

GLOBAL LOGISTIC CHAIN SECURITY: Economic Impacts of the US 100 % Container Scanning Law

By Frédéric CARLUER,

Professor in Territorial Management, University of Le Havre (CIRTAI)
Associate Researcher, Normandy Business School: Frederic.carluer@univ-lehavre.fr
And Scientific Director of SEFACIL Research Institute

With the collaboration of:

Yann ALIX, Professor in Port Management, Normandy Business School,
Director of IPER (port training and research institute) – Head of Logistics Department
Olivier JOLY, Associate Professor in Spatial Planning, University of Le Havre

**University of Le Havre study
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**WORLD CUSTOMS ORGANIZATION
ORGANISATION MONDIALE DES DOUANES**

The Secretary General

Established in 1952 as the Customs Co-operation Council
Créée en 1952 sous le nom de Conseil de coopération douanière

Re: Macro- and micro-economic analyses of the impact on international trade of the US law on 100% scanning of maritime containers before loading.

The above law, known as the '9/11 Commission Recommendations', will affect commercial transactions with the United States estimated at some USD 500 billion, and is expected to have a not inconsiderable impact on the operations of more than 600 ports throughout the world.

The WCO would like an intensive study to be made of the impact of this law on international trade. It is entrusting the University of Le Havre with this research task.

The study is to cover the following points. This list is by no means exhaustive and will be regularly reviewed through contact between University of Le Havre researchers and the Secretariat.

1. Identify the volume of transactions (US imports) concerned and the foreign ports concerned in each region of the world (Europe, Asia, Africa, South America).
2. Measure the costs and determine the additional costs (human resources, immobilization, transshipment) associated with implementation of the law.
3. Determine whether it will be possible to implement the legislation effectively in the countries of export, particularly developing countries.
4. Analyze the foreseeable consequences of this law on international trade (rising costs, slower traffic, elimination of certain ports as a result of polarization) and forecast potential future scenarios.
5. Determine whether 100% scanning can ensure zero risk and measure, approximately, its comparative feasibility and reliability in relation to risk analysis.

The WCO will reimburse the costs of travel required to carry out this study.

Michel Danet.
Brussels, 28 September 2007

SUMMARY

GLOBAL LOGISTIC CHAIN SECURITY: ECONOMIC IMPACTS OF THE US 100% CONTAINER SCANNING LAW

The ‘100% scanning’ law, or House Resolution 1 (H.R. 1), aims to protect US territory against terrorist risks likely to affect the global logistic chain. A unilateral step, it may be perceived as a disguised protectionist measure which would transfer the risk of ‘securitization’ to its partners, particularly if the principle of reciprocity does not apply.

In this changing economic (over 325 million containers handled, under 0.5% of which are currently scanned) and regulatory context (following the SAFE framework of standards developed by the World Customs Organization), this forward-looking work parts from a single hypothesis: what will happen if the US 100% scanning law adopted by Congress in July 2007 actually enters into application on 1 July 2012, or even sooner should there be an attack in the United States, and what are the alternatives?

The analysis is divided into three sections:

- the first examines the macro-economic impacts of this law, in other words analyzing the dynamics of trade flows from the key US partners (with the aid of maps). The facts speak for themselves: of the 18 million containers arriving in the 13 biggest US ports in 2006, half came from China (and 75% from Asia). Four different potential scenarios are therefore developed showing that this share should at least be maintained in 2012 (lowest hypothesis, peaking in 2009) or even reach 78% (highest hypothesis, if the dynamics of the past decade continue). Whatever happens, Asia’s share is set to oscillate between 80 and 92%, pointing to the likely appearance of interconnected global megaports as a result (polarization);
- the second part assesses the micro-economic impacts, i.e. the structure and dynamics of the scanning sector globally. The new strategies of the key actors, both big manufacturers (Smiths Detection, Nuctech and SAIC) which account for 80% of the 1,250 scanners currently operational throughout the world, and administrators (Customs, of course, but also the three big private enterprises (Cotecna, SGS and Bureau Veritas)), are therefore analyzed. They are put into perspective with the aid of a 6-section, 60-question standard questionnaire put *in situ* to port and customs authorities in 10 ports worldwide, ranging from major ports such as Singapore and Dubai to medium-sized ports such as Abidjan and Montevideo, and giving an approximate initial assessment of the unit cost of a scanned container. This invaluable collection of information is combined with a number of interviews taking in several key international organizations (European Commission, World Bank and UNCTAD), and has been benchmarked against the Channel Tunnel and the aviation sector, which witnessed the same revolution just a decade ago;
- finally, the third section attempts to construct different potential scenarios ranging from the status quo (no port in the world will be capable of scanning 100% of containers by 2012) to networking (a significant proportion of ports, in the tradition of the Southampton pilot project, will validate the technological ‘protocol’ and manage to make the logistic ‘leap’). This section touches on the positions of the developed and developing countries, and of course possible alternatives to the H.R. 1 law.

