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Identification of Megatrends Affecting Complexity in Logistics Systems

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Identification of Megatrends Affecting Complexity in Logistics Systems

Wolfgang Kersten, Birgit von See and Henning Skirde

Abstract

To cope with megatrends companies often react with changes resulting in complexity. Thus, managing complexity results in increasing costs. Especially logistics service providers have to cope with cost pressure and are due to their size often limited in case of resources. In order to assess these costs an adequate complexity cost assessment has to be developed. Before developing such an approach, the question what drives complexity in logistics systems has to be raised and answered. In this paper, 16 megatrends affecting logistics systems are identified through literature review, expert interviews, and a focus group discussion. The identification and discussion of these megatrends with regard to complexity provides a first step towards a complexity cost assessment. Megatrends can thereby function as important drivers of complexity in logistics systems.

Keywords: megatrends, complexity, logistics systems, literature review

1. Introduction

Megatrends like globalization or individualized customer demand are constantly intensifying the competition among companies (Singh 2012, p.25). That is why manufacturers as well as logistics service providers as part of a logistics system have to organize processes as efficient as possible (Vahrenkamp 2005). Especially in logistics, this efficiency is essential in order to successfully cope with the high variety of existing processes and tasks. Sophisticated management systems are required to adequately deal with megatrends like sustainability, cloud logistics or Radio Frequency Identification (RFID). In logistics research, technological trends such as cloud logistics and the implementation of RFID as well as increasing safety requirements regarding catastrophes, strikes and terrorist attacks are focused on (Kersten et al. 2011; Will 2011). Furthermore, ecological and social sustainability of logistics systems are becoming increasingly important. Therefore, these aspects have to be considered when developing innovative approaches for the assessment of costs in logistics systems (Straube and Pfohl 2008).

Megatrends like globalization have a significant impact on the complexity of logistics systems (Fontius 2013, p.134). A common definition of complexity is based on the quantity and variety of elements, their relationship as well as the changeability of elements and relationships (Meyer 2007, p.25). In many cases, companies are struggling because the system they are coping with is too complex (Adam and Johannwille 1998; Rosemann 1998). This excess of complexity results in an excess of costs.

A key question is which level of complexity a logistics company has to achieve in order to successfully cope with megatrends. Therefore, when aiming to improve the level of complexity and the associated cost management, the identification of megatrends and their effects on complexity is a first step.

This paper is subsequently structured as follows: In Chapter 2, megatrends and logistics systems are defined to build up a reference framework. In Chapter 3, megatrends in logistics systems are identified based on a structured literature

review. The results of this review are subsequently enriched by expert interviews and a focus group discussion. These megatrends are then compared and connected to complexity in order to establish a starting point for future research. Finally, conclusions are drawn from the connections among megatrends and complexity.

2. Theoretical Background

Before analyzing megatrends in logistics systems, the terms logistics systems as well as megatrends are separately introduced and defined to build up a reference framework. This aims at structuring the research field and to provide a better understanding of different viewpoints on megatrends and logistics systems.

2.1 Logistics systems

Logistics assures availability by providing the right good, in right quantity and quality, to right cost at the right place and time (Bullinger 2009, p.492; Waldruff 2007, p.168). To achieve this target of operating the material flow, the primary physical logistics processes have to be expanded by an anticipated planning and controlling of information flows (Koether 2011, p.37). This expansion constitutes one of the most recent historical developments in logistics. While in the 1970s logistics was typically associated with the principal tasks of transportation, handling and warehousing, today logistics is recognized as an integrative discipline linking companies to supply chains and functioning as a network (Neubauer 2011, p.50). Nevertheless, in Germany transportation (Transport), handling (Umschlag) and warehousing (Lagerung) are considered to be the basic functions of logistics (Pfohl 2010, p.8).

