

RISKS MANAGEMENT: NEW LITERATURE REVIEW

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Abstract: The complexity of the industrial activities and the important mass of flows crossing the supply chain promotes the emergence of risks that must be considered in the decision process. For this reason, we have developed this paper to clarify the basics of risk management through a short new suggestion of literature review for risk management. Our justification of this attempt is that this area is the most discussed in our days and it is impossible to present all definition of the risk concept, we have tried to collect the most recent studies in this paper.

Keywords: Risk, Risk management

Introduction

In recent years, the industry was severely affected by violent incidents, health crises and natural disasters. These incidents have a huge impact on economic activity, for example, Ericsson lost 400 million EUR after their suppliers of semiconductor plant caught fire in 2000, and Apple has lost order of DRAM in Taiwan in 1999 after an earthquake [8]. British petroleum has lost more than 1.5 billion USD after the Texas City Refinery explosion in 2005 that was considered as the worst industrial disasters in recent US history. Another example, the impact of Japanese earthquake and tsunami (Japan 2011) on industrial production is estimated at about (-17%) between the prediction of Japanese ministry of economy trade and industry and the achievement, the breaking of production chains is considered as the main channel of transmission of the disaster on the Japanese economy. The consequences of these accidents are uncertainly for this reason, the risks management in the industries has emerged as an important topic in the global logistic chain, indeed, the risk is absolutely linked with the uncertainty [27, 28]. Risk is defined as possible events whose unfavorable consequences are difficult to accept or are even unacceptable [24]. Nowadays, the risk assessment is an important research theme because the risks were always present in the industrial activity [30]. In the literature, we find several studies on risk management, these studies focuses only in downstream risks or upstream risks or production risks. This distinction does not a meaning when we talk about logistic chain and logistic risk. Moreover, this distinction does not consider the interaction can be exist between all the risks at the level of the links of the logistic chain, in this context it is preferable to use the concept of Supply Chain Risks Management (SCRM) and not risks management.

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Literature review

In this section, we try to provide an idea about the basics concepts of risk management based on the literature review. This includes a generic definition of risk, risks management and their method.

The risk

The thematic of risk management is not new, but it is recent and not very studied in logistic chain (or supply chain), the first work that explicitly addresses for the risk management in the supply chain dating from 2003 [27]. The risk is present in many activities including the logistic in which one consequence of the risk that it is increasing and affect around all the logistic networks, therefore the managers need to make a great deal of effort to identify and manage risks. The meaning of risk can be differ from one person to another depending on their point of views, attitudes and experience what makes the study of risk more and more complex.

Aven [34], proposed a basic risk theory based on brief selected review that over the last 15-20 years and he presented the evolution of risk concept in Oxford English Dictionary since 1679, we think that definition followed the environment evolution. **Veland and Ave [14]**, proposed the same based classification of risk given by **Aven [34]** and they used theses definition to discuss how the risk perspectives influence the risk communication between the decision-makers, the risk analysts, experts and lay people. Indeed, for **Karimiazari et al [3]**, engineers, designers and contactors view risk from the technological perspective, lenders and developers tend to view it from the economic and financial side. So, the question is: what is a risk? The first answer, the risk is the probability that an event or action may adversely affect the organization [37]. For **Mazouni [25]**, the risk is an intrinsic property of any decision, it is measured by a combination of several factors (severity, occurrence, exposure to, etc.), although it is generally limited to two factors: severity and frequency of occurrence of a potentially damaging accidents that incorporate some exposure factors. In the BS OHSAS 18001 (British Standard Occupational Health and Safety Assessment Series), the risk is a combination of the likelihood of an occurrence of a hazardous event or exposures to danger and the severity that may be caused by the event or exposure. In this context (BS OHSAS 18001), the concept of risk asks two oriented question: 1. What is the probability that a particular hazardous event or exposure will actually occur in the future? 2. How severe would the impact on health and safety be if the hazardous event or exposure actually occurred? The risk can be defined as an uncertain event or set of circumstance which, should it occur, will have an effect on achievement of one or more objectives [10]. For **Marhavidas et al [29]**, the risk has been considered as the chance that someone or something that is valued will be adversely affected by the hazard, where the hazard is any unsafe condition or potential source of an undesirable event with potential for harm or damage. For **Bakr et al [5]**, the word "risk" means that uncertainty can be expressed through probability. We can concluded that the risk is an probabilistic event that can exist and affect the activity of an organization positively (opportunity) or negatively

