Cognitive Strategic Model applied to a Port System ☆

Felisa Córdova [1,*],   Claudia Durán [2], and   Fredi Palominos [3]

[1] *Faculty of Engineering, University Finis Terrae, Avda. Pedro de Valdivia 1509, Providencia, Santiago, Chile.*
[2] *Faculty of Engineering, Universidad Tecnológica Metropolitana, Dieciocho 161, Santiago, Región Metropolitana, Chile.*
[3] *Department of Mathematics and Computer Science, Universidad de Santiago de Chile, Avda. Ecuador 3769, Estación Central, Santiago, Chile.*

A R T I C L E   I N F O.

Abstract

Port organizations have focused their efforts on physical or tangible assets, generating profitability and value. However, it is recognized that the greatest sustainable competitive advantage is the creation of knowledge using the intangible assets of the organization. The Balanced ScoreCard, as a performance tool, has incorporated intangible assets such as intellectual, structural and social capital into management. In this way, the port community can count on new forms of managing innovation, strengthening organizational practices, and increasing collaborative work teams. In this study, the concepts from analysis of the cognitive SWOT are applied to diagnose the port activity and its community. In workshops with experts and from the vision, mission, cognitive SWOT and strategies, a cognitive strategic map considering strategic objectives and indicators is designed in the customer, processes, and learning and growth axis for the port and port community. Causal relationships between objectives, associated indicators and incidence factors are established in a forward way from learning and growth axis to customer axis. Then, the incidence matrix is developed and the direct and indirect effects between factors are analyzed, which allows recommending the future course of the port and its community.

1   Introduction

The traditional approach applied to increase efficiency in ports and their terminals has been through large investments in physical assets, either in equipment or infrastructure which have mainly been used in port subsystems such as: a) Models with an econometric orientation, in problems of supply and demand of goods and services [1, 2]; Analytical Models of Operational Research using mathematical functions that can be solved by algorithms with restrictions and hierarchical analysis [3, 4]; c) Simulation Models having specific numeric methods to analyze flows with a large number of variables and restrictions in optimizing some functions [5, 6].

In order to measure the performance in an organization it is possible to use the Balanced ScoreCard method, as a managerial level management system where vision and strategies are central [7, 8]. With

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the BSC, the strategic aims of an organization can be translated into a set of performance measures, determining the trend a company takes towards the fulfillment of its goals, reaching their four axis: financial, customers, business and learning processes; establishing cause and effect relationships among the strategic objectives in a map, connecting current and future objectives and actions [9]. The BSC identifies those factors that create long-term economic value in a company, and combines the outcome measures with future performance drivers. All of these measures help to verify the success or failure of any strategy used.

The strategic map is modeled according to a variety of connections among the strategic objectives which show the existing dynamics among themselves since one or various objectives in an axis may exert influence over one or more strategic objectives in the other axis [8, 9]. If the coupling order between objectives in each axis, or among them, is unknown, nor is it known how they influence over the chain of events. Likewise, it is necessary to detect the degrees of causality between the different objectives of the strategic map where positive or negative influences should be measured.

It is vitally important to determine the status of the strategic map, based on the combination of the possible states of the strategic objectives in the different axis using first and second order incidences matrices [10]. At the same time, BSC preparation workshops are carried out with experts who provide their perceptions of the relationships and variables used which, in due course, are integrated in the strategic concepts map of relationships [11]. Qualitative expressions are required to be represented quantitatively, allowing this to determine positive, negative or null correlations among the critical success factors. In case of indirect correlations between them, the expert will have to re-evaluate that situation [10].

For the elaboration of a strategic map, this study takes into account the cognitive SWOT diagnostic, vision, mission, and strategies of a medium-sized Chilean port system as entry elements. While for the learning and growth axis, it focuses on aspects related to the intellectual, structural and social capital [12, 13].

2 Knowledge Strategy Management Model

2.1 Port Cognitive SWOT

To determine the strengths, weaknesses, opportunities and threats of the medium-sized port, an external and internal analysis is carried out [10, 14]. Each are described briefly as follows:

Strengths

Intellectual Capital: a) Training programs, Certifications and Continuous Education in the areas of Operations Management and Logistics, Energy Efficiency are developed by Port Companies; b) Companies involved in port activities compromise an ethical conduct in the processes of decision making.

