**MEGATRENDS SHAPING THE FUTURE OF THE SUPPLY CHAIN AND LOGISTICS**

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**Introduction**

Megatrends can be observed over decades (see Figure 1) and each can have different implications for businesses, society affecting different aspects of the supply chain. The terms trends and megatrends are used interchangeable; however, megatrends are non-sector specific factors that drive trends whereas a trend is the general direction in which something is going to move, develop or change. For example, increasing floods in the USA is a trend whereas a worldwide increase in number and intensity of floods would be a megatrend.

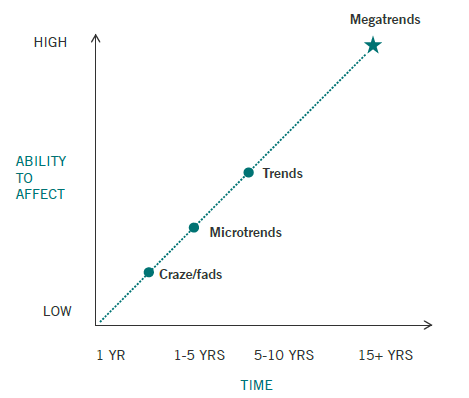


Figure 1: Impact and time horizon of megatrends (Pictet asset management, 2017)

Companies need to have a good understanding of the megatrends in order to derive future scenarios and hypotheses about how specific industries might evolve (Gernandt, 2012); a lack of understanding could have a severe impact on the future and strategic setting of their supply chain. The literature related to current megatrends and trends is scant and encompasses several concepts originating from different areas (e.g. climate change, urbanisation).

In the field of supply chain management and logistics, there are some studies that are exploring trends e.g. electric vehicles, efficient multi-modal networks (e.g. Speranza et al., 2018), training to knowledge based development to talent management (e.g. Bowersox et al., 2000; Stank et al., 2015; Sweeney, 2013), but only a few have focused on the logistics industry (e.g. Gernandt, 2012; Seppälä, 2016). Current literature seems to lack a comprehensive study on the megatrends and associated trends in the sector and therefore the goal of this research is to identify and provide a comprehensive list of megatrends and associated trends that address critical aspects of several domains of analysis (e.g. political). The remainder of the paper is organised with a section on the systematic literature review methodology that was applied in this research. This is followed by a description and a discussion on the findings. The paper closes with a conclusion and further research opportunities.

**Methodology**

This research is based on two complementary phases: a systematic literature review and a workshop with experts. During the first phase, megatrends and trends were identified by reviewing existing information with a focus on recent publications (i.e. international journals, conference papers) and mainly on grey literature (i.e. unpublished reports and other documents). The grey literature enables to capture a large amount of information that has not yet been discussed in the academic discourse (Mahood et *al.*, 2014). This study builds upon the feedback of multiple researchers and experts with long standing expertise in the area of supply chain management from Germany, the United Kingdom, Italy, Netherlands, Portugal and Spain who contributed with relevant articles to minimise bias. Thus, multiple databases were used. Five steps are followed in this systematic literature review: 1) process question formulation, 2) locating literature, 3) study selection and evaluation, 4) analysis and synthesis, and 5) finally reporting and using the results (Denyer and Tranfield, 2009).

In the first step, the primary review question is as follows: “What are the megatrends and trends that are shaping the future of the supply chain and logistics?” The second step contains an online search of relevant reports and journal papers from major scientific databases namely Science Direct, Emerald and Google Scholar. Some of the main keywords and phrases that were used to identify the relevant papers for review are: (logistics) OR (supply chain management) OR (manufacturing) OR (process manufacturing) OR (distribution) OR (transportation) AND (trends or megatrends) OR (future supply chain) OR (next generation supply chains) AND (trends or megatrends). Only articles and reports written in English were included. After the elimination of articles or reports that do not match the above criteria and do not specifically answer the research question, 349 reports, grey literature and papers are selected and analysed.

