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RISK MANAGEMENT IN PORT OPERATIONS, LOGISTICS AND SUPPLY CHAIN SECURITY

General Editors: **KHALID BICHOU, MIKE G.H. BELL AND ANDREW EVANS**

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First published 2007 by Informa Law

Published 2014
by Informa Law from Routledge
2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

and by Informa Law from Routledge
711 Third Avenue, New York, NY, 10017, USA

Informa Law is an imprint of the Taylor & Francis Group, an informa business

British Library Cataloguing in Publication Data
A catalogue record for this book is available from the British Library

ISBN 13: 978-1-843-11655-4 (hbk)

Text set in 9/11pt Plantin by Interactive Sciences Ltd, Gloucester

PREFACE

The 9/11 attacks and other subsequent events have fostered further dimensions to port, maritime and supply-chain security with a raft of compulsory and voluntary measures being put in place at both domestic and global levels. However, while much of the academic and the industry's attention was paid to the deadlines and prescriptive mechanisms for compliance, few or no attempt(s) was made to analyse the frameworks, models and applications of port and supply-chain security regulations and the interplay relationships between the regulatory framework, the risk element and the appropriate operational and management systems.

This book, based on the papers presented at a workshop on risk management in port operations, logistics, and supply-chain security at Imperial College London in 2006, offers a first and unique insight into the complex world of port and supply-chain security by combining selected peer-reviewed contributions from an international line-up of top-tier academic and professional experts in the field. In particular, the book addresses operational and management challenges that port, international logistics and supply-chain operators face today in view of the new security regulations and the requirements of increased visibility throughout the supply chain.

The book also offers a rare blend of academic and practitioner contributions covering a wide collection of security models and applications ranging from operational and functional subjects to management and policy issues. Both the structure and content of the book were carefully planned and drafted to encompass the multi-faceted nature and components of the global port and supply-chain security system, including the international maritime and trading systems.

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INTRODUCTION

Khalid Bichou, Michael G.H. Bell and Andrew Evans

PORT AND SUPPLY-CHAIN SECURITY, RISK AND RELIABILITY

The events and aftermath of 9/11 have not only fostered further dimensions to global port, logistics and supply-chain security but have also triggered a fundamental shift in the way policy and regulatory instruments are drafted, managed and implemented. On the one hand, the interplay of relationships between trans(port), logistics and supply-chain networks has led to a system of layered security whereby a combination of multi-level/multi-layer contractual and voluntary arrangements is being operated for each pattern of port, logistics, trade and supply-chain configurations. On the other hand, the complexity and multi-dimensionality of the security-risk factor may require new models and frameworks of risk assessment and management. This is because probabilistic models for the analysis of safety presume that accidents are unwanted unintentional events, and that data on past accidents and precursors provide useful information about future accidents. In the case of security, the unwanted events are intentional. In that case, the past may be a poorer guide to the future, and the characteristics of the events may be very different.

In advocating a shift (i) from facility security to supply-chain security and (ii) from safety-based to security-based risk models, both operational and strategic decisions across port, logistics and supply-chain settings must be adjusted. Operational challenges stemming from the new security framework involve far-reaching issues ranging from operational planning and execution, ICT and technology applications, quality standards and processes, cost and performance models, and reliability and recovery options. Strategic challenges brought about by the new security regime include such aspects as strategic management and competitive models, policy making and implementation, information reporting and co-operation arrangements, economic evaluation and impact analysis, and financing mechanisms and cost recovery schemes.

This book addresses operational and management challenges that port, international logistics and supply-chain operators face today in view of the new security regulations and the requirements of increased visibility throughout the supply chain. The book provides a structured selection of contributions covering a wide collection of security models and applications ranging

from operational and functional subjects to management and policy issues. The focus on ports in this book is rightly justified because although security measures have targeted a variety of entities and facilities across the international logistics and supply-chain community, ports stand as the only node/link that can bring together all these institutions, functions, assets, processes and flow-type elements.

