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A MULTI-AGENT APPROACH TOWARDS DESIGNING A CITY PORT BUSINESS MODEL

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The present paper concerns the design of a city port business model incorporating Public Private Partnership schemes. Extensive literature review was acquired, in order to fully comprehend the organizational schemes and state of practice of Public Private Partnerships at ports. A survey was conducted at the port of Volos, based on questionnaire and interviews, to define the functions and services of the port, which could benefit from the private involvement and improve its role as a transport interchange for all involved stakeholders. The collected data were analyzed, using a modified version of Analytic Hierarchy Process, which revealed the relevant importance of port functions and services. Three different management models were considered to tackle the most important issues that came up during the analysis and they were evaluated based on the literature; the current one, a landlord management model and a partial privatization management model. The results of this process indicated, that the landlord management model would be the most effective for the particular case of the port of Volos. The landlord model seemed to perform better in improving both the operation of the organization and the level of passenger satisfaction, through its increased management flexibility, due to the segmentation of services and reduction of bureaucracy, as well as the additional investment capital that it can attract. Based on the proposed management model, actions and measures improving on the port's business model are recommended.

Keywords: transport interchange, multicriteria evaluation, analytical hierarchy process, stakeholders

1. Introduction

A transportation hub (or transportation interchange) is a place where passengers or cargo change modes of transport. Transportation hubs are important for the efficient facilitation of intermodal transport, by improving the interconnection between different transportation modes, and provide the chance of seamless trips for passengers and goods, thus achieving system efficiency and high user satisfaction. They can also contribute decisively towards sustainability and support environmentally, socially and economically friendly travel, enabling the optimal combination of different transportation modes, and by providing efficient use of space, information and communication technologies and the emergence of new strategic stakeholders (City-Hub, 2015).

In order to facilitate the creation of a sustainable transport interchange, the development of an adequate business model, depending on its physical and operational characteristics, is required to support the endeavour. This is a crucial part of the interchange's financial sustainability, since in many cases, especially when managed by the public sector, an interchange can become a burden to a state's budget, due to inefficient management. A solution to this problem seems to be the cooperation with the private sector, which can differ in its form or its scope, from simple outsourcing of services to agreements for the development of new facilities. This would allow the public sector to use the private sector's capital to cover part of the interchange's operational or maintenance cost, as well as benefit from the private sector's interest in the partnership's financial results and thus more efficient management practices (City-Hub, 2013).

Ports are transportation hubs, which accommodate cargo, passengers or both. Freight can be transported to and from the port by road, rail or inland waterways. The means of transport depends on the physical characteristics of the port, its hinterland and the type of goods that are being transported (Pastori,

2015). Regarding a port's effectiveness as a passenger interchange, it is closely related to its location and the facilities in its vicinity accommodating intermodal transport. However, passenger port terminals are built on port land and their conversion to passenger hubs may prove difficult due to space restrictions and high land cost (Pitsiava-Latinopoulou and Iordanopoulos, 2012).

Various approaches have been made, addressing the appropriate business model for ports. Some gave focus on the investigation of passenger satisfaction (Kapros *et al*., 2011; Pitsiava-Latinopoulou and Iordanopoulos, 2012) and suggested an improved business model for the port focusing on the improvement of the offered services (Morfoulaki *et al*., 2012), and the overcoming of barriers and the problems related to intermodality connectivity (Reis and Macario, 2012). Other studies concentrated on intermodal freight transport, which uses the port as the main transportation hub (Zhang *et al*., 2009) and gave emphasis in the strategies, which depict business models related to the connection between port facilities and hinterland operations (van den Berg, 2015).

In most cases, ports as transportation hubs are expected to attribute similar importance to both passenger and cargo servicing; two domains very different in terms of requirements, problems, implications, stakeholders. Acknowledging the importance of a business model for ports, the aim of this paper is to introduce and implement a methodology for assessing the feasibility and appropriateness of such a model, with main objective to enable efficient functioning of the port as an interchange for both cargo and passengers. The methodology follows a multi-agent approach, using as data collection tools a passenger questionnaire survey and an interview survey targeted at port stakeholders. Moreover, the current study proposes a business model which introduces improvements to the issues that were identified by the passengers and port stakeholders, covering both passenger and cargo services.

