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Digital readiness index assessment towards smart port development

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Abstract
Digital technologies receive more and more attention in the maritime transport sector. Large ports such as Rotterdam or Antwerp are already heavily investing in digital databased technologies and thus, continue to rely on a sustainable expansion of these advanced technologies that promise security, process optimization and sustainability. Conversely, especially smaller ports have no or limited knowledge on what Industry 4.0, IoT and Blockchain are and what potentials they may have. Nevertheless, without the inclusion of small and medium-sized ports, the innovative idea towards a smart port development stays unachievable. Related to this, there exist a lack of concepts and models for measuring the digital performance of ports. Without such tools, it is impossible to audit the digital status of ports and to derive a concrete strategic roadmap for the digital transformation of ports. Accordingly, in this study, the research questions will be investigated, how the digital performance of ports can be assessed, and which strategic recommendations can be derived for ports regarding a sustainable development towards a smart port. Building upon the received qualitative data that were gathered through an online survey and IT based expert interviews, a digital readiness index for ports is applied in case of five selected seaports. The results will show that building upon the benchmarking and indexing of the ports, the current strategic positioning of the ports becomes apparent. Through this, the respective strategic recommendations for a sustainable development towards a smart port can be derived in accordance to each port classification.

Keywords Digitalisation · Smart Port · Port Performance Measurement · Port Performance Indicators · Digital Readiness Index · Maturity Model

1 Introduction

Since recent years, the interest in digital technologies and their progress in various industrial and service sectors increases. Due to the promising value proposition, the growing cross-sectoral distribution and the value creation potential of digital technologies, they also receive more and more recognition in the maritime industrial and transport sector (Philipp et al. 2020a, 2018). In the European context, especially large ports—the so-called core ports of the "Trans-European Transport Network" (TEN-T)—such as Rotterdam or Antwerp are already familiar with digital databased technologies like Blockchain or Internet of Things (IoT) and thus, continue to rely on a sustainable expansion of these advanced technologies that promise security, process optimization and sustainability. They are developing rapidly and merge into huge digital networks and platforms. By doing so, they connect and converge physical and digital worlds (i.e. machines, devices and humans). The main goal of such novel digital technologies is to optimize economic performance and energy demand, to reduce the consumption of resources and waste and to better qualify the service portfolio. Indeed, seaports rely on large transport and logistics companies when it comes to the development and implementation of innovative technology applications. Since major transport companies like Maersk are already heavily investing in digital technologies that are regarded as the enablers for the digital transformation in the context of Industry and Logistics 4.0, it is important that also ports—including in particular small and medium-sized ports—take the opportunity to apply these novel technological solutions in order to integrate themselves in a sustain-

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