

Security Risk Assessment in Container Terminals: Empirical Evidence from Greece

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Abstract: The most prominent risk assessment techniques are founded on the values of measuring and controlling the frequency and the consequences of risks in order to assure an “acceptable level” of “safeness” mainly in the lines of environmental, health and hygiene and port product issues. This paper examines security risk assessment approaches within the emerging role of ports. This paper contributes to the current literature by considering the ports of Greece as a case in point and by measuring the degree of its security risk orientation based on certain valid risk factors drawn from the current literature. Moreover, it presents a security risk assessment methodology into the domain of port container terminals. Their potential for ports were quantitatively and qualitatively assessed by discussing issues of security approaches within the maritime industry, in order to facilitate improvement strategies. A two-dimension empirical study was conducted, in a time range of ten years (2010-2020) in order to provide evidence regarding security risk assessment in the port container terminal of Thessaloniki, in Greece. The findings of this study have significant strategic policy implications and shed more light on the role of security risks in the overall risk orientation of container terminals in practice. Finally, further research directions in security risk in ports are proposed.

Key words: Greek ports, risk assessment, security, container terminals, empirical evidence.

1. Introduction

A great variety of activities are performed in port container terminals: cargo transport, chemicals storage, freight storage and transport, ship, lorry and train circulation and so on. Due to this intense activity, ports are very important facilities for the economy of a country [1] but also “a place of risk”, where harm can be directed to persons (crew/passengers/port labor/other), environment (nature) and/or property (ships/port facilities/port labor/other). On the other hand, in a global perspective, there is an emerging focus on security risks and their preparedness. Thus, prevention of security risk is a focal matter for maritime transportation. The current approaches however have focused on specific perspectives (i.e., human error, mechanical failure, etc.). It is well known that by using an estimation of the frequency of occurrence and the severity of these events, it is

possible to create an effective security risk assessment framework [2].

Considering the interest for security risk prevention in port container terminals, especially in a view of the fact that additional potential problems are continually added through new and upcoming security risks, and the fact that ports are at the very beginning of implementing modern risk approaches, already developed in other industries, this paper proposes an approach for security risk assessment, in port container terminals.

The rest of this paper is organized as follows: Section 2 provides an overview of security risks in port container terminals and in Section 3, the methodological framework is adopted. In Section 4, a case study based on interviews and empirical investigation is presented, while Section 5 presents the conclusions, limitations and further research areas of this paper.

2. An Overview of Security Risks in Port Container Terminals

2.1 Security Risks in Port Container Terminals

While it is generally accepted that the overall level of maritime security has improved over the years, further improvements are still desirable. Evidently, much of maritime security policies have been developed after serious accidents. “Why should the maritime industry and, in general, society, have to wait for an accident to occur in order to modify existing rules or propose new ones?” [3]. Promoting risk awareness rather than waiting for accidents to reveal them is a widely employed approach, especially in other industries such as the nuclear and the aerospace industries [3]. In addition, the port industry has begun to move from a reactive to a proactive approach and therefore towards more complex risk prevention plans and tools.

The security issues that are under port concern are indicatively the following:

- the security perimeter
- internal security and operation controls
- safety at sea
- port communication systems
- decision support systems
- systems for the prevention and management of emergencies.

Answers to these questions, obviously, are reflected in different directions, such as access control and surveillance of the fence, inland monitoring, cargo control equipment, as well as passenger and luggage control equipment, water monitoring in front of piers, traffic control, hazard analysis and alarm systems [4].

The literature on port security risks is considerably extensive: Altiok et al. [5], Bichou [6], Breaux [7], Celik et al. [8], Chin and Debnath [9], Christou [10], Darbra and Casal [11], Darbra et al. [12], Debnath and Chin [13], Dekker and Stevens [14], ECMT (European Conference of Ministers of Transport) [15], Faz and Orive [16], Frittelli [17], GAO (Government Accountability Office) [18], Greenberg et al. [19],

Gunes et al. [20], Johnston [21], Malak et al. [22], OECD (Organisation for Economic Co-operation and Development) [23], Orosz et al. [24], Pallis and Vaggelas [25], Peris-Mora et al. [26], Polemi [27], Rodrigue et al. [28], Sancho et al. [29], Scholliers et al. [30], Scholliers et al. [31], Srikanth and Venkataraman [32], Talas and Menachof [33], Trbojevic and Carr [34], Trucco et al. [35], Yang et al. [36], Yeo et al. [37], Yip [38], Zhu et al. [39], and several categories and subcategories were formulated.

