The container terminal characteristics and customer's satisfaction

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Abstract:

This paper attempts to evaluate and understand the port sector senior managers' perception relative to the influence of the port characteristics and specific container terminals in customers' satisfaction. The SEM (Structural Equation Modelling) methodology is used to confirm the investigation model. The sample is composed by 151 valid responses, each one of them regarding a specific terminal of a set of 12 Portuguese and Spanish container terminals. The results confirm the influence of the port and container terminal characteristics in customer's satisfaction.

Keywords: Port characteristics, container terminal, customer's satisfaction, SEM.
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1. Introduction

The containerized cargo has experienced a fast growth with the hinterland and transhipment expansion occurred in ports at the crossing points of shipping trade lanes and inland economic centres. The container traffic growth has caused a great demand for port container terminals, requiring more investment in new terminals, intensifying competition between nearby port terminals and within the same port, questioning customers' loyalty based on their search for satisfaction maximization. In such a strong competitive environment and in order to regain customer´s loyalty, it is important to maximize the level of customer's satisfaction.

The shipper (cargo owner) chooses the port and the container terminal according to his satisfaction regarding several characteristics of the terminal, concerning infrastructures, reputation, maritime services, service quality and terminal organization. Besides the strategic position of the port, liner services shipping companies search for reliability, service quality and lower costs per call and optimized turnaround times.

According to Cullinane et al. (2004) containerisation has facilitated the globalization of maritime services based on alliances and acquisitions of regular lines (horizontal integration) and on global door-to-door logistic services provided by shipownere (vertical integration). It was enhanced by the enlargement of the inland transport infrastructures and by the creation of connections between logistic centres and port terminals, which form bipolar systems (Dias et al., 2010).

Vessels have enlarged their size, reducing container freight rates, big hub ports emerged enlarging its hinterlands and feeder influence zones, and competition between ports for hinterlands and for the main shipping trade routes has grown. As a consequence, the shipping companies gained more bargaining power demanding higher performance, a better quality service and lower prices, becoming more and more disloyal (Wang and Cullinane, 2006).

The choice is increasingly being made by logistic chain operators connected to specific shipping lines, based on the accomplishment of price and quality service levels that can meet the requirements of complex systems of logistic chains.

In a competitive environment, customer's satisfaction regarding the container terminal is determined by several factors, such as its physical and organizational ability, integration in logistic chains, the maritime and inland accessibility, the type of quay handling equipment, as well as the inland service and shipping networks connected (Tongzon and Heng, 2005).

The thorough knowledge of the holistic relationship between the port and the container terminal characteristics and customers' satisfaction is essential to improve the performance of existing terminals and to build new ones that can be more competitive and adequate to customers' needs, especially those of global logistic operators. This issue is essential, both from the terminal operators' perspective which aim at higher traffic volumes and financial returns, and from public entities and port authority's perspective, which expect large economic port impacts and better service to the nearby region.

This paper is justified by the insufficient knowledge of the relationship between port and container terminal characteristics and the container terminal customer's satisfaction (Estache et al.,2005). There are a limited number of studies which use the structural equation model methodology and usually they are based only on factors reduction without confirmatory analysis of the complete structural model (Woo et al., 2011; Chang et al., 2008).

The purpose of this study is to evaluate the perception of the port sector senior managers concerning the effects of port and specific container terminals characteristics on determining the terminal customer's satisfaction.

The objectives are to analyse the effect of port specialization, inland port and terminal infrastructure, maritime terminal services and terminal logistic organization and integration in the terminal customer's satisfaction. The main questions addressed in this study are: Why do some container terminals satisfy their customers better than others? How to satisfy the container terminal customer? These questions were not fully answered in previous studies.

This paper is organized in the following way: after the introduction, the theoretical background and methodology are presented and the results analysed. After discussion, conclusions, limitations and future investigation are proposed.

2. Theoretical Background

Customers' satisfaction has become vital issue for companies regarding product's improvement and to guarantee customers' loyalty in markets exposed to fierce competition. Customers' satisfaction models are based on perceived performance of services, perceived value, brand image and customers' expectations with service quality levels (Cronin et al., 2000).

On ports and container terminals the quality results from infrastructures and port and terminal services, which we call port and terminal characteristics. The main customers are the ship owners, who choose which ports to call, the shipping agents, and the shippers, who are usually represented at ports by the logistic chain operators (Magala and Sammons, 2008), as the final customers often ignore which port or logistic route is used.

According to Robinson (2002), from time to time new values emerge changing an old fashioned business to others that better satisfy customer's needs, as their priorities change. In a changing environment, it is essential to understand how modern container terminals can actually satisfy customers. Nowadays, logistic functions are becoming increasingly integrated within inland networks and megacarrier maritime ones. Value has changed from individual logistic functions to the integration of supply chains on the hands of global logistic operators. The fulfilment of customers' needs and their satisfaction goes beyond the efficiency that was traditionally considered in the perspective of infrastructures (Robinson, 2002). This means that the creation of value has changed from the simple container terminal operation to an integrated service, delivered to the final customer's door, including inland transportation and intermediate logistic areas.

As referred by Magala and Sammons (2008) the selection of a port has become more a function of the overall logistic chain performance that provides an full integrated service. The selection process is based on port factors, shipping lines and inland transport. In the port, selection criteria such as accessibility, efficiency, quality, level of integration in the logistic chain, flexibility and rates are to be considered. Marlow and Paixão (2003) also pointed out agility.