2. Public Private Partnerships (PPPs)

2.1. Forms of PPP schemes

In recent decades, there has been an increasing interest in Public Private Partnerships. Public Private Partnerships are collaborations between the public and private sectors, aiming at developing infrastructure or providing services (Katz, 2006; Asian Development Bank, 2008; Tan, 2012).

Many different forms of PPP schemes have been used extensively worldwide. This is mainly due to the advantages they offer to the public sector, such as additional funds (Katz, 2006; Tan, 2012), reduced long term costs (Eggers and Startup, 2006), additional technical expertise (Tan, 2012) and increased efficiency (Asian Development Bank, 2008). However, there are also some disadvantages. More specifically, the complex nature of such schemes may lead to prolonged negotiations and large consulting and legal costs (Tan, 2012). In addition, there are also the issues of potential profiteering (Tan, 2012) and the business venture's possible failure (Katz, 2006) to consider.

In PPP schemes, there is a large number of stakeholders. These include the consumers, non-governmental organizations and community based organizations, workers, private firms and financiers, alternative providers, politicians and officials and media (Escobedo, 2008). Stakeholders can help towards the realization of a project or hinder its completion. Stakeholder opposition can occur in any project, as a result of disparities in expectations and desires between different groups, but is even more common in PPPs, due to the complex nature of these schemes. This problem can be overcome by analyzing the situation and adopting management practices that will help reconcile the stakeholders with the project, like including the interested parties from the beginning and engaging in social dialog (De Schepper *et al*., 2014).

A lot of PPP models have been implemented in various sectors. In service contracts, the public sector subcontracts the development of infrastructure or the provision of a service to a private entity, which has the responsibility to complete or provide it (Asian Development Bank, 2008; UNESCAP, 2011). Management contracts are agreements in which a private partner agrees to take over only the management of a public service for a certain period, without contributing any personnel or having any investment obligations (Asian Development Bank, 2008; Hong Kong Institute of Surveyors, 2009; UNESCAP, 2011). "Brownfield" concession contracts are long term concessions of existing facilities. In this case the private sector undertakes the full responsibility (management, maintenance, possible future investments) of an existing public facility. "Greenfield" concessions are similar to the previous model, but in this case the private sector has to contribute financially in the construction of the facility (Hong Kong Institute of Surveyors, 2009; Pagano, 2010; UNESCAP, 2011). In the Joint Venture model, the private and public sectors undertake a business venture and for this purpose they form a corporation, which is responsible for the project's completion and management (Asian Development Bank, 2008).

There are a lot of concession variants, which are implemented on a case specific basis. The most important are the BO (Build and Operate) model, the BOT (Build, Operate and Transfer) model, the DBFO (Design, Build, Finance and Operate) model, the BBO (Build, Buy and Operate) model (Pagano, 2010).

2.2. PPP schemes in port governance

In the port sector, the PPP models are usually applied to cargo handling services and especially container terminals, mainly due to the higher profits they offer to the investors. Another reason that PPPs are much more popular in cargo handling, is that there are concerns related to safety & security and anti-competitive practices about the concession of port services to the private sector, since most ports cannot support more than one operator for these services. As a result, most port authorities prefer to offer these services themselves or outsource them to a single, trustworthy private operator (Farrell, 2011). According to the World Bank (2007), there are a lot of opportunities for private sector participation in port operations outside container terminals. Specifically, towage services, IT services, maintenance dredging, environmental facilities and other port services like pilotage are considered to be eligible for outsourcing. In the same document though, the same concerns are expressed, as in Farrell (2011), regarding pilotage privatization, due to the possibility of a private monopoly emerging. It is also mentioned that vessel traffic services are usually best provided by the port authority. Finally, it is considered imperative that waste management, emergency response services and dredging operations remain in the hands of the public sector.

