Developing Service Concepts for Managing Disturbances in Supply Networks

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Abstract—The objective of this study was to identify new ideas and business opportunities for developing new IT-driven service concepts for managing disturbances and to minimize the risks related to disturbance management in supply chains. The data for this study were collected by arranging an electronic expert session from several perspectives, e.g. those of service and technology providers, logistic solution providers and cargo owners. The new ideas for service concepts were also prioritized according to their impact and feasibility for disturbance management. As the results of the study, altogether 94 ideas and business opportunities were identified for IT-driven services and products related to disturbance management, and the prioritization of the ideas highlighted the most significant ones for further service concept development. The most significant service concepts were related especially to the electronic monitoring services for supply chains and deviations, training services, tools for reporting and analyzing disturbances, and calculation services of the cost effects of disturbances.

I. INTRODUCTION

The logistics industry and supply chains have faced the increasing role of networking and internationalization of trade, and the expansion of the industry is responsible for the significance of safety and accountability issues [18]. The nature and complexity of global multimodal supply chains make them vulnerable to disturbances [31]. Disturbances in global supply chains, and especially in operations in the main nodes, can have prominent effects on companies’ operations and cause long-term negative effects on firm’s financial performance [23, 25]. The supply chain security cannot be achieved easily and there are many ways to execute it. In the field of supply chains, there is an overall consensus on the need to improve the security of supply chains [6], and though increase the effectiveness and continuity of the transport flows [26]. In general, the basis of a disturbance management is to save costs and aim to more profitable business [15]. During the last decade, the significance of security in supply chains has increased considerably, and especially the development of security technologies has provided new business opportunities. One of the most significant drivers for such improvement is the development of IT-driven solutions and internet-based applications. These technologies enable seamless data transmission between data terminal equipment in supply networks using various solutions.

New business concepts in the context of the present study can mean either product or service concepts or the combination of those, i.e. product-service systems. In this case the focus is on services, especially business-to-business services, and their conceptual development. IT-driven security services in supply networks can be seen as a sub-group of technology-based knowledge-intensive business services (T-KIBS). KIBS can be defined as private companies or organizations relying heavily on professional knowledge, that is, knowledge or expertise related to a specific (technical) discipline or (technical) functional domain, and supplying intermediate products and services that are knowledge based [13, 22]. Thus, new service development processes in these types of firms are much related to acquisition, integration and utilization of both internal and external knowledge.

The objective of this paper is to identify new ideas and business opportunities for developing IT-driven security services in logistic multi-stakeholder networks. The data for this study were collected from several perspectives, e.g. those of service and technology providers, logistic solution providers and cargo owners. The identification of new business opportunities were conducted in an electronic expert session, where the new ideas for business concepts were also prioritized according to their impact and feasibility for disturbance management. As a result of the study, nearly a hundred ideas were identified and the prioritization highlighted the most significant ones for further development. These were e.g. solutions for estimating the cost effects of product damages, electronic training programs for drivers related to security management, reporting and forecasting services for disturbance management, and analyzing tools for schedules, driving times, mileage and circumstantial factors.

The rest of this paper is structured as follows. Section 2 reviews the literature related to the development of new service concepts, and also the key aspects of disturbance management in supply chains. Section 3 presents the research process and the implementation of the expert session. In Section 4, the main results of the risk analysis and the identification of new service ideas and business opportunities are presented and analyzed. Section 5 discusses possible implications of the results, future research directions and concludes the paper.

II. THE LITERATURE REVIEW

A. Developing new service concepts

In the new service development literature, “Service concept” is a frequently used term, but there are several definitions for it. E.g. Heskett [14] defines it as an approach according to which the “organization would like to have its services perceived by its customers, employees, shareholders and lenders”. Edvardsson and Olsson [8] suggest a service concept as the element of the service that describes “of what is to be done for the customer and how this is achieved”.

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According to Collier [5], service concept can be identified as a service package, a combination of products and services that provide value and benefit for the customers. Bullinger and Meiren [2] propose the service concept as the combination of resource, process and product models that arise respectively from the structure, process and outcome dimensions of a service. A service concept can also be identified as an expressed solution for a specific problem [11]. A service concept should demonstrate the activities the company is going to do for a certain market segment, the approach and the resources with the help of which it will be realized [29]. Clark et al. [4] and Goldstein et al. [10] determine the service concept as the main element of the service design and development that is the intermediate between customers’ needs and the company’s strategic intent.