In the selection of a shipping line, factors such as frequency, transit time, freight rate, and level of integration within the logistic chain are pointed out. However, the shipping line's selection is necessarily interrelated with the port choice, as shipping companies also choose the ports to call based on several factor such as location, markets, efficiency, services and infrastructure prices and quality. Therefore, from the port perspective, the services and infrastructures provided should simultaneously satisfy both logistic chain and shipowners within their selection process.

Port specialization as a choosing factor, namely the containerization rate, was mentioned by Trujillo and Tovar, 2007, Medda and Carbonaro, 2007 and by Laxe, 2005, and it reflects the port evolution degree, from its industrial phase to a modern and commercial port. Ports specialized in containers usually obtain higher efficiency levels in the use of quay infrastructures.

A specialized port achieves higher efficiency levels once its specialized infrastructures in certain types of cargo are maximized to return the highest productivity of all specialized services.

Frequent container line services allow a wider choice, greater flexibility and less transit times, being associated to a higher specialization of the port in containers (Tongzon, 2002). Also, alliances and specialized logistic networks in which maritime services are integrated also determine customers' satisfaction (Tongzon and Heng, 2005).

Inland infrastructures, especially inland accessibilities, are very important to enlarge the hinterland and contribute to a higher terminal performance. The hinterland and the terminal influence area are conditioned by transport costs, alternative modes, capacity and quality of inland accesses, as well as by the integration in the main inland networks.
Turner, Windle and Dresner (2004) confirmed the importance of inland and maritime accessibilities impact on performance and Gaur (2005) identified factors that affect the terminal performance such as maritime access and connections with the hinterland.
Accessibilities are the port entrances and exits and they allow traffic flows to be performed in a more efficient way, which seems to be a decisive factor when choosing a port and contributing for customer's satisfaction.
Modal integration and the reduction of production functions and stocks in factory units with JIT (Just in Time) have developed logistic services along the transport chain and in connection with inland terminals, taking advantage of cargo waiting times to distribute production phases.
The new value-added logistic operations such as pre-assemblies, order preparation, order response, labelling, packaging and distribution have become a reality in larger ports. In order to do so, ports expanded their areas to attract logistic services which are decisive for the container terminals performance located in those ports.
The port terminal infrastructure is also vital for service quality. Hung et al. (2010) used variables such as the terminal area, quay cranes, quays berths and the quay length. While analysing efficiency, several authors used the terminal area and quay length as variables of the productive factor "land" and the number of quays, park cranes and reach stackers for the productive factor "capital".
Wu et al. (2010) used the capacity of handling equipment, number of quays or berths, terminal area and storage capacity as variables of the container terminal infrastructure. The latter is an important variable to customer's satisfaction and it may be represented by terminal width and layout, which configure an overall vision of the inland terminal infrastructure.
The terminal maritime services are vital to customer's satisfaction. The maritime accessibility limits the terminal capacity and determines the maximum vessel's size calling the port and so, the type and number of handling equipment to be used per vessel and the terminal depth, as well as maritime services to be provided. The maritime accessibilities affect the terminal efficiency by conditioning vessels size, freight rates and the quay productivity, which are reflected in the customer's satisfaction.
Tongzon (2002) and Wiegmans (2003) examined the importance of maritime accessibilities as being decisive for terminal efficiency. Maritime accessibilities define the type of market to which the terminal can have access to and determine the maritime services offer level to customers. The size of the vessels that call the container terminal is decisive in the hierarchical set of shipping line networks, being an essential factor for its performance.
The liner services determine the success of the ports they call based on their partnerships and the logistic networks in which they are integrated (Tongzon and Heng, 2005). Therefore, the port integration with maritime services is a question of the utmost importance, especially those linked with global operators and worldwide shipping companies.
Moreover, the integration of container terminals with important shipping liner services in large logistic international networks also allows them to offer a wider, global, and more complete service, with better quality and often more competitive.
In order to attract more cargo, first it is necessary to attract diverse, frequent and preferably global maritime services, especially those with direct calls or that use the terminal as a transhipment hub point or as a gateway to an enlarged hinterland, which are more attractive to logistic chains, because they offer low freight rates and reduced transit times as result of economies of scale and avoiding maritime and inland feeder links. The number and frequency of direct service calls from the world top10 shipping companies and the number of transhipment services are important variables to determine the customer's satisfaction level.

