RISK ANALYSIS FOR SUPPLY CHAIN NETWORKS

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ABSTRACT
The research is focused on the development of an integrated generic supply chain risk-, crises and performance management and monitoring system under the aspect of a comprehensive approach. Building on existing results from previous research activities we created a generic, integrated and systemic supply chain network model. Based on this model we described various scenario portfolios and single scenarios. We developed a risk assessment and analysis process model. The research results should create a unique risk rating and crises management monitoring system for decision making under the systemic view and criteria of:

- event orientation
- organisational orientation
- cause/trigger orientation
- time frame
- region
- level of abstraction

Beside the generation of the systemic supply chain network model, the scenario development, the risk assessment and analysis process and the risk rating and crises management monitoring model our research result can be used as well as for organizational development and strategic and operational decision making.

Keywords: enterprise risk management, risk rating, integrated supply chain risk- and performance management, supply chain networks.

1. INTRODUCTION

Over the past decade, the awareness of the importance of risk management for supply chains has risen continuously. Recent incident, such as the catastrophic floods in the Bangkok region in 2011 (BKK 2011) have demonstrated the high interdependency of international supply chains, in this special case the high dependence of the worldwide hardware industry on disks manufactured in the flooded region. This and other similaraly disastrous events have led to a renewed interest in robustness and resilience of supply chains (Wilding 2011).

This discussion is ongoing, especially in relation to how future supply chain network-infrastructures should be structured in a centralized or decentralized way. Of primary interest and in some cases even vital importance is the discourse of all horizontally and vertically integrated interactions and dependencies between the different supply chain networks for providing uninterrupted services. This has a direct influence on the development and the use of future smart solutions options, not only in the context of energy supply, but even more so in the context of ICT infrastructures.

Compliance constitutes a other field of discussion and research. Legal and corporate compliance should ideally guide risk management efforts of organisations and build the basis for the implementation of an Integrated Supply Chain Risk- and Performance Management and Monitoring System. While the majority of laws and regulations relevant for this research are based on European regulations, directives and guidelines, US and austrian national legislation and international and national standardizations and agreements (e.g. ISO 31000, ISO 31010, ISO 28000ff, ON ISO 31000, ONR 49000ff) also play a major role.

2. MOTIVATION

Consequently, society and economy, i.e. enterprises, governments, NGOs and individuals, have to address a wide range of issues:

- The development of a robust interaction mechanism for controlling increasingly complex and interdependent supply chain networks (Wilding 2011).

- The relation between global, supranational, regional and local supply relevance and density under resilient conditions.
- The prediction and anticipation of potential disruptions of centralized and decentralized supply chain networks in relation to potential events, space, time and level of abstraction in order to design adequate avoidance and mitigation strategies, and emergency plans both for the public and the private sector based on accumulated knowledge and empirical best-practices (Goellner, Kienesberger, Peer, Schoenbacher, Weiler, Wurzer 2010; Goellner, Meurers, Peer, Langer, Kammerstetter 2014).
- The provision of robust and reliable communication and logistics for all involved stakeholders, especially for the purpose of adequate status information (Goellner, Meurers, Peer, Povoden 2011; Peer, Göllner, Haberfellner, Bauer 2014).

Advanced concepts for future risk analysis of supply chains should therefore support and improve the above issues, which sometimes needs to be done in ways not anticipated before. Risk analysis concepts, models and methods should ideally allow for the speedy aggregation and presentation of data, information and knowledge supported by effective and efficient communications in new ways, offering improved interpretation, assessment and decisions.

3. AIM/SCOPE

One of our core research goals is to follow an integrated approach consisting in the core of contributions from logistics, risk analysis, performance management and information and communications technology including the Human factor rsp. The structured basis on the issue given in Fig.1, which is developed by Göllner, Peer (2012), builds the background of the research approach presented in this paper.

It clearly arranges critical infrastructures, sectors in society and economy, actors and events that may lead to a threat in a specific supply chain (Goellner, Kienesberger, Peer, Schoenbacher, Weiler, Wurzer 2010).

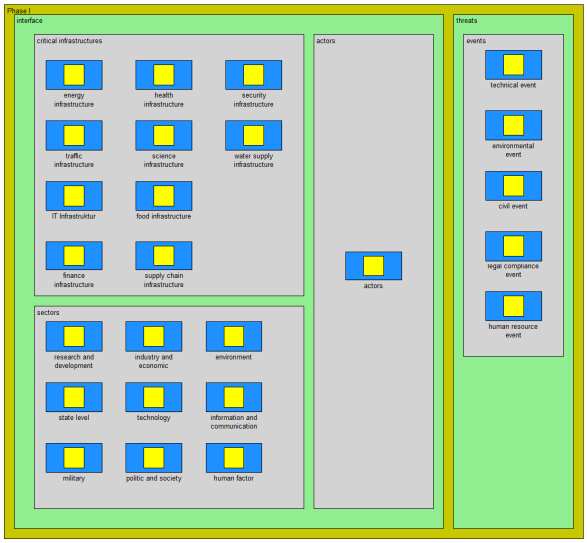

Figure 1: Structure and interface for comprehensive risk analysis

The design of complex supply chain networks will profit most from this research, while our current research in risk models and meta models, IT & network resilience, critical infrastructure risk, knowledge development & decision support form the basis for the development of an integrated supply chain risk- and performance management approach (Goellner, Meurers, Peer, Povoden 2010a-c; Christopher and Peck 2004).

