

# **Port Community Systems and organizational performance: A socio-technical approach to evaluation.**

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**Abstract.** This study aims to assess the impact of the Port Community System (PCS) on users' organizational performance. In the case of Moroccan ports, the PCS is evaluated using Mc Delonne's theoretical model by the Structural Equation Modeling (SEM) method via SPSS AMOS software, applied to the sample of 226 valid responses obtained from the Moroccan port community.

The peculiarities of the port sector, the instability of the global environment and the importance of digital management persuaded us of the importance of a port-specific evaluation trial to highlight the contribution of PCS to organizational performance. The main finding of this study is that social-technical aspects do have an impact on the success of a PCS, and that satisfaction is determined solely by the quality of the information and the actual use of the PCS.

**Keywords:** port Community system, socio-technical characteristics, Organizational Performance.

## **1 Introduction**

Ports are important nodes in the supply chain, with increasingly complex requirements for transparency and identification of goods, material and information flows. International supply chains can be built up from ports, based on the digitization of supply and demand for logistics services and goods information flows. Modern ports focus on increasing supply chain efficiency and effectiveness, developing PCS to support demand forecasting and order response level information, and reducing inventory costs. Online monitoring and transparency are becoming increasingly important to the success of supply chains and ports.

The scale of modern logistics brings complexity to the port sector and multi-stakeholder processes, requiring innovation in port communications, information flow and document management. Maritime logistics chains have evolved in recent years thanks to information and communication technologies (ICT)<sup>1</sup>. This development has facilitated deeper integration of the port community and increased demand for the provision

of port services. ICT investments for ports include the introduction of paperless communication between members of the port community, integration with logistics partners and collaboration between different ports. This is a necessary step towards competitiveness that ports must take<sup>2</sup>.

The Port Community System (PCS) is a technological platform that enables a network of public and private players and entities involved in the shipping and freight services provided by a port. Rondon & Ramis-Pujol describe the PCS as an electronic platform that connects several systems of several companies and entities that make up the port community, and whose primary function is the digitization of port operations<sup>2-7,7</sup>. Few studies have examined PCS in the field of information systems<sup>8</sup>. Moreover, most of these studies are purely descriptive, and do not assess the characteristics or performance of these systems, or their integration into existing port authority, facility and corporate systems.

The PCS is important for port performance, as Meersman, Van de Voorde and Vanelslander have pointed out<sup>9</sup>. However, few researchers have systematically investigated the importance of PCS characteristics and their impact on port performance. Karlan et al.<sup>10</sup>. Note that the impact of IT on port performance has not yet been fully investigated, as PCS development is generally analyzed in terms of features without addressing how port performance is impacted. Lee, Tongzon and Kim used performance indicators of customer satisfaction and port competitiveness to analyze the impact of container terminal management systems on port operations<sup>11</sup>. Using the SEM method, we analyze a sample of 242 valid responses collected in a survey of major port managers in Morocco. The aim of this work is to identify, analyze and measure the characteristics of PCS and its impact on organizational performance. The first objective is to analyze the properties of PCS. The second objective is to identify the impact of PCS on the organizational performance of the users of these platforms.

## **2 Literature review**

Supply chain integration ensures the cooperation of strategic partners and the joint management of organizational processes. This includes the coordination of people, processes, information, knowledge and strategies throughout the chain. Its aim is to facilitate the effective and efficient flow of materials, funds, information and knowledge in line with consumer needs.

Vickery, Jayaram, Droke and Calantone have identified the attributes of an integrated supply chain strategy as technologies that facilitate integration and integration practices<sup>12</sup>. Information technology is considered essential in the supply chain and includes:

Computerized production systems, integrated information systems and integrated electronic data interchange; Integration practices include shared objectives and rules, shared information systems and collaborative integration platforms. The aim is to create an alignment of interests between stakeholders in the port and logistics community to

ensure reliability, continuous service and adequate productivity. Visibility and transparency are essential for an efficient supply chain. The benefits of supply chain visibility include better inventory management, demand forecasting, lead times and flexibility<sup>13</sup>.

