The impact of 100% scanning of U.S.-bound containers on maritime transport

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European Commission

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TABLE OF CONTENTS

EXECUTIVE SUMMARY ........................................................................................................... VII
INTRODUCTION.......................................................................................................................... 1
I. OBJECTIVE OF THE STUDY ................................................................................................. 3
II. STUDY APPROACH ............................................................................................................. 4
III. CURRENT SECURITY MEASURES IN EU PORTS ............................................................... 5
IV. H.R. 1 IMPLEMENTING RECOMMENDATIONS OF THE 9/11 COMMISSION ACT OF 2007 .................................................................................................................. 10
V. ADDITIONAL MEASURES REQUIRED FOR 100% SCANNING ....................................... 13
   V.1. WHAT ARE THE OBLIGATIONS IMPOSED BY THE 9/11 COMMISSION ACT? ............... 13
   V.2. TECHNICAL REQUIREMENTS TO MEET THE OBLIGATIONS IMPOSED BY THE 9/11 COMMISSION ACT 14
VI. IMPACT OF SCANNING ON PORT AND TERMINAL OPERATIONS AND ON HINTERLAND TRANSPORT ................................................................. 16
   VI.1. PILOT PROJECTS ......................................................................................................... 16
      VI.1.1. Pilot SFI in Southampton ....................................................................................... 17
      VI.1.2. Pilot SFI in Port Qasim ....................................................................................... 20
      VI.1.3. Puerto Cortés, Honduras .................................................................................... 21
   VI.2. RESULTS FROM THE SFI PILOTS IN PORTS PARTICIPATING IN A LIMITED CAPACITY ................................................................................................................. 24
      VI.2.1. The port of Singapore – terminal operator PSAC .................................................. 24
      VI.2.2. The port of Hong Kong – terminal operator Modern Terminals Limited ............... 28
      VI.2.3. Port of Busan – Terminal Operator Hutchison Port Holdings ............................... 30
   VI.3. CASE STUDIES OF SELECTED EUROPEAN UNION PORTS ................................ 32
      VI.3.1. General observations ........................................................................................... 32
      VI.3.2. The impact of port and terminal lay-outs on the feasibility and cost of 100% scanning . 35
VII. THE ECONOMIC COST IMPACT OF 100% SCANNING .............................................. 39
   VII.1. THE DIRECT COSTS OF 100% SCANNING ............................................................. 39
   VII.2. RESULTS FROM THE CALCULATION OF THE EXTRA LAND-BASED TRANSPORT COSTS BECAUSE OF SCANNING ........................................................................... 43
LIST OF FIGURES

Figure 1: Overview of U.S. cargo and supply chain security measures ........................................... 5
Figure 2: Various steps in the Container Security Initiative ............................................................ 6
Figure 3: Phases of the Megaports Initiative ..................................................................................... 7
Figure 4: Participation of 14 ports in CSI and/or MI ......................................................................... 8
Figure 5: Required measures for 100% scanning .............................................................................. 14
Figure 6: Participation of 14 ports in CSI and/or MI ......................................................................... 8
Figure 5: Required measures for 100% scanning .............................................................................. 14
Figure 6: Main characteristics of the three major pilot projects .......................................................... 17
Figure 7: SFI pilot projects: status of implementation and main observations ................................... 24
Figure 8: Challenges with regard to 100% scanning according to GAO ............................................. 32
Figure 9: U.S.-bound containerised cargo in the 14 selected European ports ................................... 33
Figure 10: Number of U.S.-bound TEUs per European Union port .................................................... 34
Figure 11: Typical container flow through a container terminal ......................................................... 35
Figure 12: Pre-gate scanning area, SFI Pilot Southampton ................................................................. 37
Figure 13: Inspection lane .................................................................................................................. 37
Figure 14: Impact of 100% scanning on direct transport costs: upper cost range ............................... 41
Figure 15: Impact of 100% scanning of U.S.-bound containers on direct transport costs: lower cost range .................................................................................................................... 42
Figure 16: Impact of longer dwell times on terminal capacity and required holding capacity ........ 46
LIST OF TABLES

Table 1: Performance of SFI pilot at Southampton Container Terminal (October 2007 – February 2008) ........................................................................................................................................ 18
Table 2: Differential space requirement in additional m² – RTG system......................................................... 47
Table 3: Differential space requirement in additional m² – Straddle Carrier System ................................. 47
Table 4: Example of the capital investment cost differential in paving as a result of a two-day increase in average dwell time (from 5 to 7 days) ....................................................... 48
Table 5: Example of the total cost differential in paving as a result of a two-day increase in average dwell time (from 5 to 7 days) – terminal with throughput capacity of 600 000 containers – 960 000 TEU .................................................................................................................. 48
Table 6: External cost of trucking (in €) ........................................................................................................... 52
Table 7: External cost reverting back from the rail to road mode (in €) ...................................................... 53
Table 8: External cost reverting back from the barge to road mode (in €) .................................................. 53
## LIST OF ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>AEO</td>
<td>Authorised Economic Operator</td>
</tr>
<tr>
<td>APO</td>
<td>Auxiliary Police Officers (U.K.)</td>
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<td>APL</td>
<td>American President Lines</td>
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<tr>
<td>APMT</td>
<td>APM Terminals (A.P. Moller Terminals)</td>
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<td>ASP</td>
<td>Advanced Spectroscopic Portal</td>
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<tr>
<td>ATS</td>
<td>Automated Targeting System</td>
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<td>BAF</td>
<td>Bunker Adjustment Factor</td>
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<tr>
<td>CAF</td>
<td>Currency Adjustment Factor</td>
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<td>CAS</td>
<td>Central Alarm System</td>
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<td>CBP</td>
<td>U.S. Customs and Border Protection</td>
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<td>CSI</td>
<td>Container Security Initiative</td>
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<td>CTA</td>
<td>Container Terminal Altenwerder (Hamburg)</td>
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<tr>
<td>C-TPAT</td>
<td>Customs-Trade Partnership Against Terrorism</td>
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<td>CT4</td>
<td>Container terminal extension 4 (Ueberseehafen Bremerhafen)</td>
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<tr>
<td>DEI</td>
<td>Dirección Ejecutiva de Ingressos</td>
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<tr>
<td>DHS</td>
<td>Department of Homeland Security</td>
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<tr>
<td>DOE</td>
<td>Department of Energy (U.S.)</td>
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<tr>
<td>DP World</td>
<td>Dubai Ports World</td>
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<tr>
<td>EU</td>
<td>European Union</td>
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<td>GAO</td>
<td>United States Government Accountability Office</td>
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<tr>
<td>HMRC</td>
<td>Her Majesty’s Revenue and Customs (U.K.)</td>
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<tr>
<td>HPGe</td>
<td>High Performance Germanium Detector</td>
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<td>HPH</td>
<td>Hutchinson Port Holdings</td>
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<td>H.R.</td>
<td>House Resolution</td>
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<td>IC3</td>
<td>Integrated Cargo Container Control</td>
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<td>ICIS</td>
<td>Integrated Container Information System</td>
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<td>ICS</td>
<td>International Container Security</td>
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<td>IC System</td>
<td>Information and Communication System</td>
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<td>ICE</td>
<td>Immigration and Customs Enforcement</td>
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<td>IMO</td>
<td>International Maritime Organization</td>
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<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>ISA</td>
<td>Importer Self-Assessment</td>
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<td>ISPS</td>
<td>International Ship and Port Facility Security code</td>
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<td>IT</td>
<td>Information Technology</td>
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<td>LSCT</td>
<td>La Spezia Container Terminal</td>
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<tr>
<td>MI</td>
<td>Megaports Initiative</td>
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<tr>
<td>MTL</td>
<td>Modern Terminal LTD (Hong Kong)</td>
</tr>
<tr>
<td>n/a</td>
<td>Not available</td>
</tr>
<tr>
<td>NII</td>
<td>Non-intrusive Inspection</td>
</tr>
<tr>
<td>NNSA</td>
<td>National Nuclear Security Administration</td>
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<tr>
<td>OCR</td>
<td>Optical Character Recognition</td>
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<tr>
<td>PSAC</td>
<td>PSA Corporation</td>
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<tr>
<td>RIDD</td>
<td>Radiation Ionising Detection Device</td>
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<td>RIID</td>
<td>Radiation Isotope Identification Device</td>
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<td>RPM</td>
<td>Radiation Portal Monitor</td>
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<td>RTG</td>
<td>Rubber-tyred gantry crane</td>
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<tr>
<td>Safe Port Act</td>
<td>Security and Accountability For Every Port Act</td>
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<tr>
<td>S.A.R.</td>
<td>Special Administrative Region (Hong Kong – People’s Republic of China)</td>
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<tr>
<td>SCSS</td>
<td>Supply Chain Security Specialist</td>
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<td>SCT</td>
<td>Southampton Container Terminal</td>
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<td>SFI</td>
<td>Secure Freight Initiative</td>
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<td>SOLAS</td>
<td>Safety of Life at Sea Convention</td>
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<tr>
<td>TEU</td>
<td>Twenty Foot Equivalent Unit</td>
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<td>THC</td>
<td>Terminal Handling Charges</td>
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<tr>
<td>TGS</td>
<td>Twenty Foot Groundslot</td>
</tr>
<tr>
<td>U.K.</td>
<td>United Kingdom</td>
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<tr>
<td>U.S.</td>
<td>United States of America</td>
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<tr>
<td>VAT</td>
<td>Value Added Tax</td>
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<tr>
<td>WCO</td>
<td>World Customs Organization</td>
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<tr>
<td>ZDS</td>
<td>Zentralverband der Deutschen Seehafenbetriebe</td>
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EXECUTIVE SUMMARY

Objective of the study and the applied study approach

On the 3rd of August 2007 former President Bush signed into law the Implementing Recommendations of the 9/11 Commission Act which requires the scanning of all U.S.-bound containers by radiation detection and non-intrusive inspection equipment at a foreign port before being loaded on a vessel.

At the European Commission level it was agreed to prepare a “long-term assessment of the impact of 100% scanning in order to be ready for the discussion with the new U.S. Congress and administration”. The study ‘The impact of 100% scanning of U.S.-bound containers’ was awarded to Policy Research Corporation and analyzes the impact of the obligation of 100% scanning of U.S.-bound containers before shipping:

- on port facilities and ports, including their competitiveness;
- on transport towards ports and on adjacent regions;
- and finally also on the U.S. production using components shipped via European ports.

The study started in October 2008 with an extensive literature search, in particular legal documents and papers considering the operation and economic impact of the 100% scanning rule. In a second phase data collection was combined with a series of interviews and field trips, directed to Port Authorities, Terminal Operating Companies, transport operators, professional associations, forwarders and any other stakeholders. For these interviews and field trips a selection was made of 14 European ports including the main U.S.-bound containerized cargo.

Current security measures and H.R. 1

Since the 9/11 attacks in 2001 a number of U.S. cargo and supply chain security measures were taken to improve supply chain security:

- Customs-Trade Partnership against Terrorism (C-TPAT): a voluntary supply chain security program;
The impact of 100% scanning of U.S.-bound containers on maritime transport

- Container Security Initiative: container screening based on risk analysis and Non Intrusive Inspection equipment and currently operational at 58 ports worldwide;
- Megaports Initiative: scanning at high volume ports of as many containers as possible on radiation;
- Security and Accountability For Every Port Act: instituting new international supply chain security programmes with regard to foreign trading partners, international trade and the shipping industry;
- Secure Freight Initiative: includes a pilot program to test the feasibility of 100% scanning of U.S.-bound containers.

This review of security measures already in place confirms the multi-layered and international response to acts of terrorism from the international community, lead by U.S. initiatives but followed by a majority of other countries including the European Union and its Member States. With the mandatory 100% scanning of all U.S.-bound containers by NII and radiation equipment, required by the H.R. 1 Implementing Recommendations of the 9/11 Commission Act, a new threshold has, however, been passed.

Additional measures required for 100% scanning

The 100% scanning obligation implies the deployment of radiation and NII equipment, already operational in some ports within the Megaports and/or CSI Initiative, to scan all U.S.-bound containers regardless their potential risk or the size of the port.

With regard to the NII equipment, two major types exist. High capacity scanners can scan maximum 150 containers per hour, but due to a lower radiation level their accuracy level is rather low. Low capacity scanners are more accurate but they only scan maximum 20 containers per hour. Their high radiation level also implies the need for more extensive safety measures. Because of the different characteristics of the NII scanners, their impact (with regard to location, number, organization of transport to and from the scanner) on ports, terminals and other stakeholders will differ. The Terms of Reference for the present study expressly excluded the estimation of the costs for installing and operating scanning devices in the ports themselves and hence this study will not provide such information.

Impact of scanning on port and terminal operations and on hinterland transport

The study on the impact of implementing the 100% scanning rule on port and terminal operations and on hinterland transport has revealed the impossibility to come to a uniform assessment of general validity for all (European) ports. The potential impact of scanning all U.S.-bound containers is to very large extent decided by local conditions such as:

- the lay-out of the port and container terminal;
- the availability of green field areas;
Executive summary

- the split between the various transport modes of the transported container volumes from the hinterland to the port;
- the number, profile and location of the road and rail accesses to the port;
- the volume of U.S.-bound containers handled;
- the importance of the transhipment throughput;
- the prevailing liability regime and labour laws.

With regard to both SFI Pilot ports and the by Policy Research Corporation investigated European ports, following conclusions can be drawn with regard to the impact on port and terminal operations as well as on hinterland transport:

- scanning of U.S.-bound containers is presently only possible on a limited scale, based on a risk-analysis;
- the installation of (extra) scanning equipment could be difficult to achieve due to the inherent space constraints in ports and on terminals;
- 100% scanning of feeder and barge traffic will be a major challenge; also scanning of containers delivered by rail could pose problems;
- if scanning takes place outside the terminal, 100% scanning of U.S.-bound containers will require additional movements for the transfer of containers from the terminal to the scanning site and vice versa, which could result in inflated transfer costs;
- if scanning takes place at the terminal gate or on the terminal, valuable terminal area will be taken up which in turn will reduce the terminal’s throughput capacity;
- scanning at extended gateways is an alternative that could be considered for barge and rail traffic, but operational and legal questions would then arise regarding the container’s integrity;
- because some European ports facing inherent congestion problems, particularly regarding their road accesses, the situation would significantly be worsened by the full application of the 100% scanning rule.

Direct transport costs

The imposition of 100% scanning carries economic cost consequences. These are of two types. First there is the direct transport related costs supported by the cargo interest and thus ultimately borne by the consumer. Secondly, there are the indirect costs resulting from the less than optimal functioning of the supply chain.

For the purpose of the study and to gain a better insight into the impact of 100% scanning on transport cost, three possible alternative scenarios were constructed for two different transport options. By combining all the least favourable cost assumptions in one calculation and all the most favourable in another, it is possible to determine an upper and a lower cost range for the cost impact of 100%
scanning. In the upper cost range calculation, the security related costs\(^1\) in the European port of origin amount to some € 280 per container (excluding the actual scanning cost) of which € 270 are due to the 100% scanning obligation. Total transport cost by truck from point of origin to point of destination totals € 3 300 per container. Hence the additional cost resulting from 100% scanning, when using the road transport mode, represents for the cargo interest a 8.5% increase in total direct transport costs. If rail transport is relied upon, the impact of 100% scanning on the direct transport costs is 11.6%, whilst for the barge transport mode the impact is 12.5%. These are significant increases in direct transport costs (i.e. excluding the actual scanning cost) at a time that shippers and receivers are trying to contain their total transport bill. If all containers that were shipped in 2007 from Europe to the United States would have faced the upper range level of cost increase, the total extra transport bill would have amounted to € 440 million.

In the lower cost range calculation, the security related costs in the European port of origin amount to some € 160 per container (excluding the actual scanning cost itself) of which € 150 are due to the 100% scanning obligation. Total transport cost by truck from point of origin to point of destination now totals € 1 680 per container. Hence the scanning cost in Europe when using the road transport mode still represents for the cargo interest a 9.5% increase in total direct transport costs. If rail and barge transport is relied upon to cover the same distance, the impact of 100% scanning on the direct transport costs is respectively 7.5 and 8.5%. If all containers that were shipped in 2007 from Europe to the United States would have faced the lower range level of cost increase the total extra transport bill because of 100% scanning would have amounted to € 243 million.

**Indirect economic costs**

The impact of 100% scanning will not only generate additional direct economic costs, but also indirect economic costs. The more apparent and significant of these are:

- A reduction of the handling capacity of the container terminals as a consequence of increased container dwell times;
  - The interviews with major stakeholders in the supply chain, in particular container terminal operators, have revealed the risk that containers could remain longer in the container stacking yards than is presently customary. Opinions tend to differ as regards the length of the added dwell time, but the given estimates were generally in a range of between 2 and 3 days extra for U.S.-bound containers.
  - A two-day increase of the dwell time on a terminal with a design throughput of 600 000 containers/ 960 000 TEU per year, translates in a cost increase of € 5.35 per container for a straddle carrier operation and of €3.58 per container for a RTG operation

\(^1\) The security related costs include the terminal security charge in the port of loading and the port of discharge as well as the extra transport cost from the terminal to the scanning location and the un-stacking and re-stacking cost resulting from the need to bring the container to the scanner at the European side.
The main problem in many terminals is, however, that no extra space can be made available. What this then means is that the terminal’s annual capacity will be substantially reduced. In the example of the terminal with a design throughput of 600 000 containers this results in a lower capacity of 428 600 containers or 686 000 TEU. If it is assumed that, if the full design capacity of the terminal is reached, the actual cost of handling is € 80, then the loss of capacity due to an extended dwell time of two days would mean that the cost of handling would go up to € 112 reflecting a drop of 28.5% in the terminal’s handling capacity. Hence for each container handled the cost would increase by a very significant € 32.

An increase in the turnaround time of feeder vessels

Based on calculations transmitted by the Government of Singapore, the full application of the 100% scanning rule may result in the loss of valuable feeder vessel time. For every feeder vessel bringing on average 300 U.S.-bound containers for shipment to the U.S., at least 1.6 hours of vessel time would be lost because of lower productivity resulting from scanning. Hence, if handling U.S.-bound feeder vessels takes more time at berth due to the full application of the 100% scanning rule and the resulting reduction in gantry crane productivity, carriers could be doubly affected. They would have to pay higher berth charges as these are calculated on time spent at berth and the vessel’s transport capacity would be reduced resulting in higher slot costs.

