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## A Business Model Approach to Port Ecosystem

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### Abstract

With digitalization and the emergence of disruptive technologies, organizations should restructure their business models within their ecosystems to achieve sustainable revenues and value creation. This paper presents a business model configuration for ecosystem contexts by using the port ecosystem as an example. The paper concludes with a business model typology for the port ecosystem.

Keywords: Business model, ecosystem, platform

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## Introduction

Along with increasing digitalization, the concept of business models has changed and evolved to meet new needs. Massa et al. (2017) defined business models as an illustration of firm functions and moves to achieve their goals, such as value creation, value capture, and growth. In this sense, business models can be seen as a means to analyze how companies work and create value (Amit et al., 2011). Traditional definitions have focused on value creation from the supply-side and value capture from the demand-side, while the recent models have placed more emphasis on business ecosystems and stakeholder interaction (Massa et al., 2017).

Many businesses are currently influenced by the new concept of platformization (Ahokangas et al., 2019). Businesses change to interact around platforms which act as spaces to provide opportunities for various players, such as customers and suppliers. The platforms aim to facilitate the exchange of data, services, and views and to provide opportunities and value for related stakeholders by using appropriate business models (Teece, 2018). Rapid changes with new technologies have raised the need for platform business models as a new way of designing businesses and to encourage value creation (Thomas et al., 2014; Gomes, J. F et al., 2019). Unlike traditional business models, platform business models focus on social and economic interaction to create value by providing an infrastructure for stakeholders' communication and actions within the ecosystem (Xu, Y et al., 2020).

The ecosystem terms originate from ecology, from where the term was adopted for use in business studies and social science (Iansiti & Levien, 2004). An ecosystem can be defined as a group of interconnected players that work together to create value and gain benefits (Thomas et al., 2014). There are several types of ecosystems, including business ecosystems (Moore, 1993), industrial ecosystems (Frosch & Gallopoulos, 1989), knowledge ecosystems (Van der Borgh et al., 2012), and innovation ecosystems (Adner & Kapoor, 2010). Westerlund et al. (2014) argued that an ecosystem business model with roots in ecosystem research builds on "value pillars" and explains

the value creation and capture of the firm and its ecosystem. Ecosystem platform architecture helps to understand the whole ecosystem's parts and the way the ecosystem is partitioned (Yrjölä et al., 2019).

Ports and harbors are a good example of such ecosystems where many players interact with each other. They establish infrastructures where stakeholders can exchange data and services through the ecosystem. Furthermore, ports need to assure those platform standards are addressed at a certain level and to enhance the stakeholders' performance and to improve data exchange and security in the whole ecosystem (Gawer & Cusumano, 2002).

## Approach

This paper aims to investigate and propose a business model configuration for the port ecosystem, based on a case study conducted in the Port of Oulu, Finland. We have adopted the business model approach for the ecosystem context to provide a better understanding of the business ecosystem, both from internal and external perspectives. Businesses need to review and renew their business models as well as the business model components due to the digital transformation that is changing the role of players in the ecosystem (Yrjölä et al., 2019). The changes in the business models, from the ecosystem viewpoint, warrant more research into the role of the players within the ecosystem. Specifically, it is of interest to research the relations and interactions within the ecosystem due to the shared goals of the stakeholders (Ritala et al., 2013).

It is easier to classify and organize business models and study roles and relations in an ecosystem with a coherent business model typology. The "4C typology" (connection, content, context, and commerce) addresses a holistic view of almost all business model activities in the ICT (information and communication technologies) context, providing thus a tool for better understanding the stakeholders' activities in the markets (Wirtz et al., 2010). The 4C typology can be seen as consisting of layers where the lower layer enables value creation and capture for the layers at the higher levels. In this typology, the lowest level is

the connection and the highest one is commerce. Each stakeholder can be present at any (combination) of the layers of content, commerce, context, or connection alone or together with other stakeholders (Yrjölä et al., 2015).

In the port environment, the connection layer includes physical and/or virtual communication network infrastructures for port stakeholders' interactions. The ecosystem value proposition is realized by providing a base for exchanging information and the revenue can come from the subscription (Wirtz et al., 2010) to the port platform, for example. The content layer aims to collect, select, compile, distribute, and present data in the ecosystem. The value proposition for this layer comes from the approaches and solutions providing convenient and user-friendly access to data. At the context layer, the aim is to provide a structure, increase transparency, and reduce complexity by providing a single platform for stakeholder communication and transaction in the ports. Finally, the commerce layer focuses on negotiation, initiation, payment, and service and product deliveries in the port ecosystem. Commerce-oriented business models enable online transactions and provide a cost-efficient marketplace for buyers or sellers (Yrjölä et al., 2015).