Both the container terminal internal organization and the degree of logistic integration are essential variables to container terminal customer's satisfaction, especially regarding the connection with logistic chains and concerning their needs. A manager focused on the customer's needs and logistic ones as well as terminal organization influence all the terminal services and customer's satisfaction.
The type of terminal organization more formal or informal, flexible or rigid, hierarchic or flattened is decisive to its agility and to the proper response to give to customers' logistic network's needs. The flexible organizational structure of the container terminal is important to provide an agile service that meets customer's demands (Liu et al., 2009).
Marlow and Paixão (2003) referred to the port operators ability to integrate their operations upstream or downstream the logistic chain, making use of value-added services, competing with other value-added chain systems. Cargo volumes are transported from the origin to the final destination using various routes and ports in networks designed to minimise the global cost, and maximise efficiency levels, productivity, reliability and effectiveness, especially in intermodal interfaces.
On the other hand, agility is considered to be one of the main characteristics responsible for the supply chain industry development. Thus, container terminals that are increasingly becoming important parts of the logistic chains must have agility characteristics (Liu et al., 2009).
Integrated in logistic chains, container terminals must pay special attention to their customer's requirements that improve their satisfaction levels, as well as and to logistic information systems that integrate several services providers. Internal flexibility, agility and capability towards cooperation depend on the terminal organization system, type of management and on the terminal managers' training (Liu et al., 2009).
Panayides and Song (2011) identified communication and information systems in the logistic chain as essential to performance, productivity and competitiveness of ports and supply chains. Information and communication systems can improve the efficiency of the supply chain operations, contributing to achieve its purposes (Cachon and Fisher, 2000).
Furthermore, information sharing contributes to a higher container terminal's integration level within the supply chains. It allows organizations to improve safety, reliability and velocity in a synchronized process with impact on costs and service quality (Zhao et al. 2002), because information systems avoid document duplication, maintaining data integrity along the transport chain and reduce costs.
The agility of a company must involve flexible communication systems and an agile organization in cargo handling operations, in storage, processing and transport. The agile techniques must be combined with an agile management in order to achieve true agility. Agile organizations include flexible and flattened organic, in circle or in network (Liu et al., 2009).
Agility is the container terminal characteristic that allows a fast adaptation and with reduced costs to requirement and programming changes. Agility involves equipment, software, organization, people, training, customer orientation and a fast response to market changes, and customer cooperation, adapting the terminal to their demands and their sudden changes.
Some variables used by Lui et al (2009) in terms of terminals agility include service level, productivity, service quality, flexibility, reliability, turnaround time and of terminal berth occupancy, time response to demand, training, "empowerment" and information sharing.
In a growing competitive environment, clearly terminals can no longer expect to attract cargo only because they are natural and important links or are well located. Terminals must be integrated in a logistic chain and well organised to meet the customer's requirements, in order to assure their satisfaction. In this context, the main logistic operators and freight forwarders are becoming the shipowners' most important customers, influencing the port terminals selection decision (Magala and Sammons, 2008).
Bichou and Gray (2005) confirmed the relationship between intermodality and organizational integration and the port integration in logistic chains. Intermodality is related to container

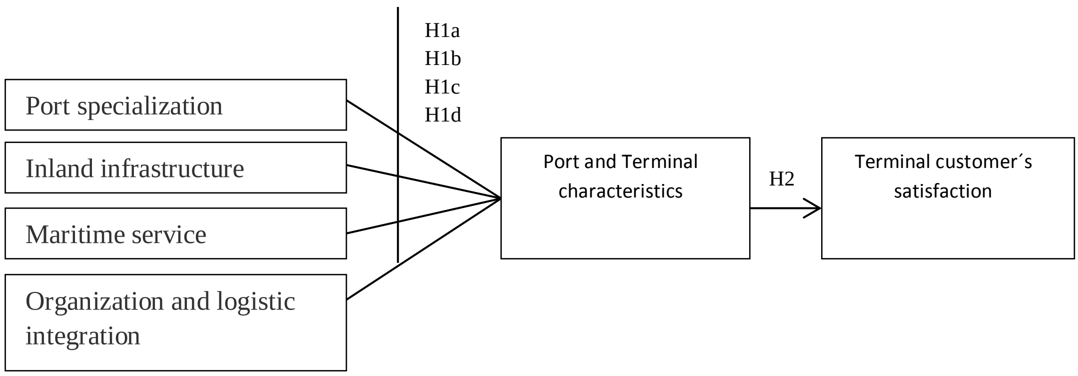
terminal management, organizational cooperation and efficiency. In the organizational integration context, the added value that ports can offer to logistic chains seems to be the key to succeed (Robinson, 2002).
Therefore, port integration in the supply chain can be achieved through information and communication technology, information sharing and through the introduction of added value to activities and handling operations.
Port integration in supply chains means a continuous improvement of lean management through the elimination of communication redundancy, waste, the reduction of handling costs, handling improvements and by offering value-added services to customers, specially contributing to shipowner's satisfaction (Panayides and Song, 2011).
The terminal reputation is also very important to customer's satisfaction. Cheon (2007) considered port marketing strategies, including communication and reputation, as essential to attract new liner services and traffic. Pando et al (2005), Pardali and Kounoupas (2007) and Cahoon (2007) analyzed the importance of port marketing tools to performance, which include communication as a way of changing the port reputation. Notteboom (2011) identified several factors related with the port demand, namely port quality service, its reputation and work developed by the port community in terms of marketing.

3. Methodology

3.1- Research model and hypothesis

The research model is based on the definition of a global conceptual and holistic model that includes port and terminal characteristics and attempts to establish a relationship between them and the terminal customer's satisfaction (Figure 1).

Figure 1 – Research model



Based on the theoretical background and research model, the following assumptions are settled:
Hypothesis 1a: Port specialization is an important characteristic of the port and container terminal;
Hypothesis 1b: Port and terminal inland infrastructure is an important characteristic of the port and container terminal;
Hypothesis 1c: Terminal maritime service is an important characteristic of the port and container terminal;
Hypothesis 1d: Organization and logistic integration of the terminal is an important characteristic of the port and container terminal;
Hypothesis 2: Container terminal customer's satisfaction is strongly influenced by port and terminal characteristics;

3.2. Constructs and variables

Based on literature and on the results of the exploratory analysis made to data resulting from the questionnaire, the port and terminals characteristics can be explained by four constructs: (i) Port specialization, (ii) Inland infrastructure, (iii) Terminal maritime service, and (iv) Organization and logistic integration.