According to system theory, a logistics system can be defined as a construct of a minimum of two elements and their connection (Kestel 1995, p.12; Jünemann 1989, p.12 f.). Elements thereby aim at conducting the material as well as the information flow (Waldruff 2007, p.167 f.). Elements which are accounting for

the fulfillment of logistics tasks, e.g. buildings, machines, organizations (Kestel 1995, p.12), sites, means of transport or persons can be attributed to the logistics system itself. For the actual execution of logistics processes these elements are connected multifacetedly and structured hierarchically (Jünemann 1989, p.12). In addition, the term logistics network has been defined by GUDEHUS (2012, p.598) as a system with a variety of functions, composed by subsystems with each of them having one or few functions.

Considering logistics systems, PFOHL (2010, p.14 f.) differentiates the scope of macro, micro and meta perspectives. While macro logistics systems are defined on a macroeconomic level and therefore constitute a holistic perspective, micro level systems are based on a microeconomic level and are therefore closer to a company specific perspective. The perspective of meta logistics systems is located in between macro and micro systems, e.g. cooperation based systems (Pfohl 2010, p.14 f.).

Figure 1 shows a schematic illustration of a logistics system on a meta level perspective which is referred to in the following of the paper.

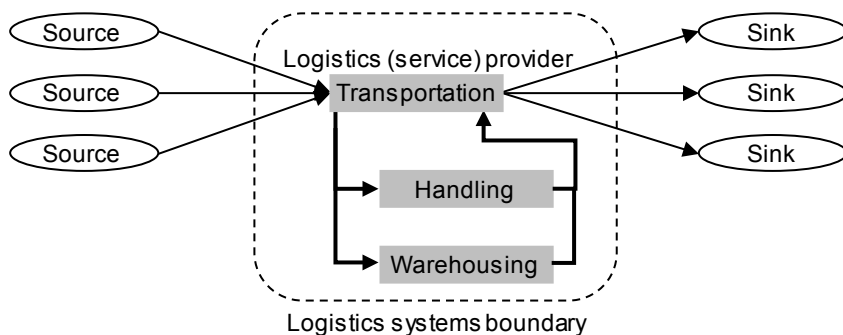


Fig. 1: Schematic illustration of a logistics system

Using system boundaries the logistics system can be distinguished from its environment. However, logistics systems are open systems and therefore influenced by their environment. According to DÜRRSCHMIDT (2001, p.25) influencing factors can be classified into intra-system, outside-system and

global factors. An important example of such influencing factors are megatrends. They are described in the following chapter.

2.2 Megatrends

Trends can be characterized as longterm influencing variables on society, companies, and individuals. They describe conscious changes and provide information on the direction of future developments which influence values, purchasing behaviour, lifestyle and economic developments (Stahr 2012, p.66; Fontius 2013, p.16; Pillkahn 2007, p.15). Hence, a trend is considered as a catalyst for innovation and change. According to FONTIUS (2013, p.16 f.) four types of trends can be differentiated with regard to their breadth and the duration of their effects: fashion trends, consumer trends, socio cultural trends and megatrends. Table 1 substantiates how these can be differentiated.

Scope \ Duration	Global	Supra-national	National	Regional
Long-term (> 25 years)	Megatrends (profound effect)			
Medium to long-term (5 – 10 years)		Socio cultural trends (major changes in attitudes, necessities and manners)		
Medium-term (5 – 8 years)			Consumer trends (changes in consumer behavior)	
Short-term (< 5 years)				Fashion trends (short-term high attentiveness and attractiveness)

Tab. 1: Differentiation of trends (Fontius 2013, p.17)

To constrain the extent of this paper, megatrends are focussed because they dominate the other types of trends.

The term megatrend was first suggested by the sociologist NAISBITT (1982) who describes large social developments. The literal meaning is composed of the Greek word “mega” (great) and the English “to trend”. Megatrend therefore means “a great tendency” or in the broader sense “a great development”. Based on the same understanding, NAISBITT (1982, p.1 f.) identified ten megatrends at his present time that were assumed to have decisive consequences on the American society. Especially the transformation from the industrial society to an information society and the globalization of the economy were predicted. Several years later at the beginning of the 1990s, the term megatrend was used to describe reactions to the renewed uncertainty of the turn of the millennium. Megatrends helped to identify future developments in the 21th century (Naisbitt and Aburdene 1992, p.9). The originally social definition of megatrends was expanded by an economical, political and technological perspective. Furthermore, investigations indicate that megatrends develop very slowly and effect society for at least a decade (Naisbitt and Aburdene 1992, p.9 f.).

