

Analysis of Port Integration: Case of Ghazaouet Port

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Abstract:

Today, the logistics integration of shipping companies with service providers seems to improve maritime performance. The objective of this work is to analyze the prospects for logistics integration of the port of Ghazaouet Tlemcen. This work aims to analyze the critical points and challenges expected from the logistics integration of the port of Ghazaouet. To do this, an explanatory survey of 60 questionnaires collected. Using factorial and structural methods, four critical items were identified. The use of statistical methods, including factorial analysis, made it possible to identify four factors of integration results, namely information technology, connectivity, port costs and organization.

Keywords: performance, port of Ghazaouet, Logistics integration Factorial analysis, structural method, ,

Jel Classification Codes: A12, C3, P47

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1. INTRODUCTION

Increasing competition and recent changes in environmental disruptions characterise international port trade today. Long lead times, rigid laws and regulations, inconsistent information exchange between partner port supply chains and international sanctions are the biggest challenges facing countries.

Faced with these changes, Algeria's port trade is unable to attract more carriers because of its moderate performance. This moderate performance of the port of Ghazaouet is due to the quality of services where operators are not fully competitive and viable in terms of time and associated services to motivate carriers to return to the port.

Such events call for innovative responses and strategies for logistics practices in the port network. It seems that integration offers an encouraging dynamic in terms of organisational and operational challenges for partner supply chains in the port environment.

In this sense, the objective sought through this study is to explore the challenges of the port of Ghazaouet, Tlemcen in terms of logistics integration.

To achieve the objective of the study, a set of questions were pursued in this work. The research questions pursued are as follows: (1) How can the logistical integration of the port of Ghazaouet in Tlemcen be achieved? (2) What are the critical factors of logistic integration from the point of view of Algerian ports ; (3) What are the challenges faced by the logistic integration of Algerian ports ; and we will try along this work to see the following hypothesis: port logistic integration plays an important role in the relationship with the partners and the sustainability of the activity.

Based on a review of the literature on port logistics, we proposed a questionnaire encompassing the majority of integration principles and applied it to the Algerian port of Ghazaouet, Tlemcen. The study uses data collected from interviews with port managers, in order to understand and deepen the information collected. The respondents were executives from the port authority, customs, shipping companies, etc. Our study population consisted of 60 observations. In addition, the use of descriptive and

econometric statistical methods as well as simulations is part of an objective to interpret quantitative data. The aim of this work is to provide :

- A literature review to establish the expected contribution.
- An overview of Algerian ports, in particular that of Tlemcen.
- An illustrative case validates the contribution and discusses port logistics integration in the port of Tlemcen.
- A brief conclusion is provided, together with suggestions for future research directions.

2. Literature Review

Port logistics is a complex system that houses multiple activities and partners. Traditionally, port logistics is considered as a junction between maritime and land activity (Cullinane et al. ,2002). Due to the complexity of port activities, Notteboom & Rodrigue (2005) argue that port operators are interested

through supply chain activities and become key players in logistics networks (ALavi, A., 2019).

The literature examines several approaches, we cite the approach of Notteboom T. (2022) which classifies port activities into three services; shipping line services, terminal activities and value-added logistics services. The literature argues that industrial companies are interested in linking suppliers in their supply chains, while port services rely on linking partners (such as ports and container shipping companies) Tseng and al. (2015).

A body of research has attempted to understand the complex port system up close. Notteboom, T. (2008), examines the relationship between seaports and the hinterland for global sourcing reasons. Furthermore, Acciaro et al. (2013) focus on international transport by specifying the different modes of transport involved in internal port activities.

3. Methodology

Our work will be based on the level of integration of the port of Tlemcen according to the theoretical concepts of integration, from an operator's point of view, in order to identify the challenges to be met in order to align with other international ports. In practical terms, several authors propose the use of statistical methods to improve the accuracy of

the analysis of the results; we propose exploratory analyzes and structural methods according to fig1.