Table 1 – Constructs and variables

Constructs	Variables	Authors
Container terminal customer's satisfaction	Shipper /logistic chain operator satisfaction	Robinson, 2002; Liu et al., 2009
	Shipowner's satisfaction	Liu et al., 2009
	Shipping agent's and freight forwarder's satisfaction	Liu et al., 2009; Magala and Sammons, 2008
	Satisfaction with productivity	Onut et al., 2011; Talley, 2006
Port specialization	Port specialization in container	Trujillo and Tovar, 2008
		Chou, 2010; Veldman et al., 2011; Onut et al., 2011; Tongzon, 2002;
	Frequency of port SSS/feeder services	Veldman and Buckmann, 2003; Hung et al., 2010
Inland infrastructure	Railway accessibilities	Juang and Roe, 2010; Onut et al., 2011; De Langen, 2004
	Road accessibilities	Juang and Roe, 2010; Tongzon, 2002, Wiegmans, 2003
	Terminal size	Sharma e Yu, 2009; Cullinane and Wang, 2010; Hung et al., 2010; Wu et al., 2010
	Terminal layout	Authors
	Railway connections to inland terminals	Juang and Roe, 2010; Chang et al., 2008; Bruce et al., 2008; Tongzon et al., 2009; Panayedes and Song, 2011; Panayedes and Song, 2009
	Logistic areas next to the port	Authors
Maritime service	Quay water depth	Wang and Cullinane, 2006
	Maritime access	Wang and Cullinane, 2006, Gaur, 2005; Turner et al., 2004
	Vessels size	Acochrane, 2008; Veldman et al., 2011; Turner et al., 2004; Hung et al., 2010
	TOP10 liner services frequency	Song e Yeo, 2004
Organization and logistic integration	Terminal reputation	Juang and Roe, 2010; Onut et al., 2011; Chang et al., 2008; Cheo, 2007; Pando et al., 2005; Pardali and Kounoupas, 2007; Cahoon and Hecker, 2007
	Type of terminal manager	Liu et al., 2009
	Overall services quality	Veldman et al., 2011; Woo et al., 2011; Juang and Roe, 2010; Hung et al., 2010;Liu et al., 2009
	Customer oriented terminal	Juang and Roe, 2010; Onut et al., 2011; Carbone and De Martino, 2003; Liu et al., 2009
	Terminal organization	Bicou and Gray, 2004; Robinson, 2002; Liu et al., 2009
	Information system	Carbone and De Martino, 2003; Panayedes and Song, 2009; Cachon and Fisher, 2000; Zhao et al., 2002; Liu et al., 2009
	Agility face to changes	Woo et al., 2011; Onut et al., 2011; Liu et al., 2009
	Operational and commercial flexibility	Liu et al., 2009
	Terminal reliability	Chang et al., 2008; Tongzon et al., 2009
	Berth produtivity	Onut et al., 2011; Tongzon et al., 2009; Juang and Roe, 2010; Liu et al., 2009
	Vessels waiting time	Onut et al., 2011
	Terminal integration in logistic chains	Juang and Roe, 2010; Tongzon and Heng, 2005; Hung et al., 2010; Panayedes and Song, 2009; Paixão and Marlow, 2003; Liu et al., 2009
	Terminal Handling charge	Onut et al., 2011; Song e Yeo, 2006; Veldman and Buckmann, 2003; Tongzon et al., 2009; Juang and Roe, 2010

3.3. Data collection and measurement

Data were collected based on a survey sent to the main Portugal and Spain container terminal's users. A question was addressed to each variable, concerning the evaluation of terminal characteristic and the customers' satisfaction level, using a 7-point Likert scale. The questionnaire was submitted to 1139 senior managers from companies operating in the selected terminals, with a 151 valid answers (Table 2).

The component of the survey relating to the construct Costumer's satisfaction was based on the question "Do you agree that the container terminal, which you identified, satisfies the customer?", after identifying each type of customer. The remaining variables were based on the general question "Do you agrees that the container terminal, which you identified, is good / appropriate in the variable x/y/z?".

Table 2 – Sample definition

Country	Sent questionnaires	Sample	%	Port	Terminal	Sample *per* terminal
Portugal	573	111	19,4	Figueira	Figueira	4
				Leixões	TCL	24
				Lisboa	Liscont	34
					TCSA	11
					TML	4
				Setúbal	Sadoport	16
				Sines	XXI	18
Spain	566	40	7,1	Algeciras	APM Algeciras	6
				Barcelona	TCB	8
				Bilbao	NCTB	9
				Tarragona	DPWT	8
				Valencia	Noatum	9
Total	1139	151	13,3	10 ports	12 terminals	151

3.4. Statistical instruments

The structural equation model is a linear model that sets a relation between observed and latent variables and between endogenous and exogenous variables, whether latent or observed. It is divided in two sub-models: the measurement model and the structural one.

The measurement model defines how the latent variables are operationalized by the observed ones, including exogenous variables and endogenous ones. The measurement model of endogenous variables is defined as follows (Bollen, 1989):

$$y = \eta + \Lambda y \ \varepsilon \quad (1)$$

where, y is the vector (px1) of observed dependent p variables, Λy is the factor weight matrix (pxr) of η in y, η is the vector (rx1) of dependent latent r variables and ε is the measurement errors vector (px1) of y.

The measurement model of exogenous variables is defined by:

$$x = \delta + \xi \ \Lambda x \quad (2)$$

where, x is the vector (qx1) of independent observed p variables, Λx is the factor weight matrix (qxs) of ξ in x, ξ is the vector (sx1) of independent latent s variables and δ is the measurement errors vector (qx1) of x. The structural model defines the causal relations between latent variables, which can be defined by:

$$\eta = \eta + B + \Gamma\xi \ \varsigma \quad (3)$$

where, B is the matrix (rxr) of η coefficients of the structural model with Bii = 0, Γ is the matrix (rxs) the x coefficients in the structural model, Σ is the vector (rx1) of r model residuals.