Based on the degree of private sector participation, there are four port management models. The public service ports are ports in which the public sector holds a dominant role. In the tool ports, the public sector provides all the infrastructure and equipment necessary for the provision of port services, whereas the private sector provides the workforce. In the landlord ports, the private sector is responsible for the management and maintenance of the port facilities, as well as the workforce, while the public sector sets the rules and decides between potential partners. The fourth management model is the fully privatized port. In this case the public sector is not involved in any way, except for protecting passenger and customer rights and keeping possible monopolistic practices in check (Brooks, 2004; Bichou and Gray, 2005; The World Bank, 2007).

Bichou and Gray (2005) argue that although, in general, ports can be categorized as described above, there are lots of different ownership and organizational models worldwide combining two or even more of these. They also recognize the difficulty of formulating a clear taxonomy due to organizational, operational, physical and regulatory differences.

One such example is the case of the Finnish ports. According to a working paper developed by Ronty *et al*. (2011), the majority of the Finnish ports fall somewhere in between the tool and the landlord model, as they bear many similarities to tool ports, but they also lease land to private operators, incorporating this way landlord model elements. Additionally, due to their small size, Finnish ports rarely leave room for more than one operators, making them quite different from standard landlord or tool ports.

Baltazar and Brooks (2001) developed the port devolution matrix, where they tried to create a summarized view of the roles of each sector, as well as those of the regulator, the operator and the landlord. Brooks (2004) examined the port governance models of five countries (USA, United Kingdom, India, Australia and Canada). She then used the devolution matrix in the case of Canada to identify the involvement of the public and private sector in the Canadian ports. The results showed that with the exception of remote ports, most Canadian ports appear to have a strong private sector participation, with the government maintaining a significant regulatory role.

Cullinane *et al.* (2002) conducted a study on the efficiency of major Asian container terminals in relation with their administrative and ownership model. The results of their study showed a clear correlation between terminal size and efficiency, as well as some relation between increased efficiency and management shift from public to the private sector. They also recognized that there is some support in the hypothesis that greater market deregulation may have a positive impact on productivity.

Vining and Boardman (2008) investigated the role of PPPs in the improvement of port infrastructure. They identified port market failures and classified them according to their degree and their relation to the port infrastructure. The results showed that PPPs would be effective in small and medium sized ports which present medium market failure. The authors argue that this is mainly due to low transaction and societal costs. They point out however that the different perspectives of the public and the private sector can cause friction and lead such a venture to failure.

Layton (2010) prepared a study for the New Zealand Institute of Economic Research. In this report, the results suggest that the corporatization of New Zealand ports in the 1980s and the transfer of their ownership to the regional counties has led most of them to decreased performance and inefficient policies. The author suggests changing the ownership and operational model of the ports and promoting competition in container handling services.

Florida TaxWatch (2014) published a report comparing Florida seaports governance models with other USA and international ports. In this report, it is argued that although there are indications that decentralized models work better, the two most important factors, irrespective of the ownership structure and the governance model, are stability and trust. Based on these two points, the report suggests acting further towards increasing the competitiveness of the port, as well as be more market oriented despite political pressure.

Cabrera *et al.* (2015) published a comprehensive review of PPP cases in Spanish ports. Emphasizing on risk allocation between public and private sector, they analyzed the international and Spanish experience. Their conclusions showed that although PPPs could offer additional investments, especially during the economic crisis, there is a number of concerns regarding risk allocation, unregulated competition, potential failure of the private sector to deliver and the lack of public information regarding tender documents.

2.3. Business models in the port sector

Business models, as defined by Osterwalder and Pigneur, (2010), "describe the rationale of how an organization creates, delivers and captures value". An extensive literature review on business models suggested that they should be studied as scientific models, while they can also function as guides to business managers (Baden-Fuller and Morgan, 2010). George and Bock (2011) published their own research based on the subject of business models. They focused on managerial perception of the term and identified that there are three main domains in each business model, namely the resource, trans-active and value structures. Their conclusion was that business models are used and formulated to take advantage of business opportunities related to one or more of the three aforementioned domains.

Ports, as any other organization, have their own business models. There are several studies concerning port business models.

