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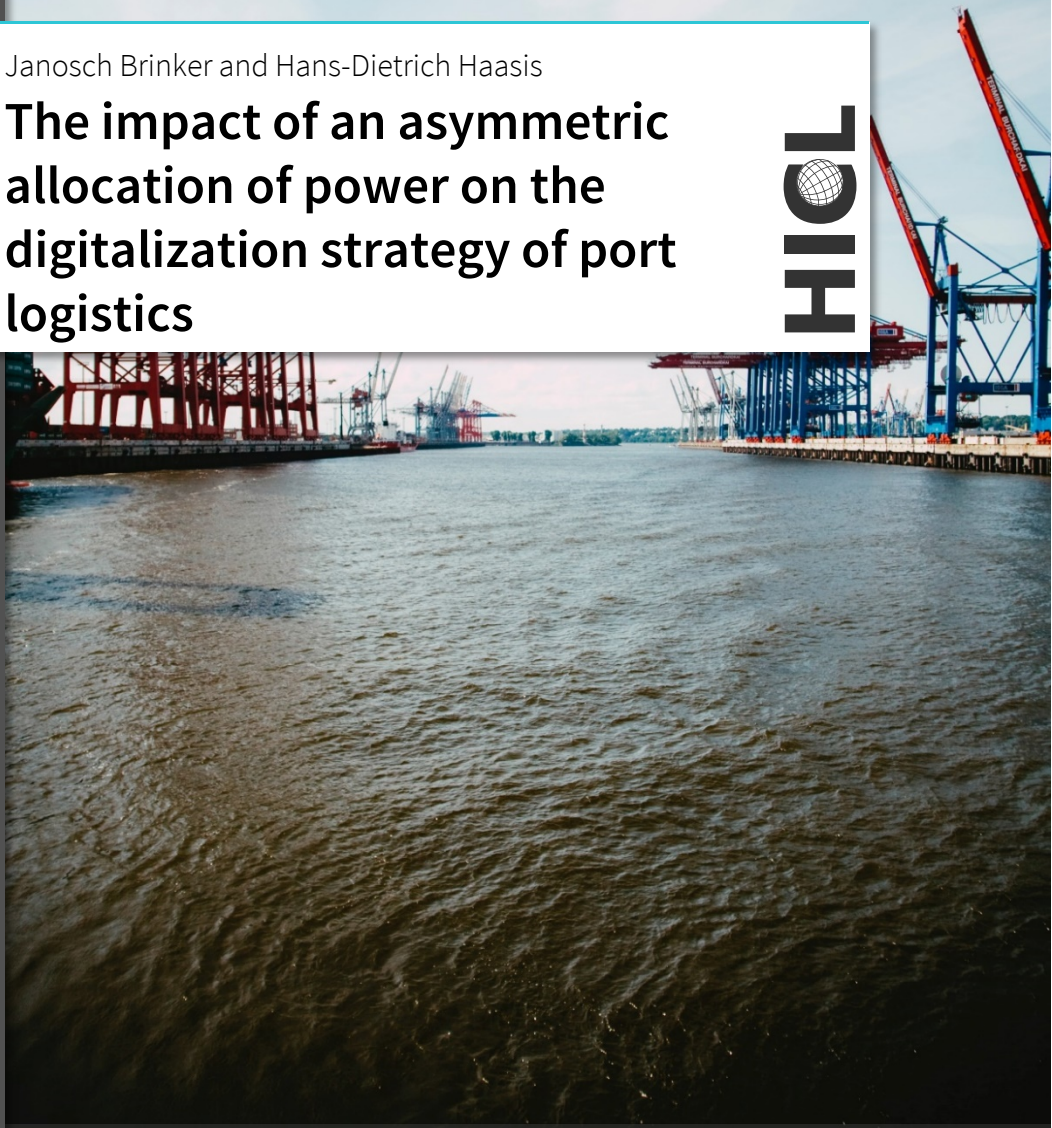

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The impact of an asymmetric allocation of power on the digitalization strategy of port logistics

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Purpose: The objective of this paper is to investigate the impact of the asymmetric allocation of power on the digitalisation strategy in port logistics. To reach this purpose this paper combines the term of asymmetric power to the concept of bargaining power, supply chain leadership theory, and the trends of digitalisation in port logistics**.**

Methodology: A systematic literature review on the asymmetric allocation of power is used to synthesize the current state of the art in this field of research**,** by selecting journals in supply chain management, logistics and operation research. This review establishes a theoretical framework while combining the concept of digitalisation in port logistics and the research about the allocation of power.