Ports play a key role in controlling and coordinating the flow of goods and information in supply chains. De Souza, Carvalho & Liboreiro and Radhika highlight the importance of ports as members of supply chains<sup>14,15</sup>.

Port and shipping companies offer electronic services to optimize their business processes. Electronic documents reduce operational costs and overheads, are easily organized and can be quickly searched, archived and indexed. Information exchanged between organizations is mainly processed by computers, and data is transferred between organizations. Electronic Data Interchange (EDI) technology, which uses United Nations Business Information Standards for the exchange of structured data, enables data to be transferred between organizational databases without printing<sup>16</sup>. Obara, Kiplagat and Okidi found that EDI enables faster and more efficient information exchange, shorter lead times, reduced costs through paper reduction, fewer errors and better data sharing and tracking<sup>17</sup>. EDI also claims to have advantages in terms of increased inventory. Sales. Time to access information from logistics service providers<sup>18</sup>.

Ports can offer value-added services by improving information and reducing processing times<sup>19</sup>. The use of electronic documents makes economic sense as it increases productivity and boosts competitiveness<sup>19</sup>.

## **2.1 Port community systems**

The success of a port is increasingly determined not only by its infrastructure and superstructure, but also by the way in which port managers coordinate interactions between different stakeholders towards a common goal<sup>20</sup>. Martin and Thomas define a port community as a business organization in which multiple services support a port in the movement of goods between sea and land transport<sup>15</sup>. The port community includes providers of port facilities and infrastructure, cargo handling service providers, shipping companies and agents, land transport companies and freight agents. The port community comprises several private and public organizations traditionally fragmented in processes related to port activities<sup>21-23</sup>.

Within the port community, Notteboom and Winkelmanns distinguished between internal players (groups within the port authorities) with formal contractual relationships, and external players<sup>24</sup>. For Tijan et al. the complexity of the port environment and the massive exchange of data, messages and documents between members of the port community have led to the need for integrated ICT systems to maintain competitiveness and quality of service<sup>23</sup>. Due to the growing importance of communication between port players, the Port Information System has been transformed into the Port Community System (PCS).

## **2.2 Port performance.**

The notion of performance is widely used in management literature, and many studies have examined how a particular parameter affects performance.

The word "performance" has its roots in the Latin verb "parformar", which first appeared in the 13th century in the Old French word "performer" (Petit Robert). In English, the verb "performer" first appeared in the late 15th century with a fuller meaning<sup>25</sup>. It was used to designate both the results of a racehorse's efforts as well as its success<sup>26</sup>. According to the dictionary In late 17th-century France, "performance" meant an accomplishment or result.

In the literature, there are two main categories of organizational performance measures: subjective, non-financial measures that aim to: assess the company's activity from an immature point of view, and more quantified financial/economic measures and objectives such as revenues, profitability and productivity. Thus, performance becomes a matter of perception, and is distinguished by its "multidimensional status" 27,28. The replacement or complementarity of these indicators is of particular interest, and several studies have shown that there is still no clear agreement on which indicator is superior to another<sup>29–31</sup>.