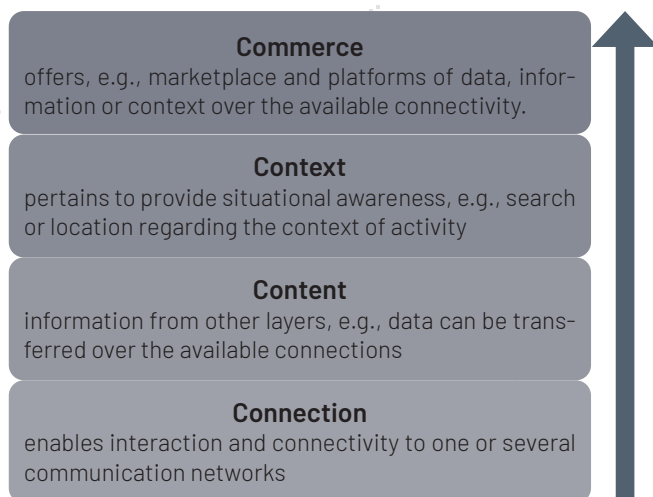


Figure 1: The 4C typology in ports

Ports as a base for connected and co-evolving players, such as campus owners, connectivity providers and users, data providers and owners, legal authorities, and customers can be seen either as a business or industrial ecosystem. A prior study (Moore, 1993)

noted that a business ecosystem emphasizes the role of a company as a part of the business ecosystem in a larger environment. ICT-based infrastructure platforms have become the basis for ecosystems, allowing them to orchestrate and organize the activities of many companies (Gatautis, 2017).

Complexity, interdependency, and co-evolution are aspects of the business ecosystems in the port context. The port business ecosystem can enable non-linear value creation (Moore, 1993), as the value is created through collaboration and cooperation within a network of different players with interconnected roles (Sorri, K et al., 2019). In the port ecosystem, the relationships between actors are cooperative and competitive, aiming at a common goal such as creating products or services. From the industrial ecosystem and successful business models' perspectives, it is important to optimize sustainability (Schaltegger et al., 2016), including the overall energy efficiency and waste in ports. According to the structural framework presented by Autio et al. (2018), ecosystem elements can be categorized into four parts that cover goals and outcomes, structure, processes, and contingencies. A structured viewpoint towards ecosystems will improve our understanding of the role of players and their effects on the whole ecosystem.

## Key Insights

This paper applies the four ecosystem elements from the structural ecosystem framework presented by Autio et al. (2018) and explores them in the port of Oulu ecosystem in Finland applying the 4C business model typology. The results in Table 1 provide a holistic view of the port ecosystem elements and the relevant business model components. The combination of the ecosystem and business model adds value to the analysis and helps to depict the complexities of multi-stakeholder ecosystems.

In the port ecosystem, the main *goal* of the port is to provide trustworthy, high capacity, and low latency connections for services utilized within the port. The ecosystem *structures* include any physical-digital infrastructures such as 4G/5G wireless connections,

Table 1.