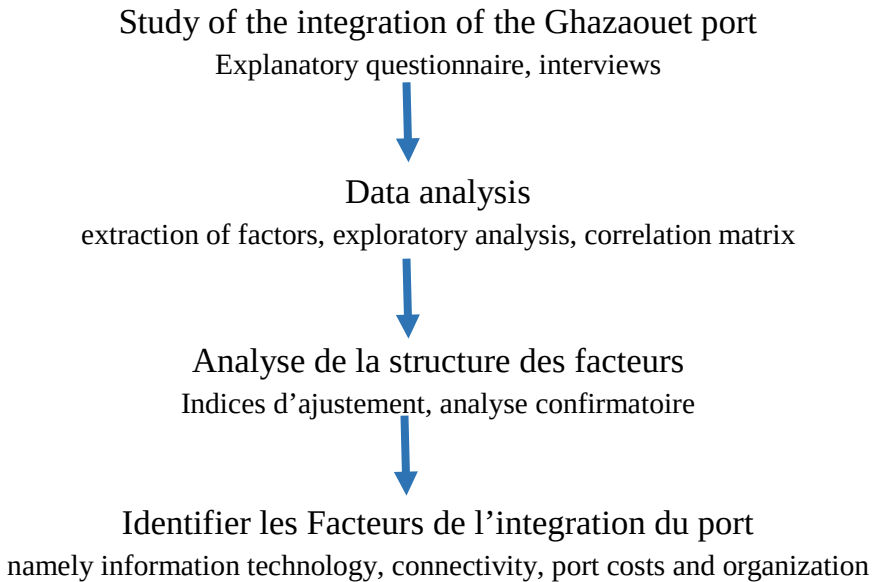


Fig. 1: analysis procedure integration

4. RESULTS AND DISCUSSIONS

The survey on port logistics integration was conducted at the Port of Ghazaouet in Tlemcen and involved 60 individuals (managers, supervisors, and employees) encompassing the following services: operations, handling, shipping company, forwarding agent, rail operations, and industrial services

4.1. Profile of Respondents:

The results of the respondents' profile help to examine the characteristics of the respondents and analyze the differences and similarities among the various actors in port logistics. Our questionnaire presents the respondents' profile according to three categories

4.2. Type of Service

Figure 1 shows the distribution of participants in the logistics integration questionnaire conducted at the Port of Ghazaouet in Tlemcen

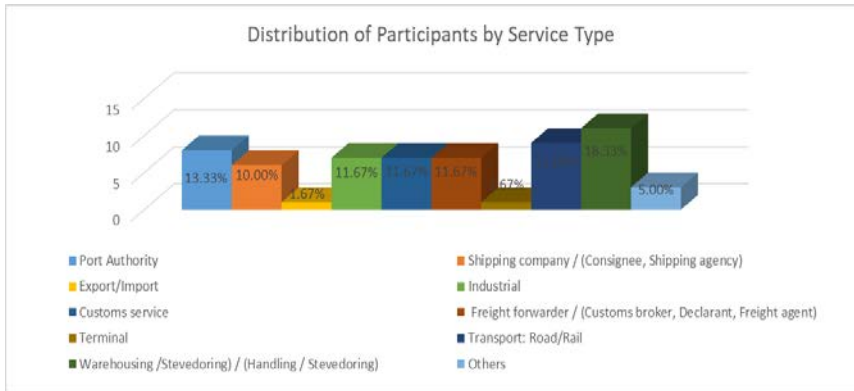


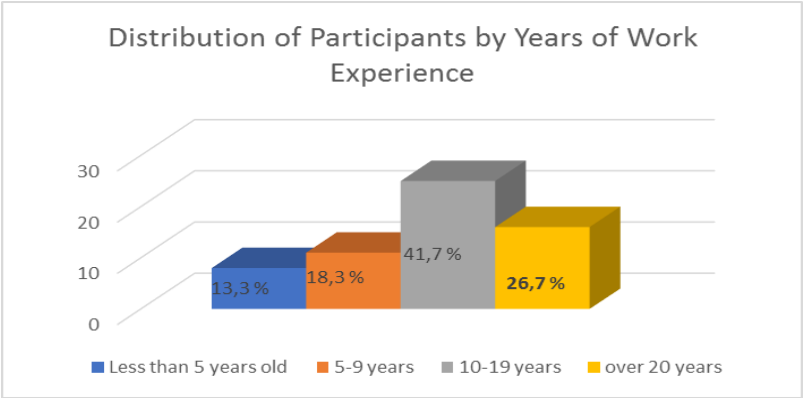
Fig.2. Distribution of Participants by Service Type

The largest proportion of participants, 18.33%, comes from warehousing and handling services, highlighting their importance within the port. Following this, the land transportation sector, including road and rail, represents 15% of respondents, underscoring the significance of land logistics in port operations. The port authority constitutes 13.33% of participants, emphasizing its organizational and administrative role within the port. Maritime companies, including consignees and maritime agencies, account for 10% of participants, illustrating the crucial importance of maritime transport in this context

4.2.Work Experience

Figure 2 presents the data on years of experience at the Port of Ghazaouet. According to the survey data, a diversity in experience levels among participants is observed.