Moreover, megatrends fulfill the following criteria. They are (Horx et al. 2007, p.33; Stahr 2012, p.67; Fontius 2013, p.17):

- Longterm, meaning that megatrends last 25 to 50 years,
- Ubiquitous, meaning that megatrends are present in all social systems, e.g. politics, economy, leisure,
- Global, meaning that megatrends have a worldwide presence, whereby specific characteristics vary from country to country,
- Robust, meaning that megatrends tolerate temporary throwbacks.

3. Megatrends in Logistics Systems

The term megatrend implies that they are ubiquitous. From this perception, the conclusion could be drawn that megatrends affecting logistics systems are

covered by general megatrends. Thus, they could be identified from a universal catalog of megatrends. However, the effects that megatrends have on different branches vary to a great extent (e.g. the trend 'electric and alternative-energy vehicles' has a higher influence on logistics than on the public health sector). This is why a specific analysis on megatrends with a focus on logistics has been carried out for this paper.

The objective of this survey is to filter megatrends with regard to their relevance for logistics. This relevance is substantiated by the research community as well as by practitioners in order to derive a manageable amount of megatrends with regard to a subsequent complexity analysis. The survey is structured into three paragraphs (Figure 2). First, a literature review is carried out. Second, practical insights are gathered by a focus group discussion. Both of these results are then, third, merged in order to derive a profound basis for further megatrends in logistics research.

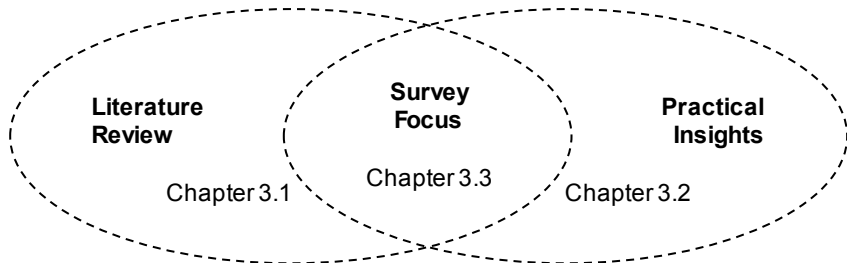


Fig. 2: Schematic illustration of the megatrend analysis

3.1 Literature Review

The objective of the literature review in this chapter is to identify a catalog of megatrends affecting logistics systems. Thereby, a profound basis is provided for a further identification of megatrends in industry, focussing on logistics.

3.1.1 Approach

First of all megatrends from literature were identified. The literature review reveals that no differentiation between the four types of megatrends introduced

in Chapter 2.2 is accounted for. Most authors use the term 'trend'. Hence, for the literature review this term is considered in the broadest sense.

Trend surveys exclusively for logistics emerged in 1988 when the German Confederation of Logistics (BVL) in cooperation with the Technical University of Berlin first established a survey focusing on trends and strategies in logistics (Baumgarten and Ziebell 1988). To this day, there is a large number of essays and surveys which discuss megatrends in logistics and try to forecast their effects (Jünemann 2000; Kille 2008; Klumpp 2010; Münchow-Küster and Zelewski 2012; Straube et al. 2013). For this paper, literature from the last ten years was analyzed. The resulting trends from the literature review were aligned and structured with regard to their relevance for logistics. Trends were then prioritized based on a frequency analysis with regard to their occurrence in literature. Trends being thematically connected to each other were additionally assigned to superior megatrends. Thus, they are double counted. Further investigation was conducted on the chronological appearance of trends in literature.

3.1.2 Results

Table 2 shows the result of the literature review. As already mentioned in Chapter 3.1.1, most authors use the term trend, merely MIKOSCH (2008), STRAUBE and CETINKAYA (2009) and LUBIN and ESTY (2010) describe megatrends.