“This pioneering book is essential reading for all in the maritime industry as well as governments and international agencies that will have to address the issues in the coming years” (Brian Slack, Preface).

I – INTRODUCTION

Efforts to secure trade in goods go back 3,500 years, when the first land and sea trade routes were already well guarded. The danger then was from pillage. The September 11, 2001 attacks mark a huge ideological shift, with the threat now from so-called ‘civilizational terrorism’, where transport becomes at once the conduit of the threat and the vector of destruction (Greenberg [2006], Sheffi, Rice [2003], Walkenshort, Dihel [2002], OECD [2002]). The ideological bedrock of terrorism appears to be a desire to shock consciences through the sheer number of victims while jamming the global trade system in order, ultimately, to challenge the dominant capitalist model of liberal obedience. The transport flow becomes the target, the container the medium of the attack, the port the receptacle (The Economist [2001], Sheffi [2001]), whence the desire to make every effort to strengthen ‘*seacurity*’ (Van de Voort [2003]).

A radical change of scale is taking place in our apprehension of a changing and complex threat: the spatial scale above all, where no crossing point can be neglected on a market which is essentially more and more global (Hummels [2006], Slater [2000]). Then the quantitative and qualitative scales, with trade in goods growing continually, in terms of tonnage and value alike (ISL [2006], Kumar, Hoffmann [2002]). And finally the time scale, with transport flows based on controlled transit times between each link in the integrated transport chain (Nordås et al. [2006]; Hummels [2001a]). This is the background against which the US authorities are advocating an optimization of global and effective securing of trade flows, as manifested in the ‘House Resolution One’ (H.R. 1) vote. The challenge is to invent a virtuous system of transport where tighter control would, in the long term, allow more fluid secure trade flows (even if bottlenecks will be inevitable short-term), themselves vectors of greater market value ultimately spawning greater production and consumption flows in a secure world market.

There are four key issues:

- **1 – Ideological and geopolitical.** Each stakeholder in the world supply chain must feel involved and be prepared to change their behaviour in order to submit to mutual safeguarding of all elements of the integrated logistics chain. Trust in partnership is essential for the development of this understanding and the involvement of a network of partners. Obviously, international organizations, particularly the World Customs Organization (WCO [2002]), have a key role to play.
- **2 – Managerial.** An organizational revolution is needed for optimal management of the staff, materials and procedures vital to the secure processing of physical flows (associated with the available land) and information flows (associated with a powerful IT system; Caldwell [2008]).
- **3 – Economic and financial.** The installation of the equipment, services and maintenance of materials, and the knowledge and skills of the millions of people involved in securing the integrated world transport chain need to be translated into the costs of the “logistics of globalization” (Daudin [2003]).
- **4 – Technical and technological.** The challenge lies in the design and production of reliable, rapid and practical solutions which function in a network for real-time protection without a major impact on the fluidity of the international containerized system (Rice, Caniato [2003]).

While revolutionizing global freight security appears inevitable, the question remains of how to implement that change effectively. This first study testifies to the magnitude of the challenges to be faced and looks at the long-term outlook for 100% scanning of container transport.

What do we actually mean when we talk about the H.R. 1 '100% scanning' law? What does it mean for the world maritime container market? For the US container market?

