

## RISK AND UNCERTAINTY IN THE MIRROR OF SUPPLY CHAIN MANAGEMENT

ILDIKÓ BALÁZS<sup>1</sup>

**Abstract:** The paper reviews the practical cases of risk and uncertainty analysis within the field of supply chain management. It is crucial to explore the risk exposure because even a tiny error that occurs in the early phases of the chain may propagate further and make any participants vulnerable. In practice, supply chain management considers suppliers and unsuitable information technology background to be the two most significant factors which make risks and uncertainties within the process of supply chain. In order to call the attention to other possible factors causing disturbance, we group the participants of the supply chain by the types of, risks and uncertainties they are exposed to, and present a detailed analysis of these risk groups.

**Keywords:** risk, uncertainty, supply chain management

### 1. Interpretation of risk and uncertainty

Even the ancient Greeks recognized the role of risk and uncertainty. Scientists have interpreted this theme in various ways.

In economics the concept of risk and uncertainty is different. According to Knight (1921) one can talk about risk, if the probability of the upcoming future events are measurable; while one can talk about uncertainty in case of not measurable future events. As Knight holds risk can be made measurable either with the help of market base or empirical experience. „Something is risky if one can prevent it in some way, because we can assume the possible outputs and probability distribution as knowledge. However, he thinks that it is impossible to prevent uncertainty because the probability distribution of the outputs is not known.” [3]

Giddens (2005) considers upcoming risks and dangers natural in our world, which we must try to handle. He made two risk groups: he used the term *outside risk* for a risk type which is always coming from outside from the given nature or from tradition; while *exploited risk* can be traced through human knowledge, which is hard to understand for mankind because of little experience [1].

”The classification of uncertainty can result in an uncertainty scale depending how thoroughly the possible events are described by the available information.”

1. *Not structured uncertainty*: in this case the stages of the system are unknown in all time different from the present one.
2. In case of *structured uncertainty* the stages of the system are known, but we cannot foretell the condition of the system.

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<sup>1</sup> assistant college professor, Budapest Business School  
[balazsildiko3@t-online.hu](mailto:balazsildiko3@t-online.hu)  
H-1149 Budapest, Buzogány st. 10-12

3. In case of *risk* not only the stages of the system are known, but its probability principles too, which are characteristic in a different stage from the present one; however we do not know the concrete outcome of the event.
4. In case of certainty stages are known and they can be described in any time's stages." [9]

During the information process, the quicker the quantity of the available information is growing and the quantity of it is improving, the deeper our knowledge about all unknown phenomena will be, as we are going ahead on the hierarchical scale. Working out the right specification, applying statistical principles one can step from level 2 to level 3. From level 3 we can arrive at level 4 by working out deterministic relationships.

"One can differentiate economical, business, social, political, cultural and environmental risks. Regarding its focus risk can be individual or grouped, corporative even affecting the level of societies or all mankind." [1]

## **2. Uncertainties and risks occurring in supply chain management and their analysis**

In all segments of life we can face many types and various scales of uncertainties. If these uncertainties are connected to reaching our goal under given circumstances, we try to lessen uncertainty by collecting more information for our decision-making [9]. One of the way is to test our possible reactions can be chosen to reach our goal; to determine all criteria needed for our decision, then we collect information about the consequences of possible actions. One must consider both professional and moral criteria [2]. "One of such moral question is a decision about a given problem, then the definition of the risk and uncertainty occurring during realization, and handling and possible reduction of this risk and uncertainty. Risk analysis is always part of our decision. The goal of risk analysis is - assuring the decision support in a given decision making - can be reached by the analyses, description and communication of the risk. A risk analyzer must know which means can be applied in a given risk analysis and which are the methodological and practical strength and hindrances of the alternative approaches."

One can use quantitative and event-oriented models in risk analysis. We can use objective and subjective methods for guesstimating risk and uncertainty. For the objective method trustful information source, or sufficient quantity of data, time, technical background or mathematical appliances are needed. In case of subjective decision the decision maker leans on his/her knowledge, experience, intuition, personal preferences. There is a need for setting out methodological steps, while applying those the decision maker gets to know the possible risks and uncertainties, which enables him/her to handle and reduce them, or in ideal case to prevent them.

Managing the uncertainties that are present in the system is conventionally considered the most actual problem of the field of supply chain management. In the recent years, the management and control of risks have become an integrated part of the supply chain management. Practical examples show that many major companies have managed to reduce their costs by re-organising their supply chains when the demand became uncertain .

