Aboul-Atta and El-Lebody
*Journal of Engineering and Applied Science* (2023) 70:8
https://doi.org/10.1186/s44147-023-00175-y

Journal of Engineering and Applied Science

RESEARCH Open Access

# Measuring the most important factors affecting the success of different logistic zones

Tarek Abdel-Latif Aboul-Atta[1] and Yara Menshawy El-Lebody[2*]

*Correspondence:
eng.yaramenshawy@gmail.com

[1] Architecture and Regional Planning, Faculty of Engineering, Cairo University, Cairo, Egypt
[2] Department of Architecture, Higher Institute of Engineering in El-Shorouk, Cairo, Egypt

## Abstract

Logistic zones play an important role in supporting global trade movements and supply chains; it also helps to achieve development in many countries of the world.

Therefore, this paper aims to explore the most important affecting factors that must be available to establish successful logistic zones through quantitative analysis for184 variables at the global and site characteristics. These include many variables such as location, infrastructure, and political and economic situation. This analysis is done for 38 logistic zones different in type, size, and degree in several countries of the world using the statistical program SPSS to get the most important factors affecting it using principal component analysis test. The research also tries to find relationship between the site characteristic variables and national variables through the linear regression test. As a result, the variables were reduced to reach the most important variables of influence, as well as the strength of the relationship between national and site characteristic variables, which shows that the success of the logistic zones requires the integration of many related development sectors such as transport, infrastructure, information technology, laws, and commercial facilities at all levels.

**Keywords:** Logistic zones, Logistic gardens, Logistic centers, Dry ports, Inland ports, Free zones

## Introduction

Logistics has now become one of the main tools supporting global trade movements and the growth of the global economy. It also works to attract foreign investments, revitalize the national economy, and create many job opportunities. It is found that logistic investment has reached US $8.6 trillion in 2020, equivalent to 20% of the size of the global investment [1]. It has been found that countries that occupy advanced positions) have the highest rank (in logistic performance indicators at the same time have high rates of development and vice versa, and the countries with the lowest rank in logistic performance indicators achieve low or modest levels of development especially in the fields of transport, infrastructure, and information technology [2, 3].

With the increase of the importance of logistic services and logistic zones, the logistic zones extended around the world, and many countries went to improve their logistical capabilities to achieve development in this field, facilitate trading and distribution movements, and achieve many competitive advantages.

## Literature review

### *Origin of the logistic zones*

Logistic zones come from the idea of special economic zones and free zones as a result of the increase in the volume of global trade and the congestion of ports and also because of the development of logistics and information technology (Fig. 1). As a result, initially, the logistic zones were automatically established at the rear locations of the port or nearby sites and were known as logistic zones or logistic parks as a molecule of the port region and special economic zones and developed over the time, which led to the multiplicity of their types, names, levels, and classification. At that time, every country started to establish the logistic sites with a different name to separate the logistics business in proportion to its needs, regulations, policies, and laws. Some of them are integrated centers, and some of them provide some logistic services [4].

In the beginning, logistic zones that provide logistic services appeared in the mid-1960s and 1970s in Europe under the name of multimodal inland stations, which are usually located on inland waterways [5].

The same name appeared for the multimodal areas in the USA, but it was not associated with the idea of waterways but rather relied on the site that facilitates the flow of goods. The term internal stations there was used as a general term for sites such as industrial complexes, the multimodal center, the air freight port, the river port and the trade processing center international, and others [6].

Then, in the 1980s, the term "dry ports" or "internal ports" appeared, which was considered as background sites belonging to the port, directly linked to it by railways, as a solution to congestion within the main ports. The size and shape of these zones were not specified in a fixed or legal framework [7].

With the beginning of the 1990s, the logistic zones appeared clearly with a functional hierarchy whose level, size, and services ranged from the international level to the site characteristic, as it included many facilities that provide logistic services and value-added services starting from the main centers or getaways, near ports, airports, and the end of warehouses and distribution centers in cities [8].

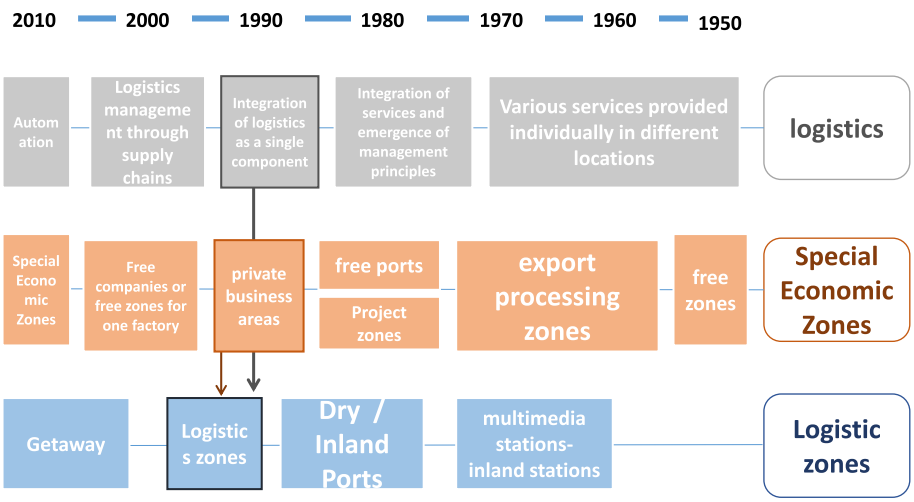


**Fig. 1** The origin of logistic zones and its development

Finally, trade logistics has become a basic necessity in local commercial operations locally, regionally, and globally, and the establishment of various logistic zones has become an essential matter in economic development processes and the development of local trade and an important opportunity for countries trying to catch up with the development.

Therefore, it was necessary to study the most important variables that affect the logistic zones in all respects, both in terms of factors that affect the logistics zones related to the choice of location of the region and factors that affect the logistical efficiency such as transport, infrastructure, information technology, and everything related to establish effective and global competitive logistics zones and achieve development.

#### *Factors affecting logistic zones*

When talking about the important elements of logistic zones, it is difficult to differentiate between commercial logistics and logistic zones, especially in the trade and economy sector. The establishment of logistic zones led to the concentration of many logistical services and operations in one location, as well as the assembly of many companies, suppliers, and tenants and the availability of a variety of goods and products. But the factors for the success of the logistic zones not only are related to a site that provides services but also are a result of the development of commercial logistics and global supply chains. The factors for the success of the logistic zones cannot be shortened to special requirements for the site characteristic and the logistics facility. Of course, site characteristic is a basic and important part, but it works within an integrated system.

Some studies that dealt with the subject of site selection considered it a strategic decision in which some indexes published by economical entities were used to comparing the efficiency of sites, and the comparative criteria were divided into two categories: national level and subnational level standards, the national level reflecting the global attraction of a country and subnational level reflecting the attraction of a city or region [9].

Like Tongzon [10] who talk about the preferences of the 6 largest companies in the logistics field on the factors that depend on them to choose the appropriate country for their investments, which indicated many factors, the most important of which are market potential, purchasing power, government policy and regulations, incentives for foreign investors, infrastructure development, availability and quality of the technological base, and the presence of relevant and supportive industries.

Also, Munoz and Rivera [11] have confirmed the existence of critical elements for the success of logistic zones, which are summarized in three groups.

