
4.	Great customer demands regarding delivery times	Demand
5.	Large and unpredictable fluctuations in demand	Demand
6.	Long delivery times from suppliers due to the variability of demand	Supply
7.	Problems of customers with payments	Demand
8.	Lack of purchased items in the market	Supply

The table shows that four out of the ten examined supply risks are in the top positions in terms of their occurrence in the examined enterprises. Figure no. 3 presents box plots of distribution of respondents' answers related to the individual supply risk factors.

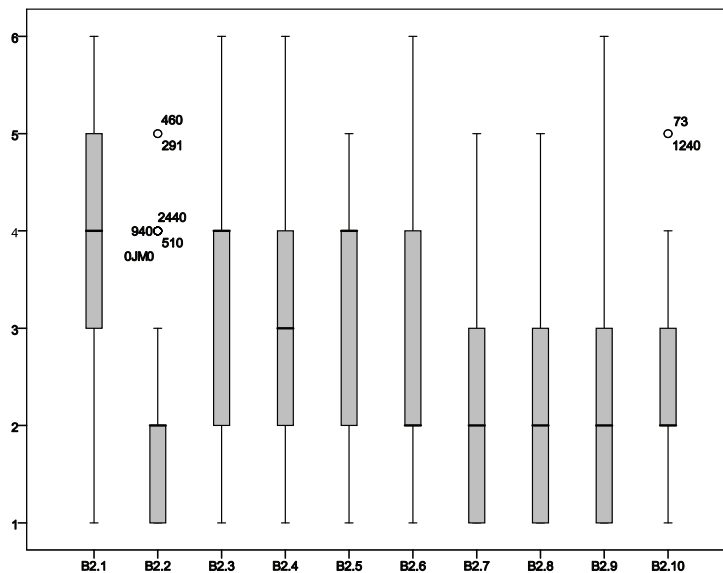


Figure no. 3: Box plots of supply risk factors

Description: 1 - not at all typical, 2 - negligible, irregular, 3 - negligible, regular, 4 - partial (sometimes), 5 - prevailing, 6 - fully typical.

The sequence of significance of the supply risks determined by the analysis of box plots is shown in table no. 3. The median position and the distribution of variability were taken into account. There were no extreme values in the box plots. The highest median value was 4 (partially typical factor), but the top whisker of five out of ten factors reaches the sixth level - fully typical factor.

Table no. 3: Classification of supply risk factors into groups according to the importance of their occurrence

Group	Median	Name of risk	Comments
I.	4	B2.1 – Dependence on a small number of dominant or special suppliers	Top quartile on level 5, whiskers to level 6 – fully typical factor.
		B2.3 – Long delivery times from suppliers	Top whisker reaches up to level 6.
		B2.5 - Lack of purchased items in the market leading to high price	Top whisker reaches level 5.
II.	3	B2.4 – Problems of suppliers with quality, reliability of delivery time, keeping the quantity, level of accompanying documents	Top whisker reaches up to level 6.
III.	2	B2.6 – Suppliers do not provide timely information on pending problems	Top whisker reaches up to level 6, however the median is 2 levels lower than in case of group I.
		B2.9 – Dependence of the supplies on the type of transport	Top whisker reaches level 6, when compared with B2.6, x_{75} and x_{25} are in lower values.
IV.	2	B2.7 – Suppliers are located in remote and hard to access territory	The box is limited only from the 1st to the 3rd level, the top whisker reaches level 5.
		B2.8 – Complexity of chain because of many interfaces	
		B2.10 – Risk of damage to the supply caused by another subject	Replies are gathered between the 2nd and the 3rd level, two outlying values.
		B2.2 - The risk of bankruptcy of suppliers	The top whisker reaches only the 3rd level, but there are 6 outlying values.

The situation of group I, which includes the three most typical identified factors, is illustrated by the bar charts of the replies frequency distribution (figure no. 4).

