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## Supply chain risk management

### An idea generator for managing disruption risks in supply chains

Paulsson, Ulf

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# **SUPPLY CHAIN RISK MANAGEMENT: AN IDEA GENERATOR FOR MANAGING DISRUPTION RISKS IN SUPPLY CHAINS**

Paulsson Ulf



22:2018

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**Keywords**

Disruption risks, Idea generation, Managing disruption risks, Risk factors, Supply chain, Supply chain security, Supply chain risk, Supply chain risk management, Risk handling, Vulnerability.

**Abstract**

This report presents an idea generator which is intended to be used when searching for new options for handling the disruption risks of the company. The initial step of the search is usually characterized as a “brainstorming session”, i.e. to generate as many risk management options as possible, and preferably untraditional ones. This is where the idea generator may be of great assistance; it consists of 22 different risk handling methods and 8 different risk factors. Together this will create 176 unique risk management options. Not all of them are relevant for the specific case, but many are, and several of these options are new and never thought of before.

The modern society of today is, in many respects, a vulnerable society and to a great extent built up round supply chains. In these strictly integrated chains, with a number of often globally dispersed links, there is a constant flow of physical goods, services and also combinations of goods and services. A disruption within any of these flows may very well lead to far-reaching negative consequences.

The private company’s (or organization’s) supply chain and its surrounding environment is exposed to constant changes, which affects its risk picture. It may be difficult to completely avoid being affected by disruptions and disturbances, and perhaps not even desirable, considering the high risk handling costs this probably would require. On the other hand, it is important not to be affected unnecessarily hard, since this of course means a waste of resources. In competitive business activities it is especially important not to suffer worse than the competitors; preferably you should be less affected. Efficient risk management can thus provide a vital competitive advantage.

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**ABOUT THE AUTHOR**

Ulf Paulsson is a retired Senior Lecturer at School of Economics, University of Lund, and also a Doctor of Philosophy (PhD). He has many years' experience of research, teaching and tutoring in the fields of Logistics and Supply chain management. During the last decade, more and more focus has been targeted at the disruption risks of the flows (Supply Chain Risk Management) and Paulsson has written a doctoral thesis and several research reports in this field.

**ABOUT THE PUBLICATION**

The text is based upon selected parts from the doctoral thesis: Paulsson, Ulf (2007) "On Managing Disruption Risks in the Supply Chain – the DRISC model", parts that here have been further developed. The number of references in the publication is limited. A more complete set of references can be found in the thesis.



## 1 GENERATING NEW IDEAS FOR MANAGING DISRUPTION RISKS IN THE SUPPLY CHAIN

### 1.1 Seen from a focal company perspective

In future when discussing risks, “risk picture” and risk management, we will take a starting point from a private company or organization in the flow chain. This will from now on be called the *focal company*. However, the risks, risk picture and risk management would look different *if we were to move forward or backward* to another part of the chain. It could even imply that what is considered a risk in one part of the chain can be seen as an opportunity from another part’s point of view. Therefore, the first step to take is to determine the identity of the focal company, before we start examining risks, risk picture and risk management in the supply chain.

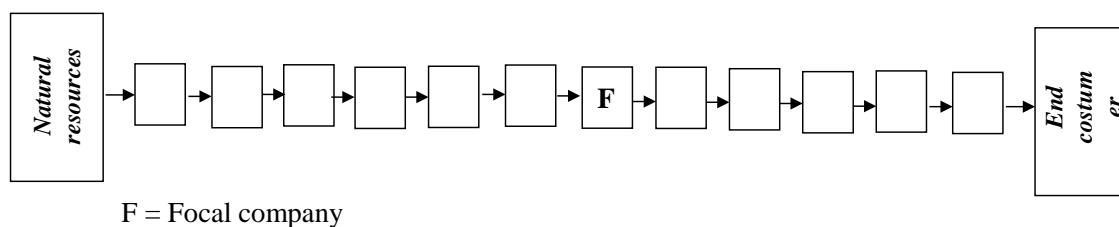


Figure 1.1: The supply chain and the focal company.