The whole process of developing a new service offering, i.e. “New Service Development” starts from the idea phase and ends with the market launch [17, 20]. New service development process can be described from a variety of perspectives. Edvardsson et al. [7] present a model that includes four general stages: service idea generation, the service strategy and culture, service design and service policy deployment and implementation. The first phase includes the idea generation and idea selection in terms of sources and methods. The second stage includes the strategy of what to deliver and how to implement this strategy. The actual development of service concept is done in a phase three. The final stage involves the preparation actions required for the actual implementing of the service. The whole range of these activities leads to the development and launching of world class services [7]. The basic elements of the model of the service development process are presented in the Fig. 1. The focus in the present paper is on the first stages of the process, especially in idea generation, idea selection and refinement of the ideas for new business concepts.

In the process of service development it is essential to understand the external and internal factors that create most value for the customers. The proximity to the customers and other stakeholders as the sources of valuable information will help in each stage of the process to leverage the data received. All the service design and development frameworks seem to emphasize the role of the customer in several stages of the development processes. The active role of the customer means co-creation of value that starts already from the conceptual development stage with the service provider. In addition to clients, all the stakeholders may have various roles in collaborative development of new service business concepts. One way to address this challenge is to follow the principles of open service innovation principles as suggested by Chesbrough [3]: 1) thinking of business (product or service) as an open services business to avoid the commodity trap, 2) inviting customers to innovation co-creation to generate valuable experiences, 3) using open innovation to accelerate and deepen services innovation, and 4) transforming the business model with open services innovation towards a platform business model. In the current study, these principles are partly applied by utilizing the expertise knowledge of the company experts and researchers in the front-end of the business concept development process for security services in supply networks. The practical progress of this research process is presented in the Chapter 3 below.

B. Disturbance management in supply chains

Supply chains are complex networks where organizations together manage and develop material and service flows, and related cash and knowledge flows. These complicated networks have high vulnerability to risks and thus transport continuity requires close co-operation throughout the whole network. [21] According to Donner and Kruk [6], there is no single path to achieve security in supply chains, and there is an overall consensus on the need to improve the security of supply chains world-wide. According to the ISO 28000 standard [16], security is defined as a resistance to intentional, unauthorized act(s) designed to cause harm or damage to, or by, the supply chain.

Supply chain disturbances can be defined in many ways. Some authors define a disturbance as “disruption”, others as risks, uncertainties and some also crises [1]. Barossa et al. [1] define a disturbance as a consequential situation that considerably threatens the normal course of actions of the affected supply chain participants. Wagner and Bode [32] define a disturbance as an entirety that consists of concepts, e.g. disruption, incident, accident, glitch, failure, hazard and crisis.

![Figure 1. Framework for the new service development process [7]](image-url)
Disturbances can be caused by many reasons and occur in different sources e.g. in the operational system, technical systems used, environmental conditions, accidents, changes in the business conditions of the supply chain network, suppliers, service providers, public events, industrial actions or security-related roots like terrorism, as well as criminal actions and the actions to control them [12]. During last ten years, the regulatory compliance requirements and stakeholder’s demands have sped up the awareness and need for supply chain disturbance management [1]. The understanding of real effects and costs of disturbances is arising and according to Barosso et al. [1], disturbance management has become one of the major concerns of many organizations.

In multi-actor networks, the clarification of the responsibilities without clear guidelines and tools is difficult and takes a lot of companies’ resources [18]. Individual companies may not even have the possibility to influence on disturbances in supply chains, because disturbances can occur at any stage of the supply chain [27]. Disturbance mitigation strategies are ways to manage disturbances and they allow supply chains to become more resilient in the face of disruptions [25].

