International Journal of Maritime, Trade & Economic Issues *pp. 3-20*
Volume I, Issue (1), 2013

Quality Assurance: Providing Tools for Managing Risk in Ports

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Abstract:
Modern ports, operating in a new environment, constitute links in the door to door transportation. This new environment is characterized by the intensification of inter port and intra port competition. The reduction of risks, derived from this vigorously competitive environment through the implementation of concrete management practices, can be considered as a major objective for the modern port industry. On the other hand the implementation of quality assurance generates a favourable environment for the provision of high quality port services and the assurance of high standards in port operation. This paper examines the way that quality assurance can be used as a risk management tool in the operation of port industry. Furthermore, this work aims to identify, and classify the risks of port industry in relation to the characteristics of the quality management systems. The result of this analysis determines the prospects and the restrictions of quality management as a tool for the management of risks in ports.

Key Words:
Quality Assurance, Quality management, risk management, port competition
***JEL Classification**: G32, D81, L15*

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1. Introduction

Port industry is one of the business sectors facing significant threats, which increase the risk taken by both investors and stakeholders in general. Managing such risks (Chlomoudis and Pallis, 2008) is an object of research and in that scope, this paper shall explore the assumption that quality assurance systems constitute an important tool in order to manage and eventually reduce port risks.

The development of a new, more complex, and less predictable operating environment as well as the rapid application of innovative concepts prompt irreversible changes on the production of port services (Chlomoudis and Pallis, 1999). Hence, the central role of ports in international trade and transportation is, among others, an indication of how important and necessary the risk management is in that particular sector. Furthermore, the reduction of risks contributes to the provision of higher quality services to users. This is the main objective of quality assurance procedures which respond to the need for risk reduction. The research question of this paper is how the quality assurance can help with the management of the risks in ports? In other words, what are the quality assurance procedures which can be used as tools for the reduction of the risks in the port industry?

The approach and analysis of this paper is based on the identification and classification of risk factors in port industry. Hereupon, this work examines the content of quality in port industry as well as the procedures and the requirements of quality management standards. This work deals with the contribution of quality assurance in managing risks within the port industry. The requirements and procedures employed by these standards are evaluated with regard to port risk management. This evaluation shall provide the potentialities and the limitations of quality assurance as a risk management tool for port industry.

Using quality management tools in port industry in order to ensure effective risk management is deemed as particularly crucial nowadays, when the international financial crisis has already brought negative impact to shipping business and shall inevitably have an adverse effect to the port business as well.

2. Risks in the port industry

Research regarding the connection of the relations between quality and risk is substantial rare (Snoj *et. al*, 2004). These two concepts, in public services at any rate, are now subject to a convergence – as managers are asked to do more and better than ever before. Furthermore, the private as well as the public sector have much to gain from being open about the reality of their risk and quality management practices (Harrow, 1997). In the past the challenge for quality management professionals was to support process and design improvements, but the challenge for

the future is to improve relationships in order to reduce and manage the most important risks. Within this context quality management discipline can help with the management of some kind of risks (Williams *et. al*, 2006).

It is acknowledged that the loading/unloading activities are the core business of ports. Higher port productivity is mostly associated with the upgrading of the total transport chain, and not so much with the upgrading of the maritime transport sector alone (Chlomoudis *et. al*, 2003; Chlomoudis and Pallis, 2005). Subsequently, ports are a major participant in a group of transportation stakeholders and therefore play a significant role in national economies. This is because the management of risks in the port sector is of great importance.

According to Ward *et al.* (1991), several conditions must be satisfied to determine whether different risks have been properly allocated or not. These conditions are introduced generally, but can be applied also in Port Industry. These are:

- Risk should be allocated to the party with the best capability to control the events that might trigger its occurrence.
- Risks must be properly identified, understood and evaluated by all parties.
- A party must have the technical/managerial capability to manage the risks.
- A party must have the financial ability to sustain the consequences of the risk or to prevent the risk from occurring.
- A party must be willing to accept the risk.

Therefore, the formal consideration of risk in port and shipping projects is of particular interest, when traffic or shipping demand, freight rates, and trading patterns are more uncertain than ever before. We cannot ignore risk or simply estimate risk intuitively in port and shipping project decisions (Frankel, 1989). For that reason, it is necessary to structure a defensible risk management strategy to deal with uncertainties and through an extended list of references, regarding risk in all aspects of economic life, to develop a risk factor categorisation.

Taking into consideration the research on the risk classification and identification, a list of potential risk categories and factors in the port industry follows in the next table. The methodology approach for the classification and identification of the risks in ports is based on the methodology followed by Chlomoudis and Pallis (2008).

