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Reclassify logistic zones in a quantitative way

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Abstract:
After the increasing importance of the logistic areas in the previous decades, the classification of the logistic areas took a great deal of controversy in academic circles. The researchers presented several different proposals and classifications. The controversy among researchers dates back to the multiplicity of names that were given to them even though they provide the same services. There was also a difference in the size and level of service and the diversity of sites. Therefore, this research will present the different attempts of researchers to classify the logistic zones and the bases on which they relied and try to classify the logistic zones In a quantitative way, using the statistical program spss, based on the classification bases that researchers relied on, and studying this on 35 different regions in many countries of the world.

Keywords: (Logistic zones- Logistic gardens -Logistic centers - Logistic clusters - Dry ports- Inland ports- freezones- Special Economic Zones).

Introduction:

The term logistic zones appeared at the beginning of the nineties as a result of the growth and expansion of global trade movements, the empowerment of globalization, the information technology revolution, and the development of logistics and supply chain sciences, but the beginning of the logistic zones dates back to the sixties of the last century. Many countries, especially European and North American countries,

provide logistics services until the first planned logistics area appeared in the United States[1]. Within a decade, these centers increased and their location, size, and nature varied. Many researchers went to study and classify the logistic zones. Researchers differed about finding a classification for the logistic zones, due to the multiplicity of names that were initially given to the zones that provide logistic services, which differed from one country to another, whether in the name or the nature and level of services. Their different locations, so classifying the logistic zones is a challenge to researchers. The term logistic zones have been used in a broad sense in previous periods, especially on the sites that were established near the ports to reduce pressure and congestion inside the port.At first, it relied on sea freight operations, but with the complexity of freight distribution operations and the focus on multimodal transportation solutions, shared modes, capacity issues, and the various logistics services themselves, until they included door-to-door services and the delivery of the commodity to the consumer directly[2], this led to the spread of services Logistics in the remote and inland zones of the country and these facilities were found, especially in zones with large commercial volumes. We find that the so-called nodal centers for goods are called shipping villages in the United Kingdom, and the same centers are called Platforms Multimodal / Logistiques in France and Interporti inland ports in Italy, and it is also called the Gueterverkehrszentren center in Germany. In light of these differences in the nomenclature and concepts of the zones that provide logistics services in their various forms, the researchers found a remarkable diversity and hierarchy of services and space according to their location and the difference in the main means of transportation that depend on them, which formed a basis they relied on to classify the logistics zones.

Literature review:

Some institutions, such as The European Logistics Platforms Association and Europe Aid, as well as many researchers, such as Michel savy, Rodrigue, Meiling, and others, have developed general concepts for logistics zones and the most important characteristic of them. All of their proposals agreed that the logistics zones are an equipped site that is set up to provide logistic services and related activities, complete multimodal transport operations, achieve logistical concepts, prevent overcrowding within sea and airports, and achieve added value to goods with the need to provide a distinct infrastructure that links them with the various modes of transport and a network High-efficiency communications.[3]

Some of them also added the need for some services, such as the possibility of reaching companies participating in logistic activities and providing general services

[1] EUROPLATFORMS EEIG – January 2004

[2] https://transportgeography.org/contents/applications/logistics-zones-freight-distribution-clusters/2021

[3] MEDA MoS Project - EuropeAid/121468/C/SV/Multi – Logistic Activity Zones - July 2010

for employees and equipment to users, as well as multimodal transport services on the site, etc. and related zones such as reloading centers and multimodal transport stations.[1]

Logistic zones typology:

Despite the agreement of most researchers on the general understanding of the logistic zones, there is a clear disagreement over the classification and definition of each type of logistic zones, due to the multiplicity of names and terms used, which reached nearly 50 names, and the researchers presented more than 5 Rankings since 1999[2]

In 1999, Wiegmans and others presented a simplified classification of logistic zones, dividing them into five types, graded in area and volume of traded shipments, and gave those symbols expressing their graduation from XXL to S[3].

Then Leitner & Harrison introduced 2001 another classification in which it divided logistics zones into four different categories according to their primary mode of use, and this includes inland waterways ports, air freight facilities, ports, and road or rail transport.

