EFFICIENT LOGISTIC PLATFORM DESIGN: THE CASE OF CAMPINAS PLATFORM

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The design of a new logistics platform is a challenge due to two main points. The first one, it is a new concept and therefore does not exist a large number of logistic platforms in the world. The second point, as a new concept there exist a very limited number of platforms and in this scenario it is hard to define a standard of efficiency to be followed by a new platform. This paper proposes the establishment of guidelines for the new logistics platform to be installed in the region of Campinas, Sao Paulo state. It follows the Data Envelopment Analyze methodology (DEA) and examines over sixty logistic platforms in the world. Among them it is chosen seven (ZAL and PLAZA in Spain, Bremen GVZ in Germany, Sogaris and Eurocenter in France, District of Nola in Italy, Dallas Logistic Hub in United States) as a reference for the design of the Campinas platform. Also it defines four main performance indexes for the analysis (area of logistics platforms, invested capital, number of companies attracted and annual load handling) of benchmarking. Finally, through a DEA-BCC model it proposes values for the outputs of Campinas Logistic Platform (CLP) that would conduct it to be a benchmark platform in the world.

Palavras-chaves: Logistics Platform, DEA, efficiency and production, productivity, supply chain

1. Introduction

With the advent of globalization it had been favored the increase of free commerce and changes in the market that encouraged increased competition among companies. In this scenario, it is important to plan and manage supply chain elements such as: cost, technologies, competitive logistic supports, services and partnership, that add value, improve the enterprise performance and is an essential condition to a better enterprise position in the market.

According to Dubke (2004) the logistic platform emerged in response to the trend of network coordination of all logistic services, providing greater competitiveness through lower costs of management and operation of the logistics chain. Also, it offers different advantages and logistical infrastructure, intermodality and a strategic positioning.

The success of these corporations can be achieved through good productivity and minimized inefficiencies of supply chain and services offered by them. This fact motivates an extensive literature in this subject. Novaes et al (2009) postulates that productivity analysis is an important decision tool for managerial control and is a way in the process of getting desired results. However, this approach must consider that each company employs different strategies and technologies in order to increase productivity and efficiency in the way to assume a differentiated position in the market.

The definition of productivity usually starts with a technical relationship between outputs and inputs of a production process. A tool frequently adopted to measure the efficiency of corporations in competitive context is the Data Envelopment Analysis (DEA). The Data Envelopment Analysis is a relatively new "data oriented" approach for evaluating the performance of a set of peer entities called Decision Making Units (DMUs). This process converts multiple inputs into multiple outputs and enables a comparative analysis of efficiencies of a number of companies that work in the same area or sector.

The DEA applications have used DMUs of various forms to evaluate the performance of entities, such as hospitals, US Air Force wings, universities, cities, courts, business firms, and others, including the performance of countries, regions, etc. (CHARNES *et al*., 1978) and in this work is used to support the design of a logistic platform sited in the Campinas region, state of São Paulo.

The aim of this paper to propose a strategic positioning for the Campinas logistic platform based on the performance analyze of seven platforms selected from more than sixty logistics platforms existing in Europe and USA (WEISBROD *et al.*, 2002). Until now there are few studies of performance analysis and efficiency applied to logistic platforms, so the results of this study may provoke greater interest in this area.

The present paper is organized in five sections. The first section provides an introduction of the theme, the second section describes logistics platforms, the third section discusses DEA methodology, the fourth section presents a problem description with the methodology of DMs selections, and the fifth section analyze the parameters that guides the design of the CLP. Finally the conclusions and suggestions for future works are presented.

2. Logistics Platform

The concept of logistics platform originated in France in the 60s as result of advances in the management operation studies (EUROPEAN COMMISSION, 1997) and grew with the initial goal of organization and optimization the flow of goods distributed in a disorderly fashion of cargo terminals on the border of large cities. It had as an objective to reduce logistics costs in an existing platform and in the following it also began to be used to study of logistics platform locations (RODRIGUES, 2004).