Table 1: Risk factors in port industry

Risk category	**Risk factor**
Political and government policy and cultural diversification	- Unstable government - Expropriation or nationalisation of assets - Poor public decision-making process - Strong political opposition/hostility - In corruption

	- Poor internationalization - Cultural obstacles - Flexibility and adaptability risk
Economic	- Poor financial market - Inflation rate volatility - Interest rate volatility - Influential economic events - Exchange rate - Credit risk - GDP growth - Balancing of national saving and debt
Legal	- Legislation change - Change in tax regulation - Industrial regulatory change - Liberalisation degree - Trade restrictions
Social	- Lack of tradition of private provision of public services - Level of public opposition to project
Technological	- No technologically mature - Old technological means and methods
Market	- Port positioning - Lack of demand - Supplier risk - Competitors risk - Barriers to entry
Accident	- Ship collisions - Mechanical accidents - Human accidents - Navigation error - Pilotage error -Vessel not under command - Fire explosion
Environment	- Water pollution - Archaeological risk
Safety	- Quality Management - Accidents prevention
Natural	- Force majeure - Geotechnical conditions - Weather - War
Project selection	- Land acquisition (site availability) - Level of demand for project
Project finance	- Availability of finance - Financial attraction of project to investors - High finance costs
Residual risk	- Residual risk
Design	- Delay in project approvals and permits - Design deficiency - Unproven engineering techniques
Construction	- Construction time delay - Material/labour availability

	- Late design changes - Poor quality workmanship - Insolvency/default of sub-contractors or suppliers
Operation	- Operation cost overrun - Operational revenues below expectation - Low operating productivity - Maintenance costs higher than expected - Lack of training
Management	- Organisation and co-ordination risk - Inadequate experience in projects - Inadequate distribution of responsibilities and risks - Inadequate distribution of authorities - Differences in working method and know-how between investors

3. Quality Management in the port industry

As already mentioned, the increased port service competition is an element entailing the provision of high quality services to port industry. Our contribution through this paper is the effort to elevate quality assurance as the vehicle that integrates techniques that may contribute to dealing with risk.

According to researchers (Song and Panayides, 2008; Song and Yeo, 2004), the quality of the services provided is a primary for strengthening port competitiveness. The competitiveness amongst ports and the exploration of inter-port and intra-port competition relation give new meaning to the quality concept in improving port competitiveness (Langen and Pallis, 2006).

Various scientific projects show that user satisfaction is a criterion defining the quality of the port services provided (Ugboma *et al*., 2004, Pantouvakis *et al.*, 2008). It is pointed out that user satisfaction is a factor relating not only to quality but also to the effectiveness of port operation (Pallis and Vitsounis, 2008). However, it should be noted that user demands may differ from port to port and consequently such demands could not determine in a uniform way the content of quality concept in port services. Specifically, the differentiation in the organizational and operational framework of ports (Chlomoudis *et al.*, 2003) as well as the conditions prevailing in the broader area of activity of ports creates special requirements in user demands.

During the last decade, the demand for safe port operation is continuously increasing (Lalousi and Tselentis, 2006) and this results to the implementation of environmental standards in ports. In this context, the demand for safety shall become the path for the extensive implementation of quality port management (Chlomoudis and Lampridis, 2006).

The introduction of quality management in port area is effected through different quality management systems. The goals and features of the major quality standards (Brooks, 2007) as well as those of other systems that might be of interest to port industry the utility of which, as port risk-management tools shall be assessed, are detailed herein below.

ISO 9001 is a standard which largely implemented in various industrial and service sectors. This standard refers to the demands of implementing a quality management system that may be used either by a company or an organization in order to present its ability to satisfy customers, evaluating at the same time such ability by internal or external agencies (ISO 9001: 2008). The attainment of specific environmental performance may result from the implementation of environmental management systems, which can be developed by implementing of standards such as ISO 14001: 2004 series standard. In compliance with the implementation instructions thereof, the standard "determines the requirements for an environmental management system, so that an organization may develop its policy and objective goals, taking into consideration the legal requirements and information relating to environmental effects" (ISO 14001 2004, BSI 2004).

4. The utility of quality management in port risk management

4.1 The contribution of quality management in risk management

Quality management may contribute in managing business risk in the following ways (Williams *et al.*, 2006):

a) By distinguishing between risks which can, and which cannot, be treated statistically;
b) Through knowledge and experience in managing key processes; and
c) Through the implementation of major organizational and cultural change.