- First: Capstone, which includes the economic base and companies that attract foreign investment
- Second: Operations, including human resources, infrastructure, administrative processes, and regulations
- Third: The strategic location, commitment, and stability of the government [11]

Another research by El-Nakib [12] focused on the opinion of companies working in the logistics field to determine the most important factors that affect their choice of the

logistic zones, which was represented in 16 elements, the most important of which are geographical location, transportation, facilities, skilled labor, logistics services, service providers, growth potential, and flexible government and political stability, which means that there are no internal disturbances of the state affecting the system of government.

Furthermore, a study by David Tennant [13] also mentioned the need for preconditions for the establishment of logistic zones, which included five important elements, namely, natural endowment, physical infrastructure and operations, economic incentives, people and processes affecting trade and logistics, and the business environment.

Based on all previous studies that dealt with the issue of logistic zones from several aspects, we have collected all the elements mentioned by the researchers, which can have an impact on the logistic zones of all categories, and divided them into two parts: first, the variables for site characteristic which comprises of four groups and the national variables for the country which comprises of five groups (Fig. 2); this groups will be explained later.

### Site characteristic variables

It means all the variables that are directly related to the logistic area and its location, and it includes four groups of variables:

#### *Location*

The location is one of the most important elements of the logistic zones. It includes the strategic location of the state and the region, such as the presence of attractive activities for development in the vicinity, the price of the land, the possibility of future extension and proximity to urban areas to provide services for workers and dealers with the area, and of course before the establishment of the area and when choosing the site must be appropriate for development and free from natural obstacles, especially geological [14].

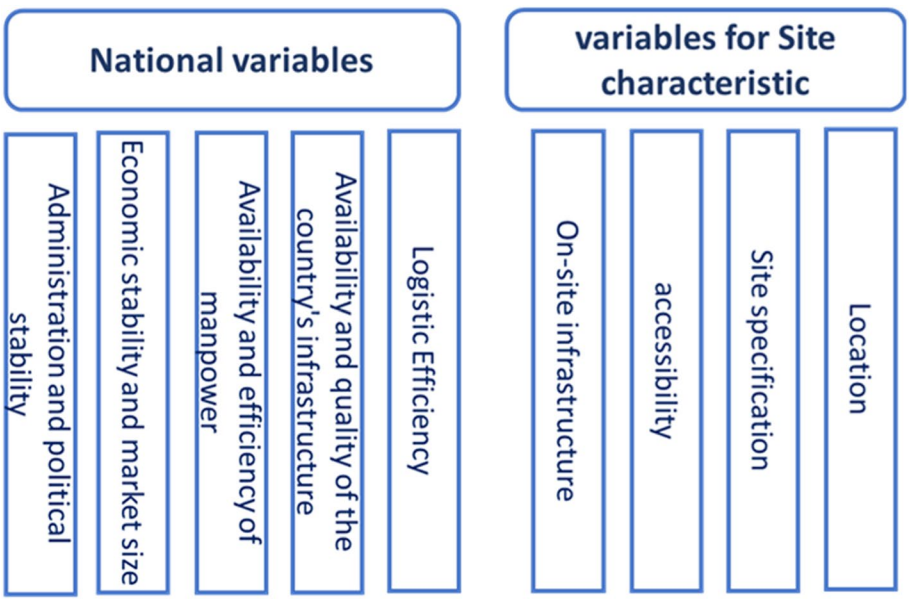


**Fig. 2** Factors affecting logistic zones

#### *Site specification*

It includes all the characteristics of the region, such as the area, the volume of containers that it deals with annually, the number of employees, the category and degree of the region, the type and size of the target markets, and the level of value-added services. Any other available elements related to the region can be added.

#### *Accessibility*

This is the ability of the site to connect with local and international markets and reduce the cost and time of transportation, which represents the largest proportion of logistical costs, as the site is close to ports, airports, and railway stations as well as major road networks [15].

#### *On-site infrastructure*

It includes the presence of all the various infrastructure services within the site, such as supplying utilities to the site (water — electricity, etc.) and the availability of transport infrastructure, roads, railways, river transport, ports, and airports, and the infrastructure also includes communications and the Internet.

#### *National variables*

Most of these variables relate to the capabilities of countries that help establish competitive logistic zones. These variables have been collected through many published international reports.

#### *Logistic efficiency*

It reflects the quality and efficiency of the country's logistical infrastructure and its position in the global supply chains through six main criteria: customs, infrastructure, international shipments, tracking and tracing, and timeliness. It also includes some variables about the time and distance that supply chains need for exports and imports, as well as the number of agencies, forms, customs clearance, inspection, and others.

#### Availability and efficiency of manpower

The human element is an essential element for the success of any organization. The human resources department in the institutions that provide logistics services must ensure that their workforce possesses the necessary skills [16]. It includes three axes, which are the availability and quality of labor, wages, and employment policies and laws.

#### Availability and quality of the country's infrastructure

It includes the availability and efficiency of all types of transport infrastructure, roads, railways, airports, ports, and regular communication with shipping lines, and the infrastructure of information and communication technology, such as its availability and use in commercial transactions and the efficiency of postal services.

#### Economic stability and markets

It includes everything related to the economic situation of the state, which ensures its stability and economic strength, such as development rates, domestic product, volume

of exports, inflation, debts, and banks. It also includes what is related to the local and international markets in terms of contact with them, openness, competitiveness, ease of doing business, and economic incentives.

#### Administration and political stability

It includes everything that guarantees political stability, such as enacting laws, resolving disputes, providing protection and security of property, and others.

## Methods

The study aims to measure the most important decisive factors affecting the logistic zones for each group of the previous elements, whether at the national or site level, in a quantitative statistical way, and to find the strength of the relationship between them. A principal component analysis test was conducted for each of the variables collected for 38 different existing logistic zones in the degree and type for each group of national variables and site characteristic variables.

Separately, to reduce the variables that numbered 21 for the site characteristic and 163 at the national variables to measure the extent of the correlation between them through the linear regression test using the statistical program SPSS (Fig. 3), using of statistical indicators enables us to identify the critical variables that affect the efficiency of the logistic zones and enables us to arrange them in terms of importance.

#### Data gathering and encoding

This paper used the previous set of variables that were proposed based on many previous studies (Fig. 4) to represent major indicators of the logistic zones at the national variables and site characteristic variables, and each indicator will be measured through a set of sub-variables that can be measured numerically. Compiling data for global variables

