

University of Economics in Katowice

Volume 12

2013

*Journal of*

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# Economics & Management

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**A CONCEPT OF MODELS FOR SUPPLY  
CHAIN SPECULATIVE RISK ANALYSIS  
AND MANAGEMENT**

## Introduction

There is a growing need for better understanding and handling of risk among decision-makers managing organizations cooperating in contemporary supply chains. The number of risks and their impact is growing, as supply chain members are becoming more and more interdependent, and their business environment is a source of many challenging situations. When it comes to risk analysis and management in the context of supply chain, it is worth to recognize which risk can bring negative or positive effect for a supply chain. In other words, successful risk analysis and management should consider its speculative nature. Due to a lack of concepts useful to analyse and manage speculative supply chain risk, the aim of this paper is to suggest a proper framework for such processes based on the literature review.

### 1. Defining supply chain speculative risk

Because of a significant growth of modern supply chain vulnerability, there is an increasing need to highlight the importance of risk analysis and recognize the methods of managing it. In the context of this paper, it is very important to distinguish between the terms such as certainty, uncertainty and risk, and consequently between pure and speculative risk. Certainty means simply a lack of doubts, while its antonym, uncertainty, can be defined as doubting in the ability of anticipating the effects of present activities. Finally, risk can be generally defined as potential event's variability of known probability and impact. Therefore, the fundamental difference between uncertainty and risk is the possibility to measure the latter. Consequently, we can manage risk, while the idea of managing uncertainty seems to be completely unrealistic (Williams, Smith, and Young, 2002).

Undoubtedly, uncertainty is a very important issue in contemporary supply chains. Uncertainty – which is always a negative phenomenon – causes the ineffectiveness of processes, which, in effect, do not add the desired value. Moreover, uncertainty results in waste, because it forces the supply chain decision-makers to generate bigger safety buffers or greater capacity to prevent disturbances in the processes managed by them. Such protection constrains operational performance and suspends the competitive advantage of a single firm participating in a supply chain, or of the supply chain as a whole (Vorst, Beulens, 2001). J.G. A.J. Van der Vorst and A.J.M. Beulens (2001, p. 412) suggest to define **supply chain uncertainty** as follows: „Supply chain uncertainty refers to decision making situations in the supply chain in which the decision maker does not

know definitely what to decide as he is indistinct about the objectives; lacks information about (or understanding of) the supply chain or its environment; lacks information processing capacities; is unable to accurately predict the impact of possible control actions on supply chain behaviour; or lacks effective control actions (noncontrollability)”.

On the other hand, **risk**, understood as a measurable uncertainty, may be described (Andersson, Norrman, 2003, p. 380) as:

„(...) a quality that reflects both the range of possible outcomes and the distribution of respective probabilities for each of the outcomes, it can be calculated by following general formula:

$$\text{Risk} = \text{Probability (of the event)} \times \text{Business impact (of the event)}$$

This kind of uncertainty may be considered on different levels and from the perspective of different human activities (Krupa, 2002):

1. On the **information level** there can be distinguished:
  - full information state (certainty area),
  - satisfactory information state (risk area),
  - incomplete information state (uncertainty area).
2. On the **functional level** risk can be distinguished in areas such as:
  - research and development,
  - logistics,
  - finance and controlling,
  - production,
  - marketing,
  - administration.
3. On the **symmetric level** risk can be considered as a threat, which means that from the decision-maker perspective taking risk can only bring loss (**pure risk**) and as a threat and an opportunity as well (**speculative risk**). Hence, speculative risk is included in undertakings and activities which can bring profit as well as loss. It may be stated that this kind of risk is a business driving force – businessmen sometimes say “No risk, no profit”.

Continuously, speculative risk is included in supply chain activities (e.g. a decision to use outsourcing can bring many benefits for the whole supply chain, while causing significant disturbances at the same time). For the purpose of this paper, the author suggests to define **supply chain speculative risk** as a possibility of obtaining negative or positive consequences of future events occurring within the supply chain or its environment, of known probability and impact.

## 2. Nature, role, and implementing guidelines of risk management

D. Borge (2001) implies that a decision-maker has to act according to his or her beliefs. Even if he or she does not have enough information about the potential effects of his/her activity, a decision has to be made. This is because even not doing anything is a kind of activity. The decision to remain passive brings certain consequences, just like any other decision. Not doing anything can mean a loss of valuable opportunities or enabling potential threats to become reality. However, idleness can also mean that potential options have not been used yet, because the decision-maker is waiting for new information. Regardless of what decision will be made, the action is always based on some kind of belief about its potential effects, even if that probability is determined in a subjective manner.