An increase in the turnaround time of the inland transport means (trucks, trains, barges) delivering containers to the port terminals

The interviews with stakeholders have brought to light some difference in appreciation regarding the impact of 100% scanning on the three main hinterland transport modes. With respect to the barge and rail mode, the general opinion is that these should not be unduly burdened by the imposition of the 100% scanning rule for U.S.-bound containers. For road transport the situation is different if the U.S.-bound containers are to be scanned before entering the container terminal where the vessel will be loaded. There is a general consensus amongst the stakeholders that the 100% scanning operation will typically add at least between one and two hours to the total travel time of the truck and if this would regularly occur trucking companies would definitely start to bill this extra time.

An increase of the external costs consequential to a shift from rail and barge to truck mode;

In ports where the scanning site would be off-terminal, additional transport by truck would be required for containers delivered by barge or rail to the terminal of loading as they would have to be brought to the scanner and back to the terminal after scanning. The use of the truck mode does also generate external costs. These costs include CO2 emissions, air pollution, noise pollution, safety and use of space. If all U.S.-bound containers would need to be transferred from the terminal to an off-terminal scanning site the total external cost would amount to € 3 856 000 per annum.

Far more dramatic could be the medium to longer term effect on modal split of a greater reliance on truck transport to bring the U.S.-inbound containers to the loading terminals from the more distant hinterland. Such greater reliance on the road could be the result of the extra cost added to the total transport bill by at least two additional horizontal moves and two vertical moves. The total differential external costs of such a reversion to the truck mode, vary from € 5 086 000 per annum to € 51 040 000 per annum.
annum depending on the percentages that will revert back to trucking and the mode previously used.

- An increased cargo inventory cost as a consequence of the extended transit times of the goods destined for the United States.

  o Many of those interviewed for the study hinted at the probability that 100% scanning could add two to three days to the present transit time of the cargoes destined to the United States. Additional transit time could be due to containers missing the loading vessel or because U.S.-bound containers are delivered for shipment several days earlier than before to avoid that particular problem. An extended transit time would result in an increase in inventory costs, although it is not possible, at this point in time, to assess accurately how many containers would be delayed, as the 100% scanning rule does not apply yet and there is no precedent to refer to. But assuming that on average all containers exported from Europe to the United States would encounter a delay of just one day the additional inventory cost, calculated on the basis of a 5% opportunity cost of the capital tied up, would amount to € 6 575 342 per annum.

  o Inventory costs do not always give a representative value of the cost incurred by the importer/cargo owner. A two day delay could be catastrophic in the case of a Just-in-Time consignment which fails to meet the deadline (parts arriving too late can stop a production line, fashion goods not being available during a special promotion event because of delays in transit, may lose half or more of their initial sales value). For this reason, the indicative inventory cost increase calculated above, may still be a very serious underestimation of the real loss the importer in the U.S. could experience.

**Critical issues, pertinent views and conclusions**

One of the main underlying reasons for the problems that stakeholders in the supply chain have identified as a result of the proposed 100% scanning of U.S.-bound containers, is that in international commerce the control on the movement of goods takes place at the import point. Hence all existing procedures, regulations and routines have been developed and implemented starting from this principle. The 100% scanning of outbound containers therefore creates a need to reconfigure ports and terminals, find more space to accommodate the extra facilities required, re-design the established procedures and introduce revised regulations.

The value of 100% scanning has as yet not been proven. In fact, in the SFI pilot ports both the U.S. and local authorities have been spending an inordinate amount of time processing consignments which were entirely inoffensive. Nothing was discovered that could not have been identified by risk targeted controls such as applied in the Container Security Initiative. What is quite likely is that the effectiveness of the scanning process, because of the sheer number of containers to be scanned, will seriously decline. Indeed, experience shows that too much irrelevant information greatly helps to mask critically important facts. Moreover, the relative incongruity of 100% scanning to warrant 100% security of the supply chain is equally revealed by the fact that the rule only applies to containers whilst far more risky cargoes and carrying modes are not subjected to the rule.
Critical is the impact of 100% scanning on smaller ports. Clearly, the three European ports with the highest U.S.-bound container throughput would possibly be in a position to attract cargoes away from the “smaller” ports. If this were to happen then 100% scanning would lead to cargo diversion from traditional ports and to a distortion of the established trade flows. Hence it becomes a factor that impacts on the competitive position of ports in a given region.

The position of container terminal operators with regard to the implementation of the 100% scanning rule is far from uniform. It is mostly inspired with what the terminal operating company sees as its priority objectives and determined by the specific local port and terminal conditions.

**Impact on port facilities and ports and on their competitiveness**

The impact of the 100% scanning rule on ports and terminals depends to a large extent on the specific lay-out of a given port and or a given terminal and on the particular conditions prevailing there. Some ports and terminals consider that the implementation of 100% scanning will not unduly upset their operations, whilst others consider it as completely unworkable and highly detrimental to the functioning of their facilities.

Thus, there are ports and terminals which can organize the scanning without creating major impediments or delays. But in other ports the prevailing conditions make 100% scanning a most intricate and costly problem, and one that has no easy or apparent solution.

The large differences in attitude and capabilities that have been observed between the different ports confirm the discriminatory nature of the 100% scanning rule. Where, however, there was initially a concern that the rule would be detrimental for the smaller ports only, further analysis has pointed out that the most serious discriminatory effects would probably affect in the first place the competitive position of some of the main ports and terminal operators in Europe.

**Impact on transport towards the port and on indirect costs**

Almost all stakeholders that were contacted and interviewed agree that there would be no major capacity problem for the different inland transport modes. They expect that inland transport costs could increase to compensate for the extra time lost in port or on terminal, but they do not expect a repeated shortage of trucks, trains or barges in the European Union. What is undeniable is the fact that 100% scanning will weaken the supply chain because there could be longer delays and more irregularity in the service schedules. This in turn could persuade shippers of U.S.-bound containers to dispatch their containers much earlier to the terminal of loading, thereby increasing both the dwell times and the risk of terminal congestion.
The impact of 100% scanning of U.S.-bound containers on maritime transport

To assess the real impact of 100% scanning on direct transport costs, it is necessary to consider the consequences for each individual shipment, each alternative routing, each selected port and chosen terminal. This is an unrealistic approach for the sort of general assessment that is called for in this study. Instead a limited number of representative scenarios were developed and the impact of 100% scanning for each these scenarios was calculated. The end conclusion from these calculations is that typically 100% scanning would add about 10% to the direct transport costs per consignment (the bracket arrived at is between 7.5 and 12.5%). The significance of the indirect costs depends on numerous factors but typical situations have been considered and representative indirect costs were calculated for these under well-defined conditions. If taken together the indirect costs resulting from 100% scanning add a significant cost burden to the total and reinforce the initial feeling that such scanning must negatively impact on the U.S.-bound trade volume.

Impact on the U.S. production using components shipped via U.S. ports

With the signing into law of the 9/11 Act, an extra burden has been added to the already cumbersome process of trade with the United States. One of the most frustrating effects of the Act for the trading partner Governments is the imposition of a U.S. mandate on trade activity in other countries and of imposing security requirements for the global industries. If anything, the Act is a restraint on international trade.

Although it may not have been the intention of the American Congress, the 9/11 Act is inherently protectionist in that it makes imports of foreign goods in the United States more arduous and onerous. The Act could, however, also have a boomerang effect in that it would make the imports of components and parts required for the U.S. industry, for which there is no substitute, more expensive and the supply chain more fragile and less stable.

In the final analysis, that most critical question that needs to be asked is whether the application of 100% scanning which, as shown in this study, carries a number of negative cost implications, can be justified by a greater impregnability of the international supply chain. The conclusion arrived at is that 100% scanning does not have any added value in terms of a reduction in the security risk. It adds nothing to the risk management approach supported in the CSI and C-TPAT initiatives and in the WCO SAFE Framework of Standards. On the contrary scanning all containers increases the work load on the CBP and other Customs greatly and may well induce the national Authorities into a false sense of security and lower their vigilance, thereby achieving exactly the opposite of what the law was intended for.
INTRODUCTION

On the 3rd of August 2007 President Bush signed into law the Implementing Recommendations of the 9/11 Commission Act (9/11 Act). This revised the SAFE Port Act provision on 100% scanning to require implementation by 1st of July, 2012 or such other date as may be established by the Secretary. The 9/11 Act stipulates that all containers loaded on a vessel in a foreign port shall not enter the United States (enter directly or via a foreign port) unless the container is scanned by non-intrusive inspection equipment and radiation detection equipment at a foreign port before it was loaded on a vessel.

The 9/11 Act constitutes a marked deviation from the Customs and Border Protection (CBP) approach of the Container Security Initiative, in which scanning of cargo is only imposed if it is identified as high risk. Consequently to the enactment of the 9/11 Act, the European Commission, Member States, port authorities, port operators, transport operators, exporters, U.S. importers and the trade community (including the World Shipping Council and the American Chamber of Commerce to the European Union) have expressed their reservations and misgivings concerning the rationale for and the practicality of implementing the 9/11 Act of 2007, in particular as regards:

− its effectiveness;
− the feasibility of its execution;
− the cost of the required changes in the set-up and organization of container terminal operations;
− its impact on the choice of port of call with a risk of concentration on centrally located ports and a loss of service level and frequency to peripheral ports;
− the possible changes in sourcing patterns;
− the effects on export competitiveness of the trading partners of the U.S. and more specifically on the negative impact on transatlantic flows between Europe and the U.S.;
− and the bearing on the global supply chain.

At the European Commission level it was agreed to prepare “a long-term assessment of the impact of 100 % scanning in order to be ready for the discussion with the new U.S. Congress and administration”. The study will analyse 100% scanning from three different perspectives, notably the impact on trade, the impact on maritime transport and the impact on customs operations and on the
security of the supply chain. The present study, which after tender procedure\(^2\), was awarded to *Policy Research Corporation* considers the impact on maritime transport of the 100% scanning obligation. It can, however, not limit itself to the impact on maritime container transport, but by necessity has to focus on the port and container terminal side, on the interfaces with the inland transport modes and on the effects on the inland transport modes themselves.

\[^2\] Tender N° TRENG2/422-2008
I. OBJECTIVE OF THE STUDY

The purpose of the study is to analyze the impact of the obligation of 100% scanning of US bound containers before shipping:

- on port facilities and ports, including their competitiveness;
- on transport towards ports and on adjacent regions;
- and finally also on the U.S. production using components shipped via European ports.

The study will first consider the security measures already implemented in EU ports and then consider the additional measures that need to be implemented to achieve 100% scanning, from a legal, technical, administrative and cost point of view. Subsequently, the impact of scanning on port and terminal operations and on hinterland transport will be assessed, first by examining the outcome of the pilot projects carried out under the Secure Freight Initiative and next by drawing lessons from the case studies of selected EU ports and terminals. Estimates of the additional cost of 100% scanning will be presented and these will cover the cost for the actual transfers to and from the scanning site, anticipated indirect costs as a consequence of reduced capacity or additional resources being made available, external costs generated by additional transport to and from the scanning site and a change in modal split and any costs or benefits resulting from changes in supply chain performance. The actual scanning cost (equipment, manning) will not be covered by this study as they were expressly excluded in the Terms of Reference for this study. The potential impact of 100% scanning on the competitive position of EU ports will be considered as well as any foreseeable impact on the U.S. production relying on the use of components shipped from or via European ports. The conclusions will concentrate on the economic consequences for the main stakeholders and on the rippling effects downstream in the supply chain.
II. STUDY APPROACH

The study started with an extensive literature search, in particular of legal documents and papers considering the operational and economic impact of the 9/11 Act. A list of the most important of these documents and papers is included in the bibliography. Data collection was then combined with a series of interviews and field trips. These were directed at Port Authorities, Terminal Operating Companies, transport operators, professional associations, forwarders and any other stakeholders. For the interviews with port and terminal operators a selection was made of 10 main European ports including the main container export ports to the U.S. This was completed with four additional ports that have a significant annual container throughput but a relatively small container export volume to the U.S.

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3 The ports included in the original list of the 10 most prominent ports include Bremerhaven, Antwerp, Rotterdam, La Spezia, Valencia, Liverpool, Le Havre, Göteborg, Zeebrugge and Amsterdam.
4 Barcelona, Hamburg, Southampton and Felixstowe.
III. CURRENT SECURITY MEASURES IN EU PORTS

Since the 9/11 attacks in 2001 a number of measures have been taken to improve supply chain security. The most important are shown in Figure 1 that details the timeline of supply security measures with regard to U.S. bound cargo.

Figure 1: Overview of U.S. cargo and supply chain security measures

The voluntary supply chain security programme C-TPAT (Customs -Trade Partnership against Terrorism) started in 2001. This is an initiative to build cooperative relationships that strengthen and improve overall international supply chain and U.S. border security. Through this initiative, CBP is asking businesses to ensure the integrity of their security practices and communicate and verify the security guidelines of their business partners within the supply chain. For certain certified C-TPAT member categories, CBP offers additional benefits. They come on top of the prime advantage of C-TPAT which is ensuring a more secure and expeditious supply chain for their employees, suppliers and customers. The additional benefits include a reduced number of CBP inspections and thus
reduced border delay times, priority processing for CBP inspections, the assignment of a C-TPAT Supply Chain Security Specialist (SCSS) who will work with the company to validate and enhance security throughout the company's international supply chain, the potential eligibility for the CBP Importer Self-Assessment programme (ISA) with an emphasis on self-policing and the eligibility to attend C-TPAT supply chain security training seminars. Since 2003 and up to 31st of December 2008 C-TPAT performed 10 367 total initial validations and revalidations.

In 2002 CBP initiated the Container Security Initiative (CSI), an initiative to push U.S. port security back into the supply chain to the port of origin. Thus, CSI proposes a security regime to ensure that all containers that pose a potential risk for terrorism are identified and inspected at foreign ports before they are placed on vessels destined for the United States. CBP has therefore stationed multidisciplinary teams of U.S. officers from both CBP and Immigration and Customs Enforcement (ICE) to work together with host foreign government counterparts. Their mission is to target and pre-screen containers based on risk analysis, radiation scan and Non-Intrusive Inspection (NII) and to develop additional investigative leads related to the terrorist threat to cargo destined for the United States. Once high-risk containers are inspected at CSI ports, they are not ordinarily inspected again upon arrival at the U.S. seaport. This means that containers inspected at CSI ports actually should move faster, more predictably and efficiently through U.S. seaports. In 2008 CSI was operational in 58 foreign ports and a total of 35 customs administrations had committed to join CSI. Some 86 percent of all maritime containerized cargo destined to the United States is now covered by CSI. The initiative has been supported by the World Customs Organization (WCO) and the European Union (EU). Also the G8 supports CSI expansion. Figure 2 shows a flow chart detailing the various steps in CSI.

**Figure 2: Various steps in the Container Security Initiative**

Due to 24-hours rule, CBP’s National Targeting Centre in Arlington (Virginia) receives cargo manifest and identifies the risk by means of the Automated Targeting System (ATS) tool

Potential risk

CSI team notifies host country’s customs inspectors of the high risk U.S.-bound containers that have to be inspected

Host government decides if it can/should conduct examination

No examination carried out

Host government scans with NII equipment (x-ray or gamma ray)

Anomaly detected?

Yes

Weapon of Mass Destruction?

Yes

Host government implements response plan

No

Container loaded onto vessel

Low risk

No

Yes

Host government conducts physical search

Host government decides if it can/should conduct examination

No examination carried out

Host government scans with NII equipment (x-ray or gamma ray)

Anomaly detected?

Yes

Weapon of Mass Destruction?

Yes

Host government implements response plan

No

Container loaded onto vessel

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Host government decides if it can/should conduct examination

No examination carried out

Host government scans with NII equipment (x-ray or gamma ray)

Anomaly detected?

Yes

Weapon of Mass Destruction?

Yes

Host government implements response plan

No
The Megaports Initiative (MI) was introduced in 2003 by the National Nuclear Security Administration (NNSA) of the U.S. Department of Energy. The initiative is a key component of a layered, multi-agency approach designed to prevent terrorists from acquiring, smuggling and using dangerous nuclear materials to develop a weapon of mass destruction or a radiological dispersion device in an attack against the United States or its global partners. To achieve its mission the Megaports Initiative works with partner countries to equip ports with state-of-the-art radiation detection equipment, sophisticated software packages and communications systems that operate in concert to indicate the presence of special nuclear material or other radioactive material in cargo containers as they move through a port. In total the NNSA identified 70 ports of interest in 35 countries, based on the volume of containers coming into the United States from these ports and also considering the regional threat. The Megaports Initiative is presently operational in following EU countries: Belgium, Greece, The Netherlands, Spain and the United Kingdom. Implementation is underway in Portugal and in additional ports in Belgium, and Spain. Figure 3 shows the different phases of the process in the Megaports Initiative and underlines the fact that both in-and outbound containers are screened on radiation. Figure 4 gives an overview of which ports in the sample of 14 main European ports participate in the CSI and MI programme.

Figure 3: Phases of the Megaports Initiative

Source: Policy Research Corporation

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5 See the “Study Approach” for a full list of the 14 ports included in the sample.
The impact of 100% scanning of U.S.-bound containers on maritime transport

Figure 4: Participation of 14 ports in CSI and/or MI

<table>
<thead>
<tr>
<th></th>
<th>CSI</th>
<th>MI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amsterdam</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Antwerp</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Barcelona</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Bremerhaven</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Felixstowe</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Göteborg</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Hamburg</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>La Spezia</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Le Havre</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Liverpool</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Rotterdam</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Southampton</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Valencia</td>
<td>yes</td>
<td>no</td>
</tr>
<tr>
<td>Zeebrugge</td>
<td>yes</td>
<td>no</td>
</tr>
</tbody>
</table>

Source: Policy Research Corporation

The Security and Accountability For Every Port Act of 2006 (SAFE Port Act) was passed by The House and Senate on 30th September 2006 and signed into law on 13th October 2006. The SAFE Port Act codifies into law a number of programmes to improve security of U.S. ports, amongst others additional requirements for maritime facilities, the creation of the Transportation Worker Identification Credential and the Container Security Initiative.

