

# Business Model Innovation to Enhance the Efficiency of Freight Logistics in the Maritime Supply Chain through Blockchain-based Industry Platforms

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**Abstract:** The emerging platform economy is transforming the maritime freight logistics industry. In particular, blockchain-based industry platforms offer enormous potential for enhancing efficiency in the supply chain network. This paper draws on the principles of platform business modelling to develop a framework for global information technology companies to enable a transformation of their current service and software-oriented operations into a platform business model. A qualitative study was conducted integrating theoretical insights from relevant extant literature and empirical evidence based on semi-structured interviews with 15 experts from a global information technology company and the maritime industry. A multi-layered approach to data analysis allowed the identification of a set of interdependent generative causal factors that underlie the platform business model transformation. The findings point to the cross-sector partnership and governance as the dominant causal mechanisms driving the platform business model transformation. This led to the development of a new platform business model framework - named the *4/9 Platform Business Model Canvas (4/9 PBM-C)* - which can be seen as a significant development in the current conceptualisation of blockchain-based industry platforms as a means of enhancing the efficiency of maritime freight logistics. The paper concludes with a consideration of the practical implications of the *4/9 PBM-C* and its application to other industries.

## 1 INTRODUCTION AND MOTIVATION

### 1.1 Introduction

The ubiquitous business models of e-commerce platforms, such as Amazon Marketplace, or collaboration platforms such as Facebook in the business-to-consumer sector are increasingly being applied to the business-to-business sector (Gallay, Korpela, Tapio, & Nurminen, 2017; Jovanovic, Sjödin, & Parida, 2021). The industry context of this paper is the maritime freight logistics industry which is a complex multi-stakeholder environment with authorities from the public sector (local port authorities and customs authorities), companies from the private logistics sector such as liner shipping companies, terminal operators, freight forwarders and other logistics service providers (Zeng, Chan, &

Pawar, 2020), and companies from the IT sector (global information technology companies, local IT providers). These are part of the value chain and provide transportation, logistics or other supply chain related services such as warehousing and handling services (Park & Li, 2021). Blockchain-based industry platforms are a “revolutionary paradigm shift” (Kamble, Gunasekaran, & Arha, 2018, p. 1) as they offer companies of the maritime freight logistics industry the possibility to organise themselves into business networks (Tan & Sundarakani, 2020) and to execute data transactions in the maritime supply chain transparently and more efficiently (Harrison, Lowry, Widdifield, & Hamilton, 2018; Jensen, Hedman, & Henningson, 2019; Sunny, Undralla, & Pillai, 2020). In this market environment, service- and software-oriented technology companies are increasingly using their technological capabilities and changing their business models to develop and operate industry platforms (Hackius & Petersen, 2017).

## 1.2 Motivation

But what are the critical success factors for a global information technology company to successfully transform its existing software and service-oriented business model into a blockchain-based platform business model to respond to the new dynamics in the emerging platform economy? And do the existing business model frameworks support such a platform business model transformation? This paper addresses the research question about the key causal mechanisms underpinning such a platform business model transformation. Based on the results, the aim is to develop a framework rooted in the principles of platform business modelling to enhance the efficiency of freight logistics in the maritime supply chain.

## 2 STATE OF THE ART

Research on business model frameworks provides insights into the structuring, visualisation, communication and implementation of business models, which can be understood as a necessary starting point for business model innovations (Li, 2020; Lima, 2021). In management research, business model frameworks for the development of new business models or the modification of existing business models (business model innovation) are intensively examined (Climent & Haftor, 2021; Foss & Saebi, 2017; Lima, 2021).