In the middle of this decade, a total of around 325 million boxes were handled in around 600 port container terminals. An average of around 18% were empty boxes, due to chronic imbalances between the major intercontinental production and consumption zones. Hence around 250 million boxes were handled in world maritime and inland port terminals, with the United States representing one-eighth of this traffic. Of this international total, around 225 million (90%) is concentrated on the major-East-West routes and the key hubs of South-East Asia, the Mediterranean and the Caribbean. By way of reference, an average of at most 0.5% of the total number of maritime boxes having been physically scanned, the current world market could be considered to total some 1.2 million scans. Evidently, regional disparities complicate the reading of the world market a little more: for instance, Canada has announced that it scans a minimum 3% of all boxes, and Australia, looks sets to increase its scans from 5,000 to 130,000 a year (out of a total 4.8 million TEU in 2006, which also approaches 3%).

However, these world market estimates of container scanning have been turned upside down since the September 2001 attack on US soil. With the 'Container Security Initiative' (CSI), 59 ports (Annex 2) representing more than 85% of exports to the United States are obliged to scan containers identified as 'high risk' following the analysis of intelligence information relating to the movement of containerized goods. And under H.R. 1, a market value of almost 500 billion would be subject to full scanning by 2012, corresponding, according to various growth forecasts for container traffic on the major East-West routes, to a total of almost 30 million containers (TEU) mainly from Chinese, Korean, Japanese and West European ports, and more recently from South-East Asia too (although this growth slowed considerably in 2007: +0.2% against more than 10% on average over the last ten years). Underlining the economic challenge, the US scanning market alone cost around USD 380 million in 2006 and this activity is forecast to triple by 2013 to more than USD 1.2 billion.

In this changing economic and regulatory context this research study, which partly comprises economic forecasting, parts from a single hypothesis: what will happen if the US 100% scanning law adopted by Congress in July 2007 actually enters into application on 1 July 2012, and what are the alternatives?

Having described the hypothesis underlying the research, our study will be divided into three sections:

- the first will examine the macro-economic impacts of this law, in other words analyzing the origin of trade flows and the geographical dynamic of those flows, pointing to the likely appearance of interconnected global megaports as a result (polarization);
- the second part will assess the micro-economic impacts, i.e. the structure and dynamics of the scanning sector globally and the new strategies of actors likely to emerge with strong impacts in terms of port reorganizations and optimization of logistics chains, and provide an initial assessment of the unit cost of a scanned container (port and sectoral reconfiguration, and new forms of management);
- finally, the third section will attempt to construct different potential scenarios based on the preceding macro- and micro-economic results combined with a large number of interviews and different surveys carried out in ten ports and several key bodies throughout the world.

II – MACRO-ECONOMIC ANALYSIS OF US-BOUND CONTAINER TRADE FLOWS

2.1 – US imports of maritime containers: global data

Examination of the volumes of transactions concerned by key world region (continent) reveals three trends (Table 1):

- largely homogeneous growth in the Americas, Africa and Oceania: around 70% over the past decade;
- a meteoric rise in Asia (+185% over the same period) led by Chinese growth (+472%!). This is not strictly speaking uniquely Sino-Asiatic growth, as India saw a 200% increase and South Korea 105%, but the figures are dizzying when compared with the low growth in Japan (+14%) and Hong Kong (+12%). Only Vietnam and Cambodia, which started from way behind on the US market, do better over this period (1997-2006).
- Europe lags behind: only +52% over the same period, corresponding to average annual growth of 4.9% while Asia hit over 12% on average.

Table 1. Evolution in US-bound container trade by continent

Continent	2006 share (%)	1997 share (%)	Evolution (points)	Growth (%)
Asia	74.42	61.88	+12.5	185.3
Europe	13.44	20.97	-7.5	52.0
Americas	10.49	14.85	-4.3	67.7
Oceania	1.00	1.38	-0.4	71.4
Africa	0.66	0.91	-0.3	70.8
World	100.00	100.00	0	+137.3

Asia today accounts for almost 75% of US imports of maritime containers, therefore, and is the only continent to have gained market share over the period (+12.5 points since 1997). In terms of numbers of containers imported by the United States, this represents almost 14 of the 18 million boxes imported in 2006. The Americans handled fewer than 8 million boxes in 1997, while experts are predicting a figure approaching 30 million in 2012.