The Secure Freight Initiative (SFI) is a key provision of the SAFE Port Act of 2006 and part of the International Container Security scanning project. It is built on the partnership between the CSI and the Megaports initiative. SFI expands the use of scanning and imaging equipment to examine more U.S. bound containers, not just those determined to be high risk. Launched in December 2006 it tested the feasibility of using integrated technology which includes radiation portal monitors, non-intrusive inspection equipment and optical character recognition.

The Diplomatic Conference of the International Maritime Organisation in December 2002 amended the SOLAS (Safety of Life at Sea) Convention 1974/1988 on minimum security arrangements for ships, ports and government agencies and established the International Ship and Port Facility Security Code (ISPS Code). The measures agreed under the Code came into force on 1st July 2004 and prescribe responsibilities to governments, shipping companies, shipboard personnel and port/facility personnel to detect security threats and take preventive measures against security incidents affecting
Current security measures in EU ports

ships or port facilities used in international trade. Four main objectives of the ISPS Code can be identified:

− to detect security threats and implement security measures;
− to establish roles and responsibilities concerning maritime security for governments, local administrations, ship and port industries at the national and the international level;
− to collate and promulgate security-related information;
− to provide a methodology for security assessments so as to have in place plans and procedures to react to changing security levels.

The ISPS Code does not spell out specific measures but instead outlines a standardized, consistent framework for evaluating risk to enable governments to offset changes in threat with changes in vulnerability for ships and port facilities. Hence, for ships the requirements include ship security plans, ship security officers, company security officers and certain onboard equipment. For port facilities the Code provides for port facility security plans, port facility security officers and certain security equipment. Additionally, the requirements for ships and for port facilities include the monitoring and controlling of access, the monitoring of the activities of people and cargo and ensuring that security communications are readily available.

As regards the European Union, Regulation (EC) N° 725/2004 of the European Parliament and of the Council of 31st of March 2004 was adopted and entered into force on 19th May 2004. Its main objective is to implement Community measures aimed at enhancing the security of ships used in international trade and associated port facilities in the face of threats of intentional unlawful acts. But the regulation was also meant to provide a basis for the harmonised interpretation and implementation of Community monitoring of the special measures to enhance maritime security adopted by the International Maritime Organization (IMO) in 2002. Consequently, the Member States are required to communicate to the IMO, the Commission and the other Member States the information requested and the special measures adopted to enhance maritime security under the SOLAS Convention. Moreover, each Member State has to draw up the list of port facilities concerned on the basis of the port security assessments carried out and establish the scope of the measures taken to enhance maritime security. Other provisions of Regulation (EC) N° 725/2004 include the obligation for each Member State to vigorously monitor compliance with the security rules by ships intending to enter a Community port, whatever their origin, and the obligation of the competent maritime security authority of a Member State to demand that the information (concerning its international security certificate and the levels of safety at which it operates and has previously operated) be provided at least 24 hours in advance or, if the voyage time is less than 24 hours, at the latest at the time the ship leaves the prior port, or from a ship announcing its intention to enter a port in a Member State or if the port of call is not known, as soon as the port of call becomes know
IV. H.R. 1 IMPLEMENTING RECOMMENDATIONS OF THE 9/11 COMMISSION ACT OF 2007

The above synthesis of security measures already in place confirms the multi-layered and international response to acts of terrorism from the international community, lead by U.S. initiatives but by and large followed by a majority of other countries including the European Union and its Member States. With the mandatory 100% scanning imposed by the United States on its trading partners a new threshold has been passed. The H.R.1 Implementing Recommendations of the 9/11 Commission Act of 2007 (9/11 Act) was signed by President Bush on 3rd August 2007. What is significant here is the fact that the 9/11 Act was signed even before the pilot integrated scanning system, established under section 231 of the SAFE Ports Act of 2006, became fully operational on the 12th of October 2007 in three case study ports: Puerto Cortez (Honduras), Port Qasim (Pakistan), and Southampton (United Kingdom) and thus before any feedback on the implementation of the pilot schemes was received and analyzed. It is therefore the more interesting that in a written statement dated June 12, 2008 Deputy Commissioner Jayson Ahern of the U.S. Customs and Border Protection, summarized the results of these pilots as follows: quote “The SFI (Safe Security Initiative) deployments in Honduras, the United Kingdom and Pakistan indicate that scanning U.S. bound maritime containers is possible on a limited scale. However SFI operations in these initial locations benefited from considerable host nation cooperation, low transhipment rates and technology and infrastructure costs covered primarily by the United States Government – accommodating and supportive conditions that do not exist in all ports shipping to the United States” unquote. Initially the 100% scanning tests provided for in the SFI were carried out in the three above-mentioned ports. Then Hong Kong formally started its participation in the SFI programme in July 2007 and will continue with the test until the end of April 2009. Singapore, which initially also agreed to participate on a test basis withdrew from the SFI tests in September 2008 before the actual implementation phase started.

For the purpose of this study it may be useful to refer back to the detail of the H.R.1 (9/11 Act) that effectively provides for radiation detection and NII scanning of all U.S. bound containers on the 1st of July 2012. Title XVII – Maritime Cargo SEC. 1701 Container scanning and seals amends Section 232 (b) of the SAFE Ports Act reads:
“(1) IN GENERAL – A container that was loaded on a vessel in a foreign port shall not enter the United States (either directly or via a foreign port) unless the container was scanned by non-intrusive imaging equipment and radiation detection equipment at a foreign port before it was loaded on a vessel.

“(2) APPLICATION – Paragraph (1) shall apply with respect to containers loaded on a vessel in a foreign country on or after the earlier of –

(A) July 1, 2012; or

(B) such other date as may be established by the Secretary under paragraph (3)

“(3) ESTABLISHMENT OF EARLIER DEADLINE. – The Secretary shall establish a date under (2) (B) pursuant to the lessons learnt through the pilot integrated scanning systems established under section 231.

“(4) EXTENSIONS – The Secretary may extend the date specified in paragraph (2) (A) or (2) (B) for 2 years, and may renew the extension in additional 2-year increments, for containers loaded in a port or ports, if the Secretary certifies to Congress that at least two of the following conditions exist:

(A) Systems to scan containers in accordance with paragraph (1) are not available for purchase and installation.

(B) Systems to scan containers in accordance with paragraph (1) do not have a sufficiently low false alarm rate for use in the supply chain.

(C) Systems to scan containers in accordance with paragraph (1) cannot be purchased, deployed or operated at ports overseas, including, if applicable, because a port does not have the physical characteristics to install such systems.

(D) Systems to scan containers in accordance with paragraph (1) cannot be integrated, as necessary, with existing systems.

(E) Use of systems that are available to scan containers in accordance with paragraph (1) will significantly impact trade capacity and the flow of cargo.

(F) Use of systems to scan containers in accordance with paragraph (1) do not adequately provide an automated notification of questionable or high-risk cargo as a trigger for further inspection by appropriately trained personnel.

“(5) EXEMPTION FOR MILITARY CARGO – Notwithstanding any other provision in the section, supplies bought by the Secretary of Defense and transported in compliance with section 2361 of title 10, United States Code, and military cargo of foreign countries are exempt from the requirements of this section.

“(6) REPORT ON EXTENSIONS – An extension under paragraph (4) for a port or ports shall take effect upon the expiration of the 60-day period beginning on the date the Secretary provides a report to Congress that –

(A) states what container traffic will be affected by the extension;

(B) provides supporting evidence to support the Secretary’s certification of the basis for the extension; and
“(C) explains what measures the Secretary is taking to ensure that scanning can be implemented as early as possible at the port or ports that are the subject of the report.

From the reading of SEC. 1701 a number of salient points emerge that may significantly impact on the feasibility and the cost of 100% scanning in foreign ports of the U.S.-bound containers. These are briefly summarized hereafter:

Under (1) the obligation of scanning for a container entering the United States has been announced, irrespective of the container coming directly or via a foreign port to the United States. However, the text remains vague as to where the scanning needs to take place, as it only stipulates that it must happen before the container is loaded on a vessel in a foreign country. For inbound transhipment containers (i.e. coming to the United States via another foreign port) there remains considerable doubt as to where the scanning is allowed to take place: in the original port of loading onto feeder vessel or in the transhipment port where the container is transferred from the feeder vessel to the U.S.-bound vessel. Which port has the responsibility for scanning? Can scanning take place in either one?

The various conditions given which would allow the Secretary to extend the date of July 1, 2012 leave still a lot of uncertainty with regard to the exact values/ circumstances that would justify an extension. What is considered a sufficiently low false alarm rate? Which are the physical characteristics that would warrant the non-installation of the scanning system? What elements would be retained to accept the non-integration of the scanning systems with the existing systems in a port? To what degree can scanning systems disrupt the trade capacity and the flow of cargo before the Secretary can decide to extend the date of application?

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6 Prior to her confirmation hearing Secretary of Homeland Security, Janet Napolitano, released mid February 2009 answers to a pre-confirmation questionnaire, where she pinpointed the problems with scanning 100% of cargo entering the U.S. She indicated that she might use her authority to extend the deadline for implementation.
V. ADDITIONAL MEASURES REQUIRED FOR 100% SCANNING

V.1. WHAT ARE THE OBLIGATIONS IMPOSED BY THE 9/11 COMMISSION ACT?

From the details of the 9/11 Commission Act it can be deduced that all U.S.-bound containers must be screened and scanned in three ways: by non-intrusive inspection (NII) equipment (X-ray or Gamma-ray), by radiation detection equipment and by Optical Character Reading.

When considering the measures already in place in the European Union, NII is carried out under the Container Security Initiative if a U.S.-bound container, based on risk analysis of the container’s manifest information, is identified as high risk. National customs authorities in cooperation with CBP-officials can demand a NII of potential high-risk inbound containers. Where the Megaports Initiative is in place, the intention is to screen on radiation as many inbound and outbound containers as is possible. Also, national customs authorities can take the initiative to screen for radiation detection inbound containers identified as posing a high risk. The 9/11 Commission Act requires NII scanning and radiation detection of all U.S.-bound containers regardless of their potential risk or the size of the port. Besides, for all these containers the OCR data will have to be associated with the radiation detection and NII data. Figure 5 summarizes the required measures to implement 100% scanning of U.S.-bound containers in EU-ports, the measures that are already in place and the additional measures that need to be taken.
The impact of 100% scanning of U.S.-bound containers on maritime transport

Figure 5: Required measures for 100% scanning

<table>
<thead>
<tr>
<th>Objective of 100% scanning of U.S.-bound containers</th>
</tr>
</thead>
<tbody>
<tr>
<td>A container loaded on a vessel in a foreign port shall not enter the United States (either directly or via a foreign port) unless the container was scanned before it was loaded.</td>
</tr>
</tbody>
</table>

### Required measures

<table>
<thead>
<tr>
<th>Measures already in place</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Non-Intrusive Imaging (NII) systems using x-rays or gamma rays to penetrate all U.S.-bound containers and produce an image of the content</td>
</tr>
<tr>
<td>2. Radiation detection equipment that absorbs radiation from all U.S.-bound containers</td>
</tr>
<tr>
<td>3. Optical Character Recognition (OCR) designed to read the container’s identification</td>
</tr>
</tbody>
</table>

### Additional measures

<table>
<thead>
<tr>
<th>Radiation detection and NII scanning of all U.S.-bound containers, regardless of their (potential) risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiation detection and NII scanning of all U.S.-bound containers, regardless of their (potential) risk and size of the port</td>
</tr>
<tr>
<td>Association of OCR data with radiation detection and NII data of all U.S.-bound containers</td>
</tr>
</tbody>
</table>

Source: Policy Research Corporation

V.2. TECHNICAL REQUIREMENTS TO MEET THE OBLIGATIONS IMPOSED BY THE 9/11 COMMISSION ACT

The 100% screening and scanning obligation of U.S.-bound containers implies the deployment of radiation and NII scanners. The radiation scanners are of the portal monitor type or can be hand-held detection devices. In the case where ports participate in the Megaports Initiative the radiation scanners are provided by the Department of Energy/NNSA. One of the key problems with the current generation of radiation detection equipment that must be resolved urgently is the need for this equipment to detect shielded radiation (i.e. to detect dirty bombs and nuclear material in containers that is transported in special containments with a certain thickness of steel which are shielding the radiating substances completely).

With respect to the NII scanners, two major types exist. The high capacity NII scanners offer high speed of processing as they can scan some 150 containers per hour (some sources even mention scanning speeds of 200 containers per hour). The radiation level of these scanners is low, but so is their accuracy level. This means that there exists a high probability that a tertiary inspection is required. Based on an average scanned throughput of 150 containers per hour, assuming that scanning can proceed 5 days a week and that the scanner operates non-stop 10 hours a day, the theoretical maximum annual capacity of a single high capacity NII scanner would amount to 390 000 containers (or 585 000 TEU assuming a 50/50 split between 20’ and 40’ containers).

The low capacity NII scanners have a low scanning speed of 20 containers per hour. Their radiation level is high which implies that they require more extensive safety measures such as the need to
embed the NII equipment in concrete and to extend the peripheral area around the scanner. Its main advantage is the greater accuracy of the results and hence a lower incidence of tertiary inspection. Its annual capacity based on the same working days and working hours assumptions used above, works out at 52,000 containers per year. Thus the characteristics of the different types of NII scanners vary greatly and this will result in different impacts (with respect to location, number, organisation of transport to and from the scanner) on ports, terminals and other transport operators and in terms of cost.
VI. IMPACT OF SCANNING ON PORT AND TERMINAL OPERATIONS AND ON HINTERLAND TRANSPORT

The investigation into the impact of implementing the 9/11 Act on port and terminal operations and on hinterland transport, undertaken by Policy Research Corporation, has promptly revealed the impossibility to come to a uniform assessment of general validity for all ports. As a matter of fact, the potential impact of the Act and the logistical feasibility is to a very large extent decided by local conditions. Most significantly, the general lay-out of the port, the availability of green field areas, the type and size of the container terminals, the split between the various transport modes of the transported container volumes from the hinterland to the port (“modal split”), the number, profile and location of the road and rail accesses to the port, the volume of U.S.-bound containers handled, the importance of the transhipment throughput, the prevailing liability regime and the applicable labour laws, all of these will define the potential impact of 100% scanning as imposed by H.R.1.

This Chapter will therefore first consider in more detail the results from the pilot projects that were initiated as part of the 2006 Secure Freight Initiative and the 2007 International Container Security programme and subsequently consider the results from the case studies carried out in selected European Union ports within the present study.

VI.1. PILOT PROJECTS

As provided for in the SAFE Port Act of 2006, phase 1 of testing the feasibility of 100% scanning was initiated with the International Container Security programme in 2007. Three pilot ports were selected for full implementation (Southampton in the United Kingdom, Port Qasim in Pakistan and Puerto Cortés in Honduras). A limited implementation was agreed for four additional ports (Singapore, Busan in South Korea, Salalah in Oman and Hong Kong in S.A.R. China). Figure 6 highlights the main characteristics of the three major pilot projects.
VI.1.1. PILOT SFI IN SOUTHAMPTON

The pilot SFI in Southampton started in October 2006 and ended on 20th February 2008. Of the three “full implementation” pilot ports, Southampton had the second highest annual U.S. bound container volume (57 300 TEU) and the largest container terminal (Southampton Container Terminal - SCT - with a terminal area of 810 000 m²). Its modal split is heavily biased towards the road (70% of the total throughput representing some 2 200 containers per day). Rail takes 27% of the total and feeder vessels account for a mere 3%.

The pre-gate area which was made available and re-arranged for the application of the SFI pilot covers an area of 30 000 m². The scanning equipment included three radiation portal monitors (RPM), one advanced spectroscopic portal (ASP), one radiation ionising detection device (RIDD), one non-intrusive inspection machine (NII) and one central alarm station (CAS). The licence plate and optical scanner recognition technology was integrated with the SCT administration system. During the pilot application a total of 101 944 trucks passed through the pre-gate in the period 1st October 2007 to 20th February 2008 or an average of 713 trucks per calendar day. The results of the screening and scanning of these trucks are shown in Table 1.
Table 1: Performance of SFI pilot at Southampton Container Terminal (October 2007 – February 2008)

<table>
<thead>
<tr>
<th>Description</th>
<th>Figures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of trucks to pass through pre-gate process</td>
<td>101,944</td>
</tr>
<tr>
<td>Total number of RPM alarms</td>
<td>935</td>
</tr>
<tr>
<td>Total number of RPM alarms for non-U.S.-bound containers</td>
<td>714</td>
</tr>
<tr>
<td>Total number of RPM alarms for U.S.-bound containers</td>
<td>221</td>
</tr>
<tr>
<td>Total number of non-U.S.-bound containers sent to ASP</td>
<td>711</td>
</tr>
<tr>
<td>Total number of U.S.-bound containers sent to the ASP</td>
<td>220</td>
</tr>
<tr>
<td>Total number of unresolved RPM alarms</td>
<td>2</td>
</tr>
<tr>
<td>Total number of trucks sent to the NII machine</td>
<td>4,392</td>
</tr>
<tr>
<td>Total number of rail trucks sent through the pre-gate process</td>
<td>688</td>
</tr>
</tbody>
</table>

Source: Report on the pilot project to assess the impact of 100% scanning of US.-bound export containers – prepared by Julian Walker for DP World

No transhipment containers passed through the pre-gate but these were scanned by hand held radiation detection equipment as primary inspection tool. Additionally, 1,124 extra moves were carried out to scan containers delivered at the external rail yard. A price of £23.89 (app. €32.87) per truck trip was negotiated between SCT and Freightliner but the total paid for the 10 week period, when the rail to pre-gate transfers were fully running, was £22,307 (app. €30,648). On an annual basis this would equate with some £116,000 (app. €159,374) or £39.69 (app. €54.5) per container. Given the average Freightliner rail rate is £195 (app. €267.9) per box this additional drayage cost represents some 20% of the price of rail transport.

