RISK AND LOSS PREVENTION WITHIN THE TRANSPORT CHAIN

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Transport and logistics operations are vulnerable to many types of risks due to an increasing dynamic and structural complexity of today's supply chain networks. Global distributed sourcing and production leads to more transported goods in general but also to more high value cargoes being shipped around the world. However, detailed information about the transport condition and integrity are not available in the end-to-end chain as e.g. a sealed container can be considered as "black box". In this paper we firstly analyze claims data from one of the largest transportation insurance providers in Europe. The sample consisted of 7,284 claims made in the recent four years (2005 – 2008) as a result of incidents in transportation. Through a variance analysis, we demonstrate differences among industries in terms of average losses, transportation mode and premium coverage. Secondly, based on these findings an active risk management framework will be developed using sensor-telematics and localization technologies to increase visibility and transparency in supply chain operations fitting industries' current needs. Findings from this paper provide facts on how prevention can be implemented in logistics. The results give practitioners in the supply chain management and marine cargo insurance industry a deeper understanding of current transportation risks and how to address them by creating innovative value-added services to differentiate logistics and insurance solutions effectively from competitors.

Keywords: Loss prevention, technology management, sensor telematics, supply chain risk management.

INTRODUCTION

Today's business world is characterized by globalization, trade liberalization, rough competition, high customer demands, and strict law obligations. In this environment, logistics services providers (LSP) need to fully integrate efficient and effective supply chains, and hence help to realize sustaining competitive advantages for their customers (Christopher and Towill, 2002). Today, competition takes place at the level of sourcing and distribution rather than at the level of production. Thus, commercial supply chains evolved into dynamic networks of interconnected firms and industries in recent years. The trend of increasing business process outsourcing (BPO) of transportation and logistics activities induced logistics companies to coordinate and accelerate physical goods and information flows on multiple levels of the supply chains. LSPs play a key integrative role, linking different supply chain elements with the entire delivery process by the systematic management of information (Cooper et al., 1998). In order to keep better control of the sourcing and shipping along with achieving productivity and efficiency gains, companies also started to implement more or less collaborative strategies across their entire network (Barratt, 2004; Sahay, 2003; Horvarth, 2001). Inventory is now pulled from one stage to the next, based on real-time demand to synchronize manufacturing execution and customer demand. All depends on more proficient and reliable transportation and communication systems (Viswanathan and Littlefield, 2009).

Although companies can realize efficiency and productivity improvements with lean principles, the growth of globalization, supplier dependency and variability of demands has led simultaneously to an increasing vulnerability of supply chain networks to disruption (Wagner and Bode, 2007). As the present paper focuses on transportation and logistics, the scope can be narrowed down to supply chain risks that occur during the transportation and warehousing process. Sources of risk in these specific logistics processes are, for examples, theft, damage, or spoilage of goods as well as in-transit or customs delays (Peleg-Gillai et al., 2006). Risk itself is an elusive construct that has a variety of different meanings, measurements and interpretations depending on the academic research field. In this context a hazard-focused interpretation common in risk management is used which presents risk in terms of:

Risk = Probability (of a given event) x Severity (negative business impact) (March and Shapira, 1987).

Identifying and assessing likely risks and their possible impact on operations is a complex and difficult task for a single company. However, to properly assess vulnerabilities in a supply chain, firms must not only identify direct risks to their operations but also the risks to all other entities as well as those risks caused by the transportation linkages between organizations (Jüttner, 2005). The process of supply chain risk management, as discussed by Closs and McGarrell (2004), refers to: "the application of policies, procedures, and technologies to protect supply chain assets from theft, damage or terrorism, and to prevent the unauthorized introduction of contraband, people or weapons into the supply chain." Risk management related to the transportation and logistics chain includes processes which reduce the probability of occurrence and/or impact that detrimental supply chain events have on the specific company (Zsidisin and Ellram, 2003).

Though many companies are devoting increased resources and attention to secu-rity efforts, little guidance is available to firms seeking to minimize their expo-sure to unexpected and potentially damaging or disruptive events impacting their supply chains (Autry and Bobbit, 2008). The use of information technology (IT) has permitted the development of faster, more reliable, and precisely timed logistics strategies – but has also lead to information-intensive transportation services. Adopting lean or agile principles, firms now require current and immediate information about the location of productive activities as well as information linking the locations with available transport opportunities. With IT, firms are enabled to more closely track and trace the flow of goods and the production process can be managed according to the current good's position (Capineri and Leinbach, 2006). In this regard, information and communications technology is of critical importance to meet challenges arising from extended supply chain networks and lean logistic strategies. Due to standardization efforts and decreasing prices for electronic parts, tracking and tracing has become a common service offered by almost any LSP. According to Sauvage (2003) technology is a significant tool for differentiation of logistics services. By using enhanced technologies, logistics companies are able to develop new services and customized products to stay ahead in a highly competitive business characterized by time compression and the need to maintain competitive lead times. Therefore leading freight forwarders, carriers, and other LSPs have developed new solutions based on localization and sensor tracking and tracing. Localization, sensor technology, and communications are part of ubiquitous computing which sets out to integrate applications and databases with the real operational environment such as warehouses or transport vehicles. By closing the gap between information and reality, ubiquitous computing systems are able to recognize changes in conditions in the real world (Fleisch, 2001). Condition monitoring allows all supply chain parties to "manage by exception," i.e., being capable to recognize and react to unplanned events during transportation and warehousing.

This paper follows the steps of a traditional risk management circle. First the pain points in transportation and warehousing are identified based on the analysis of insurance claims data. The analysis is followed by an overview of enabling technologies to monitor and control freight conditions. In order to reduce and manage risks effectively throughout the supply chain, a proactive risk management concept based on ubiquitous computing is introduced. The last section of the proactive risk management concept addresses early intervention to avoid theft, damages, and spoilage of the goods which has a direct impact on loss expenses.

