"Maritime Port Planning and Operations: An analysis of available ports masterplan guidelines, identification of challenges, and a proposal of evaluation method to measure success factors in the development and implementation of a port masterplan"

by

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Abstract

Ports masterplan is an essential document that defines a ports long term development. The aim of a masterplan is to strategically frame the direction in which port infrastructure and operations will develop in order to meeting future demand, local regulations, as well as environmental and social obligations. Maritime ssociations have attempted to develop boilerplate orientation framework for port masterplan preparation. However, limited progress has been made to incorporate mechanisms within the port masterplan to evaluate success factors in the development and implementation. This paper aims to investigate gaps in the existing models and apply a theoretical framework that draws on theories of planning evaluation to provide guidance for ports planners to use in various stages of the evaluation of the ports masterplan process.

1. Introduction

In globalised trade, goods and commodities are required to travel longer distances for delivery to places that were previously inaccessible. Ports act as main gateways to a country for the import and export of goods providing the infrastructure interface between sea and land logistics transportation network (Herz and Flamig, 2014), allocating facilities to accommodate vessels and handle cargos.

Ports belong to the logistics transportation system (Robinson, 2002). They are recognised as part of logistics centres (Bichou and Gray, 2004), in a port context logistics transportation network such as railway, and roads are infrastructure responsible for moving cargo in and out of ports (Agerschou, 2004). They can be "closed" and have a dedicated function as in some mining operations with their own railway system linking mine to port, or "open" as part of a macro network that connects to a port, including as an example city roads and railways.

With markets becoming increasingly globalised, ports and the associated logistics network play an ever-greater role in the development of a country, emphasizing the importance of a holistic plan to ensure ports and logistics network are designed to cope with this increased demand. This plan, known generally as a ports masterplan, is not just a blueprint for brick-and-mortar facilities, it compromises a long-term horizon plan (Dooms and Verbeke, 2006) in a strategic document that enables ports and associated logistics network to handle future demand, thus facilitating or impeding the growth of a country in the global marketplace.

Ports masterplan is a document that defines how ports will be developed in the future (PIANC, 2014). It is built upon fundamental themes including engineering and construction, community and environment, government regulations, type of services provided, and business focus (PortsAustralia, 2013). It is a living document that looks to the future, and therefore must be dynamic and responsive during its lifetime (Taneja et al., 2010). The preparation of a port

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masterplan is a complex puzzle. It involves a multi-disciplinary spectrum of stakeholders that require seamlessly interaction when preparing, implementing, and monitoring across all levels. **Communication tool**

The process of a port masterplans' development commences well before the port development starts, evolves over time, and expands as the facility grows and changes to meet demand. With most of the world's port infrastructure being in highly populated areas, and with an increase in the number and complexity of stakeholders, ports master planning in all its forms is going to become a more specialised and valued skill.

Whilst there is an attraction to follow industry standards and tailor the port masterplan to conform with local regulations and business needs, this does not always guarantee success of the ports masterplan objectives. Many ports masterplan approach, however, are creating static document (Taneja et al., 2010). The development of a port project, from design to construction, can take several years before is fully operational. Consequently, there are risks that a port masterplan can become obsolete document even before implementation.

Although there are a variety of techniques, standards, and guidelines available to produce a port masterplan, there is little or conflicting guidance that sufficiently covers the evaluation process involved in the ports masterplan, the process of developing the ports masterplan exercise quickly becomes a tangled web of stakeholders with widely different interests and objectives. Given the above backdrop, there is a tendency to develop and adopt various guidelines or none, generating a patchwork of confusing documentation with endless revisions and vague outcomes.

Fundamentally, the lack of an effective planning evaluation framework to be used during the development, implementation, and monitoring stages compromises the ability of the port masterplan to achieve its objectives.

It is of paramount importance organizations realise that a ports masterplan is not just a rigid blueprint document to guide the future development and be kept in bookshelves. The port masterplan must be the skeleton framework for distinct stages of the port operation, enabling the operational processes to be hung from this framework. These processes should be agile and be encouraging evaluation to react to market, environmental and innovative technologies changing conditions, both as risks and opportunities. As the individual processes adapt and grow, the port masterplan framework should be focused enough to enable evaluation against the long term horizon goals.

