Abstract – The Role of Supply Chain Event Management Systems for Supply Chain Risk Management

Late delivery, breakdown of IT-systems or production machines, variations in demand, supply, transportation are a few examples of risks that increase costs and reduce satisfaction of customers of an enterprise. If the relevant enterprise is an actor in a supply chain, then such risks do not only impact this enterprise but also those enterprises that are present in the upstream and downstream of the supply chain. Through the globalization of the economy such risk interdependencies along supply chains took on significance in the last years. In order to avoid these risks, risk management that concentrates on the entire supply chain is essential. This risk management is supported by various instruments among which Supply Chain Event Management Systems (SCEM-systems) also can be counted. This study aims to explain to what extent SCEM-systems support the risk management process in supply chains.

Keywords: Supply Chain Event Management System, Supply Chain Risk Management.

1 INTRODUCTION

As a result of global sourcing and the continued trend to leaning-down, supply chains become more complex. Due to increased complexity, uncertainty and risk in supply chains are growing [Christopher and Peck; Hillman and Keltz, 2007]. Uncertainty and risk lead to an increasing vulnerability of chains. To prevent vulnerability it is essential to manage and mitigate risks in chains through creating more resilient supply chains that are able to respond to deviations and/or disruptions and adapt themselves to necessary changes [Christopher and Peck]. Managing risks in supply chains is the function of supply chain risk management. A key instrument for risk managers in dealing with supply chain risks is a SCEM-system. It increases the visibility into processes of supply chain, captures risks when they occur and notifies decision-makers about these risks, so that corrective actions can be taken [Zimmermann, Winkler and Bodendorf, 2006; Hillman and Keltz, 2007]. This study discusses how SCEM-systems increase the visibility and thereby contribute to manage risks.

2 SCEM-SYSTEMS

SCEM-systems are application systems that monitor, register, and evaluate disruptions, deviations within an enterprise and/or among enterprises of a supply chain in real time to be able to take actions in real time [Hunewald, 2005]. Disruptions or deviations arise from events that are defined as incidents that occur as results of process flows [SAP AG Library]. Monitoring and notification are the core functions of SCEM-systems [Nissen, 2002]. In the context of monitoring, processes and/or process-referred objects (e.g. production orders, stocks) in an enterprise or in a supply chain are monitored. In this context by comparing the previously defined plan status of objects and/or processes with their registered actual status, it is controlled whether events caused any deviations or disruptions in process flows [Steven and Krüger, 2004; Heusler, Stölzle and Bachmann 2006]. The actual status of a/an process/object is gained from status messages of application systems (e.g. Tracking & Tracing...
systems) that continuously monitor and register actual statuses. Events that cause negative deviations and imply need for action are called negative events. Events that cause positive deviations and room for maneuver are denoted as positive events [Heusler, Stölzle and Bachmann, 2006]. Nissen and SAP AG take into account only such events as negative/positive events whose occurrence times deviate causing deviations in process flows. They call these events early/late events. An event is early or late (e.g. late start of a production) if it occurs before or after the planned point of time [Nissen, 2002; SAP AG Library]. Events (e.g. machine breakdown, traffic jam) that occur as a result of an unplanned, unpredicted process and for that no actions are foreseen are called unexpected or unplanned events [Nissen, 2002; SAP AG Library; Heusler, Stölzle and Bachmann, 2006]. A disruption or a deviation can also take place in a process, when an expected event does not occur. In this context, it is also important to determine whether expected events occurred. An event whose occurrence was expected/planned, but that did not occur in reality is called an unreported event (e.g. not confirming the handling over of goods at the customer by a freight forwarder as agreed) [Nissen, 2002]. Bretzke and Klett represent also the need of monitoring events (e.g. punctual arrival of materials) that cause no deviations or disruptions and require no corrective actions. Monitoring such events enables the confirmation of the occurrence of expected events, which contributes substantially to the removal of uncertainties [Bretzke and Klett, 2004]. Nissen and SAP AG denote the mentioned events as regular events [Nissen, 2002; SAP AG Library].

SCEM-systems decide by a set of rules how to react to occurred events. When early/late, unexpected, or unreported events occur, decision makers are alerted by delivering messages and/or related reaction patterns, which are planned ex ante considering the similar or alike events, are activated. In the former case, decision makers themselves develop the action alternative to minimize the negative impacts of events. In the latter case, SCEM-system executes the action alternative autonomously and automatically (e.g. automatic production of an order if the inventory falls below a certain threshold) by activating the related reaction pattern [Hunewald, 2005; Heusler, Stölzle and Bachmann, 2006].