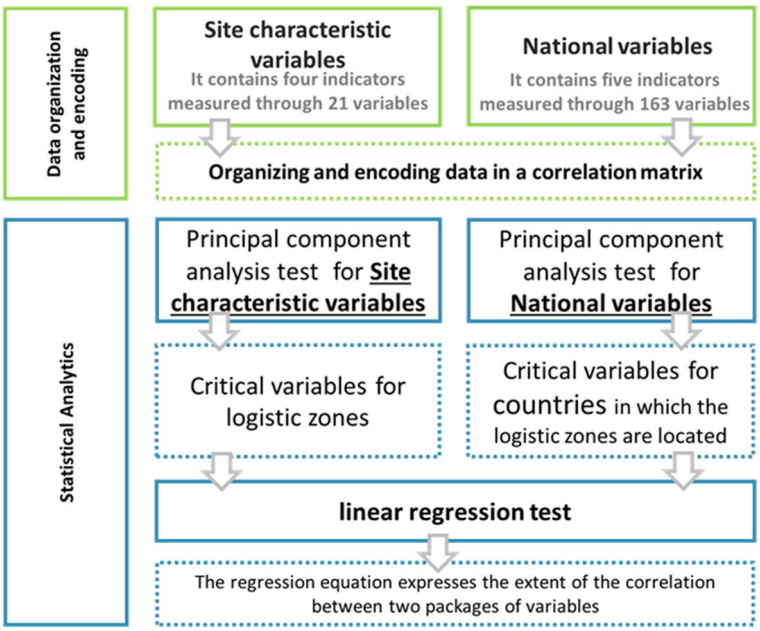


**Fig. 3** Research methodology scheme

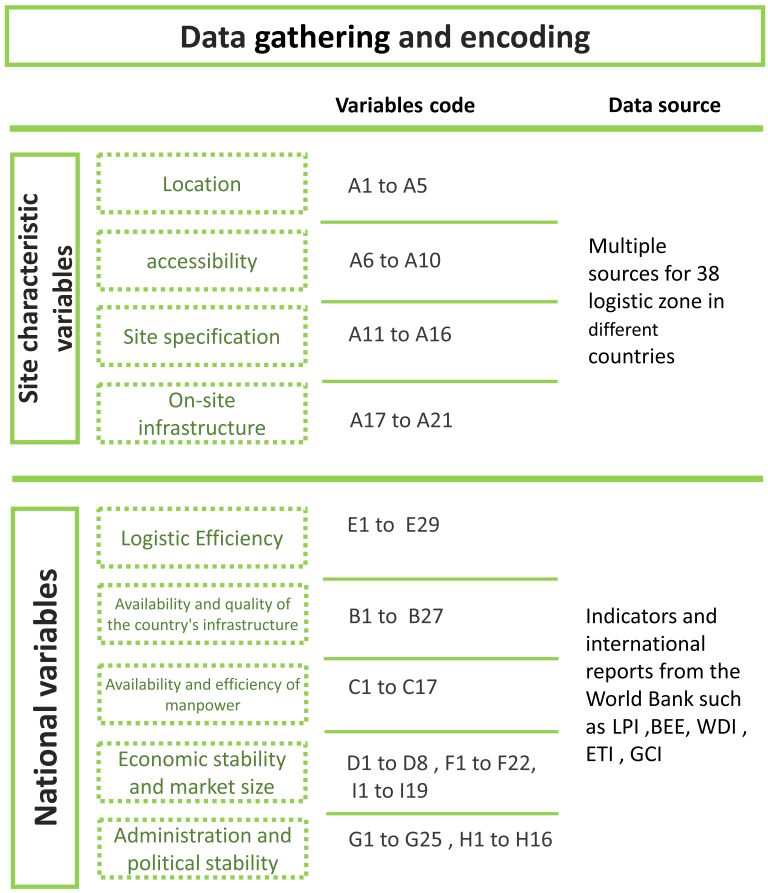


**Fig. 4** Data gathering and encoding scheme

on the published reports of the World Bank, such as logistic performance indicators (LPI) [17], enabling trade indicator (ETI) [18], Global Competitiveness (GCI) [19], business enabling environment (BEE) [20], and World Development Indicators (WDI) [21]. As for site characteristic variables, the variables differed between quantity and quality and were collected from different sources specific to each logistic zones, such as the website for the region or published reports from the state or the logistic region.

#### Principal component analysis test

It is a mathematical process used to analyze collected data, especially of large size and works to convert a number of interconnected variables to a smaller number of uncorrelated variables, which makes it easier for the researcher to easily interpret the given data. The variables resulting from this analysis are called the main components.

This test summarizes the largest possible amount of variations in the total of the measured attributes, which contribute to the differentiation between the studied variables, and it calculates varying weights that reflect the role of each variable and its importance in differentiating between those elements [22].

It calculates the correlation coefficient of the basic compounds based on the correlation matrix that contains the binary correlation coefficients between the variables, and

through the resulting values, we determine the strong correlation that gives values equal to or greater than 0.5, positive or negative, and through these values, all variables that give less values can be excluded from 0.5 [23].

And the non-influential variables are excluded by retesting again until we reach the dominant factors only with good variance ratios for the variables.

And using the principal component analysis test, we did the test twice, once for the site characteristic variables of the logistic zone and once for the national variables of the country in which the logistic zone is located.

The principal component analysis test using the SPSS program shows three results: the first shows the total variance explained between the components, the second is the screen plot, which shows the optimum number of components that gives a reliable variance ratio, and finally, the component matrix. It shows the values of each variable for the different components.

### Analysis results for site characteristic variables

We conducted the test through three rounds to exclude the least influential variables. The results for each round show the variance of eigenvalues through a table showing the highest components of PCA, from which the components that give the best reliability are selected, which are confirmed by the scree plot of each round. The following are the results of the three rounds resulting from the statistical program SPSS.

#### *The results of the first runs for site characteristic variables*

The first round gave results of a variance of eigenvalues by 47.1% for the number of 2 components according to the results of the scree plot Fig. 5 extracted 21 components; Table 1 shows some of the first runs components of PCA.

#### *The results of the second runs for site characteristic variables*

The second round gave results of a variance of eigenvalues by 38.5% for the number of one components according to the results of the scree plot (Fig. 6) extracted of 16 components; Table 2 shows some of the second runs components of PCA.

#### *The results of the third runs for site characteristic variables*

The third round gave results of a variance of eigenvalues by 58.6% for the number of one components according to the results of the scree plot (Fig. 7) extracted of 10 components; Table 3 shows some of the third runs components of PCA.

Thus, the last round gave the highest value of variance, and the variables were associated with the first component with a saturation value of more than 0.5, negative or positive, through which the site characteristic variables were reduced from 21 to 10 variables.

#### *The results of the analysis of global variables*

We conducted the test through three rounds to exclude the least influential variables. The following is a summary of the most important results of the three rounds.