Yang *et al*. (2014) studied the business model of port Everglades and investigated its implementation and the incorporation of certain strategic choices in the Wusongkou cruise port in Shanghai.

Van der Lugt (2017) argued that the main issues in ports are the organizational aspects and she analyzed two different value propositions, one for attracting investors and one for attracting and keeping port users. She went on to identify the factors that have an immediate impact on port operation and organization, emphasizing on sustainability, new technologies and logistics. In her analysis of the port of Rotterdam, she argued that the port authority assumes the role of the developer, while shifting the investments from infrastructure to networks.

The Technical University of Denmark (2013), produced a workbook, in which they implemented a PSS (Product/Service-Systems) strategy, to formulate and catalogue business models for the maritime sector, based less on sales and more on the integration and interaction of the customer and the supplier perspectives. As a result, the research team formulated seven business models, each addressing a different problem of port operations.

3. Methodology

For the development of a business model for a city port, a five-stage process was adopted. The first stage involved collection of data regarding the services and operation of the port. Both quantitative and qualitative data were considered. Quantitative data comprise passenger and cargo traffic, and economic data. Qualitative data concern objective and subjective description of the services and operations, in terms of structure of the organization, stakeholder responsibilities and interactions, goals, constraints and problems. The second stage required analysis of the data collected in the first stage. A commensurate scale was developed for the consolidation of the qualitative data, and then a correlation of these measurements was done against the quantitative information. Based on the findings from the second stage, a set of possible suitable management models was identified, in the third stage. An assessment methodology was used for the estimation of the level of efficiency of the models for the studied city port. Then, the most prominent management model(s) were discussed with stakeholders in a closed user forum

to finally conclude in the most appropriate for the port and based on this, propose certain measures for its improvement.

3.1. Data collection

Data collection comprised quantitative and qualitative data. Quantitative data were collected from the National Statistical Bureau and the Port Authority of Volos, and included the following: passenger traffic, cargo traffic, which included both container and bulk cargo and the financial results of the organization for the 2013 economic year.

Qualitative data were collected by interacting with the port stakeholders. These were identified in two groups; passengers and business stakeholders, such as port authority, employees, agents, forwarders, city authorities.

For the passengers, a structured questionnaire survey was conducted, with face-to-face interviews. The questionnaire structure was chosen based on good practices (Asian Development Bank, 2014) and was adapted to fit the characteristics of the interchange that was being assessed, as well as the particularities of the face-to-face interviews. The questionnaire consisted of three parts. The first part included personal information, specifically gender, age (18-25, 25-40, 40-65 and over 65) and level of education (elementary school graduate, high school graduate, university graduate).

The second part examined the quality of infrastructure facilities and quality of services and the respective indicators. Due to the nature of a face-to-face interview, this part was kept as simple and concise as possible, with each indicator covering a wide variety of facilities or services.

Quality of facilities was examined in terms of:

- signage
- connection with other means of transport
- waiting time utilization
- level of noise
- number and diversity of available activities in the port area
- existence of ATMs and the attractiveness of the port area.

Interviewed passengers were asked to assess whether the facility components satisfy them, do not satisfy them, or are indifferent.

Quality of services included the following:

- cleanliness
- availability of information
- accessibility in the port area
- safety
- frequency of lines
- price
- general level of port services.

For the services, passengers were asked to rank the first three of them based on the perceived need for improvement (City-Hub, 2013).

The third part included information regarding the purpose of using the port for travelling (work, education, entertainment, other reason), the means of transport used to reach or leave the port (transit, taxi, car or by foot) and the trip frequency (once a week, twice a month, once a month or rarely).

For the business stakeholders, a non-structured interview process was used, during which interviewees were guided to explain in detail their business with the port, covering strategic, tactical and operational topics. For each topic being covered, they were encouraged to provide their own perspective of the outcome, as well as the reason for it, e.g. lack of communication among stakeholders, reduced resources etc.

