

Construction and Maintenance of Port Infrastructures: Procurement through the Concession Model

Francisco de Lima Bettencourt e Azevedo Cacho

Instituto Superior Técnico

Departamento de Engenharia Civil, Arquitetura e Georrecursos

Av. Rovisco Pais, 11049-001 Lisboa

franciscocacho@tecnico.ulisboa.pt

Abstract

Since the last decade of the previous century, the development of port infrastructures has often been supported by the private sector, in particular through concession agreements. Effective risk sharing is necessary for the proper functioning of the concession and for high levels of construction and operation efficiency. This model implies a relationship between concessionaires and port authorities, established through a long term contract, which generally involves high investments in construction and maintenance, and therefore very vulnerable to risk and uncertainty. This paper analyses the structure of terminal concession contracts in the port sector, in particular the challenge of risk allocation.

A research on risks in public-private infrastructure partnership projects was conducted in order to build a well-defined risk matrix. One of the contributions of this work consists in the structuring of a risk matrix, organized in five main categories of risks: construction, environment, production, commercial and context. In addition, specific risks within each category were identified with the aim of, on one hand, supporting the construction of a risk matrix and, on the other hand, recognizing as many uncertainties as possible and their respective impacts to be considered in a port terminal concession.

Two case studies were selected and analysed from the perspective of the developed matrix. Based on a comparative analysis with the literature review, it was possible to verify the advantages of the risk structure adopted and also to name alternatives. Finally, this paper also addresses some risk mitigation proposals.

Key-words: risk; management; contract; concession; seaport terminal; landlord model

Introduction

Ports are among the oldest infrastructures that have influenced the location, shape and

development of cities. World economic growth combined with the technological evolution have contributed to the development of the port sector. Despite being expensive, port infrastructure projects are fundamental to foster economic activity through the provision of transport services (Martins et al. 2017). It is important to realize that not only are there different types of cargo to be moved in the ports, but also that there has been a high growth in the volumes of cargo to be moved. In addition, since the 1980s ports have started to develop as integrated transport centers (i.e. nodes of the multimodal network) and logistics platforms. Therefore, the development and maintenance of such infrastructures, as well as the innovation of their management and operation processes, play a central role in responding to the growing need for handling larger volumes of cargo. Such aspects, together with the search for efficiency and sustainability generate remarkable and frequent investments, making ports a capital-intensive sector.

The government alone is not capable of keeping up with the high investments, the growing operational complexity, the pressure on costs and efficiency, and global competition, thereby giving rise to private participation, through public-private partnerships (PPPs) implemented through concession contracts and sometimes through complete privatizations. As stated by the World Bank (2007), the structure, organization and management of ports depend on factors such as the socio-economic structure of the country, historical development, location of ports and the type of cargo to move. The differences refer not only to the degree of involvement of the private sector but also of the public sector, with different models depending on the participation, or not, of the port authority (Cruz 2010). In order to simplify the existing models, the World Bank has defined 4 standard models which, according to Cruz and Marques (2012a), they present themselves as models of corporate governance, and should not be understood as such since they do not have the detail that such model should contain. A public service port is when all the major functions are

guaranteed by the port authority, and a private service port is a port owned and managed by a private operator. Between these two, the public and private sector coexist, and that is where the tool port and landlord ports belong. The first one consists in a port where all infrastructure-related systems are publicly owned, managed, and maintained (Cruz and Marques 2012b). The landlord model is when the port authority owns the port land, while assuring concessions for the seaport terminals to the private sector.

Most of the Portuguese concessions are related to the operation and maintenance of existing infrastructures involving expansion investments or improvements in them. In the specific case of Terminal XXI at the Port of Sines, the infrastructure's construction, operation, and maintenance are responsibilities of the private sector. This type of case involves contracts with lengths of 10 to 50 years and capital-intensive requirements, in a competitive market, which generates several issues regarding risk management.

This paper's main objective is the analysis of the concession model regarding the construction, maintenance and operation of a seaport terminal, particularly the risks it involves. It aims to identify and understand the main risks associated with port terminal concessions. Then, it focuses on the risk sharing agreements using two case studies of concessions at the Port of Sines. For this purpose, a comparative analysis was made between the results in both terminals and the information gathered during the literature review. As a finishing touch to the construction of the risk analysis, some proposals for mitigation are suggested.

I. Literature Review

Seaport concessions

According to Rocha (2012) the right to grant may consist in a part or in its entirety. In other words, in a situation that requires the creation of a new quay or terminal (i.e. greenfield project) the concession usually includes financing, construction and operation while in the case of facilities that are already built and available only the right to operate is granted. The author divides the main types of concession used in ports into three: public works concession (i.e. the right to construct and operate a public work for a certain period, granted to a private operator), public domain concession for private use (i.e. the right to use a domanial parcel, e.g. quay, awarded to a private agent for its use and interest, as long as the private interests match the public interests), and public services concession (i.e. the right to provide a service or to perform an

activity of public interest assigned to a private agent for a given period).