Fig. 3: Distribution of Participants by Years of Work Experience



Source: Produced by students using Excel

Environ 13.33% of respondents have less than 5 years of experience, while 18.33% have between 5 and 9 years of experience. The largest group consists of respondents with 10 to 19 years of experience, representing 41.67% of the total. Additionally, 26.67% of respondents have more than 20 years of experience. These figures reflect a solid level of experience among the survey participants. This diverse distribution confirms the relevance of the data collected in the survey.

Approximately 19.05% of participants held various other jobs, while 14.29% were CEOs or senior managers. Technicians accounted for 14.29% of participants, while 11.90% held the position of sales manager. Furthermore, 9.52% held the position of division or department head, with senior managers also representing 9.52%. Participants included 4.76% experts and 2.38% CEOs or senior managers

4.3 Exploratory Analysis

Remind, exploratory factor analysis (EFA) helps determine the number of hidden factors and their respective factorial weights, but it's essential to verify the adequacy of the sample before conducting this analysis. Based on the results from SPSS 26 and R, we obtained the following outcomes

4.3.1 Extraction of Influential Factors on Integration

The extraction process allows the identification of factors from the correlation matrix. this study, uses maximum likelihood analysis with “direct oblimin” rotation is generally applied for factor extraction, according to Maskey et al., (2018) “there is no widely preferred method of factor rotation and all methods tend to give similar results.”

Table 1: Factor Analysis of Port Logistics Integration Components on SPSS

Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings
	Total	% of Variance	% Cumulative	Total	% of Variance	% Cumulative	Total
1	10.249	32.029	32.029	5.294	16.544	16.544	4.185
2	2.732	8.536	40.565	2.234	6.981	23.524	1.880
3	2.242	7.005	47.570	1.302	4.069	27.593	4.200
4	1.983	6.197	53.767	6.089	19.028	46.622	5.284
5	1.714	5.356	59.124	1.564	4.886	51.508	4.652
6	1.402	4.381	63.505	1.374	4.294	55.802	3.582
7	1.281	4.004	67.509	1.235	3.860	59.662	2.042
8	1.182	3.694	71.203	0.965	3.015	62.677	3.390
9	1.128	3.525	74.728	0.930	2.908	65.584	5.085
10	0.967	3.023	77.750				
11	0.810	2.532	80.282				
12	0.699	2.185	82.467				
13	0.667	2.085	84.552				
14	0.648	2.025	86.577				
15	0.628	1.944	88.521				
16	0.490	1.532	90.052				
17	0.414	1.294	91.346				
18	0.367	1.148	92.494				
19	0.343	1.073	93.567				

Source: calculations on SPSS

4.2.2 Simulation of exploratory factor analysis

The initial analysis involves examining several verification constraints before proceeding to a simulation to find the best model. These include assessing the relevance of factor analysis using the KMO index and checking the quality of factor representation (initial statistics > 0.20), verifying correlations between variables (at least one factor with factorial saturation), examining variables that load on more than one factor (complex variables) and considering their removal, and finally, evaluating the theoretical and conceptual relevance of retaining or removing one variable over another.

The shape matrix under SPSS and R from the initial analysis reveals that the constraints of exploratory factor analysis (EFA) are met, allowing us to iteratively refine the analysis until achieving a satisfactory, simple solution. There is no single 'correct solution.' It should be presented as a plausible solution that is not contradicted by the data. The iterations

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resulted in a solution with four factors, explaining a cumulative variance of 67%.

Table 2: Factors of Port Logistics Integration

Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	4.289	42.891	42.891	2.933	29.329	29.329	2.226
2	1.502	15.022	57.913	1.071	10.707	40.037	2.395
3	1.297	12.975	70.887	2.263	22.627	62.664	2.990
4	0.730	7.302	78.190	0.456	4.563	67.227	2.715
5	0.584	5.836	84.026				
6	0.532	5.318	89.344				
7	0.423	4.234	93.578				
8	0.319	3.193	96.770				
9	0.177	1.775	98.545				
10	0.146	1.455	100.000				

Source: Calculations on SPSS

We conducted several iterations of rotation starting from the nine factors until arriving at a stable and adjusted model with four latent factors, as shown in the following table

Table 3 : Rotation iterations on SPSS

Questions	Cost	Technology	Connectivity	Organization
Q12 : Dock fees are reasonable.	1.014			
Q11 : Shipping service fees are reasonable.	0.776			
Q24 : Use of technology to reserve space.		0.987		
Q25 : Use of advanced technology to control flow.		0.733		
Q18 : Connectivity between hinterland and foreland.			0.858	
Q5 : Adequate operations for ship-road interface.			0.701	
Q6 : Well-established international connectivity.			0.605	
Q17 : Common plans to maintain long-term relationships.				0.804
Q21 : Variety of services to manage goods transfer.				0.494
Q26 : Handling goods on time with fewer complaints.				0.423
Reliability	0.895	0.860	0.721	0.574

Source: Calculations on SPSS

The table above presents the rotated component matrix and shows how several variables are associated with the four identified factors. The first factor refers to 'Dock fees,' which is associated with factors addressed in questions Q12 and Q13, including dock fees (1.014) and service fees (0.776). Based on the results, fees appear as the most significant element in resource sharing among partner logistics actors in the port logistics chain.