3.2. Data analysis

The collected data were analyzed following a modified version of Thomas Saaty's Analytical Hierarchy Process (AHP) method (Saaty, 1980). AHP has been implemented in transportation related fields regarding decision-making, such as selecting location of transportation facilities (Regmi and Hanaoka, 2012).

Pairwise comparison was done between any two topics examined within each context; quality of facilities, quality of services and preliminary comparison matrices were created. In reviewing the quality

of facilities, the comparison was based on the estimation of the ratio of the number of "not satisfied" responses related to each pair of topics.

For the ratios of the topics regarding the quality of services the rank index was used, calculated as the weighted total number of responses. Weighing used as coefficients 0.55, 0.3 and 0.15 for first, second and third ranked topics, respectively. These coefficients rely on the understanding of the researchers of the perceived distance between the three choices made by the respondents.

Final comparison matrices resulted from the normalization of the values of the preliminary comparison matrices using a commensurate scale from 1 to 10, based on equation (1):

$$y = 1 + \frac{(x-A)[N-1]}{B-A}, \quad (1)$$

where x and y are the values of the preliminary and final comparison matrices, respectively, A and B are the lowest and highest values in the topic and N is the highest possible value (i.e. 10).

Eigen values of the final comparison matrices constituted the partial priority of each topic within its context. Assuming equal weight between quality of facilities and quality of services, the overall priority of each topic was calculated (Table 1).

4. The Case Study

4.1. The Port of Volos

The Port of Volos is a public service port. It is a medium sized seaport and one of the largest ports in Greece in terms of cargo, as well as passenger traffic, especially during the holiday season. It is located in the Thessaly region of the country, to which it is very important because it serves as the link between the mainland and the Sporades islands. It also channels a large portion of Thessaly's production towards the other Greek regions or neighbouring countries (e.g. Turkey). The port of Volos also receives cargo which is destined for Thessaly cities. This makes the port a real economic engine for the city and its whereabouts. As it is apparent from these facts, its clientele consists mainly of transport and tourist agents, shipping lines and cruise companies.

Passenger traffic comes mainly from the Sporades islands and cruise passengers during the holiday season and its container and cargo throughput comes mainly from the Thessaly region. Port data indicates that they both saw a rise before the economic crisis and a subsequent fall in recent years. More specifically, the largest passenger traffic in recent years was in 2009, with 450,355 passengers using the port, while in 2012 only 331,927 did so. As far as cargo traffic is concerned, in 2008 1,615,244 tons were moved, in contrast with the 718,899 of 2014. Finally, the container traffic saw a fall from 24,356 twenty-foot equivalent units in 2008 to 17,478 in 2014.Economic data from 2013 shows that despite the fall in both passenger and freight traffic, the Port Authority managed to remain profitable, with its net profit approximating 672,100 euros.

In conclusion, the port of Volos is a medium sized port of special importance to its surrounding area, which, despite the significant impact that the economic crisis seems to have had in terms of cargo and passenger traffic, managed to remain profitable. This shows that the Port Authority could capitalize on its role in the area, increase its efficiency and regain some of the lost traffic. It is also worth mentioning that part of the port area is sublet to private partners for commercial use. This area consists mainly of cafes and restaurants, which private individuals manage in exchange for a rental.

4.2. The survey and interviews

The survey and interviews were conducted in autumn 2014. The passenger sample was random and consisted of 100 passengers. Regarding gender, the sample consisted of 56 males and 44 females. Most of the passengers were young, as 44 of them were in the 25-40 age category, while another 24 fell in the 18-25 age spectrum. Of the rest, 27 belonged in the 40-65 category and only 5 respondents were aged above 65. In regards with the passengers' education level, 45 respondents had gone through higher education, 41 were high school graduates and 14 had only elementary education.

It can be concluded that the passengers were mostly indifferent to the quality of the port's facilities. The features related to the facilities that most passengers were dissatisfied with were the lack of ATMs and the general attractiveness of the area, as well as the number and diversity of available activities and waiting time utilization. On the other hand, the signage and the noise level gathered the least "not satisfied" responses.

The service ranking showed that the most urgent improvement to be made is by far the reduction of the fare, followed by the frequency of lines. The passengers seemed to be generally content with the rest of the services.