The aim of this paper is to review the most common guidelines and standards for ports masterplan preparation in the context of improvement of the evaluation process. It is argued in this paper that there is a need to introduce a detailed plan evaluation framework in the port masterplan preparation to support an unbiased evaluation process of port masterplan during development, implementation, and monitoring stages.

This paper is elaborated in five sections. Section 2 provides an analysis of available standards and guidelines in the evaluation process context. Section 3 explore the challenges port masterplan faces during development, implementation, and monitoring stages. Section 4 describes the evaluation framework that can be introduced in the port masterplan development process. Section 5 compile results and propose further research.

2. Port masterplan, guidelines, and standards

A port masterplan is a comprehensive document that involves contribution of many specialists of different disciplines, (Memos and Tsinker, 2004). It provides the development strategy for future years including the relationship between external stakeholders i.e. the port and the city, the financial and economic aspects, and the environmental impacts, Moglia and Sanguineri (2003). A summary of major elements of a port masterplan are described in Figure 1: Port Masterplan Topics

Figure 1: Port Masterplan Topics

As the port masterplan looks to the future, it must be able to be dynamic and responsive (Taneja and Ligteringen, 2010). However, plans in general are notorious for being vague during the preparation stage and are often written to address conflicting requirements. Even if it can achieve its goals, therefore, plans should be evaluated and a conclusion be able to be drawn as to what level of success the plan has achieved (Alexander, 2011).

Port authorities and operators demand a port masterplanning guideline is supplied by international maritime associations. The Permanent International Association of Navigation Congresses (PIANC) defines the port masterplan as a set of policies and guidelines to lead future development of ports within an overall development plan, PIANC (2014).

The PIANC Master Planning of Existing Ports Report (PIANC, 2014) provides a succinct guideline emphasizing different levels of ports masterplan from multinational to local level incorporating the main objectives to fully integrate into cities transportation planning strategies, environmental, urban, physical and eco-social constraints. Whilst thePIANC report covers port masterplan for existing ports, the same document is also applicable for existing and new port development.

Ports Australia, a body that represents Australia's ports community, highlights in the Leading Practice: Ports Master Planning study published in 2013 that the most relevant elements to be included in a ports masterplan are economic drivers, environmental and social condition, supply chain, and interface planning considerations as well as government regulations, (PortsAustralia, 2013). Although the Ports Australia study focused on Australia ports, the document suggested a detailed guideline to support Australia's ports in preparation of their ports masterplan, and in some cases is can be recommended as a guideline for other countries.

The American Association of Port Authorities published a framework to assist U.S. ports during the port planning and investment stages, the Port Planning and Investment Toolkit ((AAPA), 2017). The AAPA document does not constitute a regulatory framework, standard, or specification, but aims to provide guidelines for U.S. Ports obtain capital for their projects. Although the document focuses on the funding and financial aspects, it does emphasize essential elements of the planning process common on port masterplan and highlights the importance to provide a clear vision, goals, and objectives of proposed projects.

Despite international associations effort to produce standards and guidelines to support ports masterplan, many port authorities and operators have taken they own path and custom-made a port masterplan framework. Although these custom-made documents incorporate international standards and guidelines principles, they are tailored to reflect specific conditions associated to each terminal.

An interested example is the ports masterplan prepared by NSW Ports (NSW-Ports, 2015). They operate two intermodal logistics terminals and the Port Botany and Port Kembla. The "Navigation the Future – NSW Ports's 30 Year Masterplan" published in 2015 presents NSW Ports approach to prepare their asset to sustainably operate for the next years. The ports masterplan is built upon four pillars: the logistics intermodal system, use of land and infrastructure, improve productivity and capacity, and the environmental and social aspects. It details a series of construction of capital projects and improvement in each asset recognizing the importance of stakeholder engagement along the process.

Pilbara Ports Authorities (PPA) that operates and manages major ports in the Pilbara region of Western Australia, and the proposed Ports of Anketell, Cape Preston East and Balla Balla published The Port Development Guideline – PDG (Pilbara-Ports-Authority, 2017) that provides an overarching port planning framework establishing objectives and strategies for each port. The

PDG introduces a 5 stages approval process to facilitate proponents along their development phase.