Then the researchers Rimienė and Grundey in 2007 developed a more comprehensive classification in which they added the function and the scope of activities in shipping and logistics and divided the regions into three tiered levels. They also explained the possibility of developing regions when their size increases and regional trade flows increase to move from one level to another.[4]

As Notteboom & Rodrigue, they presented a different classification in 2009, in which the geographical location of the regions was taken into account, as they noticed a difference in the job when the location of the logistics zones differs, and that the volume of value-added services increases as the location is closer to the port، so They divided the zones into four levels, regardless of the name, in which the size of the zones and services increase the closer the site is to the ports.[5]

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[1] Meiling He 1 . ID, Jiaren Shen 1, Xiaohui Wu 1, and Jianqiang Luo 2.Sustainability 2018, 10, 2815 Review.Logistics Space: A Literature Review from the.Sustainability Perspective.

[2] C.D. Higgins, M. Ferguson & P.S. Kanaroglou. VARIETIES OF LOGISTICS CENTRES:DEVELOPING A STANDARDIZED TYPOLOGY AND HIERARCHY. Washington, D.C. TRB 2012 Annual Meeting

[3] Wiegmans, B., Masurel, E., &Nijkamp, P. (1999). Intermodal Freight Terminals: An Analysis of the Terminal Market. Transp. Plann. Technol., 23 (2), 105-128

[4] Rimienė, K., &Grundey, D. Logistics Centre Concept through Evolution andDefinitions. Engineering Economics, 4 (54), 87-95. (2007

[5] Notteboom, T., & Rodrigue, J.-P. Inland Terminals within North American and European Supply Chains. In E. a. Pacific, Transport and Communications Bulletin for Asia and the Pacific No. 78: Development of Dry Ports. New York: United Nations. (2009)

Sheffi also spoke about the importance of agglomeration to logistics groups, as they provide many advantages and benefits, especially at the local level, and that the regions have three levels: local (urban), regional and international, each of which differs in the main transport mode, optimal accessibility, and geographical scope, including global and urban supply chains, Also job classification.[1]

And this classification was the most obvious of them, as Higgins and others in 2012 developed this classification as a unified classification of logistic centers to form a hierarchy of logistic.

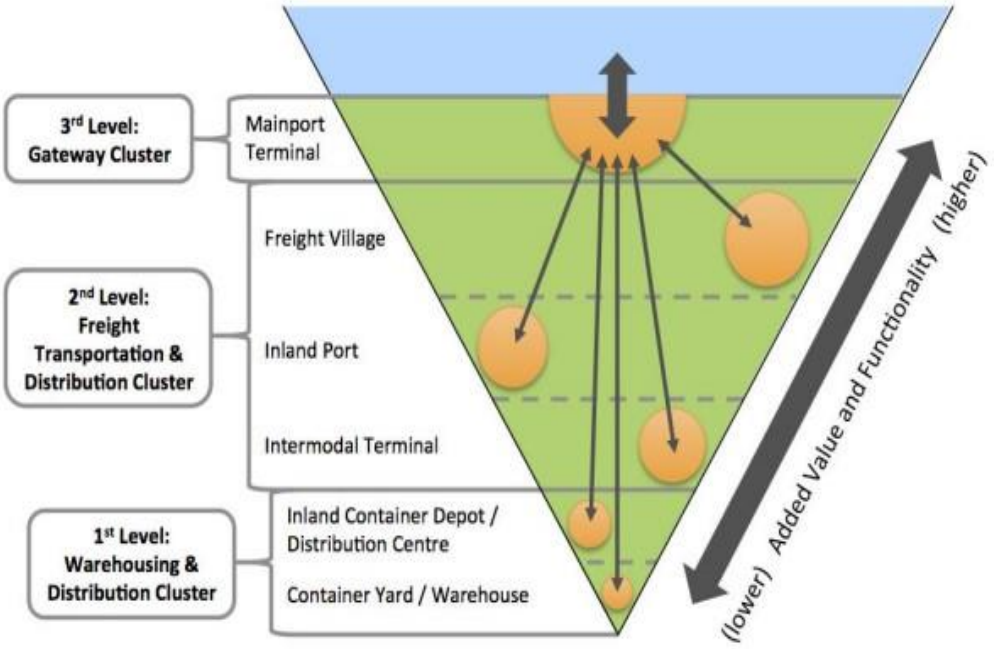

Fig 1: **Standardized Logistics Centre Hierarchy**

Source: C.D. Higgins, M. Ferguson & P.S. Kanaroglou. VARIETIES OF LOGISTICS CENTRES: DEVELOPING A STANDARDIZED TYPOLOGY AND HIERARCHY. Washington, D.C. TRB 2012 Annual Meeting

[1] Sheffi, Y. (2012) Logistics cluster: delivering value and driving growth. Cambridge: The MIT Press

centers according to the size of each facility, its impact and function in regional shipping, logistical activities, and value-added, **Fig 1** in which the logistic zones were divided into three Graduated levels Each level has a different name[1].

