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A New Hybrid Decision Making Framework for Prioritising Port Performance Improvement Strategies*

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ABSTRACT

This study aims to propose a conceptual decision making framework for prioritising port performance improvement strategies. It can be achieved by the concepts of benchmarking-best practices using analytic hierarchy process (AHP) incorporating a fuzzy technique for order preference by similarity to ideal solution (FTOPSIS) method. The leading performer (i.e. Busan New Port) and the poor performer (i.e. Busan North Port) are analysed as real cases to demonstrate the feasibility of the proposed methodology. The findings from the case study reveal that the terminal operating company (TOC) 2 represents a strong desire to choose the given strategies to improve its performance, followed by TOC3, while TOC1 has the least intention to adopt the given strategies. Amongst the 30 strategies of a benefit feature, optimisation of yard stacking planning (S4) is ascertained as the most crucial one to be implemented, followed by optimisation of berth to yard operations (S27) and optimising crane availability (S2). On the other hand, the formal training/education programmes from external professionals (S7) is identified as the most useful strategy among the 8 cost items. The results yielded by the framework present the ranking of strategy options in terms of their preference to different TOCs, which enables decision makers to find optimal solutions to improve performance under their own dynamic business environments.

1. Introduction

A number of management tools such as benchmarking, total quality management (TQM), 6 sigma, objectives based management, just-in-time, quality assurance and the like in the context of quality and strategic management have been developed to aid organisations to improve their

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performance. In the past three decades, companies have dedicated to the quality control practices in order to adapt themselves into the total quality management in the whole business process. Companies in either a private or public business have paid much effort and time to obtain the international certification and integrated management systems such as Malcolm Baldrige National quality Award and ISO 9000(1) series. They enable companies to adopt quality practices, and to improve their business process and operational efficiency, compromising toward competitive advantages (Kafetzopoulos et al., 2013).

In this regard, Ha et al. (2015) proposed a port performance measurement model that enabled to identify the strengths and weaknesses of the container ports/terminals and offered insights to find optimal strategies to improve their performance. The poor port performance indicator (PPI) score needs to be improved with reference to the associated PPI performance in a leading performer. This study is a consecutive work of port performance measurement by Ha et al. (2015). In this study, the best practices of the Busan New Port (leading performer) is used as a benchmark to improve the weak PPIs in Busan North Port (poor performer) as a case study. The list of performance improvement strategies for Busan North Port is identified through interviews with terminal operating companies (TOCs) in major Asian ports and literature review. Through benchmarking the best practices of the leading performers the Busan North Port can manage its idle resources' problems, to control the effective costs allocations and to encourage better relationship with port stakeholders in an effective way. However, scholars and practitioners have done little on the development of the novel framework for prioritising port performance improvement strategies in the literature. This study therefore aims to propose a conceptual decision making framework for modelling PPI improvement strategies. This can be achieved by the concepts of benchmarking the best practices using an analytic hierarchy process (AHP) incorporating a fuzzy technique for order preference by similarity to ideal solution (FTOPSIS) method within the Multiple Criteria Decision Making (MCDM) context.

In the next section, the literature on benchmarking modelling and MCDM approaches applicable in selecting port performance improvement strategies (i.e. AHP and FTOPSIS) is reviewed. In section 3, a new hybrid decision aid tool on port performance improvement by incorporating AHP and FTOPSIS in a benchmarking framework is presented within the context of a Busan North Port case study. Finally, the paper concludes with a discussion of results and recommendation for further research in Section 4.

2. Literature Review

2.1. *Benchmarking (Best Practices)*

Benchmarking (or best practice) has been considered as the best way to monitor a firm's own performance and to learn from the competitors (Cassell et al., 2001). The principles or beliefs of benchmarking that can lead to superior performance on a continuous basis encouraged companies to benchmark on the best performer in the industry. The term of benchmarking traces back to the late 1970s, which Xerox Corporation, a pioneer of benchmarking in the US, compared its manufacturing costs with those of domestic and foreign competitors (Camp, 1992). Benchmarking is not just comparison, emulating or stealing but a process of searching out the basis for creative breakthroughs (Elmuti and Kathawala, 1997). The definition of benchmarking is defined with various manners but the core concept is essentially expressed within a similar idea with the term of "best practices" for organisational continuous performance improvement (Camp, 1992, Partovi, 1994, Elmuti and Kathawala, 1997). However, the performance improvement or business excellence cannot be achieved through simply imposing "best practices", instead the "best practices" should be incorporated to their own style. Benchmarking types have been defined in various manners but they are generally classified in terms of following questions: 1) what is compared and 2) what the comparison is being made against (McNair and Leibfried, 1992, Bhutta and Huq, 1999). As seen in Table 1, the combination of the performance benchmarking and competitive benchmarking looks more relevant than others and hence can brings better outcome in this study. This justifies a logical approach in terms of their mutual relevance, which the benchmarking-practices between the adjacent ports, Busan New Port (leading performer) and Busan North Port (poor performer), are applied as a case study.

Table 1
Types of benchmarking and their mutual relevance

	Internal	Competitive	Functional	Generic
Performance	M	**H**	M	L
Process	M	L	H	H
Strategic	L	H	L	L
Relevance/value:	High: H Medium: M Low: L			

Source: Adapted from McNair and Leibfried (1992)

2.2. *AHP and FTOPSIS in Port Performance Improvement*

The measurement of PPIs' improvement strategies is a typical MCDM under uncertainty. The MCDM problems can be often assessed imprecisely due to uncertain and incomplete data related to different quantitative and qualitative determinants (Yang et al., 2009). In order to tackle the problems, it needs sophisticated tools that are already proven to be successfully applicable for dealing with MCDM problems under uncertainty. In the MCDM practical applications, a number of linear weighting techniques (i.e. AHP and TOPSIS) have been successfully applied (Yang et al., 2011). These techniques are based on the principle that the higher the weights/performance ratings are, the more desirable the alternatives. The weights/performance ratings assigned to/against criteria are mostly obtained through subjective judgements and the scores are synthesised as a single value for each alternative to select the best solution from the alternatives. In this study, a hybrid approach of AHP and fuzzy TOPSIS for solving MCDM problems under fuzzy environment is applied to address the choice of TOCs' strategies for improving performance. AHP is a suitable application when comprising the importance or rating of a criterion against that of other criteria at the same level in a hierarchy decision tree (Saaty, 1980). The weights of criteria in the fuzzy TOPSIS can be obtained using pair-wise comparisons or simple rating methods (Chen, 2000). However, the latter does not cater for the assurance of the assessment consistency between the criteria (Yang et al., 2011). An AHP method makes the judgements more reliable through consistency ratio investigation (Saaty, 1980).

In this study, in order to obtain the relative weights, a number of selected experts are approached to respond to a question such as "which strategy should be emphasised more to improve PPI performance, and by how much more?" A series of pairwise comparisons are conducted based on the Saaty's nine-point scale ranging from 1 (equal) to 9 (extreme). The consistency of the pairwise judgements is obtained by calculating a