As there is a development towards a recycling society, it becomes ever more difficult to find an obvious starting- as well as end point for the chain. An empty beer will serve as an example. Previously, the can was thrown into the bin bag and would eventually end up as waste at the local refuse dump. Nowadays, the can is almost always returned to the shop as deposit and transported to a smelting plant where the metal will be recycled and used to manufacture new cans or any other suitable product. In a similar way, the starting point of the chain, i.e. natural resources, at least partly means something other than a resource directly from nature, as e.g. from ore-mining – it might just as well be recycled metal. When examining the chain from a private, focal company’s point of view, it is simply a matter of deciding what is to be the chain’s starting point as well as end point.

### 1.2 Risk definition

In this context, risk refers to negative result impact, seen from the focal company’s point of view. Thus, disruption risks are risks that directly or indirectly have a negative impact on the results of the focal company. This negative impact may prove to be increased costs, but just as well lower revenues. From now on, instead of talking about negative result impact from disruption risk exposure, especially in the models, we will use the phrase “risk costs” which also includes lower revenues.

### 1.3 The result impact from disruption risk exposure

If our flow chain had not been exposed to different kinds of disruption risks, our business results would have been better – we had, e.g., not been forced to take out some specific insurance. An assumption is, for instance, that without the exposure to disruption risks, the result for our focal company would have been 20 million Euros but now, since the supply chain is exposed to certain disruption risks, the result is estimated to a mere 14 million Euros. The difference, i.e. the 6 million Euros, can be said to constitute the total negative result impact from disruption risk exposure. The purpose of risk management can be described as finding different ways to diminish this negative result impact, i.e. in this specific case to force down the 6 million Euros as much as possible.

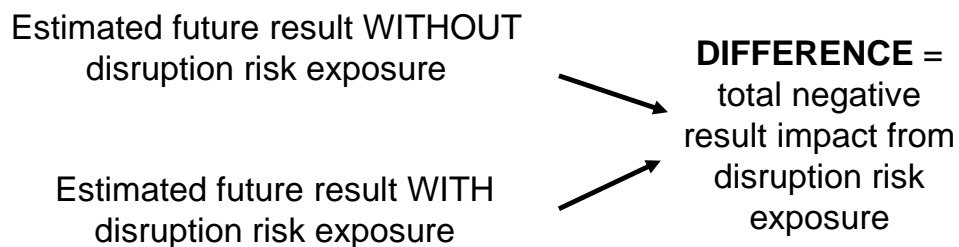


Figure 1.2: Estimation of the total negative result impact from *disruption risk exposure*.

### 1.4 Generating new options for risk management

The starting point is, furthermore, that the focal company considers itself to be exposed to unnecessarily big disruption risks and believes that there are other, better options to handle these disruption risks. The critical risks or risk areas have been identified in the initial part of the risk evaluation. In the second part there is an attempt to generate new, more effective risk handling options. This work consists of two choices:

- to choose a new method for risk management
- to choose the risk factor that will be changed by using the chosen risk handling method.

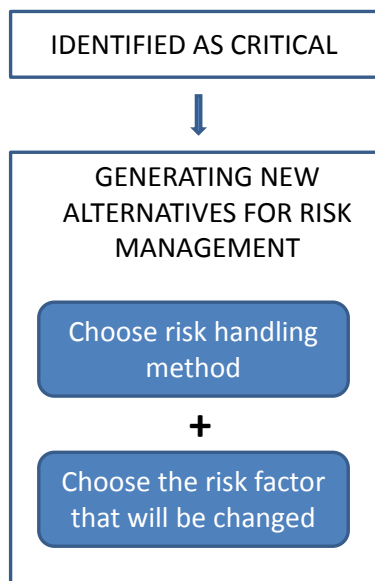


Figure 1.3: Model for generating new risk handling options.

With this approach there is, to begin with, an attempt to through "brainstorming" find out as many new ideas as possible without assessing them. On the following pages an idea generator is developed that can be used to make it easier to think outside "the box" and thereby also contribute to finding out more ideas and, above all, discover even more untraditional suggestions on managing the company's disruption risks in a better way.