Logistics platform concept vary from country to country but can be defined as a form to integrate the logistics activities as homogenous part of the logistics system, in which a logistics organization centrally design, manage and control the logistic services in a way to be base for new market positions. This includes concepts for logistics operations, a physical structure, processes and its activities as well as the information systems needed for design, operations and reporting (ABRAHAMSSON *et al*., 2003). Or as a specific area which are carried out several activities such as transportation, logistics and distribution of goods in national and international transit. It constitute is a modern alternative to organize and solve problems caused by an increased flow of vehicles in a city, caused by increasing demand of the distribution of goods (EUROPLATFORMS, 2009).

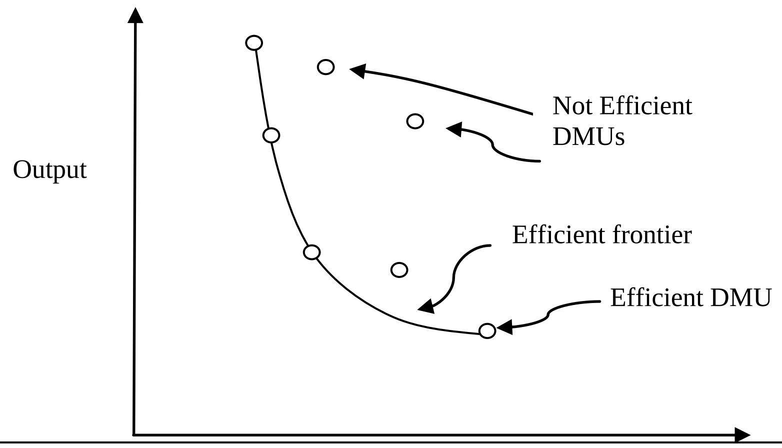
It also can be seen as a way to promote alliances between entities responsible for transport services, storage and distribution and can generate significant reductions in urban traffic, pollution and environmental and social damage (Ballis and Mavrotas, 2007).

Currently, the term Logistics platform presents several synonymous around the world as Plateformes Logistiques Publiques, Distriport, Distripark, Interporto, Freight Village, Centrales Integradas de Mercancias, Guterverkehrszentren Hub Logistic and Park Logistic Center (EUROPEAN COMMISSION, 1997).

In the present it is possible to verify logistic platforms as world trends in order to breakdown national and international barriers, offering a strategic positioning, appropriating logistics infrastructure that permit joint reduced cost with a better level of services, service customization and logistics services that provides an increase of efficiency of the supply chain.

3. DEA Model

The Data Envelopment Analysis (DEA) is a mathematical tool, non-parametric, used to measure the efficiency of production units called Decision Making Units - DMU (CHARNES *et al.*,1978). The model uses linear programming to calculate an efficiency index for each DMU and generates an empirical efficient frontier, composed of units with best practices (Benchmarks) specific to the studied samples (GOMES *et al*., 2009). The frontier units are classified as efficient, and are taken as base points to construct the frontier, and the units out of frontier are classified as inefficient. The efficiency index is calculated according to the shape or the projection of the inefficient frontier (FIGUEIREDO *et al*., 2009). An example of this is presented in Figure 1.



Input

Figure 1 – Example efficient regions and not efficient DMUs

Formally, DEA is a methodology directed to frontiers rather than central tendencies. Instead of trying to fit a regression plane through the *center* of the data as in statistical regression, for example, one 'floats' a piecewise linear surface to rest on top of the observations. Because of this perspective, DEA proves particularly adept at uncovering relationships that remain hidden from other methodologies.

The relative efficiency in DEA is defined for each Decision Making Unit (DMU) as the maximum ratio among the weighted sum of the components of the vector of production and the weighted sum of the components of the vector of inputs used in the production process. In mathematical programming it is defined as:

$$\text{Efficiency} = \frac{\sum_r u_r y_{ro}}{\sum_i v_i x_{io}} \qquad (1)$$

Where it should be noted that the variables are the u_r's and the v_i's and the y_{ro}'s and x_{io}'s are the observed output and input values, respectively, of DMUo , the DMU to be evaluated. Of course, without further additional constraints (developed below) is unbounded.