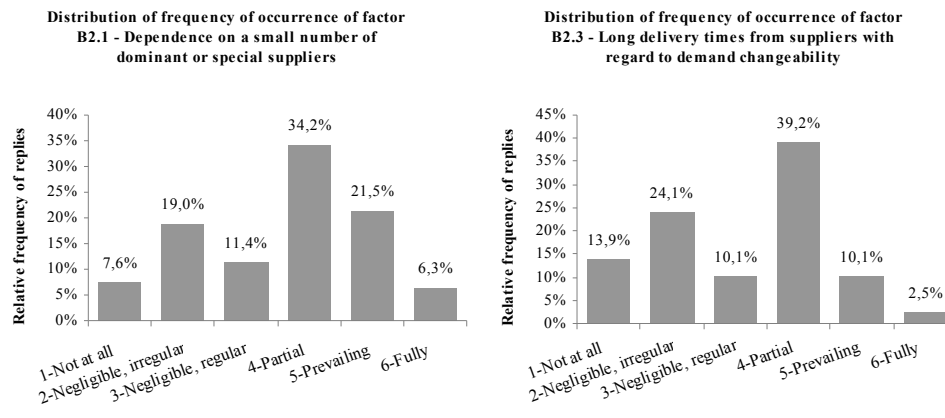


Figure no. 4: Bar charts of factors B2.1 and B2.3

The bar charts show that the dependence on a small number of dominant or special suppliers (B2.1) was prevailing or fully typical for the main material inputs for almost 30% of respondents (21.5% mentioned level 5, and 6.3% level 6) and further 34.2% responded the dependence is partially typical. 13% of the respondents mentioned long delivery times from suppliers (B2.3) as the prevailing or fully typical factor, and it was partially typical for additional 39.6% of respondents. It might be added that the lack of purchased items leading to high price (B2.5) was felt as a partially typical factor by 40.5% of respondents, as prevailing typical by 10.1%, and none of the respondents mentioned level 6 - fully typical factor.

2.2 The results of the case studies

All companies examined using the case studies were part of global supply chains. This means that the typical feature of these companies were prevailing share of foreign suppliers of basic raw materials and materials scattered in various parts of the world (China, Russia, Taiwan, Western Europe), as well as foreign customers. Only the respondent from the field of metallurgical secondary manufacturing had a prevailing share of close domestic suppliers.

Five out of six companies witnesses a demand recovery in 2011, the chemical industry enterprise witnessed even expanding demand (modern products used by high technology customers).

Although the prevailing strategy of alternative suppliers was used by the examined companies, two of the companies have shown dependence on an exclusive supplier. In four out of the six cases, the company did not have a choice of suppliers of the key items. There were situations when a list of approved suppliers was prepared centrally by the corporation departments for all companies, and the manoeuvring space of companies-respondents was limited to a decision which supplier from the list of approved suppliers to order the delivery from. Other respondents pointed out to a fact that their suppliers are determined exclusively by the customer which the questioned company depends on. This situation related mainly to companies supplying carmakers. A typical feature of the automotive industry is that even primary suppliers are from the beginning involved in the costly development of special products, as required by the automobile factory and they become the only partner for the item during its product life cycle. Companies that are situated in the middle of the supply chain (manufacturers of components and units) can't change the supplier, as a result of this system.

The main problems of inbound logistics found in all the examined cases included disruptions of supplies from suppliers and the enormous increase in prices of raw materials and materials. The respondents reported occasional occurrence, which is level 3 of the selected six-point scale in case of supply disruptions. A respondent whose company supplies automotive companies said that occasional occurrence of disruptions means 2-3x a month. Respondents replied that they had been late deliveries, partial deliveries, poor quality deliveries and damaged deliveries, and failures to provide information on delayed delivery in advance.

Problems with enormous increase of input prices were discovered in half of the cases. These were companies processing raw materials and basic materials. For example the price of natural rubber during the 1st half of 2011 increased by 80% as a result of flooding of the rubber plantations. The prices of certain refining materials for secondary manufacturing metallurgical company have increased by 40% to 70% during the last two years.

The majority of the surveyed companies said that a new phenomenon appearing in 2011 was a significant increase in bargaining power of the suppliers. They have reported the following findings:

- *Some suppliers reduced production in times of economic crisis after 2008 and some even terminated their production. Now, they are not able to respond to the growth in demand. A supplier of one raw material, where there were three global producers, has closed its plant now. The result is a lack of this item in the market.*
- *We are under the impression that the suppliers are now working with larger batches in order to utilize the capacity.*
- *Up to 2010, our syndicate as a whole had strong position when selecting the suppliers, as the world's no. 1 producer. During the turn of 2010-2011, the suppliers have become the dominant subjects dictating the terms.*
- *The suppliers keep dictating the prices; they have been increasing the minimum ordered quantity and shortening the invoice maturity. We traditionally used to purchase one palette of special additives for production, now the supplier sets the minimum order quantities to the entire truck. This causes enormous increase of inventory.*
- *The suppliers now decide whom to conclude a contract within our field of distribution of electrical engineering products. They prefer strong partners-distributors.*

A company buying electronics from Asian suppliers saw a great risk in long reloading times of orders (risk of unsaleable stock).

The examined companies have not registered a case of bankruptcy of suppliers of main input items used for manufacturing.