AN OVERVIEW

The focus of this book is on security, risk and reliability in supply chains which are having a major impact on the port and logistics industries. The chapters can be grouped into four sets, reflecting different issues associating risk and reliability with port, logistics and supply-chain security.

The first set reviews current security programmes and initiatives in port, logistics, and trade settings, highlighting in particular the increasing shift from physical and facility security to the wider supply-chain security. The first chapter thoroughly discusses the interface between marine reporting and maritime and port security, highlighting in particular the lack of information available for both cargo and passenger manifests, as well as the ability of both maritime and port stakeholders to report and share such details with maritime authorities throughout the world. The second chapter reports on the global trade system, an industry initiative that seeks to meet both the need to improve the logistics processes to handle increasing global trade and the requirement to enhance global trade security both to and from all participating nations. This concept has, since it was first presented to the United Nations in 2003, progressed to the implementation and review phase. The third chapter analyses different systems of container security from box standardization and packaging to container loading and unloading, including while in-transit or on delivery processes. It goes on to show how container security is a complex system of interrelated activities in information and data capture and controlled re-distribution, physical surveillance of the container, and inquiries into the various actors in the supply chain.

The second set suggests different methods and applications for enhancing port security and operational efficiency. The fourth chapter investigates the use of RFID systems to enhance port operations security and uses process modelling to analyse the implementation of RFID technology in yard operations. The fifth chapter uses discrete-event simulation to investigate port recoverability from security incidents. The results from a hypothetical scenario show an increase in the number of chassis and containers in the yard, as there were not enough trucks to pick them up, as well as a large increase in the gate queue. The sixth chapter examines the security and reliability of the global container-line shipping network through simulation and mathematical modelling. The study goes on to illustrate a case study of shipping networks plying

the West European and North American continents and shows how a disruption in a regional network could have wider cascading effects in global shipping networks. The seventh chapter deals with the stability and reliability of container-line schedules in the context of random events and successive ports of calls. Throughout the study, mathematical models supported by hypothetical case studies are developed to show the variability of schedule stability as the number of port calls increases. Chapter eight applies artificial neural networks to predict and test the efficiency of container-port operations. Using Hong Kong container terminals as a case study, the results show small prediction error, hence the suitability of the method in reducing operational risks and increasing reliability. The ninth chapter discusses the links between shipping alliances and terminal operations and examines how such strategic alliances could reduce operational and performance risks of port operations.

The third set of chapters provides several empirical frameworks for managing the security of global trading and supply-chain systems. The tenth chapter empirically investigates how the Business Alliance for Secure Commerce (BASC) programme, a privately-driven voluntary security initiative created in Latin America in 1996 to initially prevent legal cargo from being used to smuggle drugs, has evolved towards an integrated security management system. The eleventh chapter presents trade disruption insurance (TDI), a risk management framework, and evaluates its effectiveness along with other complementary programmes such as C-TPAT and the ISO/PAS 28000 to tackle the risk management of external security threats to supply chains. Chapter twelve uses a combination of primary and secondary data sources from maritime and related industries in Europe and the Asia-Pacific region to look at the requirements for designing, developing and implementing safety and crisis management cultures that enhance vulnerability analysis in maritime trading systems and the security assurances of supply chains. Chapter thirteen presents, through a survey of senior US executives in manufacturing and retail operations, the cargo-interest perspective of the maritime container security framework. Chapters fourteen and fifteen both provide quality management frameworks to ensure regulatory compliance and quality assurance for new security initiatives, and present case studies for implementing and managing the 24-hour rule and the ISO 28000 programme, respectively.