30 trends with regard to logistics were identified in the literature covering the past ten years. Subsequently, a frequency analysis was carried out in order to derive initial implications on the relevance of the trends mentioned. Thus, important trends in logistics turned out to be sustainability, IT-integration, networked economy, new technologies, globalization as well as security. While most of these trends are constantly named over time, especially the trend sustainability initially named in 2008 has become increasingly important during the past years.

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Megatrend	Baumgarten (2004)	Straube (2005) ***	Straube (2007)	Baumgarten (2007)	Kille (2008)	Mikosch (2008)	Straube / Pfohl (2008) ***	Straube / Cetinkaya (2009)	Straube et al. (2009)	Klumpp (2010)	Lubin / Esty (2010)	Wittenbrink (2010)	Münchow-Küster / Zelewski (2012)	Schuh (2012)	Däneke (2013)	Handfield et al. (2013) ***	Straube et al. (2013)	sum
Sustainability / Green logistics						x	x	x	x	x	x	x					x	9
New technologies		x		x			x	x		x		x						7
IT-integration			x	x						x			x	x	x			6
Security				x			x	x		x			x				x	6
Networked economy	x		x	x				x									x	5
Globalization		x	x				x	x									x	5
Outsourcing	x	x			x					x								4
Customer expectations / Individualization		x							x								x	3
Cost pressure							x						x				x	3
RFID* - radio-frequency identification				x						x								2
Cloud computing**													x	x				2
GPS* - Global positioning system										x			x					2
Talent shortfall													x				x	2
E-Business													x					1
Telematics**													x					1
Demographic change							x											1
Transparency in supply chain										x								1
Social responsibility							x											1
Value-oriented customer		x																1
Compliance							x											1
Container traffic													x					1
Electric and alternative-energy vehicles										x								1
Eastern European expansion of the EU	x																	1
Industry 4.0**															x			1
Capacity management / extension										x								1
Logistics controlling													x					1
Human centered logistics										x								1
Simulation**													x					1
Reverse logistics													x					1
Volatility																	x	1
Competition		x																1

* further new technology

** further new IT-integration

*** BVL series of studies

Tab. 2: Result of the literature review on trends in logistics

In contrast, several trends were named only a few times. For these trends, further investigation has to be carried out whether they fulfill the requirements of the megatrend definition in this paper or rather feature short or middle term characteristics.

Again, trends were identified which have been first named in literature in the past two years like cloud computing, industry 4.0, volatility and talent shortfall. Because of the currentness of these trends they might turn out to be emerging megatrends or rather tendencies in the future.

3.2 Practical Insights

Literature review mirrors investigations from several researcher. Results of the present survey will be taken in order to develop a cause and effect analysis on megatrends and complexity for logistics service provider. This is why it is necessary to integrate practical insights related to the research topic. Approach and results are described in the following.

3.2.1 Approach

The practical insights presented in this paper were extracted from an interview study. The sampling of the interview participants is based on a focus group. Focus groups consist of a small group of experts (Puchta and Potter 2004, p.6). Typically, such a group is constituted by five to ten experts who have either a homogeneous or heterogeneous background (Flick 2006, p.193).

For this investigation a heterogeneous group was sampled. The sample consists of eight experts with varying backgrounds out of five companies. By examining these several perspectives, a broad view of logistics systems is assumed.

With regard to a future analysis of the impacts on basic logistics functions like transportation, handling and warehousing (Chapter 2.1), participants within these disciplines were chosen to be part of the focus group (Table 3). Another classification is provided with regard to the size of the individual companies. The objective of this classification is to highlight small and medium-sized

companies (SME). In addition, consultants were interviewed to derive a holistic overview of logistics systems based on the experience from a number of client companies.

As a preparatory work for a focus group discussion on megatrends in logistics, individual semi-structured interviews were conducted with the members of the focus group. Hereby, megatrends rather than trends were focused. The interviews were partially transcribed into a profile matrix (Maxwell 2013, p.108 f.). From this matrix based transcription megatrends were identified and indexed.