Additional to the commercial impact, there are also a number of operational issues regarding the rail to pre-gate transfer, notably

– the need to carry out an extra 1,124 straddle carrier moves to and from the transfer area;

– the additional work load placed on the traffic office personnel of Freightliner – this additional workload has meant that other tasks were not carried out; if the pilot would have continued, then extra personnel should have been recruited;

– because the U.S.-bound containers are very specific flows which target specific vessels these containers come down in batches on the same trains – this results in the need to double lift the containers first into storage and later into the chevrons;

– on occasion Freightliner has had to change export trains between its terminals due to the amount of containers to be scanned – this in turn has disrupted the rail network.

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7 The currency rate of £ to € used here is the average rate between the exchange rate on 1st October 2007 and 29th February 2008 and works out at 1£ = €1.37391
Thus on the rail side there is the feeling that there is a real risk that containers will be shut out from vessels, but also that 100% scanning restricts a railway operator such as Freightliner to maximise capacity and use of his equipment and that therefore it actually disadvantages rail over road.

SCT employed three external software contractors to modify and extend the existing automated gate systems to interface with SFI. Additionally there was an appreciable amount of project management time spent to deal with the various U.S. Government instructed company representatives. The overall cost of the development work amounted to US$ 40 000 (app. € 26 445)

Some other useful conclusions can be drawn from this pilot with respect to the feasibility of 100% scanning. First, it takes the scanning process some 20 minutes per container. Its implementation did neither significantly impede the flow of container traffic through the port’s container terminal, nor did it create traffic bottlenecks. There would, however, have been serious problems with the scanning of transhipment containers if this traffic segment had been more substantial and if transhipment containers had been scanned by fixed scanners. The need to carry out two extra straddle carrier moves plus a truck trip coupled with the very limited time that a transhipment container dwells in the terminal makes scanning impractical for large numbers of transhipment containers.

Moreover, 100% scanning may divert containers from railroad to truck if the extra costs incurred because of the additional transfers from the railhead or feeder berth to the scanner would be passed on to the cargo owner (in Southampton the SCT terminal waived the charges for the transfer from railhead to pre-gate). The latter means that 100% scanning may go against the environmental policy of individual governments and of the European Union.

Some peculiar problems were encountered with the 100% scanning application in Southampton. Technical problems resulted in the NII scanner experiencing down time throughout the pilot programme. The NII portal had to be modified because the height of trucks in the United Kingdom is almost a foot more than in the United States. An ecological problem, which involved a pond with a resident population of endangered turtles, resulted in the modification of the construction planning.

More serious was the problem created by the many containers arriving at the port more than 24 hours in advance of their vessel’s departure. Normally, early arrivals, when scattered over several days, very much help to improve vessel stowage planning and reduce or avoid peak traffic conditions at the gates on the departure day. It leaves the CBP though without having received the corresponding commercial data (collected under the 24-hour rule). Thus the CBP needed consent from the United Kingdom Government and the cooperation from the terminal operator to obtain nominal information on a given container that was U.S.-bound and that is particularly useful for resolving radiation alarms on shipments containing material emitting naturally occurring radiation. As the European Union places limits on the amount and type of shipping data that can be shared by Member States with other

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8 Currency rate used here is that of 29th February 2008, i.e. 1 US$ = € 0.66112
governments special agreement between CBP and DOE on the one hand and Her Majesty’s Revenues and Customs (HMRC) and SCT on the other was needed to agree that SCT would provide at least commodity and destination data for solving radiation alarms.

Finally, the United States Government was charged customs duties and Value Added Tax (VAT) by the United Kingdom Government for both the equipment and construction of the pilot SFI amounting to approximately US$ 500 000 (app. € 388 420). Eventually, CBP and DOE received temporary waivers of customs duties and VAT for the duration of the pilot, but these amounts were to come due if the pilot had been extended. HMRC ceased, however, its participation in the SFI programme after the pilot was completed as it chose not to staff the SFI site and the process reverted back to CSI protocols.

In conclusion, if the SFI pilot at SCT did not lead to significant delays of trucks or vessels, it should nevertheless be noted that a number of factors have assisted and particularly facilitated the implementation of this pilot. The existence of the obligation for pre-notification of the nominal details of a container prior to arrival in the terminal means that the container is known and that there is no shipping paperwork to be completed when the truck delivering the container arrives at the terminal. The vehicle booking system, which is mandatory at SCT, ensures that every truck arriving at the terminal has a booking which has been pre-notified if it is dropping off an export container. A vast majority of the containers passing through Southampton and SCT are import/export boxes, there are very few transhipment containers. Moreover, the number of U.S.-bound containers is a small proportion of the total number of containers handled and Southampton does not handle any barges. In most other ports the concurrence of all these favourable factors is unlikely and implementation will therefore be considerably more arduous and complicated.

VI.1.2. PILOT SFI IN PORT QASIM

The deployment of the system in Pakistan predated the SFI as it was part of the Integrated Cargo Container Control (IC3) project, a CSI and MI programme purposely developed for Pakistan. The IC3 programme involves screening through a live video link of U.S.-bound containerized cargo by CBP officials and Pakistani customs officers, coordinated between the Pakistan and the United States governments. Its building cost reached US$ 8 million (app. € 6.2 million). The actual pilot became operational on 12th October 2007. The total number of U.S.-bound containers in Port Qasim is rather limited with, for example, for fiscal year 2006 a mere 1 777 containers. Port Qasim Authorities allocated 10 acres of land for the IC3 programme, outside the terminal but adjacent to a number of terminals, out of which 5 acres would be occupied by the installation of scanning equipment and the rest are reserved for the container stacking yard. For the scanning of containers (direct U.S.-bound shipments only) the IC3 equipment is used. This includes a single NII scanner, RPM systems and handheld Radiation Ionising Detection Devices (RIDD). Containers after scanning are placed on a secured site before being shipped. The government of Pakistan has been very supportive of the initiative. It waived the Value Added Tax and provided adequate staffing levels.
There would appear to have been communication problems regarding the continuous connectivity of the IC3 system with the National Targeting Centre. Consequently, from a terminal operations point of view, when this type of problem occurs it results in a delay in clearing containers through the system and therefore through the terminal. Additionally, with only one system serving several terminals and no alternative available for scanning containers it can be expected that any single point failure in the system results in a container backlog which can not be cleared.

Interviews with two prominent US importers, both bringing into the United States 625 containers annually (period August 1st, 2006 till July 31st, 2007), shipped from Port Qasim, revealed that they had not experienced any issues or negative effects from the CBP’s container scanning programme. They favour, however, risk-based targeting over 100% scanning. Their fear is that implementing total scanning of all U.S.-bound exports from foreign ports will result in increased lead times. They also pointed out that maybe the scanning systems may have sufficient capacity to accommodate the volume of containers in the port of Qasim, but that substantial delays could occur associated with the reading, reviewing, transmission and interpretation of the scanned data.

Prior to the IC3 project Port Qasim containers were diverted to and scanned at ports in Hong Kong, Colombo, Sri Lanka, Salalah and Saudi Arabia before they were shipped to the U.S. The CBP statistical data show that during the trial a 3 percent increase in the total number of exported containers was recorded in Port Qasim. This traffic increase could well be the result of exporters preferring to use a port with a screening and scanning programme offering at least in theory the possibility to cut the time required to get through at U.S. import ports. What it certainly brings to light is the fact that 100% scanning has the potential to change the routing of cargoes through the supply chain and may favour some ports or terminals to the detriment of others.

VI.1.3. Puerto Cortés, Honduras

The port of Puerto Cortés handled in fiscal year 2006 a total U.S.-bound export throughput of 77,707 containers. The figure in TEU according to the U.S. Customs statistics for the same year would be 162,741. The port’s total reported throughput was 507,946 TEU. No transhipment activities took place. Of the three SFI pilot ports this makes it the one with the highest number of U.S.-bound containers. There were, nevertheless, significant challenges to be overcome during the implementation of the pilot.

The first one was the limited availability of advance electronic data in Puerto Cortés whilst containers arrive days in advance of their loading on board ship. Thus, since manifest data is received by CBP only 24 hours in advance of departure virtually all containers arrive at the port gate without the

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9 As reported by DP World in their letter of 10th March 2008 to the Director SFI.
manifest data being submitted. All containers will proceed through the scanners and then the U.S.-bound and non U.S.-bound containers will be separated on the basis of a documentation review by the Honduran Customs personnel present on the scanning site, later to be validated by CBP once it receives the manifest data.

The second challenge had to do with the fact that the NII equipment in Puerto Cortés was purchased by the Government of Honduras on its own and in advance of the development of integrated radiation scanning systems. This resulted in a number of integration difficulties between the older generation equipment and the radiation detection equipment used in the SFI pilots. It explains why reliability was adversely affected and the overall data quality was poor, at least in an initial phase. An identical problem occurred with respect to the incompatibility of the scanning equipment with the N.25 standard used by the CBP systems. This was a consequence of the implementation of the DOE’s Megaports Initiative in Puerto Cortès before the SFI selection of the port. A retrofit of the scanning system with the N.25 standard became necessary and this caused temporary system reliability issues.

Health and safety issues attributable to potential radiation exposure from the scanning equipment lead to the labour unions expressing their concerns. To solve this problem the Unites States government provided a safety fact sheet of the equipment which contained independent research on the scanning equipment’s safety.

Finally, CBP staff safety concerns limited the working time to six days a week (from 8 a.m. to 6 p.m.). Indeed, the CBP staff had to travel back and forth from the port to CBP housing on a route with a high crime rate. Hence, any U.S.-bound container that triggered an RPM gamma alarm at times, when the CBP’s staff was not present, was sent to a holding area and handled by the CBP officers at their return the next shift. For neutron alarms no holding was possible and therefore the Dirección Ejecutiva de Ingressos (DEI) immediately had to notify the CBP officers who then directed what next actions needed to be taken.

Additional to the views and information provided both by CBP and DEI, very interesting information on Puerto Cortes has been made available in a study by Allison Bennett and Yi Zhuan Chin on the security policy implications for global supply chains of 100% container scanning. The port had previous to the 9/11 Act purchased 3 NII scanners starting in 2005. Because of union concerns the port allows private contractors to drive vehicles with export containers through the NII equipment instead of union drivers. One contractor has been hired to perform the NII equipment scanning. For this he charges US$ 27.50 (app. € 21.4) per scan with a reduction in price to US$ 25.00 (app. € 19.4) when annual scanning exceeds 200 000 containers. The port estimates that the investment cost for the

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11 Comosa
Installation of 3 RPMs and associated communications systems amounts to US$ 4.5 million (app. € 3.5 million). Honduran customs added 26 staff members to support the RPM and NII scanning operations.

Important to note is that Puerto Cortès utilizes the DHS “reach back” network to obtain technical assistance for alarm adjudication. Under the 9/11 Act, national governments may need to provide their own alarm adjudication assistance which could be a serious problem for countries without nuclear energy bodies, laboratories and university research partnerships.

Since 1st October 2007 all export containers are scanned in the port, regardless of destination. No significant delays in processing have been reported but the port handled in 2007 only 140,554 containers. Their experience may therefore not be valid for much larger ports with significant transhipment traffic and high levels of container transport by barge from the hinterland.

The status of implementation of the 100% scanning in the SFI pilot ports, as well as the main observations in this regard, have been summarized in Figure 7. It can be concluded that the SFI pilots do not constitute fully representative cases, because of the small U.S.-bound container volumes, the limited number of transhipment moves, the dominance of the road mode for transport from the hinterland to the port and the shorter than normal average dwell times in these ports. What is more, the SFI pilots did not give a sufficient insight into the total cost of the scanning operation or the economic cost resulting from possible constraints and delays.

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12 A 24-hour alarm assessment assistance by technical and scientific experts in the U.S.
The impact of 100% scanning of U.S.-bound containers on maritime transport

Figure 7: SFI pilot projects: status of implementation and main observations

<table>
<thead>
<tr>
<th>SOUTHAMPTON</th>
<th>PORT QASIM</th>
<th>PUERTO CÓRTEZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Pre-terminal gate scanning area (Radiation Portal Monitor or RPM, advanced spectroscopic portal, seal check and NII)</td>
<td>• Scanning area outside the terminal, adjacent to a number of terminals</td>
<td>• Scanning area at the port/terminal gate</td>
</tr>
<tr>
<td>• Additional time of 20 minutes for 100% scanning</td>
<td>• NII and handheld Radiation Ionising Detection Devices (RIDD)</td>
<td>• NII, RPM and handheld RIDD</td>
</tr>
<tr>
<td>• All (regardless the container’s destination) trucks pass through the scanning area</td>
<td>• Placement of scanned containers on a secured site before being shipped</td>
<td>• NII equipment was purchased by the government of Honduras</td>
</tr>
<tr>
<td>• 101 944 trucks passed through the pre-gate between 1 October 2007 and 20 February 2008</td>
<td>• 100% scanning of direct U.S.-bound containers only</td>
<td></td>
</tr>
<tr>
<td>• No scanning of transhipment containers</td>
<td>• Scanning by Integrated Cargo Container Control (IC3) equipment, CSI programme purposely developed for Pakistan</td>
<td></td>
</tr>
<tr>
<td>• 1 124 extra moves to scan containers delivered by rail ($50/move, covered by SCT)</td>
<td>• Exported volume increased by 3%</td>
<td>• Difficulties with regard to integrating the older NII equipment with the SFI’s radiation detection equipment</td>
</tr>
<tr>
<td></td>
<td>• Communication problems between IC3 system and U.S. National Targeting Centre</td>
<td>• Problems with regard to health and safety issues (radiation exposure)</td>
</tr>
<tr>
<td></td>
<td>• Delay in clearing containers through system and therefore through terminal</td>
<td>• Personnel safety issues made scanning impossible during week-ends</td>
</tr>
</tbody>
</table>

Observations with regard to 100% scanning

- Implementation and operation did not significantly impede the flow of container traffic through the port's container terminal, nor has it resulted in traffic bottlenecks
- Worries about the risk of a future shift of containers presently delivered by rail to deliveries by truck
- Exported volume increased by 3%
- Communication problems between IC3 system and U.S. National Targeting Centre
- Delay in clearing containers through system and therefore through terminal
- Difficulties with regard to integrating the older NII equipment with the SFI’s radiation detection equipment
- Problems with regard to health and safety issues (radiation exposure)
- Personnel safety issues made scanning impossible during week-ends
- SFI pilots do not constitute fully representative cases with regard to the impact of 100% scanning of U.S.-bound containers because of space constraints, shorter dwell times and larger container volumes handled at the other international ports and terminals
- Insufficient insight into total cost of scanning (e.g. investments, hardware and software, infrastructure, superstructures, staff, variable and indirect costs)
- Capturing transhipment and barge containers without seriously impeding the flow of container traffic through the port's terminal gate

Source: Policy Research Corporation

VI.2. RESULTS FROM THE SFI PILOTS IN PORTS PARTICIPATING IN A LIMITED CAPACITY

VI.2.1. THE PORT OF SINGAPORE – TERMINAL OPERATOR PSAC

Singapore is, by throughput, the first container port in the world (some 29.9 million TEU in 2008). Of these between 85 and 90% (some 24 million TEU) are transhipment containers. The total number of U.S.-bound export containers amounted in 2006 to 376 846 containers.13

The CBP approached Singapore in November 2006 requesting its participation in the SFI to scan all U.S.-bound containers prior to their arrival in the U.S. Singapore agreed in December 2006 to participate in the programme in a limited capacity. The purpose was to evaluate the feasibility of 100% scanning in a high volume transhipment and hub port like Singapore. It was agreed to limit the trial to the terminal on Pulau Brani and only involve containers shipped by APL. The quantity of containers scanned would progressively be increased during the trial.

Singapore started planning with the CBP team in January 2007 for an implementation scheduled for January 2008. In order to provide for the possibility for the equipment to be removed after the end of
the trial, CBP decided to deploy mobile and re-locatable NII and RPM portals which delayed the trial
till May/June 2008. In August 2008 CBP announced that the port of Singapore decided not to
participate any longer in a test scheduled to begin in the second half of 2008. No extensive
explanation was provided on the reasons for Singapore’s withdrawal. CBP stated, however, that after
careful consideration of trial results and feedback from the first three SFI pilots it decided to focus on
high-risk trade corridors in order to maximize the security benefit realized given the limited resources
available. This statement though stands in stark contrast with the rationale provide by the same CBP
in December 2007 when it said that Singapore was a “key location” for 100% scanning in part
because it is the world’s largest port in terms of volume of transhipments and sixth in terms of the
volume of shipments and containers imported in the United States.

Although the SFI trial in Singapore has been cancelled it is still of interest to consider the comments
made by the Ministry of Transport of Singapore on the 3rd of March 2008 and which were appended
to the CBP report to Congress on integrated Scanning System Pilots. They merit close scrutiny
because of their relevance to the present study.

13 Note that the 2008 throughput is given in TEU, whilst the figure for US-bound export containers for 2006 (the latest year
for which full data is available) is given in actual containers. Typically in Singapore 1 container is equivalent to 1.6 to
1.65 TEU.
The remarks formulated first covered infrastructure, port operator and security issues as well as the cost of implementation:

- Infrastructure issues: Most, if not all available land is either already used or unsuitable to be a SFI site. To accommodate the SFI trial PSAC would have to give up an existing container yard and doing so carries a high cost premium when traffic is growing at 12% per annum. The cost of leasing the land is approximately US$ 0.5 million (app. € 0.39 million). More costs are involved in setting up a “tertiary inspection” site for the trial.

- Port operator issues: Setting up the trial involves considerable costs for the terminal operator. Such costs include personnel costs (for planning the trial and supervision of the preparatory works), the cost of modifying the PSAC IT system, the operational cost of deploying extra prime movers as well as additional utility costs. PSAC estimates the total to come to US$ 1.5 million (app. € 1.2 million) to support the one year planning and six months trial.

- Security issues: To assist the CBP officers at the CAS to direct containers for tertiary and additional inspections, the Singapore government will be employing auxiliary police officers (APO). CBP officers have no legal jurisdiction to request a container in Singapore to undergo inspections. That is why these APOs are bestowed with limited police powers to facilitate authorization for such inspections. To engage the APOs for a 6-months trial will cost about US$ 0.4 million (app. € 0.3 million).