As Theys et al. (2010) state, the seaport terminal concessions process can be divided into three different phases. In fact, risk may be present in the following stages, in all of which both parties may be exposed to risk:

- i) an initial, pre-bidding phase, in which the public authority establishes the main requirements for the terminal's final adjudication and the method for the adjudication;
- ii) the next moment, the bidding, is when the candidate is selected, and the conditions are known;
- iii) and in a post-bidding phase, in which the concession contract is signed, and all conditions are officially established.

According to Ferrari, Parola, and Tei (2015), the bidding phase can also incorporate a pre-qualification, to verify the participants' criteria, and one where the port authority (PA) uses a contest or a negotiation-based method to select and assign the terminal.

Marques and Berg (2011) highlight the importance of the identification and allocation of risks by those responsible for the contract preparation, before the tender phase. The authors argue that a risk matrix should be provided with contractual clauses that address each risk to the competitors (Marques and Berg 2010).

Since the concession agreement is the basis of the relationship between the concessionaire and the port authority (Cruz and Marques 2012b) and critical to its success, its composition must be clear and specific so that its feasibility is not compromised (Grage, Doods, and Haezendonck 2016).

Contractual structure

According to Ferrari, Parola, and Tei (2015), the contract must balance the different rights and obligations of the players involved during the concession period. Notteboom (2006) argues that the contract design must not only describe the business model and general scope of the concession, but also regulate prices and payments, among other general provisions.

Although the proposed structure by Notteboom (2006) does not include any construction works or investments, such issues are usually written in the contract. In greenfield projects, which are projects that incorporate large investments in construction and/or expansion, the contract includes the future development plan, the form of financing, as well as the allocation of responsibilities in case of

deviations of schedule and/or excessive costs, among others (Cruz and Marques 2012b). However, the relevance of the study carried out by Notteboom (2006) lies in the deepening of the issues related to contract duration, income guarantees, concession fees, intra-port competition and penalties.

Meanwhile, Marques and Fonseca (2010) following the Portuguese Decree-Law No. 324/94 propose a contractual structure based on five groups of clauses: (i) concession basis, (ii) scope of concessions and works, (iii) operation, (iv) duration, changes, and contract termination and (v) special obligations.

Infrastructure concession contracts are in a central position of numerous discussions, not only of political but also academic origin, on the actual ability to transfer risk to the private sector (Cruz 2010).

Risk management procedure

The International Organization for Standardization (ISO) standard regarding risk management (ISO 31000:2018), states that the objective of risk management is the creation and preservation of value, providing improvements in performance, encouraging innovation, and supporting the achievement of objectives. In order to achieve this, a structured and comprehensive approach that understands the organization's external and internal contexts and that properly involves stakeholders is required in order to obtain oriented, consistent and comparable results. Figure 1 shows the risk management process according to the ISO 31000:2018.

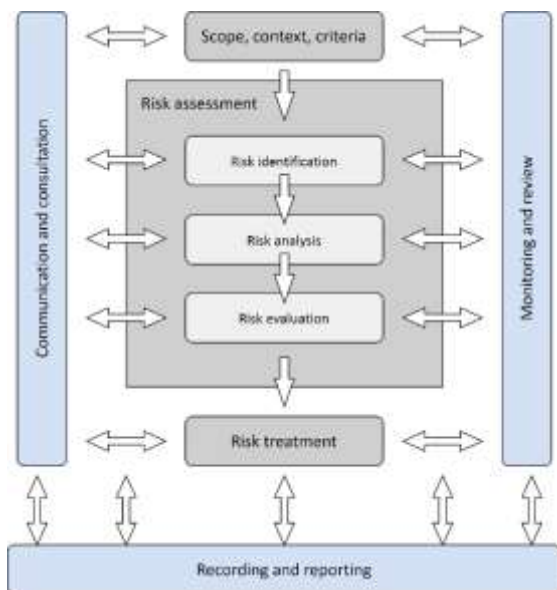


Figure 1 – Risk management procedure.
Adapted from ISO 31000:2018

Its generality allows the application of the guidelines at the most diverse levels and in the most diverse areas where risk management can be found (Sousa 2012).

According to Marques and Berg (2011), the risk analysis and assessment process in public-private partnership (PPP) projects can be divided into five steps: i) risk identification; ii) risk classification and allocation; iii) assessment of the respective probabilities; iv) quantification of the impacts of each risk; v) design of mitigation measures.