PAIN POINTS WHEN MANAGING RISKS IN THE TRANSPORT LOGISTICS CHAIN

Logistics service providers play a critical role in modern supply chains, because they integrate and coordinate material and information flows throughout the chain. Transportation, the initial core service of logistics service providers, has become a very competitive business. Customers demand high levels of flexibility and customization, information systems integration, and fast transit times – but all at low costs. Therefore, today's transportation networks of logistics ser-vice providers are highly complex and tightly-coupled systems that are vulnerable to many types of disruptions. In the presence of complexity and tight-coupling, supply chain systems become prone to accidents (Wagner and Bode, 2007). In order to impose a proactive risk management system, it is essential to have reliable information on the major pain points in transportation.

Empirical Analysis

To study this issue, we analyzed claims data from one of the largest transportation insurance providers in Europe. The sample consisted of 7,284 claims made in the recent four years (2005 – 2008) as a result of incidents in transportation. In this sample, the insurance holder was either a LSP or the shipper. The aver-age loss given incident was US$ 19,265. The five largest incidents accounted for a loss of US$4 to 11 Million; all of these five incidents involved trucks and valuable pharmaceuticals. It is important to note that this data set is not representative for the entire transportation insurance industry, as it is certainly affected by the specific customer base of the particular insurance provider. Still, it provides some clues for the identification of the current major pain points in transportation.

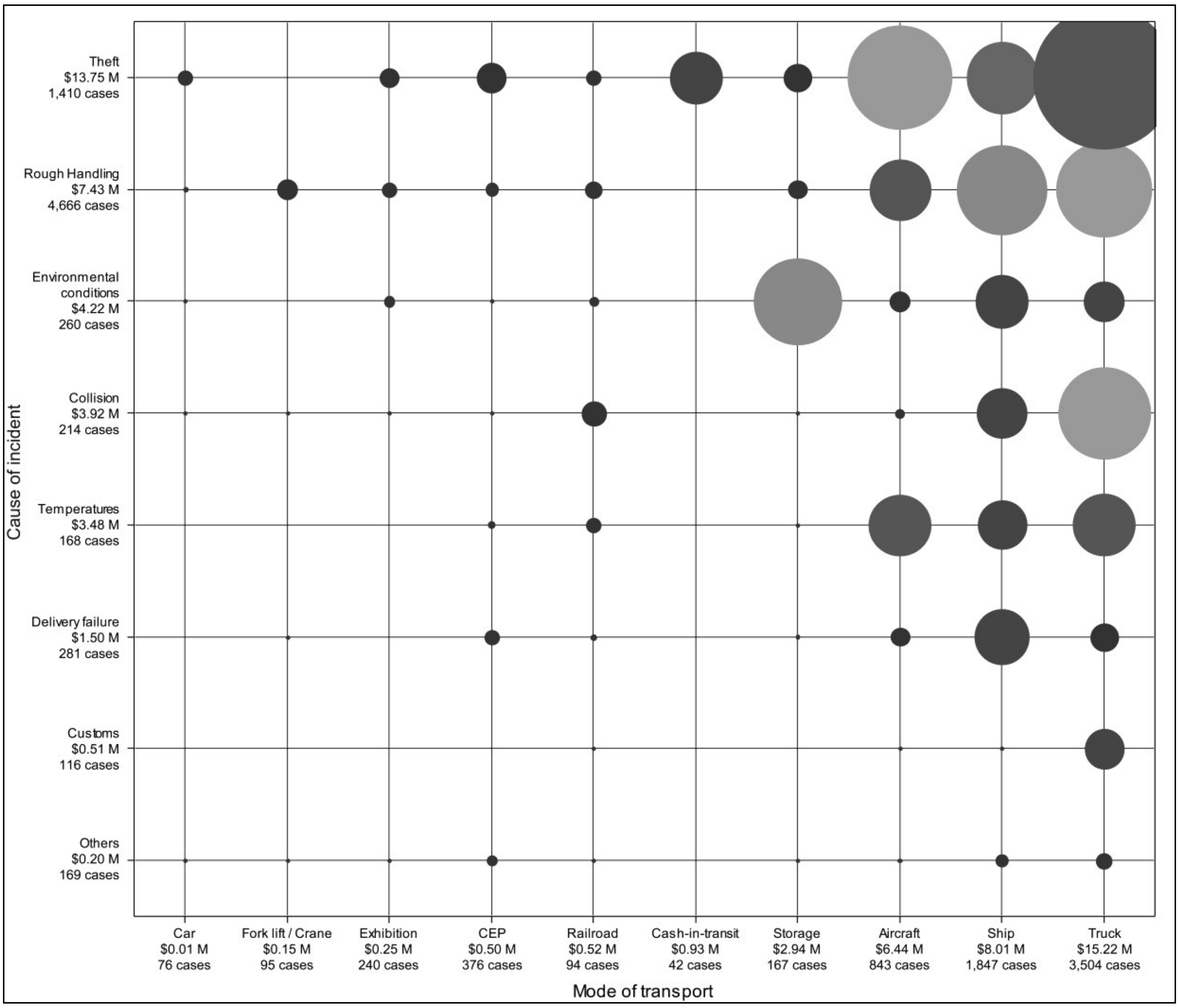

Figure 1: Total loss by means of transport and cause of incident

We investigated the relationship between the modes of transport and the causes of incidents. Figure 1 visualizes the amount of loss differentiated by the various modes of transport and causes. First, the figure shows that truck, ship, and air cargo transportation operations are most vulnerable to disruptions. Most incidents (both in terms of frequency and total loss) involved these three modes of transportation. The average loss given incident, however, was highest for cash-in-transit, followed by storage and air cargo. Second, cargo theft (includes also pilferage), rough handling, and environmental conditions (includes condensation, contamination with fresh or sea water, fire, or natural disasters) are the most salient causes for disruptions in transportation (again, both in terms of frequency and total loss). Changes in temperatures also seem to pose a significant threat to transportation. The average loss given incident was highest for incidents causes by changes in temperatures, followed by collision, and extreme environmental conditions. Third, cargo theft and rough handling are particularly important issues for the modes of truck, ship, and air cargo, while environmental conditions are a significant threat to in-transit storage. An interesting finding is that cargo theft is also a major problem in air cargo business.