### 2.1 Platform Business

The industry platform business places completely new requirements on a business model that must be oriented towards transaction markets, ecosystem management and new pricing models (Ardolino, Saccani, Adrodegari, & Perona, 2020; Fehrer, Woratschek, & Brodie, 2018). In the context of maritime freight logistics, blockchain-based industry platforms are still in an early stage of evolution (Saber, Kouhizadeh, Sarkis, & Shen, 2018). However, such platforms are of great relevance because they have disruptive effects on established industry structures and processes in the multi-stakeholder environment of maritime freight logistics. There is a wide-ranging debate in the literature and in the field of practice about the benefits of blockchain technology (Dutta, Choi, Somani, & Butala, 2020) and the compromise between data protection and transparency that is essential for the widespread adoption of this technology (Tatar,

Gokce, & Nussbaum, 2020; Zeng et al., 2020). Moreover, the formation of a required business-to-business ecosystem is challenging due to the complex relationships between the platform owner, its industry partners and the users of the industry platform.

However, as established companies are often resistant to disruptive innovations and fail to seize new market opportunities, they also tend to ignore the possibilities offered by industry platforms. This is because they incrementally improve their existing solutions to secure revenue and customer satisfaction and, thus, allegedly make correct - rational - business decisions (Christensen, 2013). This tends to be the case until startup companies engage in disruptive innovations and proactively develop new business models. A phenomenon which is described by Christensen (2013, p. 236) as "The Innovator's Dilemma. As a consequence of such entrenched corporate practice, established companies face considerable challenges in transforming their existing service- and software-oriented business model into a platform business model. The existence of a platform strategy at the strategic level and a resulting business model at the tactical level does not necessarily ensure that the pre-defined activities are also executed at the operational level. This is because an organisation is a complex and dynamic open system with employees who pursue different interests and with different IT systems and technologies (Mingers & Standing, 2017).

In such an open system, social structures are the basis of various mechanisms - which have certain characteristics and causal forces that can have a positive or negative effect on the operationalisation of the platform business model (Puvvala, McLoughlin, McLafferty, Yehorova, & Donnellan, 2020). Although "modern social theory has a tendency to describe social phenomena rather than to explain" them, (Hedström & Swedberg, 1998, p. 1), knowing the causes and mechanisms that trigger the observed social phenomena is essential for entrepreneurial practice (Puvvala et al., 2020). It is here that management research can make an important contribution by identifying and explaining the effects of social mechanisms (Albert, Brundage, Sweet, & Vandenberghe, 2020), which are active in the platform business model transformation, in order to close the gap between theory and entrepreneurial outcomes (Edling & Rydgren, 2016, p. 1136).

### 2.2 Research Gaps

In light of the above, the authors have identified a need for further research in the area of business model innovation which addresses the following research gaps:

- Lack of empirical research on the activity system of a platform operator and the causal mechanisms underlying it, which are important for the transformation from a software- and service-oriented business model into a platform business model
- Lack of understanding of platform business model frameworks and their components from which a practical platform business model can be derived. This is, however, necessary to the extent that digitalisation and new technologies such as the blockchain technology are causing a shift from established pipeline business models (Mody, Wirtz, So, Chun, & Liu, 2020; Parker, Van Alstyne, & Choudary, 2016) to business models of a networked economy (Stradner & Brunner, 2020).

This empirical investigation<sup>1</sup> aims to close these research gaps.

### 3 METHODOLOGY

The research methodology (Table 1) applied is based on an explanatory research design (Yin, 2017). A case study research design is best suited to gain new insights in the research field of platform business model innovation, where little research has been done

so far (Mody et al., 2020). The case study is the predominant research approach in business-to-business research (Easton, 2010) and is considered to be the most appropriate in “early phases of new management theory, when key variables and their relationships are being explored” (Gibbert, Ruigrok, & Wicki, 2008, p. 1465). The intention is to explain the observable social phenomena (Parr, 2013) of a business model transformation through causal institutional mechanisms. Such an approach is also suitable because the associated empirical research was carried out in a global information technology company which represents *the case* for this study.

#### 3.1 Data Collection

Since the research question requires an explorative approach, primary data was collected through interviews (Mukumbang, Marchal, Van Belle, & van Wyk, 2020) which is one of the main methods of data collection in qualitative research (St. Pierre & Jackson, 2014). Therefore, the data from primary research were collected through 15 semi-structured interviews from experts of a global information technology company (Business Consulting, Industry Solutions/Platforms, Research & Development) and from logistics providers engaged in maritime freight logistics.

