FROM HORIZONTAL COLLABORATION TO THE PHYSICAL INTERNET – A CASE STUDY FROM AUSTRIA

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ABSTRACT

The growing global flow of goods, the increasing problem of traffic congestion and the inefficiencies associated with distribution and logistics or the discerning consumers' high standards for products and delivery services lead to new logistical requirements, for which the model of the 'Physical Internet' has emerged as a probable solution. Physical Internet is a novel concept that transforms how physical objects are designed, manufactured and distributed aiming for a radical sustainability improvement. The implementation of the Physical Internet leads to the need to rethink some basic concepts of logistics such as the shift from private supply networks to open supply networks. Therefore, increased collaboration and coordination is necessary. In order to make a productive contribution to the first steps towards the Physical Internet in Austria, this article focuses on the need for horizontal collaborations, which are required to realize the Physical Internet. Moreover, the study explores the views, experiences, beliefs and motivations of transport service providers in Austria in the context of horizontal collaborations and the Physical Internet. A literature research was carried out in a first step. Afterwards interviews with forwarding agencies and logistics service providers were conducted. Findings highlight that barriers such as the fear of antitrust fines or the high administrative input have to be removed to enable close vertical and horizontal collaboration among different logistics companies in Europe, as the vision of the Physical Internet is encouraging a smooth transition from independent supply chains to open global supply networks. The implementation of a Physical Internet in its full expression could probably take decades, but individual elements of it, such as horizontal and vertical cooperation, are a first step towards this vision. Important components of the implementation process are awareness raising and information sharing.

Keywords: horizontal collaboration, logistics services, Physical Internet.

1 INTRODUCTION

Logistics activities accelerate economic growth and productivity growth. Efficient logistics is an important determinant of a country's competitiveness and source of employment (Erkan [1]). However, the logistics and transportation sector does have many negative impacts on the economy, the environment and the society such as noise and pollution, which need to be minimized for a sustainable future (Montreuil [2]). For a long time now, freight carriers have been lone fighters in logistics. They operate enormous distribution centres solely for their own purpose and have their own fleet of transport vehicles and their own distribution system. This individuality of the logistics industry is the reason why, despite efforts to the contrary, the system is relatively inflexible, inefficient and at last not very environmentally friendly (Landschützer [3]). Due to these logistics practices, a certain degree of empty running is an unavoidable part of road haulage. In 2012, almost a quarter (23.2%) of all vehicle-km of heavy goods vehicles in the European Union (EU) involved an empty vehicle, with undesirable effects on fuel consumption, high CO_2 emissions and avoidable costs. Furthermore, it can be expected that partially loaded vehicles are also common, although there is no reliable

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statistical evidence (European Commission [4]). Uniform standards are missing in the sector (e.g. for the communication between shippers) and many warehouses are often non-utilized according to the dimension of the annual peak load (Ballot et al. [5]). All these issues lead to significant inefficiencies. In addition, there are constantly new challenges. In view of globally allocated production sites and the dismantling of trade barriers, internationalization will shape the value-creation network of the future (Straube et al. [6]). These global mobility systems also entail increased complexity and higher susceptibility (Lehmacher [7]). The digitization of the global flow of goods requires entirely new processes and new ways of thinking from logistics service providers and their clients. New technologies such as cloud computing, data analyses or social media increasingly influence the business models of logistics companies. For example, e-commerce has changed the shopping habits of consumers substantially in recent decades and leads to new requirements for logistics services. Delivery reliability, short delivery times and high availability of goods are expected (Bauer and Fischer [8]). At the same time, cost pressure increases and thus the requirement for efficient processes in procurement, production and distribution (Färbinger [9]). Moreover, freight transport activity is projected to increase, with respect to 2005, by around 40% in 2030 and by little over 80% by 2050 (European Commission [10]). In order to address all these issues, it is essential to change the fundamentals of logistics and supply chain management. Academics and logistics professionals are looking to the distributed, collaborative, laterally scaled internet communication system, with its open-system architecture and commons-style management, as a model for radically transforming global logistics (McKinnon et al. [11]). The notion of the Physical Internet was first introduced by Benoit Montreuil and defined as an open, global logistics system founded on physical, digital and operational interconnectivity through encapsulation, interfaces and protocols, aiming to move, store, realize, supply and use physical objects throughout the world in a manner that is economically, environmentally and socially efficient and sustainable (Montreuil [12]). The Physical Internet is a hyperconnected global logistics system, enabling seamless asset sharing and flow consolidation (Zijm et al. [13]). Although it is a compelling vision for the future, there is a range of reasons why the Physical Internet cannot be deployed today. A number of research questions and business issues are unresolved. In order to make a productive contribution to the first steps towards the Physical Internet in Austria, this article focuses on the need for horizontal collaborations, which are required to realize the Physical Internet. According to Cruijssen ([14], p. 187) horizontal collaboration is defined as 'active collaboration between two or more firms that operate on the same level of the supply chain and perform a comparable logistics function on the landside' in this article. Moreover, the study explores the views, experiences, beliefs and motivations of transport service providers in Austria in the context of horizontal collaborations and the Physical Internet.