The second factor refers to 'Technologies,' associated with factors covered in questions Q24 and Q25, including container space reservation (0.987) and container flow control (0.733). We note that other factors do not appear as the common variance is not satisfactory (0.1-0.3), and thus rotation has excluded them from the matrix

The interpretation of these results suggests that there are four dimensions of latent factors, which may present an association among these four factors as indicated by the following results

Correlation Matrix Just like with factor analysis, this matrix allows us to see how much items within factors are correlated with each other and which items factors are more strongly correlated. To evaluate this association, we examined the correlation test, which produced the following results

Table 4: Correlation Matrix on SPSS

Correlations	BART factor score 1 for analysis 7	BART factor score 2 for analysis 7	BART factor score 3 for analysis 7	BART factor score 4 for analysis 7
Pearson Correlation	1	.284**	.318**	.144
Sig. (2-tailed)		.002	.000	.117
N	60	60	60	60
Pearson Correlation	.284**	1	.270**	.408**
Sig. (2-tailed)	.002		.003	.000
N	60	60	60	60
Pearson Correlation	.318**	.270**	1	.475**
Sig. (2-tailed)	.000	.003		.000
N	60	60	60	60
Pearson Correlation	.144	.408**	.475**	1
Sig. (2-tailed)	.117	.000	.000	
N	60	60	60	60

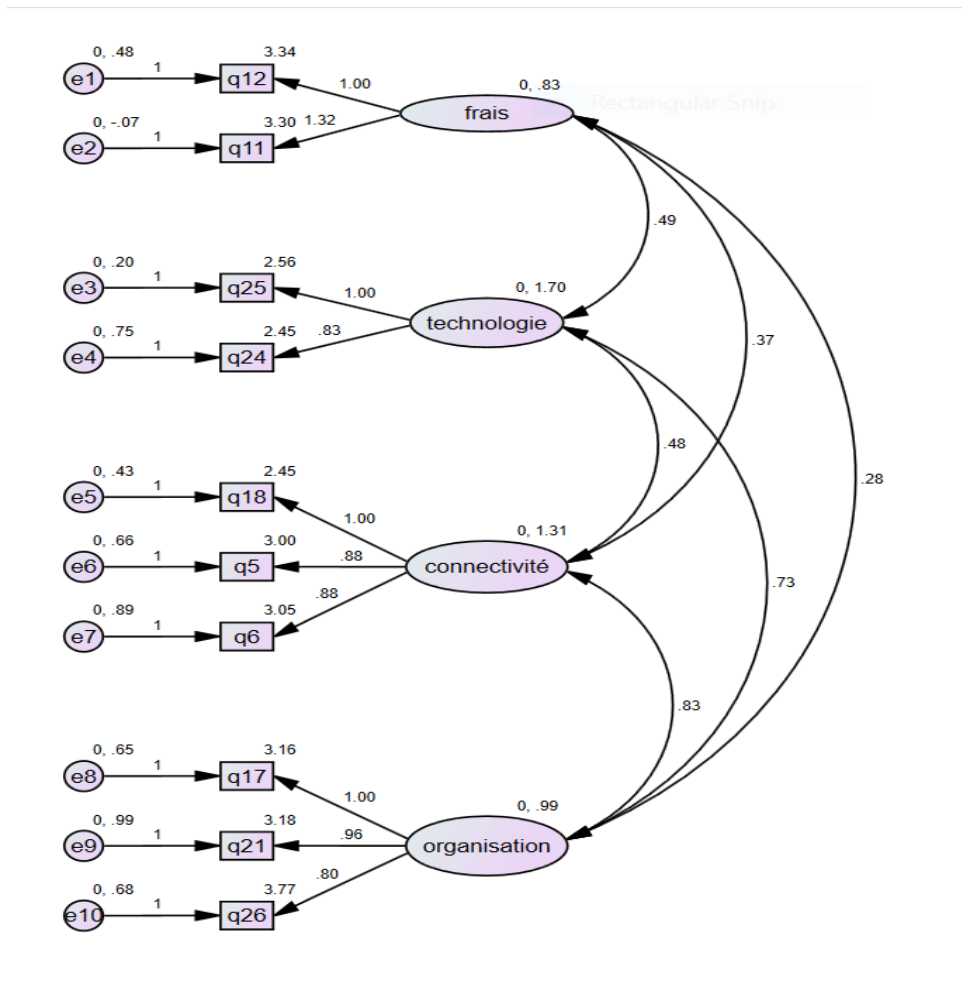
** . Correlation is significant at the 0.01 level (2-tailed).