A set of normalizing constraints (one for each DMU) reflects the condition that the virtual output to virtual input ratio of every DMU, must be less than or equal to unity. The mathematical programming problem may thus be stated as (Charnes *et al*., 1978).

$$\max h_0 = \sum_{r=1}^{s} u_r y_{r0}$$

$$\text{s.a.:} \qquad (2)$$

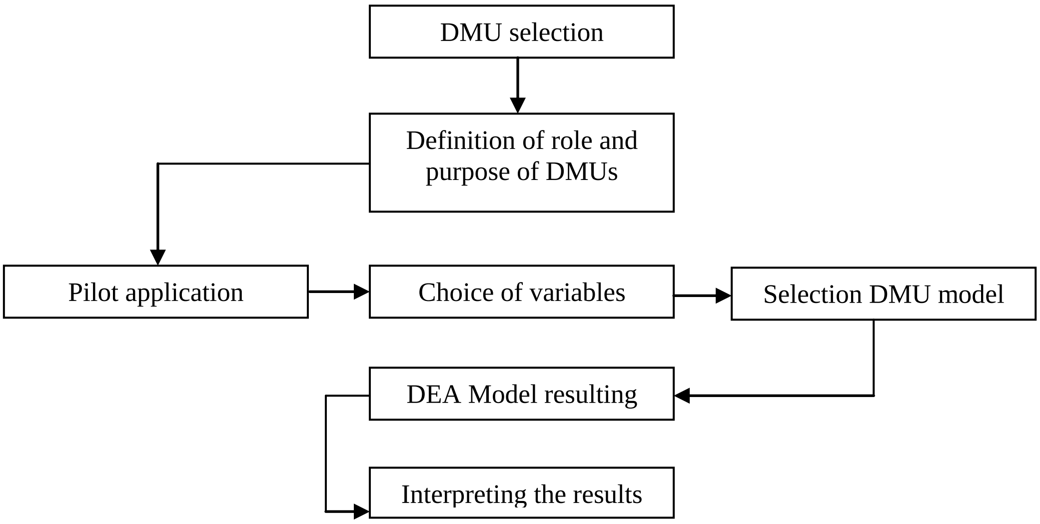
$$\sum_{i=1}^{m} v_i x_{io} = 1$$

$$\sum_{r=1}^{s} u_r y_{rj} - \sum_{i=1}^{m} v_i x_{ij} \le 0 \quad j = 1,\ldots,n$$

$$u_r, v_i \ge 0;$$

Two classic models are used in DEA; the CCR model (*Constant Return to Scale-CRS*) proposed by Charnes et al. (1978) and the BCC model (*Variable Return to Scale-VRS*) proposed by Banker et al. (1984). The CCR model supposes constant returns to scale, and the BCC model, supposes variable returns to scale and does not assume proportionality between inputs and outputs. According to Rios and Maçada (2006), BCC model are the most frequently used DEA models. The application of DEA models can be input-oriented, output-oriented or both. Input oriented DEA minimizes the input so that a desired level of output is achieved. Output-oriented, on the other hand, aims at maximizing the output while keeping inputs at a constant level. Both input- and output oriented models seek maximum efficiency, minimizing inputs and maximizing outputs. In the CCR model any variation in input produces proportional change to the output, given constant returns to scale. Since the BCC model assumes proportionality between inputs and outputs, it allows variable returns to scale.

The flowchart for DEA methodology implementation is presented below in Figure 2. It is divided into seven steps, the selection of DMUs to be analyzed, definition of the role and purpose of the DMUs pilot application of methodology, choice of variables, selection of the DEA model, resolution of the DEA model and interpreting the results.



Source: Paiva Jr. (2000)

Figure 2 - Flowchart of DEA implementation

Another important application of DEA methodology is as a tool for Benchmark analysis. This analysis is performed taking as reference best practices of the sectors in analysis (HAAS *et al.*, 2003; NOVAES, 2001). The Benchmarking objectives are to identify best practices and efficient processes that should improve organizational performance through better knowledge of their internal and external competencies, and to point to the factors responsible for the worst/best practices, among others (CAMP, 1989). DEA also helps to focus in the Benchmarking analysis of a set of DMU operationally efficient (NOVAES, 2009).

