Chapter 31
Logistics Dynamics and Demographic Change

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Abstract Change and dynamics in logistics are interestingly driven at the same time by external as well as internal forces. This contribution outlines a big data literature review methodology to overview recognizable external changes and analyzes the interaction of one major trend—demographic change—further in order to allow for change management and adaption concepts for successful logistics. Therefore, this may be a first blueprint of how to analyze and react to specific trends in a holistic manner embedded into a context and environment of trends and changes. This may allow logistics dynamics concepts also to be possibly more sustainable in terms of applicable for a longer period of time—and not to be overcome by other trends.

Keywords Demographic change · Logistic trends · Global trends · Interaction

31.1 Introduction

Trends and dynamic settings in logistics have a long tradition as well as importance still today (Craighead et al. 2007). In recent years, the notion of an internet of things —among other important ones like sustainability, agility as well as resilience and risk management—was one of the key trends implying change and dynamics for logistics concepts (Zijm and Klumpp 2016). As trend analysis is nothing new, the

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authors here propose a concept of trend *interaction* analysis with the example of demographic change as one trend which is tested and connected toward a range of other trends relevant for logistics. Therefore, Sect. 31.2 paves the ground by identifying relevant trends in the literature. Section 31.3 is elaborating on these and Sect. 31.4 is outlining the interaction analysis with the help of an expert analysis.

31.2 Trend Analysis: Research Approach

Importance as well as maturation of supply chain management and logistics as an academic discipline is confirmed by the high frequency of articles devoted to theory building, hypothesis testing, and exploratory research. In order to accommodate the evolution of supply chain management and logistics we aim to identify development trends—to do so we apply a literature review as this provides evidence for informing policy and practice on research topics in any discipline. As supply chain management and logistics topics are published in a broad array of journals (Grimm et al. 2014), we conducted an in-depth analysis using academic journals. Academic journals play a strategic role in developing and communicating disciplinary knowledge and are an important educational resource for knowledge dissemination (Fawcett et al. 1995). For our analysis we used the data platform Web of Science in order to retrieve supply chain management and logistics articles published from 2005 to 2015. In order to prioritize, we focused on the list of journals provided by McKinnon (2013). McKinnon (2013) highlighted the most recent ratings of supply chain management and logistics journals in the main listings used for business-related publications in Germany, UK, and Australia. To proceed, we developed key terms to pinpoint and analyze the literature and to avoid unbiased research (Buchkremer 2015). We collected articles focusing on keywords in titles and abstracts: "*supply chain*" and "*logistics*"; both terms were searched in following journals that are regarded as the core peer-reviewed literature in supply chain management and logistics field: *International Journal of Logistics Management, International Journal of Logistics: Research and Applications, International Journal of Physical Distribution & Logistics Management, International Journal of Shipping and Transport Logistics, Journal of Business Logistics, Journal of Supply Chain Management, Logistics Research, Maritime Economics and Logistics, Naval Research Logistics, Supply Chain Management: An International Journal, Transportation Research E: Logistic and Transportation Review*. We finally identified 3,469 articles—213 articles were deleted that were announcing for example a special issue or editorial or call for papers. Using the citation report provided by Web of Science we analyzed the high cited articles and read the abstracts. We identified a list of most cited focal themes as indicated in Table 31.1.

In order to identify the trends we conducted a further analysis as the second step using **SAS Enterprise Miner**. We created a list of further keywords using the focal themes from Table 31.1 and investigated the frequency of those themes in the abstract and title of 3,469 articles. In the third step we read the articles and identified four main trend areas from the selected articles (see Fig. 31.1).