- Cost of implementation: the cost of the trial at one terminal for six months will be more than US$ 2.4 million (app. € 1.9 million). The potential cost of implementing a 100% scanning study to cover the four terminals in Singapore together with the operating cost of conducting the scanning will therefore be many times higher.

The second set of remarks made by the Ministry of Transport of Singapore dealt with the detailed assessment of SFI scanning on port efficiency and logistics cost:

- Given the layout of the scanning site and the equipment that needs to be installed there, it would take about 2 minutes to drive through one set of SFI equipment, have its image analysed and then cleared to continue. If no alarm is raised for both the RPM and NII scans one set of SFI equipment can handle 30 containers per hour. Assuming a 24 hour continuous operation of the scanners the number of containers that can be handled is some 720 per day. PSAC handled on average 1000 containers per day with peaks of up to 1500 containers per day over its four terminals which means that a minimum of four sets of SFI equipment need to be installed as well as their ancillary infrastructure. Another complication is that not all four terminals handle the same amount of U.S.-bound containers and that some may require more than one set of SFI equipment.

- Increased cycle times: the planned concept for the SFI trial in Singapore was to scan the U.S.-bound transhipment containers upon discharge from the feeder vessels when they arrive at PSAC. This means that new routes will have to be established for the prime movers to bring the U.S.-bound containers to the scanning site. On average, the prime movers may travel up to 4 kilometres from the discharging berth to the container stacking yard (where these containers will await their connecting ship to the U.S.) and back to the feeder. Because with scanning there will be a need to divert the containers to a specially earmarked site another 2 kilometres will be added to the travelling distance of the prime movers. Given that the average travel speed is about 25 kilometres per hour, the extra travel will increase the travel time per full transfer cycle from 9.6 to 14.4

14 It is quite unlikely that the scanner will be able to maintain day after day and hour after hour this maximum design rate of 30 containers. It would be more realistic to expect a 20 hour effective working day and a scanning rate of around 20 to 25 containers. This would result in a daily scanning output of between 400 and 500 containers.
minutes. It reduces the number of trips the prime movers can make, assuming 2 extra minutes for passing through the scanner from 6.25 to 3.67 per hour.

- Based on an average deployment of 5 prime movers to support one quay gantry crane and three gantry cranes per feeder vessel carrying 300 containers for discharge in Singapore, it is possible without SFI scanning to discharge 31 containers per quay gantry crane per hour (5 prime movers taking away 6.25 containers per hour). With SFI scanning the handling rate per quay gantry crane will be reduced to 20.8 containers or 5 prime movers taking away 3.67 containers per hour (but this figure doesn’t include the time needed to go through the scanning equipment – if this is taken into account the quay gantry crane rate drops to 18.35 containers). Such a substantial drop in output of the quay has serious implications for the deployment of the terminal operator’s quay gantry cranes. His ability to provide the required number of quay gantry cranes to all the ships in operation at his berths is weakened and he will not be able to maintain the fast turnaround times he previously could offer his customers.

- Following the same reasoning as above, with SFI scanning the output rate of the quay gantry cranes will be seriously jeopardized. Before SFI scanning, working a feeder vessel with three quay gantry cranes would have allowed a turnaround time of the feeder vessel at the berth of:

\[
300 \text{ containers} / 31.25 \text{ containers per hour per quay gantry crane} \times 3 \text{ quay gantry cranes} = 3.2 \text{ hours.}
\]

With SFI scanning (without counting the two minutes per transfer cycle needed for going through the scanning equipment) this turnaround time at berth becomes:

\[
300 \text{ containers} / 20.8 \text{ containers per hour per quay gantry crane} \times 3 \text{ quay gantry cranes} = 4.8 \text{ hours}
\]

With SFI scanning (counting the two minutes per transfer cycle needed for going through the scanning equipment) this turnaround time at berth becomes:

\[
300 \text{ containers} / 18.35 \text{ containers per hour per quay gantry crane} \times 3 \text{ quay gantry cranes} = 5.4 \text{ hours}
\]

Based on:

- the Singapore figures and the figures adjusted to take into account the time to go through the scanning equipment
- the total volume of U.S.-bound containers shipped from Singapore to the U.S. in 2006 (376 846 containers)

it is possible to calculate that if a feeder vessel brings to Singapore on average 300 containers for export to the U.S. and that for every vessel call, on average at least 1.6 hours vessel time will be lost because of SFI scanning (5.4 hours minus 3.2 hours), then the accumulated total annual vessel time lost equates to: [(376 846 containers/300 containers per vessel)] x [1.6
The impact of 100% scanning of U.S.-bound containers on maritime transport

hours] = 2 010 hours. Taking an average voyage charter rate of US$ 5 000 per day\textsuperscript{15} (app. € 3 900) then the total lost vessel time would have an equivalent value of US$ 418 750 per annum (app. € 325 300).

In conclusion to clear 300 containers arriving on a feeder vessel will take more than 70% more time at berth. This affects the carrier in two ways. First he will have to pay more than 70% extra berth charges (as these are calculated in Singapore on time spent at berth). Secondly the feeder vessel’s transport capacity will be reduced and if this is reflected in the freight rate per container carried it will make the feedering of the containers more expensive.

It is important to point out that the figures presented by PSAC do not take into account the additional 2 minutes required to pass through the scanners. If this additional time loss is included the loss in vessel time in the port of Singapore would be equivalent to US$ 575 800 (€ 447 800) and the feeder vessel would stay 70% extra time at berth.

The third set of remarks looked at the legal and liability issues. These considered the question of which party would have to bear the cost of tertiary inspections of suspected containers and of delays because it is quite likely that some of the suspected containers will miss their onward connections. The time needed to complete a tertiary inspection was estimated by the PSAC at minimum 8 hours. Some transhipment containers spend, however, not more than 4 hours in the terminal before catching their next vessel and will therefore, if considered suspect, miss their connection. Someone will have to bear the cost of this delay but which party should be accountable has as yet not been established. Another legal and liability issue crops up when suspected cargo is damaged during a tertiary inspection required by CBP officers and is subsequently found to be clean. Will the cargo owner/shipper have the right to claim compensation from the United States Government? After all, the inspections are ordered by the United States CBP officers.

No doubt, given all the above remarks and particularly taking into account the fact that Singapore already participates in the Container Security Initiative (CSI) and in other supply chain security programmes (C-TPAT), it is not very surprising that the Government of Singapore has had second thoughts with respect to its participation in the SFI pilot.

VI.2.2. THE PORT OF HONG KONG – TERMINAL OPERATOR MODERN TERMINALS LIMITED

Hong Kong is a major business hub and one of the container ports with the highest annual container throughput (24 million TEU in 2008). It handles a large volume of U.S.-bound export containers. For 2006 the total amounted to 1 333 812 containers, by far the highest volume of all pilot ports. Hong

\textsuperscript{15} At charter rates for container vessels quoted in January 2009.
Kong was also one of the first ports to sign on the CSI in partnership with the industry from the Special Administrative Region (S.A.R.).

On 27th July 2007 the Government of Hong Kong S.A.R. and the United States Government exchanged letters of understanding on launching a SFI pilot in Hong Kong which was intended to be limited in scale and duration. Under the pilot all containers bound for the U.S. delivered through the gate of Modern Terminals Ltd. (MTL) were to be subjected to scanning on a voluntary basis by the Integrated Container Information System (ICIS) operated by MTL. As was agreed between the two Governments, the Hong Kong Customs and Excise Department was to be responsible for any enforcement actions, including alarm adjudications, against any suspected illicit trafficking. The pilot began its test runs on 19th November 2007 and was scheduled to end on 30 April 2008. But between 19th November 2007 and 10th January 2008, the ICIS malfunctioned on a rather frequent basis and was shut down for 450 hours over 29 days in a 52 day period (representing a break-down rate of 35.6%).

After strengthening the on-site technical support to MTL by the manufacturer, the equipment has been operating properly, but given the initial problem period, it was decided to only use data collected from 11th January 2008 till 24 February 2008 for the analysis presented by the Hong Kong Government to the CBP in preparation of the latter’s report to Congress. During the retained period a total of 8 029 U.S.-bound containers went through the designated gate. Of these 2 416 were scanned. A total of 33 alarms were recorded (an alarm rate of 1%). A total of 10 tertiary inspections were carried out and all were found to be low risk alarms.

The Hong Kong Government came to a number of conclusions with respect to port efficiency and cost, practicalities, tangible benefits for participation, data ownership, legality and liability and finally equipment. Because of their relevance for this study the main conclusions will be briefly commented hereafter.

− Port efficiency and cost: given Hong Kong’s high container throughput and limited land for terminal operations as well as a very competitive regional port climate, any port security initiative when applied to Hong Kong should consider the costs and benefits. Thus the implementation of any new port security measures should not unduly affect the efficiency of the port or impose onerous costs on traders and businesses.

− Practicalities: transhipment accounts for nearly half of the total volume of cargoes passing through the port. A very significant part of this involves the transfer of containers between local barges and river trade vessels at the quayside without going through the in-gate. The practicality of scanning transhipment cargoes needs to be considered.

− Tangible benefits of participation: in order to get the support from traders and businesses it is important to prove the tangible benefits to participants. This can be achieved by for example giving greater facilitation in clearing cargoes when they arrive at the US port of entry.

− Data ownership, legality and liability: stakeholders from industry have raised questions regarding the detailed rules governing data ownership, legal frame and terminal liability resulting from SFI scanning. These need to be addressed in any long-term security arrangement.
Equipment: the importance of being able to operate with functionally reliable scanning equipment cannot be over emphasized. Moreover, any equipment must meet the health and safety standards of the host governments and deal with the concerns of users, in the first place the truck drivers as every day they may have to go more than once through the scanning system. Concern has been expressed regarding the long term effects of frequent exposure to radiation on health.

The report of the Hong Kong Government concludes by stating that the limited pilot had not been sufficiently long in operation for the full implications of SFI scanning to become clear, such as the effect on efficiency, cost implications, health risks and ownership of data collected. Further information on the SFI pilot in Hong Kong was provided by the terminal operator MTL. The pilot only scanned U.S.-bound export containers that were delivered to the terminal by truck. The 40% that come down to Hong Kong by barges and river vessels and the 30% transhipment containers were not included and thus not scanned. Transhipment containers come from smaller Asian countries without direct U.S. calls and the capacities of the ports of origin are limited. It would therefore seem natural to establish capabilities in Hong Kong to scan these volumes. By making this point the MTL management implicitly acknowledges the inherent potential of 100% scanning to affect trade flows and contribute to the diversion from smaller less equipped ports to larger well provided ports. MTL also points out that during the pilot truck drivers in Hong Kong could go through the scanning equipment on a voluntary basis. For 100% scanning this will not be an adequate arrangement and hence there is a need for CBP to actively work with the Hong Kong Government to close the gap from voluntary to mandatory. In conclusion MTL notes that if 100% scanning is to become a reality then the CBP needs to continually engage the entire supply chain communities to ensure that they see the true benefits and buy into the programme. Which is the same as asking the CBP to clearly state what would be the indisputable and direct benefits of 100% scanning to such external stakeholders that would help to offset the extra efforts and cost demanded from them.

VI.2.3. PORT OF BUSAN – TERMINAL OPERATOR HUTCHISON PORT HOLDINGS

The SFI pilot in Busan was carried out on the Hutchison Port Holdings (HPH) Gamma Terminal. Preparations started in April 2007 with the formation of a task force by the Korean Government. Operational testing began in late May 2008. The Government of Korea as well as HPH have been strong partners and supporters of the pilot and have tried to remedy many of the challenges that arose. In particular of concern has been the challenge made by the unions concerning health and safety of the drivers using the NII equipment, notwithstanding the fact that the equipment, after testing by the Korea Institute of Nuclear Safety, was authorized. Other complications included the export licensing of the NII scanner and staffing concerns for the SFI pilot.

In a letter from the Korean Government to the CBP, the former drew attention to the fact that if a full implementation of the SFI programme by 2012 would be maintained, it would be necessary to install at least 20 sets of SFI equipment in the port of Busan alone, in order to process the same number of U.S.-bound containers as was handled by the port in 2007 (in the order of some 700 000 TEU or
In its recommendations the Government of Korea points out that the United States Government will have to provide further necessary assistance for full scale 100% SFI scanning to the countries participating in the SFI given the considerable financial burden for purchasing and operating the equipment. More importantly the Government of Korea voices its concerns with respect to the possible disruption of cargo flows because of the possibility of traffic congestion occurring in the outgoing ports or incoming U.S. ports as physical barriers and traffic signage are used to regulate the flow of traffic through the various detection processes. Finally, the Government of Korea underlines the risk that SFI is used during cargo inspection at the U.S. ports as a non-tariff trade barrier and a means of unjustified discrimination.

The reaction of the terminal operator HPH is given in a letter addressed to the Director SFI in preparation for the latter’s report to Congress. Although not specifically referring to the experience of the pilot on the Gamma terminal in Busan (quite normal because the operational phase of the pilot had not started by then), HPH in opposition with all other stakeholders including their competitors in the terminal operations field, considers SFI as a commercial opportunity and wishes no backing off from complying with the 9/11 Act for scanning all U.S.-bound containers.

The terminal operator does nevertheless admit that at present there is no solution for scanning transshipment containers. He does believe that adequately funded R&D could come up with the solution to this problem, without offering though any indication on what this R&D could be based on. As for the funding problem of the SFI this is seen as an opportunity for the private sector to manage the 100% scanning activity and make it a revenue generator. Hence, the private operator would invest in the SFI equipment (which should have a flow-through speed of at least 200 containers per hour), maintain and operate it and charge for it by way of a fee to be paid by the cargo. It is nonetheless only fair to point out that the HPH position has been strongly opposed by the views expressed by most other stakeholders who see 100% scanning as a public responsibility and not a commercial opportunity.

To conclude with the review of the results from the pilot ports it is probably appropriate to refer the United States Government Accountability Office report “Challenges to scanning 100 percent of U.S.-bound cargo containers” which listed nine main challenges that need to be overcome. This listing is presented in Figure 8. Not surprisingly, this listing is a perfect echo of all the comments, remarks and criticisms levelled at 100 percent scanning by the stakeholders in the SFI pilot ports as well as the direct actors (government ministry, port authority and terminal operator). Probably, one of the most serious critiques that the United States Government urgently needs to address is that of the obvious inconsistency between the 100% scanning obligation and the CSI and C-TPAT approaches in which risk management principles take centre stage.
The impact of 100% scanning of U.S.-bound containers on maritime transport

Figure 8: Challenges with regard to 100% scanning according to GAO

According to the U.S. Government Accountability Office (GAO), 100% scanning of U.S.-bound containers faces 9 challenges:

1. CBP’s workforce planning to review and analyze data will be critical to success
2. Host nation examination systems are not systematically evaluated by U.S. Department of Homeland Security (DHS)
3. Difficulties in defining performance measures to indicate whether security is increased by 100% scanning of U.S.-bound containers
4. Clarify resource responsibilities: no specifications available on who will bear the costs
5. Solve logistic problems with regard to scanning locations and transshipment containers
6. Solve difficulties with regard to technology and equipment compatibility and infrastructure capacity
7. Difficulties with regard to ownership and sharing of data between U.S. and foreign countries
8. Inconsistency of 100% scanning with risk management principles as proposed by CSI
9. Reciprocity of 100% scanning, called by foreign governments and trade concerns

Source: Policy Research Corporation

VI.3. CASE STUDIES OF SELECTED EUROPEAN UNION PORTS

VI.3.1. GENERAL OBSERVATIONS

In order to arrive at a better understanding of the true economic impact on the ports of the European Union of 100% scanning as made mandatory in the 9/11 Act, it was decided as part of the methodology of the underlying study to obtain general information and exchange views with stakeholders in a number of European ports which would provide a representative sample of the U.S. bound container trade from Europe. Figure 9 shows graphically all fourteen ports that were included in the sample as well as the total outbound tonnage they handled in 2007, the total outbound containerized tonnage and the total U.S.-bound containerized tonnage. In total the sample covers 18.5 million tons of U.S.-bound containerized goods. This represents 4% of the sample ports’ total outbound cargoes and 9% of their total outbound containerized cargoes.
Figure 9: U.S.-bound containerised cargo in the 14 selected European ports


Figure 10 provides further detailed information as it shows the number of TEUs per European Union port that were shipped to the U.S. in 2007. In this graph a total of 46 ports have been included, with the 14 ports of the sample representing some 2.0 million TEU out of the 2.6 million TEU of all U.S.-bound TEU shipped from the European Union. This is approximately 25% of all imported containers in the U.S. Accordingly, the sample ports handled 80% of the total U.S.-bound containerized exports from the European Union. More significantly is the fact that just three ports (Bremerhaven, Antwerp and Rotterdam) already handled close to 60% of the total U.S.-bound containerized exports (1.5 million TEU out of a total of 2.6 million TEU). Consequently, for some European Union ports the challenge posed by 100% scanning will be significantly bigger than for other ports. In the group of ports with a high exposure to the consequences of 100% scanning one should include, based on the TEU throughput volume alone, apart from the top three ports already mentioned, the ports of La Spezia, Valencia, Liverpool, Algeciras, Felixstowe, Hamburg and Barcelona.
The impact of 100% scanning of U.S.-bound containers on maritime transport

Figure 10: Number of U.S.-bound TEUs per European Union port

![Figure 10: Number of U.S.-bound TEUs per European Union port](image)

**Source:** Policy Research Corporation based on Eurostat (2007)

In principle the twenty five ports with a U.S.-bound containerized export level of less than 20 000 TEU per annum (from Göteborg to Amsterdam in Figure 10) can expect lesser investment and operational costs and fewer delays, but they risk loosing their small U.S.-bound traffic volumes altogether to larger neighbouring ports (Amsterdam and Vlissingen to Rotterdam, Málaga to Valencia, Zeebrugge to Antwerp, etc.) given that whatever extra costs are incurred, resulting from 100% scanning, these will have to be recovered from a much smaller container traffic base. The middle group of five ports (from Southampton to Bilbao on figure 10) with typically an annual U.S.-bound containerized export of between 30 000 and 60 000 TEU) could probably not fare better than the group of ports with marginal U.S.-bound containerized exports. Other factors such as the modal split and the degree of transhipment may also affect the level of exposure. What becomes quickly apparent when discussing the implications of 100% scanning with ports, terminal operators and users is the fact that possible repercussions almost entirely depend on such factors as: port lay-out; terminal lay-out; number of container terminals in the port and their positioning; modal split; number, profile and location of the port’s road and rail accesses and the significance of U.S.-bound containerized exports in a port’s or terminal’s throughput.
VI.3.2. THE IMPACT OF PORT AND TERMINAL LAY-OUTS ON THE FEASIBILITY AND COST OF 100% SCANNING

Scanning of containers in ports, regardless of their destination is bound to create additional disruptions to the supply chain. The main challenge when implementing 100% scanning in ports is to minimize the consequences of such disruptions. Their consequences can be significant and are much influenced by factors such as the location, the size and the lay-out of the port and of the terminals. To allow for a better appreciation of the significance of these three factors, it is useful to consider first the typical container flow through a terminal when no scanning is required. Figure 11 details the various phases of such a flow through a container terminal which is being served by all three modes of inland transport. This flow chart would remain valid with the implementation of the 100% scanning obligation introduced by the 9/11 Act, but a number of additions and supplementary steps would be required. What these are, where and when they take place very much depends on the lay-out of the port and its terminals.

