TOWARDS SUSTAINABLE PORT INFRASTRUCTURE THROUGH PLANNED ADAPTATION

by

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The world has entered a new area, a complex age of turbulence and opportunity (Rand, 2017). Ports worldwide are expanding capacity to accommodate trade growth. Considering their long lifetime, future developments will be key factors in determining their success. In addition to cargo and ship traffic forecasts, which are determinants of myriad uncertain external developments that can disrupt existing trade patterns and cargo flows, emerging technology, energy transition and sustainability requirements, and climate change represent uncertainties for most ports. These development will mean changed demands, new functions and new constraints for port infrastructures.

Literature over sustainable ports advocates common sustainability guiding principles and suggests that a more sustainable port can be realized through embracing the perspectives of engineering, ecosystem services and governance in an integrated approach to port development. However, in these uncertain times, the concepts of adaptability and robustness belong under the overarching definition of sustainability. Hence, sustainable infrastructures should not only achieve economic, environmental, and social objectives, but should be robust, meaning that they are robust and perform satisfactorily under multiple futures and are adaptable to (unforeseen) future conditions (Haasnoot et al., 2011; Walker et al. 2013).

International port-related organizations such as AAPA, IAPH, ESPO, OECD, PIANC, EPA, UNEP, UNCSD, USACE and WWF, are developing and regularly updating guidelines and codes of practice for sustainable development of ports and waterways. Guidelines over sustainable port development make a mention of uncertainty, as well as adaptation and flexibility as strategies for future proofing a port. However a comprehensive planning approach that incorporates the above concepts, and systematically deal with uncertainty to result in a sustainable plan, is missing. We address this research gap in this paper.

A major challenge in designing sustainable plans is the requirement to accept, understand, and manage uncertainty. Literature over uncertainty suggests that a clear understanding of the relevant uncertainties can guide the planner to choose an appropriate approach to effectively address them. Therefore, we begin by exploring the different dimensions of uncertainties. The degree or severity of the uncertainty, can range from deterministic knowledge to total ignorance, and has four levels. Level 1 indicates a fairly clear future; level 2 uncertainty is said to exist if the probabilities of alternate futures are known; level 3 uncertainties can be ranked, and level 4 uncertainties represents the deepest level of recognized uncertainty. In the current approaches to infrastructure planning, uncertainties are usually treated as either level 1 or 2, resulting in plans that prove inadequate under changing requirements.

Next we study major uncertain developments confronting ports to examine how they are handled in practice, and what are the appropriate methods recommended in current literature. These developments include cargo and traffic forecasts, new technology, energy transition, sustainability requirements, and climate change. We conclude that these uncertainties can be categorized as severe or deep uncertainties, which require complexity-aware approach that favours adaptation as a way of dealing with challenges. These approaches accept the irreducible character of (most) uncertainties about the future and focus on reducing uncertainty about the expected performance by of their plans to ensure a sustainable port system in the future.

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We propose an approach called Adaptive port planning (APP) (Taneja, 2013) based on “planned adaptation”, that is the result of deliberate decisions, based on an awareness that future might change and that action is required to return to, maintain, or achieve a desired state (Walker et al., 2013). This approach of ‘planned adaptation’ focusses on the expected performance of a plan through exploring possible adaptation strategies, and preparing a framework which includes a monitoring system and contingency plan to guides future actions. It employs strategies for shaping uncertainties or dealing with them through incorporating flexibility and adaptability in the plans, to ensure a sustainable port system in the future.

APP employs a variety of methods and techniques in the context of a generic framework (guides the planner to categorize multiple uncertainties (with various levels and requiring different time for response), in a single framework, and select appropriate methods for addressing them. These can range from extrapolation and sensitivity analysis for level 1 uncertainty, simulation for probabilistic uncertainty, multistage decision analysis for uncertainties that reduced over time with additional information, and scenario discovery, exploratory modelling and analysis (EMA), and robust decision making (RDM) among others, for deep uncertainties.

We further apply APP to three case studies pertaining to port planning projects at very different locations in the world, aimed at developing adaptable and robust masterplans. These ports are: Port of Kuala Tanjung, Indonesia; Europoort, Port of Rotterdam, The Netherlands; Port of Barranquilla, Colombia. Over short-term, local conditions, local and national regulations, port organization structure, and international standards play a role during planning. Uncertainties about the future investments in hinterland connections or in sustainability measures by the authorities, are faced by most port projects. Over the long term, the ports are confronted by uncertainties mention earlier, which belong to level 3 or 4. These case studies illustrate the application of APP framework to guide the planner to deal with both short- and long term vulnerabilities, and seize opportunities in order to create a robust port masterplan.

The paper concludes that adaptability and robustness belong under the overarching definition of sustainability. In present uncertain times, a “monitor and planned adaptation” approach is more suitable than a traditional “predict and act approach” for developing sustainable infrastructure that are robust, and able to achieve economic, environmental, and social objectives now and in the future. While the need for adaptation is increasingly acknowledged, it is still a developing concept, and requires the further development of specific tools and methods for its operationalization (Walker et al., 2010).

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