Table 31.1 Focal themes in logistics and supply chain management

Risk management	Sustainability	Coordination
Operations management	Green SC/LOG	Collaboration
Return logistics	Information technology/industry 4.0	Cooperation
Vehicle routing	Demographic change	Supply chain integration
Distribution	Performance management and measurement	Relief/humanitarian operations
Purchasing/supply management	Closed loop	Packaging
Skills/competences	Human resources	Tracking and tracing
Organizational learning (education and training)	Inventory/warehouse	Agility/lean/flexibility

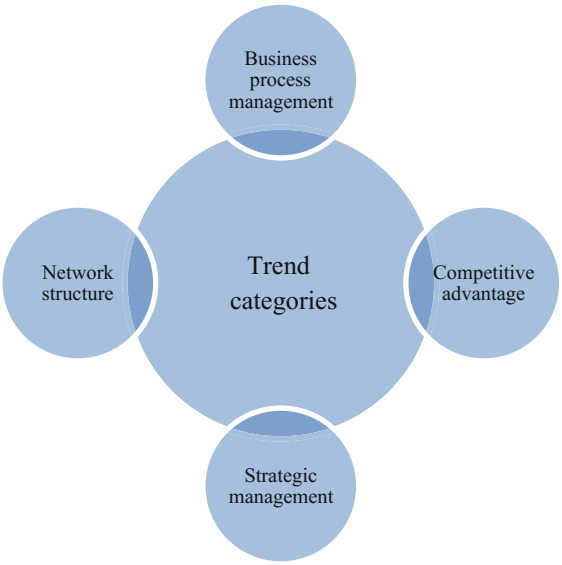

Fig. 31.1 Main areas on logistics and supply chain management trends

The area *strategic management* describes the identification and implementation of objectives based on assessment of internal and external environment factors in the organization considering efficient resource allocation. The second area *competitive advantage* is a major topic in academia and business practice. This includes innovative concepts and tools that support organizations to outperform its competitor. Furthermore, it is an element of strategic management. The area *business process management* deals with management of activities that produce a certain output based on the demand and request of customer (Cooper et al. 1997a, b; Davenport 2003). Moreover, it provides methods, techniques, and tools to support the design, management, and analysis of operational business processes (Van der Aalst et al. 2003). The last area deals with *network structure*: this gives insight on

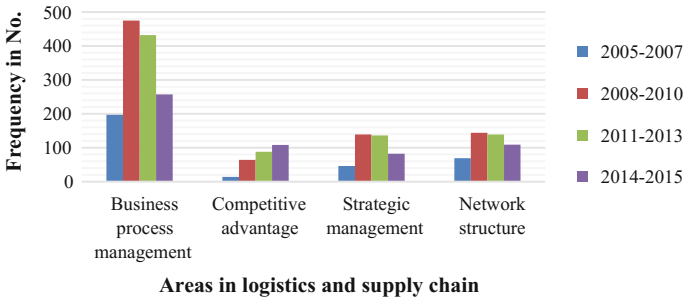

Fig. 31.2 Development of four areas in logistics and supply chain

the flow of materials and information from start to end. Furthermore, it shows value that has been created due to partner cooperation.

Finally, in order to gain an overview we summarized the results. Consequently, we have classified the articles in four *time phases* 2005–2007, 2008–2010, 2011–2013, and 2014–2015 to gain deeper insights into the development of the four areas and their related subcategories. As Fig. 31.2 indicates research on business process management is dominating—though declining—followed by network structure, strategic management, and competitive management.

31.3 Findings and Discussion

31.3.1 Business Process Management

The supply chain starts with the source of supply and ends at the point of consumption (Stevens 1989); it links each element of the production and supply processes from raw materials through to the end customer (Scott and Westbrook 1991). Supply chain management targets to synchronize the requirement of customers with the flow of material from suppliers even the goals of high customer service level, low inventory investment, and low unit cost (Stevens 1989; Scott and Westbrook 1991; Christopher and Towil 2001; Cooper and Ellram 1993; Christopher 1999). Over the last years different branches, in particular automotive branch, were confronted to increase their competition from their counterpart in the U.S. and Asian countries. This pressure leads the companies to improve quality, to reduce product development and manufacturing time as well as development and manufacturing costs. Therefore, the motivation on optimizing processes and increasing performance within and across actors of the supply chain was both to improve inventory and warehouse management and to promote distribution management while reducing costs. For example minimizing relevant **inventory and transportation** costs can be supported by using a network of inventory queue that incorporates an inventory replenishment policy for a store (Dong and Chen 2005). However, in the