Industrial applications, especially in the chemical industry, insurance companies, transport & logistics, finance, strategic resource planning, information and communication technology & energy, architecture & urban planning, information and big data analysis and network analysis can serve as case studies for testing the viability of our research (Goellner, Meurers, Peer, Povoden 2010a-c; Goellner, Meurers, Peer, Povoden 2011).

Enterprise risk management and business continuity need to be discussed in the context of a meta supply chain model, which is currently under development. Building on an identification of requirements for the envisaged meta supply chain model the model itself is described, followed by an enterprise risk management (ERM) approach based on this model, including business continuity aspects (Goellner, Meurers, Peer, Povoden 2010a-c; Bossel 2007; Buzan, Waever, Wilde 1998; Buzan, Waever 2008).

The following figure 2 was developed by Göllner J. and Peer A (Goellner, Peer 2012). This figure shows the relation between the enterprise risk management of a reference organisation and the supply chain networks.

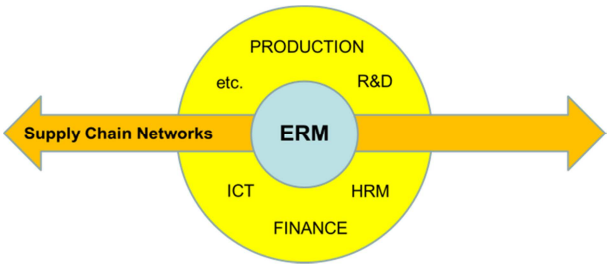

Figure 2: Relation between organisation-supply chain networks and enterprise risk management

4. RESEARCH AGENDA & PROCESS

The research follows the agenda:

1. Process representation of a selected supply chain
2. Identification and systematization of the strategic / critical supply chain networks focused on an integrated supply chain concept
3. Design and develop a "state of the art" - Network typology to generate a risk map-catalogue, which is representing the relevant risk-events
4. Verification of the relationships and interfaces along the Supply Chain Networks for presentation in a supply chain risk map and in relation to the example relevant endogenous and exogenous risk factors, according to point 1-3
5. Development of a risk rating model for the evaluation and assessment of centralized and decentralized "critical infrastructure networks" and in relation to the associated event / event portfolio (framework scenarios, scenarios portfolios and individual scenarios)
6. Development of a crisis management model for business continuity especially under the focus of chemical, biological, radiological and nuclear threats (CBRN threats) in the industrial context
7. Use Case discussion

The ongoing research process is divided into 4 phases:

1. The first element (figure 1) deals with the identification of the interfaces of critical infrastructures, sectors and actors under various threats and the analysis of strategic / critical supply chain networks in the sense or on the basis of an integrated supply chain concept is generally finished and tested.
2. The second element deals with a referenced global acting pharmaceutical enterprise, which is used for validating our comprehensive approach during various test cases.
3. The third element consists of a scenario development and the following risk management model to design and development a "state of the art" - Network typology to generate a risk map – catalogue (Howard 2009; Vester 2008). Therefore various models are still tested and a meta model is finally designed and tested.
4. In the last element the research approach is divide up into both the development of

    a. a risk rating model and
    b. a crisis management model

    including the verification and validating under the systemic view of the 5-stage-model during 2 use cases. The 5-stage-model is shown in Fig. 3 (Backfried, Göllner, Quirchmayr, Rainer, Kienast, Thallinger, Schmidt, Peer 2013).

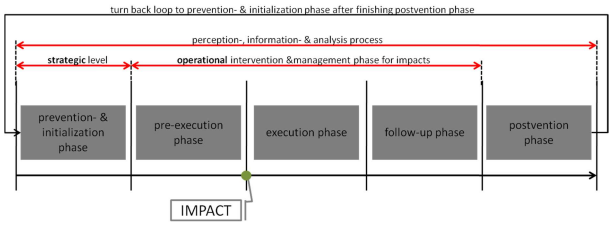

Figure 3: 5-stage-model

So with this activities the various influencing topics are documented and further on categorized. Then the interdependencies and correlations are identified and described.

5. RESULTS

Based on the research agenda and the research process we created a generic integrated systemic supply chain network model.

Various unique scenario portfolios and single scenarios were described in relation to the generic integrated systemic supply chain network model.

Further on we developed a risk assessment and analysis process and model, including the identification of the relevant and corresponding key performance indicators and key risk indicators.

Those indicators are necessary for the designed risk rating model for future trend analysis and also as well as the implementation of a effective and efficient crises management on demand.

The result of the research can be used for centralized or decentralized strategic or critical supply chain networks as well as for the crisis management.

The unique result for an organisation is at least an integrated supply chain risk-, crises and performance management and monitoring system which depends on the relevant rating elements.

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AUTHORS BIOGRAPHY

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Manfred Gronalt, has been a full professor at BOKU-University of Natural Resources and Life Sciences Department of Economics and Social Sciences Vienna since 2002 and is head of the institute of production economics and logistics. His expertise and research interests comprise simulation based optimization, traffic and logistics research and operations management. He is also member of the Austrian Society for Operations Research and the EURO working group on Agriculture and Forest management and he chairs the working group (5.04.13) on industrial engineering, operations analysis and logistics within IUFRO. For the research on simulation and capacity analysis of Binnenland Container terminal the Institute was honored with the Austrian State Award for green logistics in 2007. Prof. Gronalt was member of the department steering committee from 2004 – 2009 and also member of the university council. He is also member of the executive board of the Austrian Institute for Sustainability and with the german association of logistics (BVL) he is academic member of the jury for awarding the sustainability price on logistics.

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