The European Commission published a White Paper detailing the EU (European Union) transport policy to 2010 [40] only one day after the events of 9/11.

This report had a broad reference on the security of passengers onboard cruise vessels and ferries, as well as on the transportation of nuclear goods. Those concerns that had led to these general observations were fueled by the combination of an increasing global awareness regarding security, and of an assessed need to be in line with relevant initiatives endorsed by the international fora or developed by one of the region’s geopolitical allies and trading partner, the US. The latter acted as the locomotive for such developments, with researchers observing that the first ever prepared EU security legislations relied primarily on (existing or already published) rules that had been developed elsewhere [41].

At present, important initiatives have been undertaken, such as:

- EC Regulation 725/2004.
- U.S. Custom Service’s CSI (Container Security Initiative).
- CTPAT (Customs-Trade Partnership Against Terrorism).
- ISPS (International Ship and Port Facility Security) Code.
- U.S. Maritime Transportation Security Act of 2002.
- NIPP (National Infrastructure Protection Plan).
- SAFE (Security and Accountability For Every) Port Act [25, 42].

Chlomoudis et al. [43] have provided a methodology based on five risk categories for the port industry. Although risk categories can be generalized, different ports are mostly affected by distinct risk categories due to the uniqueness of the port operational environment, as well as the variability of the impact associated to each risk for each port. Hence, although risk categories are applicable to all ports around the world, not all risk categories are of the same importance for individual ports [43].

All security approaches based on standards are proactive in nature. However, distinctions among ports are important and the possible scenarios for assuring or enhancing security are certainly quite a few.

3. Methodological Framework

The empirical research conducted and presented, addresses the following issue: “The likelihood of appearance of certain risks and their perceived severity, in the container terminal of Thessaloniki, in Greece, confirms the theoretical background for the crucial role of security risks confrontation”.

In order to proceed with the empirical research a combined two-stage methodology has been developed,

that took place during a period of ten years. The following flowchart (Fig. 1) presents the methodological framework of our research.

(1) 1st Stage

A literature review of security-oriented risks in ports has been implemented in order to develop an initial taxonomy of security risks in the port domain.

(2) 2nd Stage

(a) Firstly, semi-structured interviews conducted by the authors with container terminal director of the container terminal in the port of Thessaloniki in two different time periods, 2010 (CT Director: Mr. S. Angeloudis) and 2020 (CT Director: Mr. S. Theofanis).

The main aims of the interviews were:

- to collect data and information regarding the likelihood and the severity of security risks in one of the two major container terminals in Greece, as it is the container terminal of Thessaloniki. Interviews represent, even their subjectivity, the most accurate conditions and issues that port confronts with security risks and
- to modify the initial taxonomy of security risks in order to proceed to a representative risk assessment.