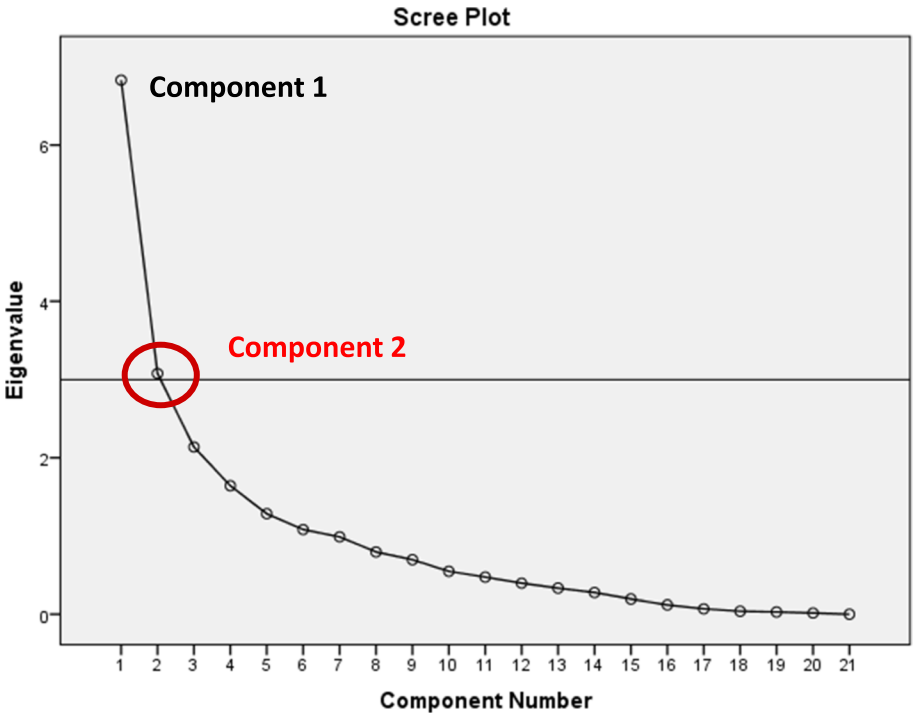


**Fig. 5** Scree plot for the first runs

**Table 1** The highest components of PCA for the first runs

| Total variance explained | | | |
|---|---|---|---|
| **Component** | **Initial eigenvalues** | | |
| | **Total** | **% of variance** | **Cumulative %** |
| 1 | 6.828 | 32.516 | 32.516 |
| 2 | 3.078 | 14.659 | **47.176** |
| 3 | 2.138 | 10.180 | 57.356 |
| 4 | 1.641 | 7.815 | 65.171 |
| 5 | 1.283 | 6.111 | 71.281 |
| 6 | 1.081 | 5.146 | 76.427 |

***The results of the first runs for national variables***

The first round gave results of a variance of eigenvalues by 35.671 for the number of one components according to the results of the scree plot (Fig. 8) extracted of163 components (Table 4).

***The results of the second runs for national variables***

The second round gave results of a variance of eigenvalues by 54.04 % for the number of one component according to the results of the scree plot (Fig. 9) out of the94 components (Table 5).

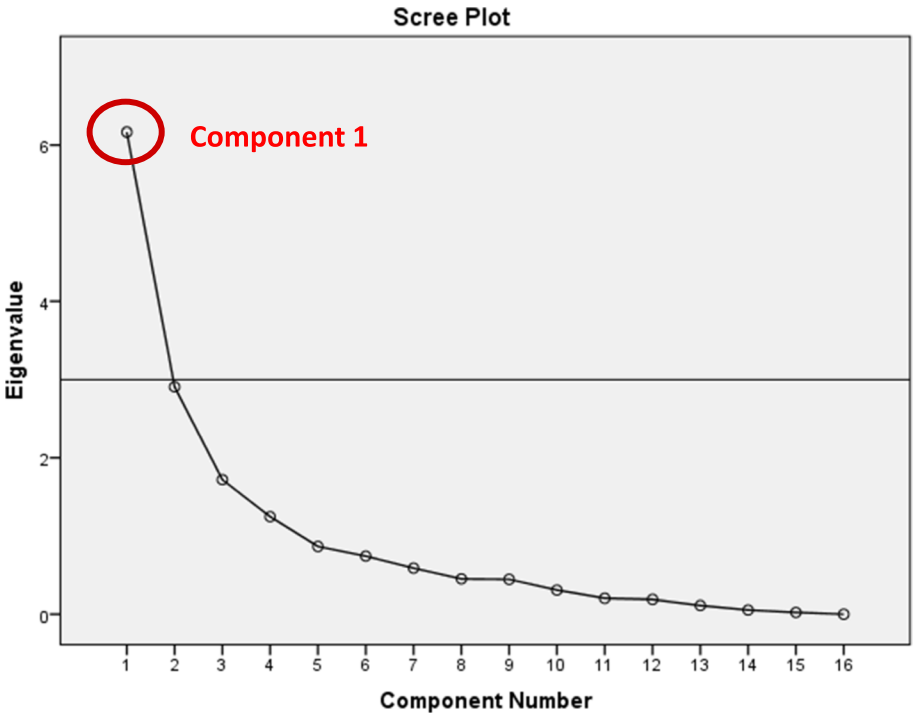


**Fig. 6** Scree plot for the second runs

**Table 2** The highest components of PCA for the second runs

| Total variance explained | | | |
|---|---|---|---|
| **Component** | **Initial eigenvalues** | | |
| | **Total** | **% of variance** | **Cumulative %** |
| 1 | 6.165 | 38.533 | **38.533** |
| 2 | 2.908 | 18.175 | 56.708 |
| 3 | 1.719 | 10.741 | 67.449 |
| 4 | 1.245 | 7.781 | 75.230 |

***The results of the third runs for national variables***

The third round gave results of a variance of eigenvalues by 56.452% for the number of one component according to the results of the scree plot (Fig. 10) out of the 78 components (Table 6). In the following is a summary of the most important results of the three rounds in tables and scree plot.

The third and last round gave the highest value of variance, and the variables were associated with the first component with a saturation value of more than 0.5, negative or positive, through which the national variables were reduced from 163 to 78 variables.

**Simple linear regression analysis (SLR)**

Simple linear regression is one of the advanced statistical methods that ensure the accuracy of inference in order to improve research results through the optimal use

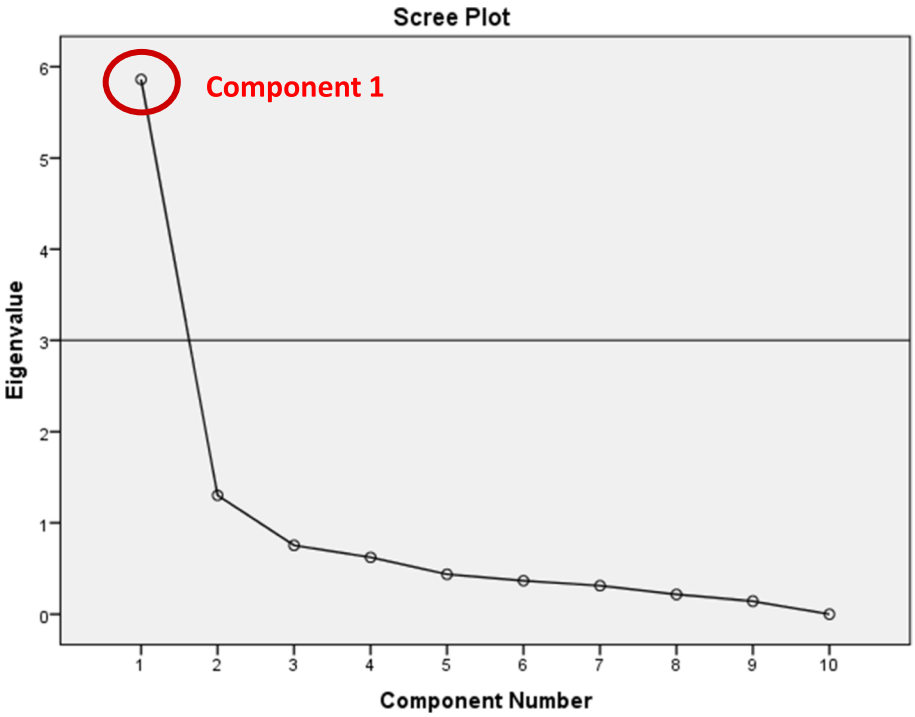


**Fig. 7** Scree plot for the third runs

**Table 3** The highest components of PCA for the third runs

| Total variance explained | | | |
|---|---|---|---|
| **Component** | **Initial eigenvalues** | | |
| | **Total** | **% of variance** | **Cumulative %** |
| 1 | 5.860 | 58.602 | **58.602** |
| 2 | 1.302 | 13.019 | 71.621 |

of data in finding causal relationships between the phenomena in question. It used to estimate the relationship between the variables [24]. This test was done using the SPSS program to estimate the relationship between the site characteristic and national variables affecting the logistic zones using the scour values that resulted from the principal component analysis test, which was used in the following test to measure the strength of the relationship between national and site characteristic variable.