Table 1: Overview of the methodology.

Theme	Characteristics	Application in this study
<b>Focus</b>	Studying complex social phenomena	Investigation of the platform business model transformation of a global information technology company for enhancing efficiency in maritime freight logistics
<b>Research Position</b>	Critical Realism	Credible explanation of causal structures which is precisely the strength of critical realism
<b>Research Approach</b>	Inductive	Inductive research approach that aims to generate new insights instead of testing it
<b>Research Design</b>	Single case study	Explanatory research design based on the criteria of a case study - focused on structures and institutional mechanisms
<b>Data Collection</b>	Qualitative	Semi-structured interviews with interview participants from different business units in order to obtain meaningful and rich data
<b>Sampling Procedure</b>	Non-probabilistic	Purposive sampling followed by snowball sampling
<b>Data Analysis</b>	Explanatory	RRRE model (Resolution, Redescription, Retrodiction, Elimination) developed by Bhaskar (2013, p. xvii) as explanatory framework to explain the platform business model transformation

<sup>1</sup> The empirical investigation of these research gaps was initially addressed by Weissshuhn (2019) in his dissertation.

### 3.2 Data Analysis

The RRRE model developed by Bhaskar (2013, p. xvii) was used as the explanatory framework for data analysis to explain the business model transformation within the chosen research context. The RRRE models stands for: “Resolution of a complex event into its components, theoretical Redescription of these components, Retrodiction to possible antecedents of the components and Elimination of alternative causes”. In the resolution stage, the primary data collected was analysed and the causal entities that might have had a significant causal effect on the observed phenomenon were identified. A computer-assisted qualitative data analysis software (CAQDAS) was used to support the coding and data analysis process. An initial coding scheme was created and structured according to the causal mechanisms identified in the literature and the business model components of the Business Model Canvas defined by Osterwalder (2011) (customer segments, value propositions, key partnerships, key activities, key resources, cost structure, channels, customer relationships and revenue streams ). After this, the main purpose of the redescription stage was to validate the causal entities identified against existing theory on industry platforms and business model innovations. This led to the retrodiction stage, which focuses on a comprehensive break down of these causal entities to identify the generative mechanisms underlying them. Finally, the - elimination stage – aimed to eliminate the least probable causes and to identify the key causal mechanisms that impact the platform business model transformation under the given conditions in maritime freight logistics.

## 4 FINDINGS AND DISCUSSION

The platform business model transformation was investigated by analysing the business model components (causal entities) based on the informants' statements in order to generalise and abstract them. The results of the interviews show that a new activity system is emerging in global information technology companies that must meet the requirements of an increasingly networked ecosystem in which industry platforms are the basis for new digital transactions.

The causal entities identified could be newly described by redescription into platform ownership, platform governance, standardisation of processes and data and user adaption (Figure 1).

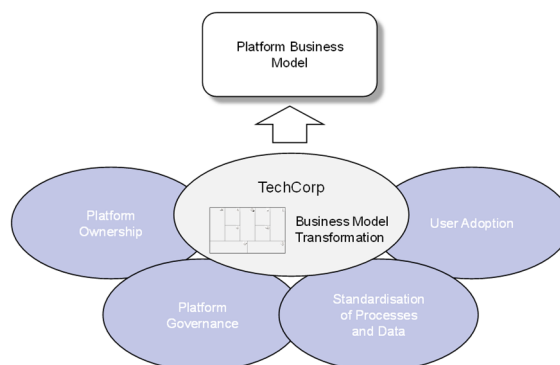


Figure 1: Causal entities affecting the platform business model transformation.