Ulmanen and Rytkönen [30] define disturbance management as the matters, factors or environmental conditions that affect or violate normal activities. Disturbance management embraces many operations e.g. immediate actions in case of damage situations, customer management, claim handling, regressions, disturbance statistics and analysis, informing the supply chain and education [26]. Disturbance management can be divided into two main approaches; 1) disturbance handling at the occurrence of a disturbance, and 2) preventive disturbance management aiming to reduce the number of disturbances [19]. Tomlin [28] describes these two approaches for disruption management as contingency and mitigation strategies. Contingency strategies are techniques used in the case of disruption occur, whereas mitigation strategies are used prior to disruptions. The entity of disturbance management in supply chains takes actions from both of the categories. To decrease the effects of disturbances in supply chains, managers must identify the probability of the disturbance appearance and severity. It is also important to create appropriate actions and strategies to response to disturbances and prevent the negative effects in supply chain networks. [1]

III. RESEARCH PROCESS

This study is a part of an on-going Finnish national research project (Security Management in Logistic Networks), which aims to develop comprehensive operation models based on security solutions and services for logistic multi-stakeholder networks, as well as methods for security and safety management. The project, develops, evaluates and pilots operations models produced by the value network based on new technologies and service packages internationally. The projects research results are used in several industry cases related to comprehensive operations models in logistics networks. The objective of this particular study is to identify new ideas and opportunities for developing new business concepts for security services in logistic multi-stakeholder networks.

A. Facility and participants

The identification of new business opportunities were conducted in a group decision support system (GDSS) laboratory at Lappeenranta University of Technology (LUT), where the new ideas for business concepts were also prioritized according to their impact and feasibility for disturbance management. The GDSS laboratory is used for teaching and research in the field of group decision support systems and processes. The GDSS laboratory has been designed to support up to ten-person electronic meetings. It is a PC-equipped Local Area Network -based meeting room designed especially for decision-making, and various commonly used decision support software have been installed. The main group support software of the laboratory is GroupSystems, which comprises different tightly integrated applications supporting different phases of group processes, such as brainstorming, list building, information gathering, voting, organizing, prioritizing, and consensus building. In this study, the GDSS-laboratory supported the work of the group, managing the use of time, communication, and decision making. In addition, it enabled simultaneous ideation and identification of new ideas and business opportunities, and simultaneous prioritization of the large number of identified ideas.

In the electronic expert session, there were altogether 12 participants who represented different roles in a logistic network. One of the participants represented a company that provides safety and security services for supply chains, another one represented a company that provides claims-related services to insurers and other risk carriers, one of the participants represented a company that acts as a service provider and a cargo owner, and one participant represented a technology provider. Six of the participants were representatives of research institutions, and their research expertise was related to supply chain and risk management, maritime logistics, technologies for safety and security, and innovation and technology management. In addition, the first author of this paper acted as the chairman of the session, and a facilitator was responsible for workshop design with the GroupSystems software.

B. The implementation of the expert session

The electronic expert session was conducted by following the process outline depicted in Table 1. The first step of the process was the introduction phase done by the chairman, who presented the objectives of the project and the expert session. Secondly, a risk analysis was made about the disturbances in logistics. The list of main disturbances based
on the literature was presented and some new ones were added during the discussion. After the list was discussed through, the participants prioritized the disturbances according to their probability and economical significance. The purpose of the risk analysis phase was to draw attention of the participants towards the variety of disturbances in logistics, and the list of the most significant disturbances was used to support the ideation phase of the workshop. Third, the participants were asked to identify ideas for services and products related to disturbance management in logistic networks. The participants were encouraged to bring out ideas either concrete or abstract. The ideas were recorded simultaneously to the system, where all the ideas were seen by all the participants. Fourth, the work progressed to the phase where the identified ideas were clarified and commented on. In addition, some similar ideas were integrated. Fifth, the prioritization of the identified ideas was conducted. The prioritization was made according to their 1) impact and 2) feasibility for disturbance management on the scales 1-5. Number 5 indicated that the particular idea has a very significant impact on disturbance management, and number 1 indicated no impact at all. Respectively, number 5 in the feasibility estimation indicated that the particular idea is very easy to implement, and number 1 indicated that implementation is very difficult. The time horizon for the feasibility estimation was 1-5 years. The objective of the last phase was to discuss about the results and to get feedback of the session and the used process.