Business model typology				
Ecosystem Elements	Connection	Content	Context	Commerce
<p><b>Goal- outcomes:</b></p> <p>The goal of the ecosystem is to optimize the port operations through the digitalization of the services utilized within the port ecosystem.</p>	<ul style="list-style-type: none"> <li>Offering and utilization of a trustworthy, high capacity connectivity network to achieve more efficient, seamless, and smooth operation and communication for the different services in the port.</li> <li>Providing a high-privacy connection network between physical &amp; virtual port models "Digital Twins."</li> </ul>	<ul style="list-style-type: none"> <li>Making services and internal/external information/data available for the different users and stakeholders when and where needed.</li> </ul>	<ul style="list-style-type: none"> <li>Providing a structure and optimizing the use of resources within the port area.</li> </ul>	<ul style="list-style-type: none"> <li>Generating indirect or direct revenue streams for the port ecosystem stakeholders</li> <li>Making replicable and scalable services available inside and outside of the port</li> </ul>
<p><b>Structure:</b></p> <p>Any physical and digital infrastructures or assets within the port ecosystem</p>	<ul style="list-style-type: none"> <li>High-quality wireless mobile communications infrastructure.</li> <li>A platform that provides the base for secure data transactions between the port ecosystem stakeholders.</li> <li>Secure, private real-time edge cloud</li> </ul>	<ul style="list-style-type: none"> <li>Real-time data used, contextual &amp; situational data, open data, data from other ports.</li> <li>Video analytics, positioning, edge analytics, drone systems.</li> </ul>	<ul style="list-style-type: none"> <li>A digital twin presenting the situational awareness of the port ecosystem.</li> <li>Support for daily operations from data suppliers.</li> <li>Optimized service performance with the help of artificial intelligence (AI) and (ML) machine learning.</li> </ul>	<p>New business systems for the port.</p> <p>Secure and confidential transactions.</p>
<p><b>Processes:</b></p> <p>Any activities and services ongoing within the port based on the port structure and to achieve stakeholders' goals</p>	<ul style="list-style-type: none"> <li>Speeding up the communication process and/or access to the information with data.</li> <li>Optimizing service behavior in the port ecosystem with AI, ML</li> <li>Integration of existing connectivity solutions at the port and interworking with systems outside the port area.</li> <li>Understanding requirements for the port processes.</li> </ul>	<ul style="list-style-type: none"> <li>Secure and private processing of data and knowledge sharing.</li> <li>Making data available.</li> <li>Providing digital service logs and reports.</li> <li>Providing a digital traffic flow.</li> <li>Providing data for existing systems.</li> </ul>	<ul style="list-style-type: none"> <li>Providing structure and navigation for users.</li> <li>Providing situational awareness for the local services.</li> <li>Improving digital services usage.</li> <li>Identifying and deploying stakeholders' needs in process design.</li> <li>Visualizing and virtualizing platform processes for the port, stakeholders and customers.</li> <li>Data ownership.</li> </ul>	<ul style="list-style-type: none"> <li>Digital trust.</li> <li>Improving business data sharing inside and outside the port. Exploit open data to develop "situational awareness."</li> <li>Development of commercial platform.</li> <li>Optimization of business transaction workload.</li> <li>Improving the attraction for new customers.</li> <li>Expanding the market for the port with other ports and ecosystems.</li> <li>Creating a holistic view of port operations.</li> <li>Making high availability &amp; robustness for business transactions.</li> </ul>
<p><b>Contingencies:</b></p> <p>Policies, regulations, standards, and culture regarding connectivity, data, and platform influencing the port ecosystem.</p>	<ul style="list-style-type: none"> <li>Global communication standards.</li> <li>Connectivity related regulations.</li> <li>Net neutrality.</li> </ul>	<ul style="list-style-type: none"> <li>Safety-related to the use of data.</li> <li>Data regulation and standards as well as privacy, security, and confidentiality regulation.</li> <li>Open data standards.</li> </ul>	<ul style="list-style-type: none"> <li>Port-specific regulations.</li> <li>Regulation related to making data available and for sharing.</li> </ul>	<ul style="list-style-type: none"> <li>Conformity of business transactions with law.</li> <li>Regulating interaction between players.</li> <li>Business platform regulation.</li> </ul>

Table1: The 4C business model typology to the port ecosystem.

fixed optical fiber connections, sensor networks, big data storage “digital twins” and analytics utilizing artificial intelligence/machine learning which are considered assets and enable a variety of operating processes in ports. Additionally, ecosystem *processes* address activities and services considering the port structure. Finally, the port ecosystem *contingencies* include regulations, standards, and local policies. Table 1 presents the key findings of an analysis that cross-examines the 4C business model framework and the elements of the ecosystem.

## Discussion and Conclusions

This paper investigates business model configurations and components for digitalized ecosystem contexts, with a specific focus on a port ecosystem. The ecosystem elements and the 4C business model typology were examined to shed light on the port ecosystem. The findings indicate that a shift in the port ecosystem goals is expected to take place as modern network communication and computing technologies offer opportunities for trustworthy mobile connectivity, data storage, transfer, and analytics, with external services and resource optimization in the port, which will improve the revenue expectations from the whole ecosystem. Indeed, the typology as such is the key conceptual contribution of the paper.

The managerial implications of the analysis for ports are of strategic and technological nature. From a strategic perspective, the findings indicate a direct relationship between the ecosystem and the business model applied by the port. Specifically, appropriate bundling of different business models—the connectivity, content, context, and commerce ones—is required and this bundling needs to correspond with the characteristics of the ecosystem. However, this bundling should not be seen as a universal approach as some customers may require more atomic or narrower approach due to their specific or restricted needs or due to the need for control by the port itself. From technological point of view, establishing high-quality wireless communications with lowered latency in ports will enable real-time data processing, open and situational data. Edge cloud computing elements and interfaces enable local, instant, private, and secure services, e.g., for situational awareness and fast discovery of people, services, devices, resources, and any local information near the user that cannot be collected by centralized search engines. Such digital twin information service platforms could be used to optimize the daily operations and enable new businesses, e.g., in the creation of a highly local and dynamic marketplace for services, resources, and information. Global communication standards and data regulations will assure stakeholders concerning the conformity of business transactions with law and regulations.

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