### 4.1 Platform Ownership

Previous research has addressed the question of how the strategy of the industry platform needs to be shaped in order to create a successful platform (Hermes, Guhl, Schreieck, Weking, & Krcmar, 2021; Trabucchi, Buganza, Muzellec, & Ronteau, 2021). As previously described, global information technology companies are increasingly responding with an industry platform strategy to the further digitisation options offered by blockchain technology. But while blockchain technology is only an enabler, industry partnerships are a critical success factor in the design and market launch of industry platforms in maritime freight logistics. On the one hand, industry partners can use their comprehensive expertise to design the industry platform sector-specifically and promote it through their operative business relationships in their industry networks. On the other hand, an industry partnership between a technology company and a company from the maritime freight logistics industry also presents challenges in terms of the commercial model underlying the industry platform and the convergence of interests pursued.

### 4.2 Platform Governance

The focus of the business model innovation is the provision of the industry platform with its properties oriented to the requirements of the maritime freight logistics industry. The resulting key features of the industry platform are essential for the transactions between the platform users related to end-to-end transportation and customs clearance. Industry platforms in maritime freight logistics are collaboration platforms with properties of multi-sided markets, on which data is exchanged between *providers of data* and *users of data* (Hayashi & Ohsawa, 2020). Without these autonomous users and



the ecosystem governance provided by the platform owner (Cusumano, Yoffie, & Gawer, 2020), an industry platform is just a technological architecture (Gawer, 2014). While according to Hermes et al. (2021), each platform ecosystem has a platform owner, platform users and external complementors. The global information technology company has the role of the *platform operator*, but also designs the business model as *platform owner* (Van Alstyne, Parker, & Choudary, 2016). This function is an interface to the network users and potential complementors of the platform (Hermes et al., 2021). All in all, the right value proposition that communicates the benefits for all participants is decisive for the success of the industry platform.

### 4.3 Standardisation of Processes and Data

The value proposition of an industry platform in maritime freight logistics is geared towards a standardisation of processes and data (Voorspuij & Becha, 2021). Today, the maritime supply chain is characterised by peer-to-peer communication between the various stakeholders in the maritime supply chain, which implies that transaction data is only exchanged bi-directionally between two companies (Hvolby et al., 2021). This means that companies still face the challenge of bringing multi-structured information from various sources together in one place - the single source of truth (SSOT) (Tapscott & Tapscott, 2016). It becomes obvious that the standardisation of processes and data is now being driven by the emerging blockchain technology underlying industry platforms. Standards organisations are of great importance here, as they define the necessary standardisation schemes that provide the framework for blockchain policies and technological requirements (Saberri et al., 2018). Through the use of blockchain technology, the next level of digitisation in the maritime supply chain can now be achieved by managing freight and customs transactions in a tamper-proof and trustworthy manner via decentralised shared ledgers (Tan & Sundarakani, 2020; Toptancı, 2021). The companies involved in the maritime supply chain can thus carry out transactions efficiently and with a high degree of standardisation and automation within the business network, thus ensuring smooth transport within an international transport network (Park & Li, 2021). On the one hand, the blockchain technology creates the possibility of a new form of collaboration in business networks along the maritime supply chain in order to take advantage of the standardisation of processes and

data (market perspective). On the other hand, this can only be achieved if technology companies offer industry platforms on this technological basis as neutral providers in order to establish these industry standards (provider perspective).

### 4.4 User Adoption

The redescription of the causal entities “customer segments, channels and customer relationships” relates to the characteristic of user adoption. While an open platform architecture enables the platform owner and third-party service provider to offer complementary innovations (Hermes et al., 2021), it is equally important to focus on the mechanisms that lead to an increasing number of platform users (Wamba, Queiroz, & Trinchera, 2020; Zeng et al., 2020). Self-reinforcing user adoption occurs when more services make the platform more attractive to platform users, which results in more users participating in the platform through network effects (Gregory, Henfridsson, Kaganer, & Kyriakou, 2020). Even more important than the registration of users, is the attractiveness of the platform itself upon which user adoption and commitment is highly dependent (Parker et al., 2016). Thus, user commitment and active use can be viewed as the key mechanisms of customer adoption (Parker et al., 2016). The global and local sales activities that are defined via the platform sales model should therefore be geared towards the integration of companies pursuing different interests into the business network.

