Development of Synchromodal Logistics Based on Modern Technologies

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Abstract As supply chain management is becoming demand driven, logistics service providers need to use real-time information efficiently and integrate new technologies into their business. Synchromodal logistics has emerged recently to improve flexibility in supply chains, cooperation among stakeholders, and utilization of resources. We survey the existing scientific literature and real-life developments on synchromodality. We focus on the critical success factors of synchromodality and six categories of enabling technologies. We identify open research issues and propose the introduction of a new stakeholder, which takes on the role of orchestrator.

Keywords Synchromodality · Logistics service providers · ICT/ITS technologies · Fifth-party logistics · Integration platform · Implementation strategy of digital market · Advertising

1 Introduction

As supply chain management becomes more demand-driven, logistics service providers must effectively use real-time information and integrate new technologies into their business. Synchromodal logistics has recently been introduced to improve

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flexibility in supply chains, collaboration between stakeholders, and resource utilization. We study the existing scientific literature and real developments on synchromodality. Moreover, the shape of the product itself changes, i.e., the product itself changes. The physical nature of goods, services, and information produced by the company to create consumer value. Information and communication technologies permeate the entire value chain at each link, changing the way activities are performed and the links between them. Customers' needs are more fully met, products are given a new look or shape, and the scale of competition changes. Based on these key points, it becomes clear why information technologies are of such strategic importance and how they differ from other technologies used in business. With the development and spread of information technologies and systems, consumers have gained access to databases of available goods and services, and the ability and right to choose the best of them. Internet technologies create new sources of value and shareholder value [1].

Value chains are disintegrating and industries are being reformed. The number of specialized firms is growing. There are positive changes in product distribution channels. New intermediaries are created and old ones are eliminated. Additional value for consumers is provided by the fact that working through the Internet allows customers to receive goods and services adapted to their individual requirements. It becomes possible for consumers to order technical devices, systems, and software products. A special feature of the digital revolution is that not only content but also processes are being translated into digital form. In particular, digital marketing processes are being actively implemented. For example, this is marketing research using Internet technologies and big data Analytics; managing customer relationships through. One of the biggest changes in human interaction is the recent proliferation of social networks. The rapid growth of web platforms that facilitate social behavior on the Internet has significantly changed the nature of human activity, habitat, and interaction [2].

Real social relationships were transferred to the virtual world, which led to the creation of online communities that bring together people from all over the world. This movement into the digital dimension allows people to share knowledge, entertain each other, and foster dialogue between different cultures [3].

The peculiarity of such advertising is that half of the cost of a click is taken by the advertising network, and the second part of the cost of a click is received by the webmaster-the Creator of the site where the ads are broadcast. These ads can be similar in subject matter (close to the page context), or different from it. This feature of setting up an ad campaign is called "behavioral targeting". If it is disabled, the site will only display ads that match its content. We focus on critical success factors of synchromodality and six categories of enabling technologies. We identify open research problems and suggest introducing a new stakeholder who takes on the role of an organizer to coordinate and deliver services through the technology platform [4].

2 Literature Review

Synchromodality is an evolving and attractive concept in logistics that has been developed and implemented in the Benelux region over the past decade. The main goal of synchromodality is to reduce costs, emissions, and delivery times while maintaining the quality of supply chain service through rational use of available resources and synchronization of transport flows. The implementation of the synchromodality concept and some research projects based on this practice have already shown how various types of logistics tasks can be achieved or significantly improved, including avoiding empty capacity, responding to failures, and reducing freight transport in favor of Railways, ships, and barges [5].

However, modern literature lacks a clear, complete, and generally accepted definition of synchromodal logistics and its features. By our definition, synchromodality is the provision of efficient, reliable, flexible and sustainable services through coordination and collaboration of stakeholders and synchronization of operations within one or more supply chains managed by information and communication technologies (ICT) and intelligent transport system (its) technologies [6].

"Logistics companies should become partners for the client, stay ahead of trends and offer innovative solutions. Simply lowering rates by reducing margins is not possible, because in addition to increasing customer requirements, the environment in which transport companies operate is also changing," says Alexandra Kotsemba, intermodal transport Manager at Raben Transport.