This classification attempted to solve the problem of pluralism in terms that appeared in the previous literature and collected all the opinions of researchers and included the different terms under three groups of levels with similar functions and ingredients.

Through the different classifications developed by researchers, especially the classifications developed by Higgins and Sheffi, we can put a brief description of the description and requirements of each level of the logistic zones, in which we explain the gradation of size, area, location, the infrastructure of transportation, target markets and the level of value services Added and others through the following table No :1 In such a table, a qualitative description of each level of the logistic regions includes many variables that express the needs of each region.

Table 1: **Specifications of the different logistics zone according to their classification**

		level 1 local (urban)		level 2 Regonal			level 3 International
		distribution centers /Inland Container Depot	Warehouses /Container Yard	Multimodal transmission stations	Inland/ dry port	fright /Cargo Village	Geteway (Mainport Terminals)
Size		s	s	m	l	xl	xxl
Area		9000 m2	9000 m2	10500 m2	36400 m2	400000 m2	400000 m2
Average volume of shipments		less than **10000** TEU/YEAR	less than **10000** TEU/YEAR	from **30000** to **10000** TEU/YEAR	from **100000** to **30000** TEU/YEAR	from **500000** to **100000** TEU/YEAR	more than **500000** TEU/YEAR
location		Hinterland / Inland	Hinterland / Inland	Inland	Inland	Inland	near to ports
transportation	**Port**	Weak	Weak	medium	medium	good	Very good
	Airport	Weak	Weak	medium	medium	Very good	Very good
	Rialway	Weak	Weak	Very good	Very good	Very good	medium
	Road	Very good	Very good	Very good	good	good	medium
Target market		local (urban)	local (urban)	- international local (urban)	- international local (urban)	-international - regional local (urban)	international-regional
The final destination of the goods		Consumer	Consumer	port or distribution centers	port or distribution centers	Port, airport or distribution centers	To export to other countries or internal regions of the country
The level of valueadded services		Weak	Weak	medium /good	medium /good	medium /good	Very good
Property		It allows the private sector to exist independently		Public ownership or partnership between the public and private sectors			Public ownership or partnership between entities

Source: author

[1] C.D. Higgins, M. Ferguson & P.S. Kanaroglou. VARIETIES OF LOGISTICS CENTRES:

DEVELOPING A STANDARDIZED TYPOLOGY AND HIERARCHY. Washington, D.C. TRB 2012 Annual Meeting

Methods:

Based on previous studies, there are many factors based on which the researchers classified the logistic zones, and here we will try to classify the logistic zones in a quantitative way through the Cluster analysis test using the spss statistical program to analyze 35 logistic zones of different size, services, and location in many countries of the world. Data for these zones for three groups of variables: location, transport infrastructure, and Description of the logistics zone which contains 17 variables.

Statistical analysis will be carried out through two tests using the statistical program spss. The first test is a two-step cluster analysis and through it, it will show the basic groups of logistic zones that are similar in characteristics, and it will also show the most reliable variables in the classification. The second test is a hierarchical cluster analysis, which will show the main classifications of logistics zones and their hierarchy as showen in Fig 2 .

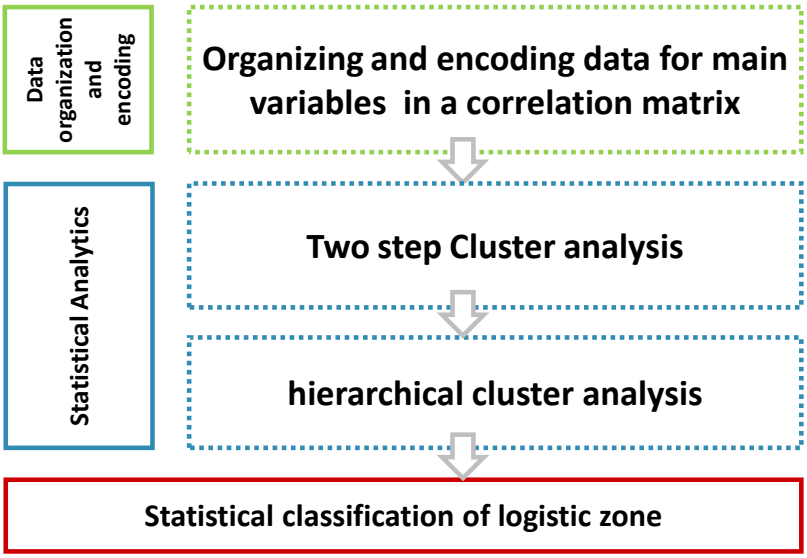

Fig. 2 Methodology Scheme

Source: author

Two-step Cluster analysis:

It is an analysis used to classify phenomena, and it divides and categorizes different data elements (variables) into several sub-groups that are homogeneous within one group (one cluster), and are differentiated and different from other groups (other clusters). This analysis does not distinguish between dependent and independent variables and can deal with binary, nominal, ordinal, and standard (interval or ratio) data.[1]

[1] S. Sinharay, in International Encyclopedia of Education (Third Edition), Elsevier; 2010, Pages 1-11.

Hierarchical cluster analysis:

That creates groups iteratively, by joining or dividing groups in succession and starts with the complete data set in one large group and then divides it successively into smaller groups that have the same characteristics[1]

Hierarchical cluster analysis builds a tree diagram that shows the main groups of samples (logistic zone) and their gradual subgroups there are Several different algorithms can be used in hierarchical cluster analysis most of them support hierarchical cluster analysis. There is no better method than the other, most of the methods give close results, and the most logical method is chosen.[2]

Data gathering

There are 17 variables were collected for 35 different logistic regions to conduct the two tests on them, The variables collected varied between Qualitative Data and Quantitative Data, for qualitative data, most of them were Ordinal Data such as the level of services provided and the degree of the logistic area Which expresses order and degree and can be expressed by rating from 1 to 10 or 1, 2 3، and the quantitative data was Interval Data collected about the zones under study, such as area, employment and distance to the port[3].

The statistical program (SPSS) has been used to perform a cluster analysis on the variables that were collected from the logistic zones, and for the ease of conducting the analysis, the used variables have been coded from F1 to F17. We can display the variables used during the analysis with an explanation of their type and code through the following table no 2

[1] John A. Bunge, Dean H. Judson, in Encyclopedia of Social Measurement, 2005

[2] Tom Tullis, Bill Albert, in Measuring the User Experience (Second Edition), 2013

[3] Pat Bazeley، The Contribution of Computer Software to Integrating Qualitative and Quantitative Data and Analyses، RESEARCH IN THE SCHOO، LSMid-South Educational Research Association 2006, Vol. 13, No. 1, 64-74

Table 2: Variables used for logistic zones

Location Variables	code	Data type	Description of the logistics zone Variables	code	Data type	transport infrastructure Variables	code	Data type
strategic location	F1	Ordinal Data	Size and area in acres	F7	Interval Data	Maritime transport link in the region	F13	Ordinal Data
accessibility	F2	Ordinal Data	Shipment volume TEU/year	F8	Interval Data	River transport link in the region	F14	Ordinal Data
Contacting the industrial areas	F3	Ordinal Data	Job opportunities	F9	Interval Data	Air transport link with the region	F15	Ordinal Data
Contacting the internal markets and urban areas	F4	Ordinal Data	The type and size of the markets served by the region	F10	Ordinal Data	rail transport link with the region	F16	Ordinal Data
The distance to the main port	F5	Interval Data	The level of value-added services	F11	Ordinal Data	road transport link with the region	F17	Ordinal Data
The distance to the capital	F6	Interval Data	The type and degree of the Zone	F12	Ordinal Data			
It contains 6 variables that describe the location and its relationship to the port, markets and the capital			**It contains 6 variables that describe the location and its relationship to the port, markets and the capital**			**It contains 5 variables that show the forces of association of the logistics area with different means of transportation**		

Source: Compiled by the author

Results:

Two-step Cluster analysis test:

Through the work of Cluster analysis of the seventeen variables, the results showed the division of the logistic zones into two groups, each of them similar in characteristics relative to the analysis of completely different variables, and we find that the first group contains 19 logistic zones and the second group contains 16 logistic zones and the following **Fig 3**, Explains the most important results of the analysis, also we find that the cluster quality value exceeds 0.5, which means the quality and accuracy of the classification.