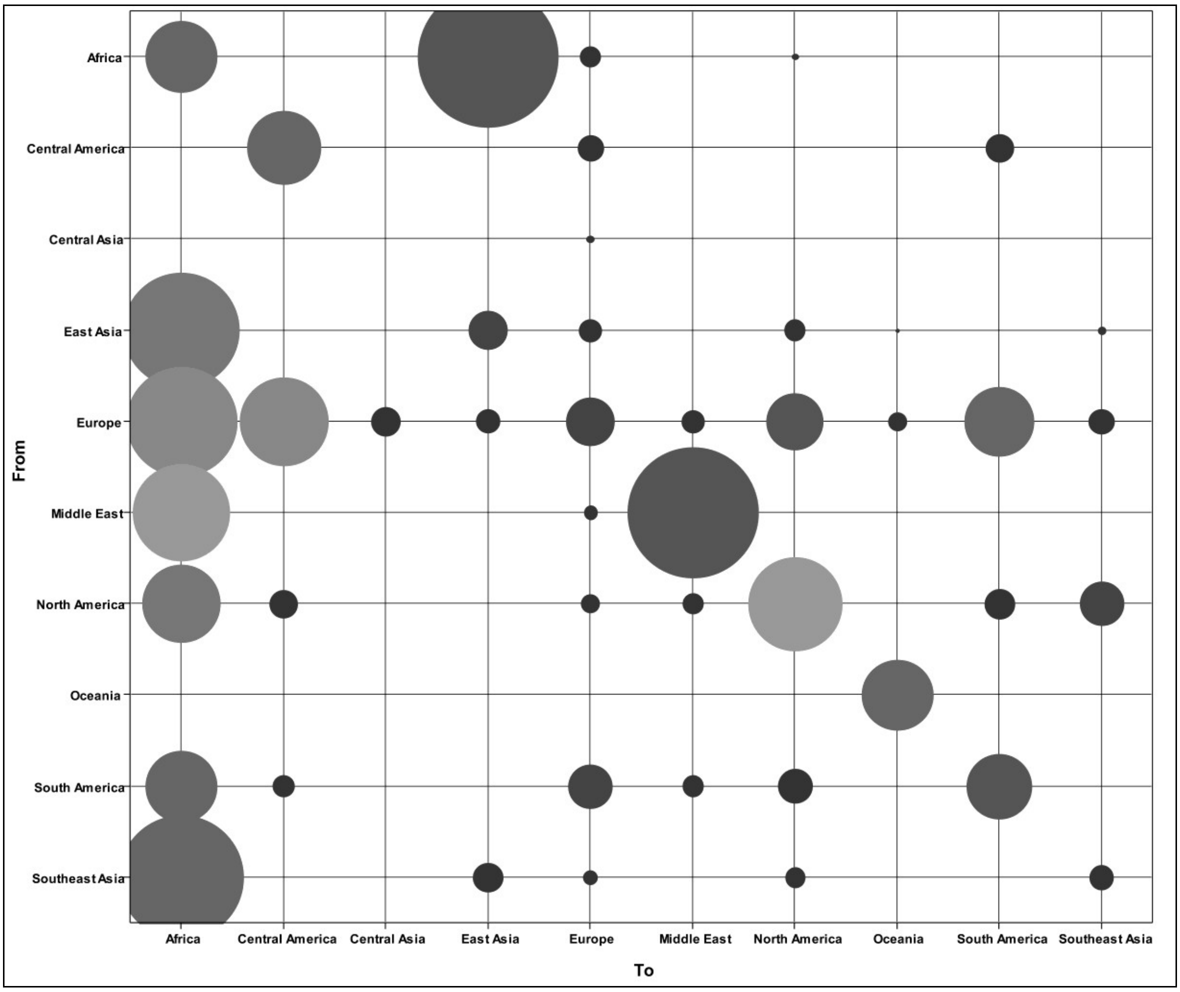

Figure 2: Average loss given incident caused by theft on routes in and between continents

As cargo theft is one of the major causes for insurance claims, we decided to have a closer look at how cargo theft occurs in various geographic regions. Figure 2 shows that cargo theft is a major problem for transportation operations that involve Africa or the Middle East. Most of the theft incidents occurred on routes that connected these regions. Transports that stay in the same regions (diagonal) also show a relatively high exposure to theft, although the transport duration is not that long. The main reason for this finding is that these shipments are usually facilitated by trucks which are particularly vulnerable to theft. Moreover, and in comparison to Europe, our data indicates that theft is also a major concern in North America.

Value of sensor information

As the claims data analysis in the previous section indicates, the damages and theft occurs primarily during land transportation, warehousing, and handling the goods. A locked and sealed ocean container, trailer, or swap body represents a black box for all involved supply chain parties. Yet, no one is able to say whether harsh environmental conditions affected the goods in transport until the package items are opened at their final destination (consignee) or at distribution centers and cross-docking facilities in between. Shipments might have been handled inappropriately (e.g., collision, hitting the ground) or impaired by spoilage which is usually not identifiable by quick visual inspections. Moreover, the localization of these incidents or the identification of the responsible persons is virtually impossible. Often times, these issues result in unexpected delays that negatively affect the on-carriage and downstream supply chain operations. The capability to track environmental parameters such as temperature, humidity, or collision (shock) for individual logistic units would allow to spot problems in the supply chain and to precisely determine the actual state of individual products (Sahin et al., 2007).