The final set of chapters presents different models for analysing the security risk element with a policy perspective. The sixteenth chapter reviews and critically analyses current maritime security and regulatory-based models and highlights the limitations of the current framework in providing an integrated approach to risk assessment and management, including supply-chain security. The seventeenth chapter presents the full and detailed results of the UNCTAD global survey on the implementation costs and financing mechanisms of the ISPS code in ports, including such aspects as cost-factor distribution and cost-recovery schemes. Chapter eighteen analyses the implications of the enactment of EU policy measures for European ports, and discusses

several related issues including such aspects as the distribution of responsibilities among port stakeholders, the search for a balance between risk and regulatory policies, and the emerging cost and financial implications. Chapter nineteen discusses the wider topic of strategic risk management in ports and presents a case study that associates strategic risk management with port security. Finally, the last chapter, chapter twenty, analyses the implications of port security on the competitiveness of short sea shipping (SSS) in Europe, which appears to be an overlooked and forgotten issue in the current EC policy framework, and mechanisms for implementing and enhancing SSS networks.

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Dr Phillipe Wieser obtained his diploma of engineering in mechanics at the EPFL in 1977 and he got his PhD in 1981. After a few years working in an engineering consulting company, he joined the EPFL as lecturer. His fields of

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PART I

BACKGROUND

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CHAPTER 1

MARINE REPORTING AND MARITIME SECURITY

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Abstract:
Much is being studied about the prevalent issue of maritime security, especially from the point of view of landside operations at sea ports. However, although the issues concerning the overall security of port operations and how these relate to the security of vessels entering, berthed at and leaving port have been investigated, less has been studied concerning the actual security of those vessels at sea, especially in relation to their complements, such as cargo or passengers. The US maritime security issues in the wake of 9/11 imposed significant compliances upon overseas traders sending goods to US shores. These security issues highlighted the lack of information available in many cases concerning both cargo and passenger manifests, as well as the ability of the vessel and its crew to effectively report their details to the US national authorities. How much less, therefore, is the ability of the same or similar vessels to report the same kind of information to other national maritime authorities throughout the world. This study, part of a larger study into the issues of maritime reporting and territorial controls, seeks to address some of the issues at stake, and to shed some light on the overall subject of marine reporting and how it could be better managed and developed.

1 A VIEW FROM THE BRIDGE

The state-of-the-art marine freighter or passenger liner bears little relationship to its forebears in terms of the technology of its control systems. Gone are the telegraphs between bridge and engine room, as are the conventional wheelhouses with their huge steering wheels. Everything is controlled by complex on-board computer systems, from steering and navigation to engine control and position monitoring. Even the marine propulsion systems have changed, from the combinations of conventional stern-mounted screws linked to huge marine engines and bow-thrust mechanisms, to azymuth propulsion systems, where the propulsion systems can revolve through 360 degrees and are connected to smaller, more efficient diesel engines by an adjustable link mechanism, which eliminates the need for a conventional rudder steering mechanism. The one main link with more traditional times is the vast array of Admiralty charts ranged across the available desk space, although even this is giving way to a large extent to the ECDIS computerized charts. Today's

control systems rely heavily on a mixture of GPS, VTS, AIS and conventional radar systems. From port of departure to port of destination, the vessel monitoring process from a navigation point of view revolves around the following systems:

- Leaving port—VTS/AIS;
- Open sea—AIS/GPS;
- Entering port approaches—AIS/VTS;
- Port arrival—VTS.

The VTS systems allow for the close monitoring of vessels within port approaches and port areas themselves, while AIS allows for the monitoring of vessels throughout their voyage, and indeed while the vessel is in port as long as the AIS transponder is switched on. The drawback with any of these systems is that they identify the ship, but not its crew or its cargo or complement of passengers. Equally, the AIS system is still subject to a slight delay between the time the transponder emits the signal and the time this registers on the system and thus registers the ship's position. All this may be good insofar as it exists, but it does not tell the full story. There are considerable gaps in the whole process, mainly because of the issue of cargo reporting, and these gaps are the issues of the greatest importance owing to the risks posed by unreported cargo and other security considerations. Other risks also prevail, in particular the lack of monitoring of vessels outside the remit of the VTS and AIS systems, which could have an adverse effect on the security and safety of vessels covered by these systems. Despite the evident technological tools available to the ship's master and his crew, the view from the bridge may still be obscured by many external factors beyond the master's control.