2 METHODS

First a literature research was conducted to represent background and research developments related to the Physical Internet and horizontal collaborations. With this background knowledge, a qualitative semi-structured interview guideline was developed. The approach of semi-structured interviews was used to clearly define the areas which are to be explored, and at the same time to allow the interviewer or interviewee to diverge in order to pursue an idea or response in more detail (Gill et al. [15]).

The guideline was clustered in three sections: (1) Physical Internet and digitalization, (2) collaborations and neutral platforms and (3) future challenges.

The interviews were conducted with 16 transport service providers in the region of Upper Austria to explore the views, experiences, beliefs and motivations of the participants in the

context of the Physical Internet and horizontal collaborations. It has also been determined if there is any willingness in the companies to collaborate horizontally. The interviews were recorded and transcribed. Afterwards the transcripts were analysed and summarized according to Mayring [16].

3 RESULTS AND DISCUSSION

3.1 Physical Internet and digitalization

Montreuil [2] described the Physical Internet vision through thirteen key characteristics. One of them is the Open Global Supply Web, which is described as 'networks of interrelated supply networks, each embedding interlaced supply chains, involving multiple organizations with collaborative or competitive relationships' (Montreuil [2, p. 15]). This Open Global Supply Web is currently only a vision. Given the current logistics organization, producers, distributors and retailers mostly rely on private supply chains, constituted of the production and distribution centres of their enterprise and those of their partner (Montreuil [2]). Therefore, a shift from private supply networks to open supply networks is necessary. A first step is a shared supply web, where resources are available for exploitation in each partnering companies' supply network (Sohrabi and Montreuil [17]).

The European Technology Platform (ETP) ALICE (Alliance for Logistics Innovation through Collaboration in Europe) was established to develop a targeted and comprehensive strategy for research, innovation and market introduction of logistics and supply chain management innovation in Europe. The platform clearly states that future research should focus on new concepts in which increased collaboration and coordination may result in the Physical Internet, where complete horizontal and vertical supply chain collaboration takes place (McKinnon et al. [11], ALICE [18]).

Making the Physical Internet a reality will be a huge challenge, but research is already underway to explore how this might be achieved since the vision receives increased attention. Researchers must work closely with managers in logistics and related functions to keep their work practical, realistic and relevant (Lu and De Bock [19]). Part of this research study was to detect the level of awareness of the Physical Internet among Austrian logistics service providers. Six out of 16 companies were familiar with the term Physical Internet and were also able to define it. Broadly speaking, they see a future vision in which the goods find their own way from A to B. Six interviewees have known the term, but couldn't explain it and in four cases the Physical Internet vision was completely unknown. In order to accelerate the game-change to Physical Internet, broad awareness rising within the companies should be realized as well as consensus building between key industry players and research should be promoted (ALICE [20]).