## Results and discussion

### Principal component analysis test results

Principal component analysis test was conducted on two sets of national variables and site characteristic variables in which the test reduces the number of variables to only the influential variables and gives scour level values for each zone.

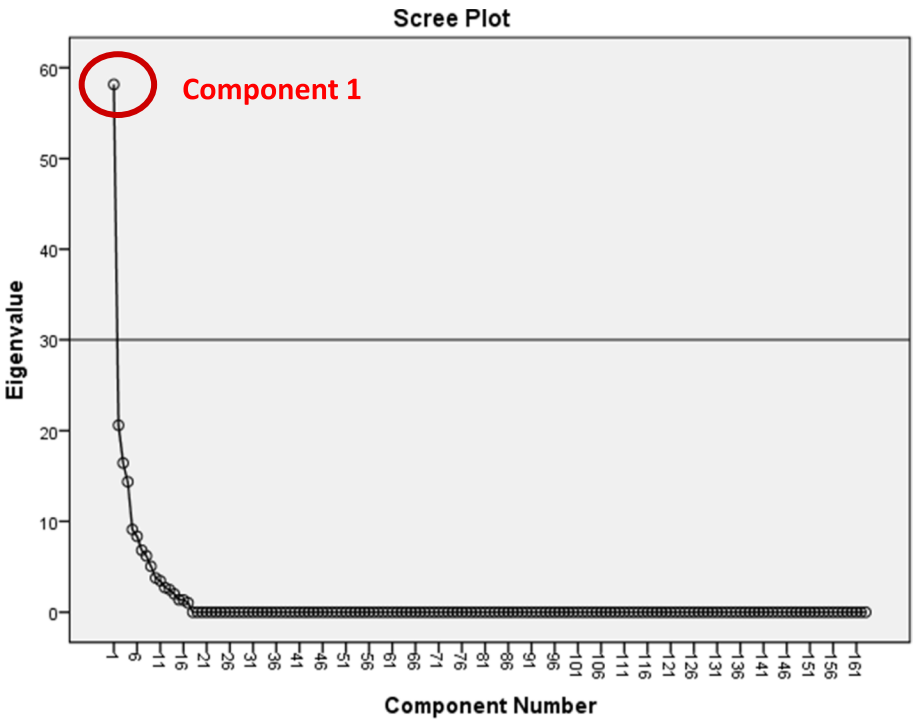


**Fig. 8** Scree plot for the first runs (national variables)

**Table 4** The highest components of PCA for the first runs

| **Total variance explained** | | | |
|---|---|---|---|
| **Component** | **Initial eigenvalues** | | |
| | **Total** | **% of variance** | **Cumulative %** |
| 1 | 58.144 | 35.671 | **35.671** |
| 2 | 20.601 | 12.639 | 48.310 |
| 3 | 16.433 | 10.082 | 58.391 |
| 4 | 14.360 | 8.810 | 67.201 |
| 5 | 9.094 | 5.579 | 72.780 |

### Site characteristic variables

The results of the principal component analysis test for the first group of the following variables in (Table 7) shows the influential site characteristic variables ranked from the strongest effect to the least according to the values issued by the program, whether negative or positive, as positive values express the positive relationship and negative values express an inverse relationship.

Through Table 7, we found that the first three variables which have the highest impact on the logistic zones are the type and size the markets served by the logistic region, the type and degree of the region, and the level of value-added services have given variance ratios of 0.9210, 0.921, and 0.880, respectively, and these variables represent the zone specification of the logistic zone. They are followed in the strength of the influence by the variables related to the infrastructure, which are the correlation

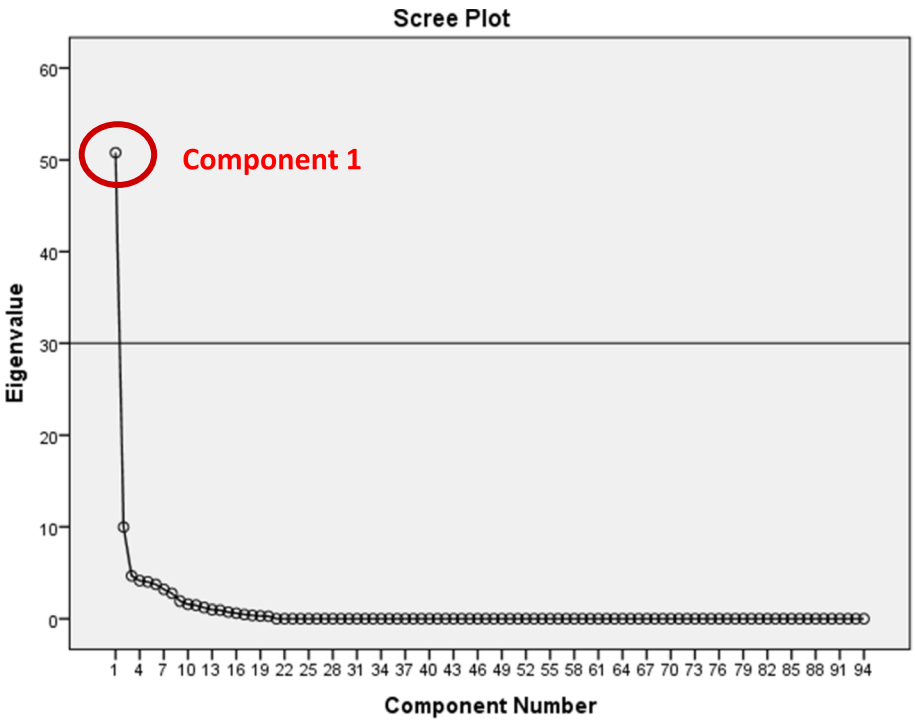


**Fig. 9** Scree plot for the second runs (national variables)

**Table 5** The highest components of PCA for the second runs

| **Total variance explained** | | | |
|---|---|---|---|
| **Component** | **Initial eigenvalues** | | |
| | **Total** | **% of variance** | **Cumulative %** |
| 1 | 50.798 | 54.041 | **54.041** |
| 2 | 9.976 | 10.613 | 64.654 |
| 3 | 4.647 | 4.944 | 69.598 |
| 4 | 4.119 | 4.382 | 73.980 |
| 5 | 4.000 | 4.255 | 78.235 |
| 6 | 3.720 | 3.957 | 82.192 |

of land transport in the region and then the sea with values of 0.817 and 0.773. We also found the least variables effectiveness, which are the distance to the main port having a negative value, which express an inverse relationship of the variable versus the logistic zones

### National variables

The results of the principal component analysis test for the second group of the following variables in (Table 8) shows the influential national variables divided by the indicators that were classified before and ranked from the strongest to the least influential according to the negative or positive values issued by the program.