supply chain, it is an important issue for logistic managers to offset the replenishment cycles of multiple products sharing a warehouse so as to minimize the maximum warehouse space requirement (Yao and Chu 2008). A further area where more attention has been paid recently is the area of **e-business**. For example research has been executed on supporting retailers to increase customer satisfaction in fulfilling orders while minimizing logistics costs. Hereby each customer demand is fulfilled from the closest fulfillment center if there are enough inventories. Otherwise, the retailer would transship stock from a nearby facility or transfer the customer order so it is fulfilled from another facility, depending on the economics of transportation (Torabi et al. 2015). To address this gap Torabi et al. (2015) developed a mixed-integer programming model to efficiently find optimal solutions. **Last-mile distribution** is an essential logistics component for practice and fossil fuels vehicles "are polluting the world´s cities, dumping increasing amounts of carbon dioxide and other greenhouse gases into the atmosphere, and consuming vast quantities of petroleum" (Sperling 1995, p. 1). Nevertheless, oil demand is increasing and will exceed production by 2035. This will have an impact on fuel availability as well as on cost of fuel (Charles et al. 2014). However, accomplishment of travel reduction or transportation of goods will be difficult therefore sustainable energy and transportation systems are needed to be established. According to this, the use of electric vehicles in the delivery process (last-mile distribution) would be an opportunity to decrease the economic and ecological key driver fuel. Another advantage would be decreasing noises and reducing carbon emission. In the logistics industry, for example Deutsche Post DHL has integrated electric vehicles in their fleet pool for urban delivery (Deutsche Post DHL 2014). To enhance the use of electric vehicles different research efforts have been driven by different disciplines such as engineering, economic, or business science research fields. Research on supply chain vulnerabilities due to macro and micro risks have been increased recently. For example since 1970 the total number of natural and technological disasters increased six times (Schulz 2009). A natural disaster can disrupt a global supply chain in few seconds after an outbreak (Canbolat et al. 2008; Manuj and Mentzer 2008), for example volcanic outbreak in Iceland and Earthquake in Japan in 2011 or hurricane Kathrina in 2005 (Munichre 2014; Manuj and Mentzer 2008). Or the company strategy such as global supply chain is afflicted with micro risks such as linguistic and cultural deficits and customs regulations (Cho and Kang 2001; Schniederjans and Zuckweiler 2004), transportation delays, logistics service differences (Cho and Kang 2001). All these risks can be counteracting with taking action even if these actions increase the costs. But at first moment, a **supply chain risk management** seems to be as an additional work for companies and manager as well as losses (Manuj and Sahin 2011). Supply chain disruptions cause a sales fall of 7 %, a down of an operating income of 42 % and a fall of return on assets of 35 % and an announcement of supply chain disruptions causes a shareholder return between 7 and 8 % (Hendricks and Singhal 2005). In the depth sight, it is to recognize that risk management brings profits which make the companies more efficient (Waters 2011). Therefore, efforts are done to mitigate risks for example Chapell and Peck (2006) developed risk management situations