Company	SME	Logistics function of the company	Participants	Position
A	y	Transportation, Handling, Warehousing	2	Executive Quality Manager
B	y	(Individual) Transportation, Handling, Warehousing	1	Executive
C	y	Handling, Warehousing	1	Executive
D	y	Consulting	2	Consultant Partner
E	n	Consulting	2	Consultant Consultant

Tab. 3: Members of focus group

3.2.2 Results

Table 4 shows the results of the semi-structured interviews on megatrends in logistics systems. 18 megatrends were individually named by single participants. Although a focus was set on megatrends, the question whether these namings represent actual megatrends or rather trends needs further discussion.

Megatrends like sustainability, globalization and demographic change were named most frequently. Furthermore, according to the experts, IT-related megatrends like transparency in supply chains, IT-integration, E-business or RFID technology are megatrends that logistics systems have to cope with.

Megatrend	A	B	C	D	E	sum
Sustainability / Green logistics		x		x	x	3
Globalization		x		x	x	3
Demographic change	x		x	x		3
Transparency in supply chains	x		x		x	3
IT-integration	x			x		2
E-Business / Online Shopping			x		x	2
RFID - radio-frequency identification	x				x	2
New technologies	x					1
Customer expectations / Individualization				x		1
Cost pressure			x			1
Talent shortfall			x			1
Container traffic		x				1
Electric and alternative-energy vehicles		x				1
Reverse Logistics	x					1
Smartphone	x					1
Euro-pallet		x				1
Speed		x				1
Lobbyoriented society		x				1
Political apathy		x				1
Work-life balance		x				1
Employee satisfaction			x			1
Urbanization				x		1
Mobility				x		1
Increased information gathering by customer					x	1
3D printing					x	1

Tab. 4: Results of the interviews on megatrends in logistics systems

3.3 Consolidation of the Results

Aim of this step is to filter megatrends that are supposed to be further considered for an effect analysis on complexity. This is achieved by a comparison of the results within a focus group discussion.

3.3.1 Approach

Both independent results were merged in order to identify those megatrends to consider for a future complexity analysis. A preselection was made by choosing megatrends being named by both, literature as well as practitioners. The results of the literature review and the semi-structured interviews as well as the preselection were then discussed and evaluated within the focus group described in Chapter 3.2.1. Focus groups can be used in order to discuss a topic related to a research problem within a small group of experts (Puchta and Potter 2004, p.6). This discussion led to an extensive view on megatrends taking different perspectives of a logistics systems into account. As a result of the focus group megatrends for further analysis were documented.

3.3.2 Results

Figure 3 presents the results of the comparison and discussion of megatrends regarded as relevant in literature and by the practitioners. 15 megatrends named in literature were stated as relevant by the experts in the semi-structured interviews. Several megatrends that are emphasized in literature were also found to be relevant by the practitioners. Noticeably, the megatrend demographic change and transparency in supply chains which were named most frequently by practitioners (Table 4), have only minor occurrence in literature (Table 1). Furthermore, megatrends exist with a high score in the frequency analysis in literature but were considered being less relevant by the practitioners, both in the interviews as well as in the focus group discussion. This is the case for megatrends like networked economy, security or outsourcing. Especially the megatrend outsourcing is no longer a megatrend

according to the expert of company C. This expert has observed a turnaround towards an increasing vertical integration in logistics.