Findings: While this paper provides an overview of the research of marketing channels, bargaining power, supply chain leadership theory, and information asymmetry in SCM, it also develops a definition for the asymmetric of power. Linked to the classification of relations within a port, conclusions are drawn about the influence of power on digitization in that port.

Originality: During the last decades the importance of ports has transformed from traditional regional gateways to key-factors in the supply chain and logistics activities. While the influence of globalisation and digitalisation increases, digitalisation becomes one of the central strategic terms for port logistics. Based on these trends the strategic decisions within the port are getting penetratively influenced by the relationships within the supply chain.

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1 Introduction

For in the last decades the port was regarded as a separate hub in the consideration of international supply chains. However, with the increasing globalisation of markets, the importance of the port in the supply chain continues to grow (Zondag et al., 2010; Tseng and Liao, 2015; Keceli et al., 2008). Companies are increasingly recognizing the dependence of their competitiveness on the flow of goods in the port (Lee, 2006; Gao, 2009; Robinson, 2002; Zondag et al., 2010). In 2018 the global container freight traffic exceeded the 11 billion tone mark. The United Nations Conference on Trade and Development expected growth of up to 3.5 percent in the international maritime trade between 2019-2024 (United Nations, 2019). In the European Union, the maritime sector handles up to 90 percent of the freight trades with third countries and up to 30 percent of the intra European Union trade (Mangan, Lalwani and Fynes, 2008). At the same time, the port and the maritime economy are also influenced by the disruptive technological change in information and communication technologies (Balan, 2020; Moshe and Arie, 1986). The logistic sector, in general, will adopt data-driven technologies faster than most other business sectors (Balan, 2020).
As an essential part of global supply chains, the ports have to manage various actors, networks and coordinate the flow of thousands of cargos, information and financial transactions (Heilig and Voß, 2016). More than ever the port is influenced by all activities and organizations within the boundaries of the port: „cargo handling, storage, clearance, ship servicing, etc. and the organizations involved – ship owners, agents, port management, stevedores, customs, transport firms“(Lee, 2006). The digitalisation will be one

of the central enablers for achieving success in the competitive environment of global markets (Heilig, Voß and Lalla-ruiz, 2017; Balan, 2020; Keceli et al., 2008). To give an example: Maersk and IBM have developed the collaborative blockchain platform TradeLens in 2018, with the objective to create a digital „ecosystem, bringing transparency, visibility and efficiencies to every actor that is part of [the] shipment“(Pradi, 2020).

With the increasing digitalisation of the supply chain, the management is expanding on various levels (Goldsby and Zinn, 2016; Stank et al., 2019; Hofmann et al., 2019). The growing demands and complexity in the supply chain lead to the necessity of making the processes and procedures in the supply chain more efficient (Butner, 2010; Oesterreich and Teuteberg, 2016, p.131). Ports are complex and multipart organizations in which institutions and processes interact at various levels. One of the central tasks of the supply chain management is to coordinate the relationships of the supply chain. This involves assessing the positioning of each supplier in the supply chain and evaluating it in terms of collaborative overall success. Each company, in turn, is striving to maximize individual profit (Monczka et al., 2016, p.22; De Martino and Morvillo, 2008; Londe and Masters, 1994). This paper distinguishes between logistics, trade and supply channels. The interaction among these three functions and the rapid change in information and communication technology justifies the high relevance of examining the relationship and power structures in the port more closely (Bichou and Gray, 2004). Nowadays there is less research that integrates the concepts of supply chain management, supply chain integration, relationships, and power along with the supply chain and the digitalisation in the supply chain. This

paper follows the objective to give a first overview, in the form of a literature review, about the impact of an asymmetric allocation of power along the supply chain on the digitalisation strategies in the port. This literature review is based on the existing research on the impact of disruptive technologies on the port and the research of power structure within the supply chain.