Also the increasingly rapid digitization and technological innovations, like smart tags, are supporting the potential implementation of the Physical Internet. Smart tags are defined as an element of the Internet of Things (Montreuil [12]), referring to the networked interconnection of everyday objects, which are often equipped with ubiquitous intelligence (Xia et al. [21]). As the Physical Internet is to exploit as best as possible the Internet of Things (Montreuil [12]), the respondents were also asked for future challenges of the companies concerning digitization. The majority of companies consider the external digitization, meaning the interfaces with customers, as the greatest challenge, but also data processing and standard data exchange were frequently mentioned. Further challenges, which were rarely suggested, pertain to the retention of flexibility, the capital expenditure, the scope of interconnection

without interface rupture, the changes in professional profiles and the need to always have state-of-the-art technology. The literature indicates that technical and technological prerequisites exist (Franklin [22]) and further improvements will facilitate the sharing of loads and the allocation of costs making asset sharing an attractive option. Therefore, logistics companies should seize the opportunities of the sharing economy to avoid losing the connection to the new networked economy. Acting flexibly within digital network structures will advance to become a key success pattern in logistics. Ultimately, every business area is being driven by megatrends like digitalization and will someday become part of the sharing or collaborative economy in the future (Simmet [23]). But until then, many challenges need to be overcome such as the macro-economic perspective vs. the individual perspective of companies, the high investments vs. the low profitability of many logistics providers, the willingness for data sharing or the technology readiness of logistics businesses (Franklin [24]).

3.2 Collaborations and neutral platforms

Horizontal collaborations were a major part within the interviews. Three companies have absolutely no experience and four companies have little or limited experience with horizontal collaborations. Two interviewees already are members of cooperation such as CargoLine, Systempo or Cargo Trans Logistic. The remaining companies stated that they have experience with many partnerships, although it should be noted that most of them collaborate with partners if they are not able to fulfil the requirements in regard of service or geographical coverage. Cooperation with competitors (which operate exactly in the same business field and in the same region) is inconceivable. This is reflected also partially in the mentioned reasons for establishing and maintaining a good cooperation. It was repeatedly said that partnership works well if there is a regional segmentation, if the participants complement each other in various sectors and if there is a very clear distinction between the core competencies of partners. The survey also revealed that the key drivers for collaboration are serving larger customers, requirements of customers and benefits for both companies. In cooperation the companies attach importance to mutual appreciation, clear rules and common goals. Negative experiences were made with missing corporate culture, envy, lack of confidence, antitrust fines and the high administrative input. Nevertheless, a first step to horizontal collaboration could be the opening of warehouses. The start-up Flexe for example allows on-demand warehousing possible by connecting organizations in need of additional space to other organizations with extra space. For this purpose, Flexe uses a web-based platform that serves as an online marketplace, finding space to fit customers' needs from 200 warehouses across most major U.S. markets, and taking a piece of each transaction (Flexe [25]).

As in the Physical Internet the role of warehouses and distribution centres will change to open hubs, which receive and cross-dock containers from other companies just such as a port (Trebilcock [26]), the interviewees were asked whether they could imagine opening their infrastructure for other service providers.

Seven companies clearly answered this question with yes, four respondents clearly with no. Those who could not imagine sharing their infrastructure commented that infrastructure is a competitive advantage which simply must not be shared. For two companies it is conceivable as long as they have the possibility to cooperate with certain partners and for another three this would only work if the infrastructure would be operated by a neutral/independent partner, who is not at all or only little involved in the industry. Concerns were also expressed about city logistics, liability and economic problems of a neutral-run infrastructure. The need for a neutral trustee in a well-designed horizontal collaboration to avoid anti-trust and

establish a sustainable collaboration between the parties was also a final key message of the CO3 (Collaboration Concepts for Co-modality) project (Cruijssen [27]) and of the study from Rodrigues et al. [28].

Thus the question if a sharing of infrastructure, such as a neutral warehouse or a neutral distribution centre, with other logistics service providers is imaginable is important and was answered by six companies with a no. Two respondents did not give an opinion and eight relied with a yes. Though these enterprises find it important that the warehouse or the distribution centre is 100% neutral and independent, there are clear and fair prices and invoice settlements and that liability in the event of damage have been settled. Hence a fair gain sharing mechanism is also considered in the literature as essential (Cruijssen [27], Rodrigues et al. [28], McKinley [29]).

As collaborative approaches lead to a more open sharing of data between supply chain partners, security and privacy protection issues also attract progressively more attention (ALICE [30], Zeng et al. [31], Hong et al. [32]).