Except for one case, the respondents have stated that consignment warehouses are applied to a small portion of the total volume of inputs and only for selected items (such as spare parts or special packaging).

The surveyed companies have been solving disruptions of deliveries from suppliers by partial use of safety stock, by supplying their customers per partes (with high cost of non-standard and multiple transport) in order to avoid the threat of production halt of customers plants (for example, a penalty for stopping assembly lines in the automotive factory caused by the suppliers is *around 2 million CZK per day, i.e. 100 000 dollars*), by fast transfer of missing stock from other companies engaged in the same field (there was an example of cooperation with a competitor).

Most of the companies have not developed written procedures in response to the unreliability of suppliers and they have used the know-how of logistic specialists, coordination of actions taking advantage of logistic departments with wide powers (coordination of flows from product and process designing through purchasing, production planning to sales) and have developed informal relationships with the co-operators.

Despite that, three of the six respondents stated that they were sometimes unable to handle the problems arising from unreliable suppliers and the level of supply services to their customers deteriorated (worse delivery times, delivery emergencies from warehouse, delayed or incomplete deliveries to customers). The respondents stated that if they used alternative local or near suppliers to operation problem solving, they couldn't fully replace the dropouts of remote suppliers.

Although some companies received penalties for failure to comply with the deadlines or quality included in their contracts with the suppliers, in fact they did not apply this tool because of their dependence on the supplier.

The surveyed companies from the chemical and rubber industries stated that it is possible to use substitute materials in the absence of input materials or additives, but it is necessary to perform laboratory tests and to develop a new formula. This slows down the reaction and increases the costs. Representatives of these companies stated that excessive variation range of their manufactured products (and therefore too specialized materials) had become a great risk for them.

However, the case studies have also led to finding elements of both formal and informal cooperation with some of the suppliers (in four of six cases). One company with exclusively Czech owners said: *In times of crisis when the company had a problem with cash flow, our suppliers helped us by allowing postponement of payments. We have long-term and fair relationships with the suppliers.* The reported forms of cooperation included *common development with the suppliers, if necessary (of materials or protective packaging materials), conferences with the suppliers, where the suppliers were evaluated and new trends in customer demands and their impacts on the suppliers were discussed, and joint planning of supplies.* One company said: *We have provided a "rest" to some of the suppliers which got into capacity problems by purchasing, for example, from the other supplier of a pair of alternative suppliers for the entire year.*

The responses to a question "what measures to mitigate the risks in the future the companies are considering" differed. In cases where a company has been a part of large corporations, there were these types of corporate actions: insourcing production of important purchased items, the unification of the raw materials portfolio used within the corporation in order to facilitate easier realignment of production between companies if necessary, increase the proportion of local suppliers, increasing the flexibility of the system of selection of suppliers by the corporation headquarters, expanding the form of consignment warehouse and the Vendor Managed Inventory system with additional inputs. On the other hand, the companies that had lower bargaining position (Czech companies as producers of components) were mostly sceptical: *dependence on suppliers selected by the customer can't be changed, because they are large customers which the company existence depends on.*

3. Risks analysis generalization and conclusions

The article presented the process and results of two closely related surveys. The questionnaire survey was of orientation nature and it has indicated significant phenomena whose contexts were better shown by the deeper case studies. The case studies have proved to be a very valuable source of information about the complexities of the supply chains. Although the surveys were primarily focused on the risks coming from suppliers, signals of tendencies related to risks and problems in the chains as a whole have been acquired as well. Joining the preliminary questionnaire surveys with more detailed case studies proved to be useful.

The questionnaire survey was conducted at the time of critical decline of demand (we asked about the period of 2008-2010). This period has already shown that the supply risks are significant and that they are dominated by the dependence on dominating and special suppliers, lack of purchased items in the market and an unexpected rise in prices.

The follow-up case studies, which were conducted at a time when there was some recovery in demand in many areas, have provided a far more detailed view of the current contexts in the supply chains and they have suggested that the supply risks were even deeper, due to the economic fluctuations.

The findings from the case studies can be generalized in the figure no. 5 capturing the framework relations among the factors of supply risks (they are not only on the side of the suppliers, but also on the side of the customers, i.e. the focal organizations), arising due to adverse events and their consequences.