Statistics and statistical process control in particular may be an important tool in quality management. The statistical process control is the implementation of techniques based on the mathematical assessment of a given process, in order to ensure that the particular service is rendered as designed, at the minimum wastage and loss. In addition, the process statistical control involves the implementation of statistical techniques to a specific process so that:

- Statistical data relating to a process are developed and collected; and
- Such techniques may be implemented as the basis for the assessment of the functionality and the effectiveness of such process.

Risk management and risk prediction may be achieved through the use of methods and models employed in quality management towards the process statistical control. However, it should be noted that using statistics in risk prediction is feasible only in the presence of a number of conditions such as the identification of causes resulting

to such risks, the appearance of such causes constantly, the existence of historical data to build databases, etc.

Such risks may not be predictable through the statistical techniques and models; however, the past experience evidences that they are often likely to be related to the weak management of key processes (Williams *et al.*, 2006). The quality management can provide significant expertise to the effective process management.

Furthermore, it should be noted that such risks might appear anywhere within an organization and at any time; consequently, risk management could not be left to the top of the administrative hierarchy or a group of specialists. Rather, awareness of the possible importance of risks, and commitment to their management need to be widespread through the organization (Williams *et al.*, 2006). This factor requires major organizational and cultural changes, in which case the quality management would assist through its long experience.

4.2 Quality assurance contribution to port risk management

In this paper is not examined the contribution of quality assurance statistical techniques to risk management in ports. Such analysis would require the ad hoc examination of certain port cases in relation to particular risks that tend to appear in ports in a constant basis. In this paper is analyzed the contribution of quality assurance to port risk management in the following ways:

a) Through the management of key processes; and
b) By the implementation of major organizational and cultural change, as these have been stated in the previous heading.

It should be noted that quality management may directly or indirectly contribute to the restriction of port risks.

- The direct method involves the implementation by port authorities of processes contained in the quality standard requirements, which are directly connected with particular port risks.
- The indirect method involves these risks that they are not directly related with requirements of the quality standards.

However, in the second case the general improvements of services and processes entailed by the implementation of quality standards assists ports to manage in a better way the risks resulting from the broader political, economical, social, technological and institutional environment. For instance, the risks that attributed by governmental instability, financial crisis, low GDP growth etc might not managed through processes which are provided by specific quality standards. However, the improvement of services and internal processes as a result of the quality standards implementation creates the appropriate conditions to the ports to respond effectively to the competition requirements.

Listing and classifying risks encountered by port industry have already been presented. The standards ISO 9001 and ISO 14001 are selected as the most prevalent and important standards for the port industry. The risks selected for evaluation are these risks which are directly related to the ISO 9001 and ISO 14001 requirements. It must be stressed that the ISO 28000 standard and the implementation of the ISPS Code should contribute to the management of the security risks in the port industry (ISO 2007). In Table 2, the correspondence between the port risks and the requirements (clauses) of the standards ISO 9001 and ISO 14001 is demonstrated. In other words, in the clauses of the table there are references which connect directly the port risks factors with the standards requirements. The following may be noticed from the evaluation presented in Table 2.

Table 2: Risk factors and quality standards requirements interrelation

Risk category	Risk factor	Requirements (clauses) of ISO 9001: 2008 Standard	Requirements (clauses) of ISO 14001: 2004 Standard
Legal	Legislation change	5.1 - 7.2.1 – 7.2.2 - 7.3.2 - 7.3.3. - 7.3.4.-7.3.5-.7.3.6	4.5.2 - 4.5.5 - 4.6
	Industrial regulatory change	5.1- 7.2.1 – 7.2.2 - 7.3.2 - 7.3.3. - 7.3.4 – 7.3.5 - 7.3.6	4.5.2 – 4.5.5 - 4.6
	Change in tax regulation	5.1 - 7.2.1 – 7.2.2	4.5.2 – 4.5.5 - 4.6
	Liberalisation degree	5.1 - 7.2.1 – 7.2.2	4.5.2 – 4.5.5 - 4.6
	Trade restrictions	5.1 - 7.2.1 – 7.2.2	4.5.2 – 4.5.5 - 4.6
Social	Level of public opposition to project		4.4.3
Technological	No technologically mature	4.1 - 5.1 - 6.3 - 7.5.1 - 7.6	4.4.1
	Old technological means and methods	4.1 - 5.1 - 6.3 - 7.5.1 - 7.6	4.4.1 – 4.5.5 - 4.6
Market	Port positioning	5.1 -5.2 - 7.2.1 – 7.2.2 - 8.2.1 - 8.4	
	Lack of demand	5.1 - 5.2 - 7.2.1 – 7.2.2 - 8.2.1 - 8.4	
	Supplier risk	7.4 – 8.4	4.4.6
	Competitors risk	5.1 - 5.2 - 7.2.1 – 7.2.2 - 8.2.1 - 8.4	
	Barriers to entry	5.1 - 7.2.1 – 7.2.2	4.5.2
Accident	Ship collisions	5.1 - 7.2.1 – 7.2.2 - 7.3.3. - 7.5.1 - 8.2.3	4.4.3 - 4.4.6 - 4.4.7 - 4.5.2- 4.5.5 -4.6
	Mechanical accidents	5.1 - 7.2.1 – 7.2.2 - 7.3.3. - 7.5.1 - 8.2.3	4.4.6 - 4.4.7 - 4.5.2 – 4.5.5 - 4.6
	Human accidents	5.1 - 7.2.1 – 7.2.2 - 7.3.3 - 7.5.1 – 8.2.3	4.4.3 - 4.4.6 - 4.4.7 - 4.5.2 – 4.5.5 - 4.6
	Navigation error	5.1 - 7.2.1 – 7.2.2 - 7.3.3. - 7.5.1 – 8.2.3	4.4.3 - 4.4.6 - 4.4.7 - 4.5.2 - 4.5.5 - 4.6
	Pilotage error	5.1-7.2.1–7.2.2-7.3.3-7.5.1-8.2.3	4.4.3 - 4.4.6 - 4.4.7 - 4.5.2 – 4.5.5 4.6
	Vessel not under command	5.1 - 7.2.1 – 7.2.2 - 7.5.1 - 8.2.3	4.4.3 - 4.4.6 - 4.4.7 - 4.5.2 – 4.5.5 - 4.6