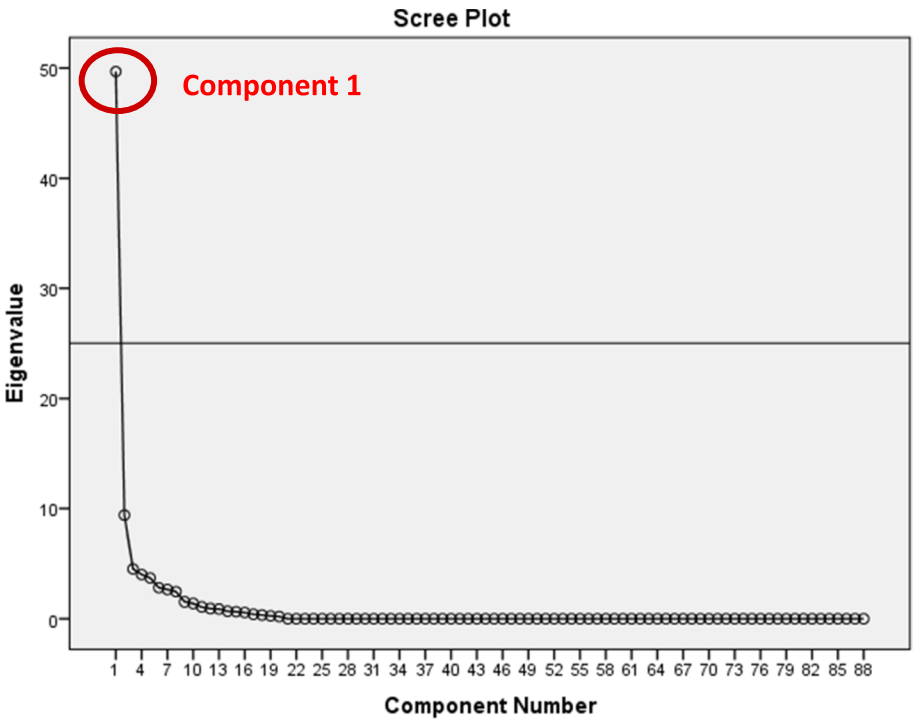


**Fig. 10** Scree plot for the third runs (national variables)

**Table 6** The highest components of PCA for the third runs

| **Total variance explained** | | | |
|---|---|---|---|
| **Component** | **Initial eigenvalues** | | |
| | **Total** | **% of variance** | **Cumulative %** |
| 1 | 49.678 | 56.452 | 56.452 |
| 2 | 9.397 | 10.679 | 67.131 |
| 3 | 4.500 | 5.113 | 72.244 |
| 4 | 3.994 | 4.539 | 76.783 |
| 5 | 3.681 | 4.183 | 80.966 |
| 6 | 2.796 | 3.178 | 84.144 |

The results also showed that the 78 effective variables gave graded variance values from 0.555 to 0.953, and they were divided into the five previous groups (logistical efficiency — availability and quality of the country's infrastructure — availability and efficiency of manpower — economic stability and market size administration and political stability) closely in number and varying proportions of variance which means that all of the five groups mentioned above are important and basic elements.

The result of the principal component analysis test for the two groups of variables gave factor scour values for each zone at the site characteristic and the same situation with

**Table 7** Component matrix for site characteristic variables

| Variables | cod | Component 1 |
|---|---|---|
| The type and size of the markets served by the region are international — local — regional | A14 | 0.921 |
| The type and degree of the logistic zone | A16 | 0.921 |
| The level of value-added services | A15 | 0.880 |
| Land transport link in the region | A21 | 0.817 |
| Maritime transport link in the region | A17 | 0.773 |
| The country's strategic location | A1 | 0.740 |
| Accessibility | A6 | 0.740 |
| Shipment volume TEU/year | A12 | 0.666 |
| Contact with industrial areas | A4 | 0.579 |
| The distance to the main port | A9 | 0-.501 |

the national variables, Through Table 9 we could know the ranking of some countries from highest to lowest according to the resulting of the scour value for both sets of variables which shows convergence in the order of the zones from the highest to the lowest.

#### Simple linear regression analysis test results

According to the scour value, whether at the level of national variables or at the site characteristic variables, we find that the order of the regions is close to both sets of variables by conducting a simple linear regression test between Site characteristic and national variables for 38 logistic regions, it was found that there is a linear relationship between the two variables, which can be represented by a straight line. Figure 11 through the following equation where Y are the site characteristic variables and × are the national variables.

$$Y = b_o + b_1 X$$

The test showed that there is a strong direct relationship between the two sets of variables, as the value of the square of the correlation coefficient) *R*-square) between them is 0.918 (Table 10).

## Conclusions

Most of the previous studies dealt with the issue of factors affecting the logistic zones either dealt with the factors related to the selection of the location of the region or dealt with the factors that affect the logistical efficiency of the country, but this research was keen to combine both sides. As influencing factors, this paper explores the most important factors affecting logistic zones with studying both sides and reaching the most important factors affecting each of them and measuring them in a quantitative manner as well as proving the strength of the relationship between them, and this was studied for 38 logistic zones of different types and sizes in different countries of the world.

**Table 8** Component matrix for national variables

| Variables | cod | Component |
|---|---|---|
| **Logistic efficiency** | | |
| Availability and quality of transport services | E18 | 0.953 |
| Mean LPI score | E29 | 0.933 |
| Customs | E23 | 0.928 |
| Infrastructure | E24 | 0.925 |
| Logistics quality and competence | E26 | 0.904 |
| Tracking and tracing | E27 | 0.898 |
| Timeliness | E28 | 0.877 |
| Postal service efficiency | E21 | 0.855 |
| Timing of shipments to the destination | E20 | 0.823 |
| International shipments | E25 | 0.818 |
| Number of models exports | E5 | −0.562 |
| Time per day does the supply chain at ports or airports need to import | E15 | −0.595 |
| The number of import agencies | E2 | −0.622 |
| Number of export agencies | E3 | −0.776 |
| **Availability and quality of the country's infrastructure** | | |
| Availability and use of ICTs6.01Mobile- | B22 | 0.897 |
| ICT use for biz-to-biz transactions | B25 | 0.864 |
| Internet users % of adult population | B21 | 0.863 |
| Quality of roads | B4 | 0.857 |
| Internet use for biz-to-consumer transactions | B26 | 0.832 |
| Quality of railroad infrastructure | B7 | 0.759 |
| Quality of air transport infrastructure | B11 | 0.756 |
| Quality of port infrastructure | B15 | 0.728 |
| Efficiency of seaport services | B13 | 0.710 |
| Efficiency of air transport services | B10 | 0.691 |
| Liner shipping connectivity | B12 | 0.653 |
| Mobile-broadband subscriptions per 100 po | B18 | 0.630 |
| Railroad density km/1000 km[[2 | B5 | 0.555 |
| Electricity supply quality % of output | B17 | −0.754 |
| **Availability and efficiency of manpower** | | |
| Skillset of graduates | C3 | 0.933 |
| Quality of vocational training | C2 | 0.917 |
| Active labor market policies | C15 | 0.827 |
| Reliance on professional management | C8 | 0.821 |
| Extent of staff training | C1 | 0.791 |
| Ease of finding skilled employees | C5 | 0.782 |
| Digital skills among active population | C4 | 0.643 |
| Cooperation in labor-employer relations | C14 | .0614 |
| Pay and productivity | C10 | 0.592 |
| Hiring and firing practices | C13 | 0.549 |
| **Economic stability and market size** | | |
| GDP | i16 | 0.920 |
| Direct foreign investment | i11 | 0.592 |
| The total external debt stock | i13 | −0.535 |
| Total debt service | i14 | −0.784 |
| Buyer sophistication | D7 | 0.796 |
| Spread of non-tariff barriers | D6 | 0.721 |
| Domestic market access | D1 | 0.707 |