The structural equation model can be exploratory or confirmatory regarding the analysis of latent variables or factors, aiming to determine the latent variables or to confirm their existence and relationships with the observed ones. This methodology was used to confirm the measurement model of latent factors explaining the container terminal performance, as well as the latent variables of performance by using AMOS18 software.

4. Results and analysis

4.1. Data analysis

By using the structural equation model methodology, the confirmatory analysis of the research and hypothesis model was performed. The collected variables were used to determine the model latent variables. In the questionnaire, senior managers were asked to choose, on the scale between total agreement (7) and total disagreement (1) regarding the high customer's satisfaction of a specific terminal previously identified. It also asked the same scale of appreciation of each of the factors of port characterization and of the same chosen terminal, qualified in a positive way with customer's satisfaction. Average high results to customer's satisfaction (between 4.89 and 4.97) and important results to characterization factors (between 4,03 and 5.23) were obtained, which confirmed the potential importance of these factors to terminal performance in the opinion of senior managers who answered the questionnaire (Table 3).

Table 3– Descriptive statistics

Construct	Variable	Min	Max	Average	Std. Deviation	Skewness	Kurtosis
Terminal customer's satisfaction	Shipper/logistic chain operator's satisfaction	2	7	4.95	1.145	-.502	-.422
	Shipowner´s satisfaction	1	7	4.96	1.311	-.592	-.137
	Shipping agent and freight forwarder's satisfaction	2	7	4.97	1.180	-.601	-.196
	Satisfaction with productivity	1	7	4,89	1,490	-,625	-.101
Port specialization	Port specialization in containers handling	1	7	5.12	1.336	-.799	.485
	Frequency of maritime SSS/Feeder services of the port	1	7	4.81	1.392	-.639	-.073
Inland infrastructures	Railway accessibilities	1	7	4.44	1.668	-.215	-.903
	Road accessibilities	1	7	4.97	1.655	-.573	-.621
	Terminal size	2	7	4.64	1.463	-.162	-.901
	Terminal Layout	2	7	4.94	1.218	-.423	-.413
	Railway connections to inland terminals	1	7	4.20	1.755	-.256	-.863
	Logistic areas next to the port	1	7	4.21	1.761	-.120	-.986
Maritime Service	Terminal quay depth	1	7	4.48	1.673	-.244	-.962
	Maritime access	1	7	4.57	1.749	-.477	-.799
	Vessels size	1	7	4.13	1.682	-.107	-.875
	Frequency of top 10 liner services shipping companies	1	7	4.03	1.593	-.175	-.727
Organization and logistic integration	Terminal reputation	1	7	5.23	1.239	-.992	1.138
	Type of terminal manager	1	7	5.18	1.410	-.930	.721
	Overall service quality	1	7	4.87	1.235	-.425	-.069
	Customer oriented terminal	1	7	4.63	1.472	-.428	-.631
	Terminal organization	1	7	5.18	1.195	-.779	.474
	Information systems	1	7	5.10	1.305	-.715	.582
	Agility facing changes	1	7	5.06	1.358	-.854	.686
	Operational and commercial flexibility	1	7	5.02	1.324	-.578	.141
	Terminal reliability	1	7	5.19	1.319	-.719	.403
	Berth produtivity	1	7	5.17	1.330	-.958	.891
	Vessels waiting time	1	7	5.23	1.342	-.755	.286
	Terminal integration in logistic chains	1	7	4.54	1.427	-.284	-.213
	Terminal handling charge	1	7	4.15	1.482	-.079	-.630

4.2. Structural equation results

With the structural equation model measurement significant coefficients of latent variables relations with the observed ones (>0.6) were obtained (Table 4). The model convergence validity (Anderson et al., 1987; Garver and Mantzer, 1999) was confirmed, which guarantees the model suitability to the input data. The face validity of latent variables was also confirmed, due to the fact that each determined latent variable showed consistency with concepts and definitions found in literature and in the theoretical model. The model aims to measure distinct and robust latent variables. The explained variance (R^2> 0.4) of the model latent variables is high, which indicates the model robustness.

Table 4 – Model estimated coefficients

			Estimate	S.E.	β	C.R.	P
Shipping agent's and freight forwarder's satisfaction	<---	Costumer satisfation	1.00		0.86		
Shipper /logistic chain operator satisfaction	<---	Costumer satisfation	0.98	0.07	0.87	14.27	***
Shipowner's satisfaction	<---	Costumer satisfation	1.11	0.08	0.86	13.42	***