	Fire explosion	5.1-7.2.1–7.2.2-7.3.3-7.5.1-8.2.3	4.4.6 - 4.4.7 - 4.5.2 – 4.5.5 - 4.6
Environment	Water pollution	5.1 - 7.2.1 – 7.2.2 - 7.3.3. – 7.5.1 - 8.2.3	4.4.6 - 4.4.7 - 4.5.2 - 4.5.3 – 4.5.5 - 4.6
Safety	Accidents prevention	5.1-7.2.1–7.2.2 - 7.3.3. - 7.5.1 - 8.2.3	4.4.3 - 4.4.6 - 4.5.2 - 4.5.3- 4.5.5 - 4.6
Project Selection	Level of demand for project	5.1 - 5.2 - 7.2.1 – 7.2.2	
Project finance	Availability of finance	4.1	4.4.1
Design	Design deficiency	7.1 - 7.3.1 - 7.3.2 - 7.3.3 – 7.3.4 – 7.3.5 - 7.3.6 - 7.3.7	4.5.3
	Unproven engineering techniques	7.1 - 7.5.2 - 8.2.3	4.5.2 – 4.5.5 - 4.6
Construction	Construction time delay	8.2.3	
	Material/labour availability	4.1 - 5.1 - 6.2.1 - 6.2.2 - 6.3	4.4.1
	Late design changes	7.2.1 – 7.2.2 - 7.3.1 - 7.3.2 – 7.3.3. - 7.3.4 – 7.3.5 -7.3.6 - 7.3.7	
	Poor quality workmanship	4.1 - 5.1 - 6.2.1 - 6.2.2	4.4.1 - 4.4.2
	Insolvency/default of sub-contractors or suppliers	7.4 - 8.2.4	4.4.6
Operation	Low operating productivity	5.6.2 - 8.2.3	
	Maintenance costs higher than expected	4.2.1 -7.5.2 - 7.6	
	Lack of training	6.2.1 - 6.2.2	4.4.2
Management	Organisation and co-ordination risk	4.1 - 5.5.1 - 5.5.3 – 7.3.1 - 8.2.3	4.4.3 - 4.4.6 – 4.5.5 - 4.6
	Inadequate experience in projects	6.2.1 - 6.2.2	
	Inadequate distribution of responsibilities and risks	5.5.1 - 7.3.1 - 8.2.3	4.4.1 - 4.4.2 - 4.4.6 – 4.5.5 - 4.6
	Inadequate distribution of authorities	5.5.1 - 7.3.1 - 8.2.3	4.4.1 - 4.4.2 - 4.4.6 – 4.5.5 - 4.6
	Differences in working method and know-how between investors		4.4.3

Table 3: Quality Standards: Titles of the Table 2 requirements (Clauses)

Requirements of ISO 9001standard	**Requirements of ISO 14001standard**
4.1 General requirements	4.4.1, Resources, roles responsibility and authority
5.1 Management commitment	4.4.2 Competence, training and awareness
5.2 Customer focus	4.4.3 Communication
5.5.1 Responsibility and authority	4.4.6 Operational control
5.5.3 Internal communication	4.4.7 Emergency, preparedness and response
5.6 Management review	4.5.2 Evaluation of compliance
6.2.1 Human resources General	4.5.3 Non conformity, corrective actions and
6.2.2 Competence, awareness and training	