IV. RESULTS

A. Risk analysis

As the result of the risk analysis phase of the expert session, the main disturbances according to their probability and economical significance were identified and prioritized. In Fig. 2, the 20 most significant and probable disturbances in supply networks are presented (i.e. the top 20 when the probability is multiplied by the economical impact). The five most critical disturbances were identified as following: 1) loss of products and thefts 2) absence of proactive disturbance management (DM) 3) strikes 4) product damages 5) different ways of action in different cultures

The loss of products and thefts were considered as the most significant disturbances with the probability of 80% and impact of 2.9. However, the impact of disturbances for a company is highly dependent on the industry and the value of a product. E.g. when the value of a single product is low, the attitudes towards the impacts of disturbances for a company are comparatively slight [25]. The absence of proactive disturbance management was also considered to be significant according to the probability (70%) and the economical impact (3.1). It can be also observed from the Fig. 2 that e.g. strikes have the highest economical impact (3.8), but the probability was estimated to be rather low, only 47%. In March 2010, there was a port strike in Finland, which had large effects on the Finnish export industry and also to the transit transportation. This could have an effect on the high value of its impact (3.8). In addition, the impact of organized criminality was estimated rather high (3.5), but the possibility to be affected by it in Finland was estimated only 38%. The

<table>
<thead>
<tr>
<th>TABLE 1. THE PROCESS OF THE ELECTRONIC EXPERT SESSION.</th>
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</thead>
<tbody>
<tr>
<td>INPUT → PROCESS PHASE → OUTPUT</td>
</tr>
</tbody>
</table>

- Objectives of the expert session
- Introduction of disturbance management

1. INTRODUCTION OF THE OBJECTIVES

- Activation of the participants
- Knowledge

- Literature review
- Previous workshop on the challenges of disturbance management
- List of disturbances in logistics

2. RISK ANALYSIS – DISTURBANCES IN LOGISTICS

- Updated list of disturbances
- A mutual understanding of disturbances in logistics
- Prioritized list of the most significant disturbances

- Expertise of different roles in a logistic network
- Prioritized list of the most significant disturbances

3. IDENTIFICATION OF NEW IDEAS AND BUSINESS OPPORTUNITIES

- List of new ideas and business opportunities for disturbance management

- Additional and clarifying comments on the new ideas
- Verbal discussions

4. IDEA CLARIFICATION AND COMMENTING

- Additional comments on the ideas
- Combinations of similar ideas

- List of new ideas and business opportunities for disturbance management

5. PRIORIZATION OF THE IDENTIFIED IDEAS

- Two lists of prioritized ideas according to their impact and feasibility
- Verbal discussion on voting results

- Participants’ verbal opinions about the results

6. DISCUSSION OF THE RESULTS

- Documentation of the results
- Action plan for analysis and utilization of the results

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The probability of an organized criminality could have been higher, if in the session there were security managers or experts also from other countries besides Finland.

The results also indicate that disturbances such as terrorism (impact 4.3), strikes (3.8), organized criminality (3.5), natural disasters (3.4), absence of proactive disturbance management (3.1) and problems in information security (3.0) have the highest economical impacts (3.0 or higher) from the point of view of a cargo owner or logistic operator. However, the probability of terrorism (20%) and natural disasters (22%) were seen very low, therefore they were not included in the list of top 20 disturbances.

On the other hand, the high probability (65% or higher) was estimated for disturbances such as, waiting (83%), loss of products and thefts (80%), changes in time schedules (73%), different ways of action in different cultures (71%), absence of proactive disturbance management (70%), traffic jams and other delays (68%), product damages (67%) and incorrect usage of information systems (65%). However, e.g. the economical impact of waiting (1.6) and changes in time schedule (1.6) were estimated rather low from the point of view of a cargo owner or logistic operator.