To reach the objective of the paper, it is structured into a theoretical overview, the review and presenting the results of this research in the last chapter. The theoretical implications present the concept of the port supply chain, defines power within the port, and gives a short overview about the digital transformation of port logistics. In the third chapter the research method, as well as the results are presented. The paper ends with a summary of the results, and the conclusion in the last chapter.

2 Theoretical Implications

In the context of globalisation, the notion of freight transport and logistics steadily increases its impact on the competitive environment and becomes one of the central enablers for competitive advantages (Robinson, 2002; Botti et al., 2017). To determine the effects of the allocation of power, in relation to the port's digitalisation strategies, it is necessary to develop a general understanding of the port's integration into the supply chain, but also to identify the individual actors within the port. The first step, therefore, is to consider the allocations and interactions along with the resources and infrastructure in the context of the port. Besides this, a general understanding of power will be developed and a short overview of port digitalisation will be given.

2.1 Concept of Port Supply Chains

Following the concept introduced by Heaver et.al. this chapter is structured along with the terminal operation model and port cross-sectoral mergers. Generally, there are three types of freight handling actors in maritime logistics; “port authorities, shipping lines with terminal operations, and independent container terminal management companies”, whose actions depend on the global supply chains (Heaver, Meersman and Voorde, 2001). The structures of port administration/port authority could be illustrated by the landlord model, in terms of its ownership and the operating structures of the port. The port could be separated into infrastructure and superstructure, whereby the infrastructure is administrated by the governance and the superstructure is operated by private companies (van der Lugt, de

Langen and Hagdorn, 2015; Chen, 2009). Further approaches incorporate terms of ownership and operating structures into the models of tool port and service port. The tool port is based on a port authority, which provides the infrastructure and superstructure, and operates some port services as well, all other services are provided by private investors. Service ports are based on the approach that the port authority provides all necessary services (Chen, 2009; Brooks, 2004).

The operation of the terminal can be divided into terminal operating shippers, terminal operator shipping companies, terminal operator port authorities, and terminal operating companies. Further structures and actors will be directly influenced by this operation model (Bichou and Bell, 2007).

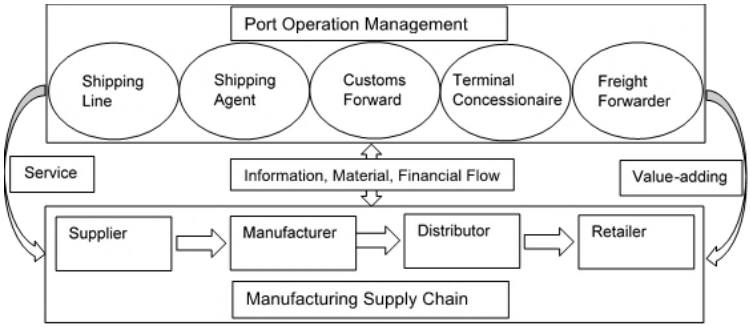

Figure 1: Port Supply Chain, in addition to (Gao, 2009, Vaio and Verriale, 2020, Robinson, 2002)

Besides the organization of the terminal, the upstream and further flow of goods via the shipping lines, the coordination and other logistics service providers plays a central role in the port's relations. As shown in Figure the port has become the convergent point of the transactions and business in-

teractions between different supply chains. For example, material and information flow between enterprises are handled through the port (Gao, 2009). The example in Figure elaborates a short overview of a manufacturing and third-party logistic distribution supply chain while including the port. The supply chain of the port is illustrated, based on (Robinson, 2002). The supply chain of the port can be separated in addition to their spatial allocation. The shipping line bypasses this allocation, other actors like the shipping agent, customs forwarder, terminal concessionaire, or the freight forwarder operate from the land segment.