A PESTLE analysis is used to identify and characterise different megatrends and trends. PESTLE analysis enables to capture the macro environment i.e. external forces. NVivo software was used to analyse these documents that helps to draw out themes emerged from the data. Thematic analysis was adopted. The analysis began by using ‘open coding’ to collect trends from the chosen sources in order to create the first-order themes. “The codes are labels which enable the qualitative data to be separated, compiled and organised” (Collis and Hussey, 2009; p. 179). Then first-order themes were connected to create the second-order themes, which are the megatrends by axial coding (i.e. more abstract coding of data into theoretical categories). The final step linked the various concepts that emerged from the data by choosing the aggregate dimension (i.e. PESTLE dimensions) to be the core category and relating all other second-order themes to that category.

Regarding phase two, a workshop, which brought together 18 experts from both the academic and practitioner domains (see table 1), discussed, refined, and extended the findings and insights gained from the literature review. Participants were asked to identify trends/megatrends for each dimension of the PESTLE analysis. Then, individuals were assigned to work in a group to discuss the megatrends and trends in the field of supply chain management. The megatrends and trends identified through the systematic literature and the workshop are discussed in the section below.

|  |  |  |
| --- | --- | --- |
| **Domains** | **Role and expertise** | **Country** |
| Academics | Researcher in supply chain development and strategy, Senior researcher with expertise in logistics and supply chain management | Germany |
| Researcher working in the area of supply chain management, mass customization, innovation management, Researcher with expertise in industrial engineering information systems (business informatics) and human-computer interaction, Researcher with expertise in logistics and supply chain management | Italy |
| Professor with expertise in 3D printing | Netherlands |
| Senior researcher with expertise in supply chain management | Portugal |
| Research Fellow with expertise in logistics and supply chain management | Spain |
| Senior lecturer in logistics and supply chain management, Research associate in manufacturing supply chains | United Kingdom |
| Practitioners | Project manager with expertise in environment, climate change and energy management | Belgium |
| Supply chain and reverse logistics engineer, Senior consultant across the spectrum of process and discrete manufacturing industries, ‎Policy and patron advisor, Chief technology officer with proven expertise in international automotive management, Senior project manager in transport and logistics services , Director of sustainable engineering solutions with extensive experience in the electric vehicle industry, Partner of the council of supply chain management professionals with experience on engineering, manufacture and operational transformations | United Kingdom |

Table 1: Workshop participants

**Findings and discussion**

22 megatrends and 66 trends were identified (see Table 2) through the literature review and the workshop (Kalaitzi et al., 2018), which are discussed in the following sub-sections.

|  |  |  |
| --- | --- | --- |
| **Dimension** | **Megatrends** | **Trends** |
| Political | Protectionism, Political stability, Supranationalism | Import tariffs, Quotas, Different tax structures, Subsidies, Terrorism/conflict, Social unrest, Trade agreements, Free movement |
| Economic | Global trade shift,  Digital economy, Financial innovation | Economic growth in emerging economies, Export growth, Investment, Globalisation, Glocalisation, Emergence of born-global firms, Sharing economy, From an economy of goods to an economy of services, Digital currencies, Cashless payment, The financial technologies (Fintech) revolution |
| Social | Population growth, Demographic change, Urbanisation, Changes in consumption pattern, Individualism, Digital natives, Knowledge based economy | Population boom in the developing countries, Growing demand of resources (e.g. land), Ageing population boom in developing countries, Young population boom in developing countries, Migration flows, Labour shortages, Megacities, Smart cities, Middle-class explosion, Healthy diets and lifestyles, Consumerism, New customer relationship, New shopping experience, Increase of customisation, Change of communication patterns, Change of purchasing patterns , Reshaping the workplace, Increased demand for high-qualification jobs, Emerging skills required, Continuous learning culture |
| Technological | Digital transformation, Technology development and automatization, Electrification of transport, Renewable energy sources | Big data analytics, Artificial intelligence, Cloud based computer systems, Blockchain, Internet of Things, Robots, Cyber-physical system, Augmented reality and virtual reality , 3D printing/additive manufacturing , Drones, Autonomous systems, Automated guided vehicles , Wearable devices, Battery electric vehicles, Hydrogen fuel cell electric vehicles, Hybrid vehicles, Production and storage of clean energy and application to transportation and industry, Renewable energy for industrial processes |
| Legal | Consumer protection laws, Intellectual property law, Social and environmental regulations | Cross-border payments, Return products free of charge or under warranty, Product safety regulations, Privacy Patents, Data sovereignty, Corporate social responsibility, Emissions control regulations, Waste and resources management regulations |
| Environmental | Climate change, Resource scarcity | Pollution, Lack of resources such as water, Land, energy, Food and rare earth elements, Waste increase |