The characteristics discussed in our definition have not yet been described together, and a common vision for how to use them to support new trends in supply chain management does not yet exist. The purpose of this study is to provide a detailed understanding of this definition, based on a critical review of the existing scientific literature and actual developments in the field of synchromodal logistics. In fact, our analysis goes beyond a simple overview of the state of this transport system.

Agnieszka Pawlowska-Ogrodnik from the waterproofing logistics and customer service Department at Renolit claims that we have been using our offer in the field of intermodal transport for a year now. In terms of traditional offers, this is a very attractive offer, because synchro modular solutions allow us to get real savings. Especially with a large volume of cargo, which we are talking about in our case [7].

According to Ziyadin, after analyzing the GEO for synchromodality at various levels of decision-making, we identify the relevant stakeholders and auxiliary technologies necessary for the implementation of synchromodality in practice. Finally, we provide recommendations for reviewing CSR for each group of enabling technologies (outlining open research issues) and possible synergies achievable on a common platform. Since stakeholders need coordination, we also identify an organizer (fifth-party logistics, 5PL) who can get this role to provide and manage the shared platform [8].

Maddison, A. writes that despite its importance, synchromodality is at an early stage both from a scientific and practical point of view. The existing materials are few and relate only to one or more aspects of the issue. A lot of material can be

found on the Internet, but it is rather disordered. Instead, in our study, we look at the phenomenon of synchromodal logistics through a comprehensive and systematic analysis, ranging from social and business consequences to operational management and enabling technologies. Thanks to the features of our analysis, our work provides insight for both managers involved in logistics operations and management, as well as for companies developing technological solutions or services. In addition, the study is a useful source of information for researchers and practitioners in various fields who are interested in this new logistics paradigm [9].

3 Methodology

For completeness, we will explain the method used in this study. Our goal is to collect, study, and classify existing literature related to synchromodality, clarify the current state, and create a solid Foundation for future research on this topic. We do not compare specific analytical models but discuss existing approaches at different levels. In fact, we analyze the synchromodal logistics paradigm from a broad perspective, while analytical models usually handle specific aspects (for example, operational optimization tasks). The main sources for this work were ransacked in the major academic databases and web resources (e.g., Scopus, Google scholar and research gate) using the selected logistics key words (such as synchromodality, synchromodal, synchro-mechanism, synchro-modal, intermodality, multimodality, 5pl LLC, the Fifth party logistics provider, 4PL, fourth party logistics provider, 3PL, third-party organization, organization of data analysis, data analysis, supply chain, Industry 4.0). In addition, we include online reports on case studies or research projects in order to present real-world synchromodality applications and advances in enabling technologies [10].

3.1 Communication Organization

The supply chain is "the flow of processes for moving goods from the customer's order through the raw material, delivery, production, and distribution stage of products to the customer", and supply chain management is "managing the chain of events in this process". Synchromodality is often associated only with the synchronization of transport modes and thus covers only the relevant supply chain management activities. However, synchromodality has the potential to address multiple supply chain activities in addition to transport. Therefore, in our opinion, synchromodal logistics should be considered in a broader sense, perhaps assuming coordination of all relevant operations in supply chain management [11].

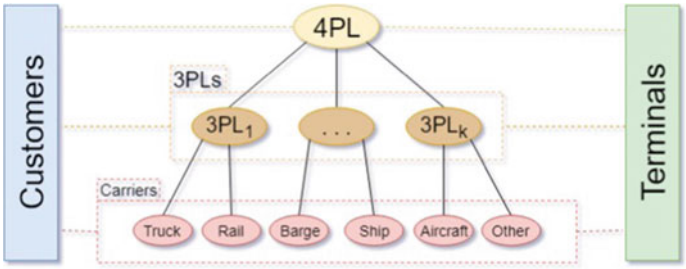

Fig. 1 4PL Logistics services

The context in which synchromodality works is presented in the following subsections. In particular, we represent stakeholders involved in synchromodal logistics, highlighting their current interaction . In addition, we show that such interactions are not well suited to effectively respond to new trends in supply chain management.