2.2 Definition of Power in the Concept of Supply Chain

The importance of power took on a central role in early research to examine sales channels (Reve and Stern, 1979; Gaski, 1984; Lusch and Brown, 1985). Frazier shows the balance of power in the cooperation between two companies, with a corresponding potential of influence in each dyad (Frazier, 1983). The concept of power within a marketing channel is defined by the ability to establish a binding guideline for the participants of the channel regarding products or brands (Lusch and Brown, 1985). However, this definition only includes a focus on the end customer and as such is not fully applicable to the supply chain. Following the approaches of marketing, the concept of power within a supply chain can be defined by assuming that there is a relationship between the actors of the supply chain (Johnsen and Ford, 2008). This relationship is shaped by reciprocal influence and also acceptance (Kouzes and Posner, 2005; Defee, Stank and Esper, 2010). Johnsen and Ford summarize the characteristics of the supply chain relationship (Johnsen and Ford, 2008). The concept of power is defined as the ability of

an actor to exert influence on customers, competitors, and suppliers against the achieving of its own goals (Cox et al., 2003; Johnsen and Ford, 2008). Johnsen and Ford distinguish three possible variants of cooperation in the customer-supplier relationship: an asymmetry on the customer side, an asymmetry on the supplier side and a symmetrical distribution of power (Johnsen and Ford, 2008; Michalski, Yurov and Botella, 2014). A corresponding power position can be based on the financial strength or size of the company (Johnsen and Ford, 2008). The structures of this approach can be further extended to relationships with, for example, logistics service providers or shipping companies. Porter provides a further approach to defining the concept of power in his model of the Five Forces, in which he shows the bargaining power of customers and suppliers over business decisions (Porter, 1980, p.4). The execution of this power can be seen, for example, in the possibilities of influencing price or product quality and thus exerting influence on the further supply chain. The power of influence increases with the dependence of the actors on each other (Porter, 1980, p.27). Furthermore, the trend of globalisation is influencing the power structures within the port. Besides this trend, three strategy patterns are evident: Merges, Regional Coverage, and Internationalisation. The increase in customers power and the need for investments to meet transhipment requirements urge many companies to merge. The merge of companies enables them to attain a stronger position in negotiations and to create the opportunity to use synergic effects vis-à-vis the port authority and shipping companies. Other ways to increase market power are regional coverages or global expansion. Companies increase their span of service in the current region or

provide a similar service in adjacent locations. Several of the regional companies increase their market power by extending internationally. (Heaver, Meersman and Voorde, 2001).

Following the concept of Johnson and Ford an asymmetric power allocation, will be defined in this paper, as the ability to influence the participants of the supply chain, to lead them to your own goals. The influence can be exerted by the supply chain leader, as well as the supplier or customer. The extent of possible influence depends on the direct or indirect bargaining power of the participants to the supply chain, which, for example, is based on the financial strength or the company size.

2.3 Digital Transformation of Port Logistics

Over the last 30 years, the increased competitive pressure and the pressure to innovate has led ports and port supply chain to optimize their processes and transform their system landscape. Related to the evolution of international trade the port has to manage an enormous quantity of cargos, by various customers in addition to the international commodity flow. A possible drive to maintain competitive pressure is the use of information and communication technology in their physical and decision-making processes (Keceli et al., 2008; Tseng and Liao, 2015). Due to an increasing digitalisation of processes, the proximity of the individual actors within the supply chain increases, and the integration of all processes into each other grows accordingly, up to a collaborative supply chain. In addition to the increasing integration of information and communication technology, the terminology of this term evolved from telematics provided for road transport to contemporary smart/intelligent solutions, like cloud computing, Internet

of things, or Big Data solutions. There are several reasons for the investments in information and communication technologies: cost reductions, an increase in the service level, the enhancement of transport and logistic processes, and lastly an improvement of safety and security. (Carlan et al., 2017). The increasing integration is based on the use of appropriate port communication systems, which enable a consistent sharing of information along with global supply chain (Vaio and Varriale, 2020; Martino et al., 2013; Carlan et al., 2017) and so the gain of market force (Lee, Padmanabhan and Whang, 2004).

In principle, different categorization can be defined to emphasize how the use of information systems changes the process landscape of the supply chain. In the literature, the standardization or the creation of a uniform database is mentioned as an example, as well as the creation of cross-organizational databases, the change in control systems through the creation of contactless control options, or the automation of transactions (Vaio and Varriale, 2020).