To express the value of information (VOI) in this context, a comparison of the actual situation (1) without any sensor technology and (2) with the sensor enhanced approach has to be done. The VOI in inventory replenishment is defined as the marginal improvement that a system achieves through the use of additional information (Ketzenberg et al., 2007). This concept is well suited to adopt it to logistics and transportation operations, as they are essential in each replenishment process. In a recent simulation study on the replenishment of perishable goods, Ilic et al. (2009a) have shown that sensor technology, which monitors the goods' temperature throughout the transport, leads to a decreased number of unsellable goods (-36%) and in-store waste (-50%) due to sensor enhanced sorting in the upstream warehouses. With the help the sensors' information, goods that are affected by (hidden) spoilage or damage can be sorted out very early. In this particular case, the VOI has added 8.5% to profit which shows the positive outcome using sensor information. Moreover, the technology has the potential to improve the resource efficiency of the related processes. As less transports are necessary, emission and carbon footprint reductions are be possible (Ilic et al., 2009b); thus the condition monitoring concept maintains the current "green logistics" initiatives by LSPs.

Employing enhanced technology in warehousing and transportation such as sensors, localization, and continuous communication systems has an operational benefit in supply chain management. The data collection and data availability provided by the technology infrastructure discussed in the following sections allow to improve forecast accuracy and to increase cross-enterprise integration among partners in the supply chain. Sensor and localization information can be used to adjust plans and to re-allocate resources and distribution routes when changes within established parameters are indicated. Indeed, there is a real opportunity for process innovation in transportation and logistics triggered by technology (Rodriguez et al., 2007). The implementation of advanced technologies, which are used to process information quickly and productively, are enables safer transportation and efficient work. LSPs can optimize their means of transportation and routing with respect to potential risks along the whole logistics chain. With respect to dangerous freight, sensor and localization technology allows to effectively control all transport facilities and the integrity of all package items to avoid accidents, thefts, and damages. The information of any deviation from the route and other related data such as door opening proto-cols are recorded to improve transportation security as well (Batarliene, 2007).

Requirements for the active risk management

Technology-based continuous condition monitoring has become a common practice for the transportation of deep-frozen goods or pharmaceuticals; in the European Union this approach is even a statutory requirement. Specialized logistics companies have therefore implemented indicator or logger systems which either show a color indicator (e.g., fade) or track the trend of temperature on physical memory. His helps to reveal rises in temperature or abusive storage conditions. The International Organization for Standardization (ISO) has recently launched the ISO 28000 series specifying the requirements for a security management system to ensure safety in the supply chain. This ISO framework gives all supply chain partners an increased ability to effectively implement mechanisms that address security vulnerabilities at strategic and operational levels, as well as to establish preventive action plans. Besides, a variety of international security initiatives such as the Customs-Trade Partnership Against Terrorism (C-TPAT), the Container Security Initiative (CSI), and Europe's relatively new Authorized Economic Operator (AEO) require control at loading freight. The objective of these initiatives is to improve the movement of cross-border trade (i.e., through using "green lanes") by ensuring that members of the supply chain are confirmed as secure trades (Banomyong, 2005).

So far, integrated risk management has focused on claims management and risk transfer through underwriting. Addressing risks in the supply chain requires the identification of triggering events and vulnerabilities while risks are assessed mainly with support of risk management tools (processes shaded in dark gray in Figure 3). Operative risk management principles expand this traditional process chain regarding loss prevention consulting, promotion of risk controlling, and cooperation in the field of technology-supported early intervention avoiding or at least minimizing losses (processes shaded in light gray in Figure 3). Risk prevention should consequently be based on continuous monitoring of the trans-port and warehousing conditions aiming to confine claims amounts.

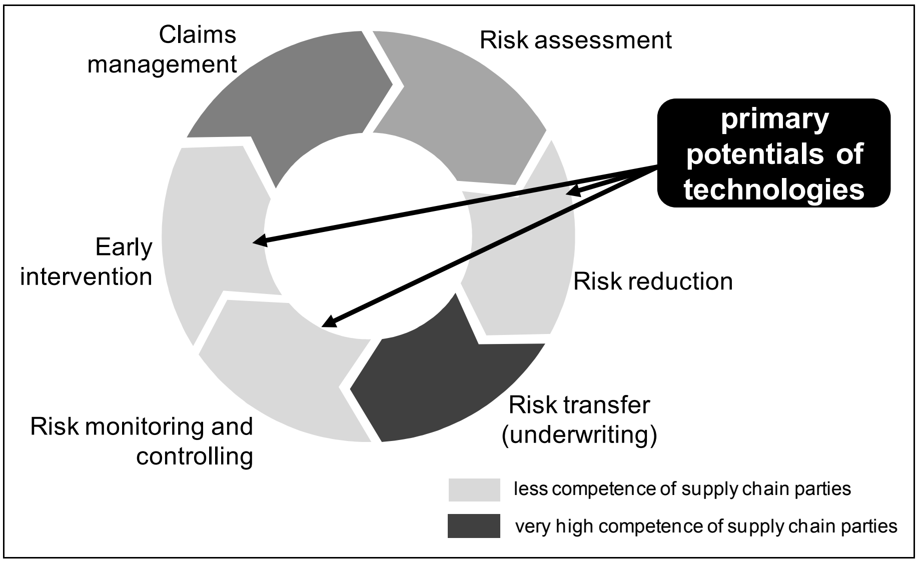

Figure 3: Risk management circle in transportation

Thus, the technology-enabled risk management strongly appears loss decreasing in two different directions: First, recurring risks can be identified based on collected data by sensors and localization systems. Adjusted transport planning optimizes risks on the long-term. Second, continuous condition as well as integrity monitoring of goods and transportation vehicles, containers, and trailers allows responding to unforeseeable exceptions in real-time. If critical values are exceeding a pre-defined range, an alarm would be generated with exact timestamp. Henceforth, counteractive actions can be initiated even before a serious supply chain disruption occurs. Aiming at realizing the above stated operational improvements by enhanced technologies, condition and integrity monitoring systems should consist of the following modules:

(1) World-wide, high-resolution (i.e., down to street levels) self-contained localization of containers, trailers and other transportation vehicles based on satellite or mobile phone networks featuring a real-time positioning and tracking.

(2) Sensor technology that is capable to monitor temperature, humidity, shocks and gases inside the containers or transport vehicles, and which records the conditions in dedicated intervals. Motion and light detectors as well as door sensors improve transport security and contribute to threat protection.

(3) Communication systems that allow sending sensor and positioning data in case of an exception or alarm. Communication is usually carried out by common mobile phone network derivates or satellite networks. Server or integrated enterprise applications receive the data packages and visualize the raw data user-orientated in web-based portals.

Localization, sensor, and communication systems are all part of ubiquitous computing technologies which connect things in the real world to the internet in order to provide information on anything, anytime, anywhere. Applied to objects such as containers and transportation units, they could thus react and operate in a context-sensitive manner appearing to be “smart” (Mattern, 2001). How these technologies create visibility in transportation and warehouse processes regarding risk management and prevention is discussed in the following two sections.

TECHNOLOGIES TO CREATE VISIBILITY

Due to ongoing price pressure and standardization efforts, technology is becoming smaller, more affordable, and more powerful, which creates enhanced business values. In the field of transportation and warehousing, the use of technology is today common or “ubiquitous” when tracking or tracing goods through the supply chain. Ubiquitous computing is a logical next step in the development of business computing. Integrated information systems like enterprise resource planning (ERP) systems have linked firm functions and departments, and thus enabled consistent business processes. Internet and e-business systems have extended these processes beyond the boundaries of organizations and have become unsupported the management of business networks (Fleisch and Dierkes, 2003).

In order to develop an intelligent transportation system Garcia-Ortiz et al. (1995) defined several key technologies such as digital maps for positioning, sensors, communication, vehicle control, and route planning. Based on these requirements, three technology fields are necessary to implement a proactive risk management in transportation logistics based real-time visibility: (1) localization, (2) sensor systems, and (3) communication. Collectively, these are often termed “telematics,” i.e., the combination of telecommunication and information technologies.

Localization

The positioning technology should meet the accuracy requirements determined by the particular service, at the lowest possible cost and with minimal impact on the network and the equipment (Kos et al. 2006). The localization of general cargo can be divided into two main categories: (1) discrete tracking and tracing methods and (2) continuous tracking and tracing methods (Hillbrand and Schoech, 2007). Discrete systems identify a shipment on predefined locations, using barcode or – increasingly common – radio frequency identification (RFID) scans within warehouses. Even with RFID, such discrete systems locate goods only in a relatively limited area of 100 to 150 meters. In contrast, the continuous approach, which uses on satellite or cell phone networks, enables the necessary seamless real-time tracking and tracing service. Permanent localization is today dominated by the Global Positioning System (NAVSTAR-GPS), a military satellite network installed and governed by the United States.

Actual initiatives by the European Union known as “Galileo project” will add a global positioning service under civilian control in the next five to ten years. Galileo will also offer an improved tracking correctness (Batarliene, 2007). In both cases, the concept is essentially the same: The receiver triangulates its position anywhere on earth by accurately measuring the distance from at least three satellites. Distance is measured by evaluating the time required for the signal to travel from the satellite to the receiver. In order to receive the satellite signals, receivers require a direct line of sight to the satellites, which cannot be achieved inside containers or packages. To overcome this limitation, this technology often comes in a form known as Assisted GPS (A-GPS) where the receiver utilizes additional data about the relevant satellites from a terrestrial A-GPS Location Server. This allows the A-GPS receiver to operate in difficult GPS signal environments such as high buildings, forests, and narrow valleys. In environments where satellite signals are severely blocked, the use A-GPS is also limited (Weckström, 2003).

In comparison to GPS-systems, localization based on mobile phone networks is available in- and outdoors at high quality, as long as network coverage exists. Kos et al. (2006) separates the adopted methods to determine the location in this regard into two opposite ones. First, network-based positioning relies on various means of triangulation of the signal from cell sites serving a mobile device. Second, device-based positioning performs estimation calculations using suitable information available wirelessly. Hybrid systems are a combination of both methods for better effectiveness and efficiency. However, positioning accuracy is highly depended on the localization method used and is in general significantly below the GPS-systems (Sage, 2001). Figure 4 exemplifies the different accuracy depending on the positioning method.