Satisfaction with productivity	<---	Costumer satisfation	1.24	0.10	0.84	12.80	***
Road accessibilities	<---	Inland infrastructure	1.00		0.72		
Railway accessibilities	<---	Inland infrastructure	1.15	0.12	0.82	9.50	***
Terminal size	<---	Inland infrastructure	0.83	0.11	0.67	7.61	***
Terminal layout	<---	Inland infrastructure	0.72	0.09	0.70	7.91	***
Railway connections to inland terminals	<---	Inland infrastructure	1.04	0.13	0.71	7.96	***
Logistic areas next to the port	<---	Inland infrastructure	1.18	0.13	0.80	9.08	***
Quay water depth	<---	Maritime service	1.00		0.48		
Maritime access	<---	Maritime service	1.13	0.09	0.75	13.23	***
Vessels size	<---	Maritime service	1.36	0.14	0.95	9.98	***
TOP10 liner services frequency	<---	Maritime service	1.10	0.12	0.80	8.99	***
Type of terminal manager	<---	Organization and logistic integration	1.00		0.76		
Terminal reputation	<---	Organization and logistic integration	0.99	0.09	0.86	11.54	***
Overall services quality	<---	Organization and logistic integration	1.03	0.09	0.89	11.88	***
Costumer oriented terminal	<---	Organization and logistic integration	1.05	0.11	0.77	10.04	***
Terminal organization	<---	Organization and logistic integration	0.79	0.06	0.71	13.10	***
Information system	<---	Organization and logistic integration	0.91	0.09	0.75	9.73	***
Agility face to changes	<---	Organization and logistic integration	1.04	0.10	0.82	10.88	***
Operational and commercial flexibility	<---	Organization and logistic integration	1.05	0.09	0.85	11.29	***
Terminal reliability	<---	Organization and logistic integration	1.10	0.09	0.90	12.07	***
Berth produtivity	<---	Organization and logistic integration	1.09	0.09	0.88	11.84	***
Vessels waiting time	<---	Organization and logistic integration	1.04	0.09	0.83	11.02	***
Terminal integration in logistic chains	<---	Organization and logistic integration	0.87	0.11	0.66	8.33	***
Terminal Handling charge	<---	Organization and logistic integration	0.87	0.11	0.63	8.03	***
Port specialization	<---	Port and terminal characteristics	1.00		0.64		
Inland infrastructure	<---	Port and terminal characteristics	1.17	0.22	0.70	5.22	***
Maritime service	<---	Port and terminal characteristics	0.92	0.19	0.57	4.74	***
Organization and logistic integration	<---	Port and terminal characteristics	1.39	0.23	0.92	6.11	***
Costumer satisfation	<---	Port and terminal characteristics	1.19	0.19	0.84	6.21	***
Port specialization in container	<---	Port specialization	1.00		0.83		
Frequency of port SSS/feeder services	<---	Port specialization	0.81	0.15	0.64	5.43	***

As Table 5 shows, the correlation between latent variables is inferior to 0.85 and inferior to square root values of average variance extracted (AVE) of the latent variables diagonally presented in the table, indicating that the latent variable are internally consistent and distinct from each other. The AVE values of first level latent variables are always greater than 0.6. In addition, the results indicate the robustness of the latent variables used in the structural equation model, demonstrating the discriminant validity of the model (Fornell and Larcker, 1981; Kline, 2005).

The results also confirm the unidimensionality of the structural equation model (Hair et al., 1998; Tabachnick and Fidell, 2001) with the following indicators of Goodness-of-fit (GoF) of the first questionnaire measurement model χ^2 808.959; χ^2/df 2.033; IFI: 0.902 (>0.9); CFI: 0.901 (>0.9); RMSEA: 0.083 (<0.1) showing a good adjustment of the latent variables measurement model.

Table 5 – Consistency of the latent variables, measurement model

Latent	Var.	AVE	1 (2nd level)	2	3	4	5	6 (2nd level)
Port and terminal characteristics	1	0.64	0.80					
Port specialization	2	0.60	0.63	0.78				
Maritime service	3	0.76	0.56	0.57	0.87			
Organization and logistic integration	4	0.75	0.80	0.60	0.53	0.87		
Inland infrastructures	5	0.67	0.69	0.44	0.39	0.66	0.82	
Terminal costumer's satisfaction	6	0.84	0.79	0.53	0.46	0.80	0.58	0.92

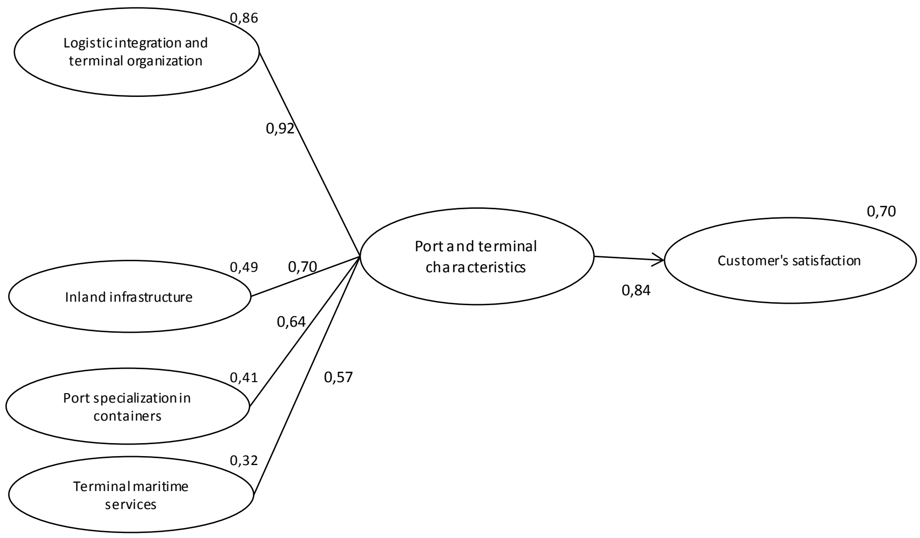
Note: AVE (average variance extracted) square root in diagonal

The resulting measurement model confirmed the existence of the dependent latent variable *Terminal customer's satisfaction* also confirming the existence of four exogenous latent variables or independent/explanatory factors of performance: *Port specialization, Inland infrastructure, Maritime service* and *Organization and terminal logistic integration.*