B. New ideas and business opportunities

As the result of the ideation phase of the expert session, altogether 94 ideas and business opportunities were identified for services and products related to disturbance management in logistic networks. The prioritization phase highlighted the most significant ones for further service concept development. The prioritization was made based on the impact and feasibility of the new ideas for disturbance management using the scales 1-5. The division of the new ideas on the different scales is illustrated in Fig. 3. In general, it can be observed from the figure that feasibilities of new service

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**Disturbances in supply networks**

<table>
<thead>
<tr>
<th>Disturbance</th>
<th>Economical impact 0-5</th>
<th>Probability 0-100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of products and thefts</td>
<td>2.9</td>
<td>80%</td>
</tr>
<tr>
<td>Absence of proactive DM</td>
<td>3.1</td>
<td>70%</td>
</tr>
<tr>
<td>Product damages</td>
<td>3.8</td>
<td>67%</td>
</tr>
<tr>
<td>Sudden changes in raw-material prices</td>
<td>2.0</td>
<td>71%</td>
</tr>
<tr>
<td>Problems in transportation units</td>
<td>2.9</td>
<td>58%</td>
</tr>
<tr>
<td>Incorrect usage of information systems</td>
<td>2.7</td>
<td>57%</td>
</tr>
<tr>
<td>Traffic jams and other delays</td>
<td>2.3</td>
<td>55%</td>
</tr>
<tr>
<td>Reaction in exceptional situations</td>
<td>2.3</td>
<td>53%</td>
</tr>
<tr>
<td>Organized criminality</td>
<td>2.6</td>
<td>60%</td>
</tr>
<tr>
<td>Handling mistakes</td>
<td>2.6</td>
<td>68%</td>
</tr>
<tr>
<td>Waiting</td>
<td>2.0</td>
<td>53%</td>
</tr>
<tr>
<td>Forgery and manipulations of products</td>
<td>1.6</td>
<td>43%</td>
</tr>
<tr>
<td>Vandalism</td>
<td>2.1</td>
<td>44%</td>
</tr>
<tr>
<td>Authoritative actions</td>
<td>2.1</td>
<td>44%</td>
</tr>
</tbody>
</table>

**Figure 2.** The most significant disturbances in transport logistics according to their probability and economical impact
ideass are estimated bigger than their impacts. The ideas with high feasibility include services such as driver training services (feasibility 4.6), calculation programs for the cost effects of product damages (4.5), and safe parking for truck drivers with decent social rooms, a gym and healthy food (4.4). Respectively, the service ideas with high impact included services such as including intelligence with a product: a product is continuously aware of its location and condition, and it reports by itself through “Internet of things” (4.0) and the control of all relevant deviations in supply chain, 24/7 monitoring, reaction and follow-up (3.9).

Further, it can be noticed from the Fig. 3 that altogether 23 ideas were identified, where both feasibility and impact were estimated 3.0 or higher. These TOP23 ideas are presented in Table 2 (i.e. the top 23 when the impact is multiplied by the feasibility). The idea of driver training services was considered as the best one when measured by its impact and feasibility. However, the high value (4.6) of feasibility explains partly its high position. The TOP23 list includes also other service ideas dealing with training programs, such as electronic security management training programs for drivers, and training and estimation tools for people responsible of transportation purchases. Further, it can be noticed that many of the ideas in the TOP23 list are related to the electronic monitoring services of supply chains, such as Control of all relevant deviations in supply chain, 24/7 monitoring, reaction and follow-up, System for monitoring identified and individualized products and transportation units, Identification and real-time tracking of pallets, and Package-specific electronic seals for preventing spoilages. Also some service ideas related to the deviations management, reporting and analyzing of disturbances and cost benefit optimization were prioritized as important for disturbance management.

![Figure 3](image-url) Division of new service ideas according to their feasibility and impact
During the analysis of the results, it was noticed that the participants identified a number of ideas, which have high impact for disturbance management, but their feasibility during the next 1-5 years was estimated rather low. In Table 3, 10 service ideas or technologies for disturbance management are presented with impact 3.2 or higher, which were not included in the TOP23 -list. These ideas with high impact and lower feasibility can be the innovations of the future. E.g. the idea about integrating intelligence with a product, and it is continuously aware of its location and condition, and it reports by itself through “Internet of things” was estimated to have a high impact (4.0) for disturbance management, but feasibility was rather low (2.6). Also the idea about a common platform, where all the parties of a supply chain will receive real-time information about the condition of the supply chain was considered to have rather high impact (3.6) for disturbance management, but the feasibility was near three (2.8). In general, the transfer of knowledge between different parties of a supply chain has been found to be difficult.