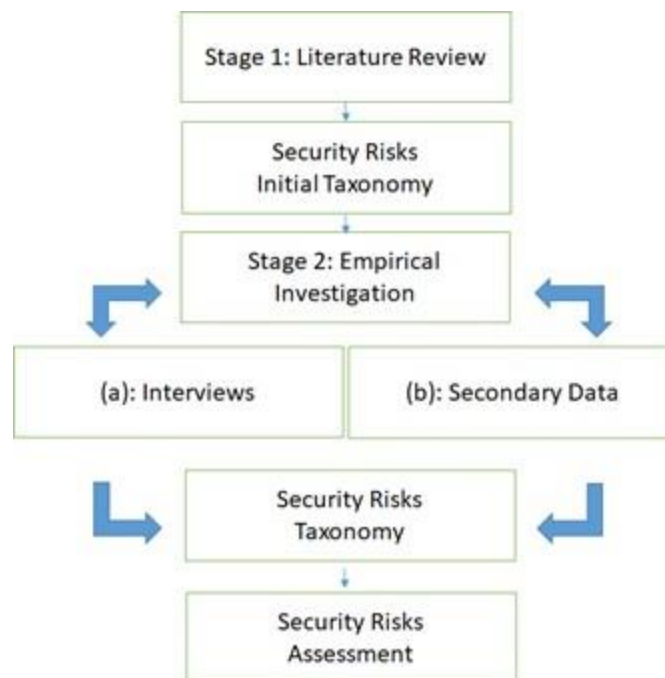


Fig. 1 Methodological framework flowchart.

(b) Secondly, an extensive investigation of security risks that took place during the period of 2008-2013, in the container terminal of Thessaloniki, in Greece, was conducted by the authors, in order to validate the findings of these two interviews.

At Stage 1, the taxonomy that was developed was based on the literature review of the past two decades and includes the main security risk categories for port container terminals at the international level [44].

To formulate all potential security risks into the following categories was possible when the risks posed a definite threat to the lives and safety of people and property [43, 45]. The methodology proposed here is similar to the one proposed for developing a taxonomy of risk parameters in Shaluf [44] and includes all the security risks reviewed in Section 2.1, and is presented in Table 1, as an initial taxonomy of security risks.

In our methodology, we assumed risk events to range in frequency and severity from high frequency and low consequence events, which tend to be routine and well reported, to low frequency and high consequence events, which tend to be rare but more complex and severe. In Table 2, secondary data of security issues, during the period 2008-2013, are captured by the authors, as they were reported by the port operator (OLTh).

Table 1 Initial taxonomy of security risks in port container terminals.

Risk categories	Risks factors
Security	War/political instability
	Cybersecurity
	Chemical residues
	Terrorist
	Theft
	Smuggling
	Illegal trade
	Vandalism
	Illegal immigration
	Blockade

Source: Authors (2023).

Table 2 Security risks on the port container terminal of Thessaloniki for 2008-2013 (secondary data).

	Total	Percentage
Smuggling	28	37.84%
Terrorist	3	4.05%
Theft	3	4.05%
Alarm (illegal immigration)	3	4.05%
Infringement (illegal trade)	14	18.92%
Vandalism	13	17.57%
Other	10	13.51%
Total	74	100.00%

Source: Authors (2023).

Table 3 Taxonomy of security risks in port container terminals.

Risk categories	Risks factors
Security	War/political instability
	Terrorist
	Theft
	Smuggling
	Illegal trade
	Vandalism
	Illegal immigration
	Blockade

Source: Authors (2023).

The taxonomy of Table 3 has been incorporated into the interview forms and the secondary data of the two axes of the second stage. The main aim of the interviews was to identify which were the most “significant” security risks in terms of their frequency and their severity of appearance. For example, Bichou [6] described the process of risk assessment as “the assessment of risk in terms of what can go wrong, the probability of it going wrong and the possible consequences”; while he further states that “the empiricist approach is to regard accidents as random events whose frequency and severity is influenced by certain factors”.

In support of the interviews, an initial consultation with port container personnel took place and both the container terminal directors (Mr. Angeloudis and Mr. Theofanis) of the port of Thessaloniki, agreed to participate in the research of three different periods of

time (2010, 2014 and 2020), by completing a specially designed interview form. The interview form was pilot-tested with a group of experts in the field of port management (Professors of two major Maritime University Departments in Greece and Port Practitioners) and its final structure included four sections:

- Section A includes information regarding the respondent and the port container terminal;
- Section B comprises three sets of questions, the first concerns the definition of risks, the second concerns information regarding the frequency of risk-related issues, and the third includes information on the implementation and certification of various quality and safety and security systems;
- The third section (Section C) contains a total of twenty-three questions or groups of questions, examining many aspects of the level of container terminal risk prevention;
- The final section of the interview form, regards the quantification of the frequency and the severity of the security risks identified in the taxonomy for the port container terminal, through a 5-point scale.