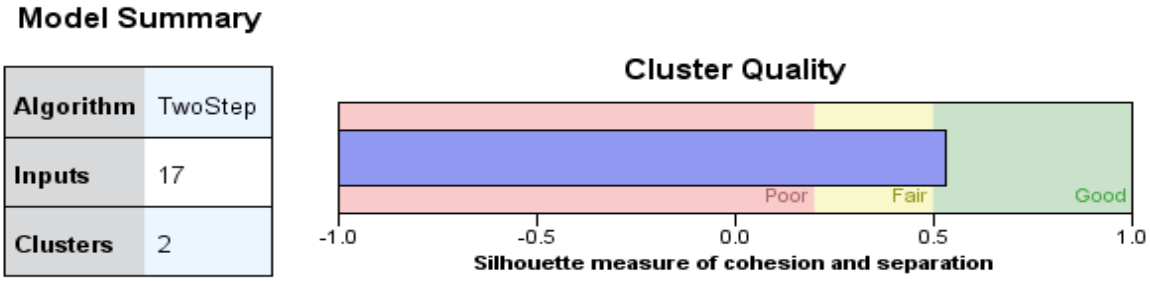

Fig 3 Cluster analysis test results using the statistical program spss

The analysis also shows the importance of the variables (predictor importance) used to divide the regions into two clusters. **Fig 4** showed the first ten variables with influence, the most important of which are the type and degree of the Zone, The type and size of the markets served by the region while ignoring the seven least influential variables.

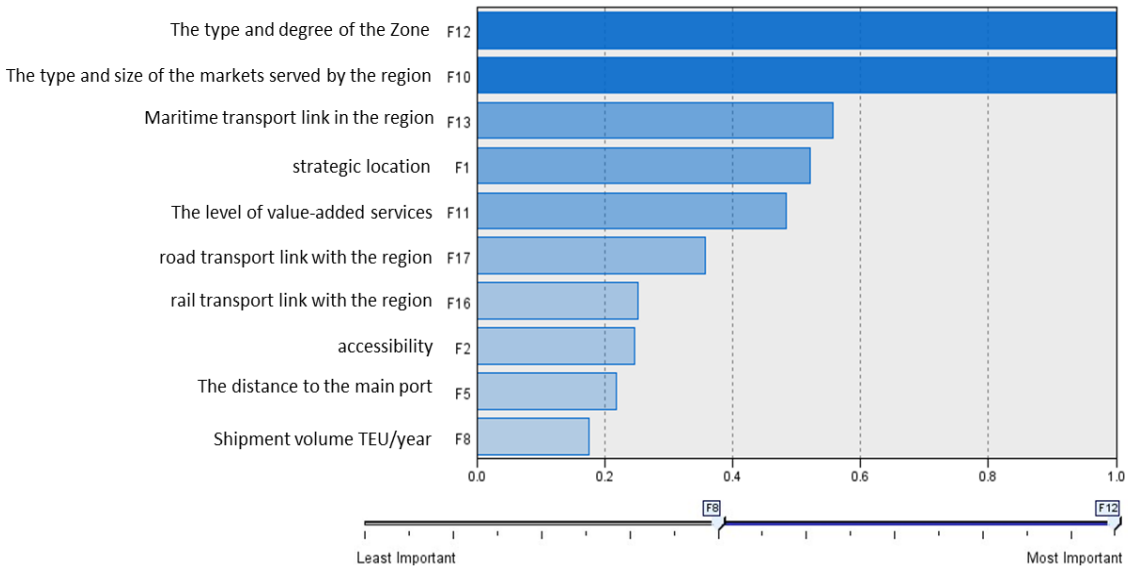

Fig 4: the highest variables affecting the classification (predictor importance)

Clusters groups :

The Cluster analysis test divided the logistic zones into two Clusters **Fig 5,** the first Cluster has 16 regions, 45.7% of the sample, and the second Cluster has 19 regions, 54.3% of the sample.

Size of Smallest Cluster	16 (45.7%)
Size of Largest Cluster	19 (54.3%)
Ratio of Sizes: Largest Cluster to Smallest Cluster	1.19

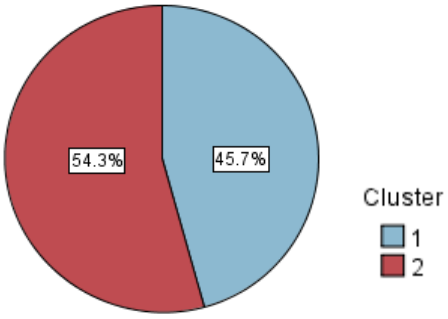

Fig 5: Number of the two cluster

Cluster one:

The first Cluster, which includes 16 logistic zones, after reviewing the zone as shown in table no 3 , it was found that most of the zones belonging to the first Cluster are the logistic zones located near the port, and most of them are according to the classification of Higgins, and the rest of the researchers are of the third level of the logistic zones in what is called the main port terminal (Getaway)Which is characterized as being the highest level of the logistic zones, as it is the largest,

number of containers, the volume of employment, diversity of value-added services and direct link to various means of transportation, especially the port.