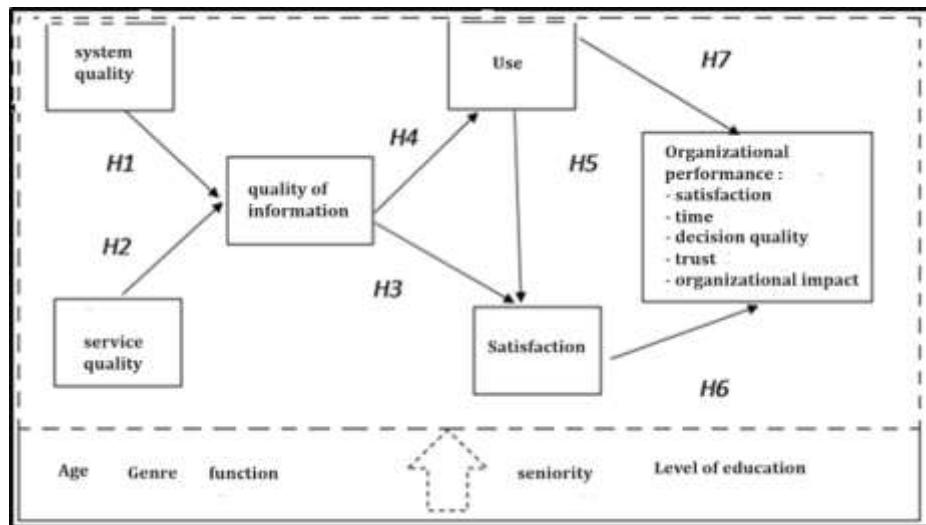
## **3 Research methodology**

This section describes the study design, hypotheses, variables and details of the sample, measurement and methodology. Our working method is purely quantitative, based on the collection and analysis of data using hypothetico-deductive reasoning.

We adopt firstly a random sampling method, as our study population is homogeneous, and secondly a data collection and item validation process in line with Churchill's paradigm.<sup>32,33</sup>.

### **3.1 Research model, hypotheses and variables**

The diagram below presents the conceptual research model. This model attempts to define the steps that lead to the vision of success for port IS users. Like explanation-based models, it prefers causal relationships between the key variables of the adopted model. We are interested in learning more about the relationships between various types of factors, including technical as well as social variables<sup>2,34</sup>.



**Fig. 1. Research model**

A trio of hypotheses will be distinguished: those relating to linear links in the PCS success evaluation model; those relating to the effects of socio-demographic factors; and finally those relating to the impact of participation on perceptions of PCS success.

## 4 Analysis of results

This section will therefore be divided into three parts. The first will deal with exploratory factor analysis, while the second section will address the subject of validation of the selected factors and finally we will present the results of confirmatory factor analysis.

### 4.1 Exploratory factor analysis

The factorization results in a six-factor structure accounting for 88.43% of the total variance. The first factor alone explains 79.795% of the variation in the 46 variables in the analysis (see Table 1).

The other factors are not taken into account, as they do not take sufficient account of variation.

**Table 1. Percentage of variance table.**

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	36,706	79,795	79,795	36,706	79,795	79,795
2	1,567	3,406	83,200	1,567	3,406	83,200
3	,802	1,744	84,944	,802	1,744	84,944
4	,591	1,284	86,229	,591	1,284	86,229
5	,558	1,212	87,441	,558	1,212	87,441
6	,454	,987	88,428	,454	,987	<b>88,428</b>

The six factors selected present a percentage of variance equal to 88.43%, but we note that the respective eigenvalues are less than 1 from the 3rd component onwards.

The ability to identify elements that are inaccurately represented by the factors and need to be removed is provided by an analysis of the factor contributions of each element to the factors.

#### 4.2 Summary of validation results

**Table 2. Summary of validation results**

Built	CR	AVE	Sys Quality	Ser Quality	Quality Info	Use	Performance	Satisfaction
<b>Sys Quality</b>	<b>0,960</b>	<b>0,828</b>	<b>0,910</b>					
<b>Ser Quality</b>	<b>0,978</b>	<b>0,898</b>	<b>0,893</b>	<b>0,948</b>				
<b>Quality Info</b>	<b>0,944</b>	<b>0,770</b>	<b>0,880</b>	<b>0,788</b>	<b>0,878</b>			
<b>Use</b>	<b>0,978</b>	<b>0,850</b>	<b>0,859</b>	<b>0,827</b>	<b>0,777</b>	<b>0,922</b>		
<b>Performance</b>	<b>0,969</b>	<b>0,888</b>	<b>0,834</b>	<b>0,821</b>	<b>0,782</b>	<b>0,841</b>	<b>0,942</b>	
<b>Satisfaction</b>	<b>0,955</b>	<b>0,876</b>	<b>0,860</b>	<b>0,883</b>	<b>0,793</b>	<b>0,830</b>	<b>0,845</b>	<b>0,936</b>

Reliability: CR values are all above 0.7 - the measurement model has excellent reliability.