P. Drucker (1976), a classic author writing about management sciences, states that managers tend to assume that nothing can be done in order to change the situation. Relatively common are attitudes which can be summarized by the following sentence: 'If we knew how to overcome constraints of a given process, we would do that'. Indeed, such process can be difficult to change, but saying that it is impossible to improve it is certainly not true. The author encourages decision-makers in organizations to act, because in his opinion:

- threats and constraints of a given situation are usually well-known or can be easily recognized;
- every crucial change proposed, which aims to overcome threats, is perceived by members of given organizations as unlikely or even impossible, but it is often coming at the right moment;
- every time a serious threat or constraint can be transformed into an opportunity, the economic effects of such transformation are usually significant – that means that such a threat/constraint can be regarded as an important opportunity; overcoming such threat/constraint almost always requires a systematic search of innovations, i.e., in short, a continuous analysis to determine the requirements of new capacity (production or service), or new information and systematic efforts to develop those innovations (Drucker 1976).

On the one hand, decision-makers are becoming aware that their protective or even passive attitudes against risk will not solve the problems they are facing and can make their situation even worse. On the other hand, in today's economy the number of risks and their impact on organizations is increasing. As a result, risk management is gaining growing importance in many different areas of human activity – insurance, finances, managing different organizations (as single entities or as parts of supply chains), design, politics, research & development, etc.

According to P. Sienkiewicz (1994), the beginning of risk management concept has to be traced back to 1920s, when the so-called *risikopolitik* was developed in Germany, and 1930s, when American insurance companies started to implement risk management practices. The main aim of German *risikopolitik* was to secure different types of business against the effects of uncontrollable inflation and, in consequence, to make them able to survive. T.T. Kaczmarek (2005) remarks that risk management played a historical part in many 20th century events important from the economical, political, scientific and technological points of view. Wars have to be mentioned in particular, namely, among others, the Russian-Japanese war, the First and Second World Wars, the Korean War and dozens of local conflicts on different continents. Many other important events have to be mentioned as well: the production of the very first car, the invention of television set and computer, the big economic crisis in 1930s, the rise and fall of totalitarian systems (fascism and communism), the invention and production of atomic bomb, the construction of nuclear power stations, the rise of environmental dangers and global warming. The above list can be supplemented with other events, such as the sinking of Titanic, the ecological disaster in the chemical factory in Servesio (Italy), the explosion of a nuclear reactor in Chernobyl (Ukraine), the Challenger catastrophe (USA), the hijacking of Exxon Valdez ship, the terrorist attacks in New York on September 11th. Last but not least, natural phenomena in different regions of the world, such as earthquakes, hurricanes, tornados and cyclones, have to be taken into consideration. All of these situations stimulated the development of a new multidisciplinary field encompassing management and economic sciences, i.e. risk management.

Risk management is also an object of growing interest in the supply chain management area. In 2002 "The Economist" conducted a survey to obtain full understanding of the new supply chain management concept's influence on executives working in international companies (Spekman, Davis, 2004). More than 65% of them declared that their organizations are now and will be even more dependent on the relationships they develop with different external organizations in order to accomplish their business goals. In their opinion, the most important features to be considered when choosing a vendor or service provider are the following: high level of expertise, reputation and excellent recognition of customer needs and requirements. At the same time more than 65% of respondents expressed their fears that such strong interdependencies between their organizations and business partners can lead to a loss of control and higher vulnerability. Therefore, on the one hand the popularization of the supply chain management concept can bring significant benefits to the organizations, however, on the other hand it increases the interdependence of supply chain members, as they intensify

their efforts to improve efficiency and effectiveness. The research conducted by “The Economist” confirms once again a growing need to supplement the supply chain management concept with the risk management factor.