Table 3: The logistic zones in the first Cluster

logistic zone	country	City	The type of logistic zone of the Higgins classification	Location	cluster number
Center, New Raritan Jersey	United States of America	Edison	port main terminal	the port within region	1
Savannah Gateway	United States of America	savanna	main port terminal	within the port region	1
Jebel Ali Logistics Zone in the UAE	United Emirates	Dubai	main port terminal	within the port region	1
Bahrain Logistics District	Bahraini	Manama	main port terminal	within the port region	1
Pasir Panjang Distripark	Singapore	Queenstown	main port terminal	within the port region	1
KEPPEL DISTRIPARK	Singapore	Keppel	main port terminal	within the port region	1
ATL Logistic Center Hong Kong	China	Hong Kong	main port terminal	within the port region	1
Yokohama port cargo centre	Japan	Yokohama	main port terminal	within the port region	1
Manzanillo International Terminal	Panama	Panama	main port terminal	within the port region	1
panama) costa del este (city	Panama	Juan Díaz	main port terminal	within the port region	1
Laem Chabang Terminal	Thailand	Lime Chabang	main port terminal	within the port region	1
HALIFAX LOGISTICS PARK	Canada	Halifax	main port terminal	within the port region	1
Distripark Maasvlakte	Holland	Rotterdam	main port terminal	within the port region	1
ZAL Port de Barcelona	Spain	Barcelona	Inland Port	inland location	1
London Logistics Park	United kingdom	London	Inland Port	inland location	1
Mills North Delta	Egypt	Damietta	main port terminal	within the port region	1

Cluster two:

The second cluster, which includes 19 logistic zones shown in table no 4, found that most of the zones belonging to the second cluster are zones far from the port region, according to the classification of Higgins and the rest of the researchers. The second cluster includes the zones of the first and second levels, as it includes the interior zones with all their names.

Table 4: The logistic zones in the second Cluster

logistic zone	country	City	The type of logistic zone of the Higgins classification	Location	cluster number
Logistics Park BNSF	United States of America	Chicago	multimodal station	location inland	2
The Virginia Inland Port (VIP)	United States of America	Virginia	Inland Port	inland location	2
Riyadh Dry Port	Saudi Arabia	Riyadh	Dry Port	inland location	2
TICON LOGISTICS PARK	Thailand	Bangkok	multimodal station	inland location	2
Lat Krabang Inland Container Depot	Thailand	Bangkok	Inland Port	inland location	2
INTERPORTO QUADRANTE EUROPA	italy	Verona	Inland Port	inland location	2
Amazon Warehouse in Italy	italy	Turin	Warehouse	hinterland	2
Falköping terminal for the Port of Göteborg	Sweden	Skaraborg	port terminal	within the port region	2
Gennevilliers Inland Port	France	Paris	Inland Port	inland location	2
(FRANCE - LILE) Delta3	France	Lille	distribution center	hinterland	2
Uiwang Inland Port	Korea South	seoul	Inland Port	inland location	2
Segamat Inland Port	Malaysia	Segamat	Inland Port	inland location	2
Whitefield ICD	India	Bengaluru	Warehouse	hinterland	2
ADANI INTERNATIONAL CONTAINER TERMINAL	India	malur	distribution center	hinterland	2
Dry Port Azuqueca	Spain	zaragoza	Warehouse	inland location	2
City Deep Inland Container Terminal	Africa South	Johannesburg	distribution center	hinterland	2
Daventry International Rail Freight Terminal (DIRFT)	United kingdom	Northamptonshire	multimodal station	inland location	2
Güterverkehrszentrum Bremen	Germany	Bremen-Strom	Inland Port	inland location	2
Budapest Intermodal Center Logistics	Hungary	Budapest	distribution center	hinterland	2

Hierarchical cluster analysis:

In this test, the same variables used in the previous test (Two-step cluster analysis) were used and the ward linkage cluster method was chosen

This test gave us the following results through the tree diagram in the following **Fig 6**

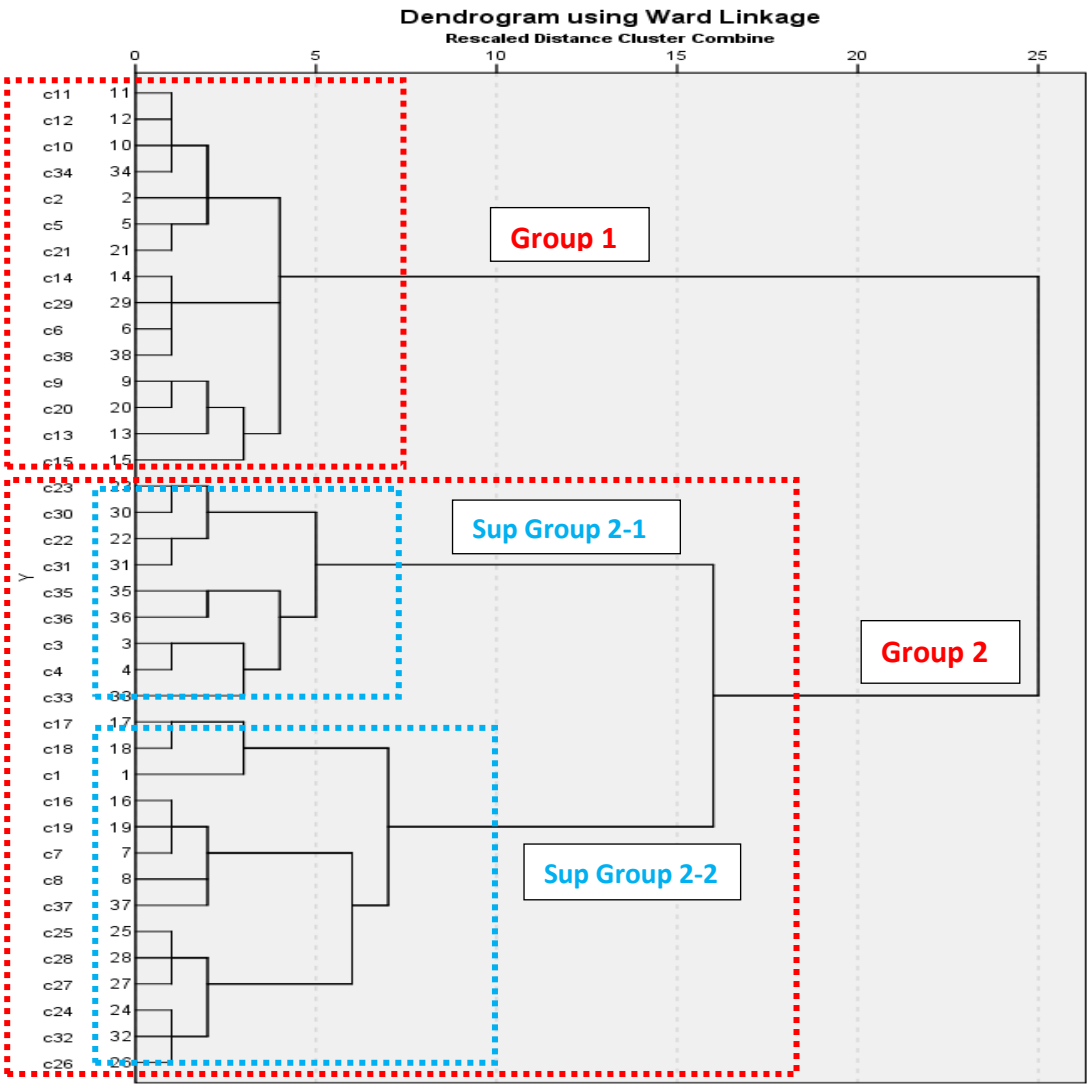

Fig 6: the results of Hierarchical cluster analysis (tree diagram)

Through the tree diagram resulting from the program, it is clear to us that the test divided the logistic zones into two main groups. The first group contains 15 zones close in characteristics so that the disparities do not produce differences that allow for a clear hierarchy within the first group. By reviewing the zones within the first group, it was found that the zone close to the port is the same as the Cluster one regions resulting from the two-step Cluster analysis.