This structural model result allows the confirmation of the theoretical research model considering Iberian Peninsula terminal users' perception. In other words, the container terminal customer's satisfaction depends indirectly on the level of port specialization in container and on the frequency of short sea and feeder lines, inland accessibilities, terminal infrastructure, on logistic areas nearby, connection to inland logistic areas, reputation, type of manager and terminal organization, on terminal service quality in the way that they allow its

logistic integration, i.e. of its orientation towards the customer, reliability, flexibility and agility, suitable information system, vessels operations duration and waiting time and handling rates.
From the measurement model, the structural model with causal relations between the latent variables was developed, with a second level latent regarding *Port and terminal characteristics* which explains the model dependent variables with which explanatory coefficients of the meaningful dependent latent variables (Figure 2) were obtained. The results of the structural model also point out the fulfilment of the unidimensionality criteria (Hair et al., 1998; Tabachnick & Fidell, 2001), with the following indicators of Goodness-of-fit (GoF), χ^2 883.657; χ^2/df 2.441; IFI: 0.868 (>0.9); CFI: 0.867 (>0.9); RMSEA: 0.098 (<0.1), harmed by the reduced sample size. The relations between the second level latent variable *Port and terminal characteristics* and the first level exogenous latent variables of the reflexive model means that the latter are the reflex of a superior variable which is confirmed by high coefficients in relations (>0.5).
One of the model limitations is the small sample size, consisting of only 151 observations for a large number of variables. In SEM models, the suitable number of observations should be 10 times the number of observed variables. Thus, there should be only 15/16 observed variables, bust instead we have 29. In order to confirm the results, the model was simplified maintaining the same constructs but only keeping the observed variables that are more important in each latent one, in order to fulfil criterion of the relationship between sample size and the number of observed variables. The results assure the latent model consistency, with the following indicators showing a good adequacy: Goodness-of-fit (GoF), χ^2 197.734; χ^2/df 2.326; IFI: 0.923 (>0.9); CFI: 0.922 (>0.9); RMSEA: 0.094 (<0.1), demonstrating that the sample size does not affect conclusions regarding the research model confirmation.

Figure 2 – Structural model



Note: In the figure,β values of variable relations and R^2 values (βxβ)of dependent variables are in evidence.
All β values are significant at 0,001 (two-tailed).

A question is whether the second level variable makes sense. Was therefore tested a formative model with the assumption of non-existence of the variable *Port and terminal characteristics*, thus directly linking the exogenous latent variables of first level to the endogenous variable Customers's satisfaction. Some explanatory variables were then eliminated: *Terminal maritime* *services* and *Port specialization in containers,* because they lack significance in the model. It was obtained a second parsimonious model with R^2=0.64 for *Customer's satisfaction*, losing some information, and with the following parameters β=0.22 for *Inland infrastructure* and β=0.64 for *Logistic integration and terminal organization*. This second model has an acceptable Goodness-of-fit (GoF), χ^2 522.734; χ^2/df 2.398; IFI: 0.905 (>0.9); CFI: 0.904 (>0.9); RMSEA: 0.097 (<0.1).

The disadvantage of this second model is losing some information with the exclusion of some of the variables that characterize the port and container terminal. On the other hand, excludes the possibility of global a latent variable Port and the terminal characteristics reflected in observable characteristics. This is a controversy matter.

Another question that arises is whether the first-level latent variables reflects the second level latent Port and terminal characteristics, or is this variable an agglomerated caused by uncorrelated first-level variables. The results shows strong correlation between latent variables of first level, and the internal consistency of the second level variable, with AVE=0.64 and high β values explaining all the latent variables at the first level, and demonstrating the existence of the reflective second level latent variable Port and terminal characteristics.

5. Discussion

The obtained results allow us to consider as pertinent the research model as well as the holistic vision about port and container terminal characteristics to have influence on terminal customer's satisfaction with a 70% high explanation degree of the respective variance.

The second level latent variable *Port and terminal characteristics*is reflected in the first level latent variables, explaining in 86% the *Organization and logistic integration,* in 49% in *inland infrastructure*, in 41% in *port specialization* and in 32% *terminal maritime service.* In turn, each of these first level latent variables explain its observed variables in high level (Figure 2).

The results of this study, that focused on the perception of specific terminals, confirm those of Caldeirinha et al.(2013), who analysed the overall abstract perception of the importance of terminal and port characteristics to performance.

On that study, results also evidenced the importance of logistic integration and terminal organization and maritime services although at a lower level, as well as the importance of maritime and inland accessibilities. Also, the previous study didn't foresee the importance of port specialization that comes up in the present one. Nevertheless, other factors were considered important, such as location in Europe and the region and port dynamics, which were not analysed in the present study. If, in abstract terms, location is important to container terminal performance, than, in the case of a specific terminal, where location is fixed, the customer's satisfaction must be dependent on other variables.

Therefore, the existence of various consistent latent variables regarding the *port and terminal characteristics* was verified. The results evidence the existence of a latent characteristic *Port specialization* (AVE=0.60; *β=0.64*), which is reflected in the observed variables C*ontainer Port specialization (β=0.83)* and *Frequency of maritime services of short-sea-shipping and feeder (β=0.64)*, which demonstrates the importance of specialization as a choosing factor, namely the containerization rate, already referred by Trujillo and Tovar, 2007, Medda and Carbonaro, 2007, and by Laxe, 2005.

This demonstrates that ports with higher container specialization usually have higher efficiency levels when using the respective quay infrastructures. A specialized port can usually achieve high efficiency levels due to the perfect suitability to a certain type of cargo handling and operations. The importance of port specialization in liner services was also demonstrated, because the high frequency of container liner services at a port allows carriers to have a wider choice, more flexibility and less "transit times", which is associated to a higher port specialization in container handling (Tongzon, 2002). *Hypothesis 1a* is not rejected, that is: Port specialization is an important characteristic of the port and container terminal.