(hazards). For more definition see [34]. There are several risks that can be divided into different types according to how its realization will have impacts on the activity of organization and its environment. For example and according to Harland et al [6], risk can be divided on:

- Strategic risk: affects business strategy implementation.
- Operations risk: affects a firm's internal ability to produce and supply goods/services.
- Supply risk: adversely affects inward flow of any type of resource to enable operations to take place.
- Customer risk: affects likelihood of customers placing orders, grouped with factors such as product obsolescence in product/market risk.
- Asset impairment risk: reduces utilization of an asset and can arise when the ability of the asset to generate income is reduced.
- Competitive risk: affects a firm's ability to differentiate its products/services from its competitors.
- Reputation risk: erodes value of whole business due to loss of confidence.
- Financial risk: exposes a firm to potential loss through changes in financial markets, can also occur when specific debtors defaults.
- Fiscal risk: arises through changes in taxation.
- Regulatory risk: exposes the firm with changes in regulations affecting the firm's business such as environmental regulation.
- Legal risk: exposes the firm to litigation with action arising from customers, suppliers, shareholders or employees.

In the logistic and based on the literature review, all of these risks may have one of three possible origins: 1. organizational, 2. network relations and 3. external environmental. We may consider the risk in the supply chain, as a breaking of flows between different components of the supply chain. All risks must be identified and bringing under control to keep all process in good working order, this is the risk management.

The risks management in the supply chain

The concept of risk management in the supply chain has developed rapidly over the recent decades and has become very important, we can consider, if we refer on Lavaster et al [26], that the paper of Jutter et al in 2005 "Supply Chain Risk Management: outlining an agenda for future research" was the first scientific researcher in the Supply Chain Risk Management (SCRM), furthermore and according to Fekete [2], risk management is an area with conflicting terms, and there is a widely acknowledged need for a critical reflection of its definition, core contents, principles and regulation. According to Lavaster et al [26], the first definition of SCRM was given by Juttner 2005, "the SCRM is the identification and management of risk for the supply chain, through a co-ordinate approach amongst supply chain members, to reduce supply chain vulnerability as a whole". The SCRM plays a major role in successfully managing business processes in a proactive manner.

Supply chain risk management is defined as the process of risk mitigation achieved through collaboration, co-ordination and application of risk management tools among the partners, to ensure continuity coupled with long term profitability of the supply chain. The SCRM can be defined as a structured and synergic process throughout the supply chain, which seeks to optimize the totality of strategies, processes, human resources, technology and knowledge in the aims are to control, monitor and evaluate supply chain risk and to safeguard continuity and maximize profitability [15].

Risk management is the process whereby decisions are made to accept a known or assessed risk or the implementation of action to reduce the consequences or the probability of occurrence of an adverse event [35]. Risk management refers to strategies, methods and supporting tools to identify and control risk to an acceptable level [31].

In accordance with ISO 31000:2009 (Risk management: principles and guidelines), risk management refers to a coordinated set of activities and methods that is used to direct an organization and to control the many risk that can affect its ability to achieve objectives.

Based on the literature review of SCRM, we can give this definition, the SCRM is a cooperative process between contributors (partners) in the supply chain in order to put the risks under control and to cope with their negative consequences. The risk management in the organization allows to assure that the decision-maker knows and understand the risks and prepare the necessary plan that can prevent disasters or reduce their impact. The risk management process is executed in four steps [10, 23, 25]:

- Risk identification: considered as the fundamental step to detect the uncertain events that can upset the good working order in the supply chain.
- Risk assessment: is necessary step for selection of suitable corrective actions for the risk identified, it refers to assignment the probability of occurrence of the events. In the end of this step, the risks can be classified in very unlikely event, improbable event, moderate event, probable event, very probable event.
- Risk management: refers to the selection and implementation of the optimal corrective strategy for the risks identified.
- Risk monitoring: this is the last step in the risk management process, where the system is supervised to measure the efficiency of corrective actions and detect the potential risks not identify in the previous steps, this step can improve the risk management system.