for the military supply chain by applying six-sigma method. Manuj and Mentzer (2008) developed a risk management and mitigation model for global supply chain. Manuj et al. (2009) developed an eight-step model for the design, assessment, and application of logistics and supply chain simulation model. Due to the increasing number of natural disasters and the resulting chaotic humanitarian emergencies an important area in supply chain and logistics management attracted the attention of researcher. The complex logistics environment due to emergencies put pressure on humanitarian aid agencies to deliver humanitarian aid in an appropriate and cost effective way (Thomas and Kopczak 2005; van Wassenhove 2006; Oloruntoba and Gray 2006; Kovacz and Spens 2007) along the humanitarian supply chain. The **humanitarian supply chain** encompasses the planning and management of all activities related to material, information, and financial flows in disaster relief. Importantly, it also includes coordination and collaboration with supply chain members, third party service providers and among humanitarian organizations humanitarian supply chain management is concerned with managing the efficient flow of aid materials, information, and services and aim to reduce the impact of disaster on human lives (Lijo et al. 2012). Humanitarian supply chain plays a central role in several phases of a disaster relief concept such as preparedness, immediate response, reconstruction, and recovery phase (Baumgarten et al. 2010). Each of these phases and activities require logistics support, although every phase has its requirements with regard to the duration, volume, the needed as well as the variety of supplies, urgency and procurement location.

31.3.2 Network Structure

Rapid technology development, contracting out, global markets, product dynamic, service complexity, reducing supplier and inventory practices are aspects behind commonplace complex and interlinked business environment (Deleris and Erhun 2005; Glickman and White 2006). Furthermore due to the highly competitive environment in which organizations currently operate, attention has shifted away from optimizing individual firm performance toward effective supply chain management (Bolumole 2001; Christopher 2011). Supply chain management refers to effectively managing the network of organizations to which the organization belongs (Cruijssen et al. 2007a; Christopher 2011), including both **vertical and horizontal business relations**. Therefore being part of an alliance might benefit an organization in two ways. First of all, participating firms can create a competitive advantage over their competitors (Bernal et al. 2002), which is perceived by customers as an additional value (Anslinger and Jenk 2004; Christopher 2011). Second, they might realize business growth through a net positive outcome from the project initiated by the alliance partners, which ultimately benefits the shareholders (Cruijssen et al. 2007b). The decision to engage in a horizontal cooperation is either driven by internal motives (e.g., management decisions and goals), or by external motives (e.g., evolving market conditions, the economic environment, and customer

requirements) (Verstrepen et al. 2009). Due to the mentioned motives, the development of the topics **collaboration and cooperation** is growing. For example Gimenez and Ventura (2005) investigated the logistics-production and logistics-marketing interfaces and their relation with the external integration. They concluded that external collaboration among supply chain members does always contribute to improving firms' logistical performance. Soosay et al. (2008) describe how differing relationships can affect the operation of organizations and their capacities to innovate. The ability to work together with partners has enabled firms to integrate and link operations for increased effectiveness as well as embark on both radical and incremental innovation. A focal question in the area of collaboration and cooperation is how the total cost or savings should be distributed among the participants. Smaros (2007) proposed an allocation method and examined a number of sharing mechanisms based on economic models including Shapley value, the nucleolus, separable and non-separable costs, shadow prices and volume weights. Ashayeri et al. (2012) highlight that supply chains exist for more than twenty years, however, partner selection and evaluation processes are still unstructured. The right choice and evaluation of strategic partnership could bring a competitive advantage, whereas inability to establish a proper relationship would bring overwhelming problems. Research by Cousins and Spekman (2003) shows that around 60 % of partnerships fails. Incompatibility with partners is one of the most common reasons for this. Hence, choosing and evaluating the right strategic partners is highly important for the performance of the alliance among a logistics network and supply chain (Lee and Cavusgil 2006). We conclude that research on establishment of horizontal cooperation between LSPs are limited (Verstrepen et al. 2009), but extensive research has been performed on vertical business cooperation, i.e., supplier selection and service selection. Due to this fact, we pinpoint that research on collaboration and cooperation should focus on horizontal cooperation between LSPs.