## 2 THE MOST IMPORTANT RISK HANDLING METHODS IN THE SUPPLY CHAIN

### 2.1 A variety of risk handling methods

There is a large number of risk handling methods. The ones mentioned below are mainly connected with flow-related disruption risks.

One way to manage a risk is of course to *avoid it*. If, e.g., there seem to be risks of flooding within a specific geographic area, we can quite simply refrain from buying from suppliers in that area.

Another method is to *accept the risk*. This is probably the most common way of risk management when dealing with minor as well as with medium-sized risks.

Yet another way is to build up *general reserves*. We might be aware that our business is risky but at the same time we are quite ignorant of the risks – where they are, their likelihood and size. Therefore, a general reserve is developed to be used in case of an emergency.

*Different sorts of buffers* is another method. This could, for instance, mean a buffer stock of inbound material and components that covers the need of several weeks, or an overall time addition of 10 per cent in the production planning for contingencies.

To *replace* (upgrade/downgrade) means that in case there is a shortage of a certain component it will temporarily be replaced with another suitable component with other capacities. This requires, though, that a replacement really is possible, e.g. from a solid, technical standard point of view. If the capacity is higher it is usually easy to make the customers accept the change. However, an upgrade leads to increased costs. A downgrade might decrease the actual cost of the component, but on the other hand you will probably have to offer the customers a discount to make them accept a product with lower capacity, and some customers will probably call off the purchase altogether.

By *diversifying* you can split something up and thereby also spread the risks. If you, e.g., have one supplier of certain, important input goods and change to three suppliers, the total disruption risk in the goods delivery decreases. This also applies when changing from one production site to a couple of others that, in addition, are placed closer to their different main markets.

You can increase the *flexibility in the supply chain* by e.g. introducing new machines with shorter set-up times or by building up the products around a few basic modules instead of completely separate, individual products.

*Insurance* is an old approved method to handle risks of different sorts, including disruption risks.

In a critical situation companies sometimes may receive voluntary help from their collaborate partners in the chain, but also from colleagues that normally are business rivals. This will probably be easier if you have *a good relationship* with them already before the disruption.

To *identify* a risk does not in itself mean that we have handled the risk, but it gives us an opportunity to assess the size and character of the risk and decide whether to act or not. In general, to improve the ability to identify a risk can therefore be seen as being a risk handling measure.

The opposite of diversifying is to *concentrate*. Example: Instead of having several, different production sites, there is only one, which makes it possible to protect it well. The benefit of this is, that you can put the available risk management resources in one production site instead of spreading them to several sites.

*Quality check* can be made at different points in the chain. One check takes place at a point before the production, which means that before any input goods are used in production, there is a thorough quality check to avoid production disruptions or quality flaws in the finished products that lead to disposal of the product. Another point is after the production. It is important to make sure that the finished products meet the quality requirements that have been made.

In those cases where we do not check the quality of a separate product or shipment, but instead the quality of the production site that produces the current product, we use the phrase *quality assurance*.

By *quantifying* risks, we learn more about them and consequently acquire a stronger basis for a decision on how to handle them in future. Perhaps the risk is small enough for us to accept it. Perhaps it turns out to be so considerable that we have to take further measures as, e.g., increase the size of our buffer stock.

By *organizing* in a way that is better adapted to the current risk exposure, e.g. to create new responsibility- and authority areas that agree with the current risk areas, the organization can achieve increased ability to handle their flow-related disruption risks.

To have *back-up plans* telling you what has to be done and who should do it in case of an incident, may lead to a faster return than usual to normal conditions for the company after an interruption, and may also minimize the negative consequences.

By *protecting* our business in different ways, we can reduce the likelihood of interruptions and disruptions. Examples of protection may be fences, alarm systems, access control, motion detectors, guards and dogs but also fire protection and IT security.

To *secure supply chain partners* is yet another risk handling method. This may, e.g., mean that we require from our partners that they are certified according to a certain standard, that we make an inspection of their financial status or the risk-related education of their staff.