3 Literature Review about the allocation of Power in Supply Chain

The objective of a literature review is the structured and scientifically qualifiable analysis and presentation of the literature of a certain topic or subject area (Denyer and Tranfield, 2009, p.671; Fink, 2014, p.3 f.). This paper aims to investigate the impact of the asymmetric allocation of power on the digitalisation strategy in port logistics. For this literature review, the review methodology according to Fink is used. To comply with the quality criteria, he recommends a step-by-step procedure in the preparation of the review.

3.1 Methodic Framework of the Review

In the first step, he recommends formulating the research question, which guides the screening of literature and helps to reach the objective of the paper (Fink, 2014, p.3). Based on the theoretical framework the following question can be deduced:

- *To what extent does existing research take up the impact of the allocation of power on port strategy, especially ports digitalisation strategy?*

Based on this question, it is necessary to locate and select the relevant literature (Fink, 2014, p.3 ff.). Denyer and Tranfield recommend to define the search term based on the theoretical background, pick the relevant databases and the period of the review. As mentioned in chapter 2.2 the term of power is currently used in different research fields. To reach a general overview this research is going to extend the term of power to "*braining power*" or "*relationship*" or "*market force*" or "*marketing channel*" and at last "*relationship*". In the combination with port and supply chain, it results in the

following research term: “*supply chain*” or “*supply chain management*” and “*port*” and "*marketing channel*" or "*market force*" or "*bargaining power*" or “*leadership*" or "*relationship*". To carry further screening these research terms were submitted to the Scopus database in March 2020, which results in 204 publications.

For the fourth step, they suggest to select and evaluate the literature. For this purpose, it is required to develop transparent evaluation criteria. In addition to the search term, this review is limited to journal publications and conference papers/proceedings, which were published in the English language between 2000 and 2020. The research excludes the papers of a first search result, which are published under the subject of Earth and Planetary Sciences, Energy, Arts and Humanities, Chemical Engineering, Medicine, Agricultural and Biological Sciences and Biochemistry, Genetics, and Molecular Biology, because these subjects are not appropriate for the topic of the research. Under these restrictions, the search result was limited to 107 papers, which were published in the last 20 years. This search result needed to be screened and synthesized in the sixth step by reading the titles and abstracts of the papers and excluding the content which did not fit the topic of the research. Especially papers were selected, which included the topic of digitalisation, so after excluding every irrelevant content, 39 papers with a corresponding relevance remain for further analyses.

3.2 Descriptive Screening of the Literature

After the selection of the relevant content, the literature must be analysed (Fink, 2014, p.5; Denyer and Tranfield, 2009; Wallace and Wray, 2011, p.143 ff.). The results of this screening will be illustrated in the following chapters.

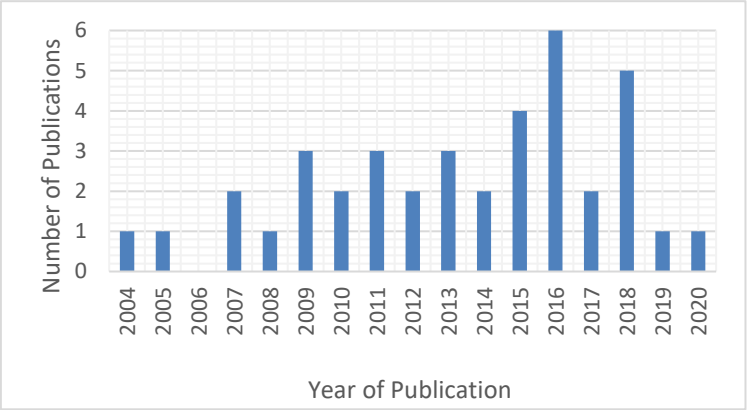

Figure 2: Analysis of papers according to the year of publication

As shown in Figure 2, the first literature on the deduced search term was published by Rodrigue in 2004. The most recent literature is based on Di Vaio and Varriale in 2020. Most of the publications on this topic were published in 2015, 2016 and 2018. A trend towards a growing or decreasing number of publications is not noticeable during the last 20 years. On average, about 2.3 publications were published in the years 2004-2020, which fit into the topic of this review.