If one analyze the supply chain management, one can make the following groups regarding the uncertainty and risk analysis:

1. The starting point is the producers of raw material, miners and exploiters. They manufacture or sell the biggest part of the exploited raw material. Thus on one hand they face the producers' uncertainties and risks, on the other hand they face the uncertainties and risks of the traders.
2. The producers and manufacturers sell the manufactured goods, so they face the uncertainties and risks of the traders beside those of the manufacturers.
3. There are traders in the supply chain who do not manufacture, only trade with the goods. If they transport before the process of manufacturing they are called suppliers; or they buy the manufactured goods in order to sell them. On one hand they are purchasers, on the other hand they are vendors. We also differentiate between wholesalers and retailers. In the 20th century, different commercial chains have appeared, having built logistic centers where they deal with packing and they run their own bakery, pastry shop etc. at vending places. So, they offer other services beside selling, too.
4. The final goal of supply chain is winning over consumers, so they seem to be the last link regarding uncertainty and risk
5. In reality, it is not the consumer who is at the end of the chain, because consumers are following waste disposal, salvage, and recycling, etc.

I grouped the parts of supply chain in order to highlight some significant risks and uncertainties, which are only examples. The same uncertainty and risk can occur to any other group, too.

According to the previous supply chain classification, all those risks and uncertainties belonging to the first group are in immediate relation to nature. So, all uncertainties and risks immediately belonging to nature, e.g. geological, climatic, flooding at mining, gassy, inland inundation at strip-mining, floods, cloud-bursting, slide; furthermore strong wind (tornado, hurricane), lightning, bad weather and earthquake, etc. plays an important part in their decision. In agriculture, weather problems like too much rain, inland inundation, drought, freezes, hailstorm, fire are all uncertainties.

In the previous list a question arises: how to differentiate between a catastrophe and damage or loss? How can *catastrophe risk* and such kind of risks be defined and measured and what is the role of insurance sector in case of handling and recompensation of this damage and special risks? To what extent can private sector recompensate and where is the need of state intervention [4]?

Natural disasters can be defined in the following ways:

- "The risk of the frequency of this event is low
- The size of the event is the risk influencing the whole portfolio
- The importance of the venue of the event is high
- The potential loss caused by one event is at high risk
- The geographical situation is significant regarding potential loss
- The measurement of risk, planning and pricing cause big fluctuation in recompensation" [4]

Coping with future catastrophes must be preventive, efficient in minimizing risks, because the cost of prevention is much less than that of the restitution not mentioning the value of human life.

In dealing with catastrophe risks there is an important role of state regulations, prescriptions and laws such as refrain or banning of building permits at venue of high risk, a ban on fire, compulsory technical checkups; moreover, setting up and running sensing, monitoring, signalling devices and alarm systems etc.

Among the uncertainties and risks of manufacturers and producers grouped 2 the following ones are of high importance:

- Energy supply, which is needed for all manufacturing process
- Second, the human factor is in all planning, running and manufacturing process
- Third, pollution can be caused or caused by manufacturers

All these three factors are dependent on each other, and all these processes are in control of human consideration.

As all human activities, making and supplying energy and manufacturing can endanger human life, health and our environment. Among these, the most turbulent is pollution, because it can have a bearing for the long run on human surrounding, too.

”Bearings causing harm to nature can endanger human life on one hand, on the other hand they can worsen human living conditions, can cause permanent damage to our environment and surrounding.” [5]

The European Union launched some research on determining the variants and outside future costs of energy supply to estimate damage costs. ”Research can help to see and determine all needed measure clearly. In recent decades this research contributed to lessen dangers, pollution and other risks (accidents, occupational hazard) not only in the developed world but in our country too, to improve living standard.”

Companies can make great contribution against pollution developing and marketing new technical devices saving energy or using renewable energy sources which do not pollute or endanger health. Engineers have faced a lot of uncertainties during planning and manufacturing. To handle these uncertainties there are a lot of patents and regulations available. [10] During planning, the system of patents make a frame, taking some legal responsibility into consideration. Engineers expect to find optimal solution under given solutions. Methods like security factor and reserve are available. In system approach, in engineering systems the importance of risk management are very high beside a great social impact emerges. Competitive edge, modifying applyers’ demands, regulation environment, political preferences come to the front. Furthermore, economical and political analyses were added to traditional engineering considerations.