Risk in seaport concessions

The most basic definition of risk is "*exposure to a danger with a certain probability of occurrence*" (Cruz and Marques 2012b) or, alternatively, "*the probability of occurrence of a certain event multiplied by its corresponding level of impact*" (Marques and Berg 2011).

It is worth pointing out that there are very few studies identifying and classifying specific seaport terminal concessions risks, namely those of Cruz and Marques (2012b) and Rodrigue, Notteboom, and Pallis (2011). The aim was to broaden the horizon of the general infrastructure studies.

Cruz and Marques (2013) claim that large investment PPP projects are exposed to three main sources of uncertainty, namely cost deviations, demand forecasts and capital costs. The cost deviations relate to the amount of investment required and the complexity of large infrastructures, since in most projects the construction models are not standardized and involve unique construction techniques (e.g. ports). Regarding cost forecasts, the authors argue that it is impossible to estimate demand for long periods with precision. Capital costs refer to the difficulties associated with obtaining financing for infrastructure projects (e.g. credit unavailability).

Depending on the authors and semantics used, there are different risk classifications. Grimsey and Lewis (2002) considered nine risks in public-private partnerships (PPP) for infrastructure projects: technical risk, construction risk, operational risk, revenue risk, financial risk, force majeure risk, regulatory/political risk, environmental risk and project default risk. The authors also suggest a second classification: global risks, associated with the project agreement and allocated during the project (i.e. political, legal, commercial and environmental risks); and elementary risks, relative to the project itself and covering construction, operation, finance and ways of generating project revenues.

Ng and Loosemore (2007) categorize the risks of infrastructure projects into two major groups. Project risks, which comprise the aspects related to

the microenvironment that are inherent to each project (i.e. project, construction, operation and environment), and the general risks that are external to the PPP project itself (i.e. nature, political, regulatory, legal and economic events).

Marques and Berg (2010; 2011), based on the analysis of public service contracts, divided the risks into production (planning, design, expropriation, construction, environment, maintenance and major repairs, operation, technology, and performance), commercial (demand, collection, capacity and competition) and contextual (financing, inflation, legal, regulation, unilateral changes, public challenge and force majeure).

Rodrigue, Notteboom, and Pallis (2011), while focusing on the economic and financial side of the port sector, state that this sector has its own set of risk factors to be considered in capital investment. Following a standardized typology, the authors divided global risks into five categories: technical, market, financial, political and environmental. At the same time, they considered two types of risk within each category: internal and external.

Based on an empirical analysis, Cruz and Marques (2012b) presented a list of risks related to concessions and their description, which includes the port's infrastructure planning, design, construction, permits, environmental impact, accessibilities, operation, maintenance and repairs, technologies, demand, finances, force majeure, legal and political aspects. According to the authors, some of the risks, such as financial or global demand for seaports, are systemic, meaning that they are not specific to the concession. On the other hand, risks such as environmental, operational or maintenance and repair risks depend on the operation and management of concessions. It should be noted that some of the risks relate only to greenfield projects or concessions where large investments must be made, such as construction or planning and design. These lose relevance when a concession is only for the management and operation of existing terminal facilities.

Meanwhile, Messner et al. (2013) identified climate change as a risk for ports and studied the respective vulnerabilities and impacts. The authors highlight the uncertainties associated with sea level rise as a major challenge for the maritime industry, particularly for port authorities.

Risk allocation in seaport concessions

Asenova (2010) argues that risk allocation is critical in public-private partnership (PPP) contracts for at least three main reasons: (i) improving risk allocation reduces economic costs; (ii) provides incentives for good PPP management; and (iii) reduces the need to enter into a renegotiation

process. In addition, an inadequate or excessive transfer of risk to the private sector could reduce the number of candidates and foster the opportunism of other competitors (Zitron 2006).

The allocation of risks is specific to each project, as it depends on contextual issues, such as the technical knowledge available to the awarding authority, the legal scenario or the macroeconomic context (Ke, Wang, and Chan 2010). However, Marques and Berg (2011) state that some of the risks that characterize public-private partnerships are usually transferred to the private sector. As an example, the authors point out the attribution of construction risk to the private sector which, according to Flyvbjerg, Holm, and Buhl (2002), reduces cost and time deviations of projects that often characterize public works.

According to Marques and Berg (2011), the demand/consumption risk should, whenever possible, be allocated to the private partner. Cruz and Marques (2012b) argue that despite the public sector interest in maximizing the volume of cargo, the concessionaires are the agents in charge of the commercial operation of the terminal. This may lead to a certain level of risk sharing between the two parties.