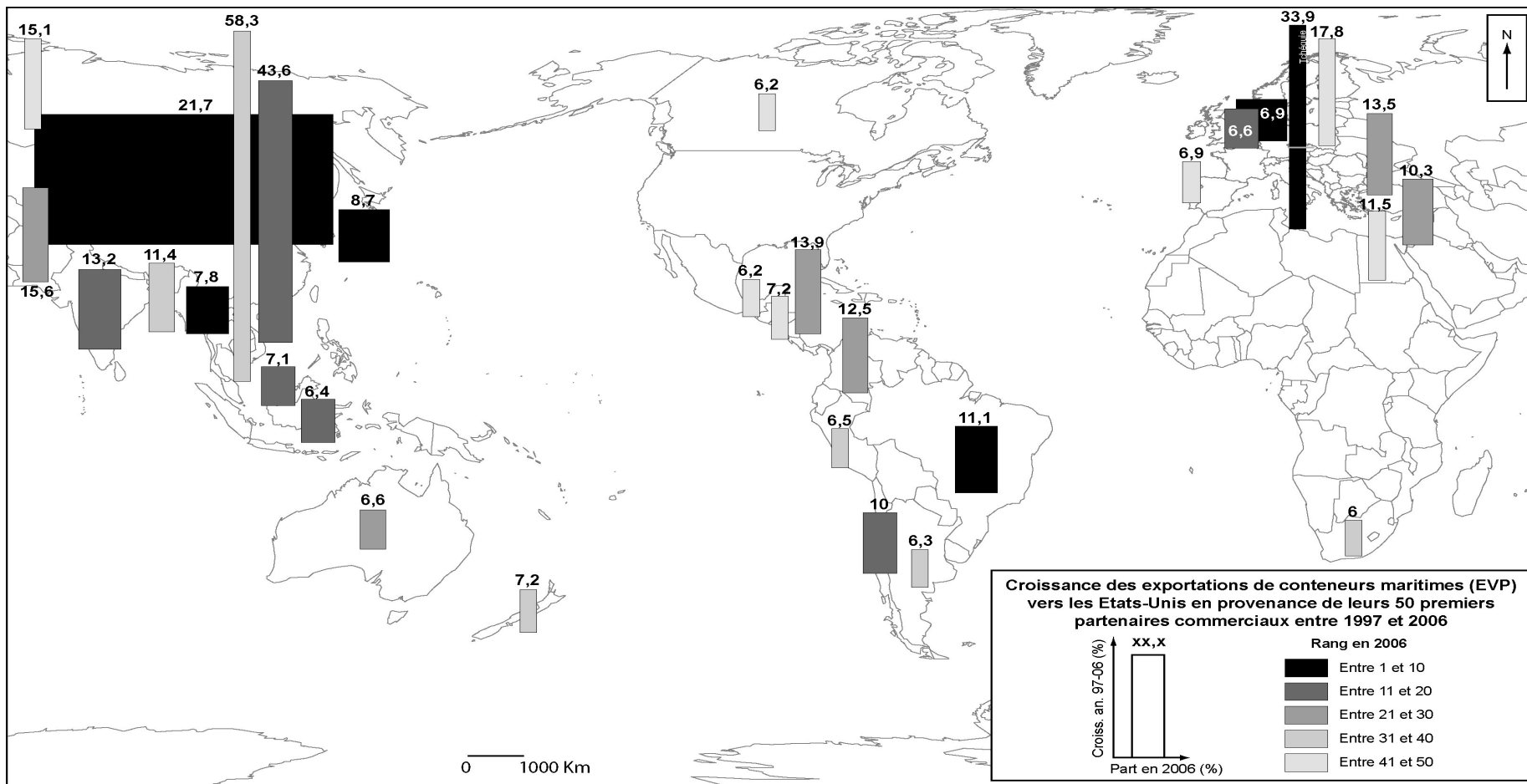
Given these extremely asymmetrical continental dynamics, with Asia, and more specifically China, representing such a large proportion of US container imports (more than 50% today against less than 5% in 1980 according to Hummels [2006, p. 3]), the leading question in our study, which should be confirmed by forward-looking analysis (point 2.3), is: would 100% scanning not ultimately be solely an Asian mechanism?