The synopsis of procedures concerning the voyage of a cargo vessel may be loosely categorized as follows:

1. the ship's agent and the freight forwarders verify specific documentation (e.g. dangerous goods notes etc.) to ensure compliance with IMO requirements;
2. the cargoes destined for loading aboard vessel are declared to Customs by electronic input;
3. Customs clearance is given for the consignments to be loaded aboard vessel;
4. the ship is loaded at port with the cargoes (e.g. containers);
5. bills of lading are issued for all cargoes loaded aboard vessel, and the cargo information is also entered on the cargo manifest;
6. a copy of the ship's manifest is given to the ship's master by the ship's agent (the port agent) and a further copy of the manifest is also submitted to Customs;
7. the ship's master notifies the port and the Customs authority that all cargoes are loaded aboard vessel;
8. the ship is given clearance to sail;

9. the master maintains contact with the port VTS concerning the ship's movement out of the port, through the channel and into the open sea;
10. the ship maintains electronic contact with other vessels and land through the use of the AIS system;
11. the ship sails across the ocean to its destination. Upon the approach to the port of destination, the following action is undertaken:
12. the vessel's agent notifies the port of destination of the arrival of the vessel;
13. the ship notifies the port of destination 24 hours in advance with details of the ship, its crew and any hazardous or dangerous cargoes aboard vessel in accordance with the IMDG Code, and its intention to dock;
14. the ship enters national territorial limits and notifies the port of details of its crew, its stores and any other information required by the national authorities;
15. the ship maintains contact with the port through the VTS system from the time it enters the port approaches, and proceeds to enter the port;
16. a copy of the cargo manifest is submitted by the port agent to the port authority and the Customs authority prior to the ship's arrival at port;
17. the ship's master submits a FAL Declaration to Customs of all details of crew and stores on board; and
18. the ship's master gives a detailed report to the port authority complying with the regulations set down by the ISPS Code.

Although details of cargo reporting may have been covered earlier in this section of the study, they still have an overall bearing upon the safety and wellbeing of both the vessel and its crew. It should be noted that the ship's master can only report details of the cargo if he is fully aware of that cargo aboard the vessel according to the cargo manifest. In many cases, the cargo may only be known by its groupage description, i.e. a generic description of the consolidated cargo in a LCL container load, and not by details of each individual consignment within that consolidated cargo. This absence of information may not yield vital information, such as the hazardous nature of an individual cargo, or whether such a cargo was (in)correctly stowed aboard vessel. It is this lack of information which may mask a much greater risk to the ship, its crew and its location depending upon the location of other vessels close by, e.g. within the confines of port approaches, or where adverse weather conditions such as fog may be prevalent. It is this anomaly which may prejudice or compromise the safety and security of not only the ship and its crew, but also the safety of the surrounding environment including the port itself. There is a further risk prevalent if the exact nature of the crew is not fully known, concerning their professional competence to crew the vessel or their

nationality or even their motives for being aboard the vessel at the time of the voyage.

A major problem arises where the buyer (i.e. the importer) arranges groupage shipments and has the cargo consolidated at a point in the country of departure under an ex works (EXW) basis. Given that the buyer initiated the transport of the various consignments, the shipping line will still issue both a master bill of lading for the LCL groupage shipment as well as a set of house bills of lading, but may not necessarily issue the house bills to the buyer unless specifically requested. Thus, the exporter may never receive a copy of the house bills of lading relating to their consignment since they did not arrange the shipment. Nor will the exporter receive a copy of the export Customs declaration for that consignment, assuming that an individual export declaration has been physically raised by the freight forwarder, which may not be the case in the event of a consolidated consignment. In many cases, this does not happen. There is thus no audit trail available to the exporter to show that their particular consignment was shipped. Furthermore, where a groupage consignment simply shows "freight of all kinds" (FAK) or a generic description such as "cosmetic products" or "automotive equipment", there is no specific means of verifying the individual consignments grouped within the container in question, as there may be the risk that no specific house bills of lading were raised for each individual consignment as far as the exporter is concerned. Furthermore, this lack of detailed information will also reflect on the cargo manifest issued to the ship's master and to Customs at the point of export.