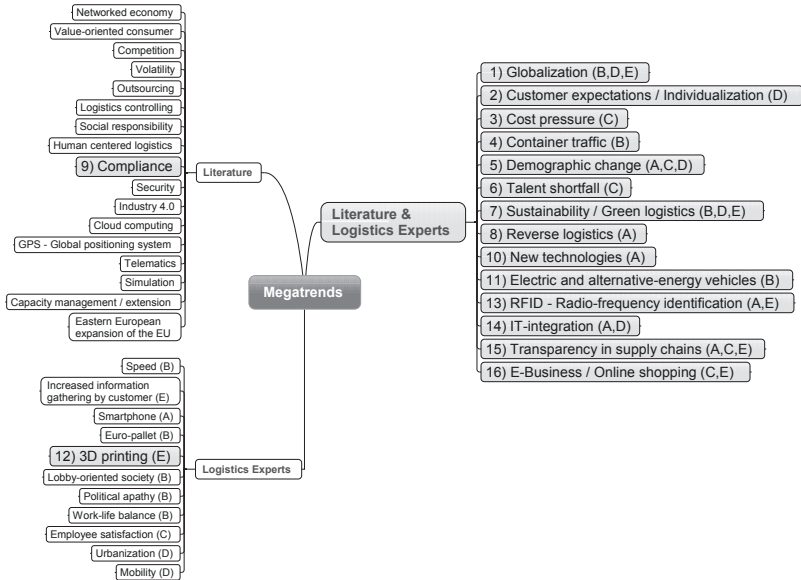


Fig. 3: Consolidated results of literature review and focus group discussion

Furthermore, there are ten megatrends which were named by respectively one practitioner but have not been found in literature. The investigation has shown that the term megatrend is inconsistently defined among companies. This inconsistency might be the reason why these megatrends have not been found in literature.

The discussion within the focus group has shown that globalization is a superior megatrend which influences many other megatrends and trends. The megatrends listed can be brought into a hierarchical order (e.g. the megatrend individualization as a result of globalization). The discussion of megatrends within the focus group has shown that an actual megatrend can seldom be distinguished from its effects.

The focus group approved the preselection of megatrends (those named by both the literature as well as practitioners) for further investigation. Discussions of the megatrends being named by only one medium, either in the literature or by one of the experts led to the conclusion to add the trends 3D printing as well as compliance. By the focus group 3D printing has been seen as a current trend which could further spread out and become a megatrend with a significant influence on logistics. Another critical megatrend for logistics is compliance. This aspect has been named by experts as a driver of complexity and was added to the list of megatrends being focused. This leads to the point where megatrends and drivers of complexity should be compared regarding their influences. A first implication can be derived from this perception that megatrends might function as drivers of complexity.

In the following, the 16 chosen megatrends are described as a basis for further complexity analysis.

- 1) The megatrend 'globalization' has a close connection to 'networked economy'. Because of increasing globalization companies are challenged to build up fast and robust supply chains (Baumgarten 1996, p.53). Networked economies are the result of growing complexity within companies and supply chains. Internal complexity is often growing because companies try to reduce the complexity elsewhere utilizing cooperations and networks (Straube and Cetinkaya 2009, p.138). Globalization can be considered being a complexity driver because it enables a relocation of production sites as well as an opening up of new markets. Thus, it influences the complexity of the entire logistics system (Straube 2007, p.1005). Globalization can be classified as an external driver, whereas networked economies represent a driver within the logistics system (Handfield et al. 2013, p.14 f.).
- 2) Increasing 'customer expectations' and 'individualization' is one of the results of globalization. It causes an increasing number of product variations and a differentiation of service patterns (Handfield et al.

2013, p.15 f.). To fulfill customer expectations it is best to identify and integrate customer requirements at an early stage into the process of building up a logistics strategy (Baumgarten and Walter 2000, p.8).