Considerable progress in information technology like the Internet has been a new opportunity. These opportunities must be used in order to make more profit. Now, there is a possibility of planning not only safe but formative and adaptable systems.

In case of planning systems of great risk it is advisable to decide regarding more respects where

- After defining the goals
- Comes the appointing all members who participate in decision making, then
- It is the time for the choice of respects to evaluate, then
- Working on the evaluation criteria

- Defining the measurability of respects
- Defining the relative weighting of the alternatives.

The different decision variants appear with a great importance because it is impossible to make optimal decision without exact data referring to the past and the future.

One can recognize in developing markets that both the greatest potentials and at the same time risks of improving environment can be found in these economies. Companies must have faced reality to have seen infected pet foods, toys polluted by lead made in China. These companies have been called account for their partners' activity within supply chain. Companies having their products from China can expect more and more thorough checking whether suppliers are environmental conscious or not. Problems in sustainable development contribute to the frightening challenge of global supply chain management with their complexity and growing risk. This means that companies must carry out structural changes much earlier than before. The partners of supply chain recognized the previous risks and uncertainties and took them seriously, some of them already reacted to these challenges. A South-Korean company, called Posco took steps to carry out structural changes. Posco managed to make steel manufacturing more environmental-conscious: they managed to save water, recycling, cutting down on energy costs and Posco was able to minimize emissions. They managed to burnish steel before the newly made steel's complete cooling cutting down 10 per cent on energy costs. Beside Posco also developed a new technique of using and reusing water in manufacturing; recycled non-ferrous metals excreta which is a by-product of steel manufacturing; sold it to companies producing cement and other building materials. Posco also combined its force with another company supplying installation in order to cut down on transport costs. They also implemented a radically new technique of using a worse quality iron from a close mine to lessen costs and carbo-hydrate emission [6].

Not only new technologies, but cutting the way of transportation can also lessen energy costs, as one can do also with techniques of planning and building firms and buildings. To manage the problems of strong enough structure, cooling and heating, installation, drainage, shielding etc. are key problems to solve. According to a research carries out in the US, more energy is used for cooling in summer than for heating in wintertime. It is very easy to count how much the it is to heat and cool shopping malls and office buildings, etc., which is partly paid by us, consumers in the price of the goods or services. All these could be substantially cut down by using the techniques of the ancient Romans who used some various blowholes, chimneys and deflectors of hot air, etc, which kept pleasant temperature. There is a need of more serious state and government intervention, not only by various supports but more strict building regulations and observance.

"Human production can make a profound impact on endurance and security levels of complex technical systems. In endurance and risk analysis the key to understand series of accidents and their complete risk analyses is right handling of human interference." Depending on the ways of the accidents, in 45-80 per cent the reasons for them originate from human activities. Consequently, there must be a greater role of human endurance tests in research of complex systems' risk analyses. The report of the 1997 Nuclear Energetic Committee highlights that "the profoud significance of human activity is more or less common. This behaviour is considerably dependent on the situation and environment

determined by the activities. The analysis of factors influencing human power is of high importance.” [7]

In risk analysis human contribution is a very important part of any analyses. E.g.: in a systematically built-up product innovation there are a lot of steps leading to solution. In all steps, some uncertainties are inevitable. If they manage to solve these problems during the process, the project is finalized by an acceptable uncertainty. If coping with uncertainty does not remain at the end of the process, the uncertainties can be built down progressively.

Human saving up is a very important means of correcting human mistake. Some characteristics of it are the following: [7] ”Somebody is monitoring another person’s job; they keep control whenever a human activity is close to finish or comes immediately after finish. The monitoring person is under control verbally or in writing to monitor a given, well-defined human activity. This monitoring happens within the frame of normal working.” Unfortunately, in most of the companies the human resource is reduced in order to cut down expenses because of powering, automatization and opportunities in informational technology

The partners of supply chain grouped 3-5 are the traders, who depend on the producers, while their dependence is mutual. Risks and uncertainties belonging to that circle are partly in connection with suppliers, on the other hand with safeguarding. The third part of uncertainty occurs at tankage and storage.

Companies shift part of the cost of the emerging risks – damages of transport vehicles, prostration, blowing up, damage or theft of transported products, damage of stored goods, burn of theirs, theft, and fire or flood damage etc. This cost is devolved to insurance companies.