31.3.3 Strategic Management

Strategy is defined as "the match an organization makes between its internal resources and skills… and the opportunities and risks created by its external environment" (Grant 1991a, b, p. 3). Even Hoover et al. (2001) pointed out that is practically difficult to deliver a high customer value while at the same time reducing cost. These trade-offs have to be resolved by developing an integrated supply chain. It targets managing the material and information flow at the strategic, tactical, and operational level by utilizing facilities, finance, people, and systems which are coordinated and harmonized as a whole (Stevens 1989). To improve customer service levels and to reduce costs a supply chain strategy has to be taken in account (Simchi-Levy et al. 2000). In the supply chain sector two well-known supply chain strategies namely **lean and agile** exist. Lean follows the idea to reduce and eliminate the waste and focus on the efficient use of resources (Ōno 1988) while the agile concept is about the ability to match supply and demand in turbulent and

unpredictable market (Christopher 2000). Lean concept is usable when the demand is stable and predictable (Christopher et al. 2006). The future development of the supply chain and logistics sector essentially depends on the success of **continuing education** of new and current employees. The supply chain and logistics sector as well as the competencies and knowledge of the employees are faced with a variety of challenges, which can be subdivided in two categories. To the first category knowledge enrichment is such as global and dynamic supply chains and complex logistics chain, the second category knowledge extension is such as extensive ICT (RFID, GPS and Dynamic Routing). All these argue for the current high lack in skilled employees not only on an operational level such as truck drivers but even experts of different disciplines such as innovation management, supply chain design, ICT in logistics as well as warehouse and inventory management and order picking systems. By regarding the identified trends, employees have to increase their knowledge to tackle the tasks of logistics goods and services in a high velocity and to improve their competences. **Competence** is defined as "the ability to successfully meet complex demands in a particular context. Its manifestation, competent performance (which one may equate to effective action), depends on the mobilization of knowledge, cognitive and practical **skills**, as well as social and behavioral components such as attitudes, emotions, values and motivations" (Hakkarainen et al. 2004). Competence demonstrates also the level of student achievement in the science education context (Liu 2009). Competence is not only skills, qualification or only knowledge but all these factors are the basic for a competence of person. Nevertheless, specific further research questions in the wake of these topics could be the question of linking individual and corporate competence levels to process efficiency and corporate results (ROI and others) in logistics companies; or also the question of specific competence diversions and gaps (blue and white collar employees in logistics, gender aspects in logistics education, regional disparities in logistics education and qualification, connections and interactions of formal and informal on-the-job learning in logistics, etc.). A further element that is essential in strategic management is measuring performance. **Performance measurement** is fundamental to improve operations (Kaplan 1990), simplify communication between supply chain actors, and increase transparency of the supply chain and logistics processes (Gunasekaran and Kobu 2007). Chow et al. indicated that performance is multidimensional, because one measure is not sufficient for a logistics performance—logistics performance has to be seen as subsection of the larger conception of firm or organizational performance (Chow et al. 1994). To know the meaning of performance there are two central organizational and logistics goals which have to be defined. These are divided in two dimensions: The simplest dimension and which affect the performance—in particular logistics performance—is to differentiate between (i) efficiency and (ii) effectiveness (Gleason and Barnum 1986). In the literature they are valuable and meaningful research concept, approaches, and case studies that analyze the presented metrics and system to evaluate the performance of supply chain as well as logistics, e.g., production, distribution or inventory, and implement performance measures (Gunasekaran and Kobu 2007). Hereby is to add that the existing research in

performance measurement metrics and systems focuses on analyzing current and in the practice used performance measurement systems and in studying the measures. All these argue for the complexity and difficulty in developing performance measurement metrics and systems for firms, organizations, and their logistics activities. Huang et al. present performance measures that are based on reliability, responsiveness, costs, and assets (Lai et al. 2002; Huang et al. 2005), Giannakis (2007), Simatupang and Sridharan (2005) determine performance measures to evaluate the collaboration within a supply chain; a performance management process for delivery services is set by Forslund and Jonsson (2007). Furthermore, there are general methodologies developed to measure supply chain and logistics performance, namely the balance scorecard (Kaplan and Norton 1992), supply chain council´s SCOR model, logistics scoreboard, activity-based costing, and economic value added (EVA) (Lapide 2000). Nevertheless, developing and implementing a performance measurement system with appropriate key performance indicators remain as a complicated process (for example Shepherd and Gunter 2006; Lapide 2000; Chae 2009).