Through right *education*, the likelihood of disruptions can be reduced and the consequences of a possible disruption may be smaller. However, education is perishable, partly due to oblivion, partly since the need of knowledge changes over time.

*Transfer through contract changes* means that risks, initially coming from ourselves through different contracts, can be transferred to another party that usually is financially compensated for this in some way.

We can by creating *overcapacity* increase the possibilities to handle the risks. Overcapacity can of course be created in production but also within many other fields. We can e.g. employ more staff than is necessary or manufacture products that are more robust than is in fact required.

Finally, we can also *increase the risks* and regard it as a risk handling method. Risks are closely associated with possibilities. In general, it is a possibility that we have seen and wished to implement and this implementation has resulted in a certain risk exposure. By increasing the already existing risks we might achieve greater possibilities that are so considerable, that they more than make up for the increased risk exposure.

## 2.2 Linked to the three risk elements

Risk can be defined in different ways. In this paper we will use a definition by Kaplan & Garrick (1981, p. 12–13), which defines risk as the answer to the following three questions:

- What can go wrong? (the scenario)
- How likely is it that it will happen? (likelihood)
- What are the focused negative consequences? (consequences)

The first question is answered by describing *the scenario*, i.e. the chain of events. The answer to the second question is *the likelihood for the scenario to take place* and which, e.g., can be expressed with a percentage rate. The answer to the third question is the negative consequences following the chain of events (the scenario). Thus, in principle a risk can be said to consist of three different elements - scenario, likelihood and consequences – in future called the three risk elements (a “triplet”). However, at first we have to decide what kind of consequences we wish to focus upon. From now on we will, if nothing else is indicated, act on consequences for the result. Depending on the type of business, the concept of *result* can mean different things. The business of a public orthopaedics clinic is not being evaluated by its profit size – on the other hand it is probably important that it stays within the budget parameters – but is rather evaluated by the number of well performed hip joint operations. From now on we will, however, (if nothing else is stated) assume that result is the same as profit or loss, i.e. the result corresponds to revenues minus costs. This means that we focus upon consequences that affect the revenues and/or costs. A scenario most often involves a number of different consequences. Some of these consequences may be positive, e.g. in the form of reduced costs. Only if the sum of all consequences is negative, we call it a risk. Should the sum be positive, it is not a risk but a possibility.

In table 2.1 each of the 22 risk handling methods will be linked to that or those risk element(s) that are affected the most by the specific method.

Table 2.1: Overview of the generic risk handling methods and the risk elements most affected by them.

<b>Risk handling methods</b>	<b>The most affected risk elements</b>
<i>Avoid the risks</i>	<i>Scenario</i>
<i>Accept the risks</i>	
<i>General reserves</i>	<i>Consequences</i>
<i>Buffers</i>	<i>Likelihood</i>
<i>Replace</i>	<i>Scenario</i>
<i>Diversify</i>	<i>Consequences</i>
<i>Flexibility</i>	<i>Consequences</i>
<i>Insure</i>	<i>Consequences</i>
<i>Good relationship</i>	<i>Consequences</i>
<i>Identify</i>	<i>Consequences</i>
<i>Concentrate</i>	<i>Consequences</i>
<i>Quality check</i>	<i>Likelihood</i>
<i>Quality assurance</i>	<i>Likelihood</i>
<i>Quantify</i>	<i>Consequences</i>
<i>Organize</i>	<i>Consequences</i>
<i>Back-up plans</i>	<i>Scenario</i>
<i>Protect</i>	<i>Scenario</i>
<i>Secure supply chain partners</i>	<i>Likelihood</i>
<i>Training</i>	<i>All three</i>
<i>Transfer through contract changes</i>	<i>Scenario</i>
<i>Overcapacity</i>	<i>Scenario</i>
<i>Increase the risks</i>	<i>All three</i>

### 3 THE MOST IMPORTANT RISK FACTORS IN THE SUPPLY CHAIN

#### 3.1 Material risk factors

One vital risk factor is *the product itself*, where matters like complexity, sensitivity and the number of unique, special components are of importance to the flow-related risks.