Figure 11: Typical container flow through a container terminal

Source: Policy Research Corporation

With the SFI scanning requirement of the 9/11 Act, three major and interrelated questions arise regarding its implementation:

− Which authority will be responsible for the scanning?
− Which parties will make the necessary investments needed to allow for 100% scanning?
− Where will the scanning and possibly the tertiary inspection of the containers physically take place?

The Authority that should logically be responsible for the scanning can be expected to be a public authority because 100% scanning is basically a security-related and non-commercial issue specifically targeting exports. Thus, the most obvious party to be made responsible for the scanning of all US-bound export containers at the port of loading would be the national Customs of the exporting country. This does, however, not signify that the Customs need themselves to carry out the physical scanning. The activity could be sub-contracted to a specialized operator but would anyway remain under the full supervision of the Customs. It is probable though, that most national governments will prefer their own Customs personnel to be fully in charge of the scanning and of all the resulting physical and documentary tasks. If the answer to the first question is that the national customs
authorities will be in charge, then it would seem natural to expect them also to invest in the required infrastructure, equipment, I.T. hardware and software. In the real world, this question may receive a somewhat more complex and qualified answer. For example the infrastructure could be provided either by the Port Authority or the Terminal Operator. The equipment could be provided by another government department or made available by the United States government (under the Megaports Initiative or its successor scheme, if any). The I.T. hardware and software would no doubt have to be acquired by the party that is made responsible on the national level for carrying out the SFI scanning properly.

The answers to the first two questions will help to give the appropriate answer to the third question regarding the physical location of the scanners. Possible scanning sites are:

- Outside the port gates on a specially developed area;
- At the port’s gate(s) which need to be suitably laid-out and equipped with sufficient scanners to avoid queuing and long truck waiting times;
- On a specially developed area inside the port but outside the container terminal;
- At the terminal gate(s) which need to be properly modified and extended to avoid queueing and long truck waiting times;
- Inside the terminal on a specially reserved and developed site.

A factor that will play a not insignificant role in the choice of location for the scanning equipment is the availability of the necessary space needed for such scanning facilities. This raises the more general question of space availability in the port area in general and on container terminals in particular.

Because of space constraints the pilot SFI in the port of Southampton for example was sited outside the container terminal at a pre-gate facility. The lay-out of the scanning area and the various scanning sites - Radiation Portal Monitor (RPM), Advanced Spectroscopic Portal (ASP) and Non Intrusive Inspection (NII) - in the pre-gate area are detailed in Figure 12. The total area occupied by the scanning site proper amounts, as indicated earlier, to some 30 000 m². This area excludes though space required for normal truck parking and for temporary holding areas to keep trucks waiting during peak scanning times. During the pilot application the average number of boxes scanned was 713 per day, each requiring at least some 3 to 4 minutes for passing through all of the various scanning phases in the “scanning street”. Assuming the facility would be effectively operational 310 days a year the total annual scanning capacity could be up to a maximum of 221 000 containers. This performance can only be attained, however, if a number of conditions are met, namely:

- if equipment reliability is 100 percent;
- the terminal has an electronic vehicle booking system with a limitation on the number of trucks that can be allowed per hour through the gate;

16 This would mean operating the scanners all days in the year except Sundays and three official holidays.
17 Based on 310 days x 24 hours x 30 containers per hour.
the trucking mode is dominant;
all containers arriving by truck are scanned whatever their destination;
and no containers arriving by feeders or barges, are scanned.

**Figure 12: Pre-gate scanning area, SFI Pilot Southampton**

Some of the European ports, e.g. the port of Rotterdam, have been studying the possibility, in order to improve the efficiency and capacity of the scanning process, to develop in-line scanning lanes as pictured in **Figure 13**.

**Figure 13: Inspection lane**
These lanes would allow for the full integration of fixed RPM, NII and OCR equipment and could therefore boost the number of scans when compared with the numbers scanned in a fragmented process. Because the number of movements would be limited to a strict minimum (one truck would go through the entire scanning process in one single continuous movement), the risk of congestion building up at the scanning site would be reduced. The total service time would be lower and for the same number of arrivals in a given time period and the same utilisation level of the scanners the probable waiting time of the trucks would diminish. The latter would certainly be the case if the inspection lane concept was linked to a vehicle booking system, but this would imply the need for each terminal in a port to have its own dedicated inspection lane. On the downside of the “inspection lane” concept is the amount of space that would be required, especially if each terminal separately would have to provide for its own scanning site as well as for adjacent parking, holding areas and areas for tertiary inspection.
VII. **THE ECONOMIC COST IMPACT OF 100% SCANNING**

The imposition of 100% scanning carries economic cost consequences. These are of two types. First there is the direct transport related costs supported by the cargo interest and thus ultimately borne by the consumer. Secondly, there are the indirect costs resulting from the less than optimal functioning of the supply chain (delays, congestion, claims and poorer resource utilization resulting in capacity loss) and which will burden national economies and make the supply chain less robust and reliable. Both types of economic cost will be considered and explained in more detail in this Chapter.

VII.1. **THE DIRECT TRANSPORT COSTS OF 100% SCANNING**

The elements that are included in the direct transport costs for a shipment of a container from point of origin to point of destination are determined by a set of factors. The most obvious of these are the distance to be covered by both maritime and inland transport means, the choice of inland transport mode, the applicable and applied tariffs and the specific requirements of shippers and receivers. Moreover, the nominal and relative cost of each individual cost element incurred in the supply chain tends to fluctuate over time and varies significantly from service provider to service provider, from transport mode to transport mode, from port to port and from terminal operator to terminal operator. Hence, a general insight of the potential impact of 100% scanning on the direct costs of transport can only be obtained, by constructing a limited number of representative scenarios and a cost model using realistic indicative parameter values that present a fair sample of the most typical situations. To determine the exact impact of 100% scanning on the transport cost for a particular shipment it will be necessary to enter into this cost model all the relevant data pertaining to such a shipment. The obtained result will then, however, only be valid for that simple shipment and no further general conclusions can be drawn from it.

For the purpose of the study and to gain a better insight into the impact of 100% scanning on transport cost, three possible alternative scenarios were constructed for two different transport options. The latter refer to the transport distance: a first option for a long inland transport distance of 500 kilometres before and after the maritime leg and a second option for a short inland transport distance of 100 kilometres. The retained scenarios consider the three possible inland transport modes. By combining all the least favourable cost assumptions in one calculation and all the most favourable in
another it is then possible to determine an upper and a lower cost range of the cost impact of 100% scanning. The results of the calculations are presented in Figure 14 and Figure 15.

The basic cost data used to calculate the obtained results demand some further explanation. This is given hereafter for each subsequent cost element shown in the figures. The cost of road, rail and barge transport in Europe is based on current representative rates for transporting a container over one kilometre: € 1.55 per kilometre by road, € 0.88 per kilometre by rail over long distances, € 2.35 per kilometre by rail over short distances, € 0.53 per kilometre by barge over long distances and € 2.0 over short distances. In the two scenarios developed for the assessment of the transport costs, the basic inland transport distance and the costs per container per kilometre for rail have been assumed to be similar in Europe and in the U.S. Barge transport in the U.S is an exception. It has therefore been replaced by a rail transport segment. Cost information on road trucking in the U.S. points at a cost equivalent to € 2.0 per container per kilometre.

The cost of stacking and restacking of containers on the container terminal itself (before and after scanning) has been put at between € 25 and € 35 per move in the higher cost range scenario. This reflects the disparity in the prices invoiced by terminal operators for these additional moves. It is assumed that these stacking and restacking costs actually include three distinct moves: the horizontal transfer move and the vertical pick-up/put-down moves.

Depending on the distance of transfer between the terminal and the scanner, the extra transport cost to the scanning location will greatly vary. This distance depends in the first place on the size of the port estate and the chosen site for the scanners. In the upper cost range calculation, a cost of € 200 for the two horizontal transport moves has been taken as representative for ports with a centralized off-dock scanning site. In ports where the scanning sites are adjacent to the container terminals a cost of € 100 for the two horizontal transport moves has been retained (the lower cost range calculation). Both these calculations assume that the scanning doesn’t take place at the terminal gates or on an on-dock scanning site. If this were the case, the internal transfer cost would have to be included but not the transfer cost to the off-terminal scanning site. The internal transfer cost would be equivalent to two times a horizontal transfer move (the two additional pick-up/put-down moves have been counted in the stacking and restacking costs) or between € 50 and € 70 per container.

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18 These are typical values but obviously significant differences in applied rates will occur depending on the precise conditions (time, place, type of cargo, etc.) under which the transport is carried out.
The economic cost impact of 100% scanning

Figure 14: Impact of 100% scanning on direct transport costs: upper cost range

Source: Policy Research Corporation
Figure 15: Impact of 100% scanning of U.S.-bound containers on direct transport costs: lower cost range

Source: Policy Research Corporation
Terminal Handling Charges (THCs) are the next cost item included in the total transport cost calculation. THCs were traditionally set by shipping line “conferences” for all their member lines, but since the European Union ended the liner conferences’ collective pricing and removed the “block exemption” at midnight on the 17th October 2008, each line has to set its own THCs separately without consultation with other lines. In principle the THCs should be determined on the basis of the price paid by the carrier to the container terminal operator for handling his containers (an all-in handling charge). Hence a THC should reflect the terminal’s capital and operating cost, the level of productivity achieved and the recorded level of throughput. In reality carriers, when setting the THC levels, are guided by a host of different factors and considerations of which the actual charge they pay to the terminal operator is only one. Not surprisingly then that THC levels vary from carrier to carrier and from trade to trade. The THCs for the trade between Europe and the United States, used in the calculation of Figure 14 and Figure 15, have been set in N.W. European ports at respectively € 115 per container (for the lower cost range calculation) and € 195 per container (for the higher cost range calculation). This cost differential is explained by the fact that a same shipping line levies different THCs for different ports in Europe (e.g. € 100 for ports in Finland and Cyprus and € 200 for ports in Germany). The two rates used are typical average THC values in European ports to-day. For the U.S. ports the difference in THCs between ports are less pronounced (for example NYK quotes € 450 for all U.S. ports), but in general the THCs for U.S. ports are considerably higher than for European ports as they reflect much higher labour costs and lower productivity and throughput levels. For U.S. ports an average of € 350 per container has been used in Figure 14 and Figure 15.

Both in European and U.S. ports a security charge related to the implementation of the ISPS code is charged. For European ports the average has been taken at € 10, whilst for U.S. ports this has been assessed at € 5.

The next cost component retained in the calculations is the maritime freight. Freight rates differ substantially from carrier to carrier and are strongly influenced by the trading conditions prevailing at a particular point in time. In the calculations, which cover the transatlantic route between N.W. Europe and the United States, the rate of € 420 per 20 ft container currently quoted by European carriers has been used as a typical reference rate. To this basic freight rate, one needs to add a Bunker Adjustment Factor of € 140, a Currency Adjustment Factor of € 45, a low sulphur surcharge of € 10 and a chassis usage fee of € 45. Thus freight plus all the extras works out at € 660 per container.

VII.2. RESULTS FROM THE CALCULATION OF THE EXTRA LAND-BASED TRANSPORT COSTS BECAUSE OF SCANNING

In the upper cost range calculation, with all scanning carried out at a distant off-dock site and for an inland transport distance of some 500 kilometres, all security related costs in the European port of origin amount to some € 280 per container of which € 270 are due to the 100% scanning obligation. Total transport cost by truck from point of origin to point of destination totals € 3 300 per container.
Hence the scanning cost in Europe, when using the road transport mode, represents for the cargo interest an 8.5% increase in total direct transport costs. If rail transport is relied upon to cover the same distance, the impact of 100% scanning on the direct transport costs is 11.6%, whilst for the barge transport mode (barge mode in Europe but rail mode in the U.S.) the impact is 12.5%. These are significant increases at the time that shippers and receivers are trying to contain their total transport bill. If all containers that were shipped from Europe to the United States would be facing the upper range level of cost increase, the total extra transport bill would amount to € 440 million (1 619 000 containers paying € 270 costs related to 100% scanning).

In the lower cost range calculation, it is assumed that the scanning takes place at a less distant site and that the inland transport distance is some 100 kilometres. Then, all security related costs in the European port of origin amount to some € 160 per container of which € 150 are due to the 100% scanning obligation. Total transport cost by truck from point of origin to point of destination now totals € 1 680 per container. Hence the scanning cost in Europe when using the road transport mode still represents for the cargo interest a 9.5% increase in total direct transport costs. If rail and barge transport is relied upon to cover the same distance, the impact of 100% scanning on the direct transport costs is 7.5% and 8.5%. If all containers that were shipped from Europe to the United States would be facing the lower range level of cost increase the total extra transport bill would amount to € 243 million (1 610 000 containers paying € 150 costs related to 100% scanning).

The calculations carried out for the various scenarios and options lead effectively to the same general conclusion. The imposition of 100% scanning on the European side will result in an increase by around 10% overall of the direct transport costs borne by the cargo interest and thus ultimately by the industrial, public or private consumers. The various assumptions and parameter values used in the calculations of Figure 14 and Figure 15 have been selected to present a realistic overall cost picture for transport from a European hinterland origin to a U.S. hinterland destination. Admittedly, for every shipment, the input data that would be valid, is likely to vary from around those values used in the above calculations, depending on the exact location of the points of origin an destination, the available transport modes, the timing of the shipment, the level of urgency given to the shipment, the chosen routing and the selected ports of loading and discharge, the choice of maritime carrier, the choice of inland carrier, the site of the scanner with respect to the loading terminal and many other factors that determine routing and cost level. The upper and lower range calculations do, however, represent typical values and confirm that the potential direct transport cost increase, because of the 100% scanning obligation, will be significant and at least some 10% of total transport cost.

VII.3. INDIRECT ECONOMIC COSTS

The impact of 100% scanning will not only generate additional direct economic costs, but also indirect economic costs. The latter are often hidden and hence far more difficult to identify and
The economic cost impact of 100% scanning

quantify. The supply chain can be expected to be hampered in various ways by the introduction of 100% scanning and each of these impediments would generate indirect economic costs. The more apparent and significant of these would be the following:

- A reduction of the handling capacity of the container terminals as a consequence of increased container dwell times;
- An increase in the turnaround time of the inland transport means (trucks, trains, barges) delivering containers to the port terminals;
- An increase of the external costs consequential to a shift from rail and barge to truck mode;
- An increased cargo inventory cost as a consequence of the extended transit times of the goods destined for the United States.

In this Chapter, each of the four mentioned root causes for an increase in indirect economic costs will be considered in turn.

VII.3.1. A REDUCTION OF THE HANDLING CAPACITY OF THE CONTAINER TERMINALS

The interviews with major stakeholders in the supply chain, in particular container terminal operators, have revealed the risk that containers could remain longer in the container stacking yards than is presently customary. The most frequently cited reasons given for such an extension of the container dwell times are:

- The likelihood that shippers, anticipating potential delays caused by the scanning process and or the need for a tertiary inspection, would bring their U.S.-bound export containers several days earlier to the terminal, in order to ensure that the container will not miss the vessel on which it is booked;
- The additional time required for those U.S.-bound containers that arrive by feeder vessel or barge, to go through the lengthier operational sequence put in place to allow the 100% scanning of these containers at an off-terminal location;
- The extra time needed to cope with U.S.-bound containers arriving in batches by block train and which need to be channelled from the railhead to the scanning site with or without moving through the terminal gates;\(^\text{19}\);
- The additional time needed to cope with U.S.-bound containers arriving in batches by barge and which need to be transferred from the barge terminal or main terminal to the scanning site and after the scanning is completed need to be send back again to the main terminal.

Opinions tend to differ on the length of the added dwell time, but the given estimates were generally in a range of between 2 and 3 days extra for U.S.-bound containers. The expectation that U.S.-bound containers would arrive earlier has also repercussions on the time that other outbound containers will be delivered for shipment. Whether this is a rational reaction of the shippers is irrelevant. What can be expected is that these containers would equally be delivered somewhat earlier as well, in order to

\(^{19}\) Clearly, the exact routing of the container will depend on the location of the railhead – is the railhead on the terminal or not and does the container have to pass through the gate to be scanned on an off-terminal site?
The impact of 100% scanning of U.S.-bound containers on maritime transport

avoid any unpleasant surprises or unforeseen delays due to the scanning of all U.S.-bound containers. The negative impact of longer dwell times on terminal capacity (see Figure 16) is well-known and not surprisingly it is much dreaded by terminal operators, who have limited influence over this factor except through the introduction of a penalty storage charge on long-staying containers. This, in any event, is only possible if the carriers agree with such a tariff measure. Figure 16 illustrates well the impact of longer dwell times on the required holding capacity of a terminal for a given annual throughput. Thus, for example, for a terminal with an annual throughput of 600,000 containers, equivalent to 960,000 TEU, if the average dwell time is 5 days the required holding capacity should be 13,151 TEU slots (excluding a peak allowance). But it should be 18,411 TEU slots if the dwell time increased by 2 days and became 7 days.