Even though port authorities and operators have developed frameworks to assist the development of a port masterplan, a proper mechanism to subsequently evaluate these port masterplans during development, implementation, and monitoring stages would promote an unbiased process during distinct stages of the port masterplan development reducing the risks of the document become obsolete.

3. Challenges ports masterplan faces

Ports are vulnerable infrastructure systems exposed to numerous potential disruptive events along the years. These events could originate from internal or external influences, trade, war or "acts of god" and the extent, duration and magnitude of such are not able to be forecast during the planning phase with any great accuracy. They are factors with the potential to cause profound consequences in a port operation resulting in direct or indirect losses (Mansouri et al., 2010). Kleindorfer and Saad (2005) categorise disruptive events as risks to interrupt ports operation and it can be defined as natural hazards, terrorism and political instability.

A port masterplan is developed based on specific parameters that direct define how ports infrastructure will operate and develop in the future. Some parameters including future demand, shipping traffic and innovative technologies are considered key drivers because disruption on these parameters completely change the proposed port infrastructure defined during the preparation of the ports masterplan. These key drivers are exposed to constant change and if incorrectly established can result in a non-functional port operation.

After completion and implementation, a port masterplan can become a static document unable to manage uncertainties including future demand, shipping traffic and innovative technologies which consequently result in failure of the port masterplan to act as a planning document or failure of the port to adapt to change if strictly adhering to the plan. (Taneja et al., 2014).

Forecasting the demand involves the use of potentially complex and sophisticated methods. However, estimating future demand is essential to determine potential ports expansion development scenarios (Patil and Sahu, 2015). The forecast of future demand suggests optimistic and pessimistic projections to demonstrate ways to ports handle different demand capacities (Suryani et al., 2012).

Innovative technologies are emerging and the pace of change is increasing, exposing ports to a dynamic environment that is perpetually reshaping, and regularly demanding continuous preparation of ports systems to adapt for changes. Lee and Lam (2016) observe that one of the key drivers that directly impacts infrastructure development is innovative technologies.

However, most of the port masterplans do not adhere to what they have planned and are infrequently updated. This leads to ad hoc and often momentary or last-minute actions which are knee-jerk corrective adjustments in some cases entirely distinct from the port masterplan (Taneja et al., 2010). A case study presented by Taneja et al. (2010) describes the example of Nhava Sheva port in Mumbai, India. The plan was initially conceived involving two containers terminals and one bulk cargo terminal, but the demand of containers was wrongly forecasted. This required the port to convert the bulk cargo into a container terminal to accommodate for a substantial increased demand in containerised cargo. This is an example of how a ports masterplan falsely assumes the accuracy of its forecasts.

It is important to emphasize the importance of understanding the key drivers in a port masterplan, and demonstrate the vulnerability of port development to disruptive events. These parameters in most of the cases are difficult to conjure up during the port masterplan development stage. Therefore, it is imperative that a strategic data collection phase to identify the key drivers and the potential disruptive events should be completed in advance and clearly articulated throughout the port masterplan.

4. The need for a plan evaluation framework for ports masterplan

Plan evaluation has to be a rigorous method to assess plans and process results against a predetermined set of criteria (Laurian et al., 2010). It fosters accountability in planners and institutions presenting results, and effectiveness of the plan including expected and unexpected results (Leeuw and Furubo, 2008). Plan evaluation encourages improvement of plans, promotes transparency, and identifies efficiency and success; however, plan evaluation is not frequently adopted (Guyadeen and Seasons, 2015).

Evaluation is the key to turn the plan from a blue sky image to one which identifies the levers to be pulled to enable the best operation, and provides a framework on how and when to activate them. therefore an evaluation criteria should be implemented to evaluate plans during preparation, implementation, and after implementation

Plan evaluation is divided into three theoretical general methods: (i) rational; that concentrates on the connection between plans and current developments, (ii) communicative; that considers plans a guideline for future planning not restricting to original plan objectives., and (iii) pragmatic integrative; that considers a combination of rational or communicative approaches depending on the circumstances (Laurian et al., 2010).