6.3 Infrastructure	preventive actions
7.1 Planning of product realization	4.5.5 Internal Audit
7.2.1 Determination of requirements related to the product	4.6 Management Review
7.2.2 Review of requirements related to the product	
7.3.1 Design and development planning	
7.3.2 Design and development inputs	
7.3.3. Design and development outputs	
7.3.4. Design and development review	
7.3.5. Design and development verification	
7.3.6 Design and development validation	
7.3.7 Control of design and development changes	
7.4 Purchasing	
7.5.1 Control of production and service provision	
7.5.2 Validation of processes for production and service provision	
7.6 Control of monitoring and measuring devices	
8.2.1 Customer Satisfaction	
8.2.2 Audit	
8.2.3 Monitoring and measurement of processes	
8.2.4 Monitoring and measurement of product	
8.4 Analysis of data	
8.5.2 Corrective Action	
8.5.3 Preventive Action	

Legal: Regarding the legal risks, the standard ISO 9001 suggests in “Management commitment" requirement (clause 5.1) that the top management should communicate to the organization the importance to meet statutory and regulatory requirements. The need of adjusting to the legal framework requirements also results by the clauses 7.2.1 and 7.2.2 on the “Determination and review of requirements related to the product”. According to the previous clauses, the organization - in our case, the port - should determine and review the statutory and regulatory requirements of the port services. Determining and recording all inputs concerning to “applicable statutory and regulatory requirements” is provided as a requirement under clause 7.3.2, which refers to “Design and development inputs”. These legal requirements should be also included in the “Design and Development of outputs” process (clause 7.3.3) as well as in the review (clause 7.3.4), verification (clause 7.3.5) and validation (clause 7.3.6) requirements. The aforementioned processes entail the systematic monitoring by port authorities of all changes and requirements of the legal framework such as changes in tax regulation, liberalization degree and trade restrictions. The issue of legal risk management is essential according to ISO 14001 standard. In such management, the requirements of “Evaluation of compliance” (clause 4.5.2), “Internal audit” (clause 4.5.5) and “Management review” (clause 4.6) may be of great importance.

Social: The quality standard ISO 14001 takes into consideration the aspects of the stakeholders and shall integrate them into the port policy. The communication

requirement (clause 4.4.3) shall entail ports to receive, document and respond to the requests from the external interested parties. The management of complaints in management review (clause 4.6) may reduce risks connected with public opposition.

Technological: The "General requirements" (clause 4.1) of quality standard ISO 9001 bind the port to ensure the availability of resources to support and monitoring processes involving the operation of the standard as well as the overall operation of the port. The term resources also include the technological equipment required for port operation. Ensuring of the availability of resources is also included as a requirement in clause 5.1, which refers to the "Management commitment". The requirement for "Determination, provision and maintenance of the necessary infrastructure" (clause 6.3) is referring to equipment, buildings, etc. In addition, the "Control of production and service provision" requirement suggests to the ports the use of suitable equipment (clause 7.5.1). The ISO 9001 requirement implementation facilitate the port to avoid risks associated with old technological means and technological immaturity. In ISO 14001 standard and in "Resource, role, responsibility and authority" requirement (clause 4.5.2), the appropriate technology is clearly defined as a necessary resource for the establishment of an effective system of environmental management.

Market: The "Customer focus" orientation of the ISO 9001 standard (clause 5.2) and the commitment of the top management (clause 5.1) to communicate to the port organization the importance of meeting customer requirements shall contribute to the restriction of the risks, which are related to port positioning, absence of demand, and competitors risk. The procedures involving determination and review of requirements related to the product (clauses 7.2.1 and 7.2.2.) as well as the requirements for measurement, analysis and improvement (clauses 8.2.1. and 8.4.), which are oriented towards customers' satisfaction, contribute to the limitation of the market risks. The customer focus character of these processes leads to the improvement of port services; and this enhances port competitiveness. It is further noted that the requirements under clauses 5.1., 7.2.1, and 7.2.2 on compliance of product and processes with the statutory framework, decrease the risks which are related to the existence of barriers for port entering into certain markets. "Purchasing" requirements (clause 7.4) contain specific criteria for suppliers' selection, evaluation and revaluation and this contributes to the reduction of suppliers' risk. The clause 8.4 which is referred to measurement, analysis and improvement requires the determination, collection and analysis of suppliers' data. The "Operational control" requirement of ISO 14001 standards (clause 4.4.6) suggests to the Organizations to communicate applicable procedures and requirements to suppliers, including contractors, reducing in this way the supplier's risk. The periodic evaluation of port operation compliance with the applicable law in the context of "Evaluation of compliance requirement" (clause 4.5.2) limits the market entrance risks attributed to non compliance with standing law.