In the trip information part of the questionnaire, it was shown that passengers travelled to and from the port mostly for work (37 answers) or recreational purposes (36 answers), while 22 respondents claimed other reasons. Finally, 5 passengers travelled for educational purposes. Regarding their means of transport, 35 passengers arrived or left on foot, 26 used a taxi, 25 their private car, while 14 used public transport. Most passengers claimed to be using the port to travel less frequently than once a month [39 answers], while 27 used it once a month, 22 twice a month and 12 once a week.

The business stakeholders that were interviewed were the Chief Financial Officer (CFO) of the port, the head of the cargo handling department and two freight brokers. The issues identified by the business stakeholders were mostly related to cargo handling services and operational issues. Specifically, all of them recognized that there was insufficient workforce in the port in terms of numbers and training, while the head of cargo handling department and the freight brokers also pointed out the outdated equipment used by the port. The freight brokers also mentioned a lack of investment in new infrastructure and equipment and the high prices that the port charged. Finally, the CFO mentioned the problem of bureaucracy and that of the lack of bonded warehouses.

From the data of both questionnaire survey and interviews, the most important issues of both the freight and passenger sectors of the port were identified. What was derived from both sets of data is a lack of competitiveness. This can be concluded by the high prices that were given high priority during the passenger survey and a special mention during the interviews with the freight brokers doing business with the port, as well as by the outdated equipment, the insufficient and inadequate workforce and the bureaucracy. The unattractiveness of the general port area and the low number and diversity of available activities recognized during the questionnaire survey contribute even more to this conclusion. Despite this, the port's important role in the area allows it to be profitable. However, an improved business model focusing on efficiency and competitiveness should have a positive impact on both its operation and financial results.

4.3. Analysis of results

After the collection and consolidation of the questionnaire data and the formulation of the preliminary comparison matrices, priorities were calculated for each questionnaire item, using the methodology mentioned previously. The items of each section of the second part of the questionnaire were the indicators of the hierarchical structure. Their final priorities were determined by multiplying the perceived weight of each section (facilities and services) with the priorities that were calculated through the pairwise comparisons. The weights of the sections were considered to be equal to each other and their value was 0.5. The results of this process are presented in Figure 1 and Table 1.

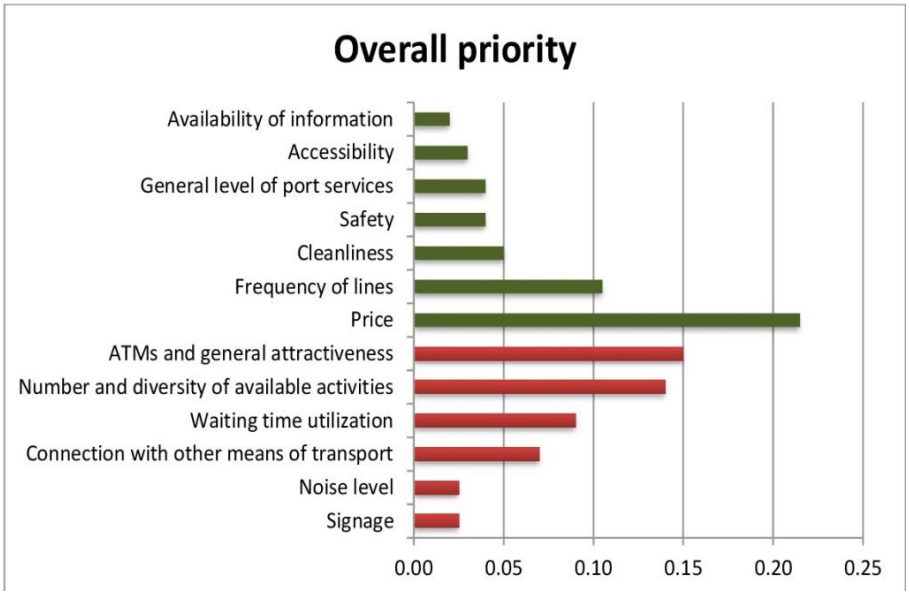

Figure 1. Priority of topics to be improved

Table 1. Priorities of facility and service improvements (% of responses)