There is a number of reasons for the increase of the importance of risk management in contemporary organizations. Among others, it should be mentioned that (Sadgrove, 1996):

- Law regulations are becoming more complicated, their number is growing (e.g. intensive E.U. legislation activity can be observed), and they are much more restrictive.
- Insurance policies are much more expensive and difficult to obtain. Moreover, insurance companies more frequently demand proactive risk management from their customers. In addition, it has to be noticed that insurance payments often do not fully cover losses and that the process of pursuing an insurance claim is long-lasting. Finally, not every asset can be insured (e.g. lack of reputation) and insurance itself does not prevent the occurrence of loss.
- Business clients more often than before try to transfer the responsibility for losses to their suppliers and are more demanding with reference to the supplied goods and services. The shareholders of customer organizations are also much more often interested in their suppliers’ vulnerability, because they are aware that as a result of today’s growing interdependencies between companies’ (e.g. through implementation of the supply chain management concept), the risk impacting their suppliers can also have an indirect influence upon them.
- Today societies are more critical against business activity and their expectations regarding companies’ attitudes towards ecology or product safety issues are increasing.
- Managers working in contemporary companies have already obtained sufficient expertise collected as a result of previous experiences of other companies in the area of risk handling and they are fully aware of the importance of risk management. Also employees demonstrate an increasing level of specialization and professional skills, and the scope and complexity of today’s managers’ tasks and objectives is growing because of globalization.

The review of risk management definitions presented below is oriented on the enterprise management, because this is the context relatively closest to the supply chain management area. Among others, the following examples of definitions can be cited:

- A bundle of activities and tools achievable for a company, which enable to reduce the impact of risk on company’s activity and performance and to ma-

ke optimal decisions aimed to reduce risk. Precise recognition of risk nature and impact allows to choose right activities preventing its negative effects in a right time (Michalski, 2004).

- Searching and taking actions which should secure the decision-maker against losses higher than those acceptable according to the adopted security level (Krupa, 2002).
- Set of mathematical-statistical and heuristic methods aimed to make optimal decisions about right activities, as well as means and ways of achieving the established goals of the enterprise (Penc, 1997).
- Set of activities aimed to determine the right way of risk handling (*Leksykon zarzadzania*, 2004).
- The ability to handle the risk (Chong, Brown, 2001).

It can be clearly concluded that the first two definitions emphasize the negative nature of risk (risk as a danger), and the rest of them assume that it is a neutral phenomenon. In other words, they are not sufficient to manage speculative risk (which can bring loss and/or benefit). M. Krupa (2002, p. 40) is one of the authors who propose the approach towards risk management oriented on its speculative nature. In his opinion (**speculative**) **risk management** is „(...) a set of activities connected with planning, organizing, motivating and controlling of personnel, as well as material and information means connected with business activities, which are characterized by probability of resulting success and/or failure (profit and/or loss)”.

D. Borge (2001) presents a similar opinion when claiming that risk management means taking rationale, well thought actions to use opportunities by enlarging the possibility of achieving beneficial results and reducing the possibility of achieving negative results. Also T.T. Kaczmarek (2005) states that enterprise development is connected with threats as well as opportunities, and thus the main aim of risk management is to identify both threats and opportunities. Finally, F. Wharton (1992) claims that risk management should not be focused only on pure risk. Thus, rational risk management approach should be based on **three cardinal rules**:

- maximizing expected opportunities,
- avoiding threats,
- ignoring less probable possibilities.

The approach implied by the above-mentioned authors should be popularized among decision-makers in today's organizations, because, as it has already been stated, situations perceived as threats (or constraints) can potentially bring great opportunities, if they are treated in a right manner. It should also be recognized that risk management:

- can have reactive or proactive orientation;
- should be treated as a continuous process in which all members of an organization are truly engaged and should be an internal part of the overall organization management process;
- needs the involvement of the whole organization to result in maximum effectiveness;
- is crucially important for the success of an organization functioning in today's business environment (Scarff, Carty, Charette, 1993).

The very first of the above-mentioned postulates needs some further explanation. In general, organizations can present one of two attitudes against risk and, as a result, adopt different risk management orientations. Reactive risk management is adopted by organizations clearly stating their risk acceptability levels. Those levels are expressed as specified objectives and then achieved through decisions made by applying rules based on quantitative analysis. Such orientation requires risk anticipation, its quantification and the specification of its effects. It constrains the actions of a given organization connected with risk management to the situations which the organization actually faces and is directly threatened by. Such oriented organizations prefer avoiding risk or transferring it to other entities.