Based on eight concession contracts in four different Portuguese ports, Cruz and Marques (2012b) studied the risk sharing agreements for port concessions. The authors argue that force majeure risks are allocated to the public sector in cases where they can be secured by the private partner. Similarly, they argue the public allocation of planning and design risks since the operator is best placed to plan the developments. Regarding the risks taken by the concessionaires, the authors point out that the financial and legal risks are not entirely privately managed due to the existence of clauses allowing public intervention, namely, guarantees by the port authority for the granting of loans, implying some influence of the public sector in the distribution of this risk. It was also confirmed that the public sector shows willingness to assume some commercial risk, usually through concession fees, although the mechanisms used are quite different between concessions.

Recently, Global Infrastructure Hub (GI Hub) together with the international law firm Allen & Overy developed the PPP Risk Allocation Tool 2019 Edition, which contains a series of risk allocation matrices for PPP projects. The tool addresses risks on a sector-by-sector basis, including the port sector.

II. Building the risk matrix

This model comes from the need for a correct identification and organization of risks, since both parties involved in a port terminal concession are united through contracts that usually last over 25 years and consequently are susceptible to changes in the surrounding environment.

Risk classification

Initially, a general classification of the types of risk identified was conducted, in order to organize the collected information. During this process, it was understood that many of the risks presented below are limited to different concession stages or to specific areas of the business. In addition, many of the uncertainties associated with each risk are interrelated.

As a result, it was understood that the risks could be divided into five categories, all of them related to the terminal (Figure 2). The first category involves the risks of the construction phase, related to the development and maintenance of the infrastructure, including obtaining all the necessary licenses for the project. The following classification refers to issues associated with the environment. The third category includes issues related to the terminal's operation phase, namely production risks. The fourth category represents the commercial factors of the terminal or, in other words, those related to its business, namely the risks of demand, competitiveness and financial markets. Finally, the last section includes all contextual risks, meaning that they were identified as limited to a specific context within the concession environment.

In order to optimize the allocation process, a decision was made to separate the maintenance and environmental risks in two parts: on the maritime and terrestrial sides. In addition, while keeping in mind the filling of possible gaps, the risks of cybersecurity and lack of information in contract management were added.

Risk description

- i) *Planning and design* - Generally speaking, the design of seaport terminals have a 30-year or more horizon in sight, which not only implies appropriate designs, techniques and construction materials, but also demand forecasts subject to a high degree of uncertainty;
- ii) *Construction* - The construction of large infrastructures, particularly port terminals, is subject to a wide variety of uncertainties. Their location, complexity and dimension raise some issues such as time and cost deviations (Ng and Loosemore 2007; Cruz and Marques 2012b);
- iii) *Expropriation and permits* - Obtaining all the necessary permits (e.g. construction, operation, etc.) can be a difficult and time-consuming task given the large number of parties involved, namely the local and central administration (Cruz and Marques 2012b);
- iv) *Accessibilities* - The links to multimodal networks, namely land and sea accessibilities are crucial for the terminal operation;
- v) *Maintenance and repairs on the water side* - When it comes to seaport terminals, particularly on the seaside, their maintenance and repair is imperative. Elements such as breakwaters are exposed to erosion caused by sea swell and wind, or to accidents such as the collision of ships;
- vi) *Maintenance and repairs on the land side* - In this case, there is a wide variety of causes, including settlements on the embankments, maintenance of buildings and warehouses present in the terminal area, and others;
- vii) *Environmental on the water side* - Maritime accidents, pollution due to spills or the construction itself, or the impact that the terminal may have on ecosystems in coastal