	Topic	Not satisfied	Indifferent	Satisfied	Partial Priority	Overall priority
FACILITIES	Signage	16.00	47.00	37.00	0.05	0.025
	Connection with other means of transport	30.00	34.00	36.00	0.14	0.07
	Waiting time utilization	36.00	35.00	29.00	0.18	0.09
	Noise level	15.00	55.00	30.00	0.05	0.025
	Number and diversity of available activities	45.00	31.00	24.00	0.28	0.14
	ATMs and general attractiveness	47.00	40.00	13.00	0.3	0.15
		Ranking of service to be improved				
SERVICES	**Topic**	**1st**	**2nd**	**3rd**	**Rank Index**	**Partial Priority**	**Overall priority**
	Cleanliness	12.00	11.00	12.00	11.70	0.1	0.05
	Availability of information	4.00	6.00	11.00	5.65	0.04	0.02
	Accessibility	6.00	8.00	17.00	8.25	0.06	0.03
	Safety	8.00	11.00	14.00	9.80	0.08	0.04
	Frequency of lines	15.00	31.00	16.00	19.95	0.21	0.105
	Price	50.00	19.00	10.00	34.70	0.43	0.215
	General level of port services	5.00	14.00	20.00	9.95	0.08	0.04

From the final priorities of the facility and service improvements, it is concluded that the port prices, the general attractiveness of the facilities and the number and diversity of available activities are the most important issues of the port, followed by the frequency of lines, wait time utilization and connection with other transportation modes. These results, combined with the interview data further support the conclusion that the main problems of the port are related to issues which characterize the competitiveness of the organization. Based on this conclusion, the appropriateness of the proposed business models towards increasing competitiveness of the port was examined, and each of the topics raised by the passengers and port stakeholders was analyzed, in the following section.

5. The Proposed Business Models

Based on the results of the aforementioned process and already known practices, three potential models were evaluated and compared. These were the current one (public service model), a landlord model resembling that is commonly used in northwest Europe (Farrell, 2011) and the current one combined with privatization of certain port services or facilities. As mentioned earlier, there is evidence to support that any one of the models could work towards raising the efficiency and competitiveness of the port. The current public service model was chosen as a Do-Nothing scenario and due to considerations like the ones expressed in Cabrera *et al*. (2015) regarding PPP models in the port sector. Moreover, according to Florida TaxWatch (2014), it is only a matter of management choices whether it can function efficiently in a competitive environment. The landlord model was chosen, due to its proven efficiency, as it is the PPP model of choice of most ports (Farrell, 2011). Finally, the partial privatization of port services or facilities, although considered an extreme solution, is a practice that has been used in New Zealand and the UK and offers certain benefits that could prove useful to the port, like minimal bureaucracy and increased flexibility (The World Bank, 2007).

These business models were evaluated based on the literature and their effectiveness in improving the most important port issues that were recognized during the survey.

Regarding the port's cargo services, there are evidence in the literature to suggest that a private sector involvement would benefit the port. Cullinane *et al*. (2002) identified a connection between container terminal efficiency and shift in management from public to the private sector. Layton (2010) also suggests a change in the management structure to promote container terminal competitiveness. In the case of the landlord model, cargo handling companies are considered to be more market oriented than the public sector, while it is also possible for them to invest in infrastructure and equipment in order to increase their profits or as part of their long-term concession deals. This is even more the case in the full