	Accuracy in positioning			
	Rural	**Suburban**	**Urban**	**Indoor**
CI	1-35 km	1-10 km	150-500 m	10-50 m
E-OTD	-	50-150 m	50-150 m	good
A-GPS	10 m	10-20 m	10-100 m	variable

Figure 4: Accuracy of different positioning technologies (Kos et al., 2006)

The basic positioning method is cell identification (CI) operating in all mobile networks, since all devices support this technology. In this case, not the cell phone itself is identified but the base transceiver station (BTS) to which the cell phone currently communicates to. Depending on the cell dimensions, the positioning accuracy ranges from several 100 m in urban areas to 35 km in the country. Using timing advance (TA) to estimate the distance between the mobile device and the serving BTS results in an average accuracy of 550 m (Kos et al., 2006). The observed time difference (E-OTD) method operates in GSM (global system for mobile communication) and GPRS (general packet radio service) networks and determines a position by the use of time delay or arrival time of radio signals which are transmitted by at least three synchronized BTS. Because time is critical to the location estimation, E-OTD requires precise time information which is ensured by the so-called location measurement units (LMUs) placed everywhere in the network where a location service is offered. Typically, one LMU is needed per three to five BTS to ensure an accurate timing source (Hofmann-Wellenhof et al., 2003). In case of UMTS (universal mobile telecommunication systems) networks this method is called observed time difference of arrival (OTDOA) and works similar to E-OTD.

For the purpose of improving indoor mapping and localization, new methods based on wireless LAN (WLAN) access points are currently developed and tested. By combining GPS outdoors and WLAN indoors a high-quality, continuous positioning service can be achieved with only slight decrease in accuracy indoors (Reyero et al., 2008). This could possibly enable permanent goods tracking during transportation and warehousing with the same device closing a still existent technology break in terms of an active risk management.

Sensor technology

Sensors permit the automatic measurement of a large number of environmental conditions such as temperature, humidity, acceleration, chemical composition, pressure. These sensors are designed for data collection (sensing), information sharing, monitoring, and evaluating data throughout the transport logistics chain. Ultimately, this approach would result in semi-automated analysis and action (response) when a set of sensor inputs are determined without hindering human autonomy (Rodriguez et al., 2007). Sensor-enabled “smart boxes” offer the possibility to analyze trade lanes with regard to conditions that may impact the freight. Sensor technology in combination with positioning enables an electronic, real-time tracking, which creates additional visibility to all supply chain partners. The transportation monitoring provides a direct view into the container or respective means during the shipment at all times. Transports are i.e. for product liability reasons already sensor continuously monitored in the pharmaceutical industry. Here, not only the drugstores, but also both the carrier and manufacturer have a strong interest in ensuring product quality up to the end consumer. Applying sensors to the truck or container enables the timely notification of problems before they arise and provides more time for actually resolving the problem.

Currently, new services and solutions are emerging because of interfacing sensor systems to monitor freight conditions with telematics modules. Controlled access, monitored conditions, and electronic documentation throughout the transport meet the requirements of the C-TPAT and AEO customs programs. It also allows identifying effectively risky containers which makes the whole chain more efficient and safer, if these are monitored more closely. The specific sensor components can basically be configured for every individual operation purpose. The various digital or analogue sensors are usually linked through cables or radio communication based on Bluetooth or ISM-frequencies, which are reserved internationally to industry, science and medical purposes. As self-containing units, the sensor telematics modules are then integrated into the containers, trailers or vehicles and where applicable connected to the on-board electronics for example to save battery power.

Communication

Since GPS-satellite networks cannot be used for communication, additional components are necessary to send the collected data and to obtain external queries to retrieve i.e. the actual transport conditions. Considering the solutions on the market, communication regarding transport monitoring is dominated today by mobile phone networks which have a relatively well developed global infra-structure in most of the populated areas. Due to quad band modems all four regional network standards can be used to communicate between the device mounted on container, truck or trailer and the receiving server. Generally, GSM-based short message service (SMS) and GPRS are as communication protocols applied. In order to save costs the monitoring units store the determined positioning and sensor data on an internal memory and send the data in predefined time intervals. In case the unit is outside the network coverage, the internal memory stores the information as long as communication is available again. Typical communication intervals are every 6 to 12 hours in ocean freight and 8 to 12 times a day in land transportation. But, whenever the monitoring unit detects an exception, it is usually programmed to send the alarm immediately or as quickly as possible after notice.

For areas without GSM/GPRS coverage, satellite communication is the only option to achieve connectivity with the backend. Communication satellites have in contrast to GPS-satellites bidirectional antennas, which enable sending (up-link) and receiving (downlink) simultaneously. 100% global coverage is the main advantage compared to mobile phone networks and hence communication is possible anytime provided that a direct line of sight to the satellite exists (Maral and Bousquet, 2002). The data transmission through satellites is additionally encrypted protecting the data integrity and accordingly no one from outside is able to intercept. Because of the high infrastructure costs a satellite network implicates, only a limited amount of providers in the market exists (Sheriff and Hu, 2001).

Satellite communication can be characterized by their orbit: Geostationary satellite systems are stationary relative to a point at earth's surface, as they resolve in the same direction and with the same speed as the earth's rotation. To provide global coverage only a few satellites in a very high distance to the earth are required. But from a usage perspective this means the antenna of the devices should be directed to the equator to achieve favorable results in terms of reliability and throughput. In case of transportation additional equipment is needed to adjust the antenna direction relative to the driving course. Low earth orbit (LEO) systems cover a smaller radius because of their lower altitude and require far more satellites for global network coverage. Thus, communication and maintenance fees are quite high, this service is only cost-effective when the data packages are small and respectively data transfer is only done in case of an alarm. As the smaller distance between the earth and the satellite this has a positive impact on the required transceiver power and on satellite latency, which makes LEO-systems most suitable for sensor networks (Schaefer, 2006). As containers can face any direction, communication is not depended on the antenna facing the equator. But in comparison with mobile phone networks, the bidirectional satellite antennas require more space and need larger antennas, which affect the overall module size of the monitoring units negatively.