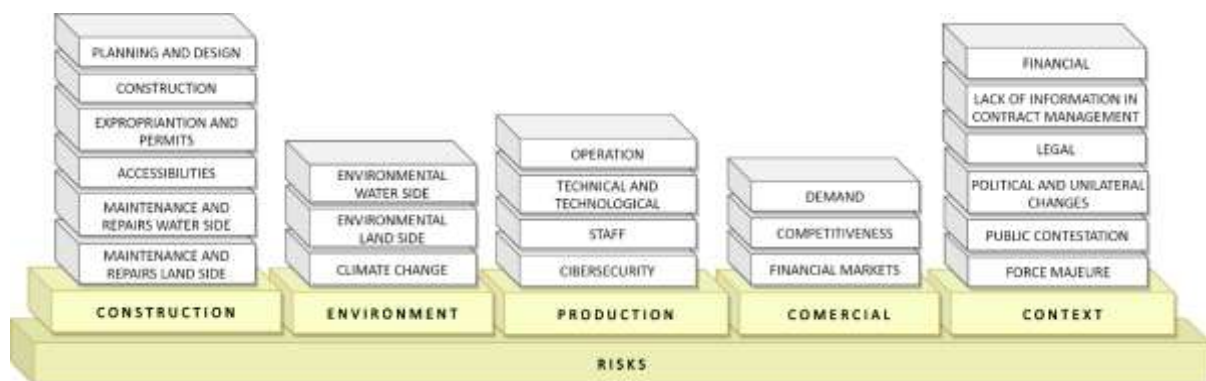


Figure 2 - Risk classification proposal

- areas or estuaries can cause serious problems;
- viii) *Environmental on the land side* - Pollution due to construction, maintenance and operation, soil contamination, and more, are factors that negatively affect the environment. Therefore, they may imply legal expenses and/or costs for infrastructure rehabilitation.
 - ix) *Climate change* - Terminal activities on the water side are subject to physical changes such as sea level rise that can cause flooding in low altitude areas, increased storm events, among others.
 - x) *Operation* - A seaport terminal operation requires complex and large-sized equipment (e.g. ships or cranes) (Cruz and Marques 2012b) that require high levels of performance. Therefore, maintenance and repair actions are also required for the equipment. On the other hand, for the terminal to function properly, port services such as pilotage, towage, accident response, electrical, water and sewage systems are also necessary.
 - xi) *Technical and technological* - The technological revolution that accompanies today involves uncertainties, namely the modernization of equipment and facilities (Cruz and Marques 2012b) and the related techniques.
 - xii) *Staff* - Besides requiring great technical expertise and experience (Cruz and Marques 2012b), the stevedoring works are subject to a certain probability of accidents. Therefore, it can lead to frequent salary negotiations or even strikes and labor conflicts with tremendous economic impact.
 - xiii) *Cybersecurity* - Nowadays it is one of the most present risks in all kinds of organizations due to their dependence on technologies as they may be prevented from performing their functions.
 - xiv) *Demand* - Market competition or the global economy and the port's very own performance increase the uncertainty about demand. This risk can be defined through concession fees, which act as a mechanism for transferring part of the risk to the port authority (Cruz e Marques 2012b).
 - xv) *Competitiveness* – As previously mentioned, market competition can influence demand and harm the terminal business.
 - xvi) *Lack of information in contract management* - The activity information is crucial for its management. The lack of detail and reliability of the operational and business

information has an influence on the performance of the concession. It can lead to an unbalanced concession or prevent the profitability of the activity from being improved.

- xvii) *Financial* - The difficulty in securing funds for the project or in amortizing the investment made may jeopardize the agreement.
- xviii) *Financial markets* - The risk of currency devaluation and/or inflation may affect both the investment made in the terminal as well as the concession business.
- xix) *Legal* - The legal risk is related to changes in legislation with a direct impact on the economic results of the concession (Cruz and Marques 2012b).
- xx) *Political and unilateral changes* - Market stability can be drastically affected by changes made by a new government in the sector strategy or when the port authority or government decides to impose conditions unilaterally, namely the development of a new terminal infrastructure (Cruz and Marques 2012b).
- xxi) *Public contestation* - The public contestation risk relates to unforeseen social sensitivities, particularly the riots or protests that prevent the terminal's activity.
- xxii) *Force majeure* - The force majeure risks are related to events with reduced probability of occurrence but with the greatest impact (Cruz and Marques 2012b). Large scale events such as earthquakes, hurricanes, terrorist attacks or wars can significantly affect or even completely disable the infrastructure.

III. The case-studies

The most recent greenfield project concessions are located at the Port of Sines and given its importance at local, national and even international level, the concessions of Terminal XXI (TXXI) and Terminal Vasco da Gama (TVG) were the ones used for this point.

Terminal XXI is currently under concession and its contract was recently renewed. The new agreement includes new investments related to the expansion of the quay front to 1,950 m, the installation of 9 more cranes, 30 parking lots and transport equipment and an expansion of the storage area from the current 42 to 60 hectares (Port of Sines 2020a).

Terminal Vasco da Gama is still in the bidding process, however, it is a BOT project and, involves the design, construction and operation of the infrastructure, installations and terrestrial and

marine equipment, and must respect the environmental constraints. In addition, maritime protection works (e.g. breakwaters), accessibilities (rail and road) and electric power supply and water and sewage system will be carried out up to the terminal limits (Port of Sines 2020b). Regarding the design and construction of the new terminal, at least one quay front of 1375 meters long, landfills and a minimum storage area of 30 hectares, a railway platform for the loading and unloading of trains, the required and appropriate facilities for the services of the concessionaire and for the authorities involved in the control of goods, persons and means of transport operated in the terminal and cargo handling equipment, including a minimum of 10 gantry cranes must be guaranteed (Decree-Law No. 103/2019).