The results also indicate the existence of a latent characteristic *Inland infrastructure* (AVE=0.67; *β=0.70*) that is reflected in the observed variables *Railway accessibilities (β=0.82),Road accessibilities (β=0.72), Terminal width (β=0.67), Terminal layout (β=0.70), Railway connections to inland terminals (β=0.71) and Logistic areas next to the port(β=0.80)*, showing the importance of inland infrastructures suited to customer's satisfaction, especially inland accessibilities, to enlarge the hinterland and contribute to maximize terminal investments.

Therefore, the conclusions of Turner, Windle and Dresner (2004) and Gaur (2005) about the impact of inland accessibilities on customer's satisfaction were confirmed. The hinterland accessibilities allow terminal expansion beyond the seaport limits, therefore enlarging its influence area to inland terminals, connected by rail. Inland infrastructures also include infrastructure quality and the terminal itself, with all its characteristics, equipment and layout, as well as the existence of logistic areas nearby, as being determinant to the customer's satisfaction. These findings support the conclusions of various authors such as Hung et al. (2010) and Wu et al. (2010).*Hypothesis 1b* is not rejected, that is: Port and terminal inland infrastructure is an important characteristic of the port and container terminal.

The results identify the existence of a latent variable characteristic *Maritime service* (AVE=0.76; *β=0.57*), which is reflected in the observed variables *Terminal quay depth*(*β*=0.69), M*aritime access (β=0.75),Vessels' size (β=0.95)and Frequency of liner servicer of the Top 10 worldwide shipping companies (β=0.80).* These results are consistent with those of Tongzon (2002) about the importance of frequent liner services, especially those of worldwide shipping companies, in shippers' terminal selection process, leading to a higher customer's satisfaction. As with previous cases, hypothesis 1c is not rejected: Terminal maritime service is an important characteristic of the port and container terminal.

The results show that there is a latent variable characteristic *Organization and logistic integration* (AVE=0.75; *β=0.92*), which is reflected on the observed variables *Terminal reputation (β=0.86),Type of terminal manager (β=0.76), Overall service quality (β=0.89), Customer oriented terminal (β=0.77), Terminal organization (β=0.71), Information system* (*β=0.75), Agility face to changes (β=0.82), Commercial and operational flexibility (β=0.71), Terminal reliability (β=0.90), Berth occupancy (β=0.88),Vessels' waiting time (β=0.83),Terminal integration in logistic chains (β=0.66) and Terminal handling charge(β=0.63)*.This demonstrates the importance of ports, while integrated in a logistic chain, to overall performance(Robinson, 2002). Logistic integration of ports requires a strong orientation towards the customer, compatible information systems, agility, flexibility, reliability, price and service quality (Notteboom and Winkelmans, 2004).

The results confirm Robinson (2002) findings about the port selection being made in the context of the supply chain, which demands an enlarged vision of the port and terminal. It is confirmed that orientation towards the customer is very important to their satisfaction by allowing a fast adaptation to market changes in cooperation with the customer.

The importance of the information systems is confirmed as they allow information sharing, leading to high levels of the container terminal's integration in the supply chain.

Also, the importance of the type of manager, oriented towards the customer and the logistic chain, is confirmed, as well as the type of organization that determines the terminal agility while answering to logistic network demands (Liu et al., 2009). Therefore, Hypothesis 1d is not rejected: The organization and logistic terminal integration is an important characteristic of the port and of the container terminal.

The results allow considering as pertinent the hypothesis that the port and terminal characteristics influence terminal customer's satisfaction *(β=0.84, R^2=0.70 in the first model and* R2=0.64 in the second model)*,* not rejecting the basic hypothesis of the research model.

The container terminal customer's satisfaction is indirectly influenced by inland infrastructure and terminal characteristics, by terminal organization and by inland services, especially regarding the logistic chain, and in the first model by the port specialization in container handling and maritime accessibilities. Hypothesis 2 is not rejected: Container terminal customer's satisfaction is strongly influenced by the port and terminal characteristics.

6. Conclusions, limitations and future research

The present study allowed the development of an explanatory overall holistic model of customer's satisfaction, based on the port and on the terminal characteristics. The study contributes to a better knowledge of ports and container terminals for having succeeded to concentrate in only one model the various elements from previous studies. This research model contributes to a better understanding of the fact that successful container terminals with high customer's satisfaction must necessarily have an adequate organization, a good manager, high quality services, orientation towards the customer, in order to meet the logistic chain demands, in which the terminal is integrated, in terms of agility, flexibility, reliability, information systems, rates, berth occupancy and vessels waiting time.

It is essential to have adequate infrastructures in the terminal and deep maritime and good inland accessibilities to the hinterland, as well a broad set of liner services with large vessels of the most important worldwide ship owners. Finally, it is important that the terminal is located in a container specialized port, benefiting from its specialized services and high frequency of short-sea-shipping and feeder services.

One limitation of the present study is the small sample size considering the number of variables used, although being representative of the population of the Iberian Peninsula ports.

An interesting future research work would be applying this model to other worldwide port terminals, testing their validity in an enlarged geographical context.

One question that might be asked is whether the structural equation modeling should be reflective or formative. In other words, the latent variables resulting from the observed variables reflect the port and the terminal characteristics or, on the contrary, are independent variables that can be concentrated in a formative latent variable.

In future studies we intend to test in detail the formative SEM model, checking its theoretical validity against the reflective model, and we intend to further test the multiple linear regression model, directly linking each port and terminal characteristic to each terminal performance variable, in order to assess in the detail contribution of each.

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