10 service ideas for disturbance management with feasibility 3.8 or higher are presented in Table 4. They are not included in the TOP23 -list. They have high feasibility for disturbance management during the next 1-5 years, but their impact was estimated rather low. The ideas with high feasibility but lower impact are ideas that need a proper cost-benefit analysis prior to further development. It can be noticed that different kinds of training programs were estimated rather easy to implement related to disturbance management. E.g. security culture training as a part of orientation and other training was mentioned, as well as training for drivers about how to anticipate threatening situations and how to act right, i.e. to prevent a threatening situation culminating into action. Different kinds of calculation programs were also considered to be rather feasible, such as calculation programs for the cost effects of product damages and thefts.

In addition, all the ideas identified in the expert session were grouped under new service categories, which are presented in Fig. 4. The numbers in brackets indicate the amount of ideas that were identified in the particular service category. E.g. 17 new ideas for the Monitoring of supply chains -category and 14 ideas for Transportation equipment -category were identified in the expert session. However, the ideas related to the monitoring of supply chains -category had the most ideas where both their feasibility and impact were estimated 3.0 or higher. Further, the categories Training, Deviations management, Reporting and analyzing of disturbances and Cost benefit optimization were considered as important ones when measured by their impact and feasibility, and in each category there were three TOP23 service ideas identified for supporting disturbance management. In other categories, there were two (Electronic support systems -category) or less ideas included in the TOP23 list.
### TABLE 3  SERVICE IDEAS FOR DISTURBANCE MANAGEMENT WITH IMPACT ≥ 3.2

<table>
<thead>
<tr>
<th>Ideas for services for disturbance management</th>
<th>Impact</th>
<th>Feasibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intelligence with a product: a product is continuously aware of its location and condition, and it reports by itself through “Internet of things”</td>
<td>4.0</td>
<td>2.6</td>
</tr>
<tr>
<td>Location technology, which consumes extreme little amount of energy, as a standard in the metal containers</td>
<td>3.6</td>
<td>2.3</td>
</tr>
<tr>
<td>Identification and individualization to all goods at a product level</td>
<td>3.6</td>
<td>2.7</td>
</tr>
<tr>
<td>Full automated transportation equipment i.e. without a driver</td>
<td>3.6</td>
<td>1.1</td>
</tr>
<tr>
<td>Common platform, where all the parties of a supply chain receive real-time information about the condition of the supply chain</td>
<td>3.6</td>
<td>2.8</td>
</tr>
<tr>
<td>Uniform standards for security technology (e.g. electronic seals), in order to guarantee common processes despite of the type and manufacturer of a device</td>
<td>3.6</td>
<td>2.3</td>
</tr>
<tr>
<td>Replacement of dockers with automated cargo handling equipment</td>
<td>3.5</td>
<td>1.8</td>
</tr>
<tr>
<td>Worldwide legislation, which covers all transportation equipment, storage and stevedoring</td>
<td>3.4</td>
<td>1.1</td>
</tr>
<tr>
<td>Follow-up system for package-specific electronic seals</td>
<td>3.2</td>
<td>2.9</td>
</tr>
<tr>
<td>Possibility for a remote control of a truck (to stop or prevent from starting)</td>
<td>3.2</td>
<td>2.2</td>
</tr>
</tbody>
</table>

### TABLE 4  SERVICE IDEAS FOR DISTURBANCE MANAGEMENT WITH FEASIBILITY ≥ 3.8

<table>
<thead>
<tr>
<th>Ideas for services for disturbance management</th>
<th>Impact</th>
<th>Feasibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculation programs for the cost effects of product damages</td>
<td>2.9</td>
<td>4.5</td>
</tr>
<tr>
<td>Safe parking for truck drivers with decent social rooms, a gym and healthy food</td>
<td>1.9</td>
<td>4.4</td>
</tr>
<tr>
<td>Outsourced verifying service (load binding of departures, equipment, documentation etc.)</td>
<td>2.9</td>
<td>4.3</td>
</tr>
<tr>
<td>Security culture training as a part of orientation and other training</td>
<td>2.9</td>
<td>4.3</td>
</tr>
<tr>
<td>Calculation programs for the cost effects of thefts</td>
<td>2.4</td>
<td>4.1</td>
</tr>
<tr>
<td>iPADs for every data users for saving, photographing and sending damage information. Rewarding the storage of information.</td>
<td>2.5</td>
<td>4.0</td>
</tr>
<tr>
<td>Container internal camera surveillance</td>
<td>2.8</td>
<td>3.9</td>
</tr>
<tr>
<td>Game about logistics security (simulation software)</td>
<td>2.0</td>
<td>3.9</td>
</tr>
<tr>
<td>Training for drivers about how to anticipate threatening situations and how to act right, i.e. to prevent a threatening situation culminating into action.</td>
<td>2.9</td>
<td>3.8</td>
</tr>
<tr>
<td>Real-time forecasting service of arriving deliveries for logistic operators and their customers</td>
<td>2.8</td>
<td>3.8</td>
</tr>
<tr>
<td>Dead man’s switch into trucks – for preventing a driver to fall asleep</td>
<td>2.4</td>
<td>3.8</td>
</tr>
</tbody>
</table>