PROACTIVE RISK MANAGEMENT ALONG THE TRANSPORT AND LOGISTICS CHAIN

The goal-oriented execution of the claims analysis reconfirms the value of in-formation in supply chain management. Henceforth, the integration of technology into a distinct risk management concept clearly enables to detect potential weaknesses in supply chains prior to failure or mistreatment. Besides, the potential supply chain security relies on other "softer factors" such as the development and continuance of business relationships among the supply chain parties. Communication between the involved companies allows for sharing information, risks, and rewards were identified as critical factors for effective supply chain risk management (Autry and Bobbitt, 2008). A study by Peleg-Gillai et al. (2006) confirms quantifiable benefits of investments in supply chain security including a 38% reduction in theft, loss, or pilferage, a 14% cut in excess inventory, a 49% reduction in cargo delays, and a 29% reduction in overall transit times. Accordingly, the US Congressional Budget Office has noted savings of 0.8% of the value of smart container's contents (Giermanski, 2008).

The technology-enabled risk management is based on a threefold concept comprising of GPS-positioning, sensor technology and communication either through mobile phone or satellite networks. The raw data received by sensors and the localization are processed by sever systems. Those drastically reduce the complexity by filtering and unmistakably visualizing the key information. The map-based view is intuitively to operate and comprises a 'hands on' approach. Users are able to zoom in getting a more detailed view on a specific area or to zoom out viewing the supply chain from a more high-level perspective. In order to inform the supply chain partners about the status of a shipment a three-color coding scheme is used. “Green” signifies that no inconsistencies are detected, “yellow” signals some deviation but no critical one, and “red” informs that there are critical events ongoing, which may result in potential damage or loss and therefore indicates a serious problem.

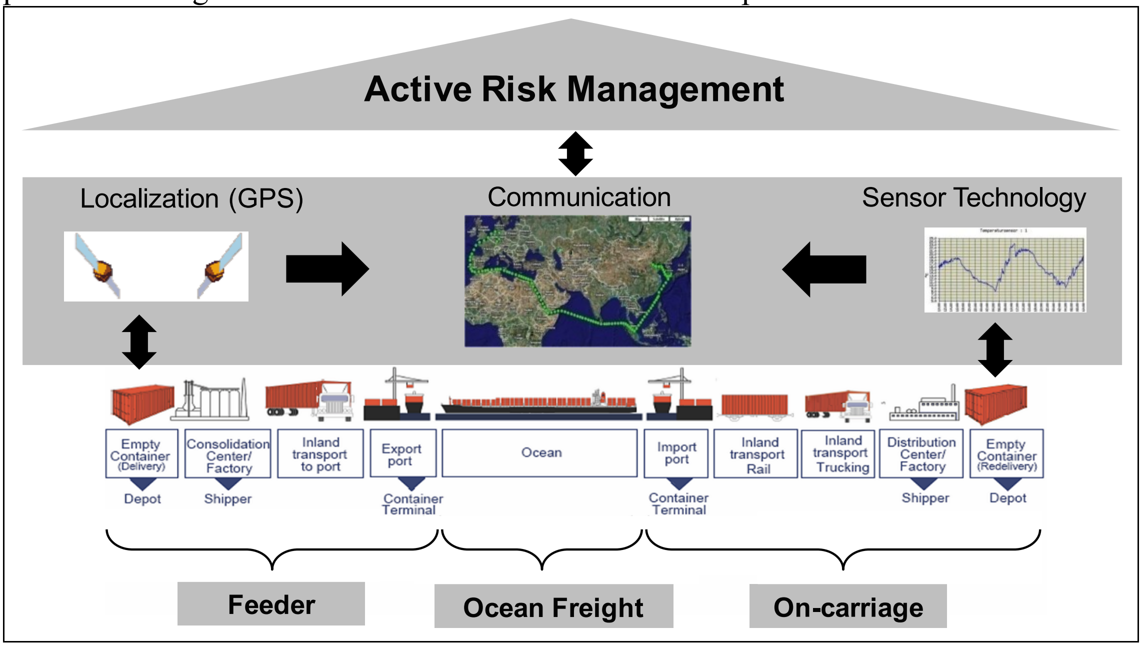

Figure 1: Active risk management spans a protective shield across the network

As shown in Figure 5, the status report is sent by the monitoring device in specific intervals and visualized as dedicated nodes throughout the transport. In this case, an ocean freight shipment was monitored from the manufacturing site in mainland China to its final destination in the heart of Germany. This demonstrates the ability of the active risk management to operate globally in inter-modal transportation. The active risk management philosophy unites different shipping parties such as ocean and rail carrier, logistic service provider, port authorities, and trucking companies together with one aim: Controlling the transportation chain to improve and maintain container security, which ultimately guarantees consistent product integrity along the whole shipping processes.
Price, time, and reliability are the fundamental factors in the decision process of the enterprises when selecting logistic companies, but similar importance is ascribed to the minimization of risks regarding the transported good loss and damage (Bolis and Maggi, 2003). How effectively a company can quantify the impact may also depend on its ability to identify collateral benefits of various investments in security and resilience. An investment in telematics technology can improve not only security by real-time tracking and monitoring cargo movements but also visibility. According to Rice and Caniato (2003), a better visibility leads to decreased inventory requirements and improved service levels. Standard operating procedures (SOP) developed by shippers and carriers how to handle and protect goods will benefit from avoiding loss and damage. Moreover, involving marine cargo insurance companies in this concept may lower insurance premiums, which positively affects premium