Accident: The requirements for monitoring, implementing and integrating statutory rules into port services is a substantial contribution of ISO 9001 standard to the

limitation of accident risks. The requirements stated in clauses 5.1, 7.2.1 and 7.3.3, which are also mentioned in the legal risk paragraph, as well as the requirement on "Monitoring and measurement of processes" (clause 8.2.3) entail the thorough observance of operational and safety regulations. The requirement of work instructions needed for controlling production and service provision (clause 7.5.1) also contributes to reducing accident risks. The implementation of ISO 14001 is important to that effect. The requirement for effective internal communication within a port (clause 4.4.3), and the establishment, implementation and maintenance of documented procedures in the framework of the operational control requirement (clause 4.4.6) limits accident risks. The "Emergency, preparedness and response" requirement (clause 4.4.7) in emergencies such as accidents; the compliance with applicable legal requirements pertaining the safety issue (clause 4.5.2) as well as the "Internal audit" (clause 4.5.5) and the "Management review" requirement (clause 4.6) may also contribute to accident risk management.

Environment: The requirements of the quality standards which contribute to the management of accident risk may also reduce the environmental strains. The implementation of requirements referred in clauses 5.1, 7.2.1, 7.2.2, 7.3.3, 7.5.1 and 8.2.3 of the ISO 9001 standard assist the port industry to manage the environmental risks through the controlling and monitoring of processes and their compliance with the legal requirements. ISO 14001 is a quality standard based on the development of a complete system of environmental management. All the requirements included in ISO 14001 standard aims at reducing or eliminating any environmental strain.

Safety: The accident risk analysis through the requirements of clauses 5.1, 7.2.1, 7.2.2, 7.3.3, 7.5.1 and 8.2.3 is also applicable to safety risk management. ISO 14001 quality standard contribution may be significant in safety matters. The requirement for effective internal communication (clause 4.4.3) is a primary safety issue. The "Operational control" requirements (clause 4.4.6) the requirements on "Emergency, preparedness and response", (clause 4.4.7) the compliance with the applicable legal requirements on the safety issue (clause 4.5.2) as well as the "Internal audit" requirements (clause 4.5.5) and the "Management review" (clause 4.6) shall reduce accident risks and therefore significantly increasing safety. The requirement for "Non-conformity, corrective actions and preventive actions" (clause 4.5.3) also contributes to the management of risks relating to safety and prevention of accidents.

Project Selection: The level of demand is a major factor for the efficient implementation of a new project. The customer orientation of ISO 9001 standard, through the requirements of clauses 5.1, 5.2, 7.2.1 and 7.2.2, should lead ports to satisfy users needs in order to ensure the necessary demand for the project.

Project Finance: The "General Requirements" (clause 4.1) of the ISO 9001 standard shall entail ports to ensure the availability of the necessary resources. In this respect, ports should ensure the financial resources needed for a new project and in this manner, any risks of insufficient funding may be limited. Ensuring the availability of financial resources necessary for the establishment of an

environmental management system is a requirement of ISO 14001 standard (clause 4.4.1).

Design: The explicit references to the method of "Planning of product realization" (clause 7.1) in ISO 9001 standard reduce significantly the risks involved in design and construction of port projects. In addition to that, the "Design and development planning" of port services (clause 7.3.1) as well as the requirement of recording all inputs relating to the characteristics of a service or a project (clause 7.3.2) may reduce design deficiency risks. Furthermore, the requirements associated with the output (clause 7.3.3), the review (clause 7.3.4), the verification (clause 7.3.5), the validation (clause 7.3.6) as well as the control (clause 7.3.7) of service design and development contributes to reduction of deficiency design risks. The implementation of the appropriate production processes as a requirement of the 'Planning of product realization" process (clause 7.1), as well as the validation (clause 7.5.2) monitoring and measurement of processes (clause 8.2.3) limit the risks relating to the unproven engineering techniques. ISO 14001 standard limits the design risks through the requirement for undertaking corrective and preventive actions in case of non conformity (clause 4.5.3). In addition, the requirements for "Evaluation of compliance" (clause 4.5.2), "Internal audit" (clause 4.5.5) and "Management review" (clause 4.6) they would not allow any legal problems that might result to unproven engineering techniques.