IV. Results and discussion

Comparative analysis between the two terminals

In order to bring the matrix closer to reality and facilitate its interpretation, risk allocation will be carried out based on the following indicators: i) public sector risk (contractor/grantor); ii) mostly public sector risk; iii) shared risk between the public and private sectors; iv) mostly private sector risk; and v) private sector risk (concessionaire).

As Figure 3 shows, the lack of treatment of financial market risk and the existence of some differences in personnel, capital, legal, political and unilateral changes, public contestation and force majeure risks stand out.

The planning and design risk treatment has many similarities between the two terminals. Taking into account that, for TXXI, the decision to renew the contract or not, as well as the definition of the renewal conditions, are one of the contractor's responsibilities, the planning risk is on its side. TVG's concession follows the same logic. Regarding the design, in both terminals the responsibility for the project is held by the concessionaire, however, it is subject to the approval of the grantor. It was concluded, therefore, that the risk of planning and design is mostly in the public sector in both concessions. However, it is important to point out that, as argued by Cruz and Marques (2012b), the private partner is better positioned to plan the terminal developments.

Construction is the aspect that surrounds the main uncertainties and impacts of the respective category (e.g. time and cost deviations), the spotlight goes to its allocation. The construction risk analysis results show that it is equally allocated to both terminals. The contractor is in charge of the breakwater construction, and the concessionaires

are in charge of the actual terminal works and therefore the risk is mostly private. Moreover, and taking into account that the concessionaire is obliged to develop and maintain the accesses both in TXXI and TVG, the accessibilities risk is assigned to the grantor in both terminals. Furthermore, the analysis carried out for the maintenance and repair risk on the sea side and on the land side allowed the conclusion that the allocation is made in the same way for both terminals, as shown in Figure 3.

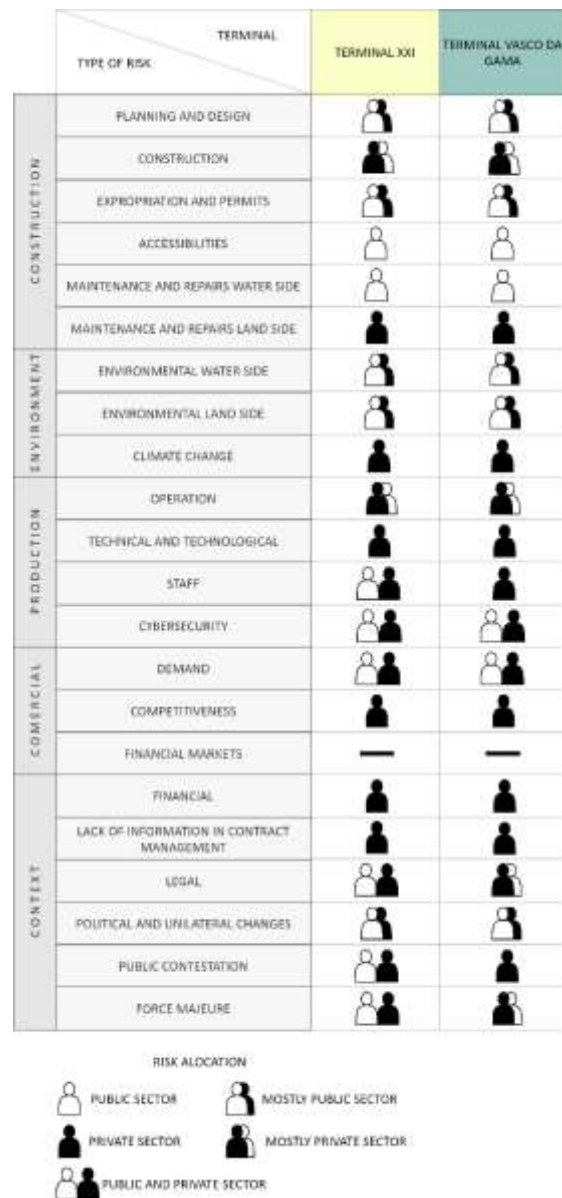


Figure 3 - Risk matrix of the analysed concessions

Regarding expropriation and permits risk, from the two concessions bases and from the information gathered at the Port of Sines, similar results were registered. In both cases, the grantor guarantees the construction and operation permits and the Environmental Impact Statement (DIA). However, there is greater collaboration when it

comes to obtaining the licenses for port work in the TXXI. It should be noted that TVG's concession contract has not yet been finalized and, as such, licensing issues might suffer slight changes and consequently increase the level of collaboration.