### 4.5 Towards an Explanatory Model for Platform Business Model Transformation

It was found that the informants did not question the overall business strategy of the global information technology company, but the practical implementation of the business model derived from it. This has led the researcher to a re-conceptualisation of the entire case. Instead of focusing on the overall platform business strategy, the focus was on its operationalisation and thus on the causal factors influencing the platform business model. Figure 1 illustrates the influence of the causal entities identified on the transformation of the business model into a platform business model. After the identification of the causal entities (resolution stage) and their redescription (redescription stage) the causal mechanisms underlying them were identified in the retrodiction stage. Given the different identified causal mechanisms, the question of the key causal

mechanisms that can be regarded as having the most significant impact on the platform business model transformation was answered finally in the elimination stage. Although several mechanisms were active, the findings of the data analysis emphasise explicitly the causal capacity of the identified *Cross-Sector Partnership Mechanism* and the *Governance Mechanism* within the open organisational system of the global information technology company as the main mechanisms impacting platform business model transformation. Figure 2 presents the outputs of the RRRE analysis. It foregrounds the causal entities impacting the platform business model transformation including platform ownership, platform governance, standardisation of processes and data and user adoption. It also draws attention to their underlying causal mechanisms and to their relationships with each other.

## 5 APPLICATION OF A NEW PLATFORM BUSINESS MODEL FRAMEWORK FOR MARITIME FREIGHT LOGISTICS

Based on the explanatory model presented in Figure 2, the relevant components for a new platform

business model framework were elaborated and validated by evidence from literature research and primary research. From this systematic analysis, the following nine business model components of a platform business model framework were identified:

- ❑ Value Proposition
- ❑ Sales
- ❑ Adoption
- ❑ Partnership Model
- ❑ Pricing
- ❑ Commitment
- ❑ Governance
- ❑ Revenue
- ❑ Resources

Building on these components, a new business model framework was developed. The authors refer to it as the *4/9 Platform Business Model Canvas*. It is built on the four (4) entities of the platform ecosystem and the nine (9) business model components derived from the systematic analysis of the mechanisms. As such, it brings the Platform Business Model Canvas originally developed by Walter (2016) to a new level of understanding and represents a significant contribution in the area. Its key features and benefits are summarised below.

- The industry platform as a collaboration platform for maritime freight logistics has an important, integrative function by linking the stakeholders (platform owner and industry partners) and network members of the user groups (providers of data, users of data) with the goal of improved supply chain transparency and increased supply chain efficiency.