Therefore the participants were questioned on security issues in terms of data and information flows relating to shared infrastructure. Seven of the companies surveyed reported that they don't have any concerns thereto. For three, it is absolutely inconceivable because data must remain 'in house'. Similarly, a very high standard is essential for three companies. In addition it has been mentioned that data security must be guaranteed, but as one has to put the data at the labouring people's disposal data protection is difficult. Concerns were also expressed relating to a breakdown of the server in a networking system and with the compliance of standards among the involved partners with the many and rapid latest developments.

3.3 Future challenges

The challenges to realize future-proof logistics are very diverse and consist, for example, in the better utilization of storage facilities and transportation and associated cost and CO_2 reduction, an increase in the complexity of logistics processes, recruitment of qualified staff, higher process transparency and better integration of the freight forwarder in the process of sales and demand planning of the producers (Straube et al. [6], Lehmacher [7], Färbinger [9]). Keywords like Big Data, Internet of Things, 3D printing or industry 4.0 have become part of the everyday language in logistics. All providers need to deal with these trends to have a chance of surviving on the future market. A paradigm shift from process to service is necessary in order to offer new products and services to customers and to assist in the transformation of its evolving business model. Of course, the same applies for logistics companies, which have to rethink their role in the value chain. Future business models will need to adapt to the trend of digitization in order to remain present on the market (Wolleb and Leuters [33]).

It is no longer sufficient just to map one's own processes in real time. Looking at the logistics service provider in the context of a value-added system that meets the criteria of real-time capability, automation and adaptability, more requirements have to be considered (Voß [34]). Increasingly reliant is the integration of the freight forwarder in the producers' process of sales and operations planning in a way that capacities can be planned early and deviations are addressed proactively. Future business models of forwarders are defined by customer needs, the forwarders' own goals as well as the setting, which is characterized by complexity, integration, cooperation, digitization and sustainability (Wolleb and Leuters [33]). On that score the interviewees were also asked how transport and logistics companies will look in the future and what position logistics might have in the future supply chain.

Numerous interviewees pointed out that the specialization, respectively the positioning in niches for small and medium-sized companies, is an important factor. Some also have called that the significance of transport logistics providers and forwarders will grow. Other issues that were named include as follows: (1) in the next ten years nothing will change for carriers, because driverless driving will not come that soon, (2) the traditional, existing logistician image will not alter, there will only be a further development, (3) the occupational profile of dispatches could disappear, (4) value added services will receive even more importance, (5) humans will recede into the background, but hopefully only for activates which in the long term lead to health problems, (6) the use of drones will increase, (7) cooperation will become increasingly important for small and medium-sized companies, (8) customers have to involve logistics service providers and shippers to a greater extent in their planning, (9) logistics costs will increase and (10) the most successful logistics companies will be almost information technology companies.

4 CONCLUSION AND OUTLOOK

This article focuses on the need for horizontal collaborations required for the Physical Internet and to meet future logistics challenges successfully. Moreover the study explores the views, experiences, beliefs and motivations of transport service providers in Austria in the context of horizontal collaborations and the Physical Internet, to make a productive contribution to the first steps towards the Physical Internet in Austria.

The implementation of a Physical Internet in its full expression could probably take decades, but individual elements of it, such as horizontal and vertical cooperation, are a first step towards this vision. The progressive digitization and the increased networking activities have great potential for cross-business collaboration. The motivation of the partners to invest resources in collaboration depends on the benefits each partner sees for himself in the cooperation. The supplement of the own competencies, the expansion of the service portfolio and/or cost savings may be such advantages. Crucial factors for successful collaboration are trust between the actors, setting of precise conditions and shareable IT structures. Since the collection and exchange of large amounts of data and information, of which some are competitive sensitive, working together with a neutral intermediary or with a neutral cooperation centre makes sense. The legality of cooperation is sometimes very difficult to assess and often associated with a high risk. A clear EU-wide antitrust regulation would be desirable and useful to further support the implementation of future cooperation. Moreover, awareness in the companies should be raised, the benefits of cooperation demonstrated and the companies supported in cooperation, because collaboration between actors will have to be further intensified in order to develop consistent and impactful solutions towards a Physical Internet. A factor of increasing importance is the integration of freight forwarders in the producers' process of sales and operations planning so that capacities can be planned early and deviations are addressed proactively. Innovative solutions and the integration of logistics providers in the entire value-added system require suitable interfaces between partners and their information technology systems. Due to the increasing networking a cross-business joint optimization of processes and workflows takes place. Logisticians operate within a networked world in which not only goods but also information and knowledge find their way – increasingly self-controlled. The challenges for logistics service providers are to become aware of the new opportunities and participate in current developments. Logistics need to be even more adaptable, more individual, faster and mainly fully integrated within the production process. The networking of all system participants is essential and research will become