Structural Capital: a) Companies participating in logistic chains contribute to the continuous enhancement of processes in the port; b) Information Technologies ICT increase the role of governance, also the port management; c) Companies participating in the port community are recognized by their good logistic services; d) Port community demonstrates a permanent concern on media communication; e) Logistics forum, analyze and optimize documentary exchange processes; f) Logistics forum communicate knowledge transfer between the agents participants of the port community and society.

Relational Capital a) Companies from logistic chains primarily use commercial criteria, and in some cases, environmental and social criteria in control and management systems; b) Port community is concerned on media communication, c) Companies participating in logistic chains are involved in commercial criteria, and only in some cases, with social and environmental criteria.

Weakness

Intellectual Capital: a) A lack of synergy of knowledge as well as of innovation networks involved in port activities is perceived; b) Companies involved in port activities are interested in maintaining an ethical behavior in their operations and in decision making process.

Structural Capital: a) A lack of operational coordination between the actors of the logistics chain is perceived; b) Some lacks in the communications network are perceived in the case of emergencies; c) Companies are affected by bottlenecks, in some of the services provided by their platforms.

Opportunities

Structural Capital: a) Public institutions participating in the port community wish to provide specialized services in transport, transfers, and services related to this activity; b) Some private companies are developing innovative initiatives adding value to the community members.

Threats

Structural Capital: a) The population living in the city near the port is not aware of the role of the port. They don't recognize the strategic role of the port neither its importance as an institution; b) Society

only considers the port when negative externalities occurs and directly affects the population.

Relational Capital: a) There are informal relationships in actors involved in the port community due to border problems between countries.

2.2   Port Cognitive Diagnostic Process

Strategic, business and operational aspects that can be identified with the Cognitive SWOT are highly relevant for knowledge generation. They are necessary because those who make decisions have to transform data and information into knowledge in order that the Port Administrator and Terminals can make long- and mid-term decisions [14, 15].

Figure 1 shows a cognitive diagnostic depicting the relation of learning aspects with strategic aspects.

The Port Community Mission includes the strategic needs of the other public and private actors who belong to the export and import logistics chain and who contribute to the competitiveness of the port, being these the main ones:

- The shipping company delivers excellent customer service and shipping while caring for the environment and culture of the countries involved.
- The Customs Chamber of Chile manages ethical and social responsibility standards assuming the leadership of the sector at national and international levels.
- The Production Promotion Productivity Development Corporation (CORFO) encourages entrepreneurship and innovation to improve productivity of companies, and achieve a world leadership position in the field of competitiveness.
- The Roads Directorate safeguard their quality of life, promoting ethnic, social, gender equity, safeguarding road safety, systematically incorporating innovative technologies in the field of roads and transportation, also giving environmental sustainability.
- Social, ethical and environmental responsibility standards are managed by public institutions and private companies.

Based on the strategic needs of the actors who collaborate with the community, a new mission is defined with focus on coordination og the multi-modal logistics chain of the port. This guarantees a comprehensive provision of port services for customers within a framework of permanent technological innovation with high levels of service quality. Thus, placing the port administrator and its terminals in a position of leadership with respect to the other actors that
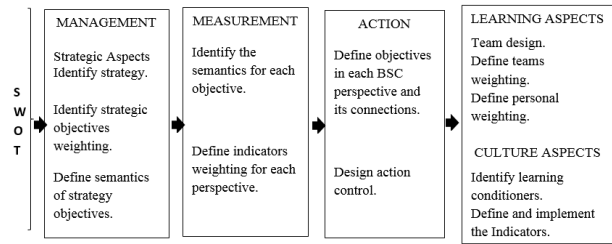

Figure 1. Cognitive diagnosis in a medium-sized port system.

collaborate with them [15].

3   Strategic Map, Indicators and Incidence Matrices

3.1   Strategic Map of the Port System

Axis and strategic objectives are classified according to the Mission of the Port Community:

Customers' axis (C) and its objectives are:

- OC_1: Improve the relationship of the port community with the city.
- OC_2: Increase the quality of services to port customers.
- OC_3: Comply with the good practices generated in the port community.