4. Problem Description

4.1 DMUs Selection

The first step to take a strategic decision regarding a logistic platform implementation is to select those that will be taken as a reference. The set of reference DMUs should have the same inputs and outputs, varying only in intensity. They should be homogeneous, able to perform the same tasks with the same goals and to be under the same work conditions of the market and have autonomy in decision-making.

According to Fitzsmmons and Fitzsimmons (2000), the number of DMUs has to be based on empirical model involving the number of variables inputs and outputs. The empirical model is $K \geq 2 (N + M)$, where K is the number of decision Making units to participate of the analysis, in tha case of this work the number of logistics platforms, N is the number of inputs and M is the number of outputs considered.

This work selected seven of more than sixty logistic platforms with similar inputs and outputs of that to be designed. Each one is described below. Two platforms chosen are situated near sea ports such as the ZAL (Logistics Activities Area) in Spain, which is part of the district of Port of Barcelona and an important hub to the Mediterranean Sea, and Bremen GVZ (Guterverkehrszentren) which is near to the Bremen port, an important hub on the North Sea in Germany. Other two logistics platforms chosen are the French Sogaris in Rungis, which were the first logistic platform consolidated in the world and Eurocentre in Toulouse is one of the youngest. The district of Nola, Italian platform was also selected due to its importance to the city of Napoli and region. The Plaza (Zaragoza Logistic Platform) in the region of Zaragoza, Spain, is a public enterprise initiative, which is currently in transition to private management and is currently the largest platform in the area. The Dallas Logistic Hub is the largest logistics platform in North America. Finally a Brazilian platform, the Campinas Logistic Platform, it is a real project in development, to be concluded in the next five years.

4.2. Variables Selection

The selection of inputs and outputs used in this work was based on data available in the literature and field research, concerning logistics platforms selected. The choice of input and output must be made from a broad list of possible variables related to the model. This list allows getting more knowledge about the units to be evaluated and explain their differences. It is possible to choose a large number of DMUs with most of them located on the border of efficient line. This reduces the ability of DEA to discriminate efficient from inefficient units. Therefore, should be established a balance between the amount of DMUs chosen and increased discriminatory power of DEA.

Considering the above observations, this paper selected two inputs variables, common to all DMUs invested capital and the logistics platform area, outputs were two variables, number of companies attracted by the investment and annual load traffic generated by the facilities offered by DMU. It also choose two output variables. In consequence, the number of DMUs for this research is eight. They are described below.

4.3. ZAL and PLAZA- Spain

The Barcelona ZAL has the highest economic activity in all of ZALs at Spain, therefore it is of great importance to the economy and development of the country. It is a multimodal center of distribution and logistics, considered the main port for container traffic and goods from the Mediterranean Sea. Due to its location, it can make the connection between more than 400 ports around the world and currently has more than 60 companies that provide comprehensive real estate deals and flexible logistics center in Southern Europe (ROSA, 2004; MARTINS, 2006). The Barcelona ZAL offers four modal infrastructures for logistics operations of air, rail, sea and road (BOCOVIS, 2007).

The Zaragoza logistics platform, known as PLAZA, is located in the city of Zaragoza on the axis road Madrid / Barcelona and is currently the largest logistics platform in Europe with 12 million square meters. The location of PLAZA is strategic and provides competitive advantages due to the small distances between the three main Spanish dry ports of Barcelona, Bilbao and Valencia. With respect to transport infrastructure the modal most used today in the PLAZA are roads, despite having extensive railways and also an airport (MARTINS, 2006; PLAZA, 2009).

4.4. Bremen GVZ- Germany

In Germany, this development presents public-private partnership. GVZ Bremen was the first logistics platform in Germany to be consolidated. Founded in 1985 in Bremen, the GVZ is structured with an area of 3,6 million square meters . Currently has 150 companies in their enterprise (BREMEN-GVZ, 2009).

The platform of Bremen is a development of public-private partnership (PPP) and offers intermodality with rail, road and air. The port of Bremen is 6 kilometers from GVZ and is used as an alternative mode of transportation (BREMEN-GVZ, 2009).

4.5. Sogaris and Eurocenter- France

According to Rosa (2004) the French logistics platforms have a strong featured strategic, investment in real estate for warehouse rentals to attract industries with focus on logistics distribution.