4. Empirical Evidence for the Container Terminal of Thessaloniki in Greece

4.1 Profile of Thessaloniki Container Terminal

This paper focuses on the one of the two major Greek ports in order to provide empirical evidence from Greece. The port of Thessaloniki is one of the largest and busiest ports of Southeastern Europe. The Thessaloniki port is an important sea hub for the European Union since it is close to the countries of Southeast Europe and the Black Sea. The ThPA S.A. (Thessaloniki Port Authority S.A.) implements a port facilitate security plan and is fully complied with the ISPS Code requirements.

The ThPA S.A. is strongly committed to security and closely observes and follows any new security initiative/rule/regulation implemented at the international, European and national level. The

company's sensitivity to personnel and passenger safety as well as its respect for environmental protection plays an important role in the company's operation. Thanks to regular measuring of radiation, noise, chemical factors and other elements, the Environment, Health and Safety Department has contributed to the improvement of occupational safety and health conditions.

Within the framework of environmental protection and sustainable development, ThPA S.A. was the first port of the Mediterranean to receive the "Port Environmental Review System" certification for environmental issues by the ESPO (European Sea Ports Organization) and the ECOPORTS Foundation. Moreover, in harmonization with the community directive 2000/59/CE and the MARPOL 73/78 Convention, ThPA S.A. implements a ship's waste reception and management plan [45].

4.2 Findings and Implications

4.2.1 Security Assessment for the Container Terminal of Thessaloniki (Time Period: 2010)

Table 4 displays the security risk assessment for the container terminal in the port of Thessaloniki during the first survey, in 2010. The survey organized by the authors and CT Director: Mr. S. Angeloudis, answered a semi-structured questionnaire.

The results for the final section of the interview identify, assess and thus prioritize the most important risks for the port container terminal of Thessaloniki. As can be seen in Table 4, eight (8) risk factors have been identified as relevant for the container terminal, operated by OLTh in the port of Thessaloniki. The first column contains the relevant risk factor, while the remaining three columns present the frequency, the severity and the overall assessment.

Indeed, "illegal trade" was indicated as the most important security risk issue, followed by "Smuggling", and "War/political instability". At that period of time, the Port of Thessaloniki, experienced many security incidents as "illegal trade" and "smuggling" and many

Table 4 Security risk assessment for the container terminal of Thessaloniki (2010).

Risks factors	Frequency	Severity	Risk assessment
Blockade	1	2	2
Illegal trade	3	4	12
Illegal immigration	1	3	3
Smuggling	3	3	9
Vandalism	1	2	2
War/political instability	2	4	8
Terrorist	1	5	5
Theft	2	1	2

Source: Authors (2023).

Table 5 Security risk assessment for the container terminal of Thessaloniki (2014).

Risks	Frequency	Severity	Risk assessment
War/political instability	1	4	4
Terrorist	1	5	5
Theft	3	1	3
Smuggling	3	3	9
Illegal trade	3	4	12
Vandalism	2	2	4
Illegal immigration	2	2	4
Blockade	2	1	2

Source: Authors (2023).

of them were publicly known as police security issues. “War/political instability”, was highly ranked by the CT Director, since Greece at that time was entering the IMF (International Monetary Fund) economic rescue program, and the uncertainty was pervasive.

4.2.2 Security Assessment for the Container Terminal of Thessaloniki (Time Period: 2014)

In addition, Table 5 displays the security risk assessment for the container terminal in the port of Thessaloniki, during the second survey, in 2014. The survey was organized by the authors and the CT Director, Mr. S. Angeloudis, who answered a semi-structured questionnaire. At that time, a secondary data analysis took place for security risk factors that were identified through a time period of five years (2008-2013).