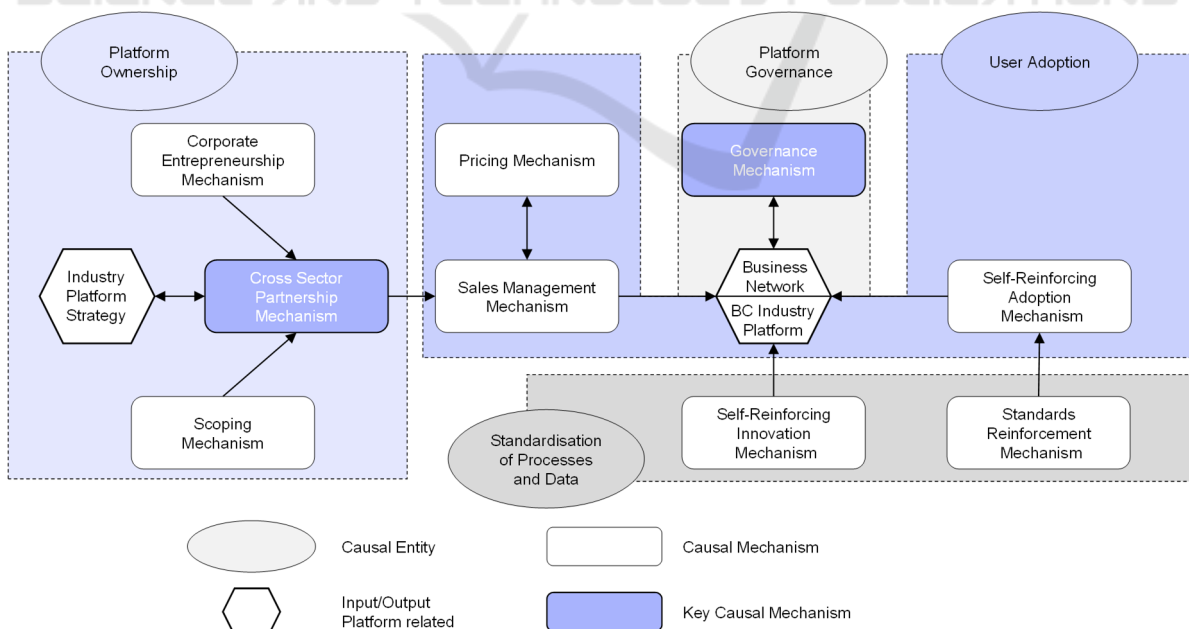


Figure 2: Causal entities affecting the platform business model transformation.

- At the centre of the Platform Business Model framework is the Value Proposition component, to which all activities of the platform owner and industry partners must be aligned.
- The components on the left side (light grey; resources, partnership model, governance, sales, pricing) of the Platform Business Model framework are controlled by the platform owner and its industry partners. Their main function is to design and create an industry platform that can generate valuable outcomes for the network members.
- The components on the right side (dark grey; revenue, adoption, commitment) are oriented towards the network members and must be designed in such a way that direct and indirect network effects are created and the industry platform is constantly growing.
- The concentric circles with the corresponding arrows illustrate the relationship between the components related to a platform economy comprising a variety of interacting stakeholders and network members:
  - The platform governance - defined by platform owner and its industry partners - has an impact on the commitment of the network members to use the platform on a permanent basis.
  - Sales activities lead to an adoption of the platform by the platform users
  - Pricing generates revenue

## 6 CONCLUSIONS

### 6.1 Summary

The industry segment of maritime freight logistics is a multi-stakeholder environment with companies from the logistics and IT sector, but also with public authorities from the public sector which have different and sometimes contradictory interests. IT innovations such as blockchain-based industry platforms enable processes to be made more transparent and efficient through increasing digitalisation on the one hand, and on the other hand, causing a change in the industry structure through the disintermediation of intermediaries integrated into the maritime value chain. This is reinforced by the increasing collaboration of logistics providers along the maritime supply chain, which is a critical success factor for new forms of data exchange via blockchain-based industry platforms.

The identification of the causal mechanisms underlying the platform business model transformation of a global information technology company, led to the development of an explanatory model that foregrounds its causal mechanisms together with their complex interactions. Although several mechanisms were active, the research findings established the cross-sector partnership and the governance as the dominant mechanisms within the open organisational system of a platform provider. But what makes these mechanisms more impactful than others? The short