**Table 8** (continued)

| Variables | cod | Component |
|---|---|---|
| Competition in services | D5 | 0.692 |
| The extent of market dominance | D4 | 0.615 |
| Debt dynamics | F2 | 0.794 |
| The share of duty-free imports | F19 | 0.685 |
| Availability of investment capital | F14 | 0.673 |
| Domestic credit to the private sector | F12 | 0.653 |
| The size of insurance premiums in relation to GDP | F16 | 0.626 |
| Inflation | F1 | −0.522 |
| Commercial tariffs | F21 | −0.847 |
| **Administration and political stability** | | |
| Efficiency and transparency of border administration | G6 | 0.919 |
| Operating environment | G20 | 0.897 |
| Border clearance efficiency | G1 | 0.895 |
| The occurrence of corruption | G4 | 0.864 |
| Physical security | G25 | 0.816 |
| Quality of land management | G5 | 0.775 |
| Protection of property | G21 | 0.744 |
| Openness to foreign participation | G24 | 0.717 |
| Efficient customs clearance process | G8 | 0.693 |
| Efficiency of the legal framework in settling disputes | G3 | 0.568 |
| Export cost: documentary compliance | G15 | −0.505 |
| Import cost: documentary compliance | G11 | −0.575 |
| Import cost: border compliance | G12 | −0.636 |
| Export time: documentary compliance hours | G13 | −0.655 |
| Export time: cross-border compliance hours | G14 | −0.681 |
| Import time: compliance hours at the border | G10 | −0.726 |
| Enforcing contracts | H9 | 0.787 |
| Pay taxes | H7 | 0.766 |
| Cross-border trade | H8 | 0.689 |
| Insolvency solution | H10 | 0.673 |
| Property registration | H4 | 0.661 |
| Issuance of building permits | H2 | 0.604 |
| Starting a business | H1 | 0.598 |
| Time required to start a business | H16 | −0.591 |

The results of the statistical analysis of the first group of variables related to the characteristics of the site revealed 10 factors, the most important of which are the variables related to the quality of markets and the size and efficiency of the services provided, followed by the variables related to the transportation infrastructure and accessibility. It also included variables that express the availability of relative advantages to the zone such as the strategic location and proximity to the industrial zones, the successful logistic zone has the ability to provide a high level of logistical services and value-added services, as well as the availability and quality of various means of transport and switching between them (multimodal transport). This is achieved

**Table 9** The highest countries according to factor scour value

| Scour for national variables | | | Scour for site characteristic variables | | |
|---|---|---|---|---|---|
| **Logistic zone** | **Country** | **Scour** | **Logistic zone** | **Country** | **Scour** |
| **Yokohama Port Cargo Centre** | **Japan** | **1.74962** | **Yokohama Port Cargo Centre** | **Japan** | **1.96332** |
| **Jebel Ali Logistics Zone in the UAE** | **United Emirates** | **1.56476** | **Jebel Ali Logistics Zone in the UAE** | **United Emirates** | **1.81682** |
| **Distripark Maasvlakte** | **Holland** | **1.54902** | **Distripark Maasvlakte** | **Holland** | **1.64892** |
| **Savannah Gateway** | **USA** | **1.52585** | **Pasir Panjang Distripark** | **Singapore** | **1.52262** |
| **ATL Logistic Center Hong Kong** | **China** | **1.3748** | **ATL Logistic Center Hong Kong** | **China** | **1.41282** |
| **Pasir Panjang Distripark** | **Singapore** | **1.34912** | **Savannah Gateway** | **USA** | **1.41029** |
| **Raritan Center, New Jersey** | **USA** | **1.2991** | **Laem Chabang Terminal** | **Thailand** | **1.24606** |
| **KEPPEL DISTRIPARK** | **Singapore** | **1.19382** | **KEPPEL DISTRIPARK** | **Singapore** | **1.07515** |
| **Laem Chabang Terminal** | **Thailand** | **1.19014** | **Raritan Center, New Jersey** | **USA** | **0.89223** |
| **ZAL Port de Barcelona** | **Spain** | **0.92329** | **ZAL Port de Barcelona** | **Spain** | **0.788** |

through a distinguished location with the elements of attraction, such as its mediation between markets and ports and its proximity to related activities.

The result of the analysis of the second group of national variables for the countries in which the same logistic zones are located that were studied in the first group showed that there are 78 variables affecting the success of the logistic zones in these countries. These variables cover aspects of the state's logistical efficiency, availability, and quality of the country's infrastructure especially transportation, information and communication technology, availability and efficiency of manpower, economic stability and market size, administration, and political stability.

The results also showed through scour values, which gives a ranking of the logistic zones in terms of priority, and there is a convergence in the arrangement for these zones for both groups of variables, which means that the logistic zones that have high site and service specifications are located in advanced countries in logistics and related fields. Also, through the factor scour level values produced by the analysis, we proved the strength of the relationship between the two sets of variables by linear regression analysis, which means that the well-equipped logistic zones with an ideal location cannot fulfill their purpose with weak services and infrastructure for the state or a lack of any other factors and vice versa. A country with logistical efficiency needs suitable site to provide these services, which means that the success of

**Table 10** Model summary[b]

| Model | *R* | *R*-square | Adjusted R-square | Std. error of the estimate |
|---|---|---|---|---|
| 1 | 0.958[a] | 0.918 | 0.915 | 0.29116 |