Figure 16: Impact of longer dwell times on terminal capacity and required holding capacity

Table 2 and Table 3 show the effect of dwell time on the required space expressed in square metres, as it gives the differential space requirement for any given dwell times between 1 and 10 days. It is

This has often not been the case. For commercial reasons, carriers will frequently plead with terminal operators to waive such penalty storage charges. Only in the case of severe port congestion have they been more amenable to the application of such charges.

The holding capacity of a storage area on a container terminal, normally expressed in TEU slots, is the number of TEUs that a stacking area can store at any one time.

Based on a split of 60% 40ft containers and 40% 20ft containers.
based on a space requirement per TEU of 35 m² for a terminal operating a RTG system and of 45 m² for one operating a Straddle Carrier system.

Table 2: Differential space requirement in additional m² – RTG system

<table>
<thead>
<tr>
<th>New dwell time</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>26,301</td>
<td>52,603</td>
<td>78,904</td>
<td>105,205</td>
<td>131,507</td>
<td>157,808</td>
<td>184,110</td>
<td>210,411</td>
<td>236,712</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>26,301</td>
<td>52,603</td>
<td>78,904</td>
<td>105,205</td>
<td>131,507</td>
<td>157,808</td>
<td>184,110</td>
<td>210,411</td>
<td>236,712</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>26,301</td>
<td>52,603</td>
<td>78,904</td>
<td>105,205</td>
<td>131,507</td>
<td>157,808</td>
<td>184,110</td>
<td>210,411</td>
<td>236,712</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>26,301</td>
<td>52,603</td>
<td>78,904</td>
<td>105,205</td>
<td>131,507</td>
<td>157,808</td>
<td>184,110</td>
<td>210,411</td>
<td>236,712</td>
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<tr>
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<td>0</td>
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<td>52,603</td>
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<tr>
<td>6</td>
<td>0</td>
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<td>52,603</td>
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<td>131,507</td>
<td>157,808</td>
<td>184,110</td>
<td>210,411</td>
<td>236,712</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>26,301</td>
<td>52,603</td>
<td>78,904</td>
<td>105,205</td>
<td>131,507</td>
<td>157,808</td>
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<tr>
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<td>0</td>
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<td>52,603</td>
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<td>210,411</td>
<td>236,712</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
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<td>157,808</td>
<td>184,110</td>
<td>210,411</td>
<td>236,712</td>
</tr>
</tbody>
</table>

Source: Policy Research Corporation

Table 3: Differential space requirement in additional m² – Straddle Carrier System

<table>
<thead>
<tr>
<th>New dwell time</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>47,342</td>
<td>94,685</td>
<td>142,027</td>
<td>189,370</td>
<td>236,712</td>
<td>284,055</td>
<td>331,397</td>
<td>378,740</td>
<td>426,082</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>47,342</td>
<td>94,685</td>
<td>142,027</td>
<td>189,370</td>
<td>236,712</td>
<td>284,055</td>
<td>331,397</td>
<td>378,740</td>
<td>426,082</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>47,342</td>
<td>94,685</td>
<td>142,027</td>
<td>189,370</td>
<td>236,712</td>
<td>284,055</td>
<td>331,397</td>
<td>378,740</td>
<td>426,082</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>47,342</td>
<td>94,685</td>
<td>142,027</td>
<td>189,370</td>
<td>236,712</td>
<td>284,055</td>
<td>331,397</td>
<td>378,740</td>
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</tr>
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<td>426,082</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>47,342</td>
<td>94,685</td>
<td>142,027</td>
<td>189,370</td>
<td>236,712</td>
<td>284,055</td>
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</tr>
<tr>
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<td>236,712</td>
<td>284,055</td>
<td>331,397</td>
<td>378,740</td>
<td>426,082</td>
</tr>
</tbody>
</table>

Source: Policy Research Corporation

Table 4 summarizes the calculation of the total required storage area for both operating systems. The total difference for the straddle carrier operation amounts to an additional investment of € 12.4 million; this investment differential is € 4.8 million for the RTG operation. The investment cost can be converted in an annual capital cost, to which should be added the annual maintenance cost and the land cost. For the latter the annual lease rent or concession fee offers a good approximation. Table 5 shows the total differential on an annual basis and per container based on design capacity.

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23 It is only an approximation because the annual rent or concession fee usually covers also the use of the quay-wall.
Table 4: Example of the capital investment cost differential in paving as a result of a two-day increase in average dwell time (from 5 to 7 days)

<table>
<thead>
<tr>
<th>Straddle-carrier operation</th>
<th>RTG operation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average dwell time</strong></td>
<td></td>
</tr>
<tr>
<td>5 days</td>
<td>7 days</td>
</tr>
<tr>
<td>Holding capacity (n° of TEU slots)</td>
<td></td>
</tr>
<tr>
<td>13 151</td>
<td>18 411</td>
</tr>
<tr>
<td>Holding capacity with 40% peak allowance</td>
<td></td>
</tr>
<tr>
<td>18 411</td>
<td>25 775</td>
</tr>
<tr>
<td>Average stacking height</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>TGS requirement with 40% peak allowance</td>
<td></td>
</tr>
<tr>
<td>9 206</td>
<td>12 888</td>
</tr>
<tr>
<td>Area per TGS</td>
<td></td>
</tr>
<tr>
<td>45 m²</td>
<td>45 m²</td>
</tr>
<tr>
<td>Total required stacking area</td>
<td></td>
</tr>
<tr>
<td>414 270 m²</td>
<td>579 960 m²</td>
</tr>
<tr>
<td>Cost per m² stacking area per year</td>
<td></td>
</tr>
<tr>
<td>€ 75/m²</td>
<td>€ 75/m²</td>
</tr>
<tr>
<td>Investment cost of stacking area</td>
<td></td>
</tr>
<tr>
<td>€ 31.1 million</td>
<td>€ 35.5 million</td>
</tr>
</tbody>
</table>

Source: Policy Research Corporation

Table 5: Example of the total cost differential in paving as a result of a two-day increase in average dwell time (from 5 to 7 days) – terminal with throughput capacity of 600 000 containers – 960 000 TEU

<table>
<thead>
<tr>
<th>Straddle Carrier</th>
<th>RTG operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Investment cost differential</td>
<td>€ 12.4 million</td>
</tr>
<tr>
<td>2 Annual capital cost (20 year depreciation and interest at 8%)</td>
<td>€ 1.26 million</td>
</tr>
<tr>
<td>3 Annual maintenance cost (5.0% of differential investment cost)</td>
<td>€ 0.62 million</td>
</tr>
<tr>
<td>4 Annual rental fee (based on a rental fee of € 8.0 per m² per year)</td>
<td>€ 8.0/m² x 165 690 m² = € 1.33 million</td>
</tr>
<tr>
<td>5 Total annual cost differential (2) + (3) + (4)</td>
<td>€ 3.21 million</td>
</tr>
<tr>
<td>6 Extra cost per container handled (based on a throughput of 600 000 containers)</td>
<td>€ 5.35</td>
</tr>
</tbody>
</table>

Source: Policy Research Corporation

Table 5 makes it quite clear that an increase of just two days in average dwell time (from 5 to 7 days) translates into a cost increase per container (based on the design throughput capacity of 600 000 containers per year in the example of € 5.35 for a straddle carrier operation and of € 2.20 for a RTG operation. In the latter case, however, because some 74 000 m² additional stacking area are added,
there will a requirement to allocate additional RTGs even if the RTGs operating on the base terminal area would part of their time also be allocated to serve some of the added area as well. To illustrate the cost impact of allocating extra RTGs it is assumed that there will be a need for at least two more and that the annual cost of an RTG is €415,000. This would add another €1.38 in equipment cost to the extra paving cost of €2.20, bringing the total additional cost up to €3.58.

The above calculations provide an order of magnitude for the additional costs caused by a moderate increase in dwell time and the resulting need for more stacking space. The main problem in many terminals is, however, that although more stacking space is needed no extra space can be made available. What this then means is that longer dwell times will then substantially reduce the terminal’s capacity (in the example developed above this would mean a reduction in throughput capacity from 600,000 to 428,600 containers and from 960,000 to 686,000 TEU). If it is assumed that, if the full design capacity of the terminal is reached, the actual cost of handling is €80, then the loss of capacity due to an extended dwell time of two days would mean that the cost of handling would go up to €112 reflecting a drop of 28.5% in handling capacity. Hence for each container handled the cost would increase by a very significant €32. This is the direct consequence of the large fixed cost element in the terminal operating cost.

VII.3.2. LOSS OF VESSEL TIME - AN INCREASE IN THE TURNAROUND TIME OF FEEDER VESSELS

As already emphasized with respect to the SFI pilot in the port of Singapore, the full application of the 100% scanning rule may result in the loss of valuable feeder vessel time because of a lower ship handling productivity. It was calculated that for every feeder vessel bringing on average 300 U.S.-bound containers, at least 1.6 hours of vessel time would be lost because of scanning. If, for instance, annually 100,000 containers are delivered for export to the U.S., scanning of these containers will lead to a total vessel time loss of approximately 533 hours or 22 days per annum. Taking an average charter rate of €3,900 per day, the annual total lost vessel time would amount to €86,665. Hence, if clearing U.S.-bound feeder traffic takes more time at berth due to the full application of the 100% scanning rule and the resulting reduction in gantry crane productivity, carriers could be affected in two ways:

---

24 The €415,000 annual cost is based on an annual capital cost of €120,000 (assuming an investment cost of 1.0 million per RTG, a depreciation period of 15 years, an interest rate of 8 percent), annual labor cost of €150,000, annual maintenance costs of €75,000 and annual fuel costs of €70,000.
25 With an increase of the dwell time from 5 to 7 days the same terminal area will only be able to handle 71.5% of the initial design capacity.
26 This is a reasonable assumption for a terminal with a capacity of 600,000 containers per year. The €80 would be the actual cost of handling a container from the ship till delivered on inland transport mode or vice versa. It is neither the price agreed between terminal operator and carrier or the THC.
27 A final comment on the impact of longer dwell times is appropriate. In the example the increase was from a typical average of 5 days to 7 days. The relative impact on cost and capacity would have been more significant if the average dwell time increase of two days was from 3 to 5 days.
28 [(100,000 containers/300 containers per vessel)] x [1.6 hours].
29 At charter rates for container vessels quoted in January 2009.
− where berth charges are calculated on time spent at berth, the carrier would have to pay more port dues;
− the vessel’s transport capacity would be reduced; resulting in higher slot costs.

In conclusion, as illustrated in the above calculated example, 100% scanning of U.S.-bound containers can increase berth charges by more than 50% and reduce the feeder vessels annual operating capacity. In the final analysis this will mean more costly feeder transport and in the long run maybe less transhipment volumes to handle.

VII.3.3. AN INCREASE IN THE TURNAROUND TIME OF THE INLAND TRANSPORT MEANS

The interviews with stakeholders have brought to light some difference in appreciation regarding the impact of 100% scanning on the three main hinterland transport modes. With respect to the barge and rail mode, the general opinion is that these would not be unduly be burdened by the imposition of the 100% scanning rule for U.S.-bound containers. But even to-day, without this rule in force, both the rail and barge mode encounter serious difficulties in the main European ports.

According to a specialist source on inland waterway transport, a barge typically spends some 44% of the total voyage time in inland ports and in the seaport, either waiting for a berth or being loaded or discharged. Given that the same barge spends 13% of the total voyage time in inland ports for carrying out the same activities, it can be deduced that in sea ports some 30% of the total voyage time is lost because of waiting for a berth30. This high percentage of waiting is, however, not surprising and can be explained by two main factors:

− A majority of barges arrive at terminals unannounced or if announced with a considerable delay on their given ETA (this is because barges deliver often small quantities of containers to a multitude of terminals in the same port and because delays encountered on previous terminals tend to accumulate). Only barges operating in a dedicated service of a defined carrier are better in maintaining their ETA as they mostly call at one or a limited number of terminals in the same port on scheduled days or within agreed time windows;

− Most ports and terminals today do not offer special “barge berths”, hence barges compete for berthing space with sea-going vessels. Few, if any barge operators have a contractual arrangement with the terminal operator. The latter only enters into service contracts with shipping lines and these contracts provide often for specified berthing windows and even penalty clauses if the terminal operator cannot offer a berth during this window. It is therefore standard for a terminal operator to allocate in priority his resources to the operation of the sea-going vessels and not to the handling of barges, which arrive randomly at his terminal takes second place. In recent years, especially for high volume terminals, operators have been planning and building special made-to-measure barge berths in order to minimize the waiting time of the barges and allow their operation at better suited facilities (e.g. shallower draught berths which are more adequate for receiving barges) and equipment (lower profile gantry cranes, gantry cranes with a long landside outreach and a wide rail span, etc.).

30 See also in this respect “The congestion question” in “Containerisation International” – February 2009
The existing problem with barges at container terminals is not at all related to scanning, and the introduction of 100% scanning of U.S.-bound containers will probably only marginally aggravate the current situation with respect to the barge waiting time. The reason for this is that containers arriving by barge and required to pass through the scanning equipment (probably located off-terminal) will in any event, after being discharged, be first placed in a temporary stack on the terminal before being transferred to the scanning area and then returned to the terminal, awaiting loading on board of the sea-going vessel in the export stack. The problem is therefore one of containers staying longer than before on the terminal, as the container dwell time will include both the time before and after scanning. The issue of longer dwell times was discussed and its effects quantified in the previous section.

As for rail transport, the late arrivals of block trains on terminals have been proverbial, at least in the past. The unreliability of the block train arrivals on container terminals has many causes, but prominent amongst those are:

- The absence of dedicated rail tracks for cargoes (except for the Betuwé line in the Netherlands) resulting in many stops in shunting yards;
- The practice of putting deep-sea and short-sea containers on the same block trains making it necessary to call at different terminal railheads;
- Infrastructural bottlenecks and insufficient coordination between the various rail operators

Again, none of the above listed problems occurs because of 100% scanning. Its introduction would either increase the dwell time of containers in the port terminal, exactly as it does for containers delivered by barge or it would substantially increase the need for holding capacity at the off-terminal railheads. Hence, it can be seen once more as a problem of longer dwell times impacting on the capacity of the rail terminals involved.

For road transport the situation is very different if the U.S.-bound containers are to be scanned before entering the container terminal where the vessel will be loaded. There is a general consensus amongst the interviewed stakeholders that the 100% scanning operation will typically add at least between one and two hours to the total travel time of the truck and if this would regularly occur (as will be the case if 100% scanning of all U.S.-bound containers becomes the rule), trucking companies will definitely start to bill this extra time. The current hourly cost of a truck is some € 55$^{31}$ and thus the extra trucking costs in Europe could typically be between € 55 and € 110, at least if waiting time at the scanning site does not exceed 1 to 2 hours. As pointed out in the Chapter describing the arrangements in various European ports, with the introduction of the 100% scanning rule it will be necessary to significantly increase the scanning capacity. If this extra capacity is not available, then queues at the scanning sites will quickly start to build up and, in the worst case scenario, may start to impede on other cargo flows in the ports. Waiting times could then become much longer than the 1 to 2 hours assumed in this

$^{31}$ This is based on a container truck with an annual transport performance of 105 000 kilometers.
The impact of 100% scanning of U.S.-bound containers on maritime transport

report. Undoubtedly, this will then lead trucking companies to increase their trucking rates by a much bigger proportion than warranted by the extra waiting time, in order to compensate for the increased operational uncertainty (when will the trucks thus caught up in the queue be available for the next shipment?) and the resulting impossibility to optimize the allocation and use of their assets.

**VII.3.4. AN INCREASE OF THE EXTERNAL COSTS CONSEQUENTIAL TO A SHIFT FROM RAIL AND BARGE TO TRUCK MODE**

In ports where the scanning site would be off-terminal, additional transport by truck would be required for containers delivered by barge or rail to the terminal of loading. The direct cost for this transport was already included in the cost calculations of Figure 14 and Figure 15. The use of the truck mode does also generate external costs. These costs include CO2 emissions, air pollution, noise pollution, safety and use of space. *Table 6* shows representative upper and lower values for these external costs expressed in € per kilometre as applied in the Marco Polo programme.

**Table 6: External cost of trucking (in €)**

<table>
<thead>
<tr>
<th>Type of external cost</th>
<th>External costs for road per 1000 tonnes/km</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accidents</td>
<td>5.44</td>
</tr>
<tr>
<td>Noise</td>
<td>2.14</td>
</tr>
<tr>
<td>Pollutants</td>
<td>7.85</td>
</tr>
<tr>
<td>Climate costs</td>
<td>0.79</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>2.45</td>
</tr>
<tr>
<td>Congestion</td>
<td>5.45</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>24.12</strong></td>
</tr>
</tbody>
</table>

*Source: European Union’s Marco Polo programme*

Using the values of *Table 6* the external cost of the extra transport for transferring all U.S.-bound containers to the scanner, has been calculated for different modal splits based on a total of 1 625 000 U.S.-bound containers (2 600 000 TEU) and assuming an average distance between terminal and scanner of 5 kilometres.

If all containers would need to be transferred from the terminal to an off-terminal scanning site the total external cost would amount to:

\[ 1\ 625\ 000\ \text{containers} \times 10\ \text{ton/container on average} \times 10\ \text{kilometres} \times 0.0241\ \text{€/tonne-kilometre} = € 3\ 916\ 250 \]

If 75% of the containers would have to be transferred the external cost would be € 2 937 000 and if that percentage would drop to 50% then the external cost would amount to € 1 958 000.
Far more dramatic could be the medium to longer term effect on modal split of a greater reliance on truck transport to bring the U.S.-inbound containers to the loading terminals from the more distant hinterland. Such greater reliance on the road could be the result of the extra cost added to the total transport bill by at least two additional horizontal moves and two vertical moves (€ 50 to € 70 per container) if containers are delivered by rail or barge. For many shippers, or those deciding on the inland transport mode, this could be sufficient reason to revert back to the use of the trucking mode as this would avoid the added expenditure. Based on the differential external costs calculated for the Marco Polo programme\textsuperscript{32} for the three modes, Table 7 and Table 8 show the total differential external costs for respectively the rail and barge mode if different levels of reversion to truck would occur.