As a consequence of lack of knowledge of the extended supply chain, even one single mistake can make any partners of the chain vulnerable. That is why it is very important to map the members of the extended supply chain, to concentrate on the risks and possibilities in connection with sustainability. There is a need for observing which accomplishment factor must be followed continuously, so that all members would keep up to the settled standards and goals. E.g.: the manufacturer or the trader must be familiar with the detailed description needed for production, also with the structure of it, with the standard of monitoring quality and the results of product analysis, to which they can add their own audits while making contact with governmental and non-profit organizations which monitor companies’ social and environmental accomplishments [6].

In supply chain, heading from consumer to retailer-wholesailer-producer-transporter the demand shows more and more significant deflections. This phenomenon is called ”swish-effect”. The naming comes from the fact that the earlier uncertainties accumulate at the partner at the end of the chain. At any point of the supply chain lack of knowledge of the demand can lead to various unpleasant consequences. This unpunctuality is strengthened by the swish-effect. This can also grow the number of problems widely at the two termini of supply chain. The higher we get in supply chain the more difficult is to foretell anything because as a consequence of the swish-effect, uncertainty accumulates in demands. The information which appears at producers does not mirror the real demands. [11]

The reasons for the worse and worse estimation of the demand are the following:

- demand forecast is unpunctual,
- orders are sent periodically,
- fear of short supply,

- ranging of prices.

As well as in trading, also in manufacturer companies the unpunctuality of foretelling demands is an as serious risk factor as the lack of such forecast. To analyze it, there is a need for punctual, trustworthy and sufficiently enough data from the past, besides good mathematical models, quick softwers, quick reactions to market tendencies, and an as close teamwork of partners as possible. A company can gain a lot by right foretelling. However, whatever way, whatever method is used in foretelling, still some uncertainties remain. The more developed methods estimate the expected demand by intervals, thus one can trace a pessimistic and an optimistic estimation, so it worth working out right techniques and business planning.

The highlighted partners of supply chains are the consumers. Nowadays, "consumers, governments, and companies want to know more and more about the methods and sources of manufacturers. One of its reasons is that recently there were various product recalls in supply chains because problems occurred in far places from the final production. That is the reason for documenting and making available the complete supply chain information of products both for producers and consumers. The questions of quality and safety, the ethical and environmental effects have made the consumers worry. Progressive companies are dealing with new dangers and opportunities. "Due to the informational technology, companies can share a lot of information about the given products which can be used for improving quality and safety, certifying origin." The knowledge of information is very important for both the upward and downward branches of the supply chains. If companies decide to suspense data of products, they cannot be sure whether activists or their rivals will not publish them." The bombing development of global electronic communication gives way either to destroy the reputation of companies or to give a chance to build trust for them." [6]

Producers making demands on various services want to take part more and more in decision-making about services; they want to know all their details and risks. Consumers can make a wrong decision about making demands for a given service without concrete information or on the basis of misleading data, e.g.: whether to buy a given product or if they have already done so, how to handle this product. Consumers can reduce accidents and damage resulting from unworkmanlike use. Both supplier communication and that of the demand-maker have a great role in giving the right information. Inadequate communication is a risky factor [8]. "Risk communication includes all kinds of communication which deals with identifying, guesstimating, evaluating and management of risks." This risk can be reduced by training of suppliers, e.g.: shop assistants.

During recycling and waste handling there are also great risks and uncertainties. Risk standards depend on the type and quantity of the given waste and on the product. Costs and risks can be reduced if companies, even rivals, join with each other [6]. "Four companies gave a good example when they made European Recycling Platform, and collected the electronic waste of 34 companies of 11 countries and recycled it.

As consumers, we all participate in global supply chains, thus we all face the previously described uncertainties and risks. It is our responsibility to do our utmost in keeping our environment healthy and safe, saving energy by environmental-conscious behaviour, protecting nature, paying attention to ourselves too. The more do their best the merrier the result will be.

### 3. Summary

The uncertainties the participants of the supply chain are exposed to differ in how much the participants can reduce them. In particular, the uncertainties due to natural disasters are the least possible to eliminate. The next in the line of the poorly eliminable uncertainties is the exposure to human factors such as design error, lack of communication, and negligence. Uncertainties in factors such as quality, quantity and price of the supplied goods, the punctuality of the shipment and the reliability of the partners define the risks that are most relevant for the supply chain management.

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