SCEM-systems also help the simulation, control, and measurement functions in supply chains [Hunewald, 2005]. As already mentioned, SCEM-system decides by a set of rules how to react to an event. If the rule set concludes that the considered event requires replanning, then a simulation process initiates. Not SCEM-system but Supply Chain Planning System (SCP-System) (e.g. APS (Advanced Planning System)) executes this process [Hunewald, 2005]. For replanning, SCP-System uses data that are generated by SCEM-system and Supply Chain Execution System (SCE-System) (e.g. Warehouse Management System, Transport System, System for Material Administration) and simulates the

![Event Types](image-url)
effects of events on subsequent supply chain processes. Consequently, action alternatives are determined based on what-if scenarios [Masing, 2003; Knickle and Kemmeter, 2002]. After the selection of the best alternative among simulation results, SCE-System executes the selected alternative [Masing, 2003].

SCEM-systems support the control process in supply chains by allowing decision makers to change previously established decisions or conditions to realize the selected action alternative [Masing, 2003]. SCEM-systems gather also process performance data [Straube, Vogeler and Bensel, 2007] that are used to calculate key performance indicators for the measurement of supply chain performance [Masing, 2003; Steven and Krüger, 2004].

3 SUPPLY CHAIN RISKS

Kajüter defines risk as “a future development or event (...) that causes objectives of an enterprise or a supply chain not to realize” [Kajüter, 2003]. Wagner and Bode describe risk as the negative deviation of a target value, which has negative impacts for the concerned enterprise or supply chain [Wagner and Bode, 2007]. Kontio identifies risk with the attributes probability and damage. He describes it as a damage that arises with a certain probability [Kontio, 2000]. In terms of these definitions, in this study supply chain risk is understood as an event, probability of occurrence and damage of which are calculable as well as occurrence of which can deviate the planned supply chain efficiency.

According to planning levels supply chain risks can be categorized as strategic, tactical and operational risks [Götze and Mikus, 2007; Gaonkar and Viswanadham, 2007]. Strategic risks (e.g. manufacturing capacity reduction, dependency on a supply chain partner) prevent or distress the realization of long-term, global objectives of a supply chain and usually represent risks for a supply chain in total. Tactical (e.g. variations in order forecast) and operational risks (e.g. machine/truck breakdown, lead-time variation) prevent or distress the realization of medium-term and short-term objectives in particular partitions of a supply chain [Götze and Mikus, 2007].

SCEM-systems generally monitor operational processes that are executed to realize plans of tactical and operational management. Logistical processes such as transport, warehousing, picking, handling, which are executed to ensure the availability of the right product, in the right quantity, in the right condition, at the right place, at the right time, at the right cost, for the right customer, have to be understood under operational processes. In this context, operational risks, which refer to operational/logistical processes and lead to deviations or disruptions in supply chains at operational level, are relevant for SCEM-systems.

4 RISK MANAGEMENT IN SUPPLY CHAINS

General risk management, over whose operation and processes compromise exists in the literature, forms the point of origin for supply chain risk management. General risk management and consequently supply chain risk management consist of the following processes [Wagner and Bode, 2007]:

- Risk identification
- Risk analysis and evaluation
- Risk controlling
- Risk monitoring.

In the context of risk identification potential supply chain risks are systematically identified. Within the context of risk analysis and evaluation the identified risks are evaluated in terms of the probability of their occurrence and their damage potential. In order to cope with risks, measures are specified in the context of risk controlling. Risk monitoring serves permanent monitoring of risks [Wagner and Bode, 2007]. Through monitoring one can receive information as to whether the defined risks are still current as well as the taken actions are still effective. Risk management process is an iterative process,
in which after monitoring, risk identification and the consequent processes are executed again as far as it is necessary.

![Risk Management Process Diagram]

Figure 2. Risk management process.

According to the type of executed activities supply chain risk management is classified into strategic, tactical and operational risk management [Rajamani, Sriskandarajah, Pickens and Hameed, 2006]:

- **Strategic Risk Management**: It is the function of strategic risk management to design a supply chain for which disruptions/deviations arisen from risks, actions to prevent or mitigate disruptions/deviations and metrics to measure the success of taken actions can be defined as well as in which necessary time for recovering is short and costs for covering disruptions/deviations are low. Furthermore, in the context of strategic risk management the organization who is nominated to struggle against disruptions/deviations is determined.