Figure 3: Overview of the Sources

Figure 3 displays the sources in addition to the references. The most frequently publishing journals, in this research field, are Maritime Policy (5

publications), Management and Maritime Economics and Logistics (3 publications), and Research in Transportation Business and Management (3 publications). Every other journal has published a maximum of one or two papers.

As shown in Figure 4 most of the papers, up to 27 %, are published to the subject of social science. Further research areas are business and accounting (16%), engineering (14%), decision science (11%), finance (10%), environmental science (9%), and computer science (6%). This allocation to the

different topics of research shows the high interdisciplinary significance of the port and its development of strategies.

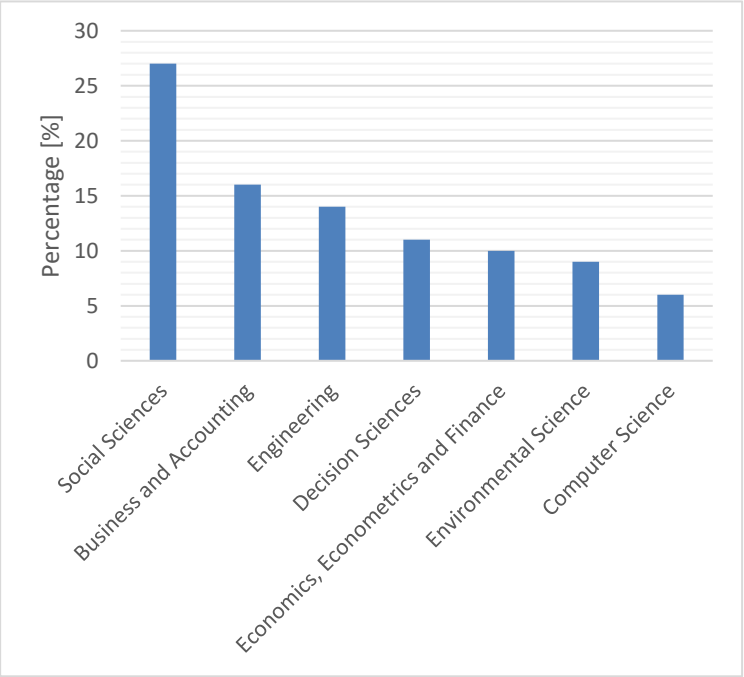

Figure 4: Percentage depending on the subject area of publication

3.3 Meta-Analysis of the Literature

In the previous chapters, the selection and descriptive analysis of the relevant literature was carried out using formally derived, mostly quantitative

criteria. Based on this previous analysis, the research question is answered by screening the content.

Basic structures of power allocation in the port can already be found in research on the position of the port in global supply chains or on the structural design of the terminal. This positioning of the port is, among other things, due to the emergence of the possible bottleneck, which a port can represent in the global supply chain. Furthermore, the research focuses on the structures within the port, the role of the government, or terminal operators (Rodrigue and Notteboom, 2009; Hall and Jacobs, 2010; Lam and Yap, 2011; Jacobs and Hall, 2007). Port strategy must be developed dependent on ports role in the global supply chain. With the positioning of the port/terminal as part of a multimodal platform, its importance in global supply chains is growing further. Especially about concerning the availability of information, the port is of crucial importance (Veenstra, Zuidwijk and Van Asperen, 2012). This research thus addresses the central role of the port in the supply chain, the power that the port can exert on the supply chain, but at the same time, it does not explain how power structures affect strategy formation in the port and digitization strategies.