However, C. Smallman (1996) claims that organizations successful in risk management are focused more on risk prevention, its reduction or acceptance by adopting a more proactive orientation in risk handling problems (as opposed to simply reacting to risk). Proactive risk management is based on the assumption that risk anticipation is constrained by the uncertainty experienced by decision-makers and that the environment of an organization is continuously changing. Thus, developing models which support the decision-making process, as well as the decision-making process itself, can be a significant challenge.

### **3. Review of risk analysis and management concepts and considerations connected with adopting them for the purposes of supply chain members handling with speculative risk**

A broad review of different concepts of constructing the process of risk management conducted by the author of this paper has resulted in three main conclusions, namely:

- models of risk management process which consist of different number of phases (or steps) can be found in literature from different disciplines – there



can be found models consisting of three or four phases (e.g. Smith, Merritt, 2002), as well as models which are complicated constructs made of many more phases or steps (e.g. Scarf, Carty, Charette, 1993);

- because of the above-mentioned fact, the phases of risk management process proposed in the literature include different scopes and kinds of particular activities (e.g. some authors claim that risk analysis should precede risk management, while others state that it is just one of the components of risk management process;
- a significant number of authors (see: Carter et al., 1994; Zsidisin et al., 2000) emphasize that risk analysis and risk management should be separated processes, because the first one prepares decision-makers to manage risk – in other words, risk management is not feasible before risk analysis has been done properly.

The author of this paper agrees with the postulates that risk analysis should be treated as a separated process preceding risk management. Thus, as a starting point for further considerations, it is suggested to adopt the concepts of risk analysis and risk management discussed briefly below. When it comes to risk analysis, D. White (1995) states that this process should consist of three main phases:

- risk identification, which includes determining possible kinds of risk, as well as their sources, causes and effects;
- risk measurement (risk estimation), which includes determining risk probability and impact, risk description and quantification;
- risk assessment, which includes determining risk severity and acceptability from the perspective of an organization facing risk, as well as enlisting and comparing different positive and negative risk effects.

Properly constructed and clearly described is the risk management model presented by B. Carter, T. Hancock, J. M. Morin and N. Robins (1994). According to them, risk management process should encompass the following four phases: planning, organization, realization, and control.

It still needs to be recognized what specific attributes such constructed model of risk management should have in order to meet the requirements of handling speculative risk in organizations cooperating in supply chains.

According to J. Teczke (1996, p. 60), the speculative risk management model should be:

- highly flexible (to enable an organization to quickly react to environmental changes and new decision situations) and focused mainly on future events;
- functioning as an internal organization management tool which ensures to rationalize the process of planning, organizing, motivating and controlling different activities and it should encompass the whole organization;

- written in a business language to enable rational and objective decision-making on strategic, tactic and operational levels of an organization.

With reference to the cooperation between organizations in supply chains, P. Kajuter (1993) emphasizes that when they implement the risk management process, they should integrate it with the management of the whole supply chain. He also suggests primary rules to be considered when managing risk in a supply chain, namely:

- supply chain risk management requires close cooperation of this supply chain's entities;
- risk identification, made before risk management, should be conducted by all supply chain members continuously;
- open communication about the effects of risk identification is crucially important for the supply chain success among its members;
- when undertaking different actions in a supply chain, different kinds of risk which can influence each and every supply chain member should always be considered;
- supply chain risk should be managed effectively;
- risks which cannot be avoided or eliminated have to stay under continuous control of decision-makers in a supply chain.

When considering concepts, requirements and rules presented above, the author of this paper decided to construct risk analysis and management models proper for supply chain organizations handling with speculative risk. These models will be discussed in detail in the next part of the paper.

#### **4. Models of supply chain speculative risk analysis and management**

The general model of speculative risk analysis and management from the whole supply chain perspective is presented in Figure 1. (model A). This model places speculative risk analysis and speculative risk management processes in a broad context, including all members of the supply chain directly exposed to such kind of risk.

First, risk will affect directly the supply chain member which made a decision related to its business (company 'X'). However, because this is a member of a supply chain and cooperates with other members to achieve the goals and objectives of the supply chain, its decision will also affect its supply chain partners. Because the number of supply chain members can be significant, the model presents in a symbolic way the main parts/relations which can occur in such a complicated business network, i.e. the decision-making company, its direct customer

and supplier (as main parties of a transactional process) and its logistic service provider (as a facilitator of supply chain processes). Instead of a graphical presentation, it has to be emphasized that according to the ultimate supply chain concept, speculative risk as a result of decision made by one of supply chain members can affect (directly or indirectly) all its other members. What such a formulated model also indicates is that the process of speculative risk analysis should precede the process of speculative risk management. Moreover, these two subsequent processes should be integrated with the management system of each supply chain member and, at the same time, with the whole supply chain management system.