One and the same product is often manufactured in somewhat different ways, e.g. with different degrees of automatization. You could also add more or less overcapacity and flexibility in *the production process*. Another aspect is whether there are several different parallel production lines or just one within the private production site (the factory) and whether there are several production sites or just one.

The flow of raw material, components and finished products in the chain, here called *the product flow*, can be built up in different ways, depending on e.g. the logistical solutions. For instance: Are there parallel distribution channels? What about time perspective and time margins? Are there buffer stocks? If so, where are they and how big are they?

The product flow and the production flow must be supported by various *support systems* as e.g. systems for invoicing, production planning and storage.

Another important risk factor is the *risk management system* and its design. What kind of insurances are there, and what do they cover? Measures are taken to prevent fire, leakage etc. What does the assignment of responsibilities look like? Are there any clear contingency plans? How many buffers are there and how much flexibility is incorporated in the business?

*The staffs* are another risk factor. What knowledge do they have of flow-related risks? What about their responsibility and authority? Are they motivated to take action? In the end, it is after all the individual person in the organization who will make the decisions and implement them.

#### 3.2 Intangible risk factors

The above stated risk factors are all material, but there are also intangible risk factors. One such factor is the company's *business concept*. If, e.g., the business concept includes the capacity to deliver within 48 hours, this leads to a stronger focus on the disruption risks than would be the case if the normal delivery time is four weeks.

Another intangible risk factor is *the brand* or *brands* that are linked to the business concept, especially when selling to end customers. If you e.g. sell quality, meaning that the brand guarantees a high and uniform product quality, any quality defects will be especially serious.

It is all being summarized in Figure 3.1.



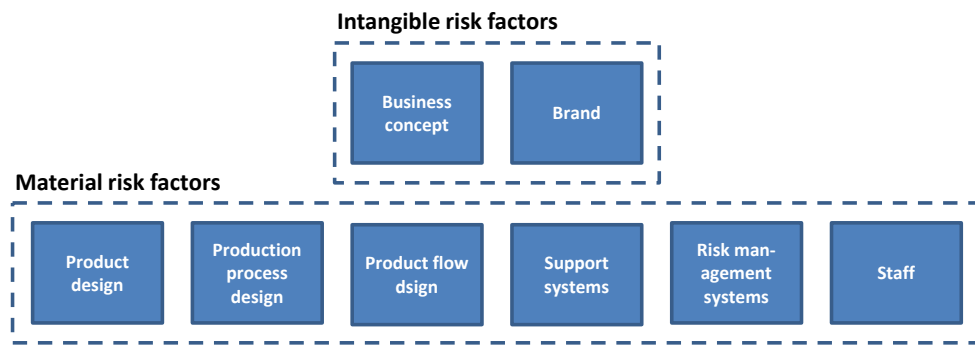


Figure 3.1: Important material and intangible risk factors for the supply chain.

## 4 THE COMBINATION OF RISK HANDLING METHOD AND RISK FACTOR

### 4.1 The finished idea generator

Once we have chosen risk handling method, we have to follow up by choosing what risk factor to change by using the chosen risk handling method. Since we have 22 different risk handling methods to choose between and eight risk factors this will, in theory, give us 176 possible combinations. In practice all these combinations are not possible or meaningful. In a study by V&S in Sundsvall (Paulsson & Nilsson, 2008), where the idea generator was used, some 50 new risk handling options were generated.

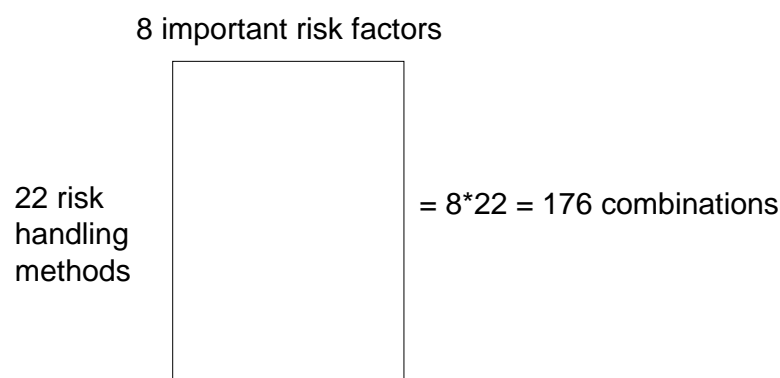


Figure 4.1: The theoretical number of combinations of risk handling method and risk factor.