The second group contains 20 logistic zones. We also find that the second group was divided into two smaller groups and close in characteristics, and the zones of the second group are the same zones of Cluster two in the previous test, and following tables no 5 & 6., we will explain each group and the regions in it and their hierarchy.

Table 5: The logistic zones in group 1 by Hierarchical cluster analysis compared with two-step Cluster analysis

Hierarchical cluster analysis group 1			Two-step Cluster analysis
group 1			
name	location	code	
Gateway Savannah	within the port region	c 2	Cluster one
Jebel Ali Logistics Zone in the UAE	the port region within	c 5	Cluster one
Bahrain Logistics District	location inland	c 6	Cluster one
Pasir Panjang Distripark	the port region within	c 9	Cluster one
KEPPEL DISTRIPARK	the port region within	c 10	Cluster one
ATL Logistic Center Hong Kong	the port region within	c 11	Cluster one
Yokohama port cargo centre	the port region within	c 12	Cluster one
International Manzanillo Terminal	the port region within	c 13	Cluster one
(panama city) costa del este	the port region within	c 14	Cluster one
Terminal Laem Chabang	the port region within	c 15	Cluster one
HALIFAX LOGISTICS PARK	the port region within	c 20	Cluster one
Distripark Maasvlakte	the port region within	c 21	Cluster one
ZAL Port de Barcelona	location inland	c 29	Cluster one
London Logistics Park	location inland	c 34	Cluster one
Mills North Delta	the port region within	c 38	Cluster one

Table 6: The logistic zones in group 2 by Hierarchical cluster analysis comparing with two step Cluster analysis

Hierarchical cluster analysis Group 2							
group 2: sup group 2-2-1			Two step Cluster analysis	group 2 : sup group 2-1			Two step Cluster analysis
name	location	code		name	location	code	
Raritan Center, New Jersey	the within port region	c1	Cluster one	Daventry International Rail Freight Terminal (DIRFT)	inland location	c 33	Cluster two
Lat Krabang Container Inland Depot	inland location	c 17	Cluster two	Güterverkehrszentrum Bremen	inland location	c 35	Cluster two
INTERPORTO QUADRANTE EUROPA	inland location	c 18	Cluster two	Budapest Intermodal Logistics Center	hinterland	c 36	Cluster two
group 2: sup group 2-2-2				Falköping terminal for the Port of Göteborg	the within port region	c 22	Cluster two
Dry Port Riyadh	inland location	c 8	Cluster two	Gennevilliers Inland Port	inland location	c 23	Cluster two
TICON LOGISTICS PARK	inland location	c 16	Cluster two	Dry Port Azuqueca	inland location	c 30	Cluster two
Amazon Warehouse in Italy	hinterland	c 19	Cluster two	BNSF Logistics Park	inland location	c 3	Cluster two
(FRANCE - LILE) Delta3	hinterland	c 24	Cluster two	The Virginia Inland Port (VIP)	inland location	c 4	Cluster two
Uiwang Inland Port	inland location	c 25	Cluster two				
Segamat Inland Port	inland location	c 26	Cluster two				
Whitefield ICD	hinterland	c 27	Cluster two				
ADANI INTERNATIONAL CONTAINER TERMINAL	hinterland	c 28	Cluster two				
City Deep Inland Container Terminal	hinterland	c 32	Cluster two				

Conclusions

We find that the results of the two-step Cluster analysis or Hierarchical cluster analysis both confirmed that the logistic zones are divided into two main groups, a group that includes logistic zones close to the port (Getaway) and a group that includes inland logistic zones. The results of these tests appear as if they depended on one factor, which is the location, but in fact, the factors of the location have an impact on other aspects such as connectivity, available means of transportation, type of markets, level of services, and others. There are similar services motivating

investment, and we find that frequently in most zones, nearby. As for the internally located zones, with the clear difference between them and the zones of the first group, there is a discrepancy between the internally located logistical zones, and this was confirmed by the Hierarchical cluster analysis test. They are divided internally into smaller groups.

This research does not negate the previous classifications and hierarchy proposed by the researchers, but it confirms the difference between the nature of the logistic zones near the port, which often represents a logistical group for the multiplicity of activities, services, and sites ،And between internal sites, which can be independent or have limited services.

But, this research recommended when classifying the logistics zones, especially the hierarchical classification, separating the two types, the Getaway logistic zones and inland logistic zones, and the rest of the sub-categories that can be added fall under them. due to the different needs, standards, and conditions for each type.

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