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Applying multi-criteria analysis in a port system

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Abstract

This work presents a study developed in a medium port system composed of 50 public and private actors interacting with their macro-environment, which can generate strategic synergistic relationships. In order to determine these synergistic links between their components, the strategic phrases contained in their missions are analysed and classified according to the multi-criteria that are part of the macro-environment of each port actor: political, economic, social, technological, environmental, risk and learning. Likewise, new characterizations and classifications are proposed for groups and sub-groups of port actors. From absolute frequencies, Contingency Tables and the Chi-square test, quantitative results are obtained, which show the potential cases of strategic synergistic relations in the port system and the behavior of each group and sub-group of actors, as well as dependence / independence between every pair of criteria. Finally, it is verified that it is possible to use quantitative methods to analyze the strategic synergistic relationships between the actors of the port system.

Keywords: Multi-criteria; strategic information; statistical analysis; Port System

1. Introduction

A publicly owned port is understood as a complex system and, at the same time, a mixed network interacting with a suitable degree of synergy, becoming more competitive at a global level. The network is coordinated by a Port Community comprising a Port Authority and actors from the Terminals who, by law, manage strategic purposes and actions with the remaining public and private actors interacting with it [1-2-3]. The Port Community makes strategic decisions that affect business and operational relationships it holds with other actors who interact and integrate the port system, as those private enterprises providing services to the export and import logistics chains, trade associations, social groups and public components that play a regulatory role [3-4].

Furthermore, the port business is subject to frequent changes coming from the macro-environment, which may not be part of the annual Strategic Planning devised by the Port Authority and the State. The interaction with

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political, economical, social, technological, environmental, risk and learning multi-criteria, exogenous to the port industry, generates uncertainty in the management and development of port activities [3-5-6-7].

Concerning the research done and focused on ports, it should be pointed out that between 2005 and 2009 most publications deal with a conceptual analysis in fields like Economics, Geography and Research of Operations and a low percentage of studies are focused on statistical analysis in port organizations [8]. Likewise, varied authors have explored different attributes of the above multi-criteria: previous works have confirmed the existence of strategic synergy between politics and technology because of a relationship of slightly inverse dependence between them [1]. Applying both the Matrix of Eigenvalues and the Matrix of Pearson Correlation, existing synergic relationships between two port actors were explored [9]. The impact of the economic aspect in a port was examined by using the Solow model and the econometric analysis [10]. The cluster analysis was used to study the relationship between the economic and the environmental aspects of a Spanish port system, where the relationship between both aspects was determined [11].

In a qualitative way, an inverse correlation between the agglomeration of actors and the financial results was also determined [12]. In addition, the pressures on the Port Authority were studied. They can be economic, produced by market influence; public, coming from the government; and social tension, caused by negative external issues due to port development [13]. In relation to technology, there is a link with the strategic need to develop ICT; as for knowledge, the actors of the Port Community have a relational or commercial capital when dealing with providers/clients but require structural capital from other enterprises in order to develop new technologies [14]. It is concluded that external political, social and technological factors neither always show any coherence, nor take the same direction [13].

Other studies state that the multi-criteria of the micro-environment can present synergic relationships between them; however, it is noticed that it is difficult to generate technological synergy in terms of innovation when there is intervention of political aspects [15]. With regard to the economic aspect, it is linked to a network of actors under risk, which, consequently, may affect profitability [16]; in relation to the information and knowledge shared through the green social network, it is linked to the sustainable development of an industry [17]. Thus, in ports, we can find synergy among logistics, urban economy, environmental protection, government laws and policies [18].

Based on the qualitative data from the available strategic information [1], a statistical analysis was performed using Contingency Tables [19] and the Chi-square test [20] of independence to identify eventual synergy relationships quantitatively between the 50 actors who comprise the port system and the political, economic, social, technological and environmental multi-criteria. As a result, it was determined that in those cases where the application conditions of the statistical tests are met, there is a low amount of strategic synergistic relationships, and a slightly inverse relationship between the political and technological criteria. In this research paper that study has been expanded and two additional criteria have been incorporated: risk and learning. It is a descriptive study on the presence of synergy in the multi-criteria, and the strategic attributes found in the mission statements of each port actor have been determined.

2. Multi-criteria of the Port System

2.1. Determining the strategic criteria

The Chilean port system comprises 50 private and public actors (including a private non-profit enterprise) who individually declare their mission statements as an expression of strategic purpose which may be the outcome of the Strategic Plan declared to achieve a leading level in a complex system [1-3-8]. As presented in Table 1, for each strategic purpose a relationship with the macro-environment can be determined which can be classified as a specific criterion: political, economic, social, technological, environmental, risk and learning [1-