Traditionally, plan evaluation compromises distinct stages including (a) Elaboration that occurs during preparation of the plan, (b) Implementation takes place during the applocation of the plan, and (c) Verification occurs after the plan is implemented to identify if the plan accomplished its goals, (Oliveira and Pinho, 2010).

Despite these different evaluation methods, ports masterplan should be evaluated during distinct stages of the planning making process by different type of evaluators, and It should have distinct criteria of what is being evaluated.

Plan evaluation can be defined in two important concepts, the conformance and performance based processes (Baer, 1997). The conformance or input based process follows plans as a blueprint document to meet the intend objectives by controlling the plan execution, whereas the performance or output based process the plan is used as a guideline and variations of the plan are if deemed necessary to meet a performance objective. Due to the complexity of port masterplan involving multiple disciplines, a distinct plan evaluation method is necessary to be adopted because the lack of a specific method to evaluate ports masterplan can compromise the efficacy of plans achieve its objectives.

The methodology selected to address the objectives of the ports masterplan evaluation framework involves the use of plan evaluation theory. The aim is to adapt the concepts of planning process model and the list of general criteria for plan assessment described by Baer (1997) and tailor to the evaluation of ports masterplans.

Baer illustrates distinct evaluation stages described for the plan evaluation process. Several types of evaluation can be applied during the development of a plan, thus a plan can be evaluated in any or all stages of the planning process. The types of evaluation include:

1. Plan assessment: It occurs in any stage of the process from the Problem Diagnosis to Evaluation stage.
2. Plan testing: It comprises of the testing of alternative plans and comparison of these to the base plan. The team that prepared the base plan conducts the comparison to alternatives.
3. Plan critique: It is conducted after the plan being published, but before the plan is implemented. The evaluation is executed by a team of people not involved in the planning preparation process.
4. Comparative research and professional evaluation: It is conducted after the plan being implemented. The evaluation is executed by a representative that was involved in the planning preparation process and a researcher.

5. Evaluation post hoc of plan outcomes: It is conducted after the plan is concluded and implemented. The objective is to confirm whether the plan was indeed implemented, how the plan performed, and how effective the plan was.

5. Results and recommendation

Port masterplan contents come in different forms and shapes in order to function in a range of diverse types of operations. However, most port masterplans lack a structured evaluation framework to assess ports masterplan effectiveness. In particular, it fails to recognize the potential change to key drivers and impact of disruptive events that critically affect the core premises of the port masterplan. Therefore, It is important to allocate a specific set of criteria in order to determine how the port masterplan should be evaluated during development, implementation, and outcome.

A specific port masterplan framework should be developed to do more than just categorize the level of success or failure of a proposed ports masterplan (Figure 2 - Ports Masterplan Framework) . The port masterplan evaluation framework should identify areas of the port masterplans that require corrective actions to refocus the ports masterplan in case disruptions in the key drivers occur.

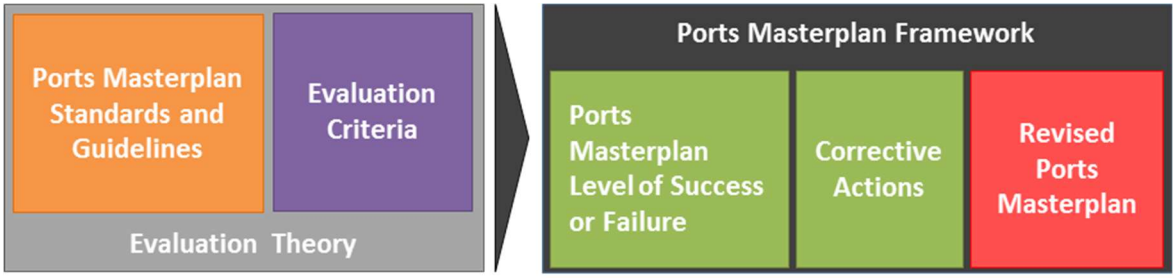

Figure 2 - Ports Masterplan Framework

The proposed port masterplan framework intends to be used by port engineers, operators, and other stakeholders to evaluate their plans. They are responsible to integrate a variety of stakeholders during the preparation stage of ports masterplan namely community representatives, government bodies, investors, and future potential clients.

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