more important. Since the basic logistics processes will probably be fully automated in the future, logisticians will need to focus on that aspect even closer than before, taking advantage of highly innovative technologies. To accelerate the game-change to Physical Internet, broad awareness rising within the companies should be realized and debate and consensus building between key industry players and research should be promoted. Joining forces between different industries in the value chain and academia to design a Physical Internet model region in Austria is a worthwhile focus for future research.

REFERENCES

[1] Erkan, B., The importance and determinants of logistics performance of selected countries. *Journal of Emerging Issues in Economics, Finance and Banking,* **3**, pp. 1237–1254, 2014.

[2] Montreuil, B., Toward a Physical Internet: meeting the global logistics sustainability grand challenge. *Logistics Research,* **3**, pp. 71–87, 2011. DOI: 10.1007/s12159-011-0045-x.

[3] Landschützer, C., Effiziente Güterströme: Das World Wide Web als Vorbild der Logistik, available at http://presse.tugraz.at/pressemitteilungen/2014/24.02.2014.htm (accessed 17 June 2015).

[4] European Commission, COM/2014/0222: Report from the Commission to the European Parliament and the Council on the State of the Union Road Transport Market, Brussels.

[5] Ballot, E., Montreuil, B. & Meller, R.D., *The Physical Internet: The Network of Logistics Networks,* La Documentation Française: Paris, 205pp., 2014.

[6] Straube, F., Scholz-Reiter, B. & Hompel, M.t., *Voruntersuchung: Logistik im produzierenden Gewerbe. Abschlussbericht,* Druckerei Wagner: Großschirma OT Siebenlehn, Germany, 52pp., 2008.

[7] Lehmacher, W., *Wie Logistik unser Leben prägt: Der Wertbeitrag logistischer Lösungen für Wirtschaft und Gesellschaft,* Gabler Verlag: Wiesbaden, Germany, 222pp., 2013.

[8] Bauer, I. & Fischer, D., *Transportation & Logistik Kompass – Transporteure und Logistiker im digitalen Zeitalter,* PricewaterhouseCoopers: Germany, pp. 1–12, 2014.

[9] Färbinger, P.M., Am laufenden Band. *E-3*, pp. 61–63, 2014.

[10] European Commission, MEMO/11/197: Transport 2050: The major challenges, the key measures, Brussels.

[11] McKinnon, A., Browne, M., Whiteing, A. & Piecyk, M., *Green Logistics: Improving the Environmental Sustainability of Logistics,* Kogan Page: London, 426pp., 2015.

[12] Montreuil, B., *Transforming the Way Physical Objects Are Moved, Stored, Realized, Supplied and Used, Aiming Towards Greater Efficiency and Sustainability. Physical Internet Manifesto*. Laval University, Quebec, Canada, version 1.11.1, 2012.

[13] Zijm, H., Klumpp, M., Clausen, U. & Hompel, M.t., *Logistics and Supply Chain Innovation: Bridging the Gap between Theory and Practice,* Springer International Publishing: Switzerland, 431pp., 2016.

[14] Cruijssen, F., *Horizontal Cooperation in Transport and Logistic*. Tilburg: CentER, Center for Economic Research, 2006.

[15] Gill, P., Stewart, K., Treasure, E. & Chadwick, B., Methods of data collection in qualitative research: interviews and focus groups. *British Dental Journal,* **204**, pp. 291–295, 2008. DOI: 10.1038/bdj.2008.192.

[16] Mayring, P., *Einführung in die qualitative Sozialforschung,* 5th ed., Beltz Verlag: Weinheim und Basel, 170pp., 2002.