- Convergent validity: The AVEs are greater than 0.7, which means that each construct is highly correlated with the respective items, hence the convergent validity of the measurement model.

- Discriminant validity: All the values of the AVE roots (on the diagonals) are greater than the correlations of the respective construct with the rest, hence establishing the discriminant validity of the measurement model.

- Goodness of fit: CMIN/DF = 2.816 < 3, CFI = 0.94, SRMR = 0.026, RMSEA = 0.09. Based on these values, we can say that the model has acceptable goodness of fit, since most indices are satisfactory except for RMSEA, which can be improved.

Finally, we have been able to establish the various reliability and validity criteria of the measurement model, which can then be used to test the various hypotheses of the theoretical model, by means of a structural model.

We would like to point out that all the measurement instruments meet the fit conditions of the overall model and the measurement model, and that the convergent validity of the measurement model and the discriminant validity of the measurement model have been verified by calculating several statistical indicators.

### Setting up the structural model.

To put the model into use, simply plot the causal relationships of our theoretical model, then add the error terms to all the variables that are considered dependent, namely: Information quality, PCS usage, satisfaction and performance. The rest of the variables are considered independent and must be correlated.

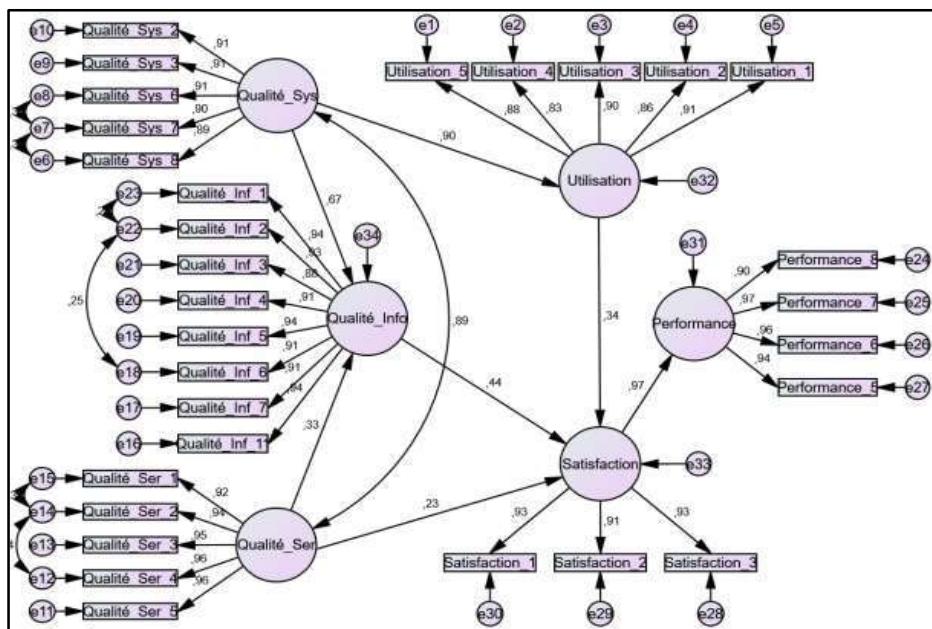


Fig. 2. Structural research model

This model requires several interpretations. Firstly, it confirms the significant effect of the quality variables - system quality, information quality and service quality - on satisfaction and usage, with regression coefficients ranging from 0.23 to 0.67. It is also

important to underline the mediating role of information quality between service quality and satisfaction, given that the latter variable is explained by information quality with a regression coefficient of 0.44. Utilization has no direct significant effect on organizational performance, but satisfaction explains the latter with a highly significant coefficient of 0.97 (close to 1).

Table 5 shows the results of hypothesis testing for the validation of the relationship between variables based on path analysis of the structural equation model.