### 4.2 An application example

If we for instance have chosen the risk handling method *overcapacity*, we can link this method to the following six material risk factors:

- *Product design*: By e.g. making the product more robust, for instance with a stronger shell, the risk of damage during transport is reduced and so is the disruption risk.
- *Production process design*: By investing in new machines of higher capacity you can more easily prevent possible changes and inbound disruptions and you are not, to the same extent as before, required to pass them on to the next part of the chain.
- *Product flow design*: By investing in parallel distribution channels instead of in just one, the negative impact of a potential disruption is reduced.
- *Support system*: By increasing the liquidity, e.g. by raising the overdraft facility, the risk of not being able to pay the suppliers in time will be reduced and so is the risk of delayed deliveries.

- *Risk management system*: By adding to the number of sprinklers in the sprinkler system, the possibility of detecting a minor fire at an early stage and turn it out before it spreads will increase.
- *Staff*: By adding to the number of employees, you create a staff reserve to be used and thereby reduce the risk of production disruptions, e.g. during influenza periods when many staff members are reported sick.

### **4.3 For those who want to know more**

As was mentioned in the introduction, this text is based on a further development of selected parts from the thesis "*On Managing Disruption Risks in the Supply Chain – the DRISC model*".

The idea generator has been applied to V&S in Sundsvall and the result is presented in the study "*Potential Risk Handling Alternatives for Supply Chain Disruptions in Liquid Food Production – the case of V&S Vin & Sprit AB, the Sundsvall site*".

## REFERENCES

Kaplan, S. & Garrick, B. J. (1981). On The Quantitative Definition of Risk. *Risk Analysis*, Vol. 11, No. 1, p. 11–27.

Paulsson, Ulf (2007). *On Managing Disruption Risks in the Supply Chain – the DRISC model*. A doctoral thesis. Department of Industrial Management and Logistics. Lund University. Lund. ISBN 978-91-976974-1-5. 377 p. <http://www.lu.se/lup/publication/598913>

Paulsson, U. & Nilsson, C.-H. (2008). *Changed Supply Chain Disruption Risks through Installation of a Pasteurizer – the case of Brämhults Juice AB*. 43 pages. Lund University Centre for Risk Analysis and Management, LUCRAM 1016/2008. ISSN 1404-2983. <http://www.lu.se/lup/publication/1388210>

Paulsson, Ulf & Nilsson, Carl-Henric (2008) *Potential Risk Handling Alternatives for Supply Chain Disruptions in Liquid Food Production – the case of V&S Vin & Sprit AB, the Sundsvall site*. 42 pages. June 2008. Lund University Centre for Risk Analysis and Management, LUCRAM 1015/2008. ISSN 1404-2983. <http://www.lu.se/lup/publication/1388243>

Paulsson, U., Nilsson, C.-H. & Wandel, S. (2011). Estimation of Disruption Risk Exposure in Supply Chains. *International Journal of Business Continuity and Risk Management*. Special issue on "Enterprise Risk Management – Foundation issues". Vol. 2, No 1, p. 1-19.

IEC (International Electrotechnical Commission), 300-3-9, 1995. *Dependability management – part 3: Application guide – section 9: Risk analysis of technological systems*. IEC 1995.

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Port facilities are often located close to residential areas, thus potentially exposing a large number of people to the consequences of accidents. The HAZARD project deals with these concerns by bringing together Rescue Services, other authorities, logistics operators and established knowledge partners.

HAZARD enables better preparedness, coordination and communication, more efficient actions to reduce damages and loss of life in emergencies, and handling of post-emergency situations by making a number of improvements.

These include harmonization and implementation of safety and security standards and regulations, communication between key actors, the use of risk analysis methods and adoption of new technologies.

See more at: <http://blogit.utu.fi/hazard/>