- 3) Because of growing global competition companies are challenged to work cost efficient. This 'cost pressure' is another megatrend (Handfield et al. 2013, p.19 f.). For logistics systems this pressure is intensified by increasing logistics costs originating from rising costs for energy and fuel (Straube and Pfohl 2008, p.6) as well as fees like duty or toll costs (Münchow-Küster and Zelewski 2012, p.7).
- 4) According to MÜNCHOW-KÜSTER and ZELEWSKI (2012, p.6) a rising tendency can be observed with regard to the importance of 'container traffic'. This mirrors megatrends like globalization and E-business. The expert from company B mentioned container traffic in the same breath with the euro-pallet. Both of these standardizations in logistics function as an answer to the rising variety and complexity of products and processes.
- 5) 'Demographic change' reflects the aging of society. This megatrend has an increasing influence on logistics. Influences can be divided into two extents: employees and customer. Due to demographic change well qualified employees are limited. Talent shortfalls (which as a result of demographic change are described in no. 6) enforces companies to put efforts in training and ergonomics. Demographic change from the customer perspective leads to rising and changing demands in case of products and services (Straube and Pfohl 2008, p.14).
- 6) 'Talent shortfall' is said to be the megatrend most challenging for logistics in the next years. This megatrend currently turns out to be a result of the demographic change (Handfield et al. 2013, p.8). Especially for young people working in the logistics sector seems to be rather unattractive. While HANDFIELD et al. (2013, p.25 f.) investigate a lack of skilled labor jobs like managerial controlling or planning

functions, the focus groups laid a focus on the operational level, in detail the lack of qualified truck drivers and warehouse staff. This megatrends leads not only to labor shortage but also to knowledge management problems caused by the future retirement of the current employees (Handfield et al. 2013, p.24 f.).

- 7) A very important megatrend is 'sustainability'. The concept of the triple bottom line states that sustainability should cover an environmental, economic as well as a social perspective (Elkington 1998). With regard to logistics the term sustainability is often recognized synonymously as its fraction of 'green logistics' (Kersten et al. 2010, p.371; Handfield et al. 2013, p.16) which only takes environmental aspects into account. Because of growing customer demands and tight legal policies, sustainability is getting more and more important. Therefore, the megatrend is most frequently mentioned in the recent literature (Straube et al. 2013, p.7). Especially in current empirical studies the importance of this megatrend becomes apparent (Klump 2010, p.10; Handfield et al. 2013, p.8). Nevertheless, there is still a lack of sustainability assertion on the management level, which is why it could be a competitive advantage to step up the effort on sustainability in an early stage of time (Lubin and Esty 2010, p.76; Wittenbrink 2010, p.19).
- 8) The megatrend sustainability directly enforces the trend 'reverse logistics'. The importance of return-to-use aspects and thereby reverse logistics rises (Münchow-Küster and Zelewski 2012, p.6). This has a direct influence on logistics. Experts feel confronted with both an increased transport volume but also a diversification of requirements.
- 9) The megatrend 'compliance' with regard to logistics is enforced by politics. Especially forwarding agencies are increasingly influenced and restricted by regulations. In addition, these regulations are constantly changing. This uncertainty and the associated need for business adaptations challenges logistics companies in being flexible

and ties up resources (Straube and Pfohl 2008, p.14). According to experts from company A, compliance also leads to product changes resulting in altered transport requirements.

- 10) 'New technologies' is another megatrend influencing logistics. Its importance also becomes apparent by analyzing individual new technologies, for instance the Global Positioning System (GPS) (Münchow-Küster and Zelewski 2012, p.20 ff.) and RFID (Klump 2010, p.10). Furthermore, new information and communication technologies (ICT) provide the basis for IT-Integration (as a megatrend) and influence them significantly. Especially RFID is important to logistics. As an interface to IT-systems, it enables a broad availability of information for supply chains (Baumgarten 2007, p.991).
- 11) The trend 'electric vehicles and alternative-energy vehicles' is named by KLUMPP (2010, p.10). Participants of the focus group pointed out that this trend is a direct effect of the trend 'green logistics'. Furthermore, alternative-energy vehicles can be regarded as an effect of compliance demanded because of legal reasons (Esch and Dahlhaus 2013, p.501). The refueling infrastructure for alternative-energy vehicles is not yet sufficient for commercial applications in the overland transport logistics sector. For instance, hybrid vehicles are most efficient in city traffic and therefore not prevalent in overland fleets (Zieringer 2010, p.122).
- 12) '3D printing' was not identified as a trend in literature. One expert (company E) stated that this technology might have a significant impact on logistics, leading to a reduced amount of goods to be transported. Thus, 3D printing has the potential to become an important megatrend. The focus group agreed to register 3D printing as a trend because of this possible development. According to LEHMACHER (2013, p.84) this technology might change global trade characteristics. This would obviously have a significant influence on transport volume, enforcing logistics service providers to develop new