Construction: The ability of a port authority to adopt processes to achieve planned results through the requirement of ISO 9001 standard concerning the "Monitoring and measurement of processes" (clause 8.2.3) should limit the time delay risks during the construction of a port project. As regards risks associated with material and labor availability and poor quality workmanship, the general ISO 9001 requirements (clause 4.1) as well as those for "Management commitment" (clause 5.1) should entail ports to provide the necessary resources. Moreover, the "General" requirements on human resources (clause 6.2.1) as well as "Competence, awareness and training" requirements (clause 6.2.2) contribute in managing human resources risks. The clause 6.3 which refers to infrastructure requirements limits the risk related to material unavailability. The appropriate process for determining and reviewing the requirements related to the product (clauses 7.21 - 7.22) as well as the those related to product design, (clauses 7.3.1- 7.3.7) shall contribute in reducing risks of late design changes. The "Purchasing" requirements (clause 7.4), as well as the "Measurement, analysis and improvement processes" (clause 8.4) should assist ports to manage the risks relating to insolvency / default of subcontractors or suppliers. It should be noted that the ISO 14001 quality standard should entail port to ensure the availability of resources (clause 4.4.1) and to provide training to the human resources (clause 4.4.2) in order to limit the risks relating to material/labour availability and the poor quality workmanship. The requirement of "Management review" (clause 4.4.6) contains processes for the suppliers that might limit the risks resulting from such cooperation.

Operation: The ISO 9001 standard should contribute to the management of low productivity risks through the consideration of the processes performance (clause 5.6.2) and the application of suitable methods which shall demonstrate the ability of the processes to achieve planned results (clause 8.2.3). The recording and documentation of information to ensure the effective planning, operation and control of production processes (clause 4.2.1), the validation of processes for production and service provision (clause 7.5.2) as well as the protection of the measuring equipment from damage and deterioration during maintenance (clause 7.6) should assist ports to reduce the risks related to maintenance costs. The operation risks which are related to the lack of training may be reduced through the general requirements for human resources (clause 6.2.1) as well as the requirements for competences, awareness and training (clause 6.2.2). The ISO 14001 quality standard requirement in clause 4.4.2 shares the same title, and involves the obligation to provide personnel training. It must be stressed that a better management of operational risks should be achieved through the application of ISO 9004 standard. ISO 9001 focuses on the effectiveness of the quality management system in meeting customer requirements. ISO 9004 gives guidance on a wider range of objectives of a quality management system than does ISO 9001, particularly for the continual improvement of an organization's overall performance and efficiency, as well as its effectiveness.

Management: The requirements of the ISO 9001 standard for the determination of the sequence and interaction of the processes (clause 4.1), the "Responsibility and authority" (clause 5.5.1), the "Internal communications" (clause 5.5.3) and the "Monitoring and measurement of processes" (clause. 8.2.3) shall contribute in managing risks which are related to organization and coordination as well as to responsibility and authorities distribution. In addition, the determination of responsibilities and authorities on design and development is a requirement of the design and development planning process (clause 7.3.1). Finally, the provision of qualified personnel with training, skills and experience (clause 6.2.1) as well as the competence and awareness of the personnel (clause 6.2.2) should assist ports to manage the risks associated with inadequate experience in projects. The ISO 14001 communication processes included in clause 4.4.3 shall contribute to manage coordination risk in ports and reduce risks of improper cooperation with external parties. Moreover, establishing, implementing and maintaining documented procedures in the context of clause 4.4.6, minimize coordination risks as well as those of distributing authority and responsibility. The clause 4.4.2 refers to the establishment of procedures for personnel training and the orientation of personnel roles and responsibilities in achieving conformity in system management, which could reduce the risk of inadequate distribution of responsibilities and authorities. Finally, the ISO 14001 requirements for internal audit (clause 4.5.5.) and management review (clause 4.6) should assist ports to reduce the risks related to management. It should be noted that the ISO 9001 standard requirements for audits (clause. 8.2.2) as well as for corrective and preventive actions (clauses 8.5.2, 8.5.3) shall contribute in managing all risk categories. It should be, finally, stressed that the

ISO 9001 and ISO 14001 standards are compatible and there is a correspondence between both standards clauses.

4.3 Terms and Conditions for the Implementation of Quality Management Tools in Port Management

The basic question that rises with regard to risk management is whether a company or an organization is willing to pay, and to what extent, the cost involved in managing specific risks. The main criteria for such a choice are:

a) The cost and potential malfunctions that may be brought to a port by adopting risk management processes.
b) The cost that may be brought to a company in case that such damage could not be avoided if the associated risk would be "realized".
c) The possibilities for such a risk to become a reality.