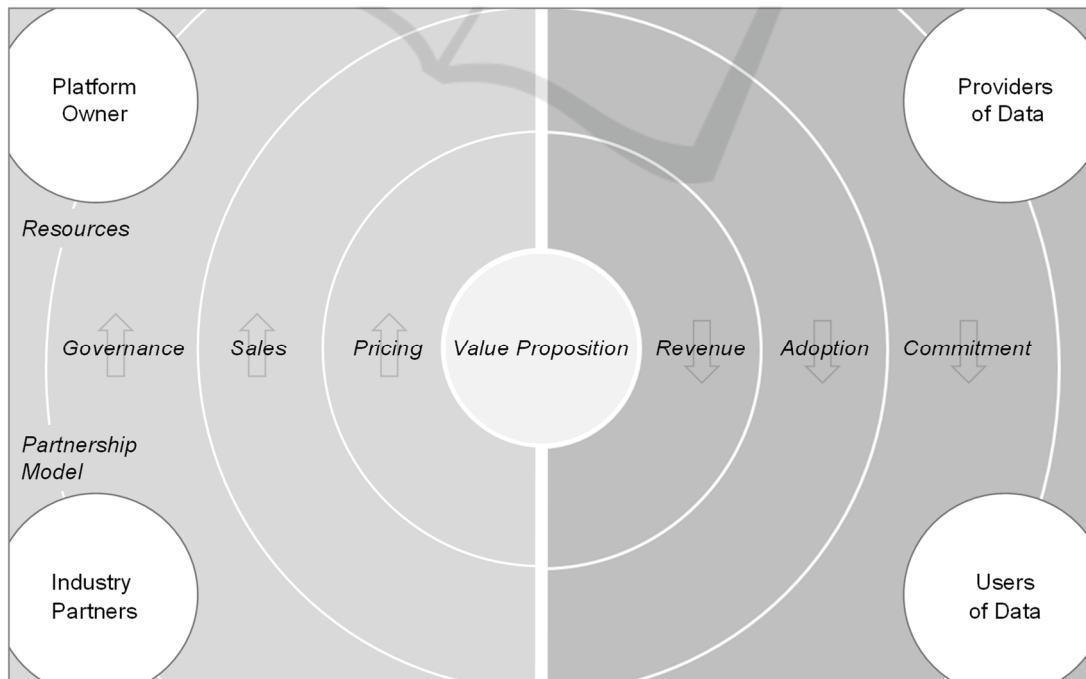


Figure 3: The 4/9 Platform Business Model Canvas for maritime freight logistics.

answer is that these mechanisms emerged from the data analysis as those with the strongest explanatory power in tracking the transformation from a software- and service-oriented business model into a platform business model for maritime freight logistics. This mechanism approach had two major advantages: First, the chain of causality identified in this study has allowed for a multi-layered understanding of the platform business model transformation. It has also provided some solid evidence for the causal mechanisms underlying this phenomenon - thereby adding to the overall credibility of this study.

With the emerging platform economy and the “shift from linear value chains to value creation networks” (Walter, 2018, p. 3), the evolution from pipeline oriented to network-oriented business model frameworks becomes evident. Building on Walter’s Platform Business Model Canvas (Walter, 2016), this study has also developed a new platform business model framework to enhance the efficiency of maritime freight logistics – the 4/9 Platform Business Model Canvas (4/9 PBM-C) - which consists of nine components: Partnership Model, Governance, Sales, Pricing, Value Proposition, Revenue, Adoption, Commitment and Resources.

## 6.2 Limitations of Study and Next Steps

This study has a number of limitations.

First, the findings of a single case study are not representative or statistically generalisable in the traditional positivist sense (Eisenhardt & Graebner, 2007; Flyvbjerg, 2006), but the identified causal mechanisms can explain an outcome in more detail than other methodological approaches (Bygstad & Munkvold, 2011). It is the in-depth description of the mechanisms in the industry context of this study that allows the findings to be applied also to other situations (Langley, 1999). Secondly, the interview data are constrained in terms of completeness as the researcher's ability to fully consider the entire dynamic system of maritime freight logistics is limited. The research was restricted in the selection of the informants identified by snowball sampling. However, the resulting biases were mitigated by conducting interviews with informants from different business units of the global information technology company and the results were confirmed by more than one data source. A third limitation is that this study was conducted in the industry context of maritime freight logistics. A transfer of the findings of this study, the application of the “4/9 Platform Business Model Canvas”, as well as the

recommendations for actions to operate industry platforms in other multi-stakeholder environments (air cargo industry, ...) must therefore be evaluated precisely. On the other hand, this has the advantage that this study contributes to the - still limited – research field of B2B industry platforms and platform business model innovation.

Therefore, this study can only be an initial step in extending the existing business model literature by a new platform business model framework for blockchain-based industry platforms - with the aim of establishing it sustainably in business practice. Although the “4/9 Platform Business Model Canvas” was systematically derived from the analysis of causal mechanisms, a detailed scientific investigation of business models derived from it in a comprehensive field test would provide important insights. This becomes relevant precisely because blockchain-based industry platforms and corresponding business models are still in their early stages at the time of this research and are only beginning to assert themselves in a networked economy (Wang, Han, & Beynon-Davies, 2019).

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