Table 7: External cost reverting back from the rail to road mode (in €)

<table>
<thead>
<tr>
<th>Total number of containers</th>
<th>Hinterland transport distance</th>
<th>Average weight per container</th>
<th>Percentage reverting back to road</th>
<th>Differential external costs between rail and road</th>
<th>Total additional annual external costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 600 000</td>
<td>100</td>
<td>10</td>
<td>0.1</td>
<td>0.0118</td>
<td>1 880 000</td>
</tr>
<tr>
<td>1 600 000</td>
<td>100</td>
<td>10</td>
<td>0.2</td>
<td>0.0118</td>
<td>3 776 000</td>
</tr>
<tr>
<td>1 600 000</td>
<td>500</td>
<td>10</td>
<td>0.1</td>
<td>0.0118</td>
<td>9 440 000</td>
</tr>
<tr>
<td>1 600 000</td>
<td>500</td>
<td>10</td>
<td>0.2</td>
<td>0.0118</td>
<td>18 880 000</td>
</tr>
</tbody>
</table>

Source: Policy Research Corporation

Table 8: External cost reverting back from the barge to road mode (in €)

<table>
<thead>
<tr>
<th>Total number of containers</th>
<th>Hinterland transport distance</th>
<th>Average weight per container</th>
<th>Percentage reverting back to road</th>
<th>Differential external costs between rail and road</th>
<th>Total additional annual external costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 600 000</td>
<td>100</td>
<td>10</td>
<td>0.1</td>
<td>0.0201</td>
<td>3 216 000</td>
</tr>
<tr>
<td>1 600 000</td>
<td>100</td>
<td>10</td>
<td>0.2</td>
<td>0.0201</td>
<td>6 432 000</td>
</tr>
<tr>
<td>1 600 000</td>
<td>500</td>
<td>10</td>
<td>0.1</td>
<td>0.0201</td>
<td>16 080 000</td>
</tr>
<tr>
<td>1 600 000</td>
<td>500</td>
<td>10</td>
<td>0.2</td>
<td>0.0201</td>
<td>32 160 000</td>
</tr>
</tbody>
</table>

Source: Policy Research Corporation

The total differential external costs, depending on the percentages that will revert back to trucking from the mode previously used, vary from € 5 096 000 per annum (assuming rail and barge each lose 10% to trucking and the average transport distance is 100 kilometres) to € 51 040 000 (assuming rail and barge lose each 20% to trucking and the average transport distance is 500 kilometres).

\textbf{VII.3.5. INCREASED CARGO INVENTORY COSTS}

As already pointed out, many of those interviewed for the study hinted at the probability that 100% scanning could add two to three days to the present transit time of the cargoes destined to the United States. Additional transit time could be due to containers missing the loading vessel or because U.S.-bound containers are delivered for shipment several days earlier than before to avoid that particular

\textsuperscript{32} The differential external costs between road and rail amount to 0.0118 per tonne/kilometer and between road and barge to 0.0201.
problem. Extended transit time would result in an increase in inventory costs. These need to be considered as another indirect economic cost.

It is not possible at this point in time to assess accurately how many containers would be delayed, as the 100% scanning rule does not apply yet and there is no precedent to refer to. But assuming that on average all containers exported from Europe to the United States would encounter a delay of just one day the inventory cost, calculated on the basis of a 5% opportunity cost of the capital tied up, would amount to:

\[
1\,625\,000 \text{ containers} \times \varepsilon 30\,000/\text{container} \times 0.05/365 = \varepsilon 6\,678\,082
\]

In this calculation the average cargo value has been taken as € 30 000 per container. Clearly, there are wide variations in cargo value, as can be seen from the claim figures received by insurers for lost containers in major maritime casualties\(^33\). Average cargo values used by insurers in their calculations oscillate, however, around € 25 000 to € 30 000 per container.

Inventory costs do not always give a representative value of the cost incurred by the importer/cargo owner. A two day delay could be catastrophic in the case of a Just-in-Time consignment which fails to meet the deadline (parts arriving too late can stop a production line, fashion goods not being available during a special promotion event because of delays in transit, may loose half or more of their initial sales value). For this reason, the indicative inventory cost increase calculated above, may be a very serious underestimation of the real loss the importer in the U.S. could experience.

\[^{33}\] In the case of the Hyundai Fortune casualty the average cargo value per TEU was between US$ 204 000 and US$ 300 000 (€ 159 000 and € 233 000) , in the case of the APL China casualty the average cargo value per TEU was US$ 211 000 (€ 164 000).
VIII. CRITICAL ISSUES, PERTINENT VIEWS AND CONCLUSIONS

The previous Chapters have dealt with the direct and indirect cost impact of the possible implementation of the 9/11 Act, based on information from the pilot ports and from views expressed by the stakeholders in the supply chain, from published documents and statements and from a series of visits and interviews conducted by Policy Research Corporation. This final chapter will first focus on a number of critical issues and pertinent views and then present the main conclusions emerging from the study.

VIII.1. CRITICAL ISSUES AND PERTINENT VIEWS

One of the main underlying reasons for the problems that stakeholders in the supply chain have identified as a result of the proposed 100% scanning of U.S.-bound containers, is that in international commerce the control on the movement of goods customarily takes place at the import point. Hence all existing procedures, regulations and routines have over the years been developed and implemented starting from this principle. The 100% scanning of outbound containers which shifts the control of goods to the export point therefore creates a need to reconfigure ports and terminals, find more space to accommodate the extra facilities required, re-design the established procedures and introduce revised regulations.

Consequently, in the SFI pilot ports obstacles and obstructions have occurred as a result of the imposition of an atypical control system, whereby the responsibility of control is shifted away from the importing country and squarely placed with the exporting country. Not only does the exporting country traditionally waive this responsibility, it generally continues to firmly reject and oppose it. Admittedly, the obstacles consequently to the application of the 100% scanning rule in the SFI pilot ports have been overcome, because the sample sizes were small and because of the extraordinary goodwill shown by the authorities of the host countries. Most of the agreed solutions to eliminate the initially identified obstacles are nevertheless only acceptable on a limited trial basis, but could not become permanent features (e.g. because they were against health and safety laws, or because labour will not tolerate certain arrangements over an extended period of time).
The value of 100% scanning has not been proven by the results of the pilots. In fact, in the SFI pilot ports both the U.S. and local authorities have been spending an inordinate amount of time processing consignments which were entirely inoffensive. Nothing was discovered that could not have been identified by risk targeted controls such as applied in the Container Security Initiative. Thus, not surprisingly there are few if any Governments, except the U.S., that support the 9/11 Act, because they realize it would be difficult to defend the deployment of public sector resources to produce no tangible results. As a matter of fact both the SAFE framework and the Kyoto convention as well as initiatives such as the 10+2 and the C-TPAT use as their key driving principle the “risk targeted control”. They do not advocate that scanning of containers should drive the control effort. Rather they see the use of technology as a support for a risk management approach to control. And although the 9/11 Act clashes with the World Customs Organisation programmes such as Authorised Economic Operator (AEO), even more perplexing is the fact that it clashes with the CBP’s own CSI and C-TPAT programmes. Moreover, there is no indication that the burden imposed by 100% scanning on the export side will be compensated for by a speedy release on the U.S. side. Deliveries of imports in the United States, for example, were not speedier for containers that were scanned in the SFI pilot ports than for non-scanned containers imported from other ports.

The relative incongruity of 100% scanning approach to warrant 100% security of the supply chain is equally revealed by the fact that the rule only applies to containers whilst far more risky cargoes and carrying modes are not subjected to the rule. General cargoes and project cargoes shipped on board conventional vessels and bulk carriers are simply dispensed from the rule. The inherent ineffectiveness of 100% scanning is also consequential to the impossibility for the responsible authorities/stakeholders to ensure the integrity of the container once it has been scanned. The most effective method terrorists can employ is that of compromising a consignment at some point after the controls have been carried out and 100% scanning does nothing to avoid or diminish that risk.

The position of container terminal operators with regard to the implementation of the 100% scanning rule is far from uniform. It is mostly inspired by strategic concerns and considerations and by the terminal operating company’s priority objectives. Hence, it is to a large extent determined by the specific local port and terminal conditions. Priority objectives could be a re-focusing on the container terminal’s core business by offering the most cost effective solutions with respect to the transit of the containers through a port, or the maximization of the terminal’s business through the inclusion of as many value-adding activities as feasible, such as scanning. In the former case the terminal in all probability will decline the responsibility for scanning whilst in the latter the scanning activity is considered from a purely commercial angle with the prospect of generating extra revenue and increasing margins. Additionally, the latter also expect to attract traffic from smaller ports not capable or willing to make the required investments in scanning infrastructure and equipment. At present, most terminals continue to defend the premise that the integrated scanning function is a law enforcement and government function, hence that is one of the sovereign nation functions and thus
that it should not be performed by port facility operators. But there are some global terminal operators which are at variance with this opinion.

For many of the problems that have been surfacing during the implementation of the 100% scanning rule in the pilot ports a workable solution has, as yet, not been found. These include amongst others the following:

- The practicality of the scanning of transhipment containers remains a difficult question and can only be solved by a far-going re-engineering of the transhipment flows and a re-working of the operational routines for this container status. The same problem exists for all containers delivered by barge and in many ports those delivered by rail;

- The gate process is on any terminal one of the most vulnerable because arrivals of transport vehicles from the hinterland routinely bunch. As some of these carry a high number of US-bound containers in one transport unit (e.g. barges that can bring in several hundred US-bound containers, block trains may deliver tens of such containers, hence the bunching at the gates will be much aggravated). How can the already existing pressure on the gate be diminished in future when the gates will have to cope with many more moves as a result of the use of an off-terminal scanning site?

- Data ownership, legality and liability issues still need to be addressed as well as the question who will pay for the cost of a container missing a vessel due to the need for a tertiary inspection or because of the late return of a container from the scanning site;

- The NII images are assessed, analyzed and matched against manifest information and other pertinent data that may be available. Manifest information though is often not available when the container arrives at the port terminal or off-terminal site where the scanning is completed because such data has only to be submitted 24-hours in advance of ship departure whilst containers tend to arrive many days ahead of the ship’s arrival.

- Health and safety issues have not yet been solved. Truck drivers at various terminals refuse or are reluctant to go through the NII scanners and a full implementation of the 100% scanning rule on a worldwide basis could well set off an orchestrated reaction from truck driver and dockworker unions to block large-scale scanning.

**VIII.2. CONCLUSIONS**

With the signing into law of the 9/11 Act, an extra burden has been added to the already cumbersome process of trade with the United States. One of the most frustrating effects of the Act for the trading partner Governments is the imposition of a U.S. mandate on trade activity in other countries and of mandating security requirements for the global industries. If anything, the Act is a restraint on international trade.

*Impact on port facilities and ports and on their competitiveness*

In the present study, the economic cost implications of the 9/11 Act have been analyzed. From the SFI pilot cases, from interviews conducted by *Policy Research* for the purpose of the study and from case studies it becomes clear that the impact of the 100% scanning rule on ports and terminals depends to a
large extent on the specific lay-out of a given port and or a given terminal and on the particular conditions prevailing there. Some ports and terminals consider that the implementation of 100% scanning will not unduly upset their operations, whilst others consider it as completely unworkable and highly detrimental to the functioning of their facilities. The duality in the views expressed by ports and terminal operators is not the result of their opinionated view, rather the logical conclusion of the analysis they have made of the rule’s impact on their own operations. Thus, there are ports and terminals which can organize the scanning without creating major impediments or delays (a Greenfield sited terminal with plenty of space, a conceptual design developed with a view to scan 100% of the containers, access to the port limited to one major artery, a manageable number of U.S.-bound containers to scan, a dominant truck mode, etc.). But in other ports the prevailing conditions make 100% scanning a most intricate problem, and one that has no easy or apparent solution (a port domain that has limited space for future development, an existing terminal trying to cope with occasional yard and gate congestion, multiple and diversified accesses to the port, a highly diversified modal split, etc.).

Critical is the impact of 100% scanning on smaller ports, whereby the designation “smaller ports” needs to be more accurately defined. In a European context, it would be possible to quantify all ports that achieve an annual US-bound throughput of less than 50 000 containers as small, because below this “cut-off” throughput, ports will have difficulties to financially justify the investment in the required infrastructure, equipment and I.T. Hence, ports such as Barcelona, Southampton, Gioia Tauro, Livorno, Marseille, Le Havre, Göteborg, although none of them can be called small container ports, would all be at risk to loose their U.S.-bound export trade because it amounts to less than 50 000 containers per year and only represents a marginal share of their total container throughput. Clearly, the three ports recording the highest U.S.-bound container throughput (Bremerhaven, Antwerp and Rotterdam) would possibly be in an excellent position to attract cargoes away from the “smaller” ports. If this were to happen then 100% scanning would lead to cargo diversion from traditional ports and to a distortion of the established trade flows not on grounds of better service or higher performance, but because a new rule, imposed by a foreign government changes the basic economics and the relative competitive relationships between ports. Hence it becomes a factor impacting on the competitive position of ports in a given region. But for the potential for bigger ports to attract more U.S.-bound cargo away from smaller ports, may not only carry advantages. It could as easily contribute to a greater level of congestion, particularly during peak times, and result in longer cargo transit times, higher handling costs and less efficiency. For the vast majority of the European ports (at least 20 ports with less than a thousand containers per year), the U.S.-bound containerized cargo is such a small percentage of their activity that its loss may not be too significant, at least if it does not lead to the cancellation of existing shipping services catering mainly for non-containerized cargoes to the United States.

The large differences in attitude and capabilities that have been observed between the different ports confirm the discriminatory nature of the 100% scanning rule. Thus, where there was initially a
concern that the rule would be detrimental for the smaller ports in Europe only, further analysis has pointed out that the most serious discriminatory effects would probably affect in the first place the main ports. There is little doubt that 100% scanning could affect the competitiveness of the more prominent ports with significant U.S. bound exports, whereby some would be gaining market share and others loosing it. There is no denial of the fact that for a number of ports, with a small U.S.-bound export volume, it would be unrealistic to invest in the required infrastructure and equipment. They would no doubt lose their marginal U.S.-bound throughput share to those competing ports and terminals that are in a more advantageous position to carry out 100% scanning.

Impact on transport towards the ports and on indirect costs

To assess the real impact of 100% scanning on direct transport cost towards and in the ports, it is necessary to consider the consequences for each individual shipment, each alternative routing, each selected port and chosen terminal. This is an unrealistic approach for the sort of general assessment that is called for in this study. Instead a limited number of representative scenarios were developed and the impact of 100% scanning for each these scenarios was calculated. The end conclusion from these calculations is that typically 100% scanning would add about 10% to the direct transport costs per consignment. The 10% only represents the extra aggregated cost for each of the steps in the supply chain, but excludes the scanning cost itself and any premium or profit margin that the individual service providers would add. Although at this point in time it is not clear which parties will bear the different extra cost components, there can be little doubt that ultimately it will be the consumer that pays this extra cost augmented by successive profit margins taken by the different stakeholders in the supply chain.

The indirect costs concern in particular the loss of handling capacity on terminals as a result of longer dwell times, increases in the turnaround time of feeder vessels and of the inland transport modes delivering U.S.-bound containers to the port terminals, increases in external costs because of a potential shift from the rail and barge modes to the truck mode and increased cargo inventory costs. Again, the significance of these costs depends on numerous factors but typical situations have been considered and representative indirect costs were calculated for these under well-defined conditions. If taken together the indirect costs resulting from 100% scanning add a significant extra cost burden to the total and reinforce the initial feeling that such scanning must negatively impact on the U.S.-bound trade volume.

Almost all stakeholders that were contacted and interviewed agree that there would be no major capacity problem for the different inland transport modes. They expect that inland transport costs could increase to compensate for the extra time lost in ports or on terminals, but they do not expect a shortage of trucks, trains or barges. What is undeniable is the fact that 100% scanning will weaken the supply chain because there could be longer delays and more irregularity in the service schedules. This
The impact of 100% scanning of U.S.-bound containers on maritime transport

in turn could persuade shippers of U.S.-bound containers to dispatch their containers much earlier to the terminal of loading, thereby increasing both the dwell times and the risk of terminal congestion.

Impact on the U.S. production using components shipped via U.S. ports

Although it may not have been the intention of the American Congress, the 9/11 Act is inherently protectionist in that it makes imports in the United States more arduous and onerous. The Act could, however, also have a boomerang effect in that it would make the imports of components and parts required for the U.S. industry more expensive and the supply chain fragile and unstable. All the costs incurred with respect to scanning will, without any doubt, be added to the final bill the U.S. importer of European components will have to pay whilst he will have to put up with longer delays and possibly bigger inventories.

To assess the exact impact of the 100% scanning rule on U.S. imports would require a separate and very detailed analysis of the individual supply chains in order to determine the degree of vulnerability of the production processes in each of the industrial sectors that could be affected. To carry out such a detailed analysis is beyond the scope of the present study as it would require not only a major research effort on a case by case basis, but it would heavily rely on confidential information from U.S. industries that could be difficult if not impossible to obtain.

A final conclusion

In the final analysis, that most critical question that needs to be asked is whether the application of 100% scanning which, as shown in this study, carries a number of negative cost implications, is justified by a greater impregnability of the international supply chain. The answers received from the stakeholders that were consulted and the opinions made known by international trade authorities, such as the Customs Cooperation Council, leave little doubt. 100% scanning does not have any added value in terms of a reduction in the security risk. It adds nothing to the risk management approach supported in the CSI and C-TPAT initiatives. On the contrary scanning all containers may well induce the Authorities into a false sense of security and lower the vigilance of the Customs carrying out and analysing the results of the scans. This would be particularly true if the staffing of CBP would become problematic because of inadequate funding. A majority of the stakeholders that were contacted for this study expressed their support for improved port and terminal security, but believed that this would be best achieved through a multi-layered and risk-based approach.
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