Tongzon, Chang, and Lee point out the importance of building long-term relationships and collaboration to increase supply chains profitability (Tongzon, Chang and Lee, 2009). Collaboration enables the port to gain competitive advantage and increase "port performance such as connectivity, value-added service, safety and security, efficient operation, cost efficiency, reliability and convenience of port users" (Seo, Dinwoodie and Roe, 2016). Liu et al. amplify these advantages by the example of the short time scheduler and decreasing port times. A consistent sharing of information

between the shipping lines and the terminal operator enables them to decrease port time, by, for example, optimize the use of quay cranes (Liu et al., 2016). Seo et al. highlighted five key factors of collaboration among maritime logistics, "information sharing, knowledge creation, goal similarity, decision harmonisation and joint supply chain performance measurement". They suggest the development of collaborative information and trading platforms for the maritime sector (Seo, Dinwoodie and Roe, 2015), which should include governance, terminal operators and shipping companies (Ascencio et al., 2014). As mentioned in the preceding literature the concept of collaboration demands an equal allocation of power along to the supply chain.

Vaio and Varriale show the positive impact of digitalisation on the inter- and intraorganizational relationships of the port. Port communication systems enable the port authority to redesign the inter-organizational relationships and supply chain processes within the port. Digital platforms change the interaction between the players through automation and simplification (Vaio and Varriale, 2020). This positive impact of the digitalization to the inter-organizational relationships can be deducted by the optimization of the hinterland connection. The container barging will be more efficient, while using the digitalization to optimize the coordination between shipping companies, terminal operators and freight forwarder (van der Horst et al., 2019).

The development of deeper intra-organizational relations positively influences the extra organizational relations and helps to increase supply chain integration. Nowadays a competitive environment leads companies to cooperate more closely with their partners and meet their requirements for

lower costs and higher quality. Especially in maritime logistics, the knowledge of these impacts could help to develop a strategy to compete in this fast-changing environment (Yang, Yeo and Vinh, 2015).

4 Conclusion

Depending on the structure of the port supply chains a specific allocation of power is created, and thus leads to a corresponding level of influence. In the complex global environment, collaboration enables the economic activity of the port. Finally, the relationships between the individual actors create a network, which influences the strategic formation. The objective of this research was to determine the current state of research on the effects of an asymmetrical allocation of power on strategy development in the port, in particular the development of digitalisation strategies. Based on this literature review, the poor level of the present research, about the impacts of asymmetries in power allocation on strategy development in the port, can be deducted. The main results of today's research, are about relationship management and the impacts of collaboration to ports supply chain strategy or the positive impacts of the digitalisation in general. Despite these poor results, some implications can be concluded.

The central role of the port as a collaborative link in global supply chains is emphasized. Especially about concerning the availability of information, the port plays a central role. The objectives of a digitalisation strategy should, therefore, be based on the creation of a consistent exchange of information along with the supply chain. A reference to the impact of power allocations on digitalisation strategies can only be identified in its basic features based on this review. The collaborative approach provides the supply chain with balanced power, which leads to the necessity of the strategy development to reduce barriers of equal power and support supply chain collaboration.

Following the advantages of a collaborative port strategy, further research focuses on the benefits of closer cooperation with corporate partners. In this regard, the focus is primarily on the possibilities opened up by the digitalisation of processes in the port. Port communication systems enable every participant to share necessary information along with the supply chain and could optimise the processes within the port. Due to the effect of an asymmetry of power, and an inconsistent share of information by individual users, it will decrease the effort of digitalisation for the whole chain. Closer cooperation along with the supply chain thus also increases competitiveness and strategy development has to support cooperation by the implementation of the right IT infrastructure. The focus on customer centricity enables the shipping line and logistic provider, based on the growing negotiating power of the customers, to influence the digitalisation strategy of the port. In addition to the strategy development, this focus on the customer can lead to an asymmetric allocation of power. While the terminal operator provides the infrastructure, they influence the port strategy to a particular extent. With the providing of the infrastructure, they occupy one of the most powerful positions to influence the strategy of the other participants and construct guidelines for the digitalisation.

Our research offers a first qualitative overview of the state of research on the effects of power on strategy formation in the port. The research is limited, in the first instance, by the limited number of specialist data banks on which the review was based on, as well as the subjective selection processes of the search term and literature by the researchers. For further research, it is advisable to expand this understanding of power. Approaches

on this matter can be found in qualitative research, for example in the conduct of further reviews or interviews, but also by quantitative research. To develop deeper insights into the influence of power on strategy development, it will be necessary to provide a framework, which enables the researcher to measure these impacts.

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