Source: Calculations on SPSS

The correlation table reveals significant correlations at the 0.01 level for the following pairs of factors: factor 2 and factor 1 ('Fees and technologies'), factor 3 and factor 1 ('Fees and connectivity'), and factors 4, 3, and 1 with factor 2 ('Organization, connectivity, fees' with 'technologies'), and finally factors 3, 2 ('Connectivity, technologies') with factor 4 ('Organization')

4.3 Simulation Confirmatoire

In confirmatory research, the relationship between observed data and produced factors is measured. . Cangur and Ercan (2015). Confirmatory analysis is evaluated by “fit indices”. Cangur & Ercan (2015) and the most



important indices to use: they cite the “root mean square error of approximation” (RMSEA), the standardized Chi square (CMIN/DF) and the comparative fit index (CFI)”. The results of the confirmatory research were obtained using SPSS and AMOS software.

The results of the structural method show that the fit indices are interesting. Table 5 shows that the CMIN/DF is 2.12, revealing a good estimate of the model, while the p-value indicates that the model is significant.

Table 5: Model Fit Summary

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	36	61.624	29	.100	2.125
Saturated model	65	.000	0		
Independence model	10	565.737	55	.000	10.286

Source: Student calculations using AMOS

Table 6 : Baseline Comparisons

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.891	.793	.939	.879	.936
Saturated model	1.000		1.000		1.000
Independence model	.000	.000	.000	.000	.000

Source: Student calculations using AMOS

Table 7 : RMSEA

Model	RMSEA	LO 90	HI 90	PCLOSE
Default model	.054	.063	.131	.014
Independence model	.279	.259	.300	.000

Source: Student calculations using AMOS

RMSEA is the root mean square error of approximation a value of 0.05 indicates an excellent fit,

Table 8 : RMR, GFI

Model	RMR	GFI	AGFI	PGFI
Default model	.032	.966	.939	.542
Saturated model	.000	1.000		
Independence model	.147	.668	.601	.556

Source: Student calculations using AMOS

Table 8 indicates that the RMR = .032 is less than .05, suggesting that the data fit the model and the GFI = .966 is greater than the threshold value of .9 and also indicates that the data fit the Ghazaouet port integration factors model.

The CFA results indicated that the hypothetical four-factor structure demonstrated very good fit to the data, as all parameters aligned well with recommended criteria. Results showed RMSEA = 0.054, GFI = 0.966, CFI = 0.936, TLI = 0.879, and RMR = 0.032(See tables 5, 6, 7, 8).

5. CONCLUSION

The competitiveness of a seaport depends on its logistical efficiency and its integration with partners in the supply chain. Our study, focusing on the port of Ghazaouet, identifies four key factors for this integration. These factors were determined through exploratory factor analysis (EFA) and confirmatory factor analysis (CFA), highlighting their importance in improving the efficiency and competitiveness of Algerian ports.

Based on the results of the quantitative analysis of the questionnaire proposed to Ghazaouet port managers, a number of lessons were drawn:

- The interpretation of these results suggests that there are four dimensions of latent factors, which may present an association between these four factors. The EFA results identified four critical factors, namely information technology, connectivity, port charges, and organisation.

- The results of the CFA and EFA analyses will make it possible to answer the search for the critical factors of logistics integration from the point of view of Algerian ports.

- The results of the CFA and EFA analyses confirm the hypothesis that logistics integration plays a role in the relationship between partners and the drainability of the activity.

- The current challenges in terms of integration for Algerian ports are to extend infrastructures, digitise processes, automate and digitise operations for greater efficiency, and connect with the international transport network.

- More broadly, port development must be aligned with that of rail and road transport in the context of transport and logistics.

and road transport within the framework of transport and logistics.

The final open question in the survey allowed participants to express their views on "recommendations for the integration of logistics systems in the Algerian port of Ghazaouet? The majority of recommendations provided by participants concerned the development of infrastructure, in particular the improvement of quays and the dredging of basins, and also the encouragement of rail investment to connect the port to rail networks in order to facilitate transport, among other things, the improvement of access to the port by optimising truck turnaround times and port operations, and finally, investment in advanced handling equipment.

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