The Eurocenter is a logistics platform in the northern part of the city of Toulouse. It is a public institution which focuses on industrial activities. It was developed in conjunction with various non-governmental partners and also funded by the French and the European Union. The Eurocenter has an area of 2,8 million square meters of development and an annual turnover of 77 million of goods (EUROCENTRE MULTIMODAL LOGISTIC PLATFORM TOULOUSE, 2009; Dutra 1999).

The Rugis logistic platform is a private enterprise that began with the Sogaris group in 1960. Rugis platform was the first platform to be consolidated in the world. It covers an area of 0,51 square meters and offers intermodality as modal road, rail and air, Orly Airport is within10 kilometers from the enterprise (NUMATA JR. AND NACIMENTO, 2009).

4.6. District of Nola- Italy

The District of Nola, near Naples, is currently a large logistics area. It was founded in 1987 initially only with the sector wholesale commercial district, known as CIS. In 1999 it was consolidated with two other sectors of the intermodal logistics, known as Interporto Campano, and the service sector and retail, known as shopping Vulcano Buono (INTERPORTO CAMPANO, 2009).

The management of the District of Nola is private and has a solid infrastructure with road, rail, air and also serves as a dry port. Today the shift is the most used rail due to characteristics of the loads carried that are extremely heavy. This development is an area of 3 million square meters and offers various activities and services that add value to circulating goods (INTERPORTO CAMPANO, 2009).

4.7. Dallas Logistic Hub – USA

The logistics platforms in the United States are known as Freight Villages or hubs and are an emerging concept. The goal of the United States with this type of business is to solve a practical problem of urban congestion and therefore improve the efficiency of transport freight (WEISBROD *et al.*, 2002).

The Dallas Logistics Hub is the largest logistics park in North America, with 25,7 million square meters of intermodal terminals, planned park to activities such as distribution, manufacturing, offices and retail stores. The hub works with road, rail and air. The Hub is strategically centered between five of North America's major business hubs in New York, Chicago, Los Angeles, Mexico City, and Toronto (DALLAS LOGISTICS HUB, 2009).

4.8. Campinas Logistics Platform- Brazil

In Brazil, the logistic platform is still a very recent concept, but a concept has taken significant dimension. The Campinas logistic platform is a real project in progress for an area of 7 million square meters near the Viracopos airport, in Campinas, São Paulo. It is being studied and planned on the basis of existing logistics platforms under the precepts of industrial ecology, guided by sustainability concepts for the development of incorporating in its design a balance between logistics activities and environmental constraints taking into account the viability of the business . This logistic platform is a development of private enterprise (LIMA Jr. *et al.*, 2009).

5. Model and Case Application

Based on the literature and the characteristics of a case study, the present paper propose BCC model to project a logistic platform. The objective is to obtain a good productivity for the (Campinas Logistic Platform, CLP) to have decisions index that support decisions and actions to choose good outputs that make DMU CLP to be efficient. The model takes the output orientation, and considers the total area of the platform and invested capital fixed value and intend to determine the outputs that maximize the productivity of the platform. The output is the number of companies to be held in the CLP and the total number of tons processed per year. Thus the model adopted in the study is BCC outputs oriented.

The table 1 presents the data for the application of the DEA methodology to analyze the performance of the seven selected DMUs. In order to determine the outputs value to Campinas logistic platform that conduct it to an efficient region, it was assumed the inputs specified in the last line, table 1. It is based on the initial proposition of the project managers for the platform.

	Inputs 1	Inputs 2	Outputs 1	Outputs 2
DMUs	Plataforma Area (Mm2)	Invested Capital (Mill Euros)	Enterprise Number	Annual Load handling (Mton.)
Barcelona	2,02	110,00	74	36
Rugis	0,51	130,00	83	25
Bremen	3,60	460,00	300	77
Toulouse	2,80	762,00	270	80
Nola	3,00	600,00	175	30
Zaragoza	12,83	3189,00	150	22
Dallas	25,7	3000,00	500	400
CLP	7,00	500,00	-----	-----

Table 1 – Inputs and Outputs of selects DMUs

The BBC model oriented outputs and the Benchmarking analysis was used the software SIAD (Integrated System of Support Decision) Meza, (2005).
The Table 2 shows the results obtained from the SIAD model, the DMUs efficiencies and DMUs Benchmarking.