[17] Sohrabi, H. & Montreuil, B., From private supply networks and shared supply webs to Physical Internet enabled open supply webs. *IFIP Advances in Information and Communication Technology,* **362**, pp. 235–244, 2011. DOI: 10.1007/978-3-642-23330-2_26.
[18] ALICE (Alliance for Logistics Innovation through Collaboration in Europe), ETP-Alice, available at http://www.etp-logistics.eu/ (accessed 16 September 2015).
[19] Lu, M. & De Bock, J., *Sustainable Logistics and Supply Chain: Innovations and Integral Approaches,* Springer International Publishing: Switzerland, 185pp., 2016.
[20] ALICE (Alliance for Logistics Innovation through Collaboration in Europe), ALICE Recommendations to H2020 Work Programs 2016–2017, December 2014, http://www.etp-logistics.eu/wp-content/uploads/2015/07/ALICE-Recomendations-HORIZON2020-WP-2016-2017-v141218_DEF-2.pdf (accessed 16 September 2015).
[21] Xia, F., Yang, L.T., Wang, L. & Vinel A., Internet of things. *International Journal of Communication Systems,* **25**, pp. 1101–1102, 2012. DOI: 10.1002/dac.2417.
[22] Franklin, R., Revolution in the global logistics sector – the Physical Internet, available at https://www.the-klu.org/news-events/news/singleview/article/revolution-in-the-global-logistics-sector-the-physical-internet/ (accessed 25 August 2015).
[23] Simmet, H., Sharing economy: Ein neuer Trend in der Logistik, available at http://hsimmet.com/2015/08/23/sharing-economy-ein-neuer-trend-in-der-logistik/ (accessed 16 December 2015).
[24] Franklin, R., Personal communication, 02 February 2016, Dean of Programs and Adjunct Professor of Logistics, Kühne Logistics University, Hamburg.
[25] Flexe, Flexe connects you to warehouse capacity when, where, and how you need it, available at https://www.flexe.com/ (accessed 27 January 2016).
[26] Trebilcock, B., Physical Internet initiative: pipedream or possibility. *Modern Materials Handling,* **67**, pp. 22–29, 2012.
[27] Cruijssen, F., CO³ position paper: framework for collaboration, available at http://www.co3-project.eu/wo3/wp-content/uploads/2011/12/CO3-D-2-1-Framework-for-collaboration-full-report-2.pdf (accessed 7 October 2015).
[28] Rodrigues, V.S., Harris, I. & Mason R., Horizontal logistics collaboration for enhanced supply chain performance: an international retail perspective. *Supply Chain Management: An International Journal,* **20**, pp. 631–647, 2015.
[29] McKinley, M., North American Horizontal Collaboration in the Supply Chain, available at http://faculty.ineg.uark.edu/rmeller/web/CELDi-PI/NAHCSC-2011.pdf (accessed 13 August 2015).
[30] ALICE (Alliance for Logistics Innovation through Collaboration in Europe), Information Systems for Interconnected Logistics, available at http://www.etp-logistics.eu/wp-content/uploads/2015/08/W36mayo-kopie.pdf (accessed 7 September 2015).
[31] Zeng, Y., Wang, L., Deng, X., Cao, X. & Khundker, N., Secure collaboration in global design and supply chain environment: problem analysis and literature review. *Computers in Industry,* **63**, pp. 545–556, 2012. DOI: 10.1016/j.compind.2012.05.001.
[32] Hong, Y., Vaidya, J. & Wang, S., A survey of privacy-aware supply chain collaboration: from theory to applications. *Journal of Information Systems*, **28**, pp. 243–268, 2014. DOI: 10.2308/isys-50692.
[33] Wolleb, C. & Leuters, C., Neue Rolle für die Logistikdienstleister, available at https://www.kpmg.com/CH/de/Library/KPMG-in-the-Media/Documents/ch-pa-20150827-hz-neue-rolle-fuer-logistikdienstleister-de.pdf (accessed 15 December 2015).
[34] Voß, P.H., *Logistik - eine Industrie, die (sich) bewegt. Strategien und Lösungen entlang der Supply Chain 4.0*, Springer Fachmedien: Wiesbaden, 229pp., 2015.