For the validation of our results, we used the same eight (8) risk factors that have been identified as

relevant for the container terminal, at the previous survey (2010). The verification of those eight risk factors came along with the findings of our secondary data research, which indicated those risks as the most sovereign. There were no security issues regarding other risk factors, that literature review highlighted, such as “cybersecurity” or technology-oriented risks in a broader sense.

Indeed, “illegal trade” was indicated as the most important security risk issue, followed by “Smuggling”, as we have already mentioned during the first research attempt (Table 4, 2010). “War/political instability” was lower ranked than the previous survey, for years ago, since Greece was struggling to recover from the economic recession and at that time there was a political stability. On the other hand, “illegal immigration” and “vandalism” started to obtain higher significance. At that time, for the first time, Greece emphatically experienced the outcomes of war and political instability in its neighbourhood and the first illegal immigration wave that came from the south-eastern Mediterranean area.

At that period of time, Mr. S. Angeloudis was still the CT Director of OLTh, therefore risk issues that were important in his consideration before four (4) years, were still in his operational activities and his prevention risk agenda.

4.2.3 Security Assessment for the Container Terminal of Thessaloniki (Time Period: 2020)

Moreover, Table 6 displays the security risk assessment for the container terminal in the port of Thessaloniki, during a survey that is conducted during 2020. The survey was organized by the authors and the Laboratory of Integrated Port Economy and Management of Department of Maritime Studies, in the University of Piraeus and the CT Director, Mr. S. Theofanis, who answered a semi-structured questionnaire.

For the validation of our results, we used the same eight (8) risk factors that have been identified as relevant for the container terminal, operated by OLTh in the port of Thessaloniki.

Table 6 Security risk assessment for the container terminal of Thessaloniki (2020).

Risks	Frequency	Severity	Risk assessment
War/political instability	1	3	3
Terrorist	1	3	3
Theft	2	3	6
Smuggling	3	4	12
Illegal trade	2	3	6
Vandalism	2	3	6
Illegal immigration	2	2	4
Blockade	2	3	6

Source: Authors (2023).

Table 7 Security risk assessment for the container terminal of Thessaloniki (2010-2020).

Risks	Risk assessment 2010	Risk assessment 2014	Risk assessment 2020
War/political instability	8	4	3
Terrorist	5	5	3
Theft	2	3	6
Smuggling	9	9	12
Illegal trade	12	12	6
Vandalism	2	4	6
Illegal immigration	3	4	4
Blockade	2	2	6

Source: Authors (2023).

The findings are slightly differentiated from the previous two (2) investigations. Indeed, “Smuggling” was indicated as the most important security risk issue, followed by “Theft”, “Illegal trade”, “Vandalism” and “Blockade”. “War/political instability” was even lower ranked than the previous survey (2014), since Greece overcame a long period of economic recession and political instability. On the other hand, it still presents the outcomes of “illegal immigration” and steady

increase of securities risks of “traditional” delinquencies, such as “Theft”, “Illegal trade”, and “Vandalism”.

4.3 Aggregate Data Analysis (2010-2020)

Finally, Table 7 displays the security risk assessment for the container terminal in the port of Thessaloniki, as aggregated through the period of ten years (2010-2020) and three different research investigations by the same researchers (Professor C. Chlomoudis and Dr. Petros Pallis) and two different container terminal directors (Mr. S. Angeloudis and Mr. S. Theofanis).

Therefore, we identified two (2) patterns during that period. There is a declining pattern, where security risk factors were declined through the period of time, such as “war/political instability” and “illegal trade” mainly because of Greece economic recession and afterwards political instability with six (6) different Prime Ministers at that time. Moreover, the immigration problem in south-eastern Mediterranean area, that European continent experienced, created major problems in national level with respect to the two major entrance gates of Greece, as Port of Piraeus and Port of Thessaloniki. There is an upward pattern, where security risk factors were increased through the period of time, such as “Theft”, “Smuggling”, “Vandalism” and “Blockade”, indicating the problem that illegal immigration, consisted one of the major variables of increasing “traditional” delinquencies.

Fig. 2 visually presented the security risk assessments organized and implemented by the authors, in cooperation with the CT Directors of Thessaloniki Port, in those three different time slots.