31.3.4 Competitive Management

Supply chain and logistics sector is facing with two themes demographic change and sustainability that need more pioneering concept to help organizations to outperform its competitor. The **demographic change** has a high impact on economy (Klumpp et al. 2012), health care service, infrastructure, mobility as well as the pension system in Germany. The working-age population (20 to 64 years old) in Germany is currently 49.8 million. In 2030, the working-age population will probably have 6.3 million fewer persons than in 2010 (Federal Minister (Bundesministerium des Inneren 2011, p. 6)) and in 2060 the working-age population will decline about 35 % compared to 2013 (Federal Statistical Office (Statistisches Bundesamt 2013). Not only Germany is faced with the demographic change even the "European Union is facing unprecedented demographic changes (an aging population, low birth rates, changing family structures and migration). In the light of these challenges it is important, both at EU and national level, to review and adapt existing policies" (European Commission 2010). However, in the future economic demand has to be adjusted due to the demographic change. Skilled and productive employee allows economic growth. To resolve the conflict due to the impact of demographic change and to mitigate the threat of a shortage of employees we should strengthen the current employees, the underutilized population in the labor system, i.e., women and disabled people and integrate the qualified immigrants in the labor system. The theme **sustainability** has been explored in a variety of settings. For example, local governments in Western Europe increasingly applied city time-access regulations to improve social sustainability. These rules significantly affect the distribution management and process of retail chain companies. Quak and de Koster (2007) studied the impact of governmental time-window

pressure on retailers' logistical concepts and the consequential financial and environmental distribution performance. Carter and Dale (2008) introduce the concept of sustainability to the field of supply chain management and demonstrate the relationships among environmental, social, and economic performance within a supply chain management context. Using qualitative and quantitative survey data Walker and Brammer (2009) explored sustainable procurement in the UK public sector. Sharma et al. (2010) argued that less attention has been given to marketing's role in a green supply chain and its interface with environmentally friendly manufacturing and operations. Therefore, they identified three major strategies for achieving competitive advantage and financial performance such as reduction of surplus supply of products, reduction of reverse supply, and internal marketing. Asgari et al. (2015) presented the sustainability performance of the five major UK ports. One objective of an EU funded project (SCALE) was to improve the sustainability of food and drink supply chain logistics in the context of rising food demands, increasing energy prices, and the need to reduce emissions (Bloemhof et al. 2015). Meixell and Luoma (2015) find in which ways stakeholder pressure may affect supply chain sustainability: The three main findings includes sustainability awareness, adoption of sustainability goals, and/or implementation of sustainability practices. We conclude that further research should focus on developing innovative sustainability concepts that have to be integrated in logistics service provider network, in maritime waterways logistics, logistics hubs as well as in the air freight division.

31.4 Trend Interaction: Demographic Change

In order to visualize and analyze the specific trend of demographic change with its individual dynamic interaction with other trends, a short expert survey was used. Four individuals from an annual German logistics summit[1] were interviewed using an interaction chart. Results are depicted in the following Table 31.2.

The relationships between demographic change and the theme fields of the first column (agility to tracking and tracing) were polled. The experts were asked to indicate from strong positive (++) to strong negative (–). The given information is represented in column # 1 to # 4. As can be seen by the variance, the respondents to the areas of coordination, human resources, and inventory/warehouse are very uneven (bold print). Referring to the average strength of trend interaction, it becomes clear that for example *organizational learning* as well as *collaboration* and *information integration/industry 4.0* are strongly influenced by demographic change. This is very interesting—and for the latter two trend themes may be quite unexpected. But with a second thought, it is evident that this expert feedback is quite thorough and foresighted: Collaboration as well as information integration

[1]"Zukunftskongress Logistik", hosted by Fraunhofer IML in Dortmund, Germany.