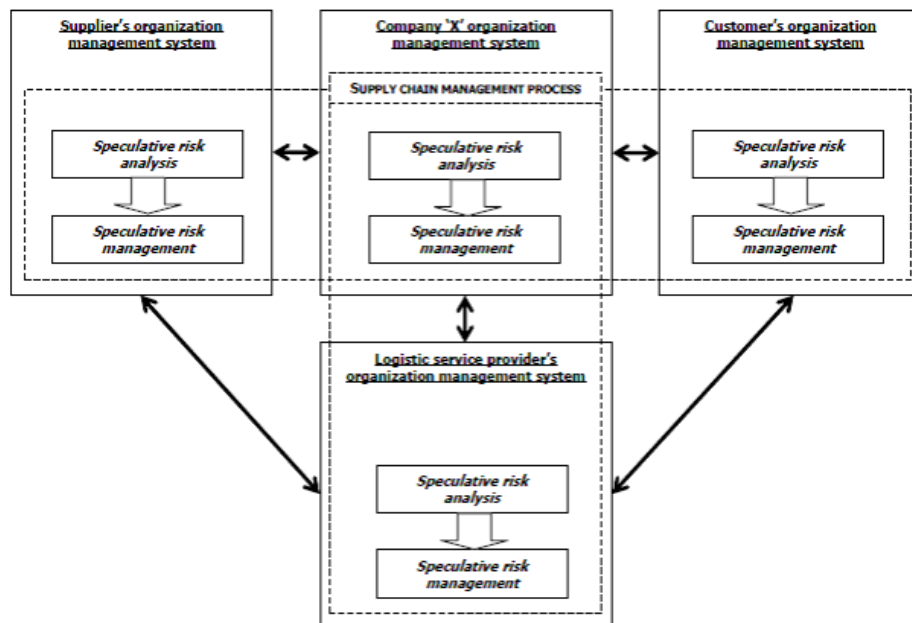


Figure 1. Model of speculative risk analysis and management from the whole supply chain perspective (Model A)

Because the model presented in Figure 1 provides only an overall view of supply chain speculative risk analysis and management concept, its fragment was extracted and described more precisely (see: Figure 2). In other words, Figure 2 illustrates a new model (model B) which presents supply chain speculative risk analysis and management concept from the perspective of bilateral relation in-between two given supply chain members. One of those is a decision-making company 'X', which is a source of speculative risk from model A and the other is one of its supply chain direct cooperators (it can be for example its customer, supplier or logistic service provider from model A).