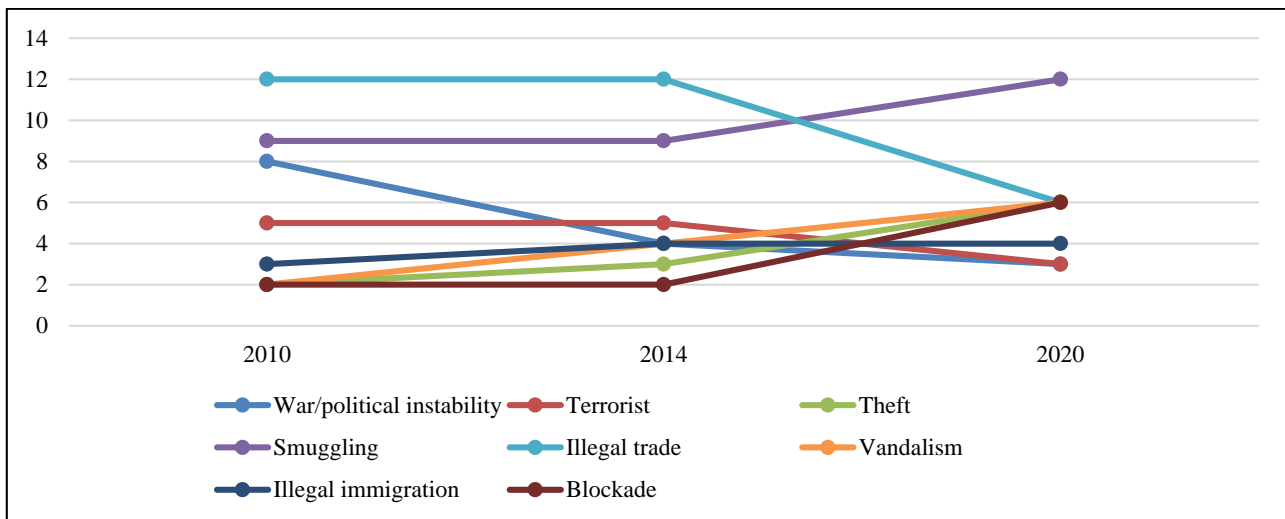


Fig. 2 Security risk assessment patterns for the container terminal of Thessaloniki (2010-2020).

5. Conclusions, Limitations and Further Research Areas

One of the major container terminals in Greek ports, as the container terminal of Thessaloniki faces significant threats due to a number of security risks recorded in our surveys. The aim of a security risk assessment, as a methodological framework, should be to provide equipment and procedures able to minimize the possibility of security risks and the potential occurrence of fatal injuries or accidents.

The above-mentioned methodology could be employed as a vehicle of security risk assessment in other container ports. Indeed, this study could be extended with more case studies, in a number of ways, especially at the geographical region of the Southeastern Europe due to the similar characteristics and culture of the region.

Finally, there are some limitations that should be acknowledged. The security risk assessment depends on the taxonomy or categorization of security risk issues and security risks factors are prioritized depending on the frequency and/or the severity of them. Therefore, it is of crucial importance to incorporate all the updated security issues that ports confront. In our research, we insisted in specific risk factors, in order to extract robust outcomes. Obviously, new security risk factors, such as, cybersecurity, chemical residues, even

risk factors that are accompanied to health and safety parameters, such as a pandemic occurrence, should enrich the aforementioned framework.

Moreover, further areas of application should be explored considering the proposed model as a support tool for security risk prevention and decision-making at different levels (policy, design or operating procedures, etc.) and for different stakeholders of the container terminals. As a matter of fact, while for policy makers and regulators the objective is providing security with affordability as a prerequisite, for the industry (e.g., ship operators, shipyards, port) the objective is achieving affordability with security as an indispensable condition. The proposed approach is suitable for further extensions on the side of economic and societal impact, as well as for cost benefit approaches in order to help the administrations or the authorities achieve the most profitable improvements and implications.

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