**Table 3. Conceptual model hypothesis testing**

Hypotheses	T statistics	p-value	Décision
H1	11,197	0,000	Confirmed
H2	6,258	0,000	Confirmed
H3	5,165	0,000	Confirmed
H4	0,195	0,845	Rejected
H5	6,466	0,000	Confirmed
H6	11,727	0,000	Confirmed
H7	-0,426	0,670	Rejected
H1-4 : System quality has a significant effect on usage	4,030	0,000	Confirmed
H2-3: Service quality has a significant effect on satisfaction	3,595	0,000	Confirmed
Participants' age has a significant effect on model relationships	-	0,680	Rejected
Participants' gender has a significant effect on model relationships	2,292	0,000	Confirmed
Participant function has a significant effect on model relationships	0,122	0,808	Rejected
Participant seniority has a significant effect on model relationships	0,187	0,847	Rejected
Participants' level of education has a significant effect on model relationships	0,105	0,283	Rejected

The results of this section proved highly significant and enabled us to test our theoretical model empirically, using covariance-based structural equations as a modeling method so that all hypotheses could be tested effectively.

This modelling method provides highly reliable parametric estimates, which can be used to extrapolate the results based on the data from this sample, assuming that it is representative. On the basis of these estimates, we have been able to give an indication of the intensity of the various relationships.

In addition, the model showed an acceptable to good goodness of fit, based on the various indices already presented, and this shows the effectiveness of the constructs

prepared in the literature review, as well as the good choice of sample and collection method, since they did not present any huge bias (errors).

Concerning the test of the various hypotheses of the model we were able to make the following decisions:

We note that eight relationships evaluated are significant at the 0.05% threshold. This concerns the relationships supported by hypotheses H1; H2; H3; H5; H6; H1-4 and H2-3, as well as the significant effect of the "gender" control variable on the model's relationships.

We also note that two relationships with values below 1.96 are not significant at the 5% level. These are relationships supported by hypotheses H4 and H7. These results confirm that in the port logistics sector, the quality of information is vital and has a significant impact on satisfaction, but not directly on use, since in the years when these one-stop-shops were launched, use was compulsory, which justified the absence of a direct causal relationship between the two latent variables.

The proportion of variation explained by the model's links seems perfect in terms of information quality (97.3%), net benefits (81.6%) and satisfaction (86.6%). It is a little below average for usability (29.6%), but in line with accepted standards in the literature, it is adequate.

## 5 Conclusion

In the light of a literature review, a conceptual model was adopted to evaluate the success of the PCS after an empirical field study with users of this Port IS.

We described how we operationalized the different variables of our conceptual model. Thanks to a literature review, we were able to provide measurement elements for each variable of the conceptual model.

The process of purifying the measurement scales, carried out in accordance with Churchill's paradigm, was outlined. In order to reduce the amount of information and determine the dimensionality of each variable. Exploratory factor analyses were carried out. This data purification operation was carried out on 227 respondents from the sample in order to further refine the measurement scales. The structure of each variable was then confirmed using confirmatory factor analyses. Overall, the results were quite good, giving us scope to test the conceptual model.

All the hypotheses of the conceptual model are tested. The latter first presents the various research results. We draw the relationships between the different variables in our model and then test our hypotheses.

The main research hypotheses were validated by a model composed of structural equations (SEM). In order to examine the impact of one variable on another, analyses of variance were implemented. Analysis of the main results leads to several findings:

- The assessment is multi-faceted and takes into account both social and technical factors.
- The path to the perception of success is made up of several strong qualities and connections:

Information quality is strongly influenced by system quality and less by service quality; Satisfaction is determined solely by the quality of the information and its use.

The control variables have no impact on the model's relationships, except for the impact of gender on the relationship between satisfaction and service quality.

In a second instance, we presented the research contributions. Theoretically, our research has enabled us to present an explanatory model that corresponds to the socio-technical trend and underlines the importance of management factors, as well as the unique and essential role of the variable of information quality and use in the port domain. As far as managerial contributions are concerned, both users and IS managers lack the necessary tools to evaluate their PCS. So we're committed to providing them with an assessment tool in a sector characterized by a dearth of research in this area.

This work opens the door to other avenues of research that can help us refine the model we have put forward. These points of view relate either to a strategy for deepening the research already carried out, or on a plan to broaden the field of research.

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