Processes axis (P) and its objectives are:

- OP_1: Coordinate actions of the port multimodal logistics chain.
- OP_2: Provide transport and transfer logistics services.
- OP_3: Increase control of port security.
- OP_4: Improve the transactional processes in logistics chains.

Learning and growth axis (LG) and its objectives are:

- LGO_1: Improve Information Technology (IT) Management.
- LGO_2: Introduce good practices in logistics processes.
- LGO_3: Increase innovation technologies and networks.
- LGO_4: Provide continuing education to the members of the port community.

The Strategic map, shown in Figure 2, is made up of the strategic objectives from each of the above axis.

3.2   Outcome Indicators and Incidence Matrices

Each strategic objective is matched to an indicator as shown in Table 1.

Based on Figure 2 and the opinion of experts from 2 Chilean ports, the incidence matrix in Table 2 is
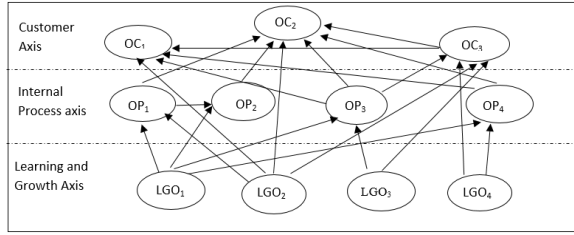
Figure 2. Outcome Indicators and Incidence Matrices.

Table 1. Incidence matrix

Strategic Objective	Indicators
OC_1	Waste of time for citizens due to traffic jams in access ways to the city
OC_2	Percentage of improvements in technological connectivity in multi-modal logistics
OC_3	Total protection mechanisms for user information
OP_1	Amount of actions for the prevention of risks for the transport of cargo
OP_2	Number of permits used in Terminals
OP_3	Occupational Accident Rate
OP_4	Percentage of transactional documentation processed online
LGO_1	Total Information processed online by the Port Administrator
LGO_2	Percentage of approval of quality certifications
LGO_3	Level of implementation of the Port Community Systems (PCS)
LGO_4	Number of Safety Training courses

Table 2. Incidence matrix

DIM	OC_1	OC_2	OC_3	OP_1	OP_2	OP_3	OP_4	LGO_1	LGO_2	LGO_3	LGO_4
OC_1	1	0	0.8	0	0	0.5	0	0	0.7	0	0
OC_2	0	1	0.7	0.9	0.8	0.6	0.8	0	0.8	0	0
OC_3	0	0	1	0	0	0.4	0	0	0.9	0.6	0.8
OP_1	0	0	0	1	0	0	0	0.4	0.7	0	0
OP_2	0	0	0	0.7	1	0	0	0.7	0.4	0	0
OP_3	0	0	0	0	0	1	0	0.6	0	0.8	0
OP_4	0	0	0	0	0	0	1	0.9	0	0.8	0.7
LGO_1	0	0	0	0	0	0	0	1	0	0	0
LGO_2	0	0	0	0	0	0	0	0	1	0	0
LGO_3	0	0	0	0	0	0	0	0	0	1	0
LGO_4	0	0	0	0	0	0	0	0	0	0	1

Table 3. Matrix of indirect effects of first order

DIM	OC_1	OC_2	OC_3	OP_1	OP_2	OP_3	OP_4	LGO_1	LGO_2	LGO_3	LGO_4
OC_1	1	0	1.6	0	0	1.32	0	0.3	2.12	0.88	0.64
OC_2	0	1	1.4	2.36	1.6	1.48	1.6	2	3.18	1.54	1.12
OC_3	0	0	1	0	0	0.8	0	0.24	1.8	1.52	1.6
OP_1	0	0	0	1	0	0	0	0.8	1.4	0	0
OP_2	0	0	0	1.4	1	0	0	1.68	1.29	0	0
OP_3	0	0	0	0	0	1	0	1.2	0	1.6	0
OP_4	0	0	0	0	0	0	1	1.8	0	1.6	1.4
LGO_1	0	0	0	0	0	0	0	1	0	0	0
LGO_2	0	0	0	0	0	0	0	0	1	0	0
LGO_3	0	0	0	0	0	0	0	0	0	1	0
LGO_4	0	0	0	0	0	0	0	0	0	0	1

constructed. From this, the matrix of indirect effects of first order (R2) is obtained and shown in Table 3.