2.2 – Main trade partners on import

The most striking factor is of course the surge in China's strength: it now accounts for almost half of all containers bound for the United States (45.2%, or 50% including Hong Kong) against under 20% ten years ago. The second key exporter is Japan with less than 5%.

The second key finding is that five Asian countries rank in the top five (seven in the top ten), accounting for 60% of US container imports. In the rest of the world, Italy slides back three places, France five and the United Kingdom seven. This contrasts the incredible dynamics in Vietnam (20-fold increase in the number of US container imports corresponding to 43% average growth), Brazil and Chile (10% annual growth).

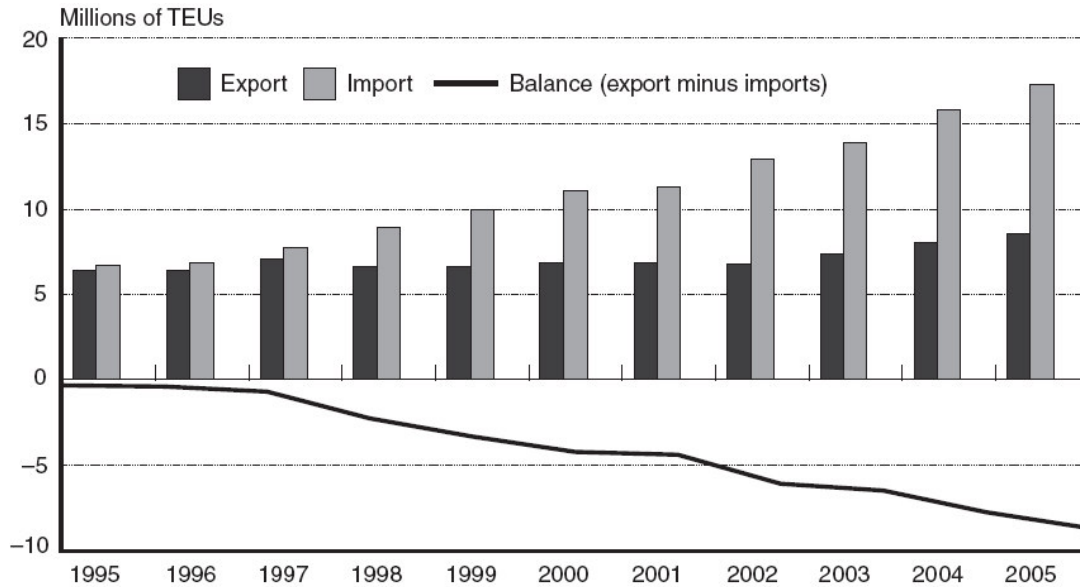
Map 1. Growth (in %, top of histogram) of exports of US-bound maritime containers (TEU) from their top 50 trade partners 1997-2006 (relative to the share of each country: width of the histogram, and to the ranking of each: colour of the histogram)



Source : D'après les calculs des auteurs à partir des données de Port Import Export Reporting Service (PIERS), collected from Vessel Manifests and Bills of Lading. The statistics exclude postal and military shipments
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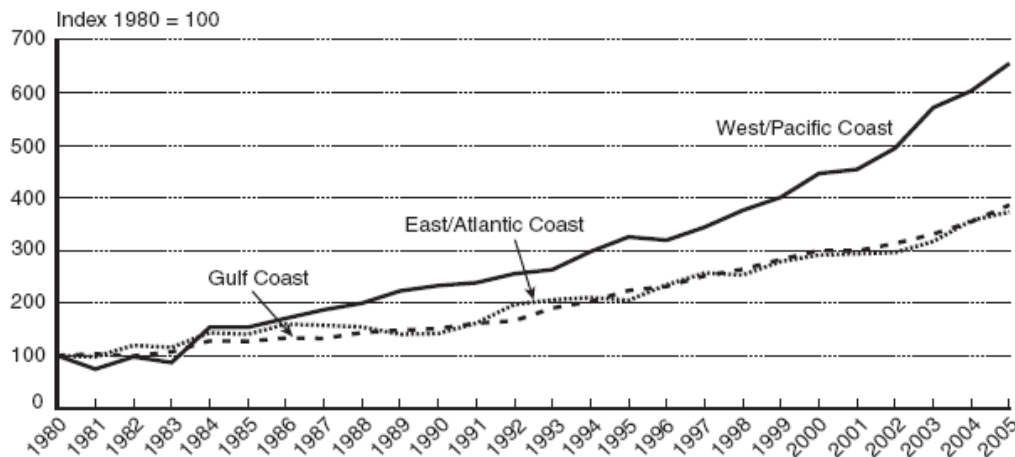
2.3 – US ports faced with the challenges of growth and logistic reorganization