- **Tactical Risk Management**: Tactical risk management deals with the identification of potential risks, classifying the identified risks by probability of their occurrence and their impact on the business continuity in supply chains. Identifying action alternatives and ranking these alternatives are also the functions of tactical risk management.

- **Operational Risk Management**: In the context of operational risk management, which can be supported through SCEM-systems, the following activities are executed:
  - Capturing events
  - Communication of event-related information to all relevant parties
  - Enabling collaboration on selecting the optimal mitigation strategy
  - Continuously improving supply chains against risks by updating the risk management database, which includes data such as type of risk, preferred mitigation strategy, alternative strategies, alert criteria, with lessons learned. The database is updated through tracking how often a risk event occurs, what was done, how effective it was, and how it could be improved for the next time. Rajamani et. al. define a sophisticated risk management database as an ultimate tool for survival and success in an increasingly uncertain world.

5 **SCEM-SYSTEM AS AN INSTRUMENT FOR RISK MANAGEMENT**

As important instruments of operational risk management SCEM-systems - through their monitoring and notification functions - substantially contribute to capture and notify operational risks and thereby to increase the visibility in supply chains. Visibility is an important aspect to alert decision-makers in supply chains of an undesirable event and a prerequisite for enabling a proactive response [Richardson, 2003; Rowat, 2004] as well as a resilient supply chain. Resilient supply chains adapt themselves quickly to the changes that arise as an action against undesirable events such as delays at suppliers [Rowat, 2004]. Being able to react quickly to undesirable events is an advantage in an uncertain environment. Many organizations are at risk because their response times to events are too long [Christopher and Peck]. Capturing events in real-time, alerting decision-makers automatically, responding to events on time through the utilization of SCEM-systems prevent costly expenses and revenue risk due to unsatisfied customers [Strozniak, 2002; Sapient Corporation, 2002]. SCEM-
systems are important instruments to enable invisible supply chain problems into profit opportunities and improved service [Strozniak, 2002].

The following example serves to concretize the above explanations about the contribution of SCEM-systems to risk management and illustrates how SCEM-systems can support the monitoring process of an operational risk management. The example is based on a simple two-tier supply chain structure where the customer demand is directly fulfilled by a manufacturer, whose components are supplied by a set of suppliers. Logistics service providers handle the material flow between all of the parties as shown in Figure 3.

Considering its breakdowns in the previous periods, the breakdown of the machine X in the workstation 1 of the manufacturer was defined as a risk. Furthermore the utilization of the machine Y in (alternative) workstation 2, which will be applied if the machine X breakdowns, was defined as a measure. In the current period SCEM-system detects that the machine X has broken down i.e. the predefined risk has occurred. After this detection the maintenance personnel is notified for repair and the concerned personnel in production is notified for the utilization of machine Y. Through the notification of production personnel in real time and directing the orders to the alternative machine, orders could be produced and delivered to the customer without delay. In this way both the dissatisfaction of the customer, which could result from late delivery, and the costs, which could incur e.g. by express delivery by air, are prevented.

SCEM-systems make also contributions to determine the occurrence frequency of risks, the efficiency of taken precautions and how precautions can be improved for future. They provide information for both the identification and controlling processes of risk management. Differently from the example above, in supply chains also unplanned risks, whose effects can be monitored, recorded and notified through SCEM-systems, can occur. Although measures against these risks cannot be fixed ex ante and their negative effects cannot be prevented, the identified risks are expanded through these unplanned risks within the context of risk identification and the identified measures are expanded through actions against unplanned risks. Thereby on the basis of experiences chain reflexes can be improved for future risks [Rajamani, Sriskandarajah, Pickens and Hameed, 2006]. Expanding of risks and measures is important for the improvement of supply chains against risks. Furthermore based on the recorded risks the frequency of their occurrence can be determined [Rajamani, Sriskandarajah, Pickens and Hameed, 2006] and evaluated. Performance indicators, which are determined - after the execution of measures - on the basis of data gathered by SCEM-system, point out whether taken precautions are sufficient. If it is found out that precautions are not effective enough for the realization of desired performance, then they have to be changed and improved in the context of risk controlling.

6 CONCLUSION

This study gives rise to an improved understanding of the role of SCEM-systems for supply chain risk management. In the study, on the basis of previous studies in the relevant literature it was determined that SCEM-systems contribute substantially to capture operational risks in supply chains and notify decision makers about these risks as well as to provide information to determine the occurrence
frequency of risks, the efficiency of taken precautions and how precautions can be improved for the future. Gaining insights from the implementations of these systems in practice, which validate the theoretical determinations in the study, can be scheduled as future research.

References