Table 4. Matrix of indirect effects of second order

DIM	OC_1	OC_2	OC_3	OP_1	OP_2	OP_3	OP_4	LGO_1	LGO_2	LGO_3	LGO_4
OC_1	0	0	0.8	0	0	0.82	0	0.3	1.42	0.88	0.64
OC_2	0	0	0.7	1.46	0.8	0.88	0.8	2	2.38	1.54	1.12
OC_3	0	0	0	0	0	0.4	0	0.24	0.9	0.92	0.8
OP_1	0	0	0	0	0	0	0	0.4	0.7	0	0
OP_2	0	0	0	0.7	0	0	0	0.98	0.89	0	0
OP_3	0	0	0	0	0	0	0	0.6	0	0.8	0
OP_4	0	0	0	0	0	0	0	0.9	0	0.8	0.7
LGO_1	0	0	0	0	0	0	0	0	0	0	0
LGO_2	0	0	0	0	0	0	0	0	0	0	0
LGO_3	0	0	0	0	0	0	0	0	0	0	0
LGO_4	0	0	0	0	0	0	0	0	0	0	0

Finally, through the difference, $R^2 - R$, indirect effects of second order are obtained in Table 4, whose incidence is greater than that of the first (R^2).

4 Discussion and Results

Based on the results obtained in the matrix of indirect effects in first order, it is possible to observe that the strategic objective of introducing good practices in the logistics processes (LGO_2) has a great influence on the objectives of improving the relationship of the port community with the city (OC_1) showing an incidence factor of 2.12 and increase the quality of services to port customers (OC_2) with an incidence factor of 3.18. It is also perceived with a strong influence coordinating actions of the port multi-modal logistics chain (OP_1) over (OC_2) with an influence factor of 2.36. The information processed online by the port operator (LGO_1) has an influence over providing transport and transfer logistics services (OP_2) with a factor of 1.68. Likewise, it is deduced from the second-order incidence matrix that introducing good practices in logistics processes (LGO_2) has a strong impact on increasing the service quality to port clients (OC_2) with an influence factor of 2.38 . This improves the relationship of the port community with the city (OC_1) with a factor of 1,42. The influence of coordinating the actions of the port multi-modal logistics chain (OP_1) on increasing the quality of services to port customers (OC_2) with a factor of 1.46 is also highlighted.

5 Conclusion

The Knowledge Strategy Management Model designed is an effective tool for the management of complex organizations. The diagnosis based on the Cognitive SWOT has made it possible to detect the influence of intellectual, structural and social capital of the port community. The cognitive strategic map guides the expert in the causal relationship of strategic objectives, indicators and quantitative evaluation. Finally, the matrices of incidence of first and second order help the expert to validate his/her criteria.

Acknowledgment

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Felisa Córdova is graduated in Electrical Engineering at the University of Santiago of Chile USACH. She obtained the D.E.A. in Electronics and the Docteur Ingenieur degree at the University of Paris XI, France. Now she is Professor and Director of the School of Engineering at the Faculty of Engineering at University Finis Terrae, Chile. Her main research interests include Neuromanagement and Neuromarketing, Strategic and Operations Management and Knowledge Management of the Supply Chain.

Claudia Durán received M.S. and Ph.D. degrees in industry from University of Santiago de Chile. In addition, she is a Civil Industrial Engineer from the University of Chile. Now, she works in the Department of Industrial Engineering of the Universidad Tecnológica Metropolitana as an academic. She has been a researcher in different projects related to data science and management decision making. Her current research interests include data science, knowledge engineering and logistics management in private companies and public organizations.

Fredi Palominos has a PhD degree in Computer Science and Magister in Statistics. He is currently an academic member of the Department of Mathematics and Computer Science of the University of Santiago de Chile (USACH) and has been a researcher in different types of projects. In the field of academic management, he has been Director of the Department of Mathematics and Computer Science and Director of Continuing Education of USACH. His activities focus on the development of teaching in higher education, database technologies and information technologies.