So we can consider the risk management such as a systematic application of management policies, procedures and practices to assess and manage risks. In the literature review, there are several methodologies for the realization of these steps depending on it is a proactive strategy (i.e. predict risks and implement measures to prevent undesirable effects) or reactive strategy (i.e. following the occurrence of risks).

Methods

Based on the literature review, we can find several methods for the risks management. These methods can be classified into two categories: the deterministic approach (that includes the qualitative, quantitative and hybrid techniques) and the stochastic approach (that includes classic statistical approach and the accident forecasting modeling). We can mention the checklists, what-if analysis, task analysis, Hazard and Operability (HAZOP), Quantitative Risk Assessment (QRA), the Critical Risk and Error Analysis (CREA), Fault Tree Analysis (FTA), the Event Tree Analysis (ETA), Failure Mode and Effects Analysis (FMEA), Probability Distribution of Failure and Reliability (PDEA), Petri networks, Bayesian networks, etc.

According to our level of knowledge, we will try to give an overview of some new applications of risks management and their methods. For example, and to study the impact of disruption risks on the process of inventory management of a newsvendor, a stochastic model has been developed by Xanthopoulos et al. [4]. This model is considered as the first on the joint examination of inventory management and disruption risks for supply chain networks considering risk-averse decision-making. It can be applicable to different types of disruption (production process, supply of raw materials, etc.).

In 2013, the QRA has been used by **Ma et al [18]** to analyze gas network accident probability and its consequences of a Chinese urban pipe network, this case study can be interpreted as a distribution problem in supply chain. This same method was already used by Si et al in 2013 to quantify the risk of hazardous chemicals leakage and take precautions against its accidents. The model has been applied to quantitatively assess a storage tank in a Chinese company (Changshow chemical Industry). This two cases may justify the implementation of this method (QRA) in supply chain problems and more accurately in pharmaceuticals supply chain and pipeline transport network (water, petroleum, gas).

Lavastre et al. [26] in their paper demonstrate that for organizations to be effective, SCRM must be a management function that is inter-organizational in nature and closely related to strategic and operational realities of the activity in question. They suggest that effective SCRM is based on collaboration and the establishment of joint and common transverse processes with industrial partners. They used a hybrid methodology based on face to face interviews, questionnaires and statistical analysis. They Based on an empirical study of 142 general managers and logistics and supply chain managers in 50 different French companies, The Fuzzy Analytical Hierarchy Process (FAHP) is used to determine the most important supply chain risks and the corresponding risk management strategies for a Turkish company operating in the iron and steel industry. The results of this research conclude that the supply risks and operational risks are quite important compared to environmental risks [7].

If we take the logistic concept, we find several applications with the Petri Network because its simplicity compared to other methods, for example **Zegordi**

and Davazani [33] used the Petri Network as a tool to understand the dissemination of disruptions and to trace the operational performance of a supply chain. Also, the Petri Network has been used by Aloini et al. [9] to incorporate risks factors into Enterprise Resource Planning projects (ERP) in order to deal with the problem of interdependence in risks assessment.

To investigate the vulnerability of supply chains in general and examine key drivers of supply chain risks, an empirical analysis chain risks management practices had been made in the German automotive industry. The analyses result based on probability-impact matrix reveal that companies with a high implementation degree show a better supply chain performance [16]. To modulate and analyze a supply chain network which is subject to various risks, a timed Petri Networks (PN) had been used to integrate the risks management procedures into design, planning and performance evaluation process of supply chain network of Turkish company. The PN had been used to modulate dynamic supply chain and solved risks problems using a real-time decision-making [10].