Listing of such fundamental criteria results to a significant question, meaning whether and to what extent would such criteria be common to all ports. For instance, does the implementation of a quality assurance system as a risk management tool entail the same cost and utility to all ports? The analysis of the port industry by many researchers converges to the point that the ports are different to such extent that they become unique cases (Chlomoudis *et al.*, 2003). Consequently, using quality assurance processes to manage risks, as suggested in the context of this paper, could not be an integrated solution but it might be adopted for each port separately according to port needs.

Furthermore, it should be recognized in this approach that there are several reasons to limit the adoption of quality management in the port industry (Chlomoudis and Lampridis, 2006; Lampridis, 2008). A prosper environment for the application of quality management could be achieved through an integrated port governance approach on a port community level. This approach should be:

- An internal developed and first party audit approach which is an integrated management approach for the port community
- A multi-systemic approach which includes quality sub-systems that fits to the specific needs of each port producer and sub-systems that applied to the port community as a whole.
- An approach which creates interrelations between the members of the port community and integrates the common processes of the port producers
- An approach with a steering committee comprising from the port producers on a voluntary basis.

The role of the steering committee is to coordinate the port producers, to set quality standards and targets, to integrate the common processes, to audit the operation of each producer and the community as a whole etc. Such an approach should contribute to the utilization of quality management in risk minimization. The development of the approach is based, among others, to the assumption that the port

operators do not have the same needs regarding the implementation of quality management systems. The implementation of certain standards in risk management may not respond to the needs of every port operator. In such a case, ports' being certified according to the same standards is not necessary; instead, the implementation of processes according to standards may be possible. The implementation of processes that shall be developed by the port authorities and port operators it should be a choice. However, such processes should include the basic elements of a quality standard.

It should be taken into account that quality assurance systems such as the ISO 9001 standard can assist ports with managing risk, but they were not designed as risk management systems. This is a fact that further restricts the implementation of quality assurance systems towards the risk management. During the recent years significant efforts have been made towards risk reduction. The European Excellence Organization has already proceeded with the publishing of criteria for managing risk through the European Excellence Award. In addition to that, the International Standards Association (ISO) has constituted a technical committee responsible for the development of a risk management guidance standard (ISO 31000). The development of such standards shall contribute to the use of quality tools for port risk management, thus lifting the existing limitations to a great extent.

Finally, the restriction of various types of risks is among the main incentives for the adoption of quality management systems by port authorities. The improvement of safety for personnel, the port zone and the surrounding area is one of the three kinds of benefits of the application of an internal quality management system by the Nantes / St. Nazaire port authority (UNCTAD, 1998).

In the case of the port of Valencia, the quality system minimizes uncertainties and the consequent adverse selection and moral hazard (Lopez and Poole, 1998). The development of the ISO 9001 standard to the bulk terminals of European Union ports, in accordance with the context of the Directive 2001/96/EC, aims to minimize the risks which are related with the high number of shipping accidents involving bulk carriers with an associated loss of human lives. The restriction of the security risks in the port of Barcelona is pursued through a quality management system which measures the integrity and security of customs seals and goods during their stay and handling at terminals (Port de Barcelona, 2009).

5. Conclusions

The management of the port industry risks is of great importance not only to the ports, but for the economy as a whole. The literature review indicates the financial and political situation, the statutory framework, the society, the technology and the

market as sources of risks to the port industry. Risks associated with the safety and the implementation/management of port projects are equally important.

Ports nowadays play an important role in the international transport and trade. The provision of high quality services and the reduction of risks are two decisive factors to port effectiveness. Being mainly expressed as time consistency, reliability and safety, quality is also a decisive factor to port competitiveness. Quality may be also attained by implementing quality management systems, which includes processes directly or indirectly contributing to risk management.

Reducing risks through such systems is particularly important in conditions of world recession, which affect shipping creating problems in operators and ports authorities. The quality management implemented by the use of statistical methods, through knowledge and experience in managing key processes as well as the implementation of major organizational and cultural change may decisively contribute to dealing with risks in port industry. The evaluation of the requirements of quality assurance systems such as ISO 9001 and ISO 14001 in relation to particular risks in ports evidences that quality assurance has the tools, which may contribute in managing port industry risks. It should be noted, however, that ports shall have the option of implementing specific processes of quality assurance towards the risk management, without the need of being certified for the implementation of a standard. Furthermore, ports should take into account the implementation and certification costs of such standards in relation to the costs and possibilities of realization of particular risks. Finally, it should be noted the need to avoid general or specific quality management implementation problems in order to use quality assurance as a risk management tool, through integrated port governance approach towards quality.

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