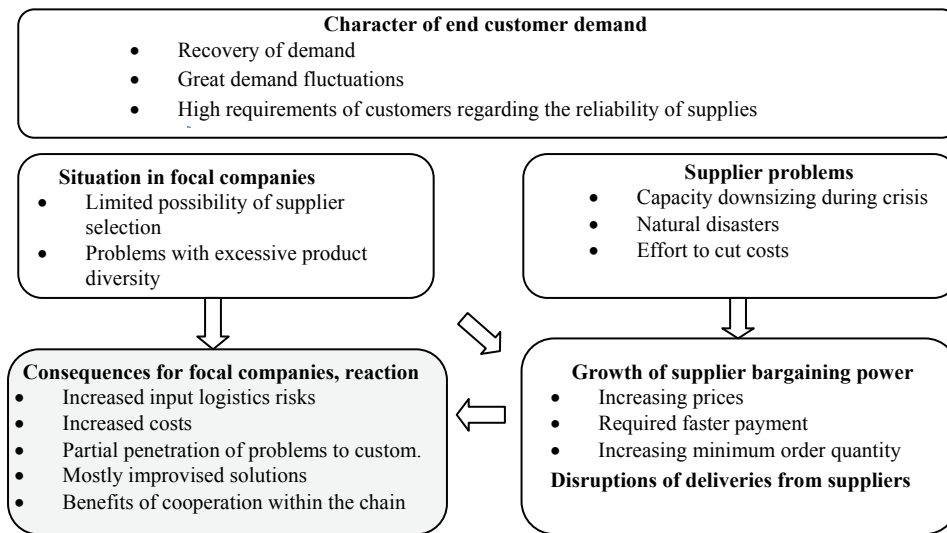


Figure no. 5: Summary of the most significant recognized relationships

The recovery of demand caused destabilization of the supply chains and it strengthened the enforcement of individual interests of enterprises in the chain, especially those in position of a large supplier or a major customer. Since the surveyed enterprises were parts of the global supply chains, it is likely that a similar situation will occur in other companies and in other territories than those examined.

The surveys have confirmed that, for various reasons (natural disasters, the bargaining power of suppliers, economic fluctuations), the possibilities to reduce the occurrence of risks are limited. The economic fluctuations magnify the risks, thus becoming another important factor of imbalance in the supply chains. The discovery of the circumstances under which enterprises are virtually excluded from the selection of their suppliers represented a rather serious finding (suppliers are determined by the parent company, customer, or supplier). The risks are related to the position of the enterprise in the supply chain. Enterprises situated in the middle of the chain (manufacturers of components and units), especially smaller ones, are exposed to risks from two sides. Their major customers determine their material suppliers, but the consequences of unreliability of the selected suppliers are not compensated by any means by the customers. As far as the bankruptcies of suppliers are concerned, they were not recorded as a significant factor during the surveying period in the examined companies. However, the situation could change over time and it would be useful to evaluate their frequency in the future, according to the individual fields and also their impact on the functioning of the supply chains.

The conclusions from the case studies also confirm the fact that the supply chains where the supplies follow the principle of just-in-time (especially in the automotive industry chains) are highly vulnerable. At the same time, the vulnerability has negative effect on the companies in more remote levels of the chain (it turned out here that there were companies in the middle of the chain, depending on large suppliers and large customer at the same time). Isn't it the right time (in relation to green logistics and environmental sustainability) to reassess the role of inventory and to create a common strategy including the inventory management in the supply chains?

Large corporations are beginning to respond to the increasing risk by preparing important measures for which it is common that they are either focused on reducing dependence on suppliers (insourcing), or to increase the ability to easily handle the resulting risk events (standardization), increasing the share of local suppliers, consignment stores. These structural measures can lead to increasing of supply chain resilience, but on the other hand it is necessary to consider, that the new risks could be connected with them.

The surveys have also indicated some positive phenomena - certain elements of cooperation within the supply chain, but they were only exceptions. Nevertheless, it would be useful to examine to what extent the cooperation in the chain is systematic and who initiates it.

The concrete situations from the case studies confirm the urgency of systematic risk management, not only within a single organization, but in the entire supply chain. The economic fluctuations on the one hand can lead to deeper individualistic attitudes of enterprises but, at the same time, they can also function as an accelerator of cooperation in situations where the dominant players in particular will realize that only mutually beneficial solutions can help them to cope with the increasing risks in the long term.

The acquired findings have a character of signals. The surveys had the character of a probe and the recorded tendencies should be verified by further empirical research. The questions to be answered by the further research could be the following:

- what ways to reduce the dependence on significant and special suppliers are applied in enterprises and how successful are they?
- are the discovered trends towards insourcing of main component suppliers and replacing remote suppliers with close suppliers significant, and what are their barriers and secondary risks?
- what are the practical changes in the cooperation within the supply chain towards sharing the risks, costs and benefits? To what extent are they accelerated by the economic fluctuations?

This research should be performed for various kinds of supply chains and should take into account their specifics.

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