Table 2: Megatrends and trends in the field of supply chain management and logistics.

**Political dimension**

*Protectionism, political stability, and supranationalism* are the megatrends that emerged under the political dimension. Regarding protectionism, it has been boosted by political events across the world that may lead to supply chain disruptions. For example, Brexit will have a direct impact on supply chains as it is supported that 32 % of European Union (EU) suppliers will be substituted by national ones and 46 % of business will not use many UK suppliers (McKevitt, 2017). Recently, the US announced import tariffs of 25% on steel and 10% on aluminium and manufacturing companies with plants overseas (e.g. Mexico, China) may be affected by increasing import duties and tariffs (PwC, 2017).

Regarding political stability, the second megatrend, terrorism/conflict lead to more cross-border security regulations, which in turn affects supply chain flows. For example, the attack in the twin towers of New York City on September 11, 2001 disrupted the Mexico–USA trade namely increased the time of border-crossing and affected the in transit inventory (Bueno-Solano et al., 2014). In 2016, 38% more countries suffered supply chain terrorism attacks, even so, the top 10 countries for supply chain terrorism incidents accounted for $664 billion worth of global exports (Hines, 2017). Finally, supranationalism is associated with trade agreements and free movement and can affect supply chain decisions regarding the number and location of the production facilities, and supplier selection.

**Economic dimension**

This dimension comprises of the megatrends: *global trade shift, digital economy and financial innovation*. High economic growth in emerging economies such as China and the MINT (Mexico, Indonesia, Nigeria, Turkey) countries could result in global trade shift (Francesco and Ardita, 2015). By 2030, China will be the largest economy in terms of Gross Domestic Product (GDP) (PwC, 2015) that will influence the demand, and the design of the supply chain networks respectively. Another trend with high impact on supply chain and product structure is ’glocalisation’, which aims at adaptating products to local cultures while globalisation continues (Hong and Song, 2010).

The second megatrend, digital economy, includes the trend sharing economy, which support to pay for assets or services by consumption or on demand (Deloitte, 2016). The biggest sector of Europe’s industrial sharing economy is peer-to-peer transportation, facilitating transactions totalling €5 billion in 2015 (PwC, 2016a). Both developments demonstrate a shift from an economy of goods to an economy of services with respective impact on the supply chain (Deloitte, 2015). Last, financial innovation is another megatrend that can affect and improve in terms of security the financial transactions in the supply chains e.g. cashless payments and digital currencies (including cryptocurrencies). Moreover, B2C transactions are increasingly digitised and there is a shift from physical money to digital payments (Bons et al., 2012). These financial innovations support the emergence of Financial technology (Fintech) firms that revolutionise supply-chain finance.

**Social dimension**

The megatrends emerged under the social dimension are *population growth, demographic change, urbanisation, changes in consumption pattern, individualism, digital natives* and *knowledge-based economy*. Regarding population growth, world population is estimated to reach 8.5 billion in 2030 and most of the people will be 60 years or over as it is projected to account 56% of the total population in 2030 compared to 2015, mainly in the developed regions (United Nations, 2015). Ageing population can lead to a lack of available labour pool such as truck drivers in the logistics industry that it is estimated to be almost 25,000 by 2020 in Canada (Millington, 2017). However, between 2015 and 2030, 35 million people will move from less developed countries to developed ones (Rolland Berger, 2017), expanding the workforce and consequently increasing demand and investment. Specifically, new megacities and smart cities will grow, and the related investments will require $1.8 trillion by 2030 (OECD, 2015). The enhancement of smart cities will force companies to implement new distribution strategies and find alternative transportation modes for urban centres to respond faster to changes in consumer demand (Öberg and Graham, 2016).