The problem is compounded by the fact that the forwarding agent notifies the port agents about the cargo once the shipment has been arranged for loading aboard the vessel. The freight forwarder is responsible for sending full details of the cargo to the port agent for the latter to incorporate the details of the consignment and the container in which it is loaded on the cargo manifest. The port agents are responsible for dealing with all affairs relating to the vessel while it is berthed at port, including the loading and unloading of the vessel, and the liability for conservancy and port handling charges. It is thus the responsibility of the port agent to ensure that the ship's master is made aware of all cargoes loaded aboard the vessel, and that all hazardous or dangerous cargoes are notified in advance to the master of the vessel in order to ensure compliance with port regulations, SOLAS regulations and the general regulations concerning the correct stowage of all cargoes aboard the vessel. If a freight forwarder does not submit the correct information concerning cargoes, especially those of a groupage or consolidated nature, to the port agent, the freight forwarder could be made liable for any accident or damage which could occur as a result of the failure to inform the port agents or the ship's master or even the port itself of the nature of the cargo being loaded aboard the vessel. In reality, the responsibility for correctly divulging information pertaining to the cargo lies with the exporter. If the exporter does not inform the freight forwarder of the true nature of the consignment, the rest of the chain of

reporting is severely prejudiced, including the ramifications for insurance of the cargo in question.

In short, the neither the ship's master nor the shipping line nor the port authority may be entirely knowledgeable about the crew of the vessel or its cargo. Although the ISPS Code goes a long way towards tightening up security measures aboard vessels as well as providing information about the crew, it only covers that which is known or is divulged in the company's interests. In the case of the ISPS Code, there are, however, likely to be cases where although the crew's nationality may be known, other information about each crew member may not be known because of the withholding of personal information by certain crew members for personal or other reasons. Furthermore, there is no internationally-binding code obliging the exporter or the freight agent to correctly declare all freight being loaded into a container, and in this way the cargo considerations are completely divorced from the issues of the nature of the vessel's crew. Even the recently introduced ISO 28000 and 28001 standards allow the trader to compile and implement their own set of checklists and procedures concerning cargo security, and do not dictate the exact details of such procedures. The underlying principle is still one of *uberrimae fidei*. Thus, in an age of information technology and access to information, the data held by the shipping line pertinent to the cargo on any of its vessels may only be as accurate as the organization inputting that information to the shipping line, such as a freight agent. With large-scale cargo consolidations, the risk of inaccuracy and heightened risk on this basis is greatly increased. A ship will not report in either to a sea port or a control centre overlooking a narrow strait concerning the nature of its cargo if it is not aware of any hazardous or dangerous cargo on board, especially since the 24-hour reporting mechanisms in place at many ports, particularly those in the UK, are still voluntary and not fully mandatory. The ship is entirely at the mercy of the shipping line's agents and the freight agents responsible for shipping cargo consignments. This level of uncertainty only adds to the risk of accidents or catastrophes occurring as a result of marine accidents, and thus severely compromises marine safety for the vessel, its crew and other cargoes aboard the vessel.

2 A VIEW FROM THE SHORE

The aspect of maritime reporting is naturally important from the onboard vessel perspective. However, from the port perspective, there are many issues which beset port and landward activity which need to be addressed on a long-term basis, mainly as a result of recent maritime legislation which affects worldwide maritime activities.

The EU Directives covering vessel monitoring and tracking have meant that more sea lanes must be covered by some form of VTS system. The waters around southern Scandinavia are being increasingly brought under some form