Table 31.2 Demographic change and dynamic trend interaction (from 2 strong positive to -2 strong negative)

Area	#1	#2	#3	#4	∅	Variance
	Demographic Change with …					
Agility/lean/flexibility	1	1	–2	0	0.00	2.00
Closed loop	0	2	–1	0	0.25	1.58
Collaboration	2	2	2	1	**1.75**	0.25
Cooperation	2	2	1	1	1.50	0.33
Coordination	2	2	–1	2	1.25	**2.25**
Distribution	1	–1	1	2	0.75	1.58
Green supply chain/logistics	0	1	1	1	0.75	0.25
Human resources	–1	0	–2	2	–0.25	**2.92**
Information technology/industry 4.0	1	2	2	2	**1.75**	0.25
Inventory/warehouse	0	1	–2	2	0.25	**2.92**
Operations management	1	0	–2	0	–0.25	1.58
Organizational learning (education and training)	2	2	2	2	**2.00**	0.00
Packaging	0	1	–1	1	0.25	0.92
Performance management and measurement	–1	0	0	0	–0.25	0.25
Purchasing/supply management	0	1	–1	0	0.00	0.67
Relief/humanitarian operations	1	–1	0	1	0.25	0.92
Return logistics	–1	2	0	2	0.75	**2.25**
Risk management	1	1	0	1	0.75	0.25
Skills/competences	1	0	2	2	1.25	0.92
Supply chain integration	2	1	1	0	1.00	0.67
Sustainability coordination	1	2	1	1	1.25	0.25
Tracking and tracing	1	0	0	0	0.25	0.25

and industry 4.0 have to be designed to be operable intuitively and with (almost) no knowledge of the system. Therefore, it requires highly educated people to develop these. Therefore, the conclusion to this regard should be adapted. Though automatization and artificial intelligence may be advanced and increasingly taking over human tasks, in the near future complex and conceptual tasks will still reside in the hands of capable humans who have to be found, trained and given time to accumulate experience with logistics operations. And this will be very hard facing demographic change and a "war for talents." Therefore, the logistics industry may have to drastically change their operating scheme in human resource management: From a typical provider of low or unskilled labor in large quantities (blue collar) to a hunter of rare talent in high qualification areas such as strategic management, information technology and intercultural competences agile, resilient and sustainable global cooperating supply chains of the future.

31.5 Conclusion

In outlining trend themes and connecting them to the major trend of demographic change this paper has provided three major results: (a) A bunch of important trend themes for logistics can be identified from the research literature, among them sustainability, information integration/industry 4.0, supply chain collaboration, and coordination as well as integration, operational and performance topics such as vehicle routing, reverse logistics, purchasing, and distribution, "soft themes" such as skills/competences and organizational learning as well as risk management and agile, lean and flexible logistics processes. (b) A new trend interaction approach has been tested—and shall be extended to further experts and surveys in the future—in order to gauge the interaction of demographic change with the other identified main trends in logistic, providing a "proof of concept" for this methodological approach. (c) The results of the trend interaction analysis turned out to show that besides human resources and skills/competences as obvious suspects, the experts rated a high interdependency also for collaboration and information integration/industry 4.0. This is obviously an interesting insight and can be reflected further—and will surely influence the strategic perspective on human resource and knowledge management in logistics when thinking about these important long-term trends.

Altogether the contribution has shown the value of a deep insight into trend developments for the strategic development of dynamic logistics concepts for the future. Research shall continue on this path in order to avoid just jumping to individual trends and management fads—but instead think hard about the interconnections and long-term implications of logistics trends. This will enhance the capability to design resilient, agile, and sustainable supply chains in the future.

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