Further to the above megatrends, consumption pattern will change due to various trends such as middle-class explosion, on-line shopping. For example, rising incomes and increasing urbanisation change the dietary needs e.g. cereals account for 37% of the total caloric intake in developed countries while they provide 71% of caloric intake in less developed (OECD–FAO, 2017). Moreover, healthy eating is considering an important aspect that change the patterns of consumption especially for nearly half (47%) of millennials ( 18-34 age-group) who over the past year changed their eating habits towards a healthier diet, as compared to just 23% of those aged over 55 (PwC, 2016).

According to Nielsen (2016), 62% of customers will buy more and/or more often when they receive a personalised retail. Human Centred design companies can offer their product and services that meet in a better way users’ evolving needs. Moreover, the customisation of the products and services will become an added value, while technologies such as 3D printing will enable customers to involve directly in the design phase (Kudus et al., 2016). Thus, new business models and flexible manufacturing systems capable of producing will be introduced (UNIDO, 2016, p.17). These models have to consider increasing the social media engagement e.g. 68% of millennials will buy specific products or services based on friends’ social media (Emarketer, 2014). Moreover the demand for high-qualification jobs will increase; for example, in the manufacturing sector, it is projected that by 2025 the number of jobs requiring high-level qualifications will increase by 1.6 million (21%) whereas in the automation of production processes the number of low-and medium-skilled jobs will decrease by over 2.8 million (Schröcker, 2017).

**Technological dimension**

The main megatrends within this dimension are *digital transformation, technology development and automatization, transport electrification and renewable energy sources*. Digital transformation is driving companies to rethink what customers value most in order to create operating models which could achieve competitive advantages. Some of the digital technologies with higher impact in supply chain are artificial intelligence, big data analytics, blockchain, internet of things and cloud-based computer systems. Regarding the first two technologies mentioned above, the direct and indirect application of artificial intelligence will generate a revenue of more than $36 billion by 2025 (Tractica, 2016) while it is expected that banking, discrete manufacturing and process manufacturing companies will invest approximately $15 billion in big data analytics in 2020 (IDC, 2017). Regarding blockchain, it is expected that 36% of financial services firms will make substantial investments in blockchain in the next three years (Harvey, 2017). Blockchain can be used in supply chains for ease paperwork processing in ocean freight, identification of counterfeit products, and origin tracking (Hackius and Petersen, 2017). Moreover, the use of augment reality will increase and it is expected to be used in manufacturing for projecting assembly instructions, picking optimization, facility planning, etc. (Merlinoa and Sproģeb, 2017). Concerning, internet of things and cloud-based computer systems, it is expected that Internet of Things will provide the connection of approximately 20 billion of devices in 2020 while it is expected the worldwide spending on public cloud computing will be $162 billion in 2020 (IDC, 2017).

Regarding the megatrend technology development and automatization, the use of robots in factories and cyber physical systems will affect manufacturing companies in terms of production systems (Leitao et al., 2015). Additive manufacturing is also useful for prototyping and product development, create innovation (Columbus, 2015), producing after-market parts or products (PwC, 2016) and reduce design-to-manufacturing cycle times (Boon and van Wee, 2017). Moreover, the annual growth rate of drones is expected to be 19% until 2020 (Business insider, 2016).The main use will be in infrastructure, transportation industry and agriculture (PwC, 2017) and it will be used mainly for internal delivery, tracking inventory and in order to minimise the traffic in the roads (DHL, 2014). Automated vehicles will impact logistics and it is projected that $500 millions of it will be in use worldwide until 2025 (KPMG, 2015). Transport electrification is another megatrend that is influenced by regulations regarding emissions and fuel efficiency. The main impacts on supply chain and logistics industries will be the use of battery electric vehicles, hydrogen fuel cell electric vehicles and hybrid vehicles. It is expected that 1 in 12 cars sold in Japan, California, South Korea and Germany would be powered by hydrogen by 2030 (Hydrogen Council, 2017). Last, renewable energy sources as a megatrend has several impacts on supply chain and logistics industries, such as the production and storage of clean energy and the application to transportation and other industries (e.g. companies such as Apple aim to procure 100% of their electricity from renewable sources to minimise emissions from supply chain operations) (Apple, 2018).