Within the two concessions, both environmental risks are mostly allocated to the public sector, which, as mentioned, assumes the immediate repair of environmental damages that may influence the terminals, while the concessionaires participate actively in this process. While securing the DIA, the grantor has accepted a large part of the environmental risks. The climate change risk allocation presents slight differences between the two terminals. Unlike the bases of the TXXII concession, the bases of TVG define that the impacts of events such as floods, fires or storms must be mitigated by the concessionaire. However, the information gathered at the Port of Sines led to the conclusion that the climate change risk is entirely attributed to the private sector in both terminals.

Regarding the operation risk, the two terminals have the same scope and purpose, so they will operate in similar ways, including the provision of pilotage and towage services by the grantor. Therefore, its assignment was considered to be mostly private in both terminals. As for the staff risk, namely strikes and labour conflicts, a different treatment was found between the two terminals. The TXXI concession considers such events to be cases of force majeure, so the risk is shared. On the other hand, the TVG's bases explicitly state that strikes and labour conflicts related to the concessionaire's personnel and its subcontractors are entirely their responsibility. Since human resources are managed by the private sector in both terminals and the contractor does not directly interfere in these processes, it is considered relevant to point out the strategy change for the treatment of this risk in TVG. As for technical and technological risk, it is clearly allocated to the concessionaires in both concessions. Both are related to the terminal operation activities, which are specified as concessionaires' responsibility. Although cybersecurity risk is not addressed in the bases of the TXXI concession, the information obtained allowed the conclusion that, as for TVG, the risk is shared.

Another spotlight goes to the demand risk. As for TVG's concession fees, these are not defined, however, the conditions imposed by the grantor are the same as those of TXXI, as shown in Figure 4. As such, demand risk is shared in both concessions. Since the two terminals at the Port of Sines operate based on containerized cargo handling,

competition is naturally on the side of the concessionaires.

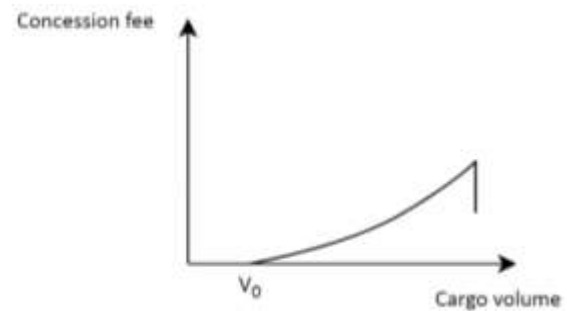


Figure 4 - Schematic representation of the concession fee as a function of the cargo volume at Terminal XXI
Adapted from Cruz and Marques (2012b)

When analysing the financial markets risk, no information was found. It was considered, on one hand, that the risk may be distant from the actual object of the terminal concession's and, on the other hand, that it may reveal the confidence that exists in the stability of the markets once the risk effectively affects the concessions business.

Financial risk is entirely allocated to the private sector at both terminals. As for TXXI, it is worth noting that no loan guarantees by the public sector were observed. On the other hand, the TVG's concession bases explicitly define that the concessionaire agrees to finance all the activities included in the concession and no issues of financial support by the public sector were mentioned.

As for the lack of information in contract management risk, the TXXI concession bases proved to be rather incomplete, however, according to the testimonies gathered, the data sharing is effectively conducted. Regarding the bases of the TVG concession, the level of detail of the information subject to sharing was considered to be much higher. However, in both cases the concessionaire is responsible for providing the data established by the concessionaire and therefore the risk is totally private.

The allocation of legal risk differs between the two concessions. Given that legislative changes are considered force majeure events, legal risk is shared in the TXXI. As for TVG, given the level of detail and clarity of legal issues, it was understood that this risk is mostly attributed to the concessionaire.

Once again, it was considered that the lack of detail in the TXXI exposes the public sector to political and unilateral changes risk, as well as the public contestation risk. Since the available information on the concession bases attributes responsibility to each party for their respective unilateral changes, the conclusion was that there is

no sharing of risk, so the allocation of political and unilateral changes risk is mostly public. In the TVG's case, the concessionaire is obliged to mitigate the effects of public protests and is responsible for popular demonstrations that arise from its defaults, while in the TXXI the general treatment of these events implies that there is risk sharing.

Regarding the force majeure risk, it was observed that the treatment was too vague and that, consequently, while sharing the risk in the TXXI, the grantor was too exposed. Considering that TVG bases entrusted the damages due to force majeure events mitigation to the concessionaire, it was considered that the grantor is properly protected from the risk and, as a result, it was attributed as a mostly private.