Figure 4 Categorization of the identified service ideas for disturbance management
V. DISCUSSION AND CONCLUSIONS

The objective of this study was to conduct a risk analysis, where the main logistics disturbances were prioritized according to their probability and economical significance. Based on the results, the most critical factors that disrupt logistics operations in supply chains were identified as the loss of products and thefts, the absence of proactive disturbance management, strikes, product damages, and different ways of action in different cultures. Another objective of the study was to identify new ideas and business opportunities for developing new service concepts in order to minimize the risks related to disturbance management. As the results of the conducted expert session, altogether 94 ideas and business opportunities were identified for IT-driven services and products related to disturbance management, and the prioritization phase highlighted the most significant ones for further service concept development. The most significant ideas were related to the monitoring of supply chains. These included ideas such as the monitoring of returnable transportation units and customer invoicing based on this data, the combination of video surveillance and an identity of a container, a system for monitoring identified and individualized products and transportation units, and an optimizing tool for supply chain management based on the tracking data of shipments. Frost & Sullivan [9] have identified the demand in governmental and healthcare sectors, technological innovations and declining prices as the most relevant driving factors of real time location applications. On the other hand, the restraints include standardization and awareness deficiencies.

Based on the results it can be observed that the feasibilities of the new service ideas are bigger than their impacts. Is it possible that in the logistics supply chains, it is very hard to find solutions with high impact? Or are the participants of the expert session suggesting mainly ideas that they know to be easily implemented, such as services related to training? One question is that are the experts really ready for open service innovation principles as suggested by Chesbrough [3]? Especially are the technology-based knowledge-intensive organizations, where they rely heavily on a specific technical discipline, ready to open their sources of competitive advantage? Especially these types of companies should utilize both internal and external knowledge in their service concept development. This study provides a new perspective to use the open service innovation principles by utilizing the expertise knowledge of the company experts and researchers in the front-end of the business concept development process for services related to disturbance management in supply networks.

On the other hand, the results of this study indicate that there were also a lot of ideas with high impact for disturbance management, but their feasibility during the next 1-5 years was estimated rather low. These ideas can be considered as the future services for managing disturbances that should be taken into account, e.g. the idea of integrating intelligence with a product where a product is continuously aware of its location and condition, and it reports by itself through “Internet of things”, or the idea of the common platform, where all the parties of a supply chain can receive real-time information about the condition of the supply chain. In addition, it can be noticed that many of the ideas with high impact require the integration of information from different sources, such as transportation, transportation equipment, a company’s database, area surveillance etc. This can be one reason for low feasibilities when evaluating the high impact ideas.

The results of the expert session also reveal that there exist a lot of ideas, which were not included in the list of the TOP23 ideas for disturbance management. Future research and actions are required to ensure that these ideas will end up to TOP23 list in the future. E.g. the ideas of uniform standards for security technology (e.g. electronic seals) and worldwide legislation covering all transportation equipment, storage and stevedoring, will call for the cooperation over organizational and international boundaries.

As a conclusion, this study identified several new service concepts for further service development. These were related especially to the electronic monitoring services of supply chains, deviations management, training, tools for reporting and analyzing of disturbances, and cost benefit optimization of disturbances. The development of these service concepts will help companies with minimizing the risks related to the loss of products and thefts, absence of proactive disturbance management, product damages and different ways of action in different cultures among others.

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