**Legal dimension**

*Consumer protection laws, intellectual property law and social and environmental regulations* are megatrends emerged under the legal dimension. As for the consumer protection laws, the policies tend to provide customers the right to return products free of charge or under warranty while companies also have to recall their products in case of problems towards customer’s safety influencing the return process of supply chain. In addition, privacy topics gain increasing importance (e.g. new EU privacy regulations) with the expanding amount of regular Internet shoppers (European Commission, 2016). Regarding the second megatrend, intellectual property law, along with the exchange of data, companies and private entities fear security risks and loss of control when exchanging data (PwC, 2016b). To create clarity, data sovereignty concepts need to be established. Similar concepts are required for the protection of intellectual property with fast evolving technologies. There is a trend towards the establishment of patents granting exclusive rights to promote utility objects and innovative processes for a limited period (Menell et al., 2017). Last, the megatrend social and environmental regulations, is related to corporate social responsibility that. Those legal settings influence the supply chain especially in terms of data management, but also regarding process and product settings. For example, the vehicle electrification market is driven by stringent emission and fuel efficiency regulations across the globe.

**Environmental dimension**

Climate change and resource scarcity are the megatrends emerged under the environmental dimension. Regarding climate change, supply chain emissions are being targeted by many multinationals such as Walmart. The US retailing giant has recently launched a program to reduce the CO2 emissions from its Chinese suppliers by 50 million tonnes by 2030 (Reuters, 2018). Furthermore, increasing CO2 levels are linked to atmospheric changes which lead to accidents, cancelation and delays and thus impact the supply chain network. Resource scarcity, the second megatrend, is influenced by the global population, and the increasing demand for resources from consumers (Balatsky et al., 2015). For example, land scarcity rises in densely populated cities. In the logistics industry, solutions are focused on maximising land productivity with e.g. the construction of an innovative logistics hub such as in Singapore. This hub will be completed in 2019 and it will integrate a multi-level inland container depot, warehouses and a heavy vehicle park (Mizar, 2016).

Apart from land scarcity, rare earth elements scarcity is a crucial issue in the manufacturing supply chains. Rare earth elements are used in high technology-based products for different sectors, e.g. medical, defence, clean energy. The EU is self-sufficient in construction minerals. However, China dominates the market of these elements (35 % of global supply) (Zhou et al., 2017), also affecting the availability, supply and prices, due to the implementation of tax and export quotas (Humphries, 2003). Water scarcity also is a high risk especially for some regions such as India or Europe where some countries face sporadic or local water stress e.g. Cyprus, Belgium, Spain and Malta (Morrison et al., 2009; Roland Berger, 2016; Walsh et al., 2015). Companies especially the ones that use water as a primary ingredient in their productions plants faced disruptions e.g. Coca-Cola has been forced to shut down factories in India due to social forces that support that Coca-Cola used water resources from the community to feed its own plants and destroyed the local agriculture industry (Chilkoti, 2014).

**Conclusions**

Based on a systematic literature review and an expert’s workshop, 22 megatrends and 66 related trends were identified. These megatrends and trends are critical for the generation of future industrial scenarios. The main contribution of this literature review is that it brings together not only scientific publications, but also sectoral studies, governmental reports. Further insights on the megatrends/trends have been collected and merged within an interactive session. Future research can formulate scenarios of the possible evolution and implications of the identified megatrends/trends on future supply chains. In fact, this study gives a glimpse into the opportunities and challenges that supply chain managers may face in the future. It provides an opportunity to prepare and respond to a broad range of potential disruptions in the future and to create more resilient supply chains. Future research can consider other megatrends/trends given the dynamic, complex and fast evolving nature of modern supply chains.

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