Nº	DMUs	Efficiencies DMUs (%)	Benchmarking Unit
1	Barcelona	100 %	Efficient
2	Rugis	100 %	Efifcient
3	Bremen	100 %	Efficient

4	Toulouse	100 %	Efficient
5	Nola	64,44 %	Bremen e Toulouse
6	Zaragoza	39,11 %	Bremen e Dallas
7	Dallas	100	Efficient
8	CLP	0%	Barcelona e Dallas

Table 2 - Efficient DMUs and Benchmarking units

The Barcelona, Rugis, Bremen, Toulouse, and Dallas platforms were identified as 100% efficient, through BCC analysis. On the other side, Napoli, Zaragoza platforms showed efficiency 64.44% and 39,11% respectively, this means that these platforms can increase their technical efficiency into 35.66% and 60,09% respectively without increasing their areas and investments, that are input variables. The CLP has not been evaluated regarding its output since it is the object of design.

The analysis by DEA beyond measure the efficiency, it also provides a guide to reduce the platform inefficiencies. That is, in this case, further analyzes of the weights obtained in the DEA results indicate that Zaragoza and Napoli platform would increase their efficiency if they increased the numbers of companies participating in its site.

The goals and benchmarks for inefficient DMUs should be calculated from the classical frontier. Note that the logistics platforms that have reached their maximum technical efficiency (100%) "may" not increase handling activities and the number of companies in their site. The inefficient DMU can reach better performance taking as reference those with technical efficiency equal to 100%, which are considered their benchmarks. From Table 2 Napoli has Bremen and Toulouse as benchmark platforms and Zaragoza has Dallas and Bremen, respectively. These platforms will serve as reference benchmarks for the inefficient platforms to achieve its efficiency and determine the direction and the size they have to work to reach the efficient frontier.

Table 3 shows the results of targets and slacks. Following the same way of analysis for the CLP would have inside its site 132 enterprises and 85 ton of cargo handling. The analysis also shows the possibility of reduction of Platform area from 7 to 5 millions square meters or use this area for other business opportunity.

DMUs	Input 1	slack	Target	Input 2	slack	Target	Output 1	slack	Target	Output 2	slack	Target
1	2,02	0	2,02	110	0	110	74	0	74	36	0	36
2	0,51	0	0,51	130	0	130	83	0	83	25	0	25
3	3,60	0	3,6	460	0	460	300	0	300	77	0	77
4	2,80	0	2,8	762	0	762	270	0	270	80	0	80
5	3,00	0	3,0	600	0	600	175	0	271	30	29	75
6	12,83	0	12,	3189	1668	1520	150	0	383	22	155	211
7	25,7	0	25,7	3000	0	3000	500	0	500	400	0	400
8	7,00	1,780	5,21	500	0	500	0	46,36	131,48	0	0	85,12

Table 3 – Backlash and Target to DMUs

6. Conclusion

This study aimed to analyze the logistics platforms ZAL Barcelona Sogaris Rugis, EuroCenter Toulouse, Breman GVZ, District of Nola Naples, PLAZA Zaragoza, Dallas Logistics Hub and Platform Logistics Campinas. Technique was used non-parametric efficiency analysis known as Data Envelopment Analysis (DEA), to quantify the level of efficiency of the enterprises analyzed and propose alternatives to improve performance.

The efficient Logistics platforms, based on the results of applying the BBC model oriented output, were ZAL Barcelona Sogaris Rugis, EuroCenter Toulouse, Bremen GVZ, Dallas Logistic Center and Campinas Logistic Platform. This does not mean that the platforms of the District of Nola are inefficient as an enterprise, but based in the model and comparing all platform analyzed, can be concluded that the District of Nola could improve performances. Zaragoza is already at 40% efficiency, from the model used and the selected data can be concluded that Zaragoza is an inefficient platform. Therefore, two platforms that did not obtain satisfactory efficiency can increase the scale of production, or increasing the number of companies active in the development or increasing the annual load.

Recommendations for future research are to be using a other mathematical models as a the additive and multiplicative models, and could be added more variables and DMUs in analysis.

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