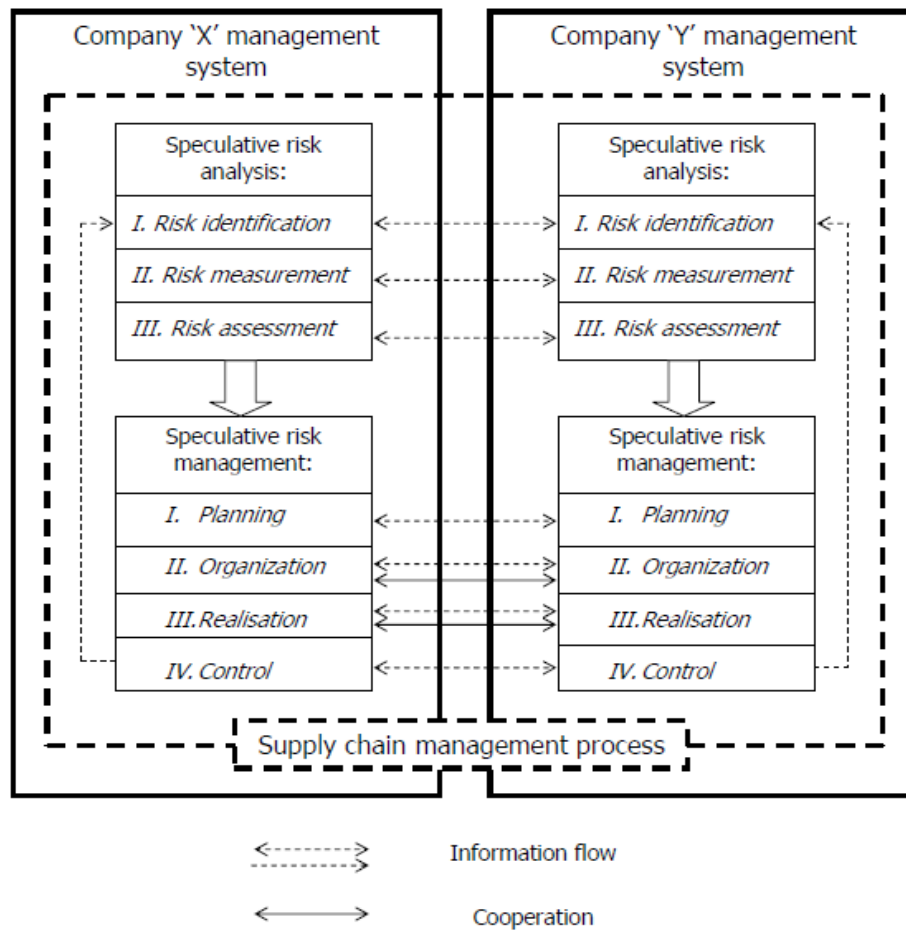


Figure 2. Model of speculative risk analysis and management from the perspective of bilateral relation in-between two given supply chain members (Model B)

The perspective adopted for model B purposes ensures a more detailed insight into the nature of relationship and cooperation between both presented companies needed to run a supply chain speculative risk analysis and management processes in a proper and effective way. Most of all, model B clearly indicates that a two-way continuous communication is necessary during the speculative risk analysis process, as well as during each phase of risk management. In other words, both partners should analyze speculative risk from their perspective and then inform each other about the results of such analysis. They should also share information about the effects of their efforts at each and every phase of the speculative risk management process. What is more, model B shows that the controlling phase of speculative risk management should ensure feedback necessary

for further risk analysis, which enables continuous improvement of the speculative risk management process. Model B also implies the necessity of compliance and coordination of both companies' activities during the organization and realization phases of the supply chain speculative risk management process in case of preventing suboptimal solutions.

## **5. Supply chain risk analysis and management initiatives**

As a few risk analysis and management concepts have been already developed for supply chain purposes and very first pioneer-companies have already implemented their projects of supply chain risk management, today supply chain members should be more encouraged to start their own initiatives connected with their businesses. Two examples (one on supply chain risk analysis and one on risk management) of business initiatives are shown below.

IBM's product supply chains is a complex network of suppliers, manufacturing sites, and shippers. In its risk analysis efforts IBM focused on its supply chain for the System X server product. Using probabilistic risk analysis the company achieved a comprehensive and unified perspective on risk factors affecting the supply chain: from frequent operational problems to rare but serious events, and from local delivery delays to industry-wide disruptions. The study also helped to quantify the impact of negative events on the cost and order-to-delivery time for supplying the servers to IBM's customers (WWW2).

Second example presents two different risk management attitudes towards risk and their effects. In 2001 lightning struck a Philips microchip plant in New Mexico, causing a fire that destroyed millions of mobile phone chips. Important Philips' customers were Nokia and Ericsson, the mobile phone manufacturers, but each reacted differently to that catastrophe. Nokia's supply chain management strategy allowed it to switch suppliers quickly; it even redesigned some of its phones to use both American and Japanese chips, which meant its production line was relatively unaffected. Ericsson, however, accepted Philips' word that production at the plant would be restarted in a week and took no action. That decision cost Ericsson more than \$400m in annual earnings and finally the company lost its market share. By contrast, Nokia's profits rose by more than 40% that year (WWW1).

## Conclusions

The aim of this paper was to present the models of risk analysis and management processes useful for the purposes of decision-makers in contemporary supply chains, based on broad literature review. Moreover, both models can be adopted for speculative risk handling, i.e. they can be used to reduce, avoid, transfer or mitigate risk which can cause negative effects, as well as to use the opportunities potentially beneficial for the supply chain. Still there is a need for further decomposition of presented models to operational perspective. Such a perspective would be best for the decision-makers willing to implement the concepts presented above in practice. Still, both suggested models can be very useful in order to understand the nature and role of speculative risk analysis and management in organizations cooperating in such complex structures as today's supply chains.

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