calculation and potentially eases claims administration. Cargo insurance companies offered in the recent years low premiums because they were feeding revenue of its profits from their stock market turnover. This has made it easier to compete aggressively in the insurance market with dumping premiums. Depending on the economic situation, insurance companies in general are setting the premiums in the industry insurance sector after the overall return of investment (ROI). But because of the actual downfall of global stock exchanges, premiums are on the rise and especially valuable goods are only insurable with tight orders as to secure the transport. However, insurers have only little knowledge about the status of the goods they are insuring. They do not know in what shape the goods are, if they are where they are supposed to be, if they are stolen or not, etc. The deployment of a combination of communication, localization (e.g. GPS, Cell-ID, WLAN, RFID, and Bluetooth), and sensor technology (e.g. temperature, shock, humidity, movement, and door activities) on transport containers or trailers creates the basic collaborative infrastructure to link the tracked data via the service platform with respective enterprise systems, as it is shown in Figure 6. The enterprise systems store and analyze the data in order to recognize problem events like damaged or spoiled goods or misrouted containers. Thus, the implemented technology has to be considered as shared resource, which links the value chains of logistics and insurance companies by transferring data into each company's business application through a software-as-a-service application. The information then can be used in each value chain to optimize the own products and solutions for the end-customer. This includes early intervention as part of a proactive risk management to avoid damages of the goods to be conveyed based on real-world data, new pricing models, impacts on accumulation of risk (e.g. multiple containers from different sources on the same ship or warehouse), insurance on demand and the like. The logistics company is able to use the sensor data e.g. as part of an improved information management for its customers.

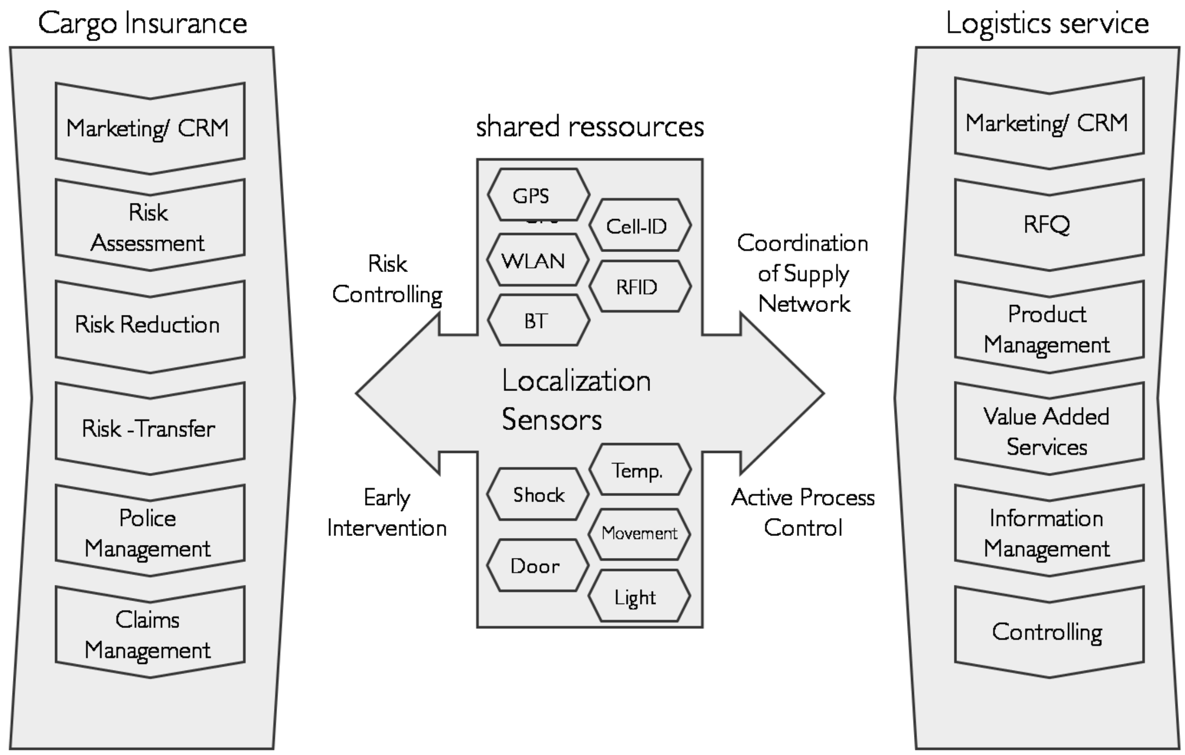

Figure 6: Risk prevention technology as link between two value chains

Besides adding customer value the technology improves internal processes of each company's value chain as well. The insurance companies can further optimize their risk portfolio including the new given transparency into the police management and in terms of risk transfer. Higher resolution concerning cargo conditions also helps to speed up the claims management process. For logistics companies the proposed solution has the potential to optimize e.g. asset management or the whole product management such as better coordinated timetables between air or ocean freight and land transportation.

In addition, competitive advantage for logistics and transportation companies could be achieved through securing the supply network and managing supply chain risks. Unsecured companies will experience significantly greater time delays than secured firms in resuming regular conditions. Similarly, companies who have prepared their supply chains are moving quickly to advertize security and risk minimization as desirable win-wins for customers (Autry and Bobbitt, 2008).

Thus, we expect the following results, when implementing the proposed solution together with one major insurance company:

(1) Reduction of claims aims at less damage probability and severity. As consequence the transportation risks decrease.
(2) Improving transparency in the pricing of insurance premiums. So far cargo insurance companies usually use the customers' turnover value as reference and offer lump-sum premiums as specific proportion of the turnover. More accessible information through the condition monitoring leads to a more risk-adequate pricing.
(3) Improved transportation processes which lead to high quality supply chain network with a better coordination and communication be offered.
(4) The linkage of the value chains of insurance and logistics companies enables for the respective parties product and service innovation e.g. an integrated risk management. This allows differentiating with a high service strategy to be competitive in very price-sensitive industries.

Summing up, it is the perfect time for the implementation of a technology-enabled risk management achieving higher efficiency and productivity gains, thanks to today’s real-time availability of information in case of any disruptions during transport. Shared visibility related to freight conditions allows corrective actions executed by the responsible forwarding agent, which helps to monitor risks as well as to reduce the probability and extent of damages.

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