[a] Predictors (constant), national

[b] Dependent variable: site characteristic

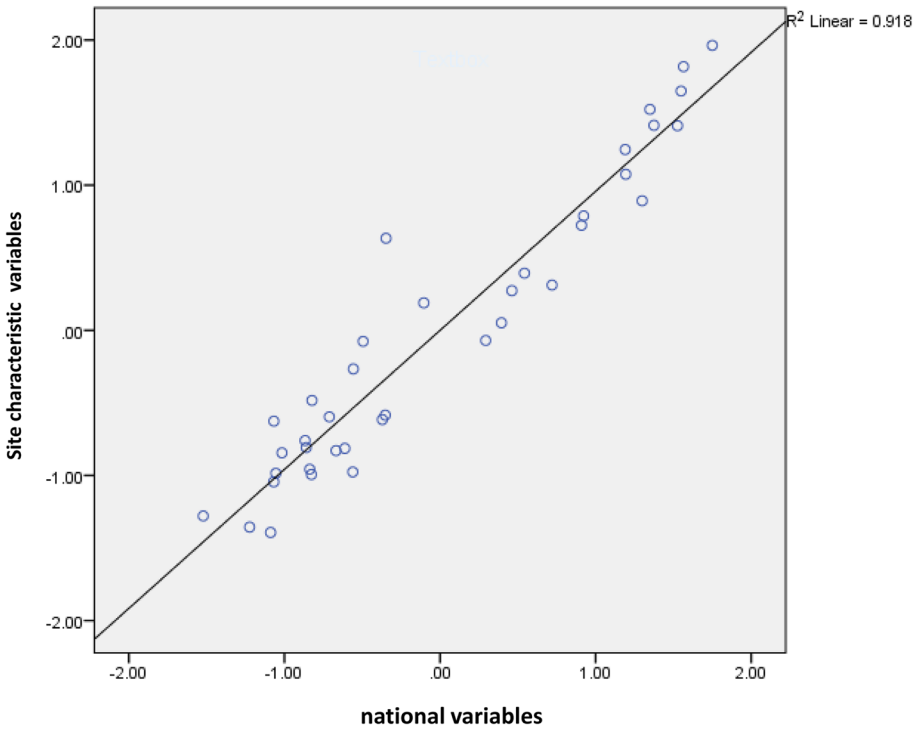


**Fig. 11** The liner relation between the national variables and the site characteristic

the logistic zones depends on both site characteristic and national variables, and that the way to establish a distinct and competitive logistic zone is to achieve a balance between building a logistic zone that has a standard specifications, ideal location, good connectivity, and available all relevant services and improving the efficiency of the state itself in all elements related to the aforementioned logistical and commercial operations.

**Abbreviations**

| | |
|---|---|
| SPSS | Statistical Package for the Social Sciences |
| LPI | Logistic performance indicators |
| ETI | Enabling trade indicators |
| GCI | Global Competitiveness Indicators |
| BEE | Business enabling environment |
| WDI | World Development Indicators |
| PCA | Principal component analysis test |
| SLR | Simple linear regression analysis |

**Acknowledgements**
Not applicable.

**Authors' contributions**
Each author has made substantial contributions to the conception and design of the work. YMM has prepared the original draft, conceptualization, and methodology, has performed the data curation formal analysis and interpretation of data, has utilized the software, and has attained manuscript review and editing. TA has substantively revised the manuscript, has verified all data and materials, and has approved the submitted version. The authors read and approved the final manuscript.

**Funding**
The authors declare that they did not receive any funding sources.

**Availability of data and materials**
The datasets used are available from the World Bank database Logistic Performance Index [17], business enabling environment [20], World Development Indicators [19, 21] the World Economic Forum Global Enabling Trade Report [18], and Global Competitiveness Report [19], and the combined dataset is available to the authors.

## Declarations

**Ethics approval and consent to participate**
Not applicable.

**Consent for publication**
Not applicable.

**Competing interests**
The authors declare that they have no competing interests.

Received: 24 June 2022 Accepted: 12 January 2023
Published online: 27 January 2023

**References**

1. Placek M (2020) Size of the global logistics market in 2020, by region. Germany Published online at Statista, Hamburg Retrieved from: https://www.statista.com/statistics/1069868/total-global-logistics-market-size-region/. Accessed 12 Apr 2022
2. Sezer S, Abasizr T (2017) The impact of logistics industry on economic growth: tan application in OECD countries. Eur J Soc Sci 5(1):11–23. https://doi.org/10.15604/ejss.2017.05.01.002
3. Erin Scronce (2016) Richer countries score better on logistics. Published online at World Bank. Retrieved from: https://blogs.worldbank.org/opendata/chart-richer-countries-score-better-logistics. Accessed June 2022
4. EUROPLATFORMS EEIG (2004) Logistic centers directions for USA. Retrieved from: https://unece.org/fileadmin/DAM/trans/main/eatl/docs/EN-REV What_is_a_Freight_VillageFinalcorretto.pdf. Accessed May 2022
5. Rodrigue J-P et al (2020) The geography of transport systems. Hofstra University, Department of Global Studies & Geography https://transportgeography.org
6. Trainaviciute L (2008) The dry port. In: Concept and perspectives. FDT- Association of Danish Transport and Logistics Centers Rev.no. 16; Aalborg.
7. Woxenius J, Roso V, Lumscouren K (2004) The dry port concept connecting seaports with their hinterland by rail. ICLSP, Dalian
8. Notteboom, Rodrigue (2009) Inland terminals within North American and European supply chains. Transport and Communications Bulletin for Asia and the Pacific No. 78; Bulletin for Asia and the Pacific.
9. Essaadi I, Grabot B, Fannies P (2016) Location of logistics hubs at national and subnational level with consideration of the structure of the location choice. IFAC-PapersOnLine 49-31:155–160
10. Tongzon (2004) Determinants of competitiveness in logistics: implications for the region. In: International conference on competitiveness: challenges and opportunities for Asian countries, Bangkok: Jose Tongzon.
11. Muñoz D, Rivera Virgüez ML, Liliana M (2010) Development of Panama as a logistics hub and the impact on Latin America. Massachusetts Institute of Technology thesis, USA
12. El-Nakib (2010) Egyptian firms' location preferences for logistics hubs: focus on the southeast African region. In: 8th international conference on supply chain management and information systems, Hong Kong
13. Tennant D (2014) The Jamaica logistics hub: looking beyond ports and parks. The Caribbean Policy Research Institute (CaPRI) Retrieved from: https://www.readkong.com/page/creating-national-wealth-through-the-jamaica-logistics-hub-3956378
14. Tseng Y-y, Yue WL, Taylor MAP (2005) The role of transportation in logistics chain. Proc East Asia Soc Transp Stud 5:1657–1672
15. Rodrigue J-P (2020) The geography of transport systems, 5th edn. Routledge, New York
16. Anastasiou S (2014) Critical human resources management functions for efficient logistics and supply chain management. In: 2nd international conference on supply chains
17. World Bank (2018) Logistic performance index 2018(LPI). Retrieved from: https://www.worldbank.org/en/news/infographic/2018/07/24/logistics-performance-index-2018. Accessed Apr 2022
18. World Economic Forum (2016) Global enabling trade report 2016 (ETI). Retrieved from: https://reports.weforum.org/global-enabling-trade-report-2016/. Accessed May 2022
19. World Economic Forum (2020) Global competitiveness report special edition 2020 (GCI): how countries are performing on the road to recovery. Retrieved from: https://www.weforum.org/reports/the-global-competitiveness-report-2020/https://www.worldbank.org/en/programs/business-enabling-environment. Accessed Apr 2022
20. World Bank (2020) Business enabling environment 2020 (BEE) Recovery retrieved from: https://www.worldbank.org/en/programs/business-enabling-environment
21. World Bank (2019) World Development Indicators 2019: the changing nature of work. World Bank, Washington Retrieved from: https://databank.worldbank.org/source/world-development-indicators. Accessed Apr 2022
22. Meng Y, Qasem S, Shokri M (2020) Dimension reduction of machine learning-based forecasting models employing principal component analysis. Mathematics 8(8):1233
23. Ambapour S (2003) Introduction à l'analyse des données, bureau d'application des méthodes statistiques et informatiques, p 24
24. Weisberg S (2014) Applied linear regression, 4th edn. Wiley, Hoboken

## Publisher's Note