Comparative analysis between the literature review and the developed risk matrix

It is noteworthy that the staff, cybersecurity, financial markets, lack of information in contract management and public contestation risks were not addressed in the risk structure proposed by Cruz and Marques. Comparatively, the relevance of the risk matrix developed in this paper is due to, besides organizing the risks into categories and analysing some of the risks in common in a different way, it also studies some additional and pertinent uncertainties in seaport terminal concessions. Furthermore, it is considered that the separation of environmental and maintenance and repairs risks on the maritime and land side, as well as the separation of demand and competition risks improve both the analysis and the allocation of these risks. On the other hand, the role of port services is highlighted as a factor to be taken into account in operational risk.

GI Hub's matrix (PPP Risk Allocation Tool 2019 Edition) additionally covers the variations, early termination, the condition at handback and strategic risks. Also, the complete matrix has a high level of detail as it includes a large number of risk subcategories, the respective allocations and mitigation measures. Nevertheless, it is important to note that the fact that the tool is based on the premise of entirely private financing implies that it does not treat financial risk. Likewise, it does not consider the cybersecurity and lack of information in contract management risks, which reinforces the added value provided by the work carried out in this paper. Finally, it is considered important to emphasize the idea that any list of risks is necessarily incomplete (Cruz and Marques 2012a). Furthermore, the variety of ways of assigning risks in a concession and the complexity associated with each project make the task of developing a unique

risk matrix, such as the one of GI Hub, quite complicated.

Risk mitigation recommendations

Although the main objective of this paper is not the risk mitigation analysis, it was considered relevant to highlight some of the proposals of Cruz e Marques (2012b). The first one refers to the vertical disaggregation through the adjudication of a thirty-year concession for construction and maintenance, while the operation concession for the terminal would be attributed with a five to ten-year period. The authors also note that the terminal operator would have to pay a rent to the terminal infrastructure manager. This way, while maintaining the same incentives for construction, it would encourage competition for operations.

On the other hand, public tender for all construction and engineering works is equally interesting. The fact that the operator makes large investments without any kind of competition may harm the terminal's performance as the concession becomes more appealing from the perspective of the construction works than the terminal's activities itself (Cruz and Marques 2012b). If there was a mandatory public tender clause for all engineering works in the contract, the focus of the competitors would be on the terminal business.

In addition to this, given that the contractual changes, the rules governing renegotiations and the performance indicators for concessions should be public, transparency and public scrutiny are also important (Cruz and Marques 2012b). Public access to contractual terms, which by their nature should be unrestricted, would keep abusive behaviour from both parties under control. Furthermore, the work carried out in this paper could be more complete and consolidated if this was the case.

Additionally, Martins et al. (2017) support the hypothesis that a higher economic value of a project can be obtained if its planning allows contractual flexibility according to the evolution of cargo demand. In other words, the evolution of demand defines the stages of the expansion project. The authors' proposal is considered relevant as it allows the terminal to match the demand. This means that once a certain percentage of the terminal's maximum capacity is reached, the next phase of the terminal is expanded. The main difference in this approach is that there is no fixed date for delivery of the following terminal stage.

V. Conclusions

In order to address the needs of the cargo trade, different models of port governance have emerged, of which landlord stands out, whose private involvement is carried out through seaport terminal concessions. The need for a proper risk sharing agreement is evident as the partnership success depends on it. Also, it can improve its operational and economical results and provide a healthy relationship between stakeholders.

This document analyses the concession model within the construction, maintenance, and operation context of a terminal, particularly its risks and allocation. A total of 22 risks were selected in order to build a detailed and complete risk matrix that would facilitate the risk allocation process. On one hand, the construction risk is mostly given to the private sector, as the vast majority of the production risks category and capital risks, which relieves the public sector of construction and operating tasks and financing issues. On the other hand, it is considered relevant to note the sharing of demand risk, which apart from protecting the private sector in case of poor outcomes also stimulates the partnership to obtain better results.

The main conclusions of the comparative analysis reveal that, given the wide variety of factors to be taken into account, any list of risks will be incomplete. Furthermore, the difficulty in assessing all the risks stands out since within each risk considered there are several associated risks or, in other words, several subcategories, which may have different allocations. Furthermore, the relationships between the two parties evolve, changing the risk allocation initially defined in the contracts.

The present work also provides all the foundations for the next step: a quantitative risk analysis, that evaluates the impact of risks on the project's profitability, thus contributing to more detailed analyses on the viability of the current concession models. In other words, based on investments, costs and revenues, it is possible to develop a simulation of risk allocation variations in those risks that are quantifiable. The study of these issues together with the defined matrix and the results of the risk allocation would ensure a major contribution to the studies of seaport terminal concessions. Furthermore, the extension of the study to other port terminal concessions would provide a better understanding of the Portuguese or international reality. It would be useful to understand the different approaches and mechanisms of risk transfer from other

international ports. Additionally, risk mitigation requires further study.

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