In 2012, the Bayesian network was used to prioritize the factors that influences the risk of hazardous material transportation accidents in china, the authors collected and analyzed 94 cases of Chinese transportation accidents. They found that the three most influence factors in hazardous material transportation accidents (human factors, the transport vehicle and facilities, and packing and loading of the hazardous material [21]. Also, in the context of risks of human error, and to improve the quantification of organizational influences in human reliability analysis frameworks and to model the effects of organizational factors on human reliability, the fuzzy Bayesian network was used to identify the most likely root causes and the prioritization of root causes causing human error [19].

In their paper, Deublein et al [22] used a novel methodology for the prediction of the occurrence of road accidents. This methodology is a combination of three statistical methods (gamma-updating of the occurrence rate of injury accidents and injured road users, hierarchical multivariate Poisson-Lognormal regression analysis and Bayesian inference algorithms). The methodology is illustrated through a case study using data of the Austrian rural motorway network.

We can considered in the high-hazard industries the critical role that human, management and organizational risk factor play in major accident, for this reason and to establish a relationship between the concepts of safety culture and organizational culture in Nuclear Power Plan (NPP), Bayesian networks have been used in Spanish NPP. It therefore provides a methodology to identify potential strategies for safety improvement [32].

In the aim of survey the risk concerning the mining of coal in Colombia, the combination of methodologies MADS/MOSAR (Model Analysis of Dysfunctions of the System/Method Organized and Systemic Analysis of Risk) and the fault tree was used in 2012. The obtained analysis result had been useful to improve the risk legislative and normative barriers [20].

Marhavalas et Koulouriotis [29], developed an alternative risk assessment framework by including a stochastic and a deterministic process, they called STODET method. It is applied on the Greek Public electric Power Corporation. This method was considered as an improvement on the risk assessment techniques due to the presentation of a new complete risk assessment technique combined with real data of undesirable events and accidents.

In order to quantify the risk of hazardous chemicals leakage in the chemical industry, the Fire-Explosion-Poisoning Quantitative Probability Model (FEPQPM) based on the Quantitative Risk Assessment (QRA) has been established. It has been applied to an enterprise storage tank in China [11].

Among the methods used in risks management in the logistic, we can mention the Failure Mode and Effects Analysis (FMEA). the FMEA is a widely used risk assessment tool for defining, identifying and eliminating potential failures or problems in product, process, designs and services. There are several application that used FMEA [36,1, 12, 13, 17].

Summary

Through this paper, we wanted to make an opportunity for researchers for understanding the basic concepts of risk management. We did a study several recent research on this topic as well as the methods used, the question that remains is which method that can we use?

Our paper starts with a set of risk definitions since it is essential to distinguish between risk and other terms that are similar. Moreover, since the risks may occur anytime and anywhere in supply chain, then the risks management becomes necessary, for this reason we give definitions of this concept and an idea about its methods. We will try, in other studies, to compare these methods to select the most appropriate.

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ZARZĄDZANIE RYZYKIEM: NOWY PRZEGLĄD LITERATURY

Streszczenie: Złożoność działalności przemysłowej i istotność masy przepływów w łańcuchu dostaw sprzyja powstawaniu zagrożeń, które należy uwzględnić w procesie decyzyjnym. Z tego powodu, opracowany został ten artykuł w celu wyjaśnienia podstaw zarządzania ryzykiem poprzez nową propozycję przeglądu literatury w zakresie zarządzania

ryzykiem. Uzasadnieniem dla krótkiego przeglądu jest to, że obszar ten jest często podejmowany w naszych czasach, a przedstawienie wszystkich definicji pojęcia ryzyka nie jest możliwe, dlatego też staraliśmy się zebrać najnowsze opracowania w badanym zakresie.

Słowa kluczowe: ryzyko, zarządzanie ryzykiem.

風險管理：新的文獻綜述

摘要：工業活動的複雜性和流動供應鏈的重要質量促進風險的出現，必須在決策過程中考慮。為此，我們開發了本文通過對風險管理文獻綜述的短新建議明確風險管理的基本知識。我們這次嘗試的理由是，這個區域是在我們這個時代討論最多的，這是不可能的介紹該風險概念的所有定義，我們試圖收集本文的最新研究。

關鍵詞：風險，風險管理。