privatization of the cargo handling services. In this model, there is minimal government interference and bureaucracy, as well as fully market oriented policies followed that are guaranteed to raise the competitiveness level of the port. Another advantage is the high profits that a port land sale can produce. On the other hand, this model also comes with severe disadvantages, like potential monopolistic behaviour, loss of potential long-term profits by the public sector and the possibility of speculation by the cargo handling operators. The current model has the advantage of all operations being governed by a single entity [the port authority], but this leads to low flexibility, especially in labour related problems, lack of investment funds, inefficiency, non-market oriented policies and lack of innovation (The World Bank, 2007). Based on the problems identified during the interview survey, the landlord and the full privatization model seem to be able to increase the port's competitiveness and efficiency. These two models can solve the port's issues with outdated equipment and insufficient workforce, as the cargo handling operators are going to have to invest in equipment, infrastructure and workforce to rationalize the terminals' operation. Taking into account the advantages and disadvantages of the two models, it is deemed necessary for the public sector to retain a regulatory role. It is therefore easier and safer for a landlord model to be implemented, since the formation of a regulatory body would be necessary even in the full privatization of the cargo handling services due to the disadvantages mentioned earlier. In conclusion, the landlord model is the best suited model for the port of Volos cargo handling services, since it deals with the issues that came up during the survey and at the same time allows the port authority to retain some control over port land and its regulatory role.

The issues identified during the passenger questionnaire survey are more complex. While the improvement of the facilities in terms of attractiveness and available activities could be achieved through the concession of port land to private investors, this leaves the problem of the pricing, as well as that of the frequency of service unsolved. The pricing in particular is something that the passengers pointed out as the most important issue. Due to the nature of the area's geography the shipping lines connecting the port of Volos with the Sporades islands are necessary, since they are the only connection of these islands with the mainland. The demand traffic however does not justify many routes daily, especially during winter, and this, combined with high operational costs (taxation, wages, high fuel prices) results in sparse routes and very high prices. Lowering the price or increasing the routes would make the lines highly unprofitable. So, the solution proposed, is that of the long-term concession of parts of the port land to the shipping companies under the landlord management model. The shipping companies would be incentivized to develop and manage this land in order to create an attractive port area that will offer a number of diverse activities. In return, the shipping companies would be expected to up the frequency of the routes to and from the Sporades islands and lower the price of the fare. This suggestion is similar to the approach of the Maldives' government to deal with the issue of irregular ferry services (Asian Development Bank, 2014). Due to the obvious sensitive nature of the venture, the only viable model would be the landlord one, since there is a high chance that a full privatization of port land would jeopardize the reduction of the prices and the increase of the route frequency.

6. Conclusions

The current study took a multi-agent approach to design a city port business model based on a potential Public Private Partnership and incorporating the changes in management and policies suggested by the research. This business model would help the port raise its level of service and passenger satisfaction, as well as its general effectiveness and competitiveness.

The analysis of the data indicated that the main problem of the port is its low competitiveness, as high prices, underdeveloped port land (as is apparent from the low number and diversity of the available activities in the port area), outdated equipment and insufficient workforce are clear indications of this. To remedy this, three port management models were evaluated (the current one, the landlord model and the privatization model) based on the literature. The model that was chosen as the most appropriate was the landlord one and based on this, the resource, trans-active and value structures of the port as defined by George and Bock (2011) were adapted to fit the new model.

The resource structure (the management architecture, the technology and resources) of the new landlord port's business model would differ greatly from the current one, as the port authority would have a much less dominating role in the port's management, while the involvement of the private sector would result in the influx of a new resource stream in the organization in terms of revenue, management practices, infrastructure and equipment.

Regarding the trans-active structure (the transactions of the organization with its stakeholders and partners), the port authority would engage in transactions from a different role, that of the landlord and

regulator. Its costs would be limited to its operation and its main revenue influx would come from the concession fees of the private partners. The cargo handling and port land operators would engage in direct transactions with their customers, specifically the freight companies and brokers for the cargo terminals' operator and the passengers and private individuals for the shipping companies (at the same time serving as port land operators).

Finally, the value structure (the mechanics of value creation and capture), would be much more market oriented. Each partner would develop its own value proposition to attract and retain customers. The port authority would try to provide an appropriate environment for investors, keeping rules and regulations as clear and simple as possible, while the shipping companies would try to offer high quality services and frequent routes at affordable prices. The shipping companies would also try to attract passengers and other customers to their port facilities which would offer diverse recreational activities. The cargo handling partner would try to create value through efficient and fast cargo handling, competitive prices and modern equipment and infrastructure.

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