Stakeholders and their relationships [12]. The evolution of supply chain management has been gradual, moving from relationships based on simple dyadic relationships to complex multi-factor networks. Currently, participants in the supply chain are linked directly or indirectly, and their relationships are not only related to the physical movement of goods, but also to the exchange of information. When stakeholders build supply chains based on such complex networks, there is a need for a coordinating intermediary to achieve a balance between cooperation and competition. In addition, stakeholders are increasingly aware that their own success is closely linked to the effectiveness of the entire supply chain. For these reasons, modern businesses rely heavily on so-called logistics service providers (LSP), which offer their customers a wide range of services, from simple transport operations to complete supply chain management. In fact, depending on their needs and convenience, companies decide to outsource some activities or the entire logistics of their LSP supply chain [13] (Fig. 1).

It is important to note that the most common types of outsourcing are 3PL services, such as transport, warehousing, and freight forwarding. In contrast, 4PL services are relatively new in the real market, and their advantages are still not recognized by many companies that are often reluctant to give full control of their supply chain to outsiders [14]. However, since Internet service providers often offer different types of services, it is not always possible to accurately classify real companies into one of the previously analyzed categories [15].

The previous description reflects the current situation, but new trends in supply chain management create a need to rethink and redesign the organization and stakeholder engagement [16].

4 Conclusion

In this study, we presented a comprehensive overview of the state of synchromodal logistics. Since there has not yet been an exhaustive definition of synchromodality, we have presented the main features of this paradigm to help other researchers clearly understand the characteristics of synchromodality and use them for further study. In addition, we tried to link the identified CSR of this paradigm with six classes of providing ICT / it technologies. Characteristics, relationships, and future research directions were analyzed for each technology that provides support. In addition, we noted the importance of enhancing synergies between enabling technologies by defining a common technology platform that allows stakeholders to synchronize their activities and simplify their business. We also proposed a new type of LSP (5PL, often discussed in the literature but never clearly defined) that could develop this common platform by taking on the role of a synchromodality Orchestrator [17].

Our definition of synchromodality, given in the introduction, is based on the main characteristics identified in the analysis of this study. Now we motivate our choice. With "efficient, reliable, flexible and sustainable services", we focus on the characteristics that synchromodal services should have, inheriting efficiency and sustainability from previous concepts and implementing reliability and flexibility to provide fault-tolerant services. In the "stakeholder coordination and collaboration" section, we emphasize the importance of collaboration and the need for an organizer (5PL) to coordinate the system. The main feature of synchromodality is laid down in the "synchronization of operations". Note that when using the word operations, we move the focus from syncing only transport operations to possibly syncing all operations that are performed in the supply chain. When we refer to "one or more supply chains", we point out that collaboration can be improved by integrating activities and related information into a broader network. Finally, "driven by ICT/IT technologies" emphasizes the importance of the described technological mechanism for the effective implementation of synchromodal logistics concepts [18].

In conclusion, we argue that synchromodal logistics should be explored in the future by considering all possible assistive technologies related to CSFs. In particular, scientists analyzing each of these technologies should develop studies that confirm the features of the synchromodal paradigm. In addition, integration between technologies within the 5PL common platform is important to increase the benefits of using synchromodality and building a stronger, more reliable, and flexible system. In addition, it is important to examine and define the role of 5PL service providers in the supply chain from various perspectives, such as business management or law. 5PL service providers can be interpreted either as technology solution providers, or as an evolution of 4PL service providers with their businesses largely driven by technology. There are good reasons to use recent or current research projects and case studies of real-world applications of synchromodal logistics as a starting point for implementing synchromodality in a broader context. For example, completed a feasibility study for implementing synchromodality in a developing country (Ghana). However, building a global supply chain based on synchromodality requires additional effort.

In addition, social media offers the potential to create awareness and interest through viral or rapid dissemination of experiences and opinions about products and services. Digital marketing is based on Internet channels with the highest frequency of use, which are dynamic, they can change from year to year and are always influenced by market trends. However, this type of advertising does not work in all business niches and requires special knowledge to get a high return on it [19–21].

If you are new to this topic, a directologist who specializes in contextual advertising will help you set up your ad campaign professionally.

This ad can be used as the only tool to attract customers on the Internet, or by combining it with other types [22, 23].

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