business models (e.g. offering 3D printing shops) (Lehmacher 2013, p.84 ff.). Today 3D printing is at the peak of inflated expectations on the hype cycle (Gartner cited in Strauss 2013, p.252 f.). Nevertheless, whether this revolutionary technology (Rayna and Striukova 2014, p.119) will be established is more or less unpredictable (Lehmacher 2013, p.85).

- 13) 'RFID' is a technology for wireless identification of products or carriers in logistics systems. Using this technology, data is generated, thereby information transparency is increased. This can be used in order to optimize processes and information flows (Baugarten 2007, p.991). According to KLUMPP (2010, p.10) RFID ensures transparency and security within the supply chain and can be seen as an important trend. This trend has the potential to cope with an increasing complexity.
- 14) One of the megatrends referred to most frequently is 'IT-Integration', both in general as well as in the field of logistics. Because of the development of the latest ICT systems, a company's relationships with customers as well as suppliers could be simplified. At the same time many processes regarding global sourcing, production or distribution could be accelerated (Baumgarten 1996, p.54). The development of the internet is considered as a crucial milestone of IT-integration (Straube 2007, p.1005). Especially current empirical studies point out the importance of this megatrend (Klumpp 2010, p.4; Münchow-Küster and Zelewski 2012, p.19 ff.).
- 15) Focus group members directly relate the trend 'transparency in supply chains' to IT-integration. This trend, which was named with respect to logistics by KLUMPP (2010, p.10) mirrors the use of data and ICT. This usage first allows tracking and tracing via GPS or RFID, second provides realtime information allowing for prediction of problems and third facilitates the collection of data for measuring performance (Notteboom 2013, p.89). MEIER et al. (2008, p.311 ff.) show a

causality between transparency and complexity in supply chains. According to them, rising transparency leads to increasing complexity (Meier et al. 2008, p.315).

- 16) 'E-Business' is one of the results of new ICT. The internet dramatically changed the relationships among companies and their customers as well as the cycles of business processes (Baumgarten and Walter 2000, p.6 f.). But that is how innovative business ideas and bidirectional communication with the customers are enabled (Jünemann 2000, p.9).

4. Conclusions and Opportunities for Further Research

When providing a cost management system for logistics, the identification of megatrends is essential due to their effects on complexity. Within the scope of this study, 16 megatrends relevant for logistics systems were identified. The study was conducted as a combination of a literature review and a focus group with eight experts from five companies guaranteeing different perspectives on logistics systems. An extension of the sample in the future might contribute to the validation of the initial results.

For the trends identified, effects on complexity will have to be analyzed with the aim to set up a complexity cost assessment for logistics systems. Therefore, trends will be evaluated according to their range of influence on complexity.

In the course of the study, a need for further research with regard to the following questions has been identified:

- How can megatrends be distinguished from each other and ordered hierarchically?

Investigation showed that trends identified were not differentiated. Many interferences were identified which is why the trends need to be further distinguished from each other. Fontius (2013) showed a possible concept to structure trends as a function of time and scope. This may lead to a way how to

first group trends and then bring them into a hierarchical order. This directly leads to the following question:

- How do megatrends affect each other?

Due to the fact that trends identified in this study were obviously located on different levels (e.g. new technologies and RFID), causes and effects of megatrends need to be analyzed. This could be achieved by developing a trend network showing cause-effect relations. These relationships will help to answer the question being raised at the beginning of this paper:

- What effects do megatrends have on complexity?

With regard to complexity, the study showed that several megatrends were regarded as direct drivers of complexity by the experts (Chapter 3.3.2). This finding needs to be further evaluated for all of the trends identified.

- Which megatrends function as a complexity driver?

Answering these questions raised above will help to map cause-effect relationships on megatrends, complexity and the associated costs.

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