Graph 1. US International Maritime Container Traffic: 1995-2005
(US Department of Transportation [2007a, p. 2])



SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, based on data from U.S. Department of Transportation, Maritime Administration, which are drawn from the *Journal of Commerce*, Port Import/Export Reporting Service (PIERS) data system, and available at www.marad.dot.gov, as of November 2006.

Graph 2. Growth of US Maritime Containerized Exports and Imports (TEU) by Coastal Port Region: 1980-2005 (US Department of Transportation [2007a, p. 6])

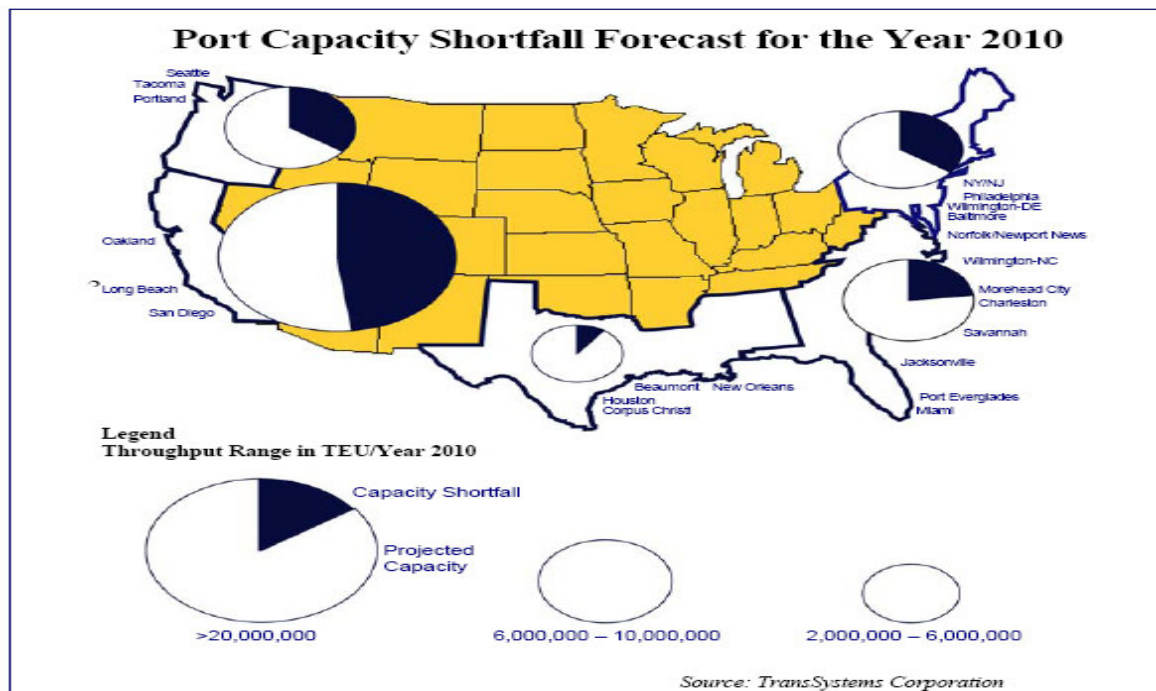


NOTE: TEUs = twenty-foot equivalent units. One twenty-foot container equals one TEU while one forty-foot container equals two TEUs. Total includes ports for all container ports in all 50 states and Puerto Rico. The data in this figure include both loaded and unloaded containers in U.S. international maritime activity. It includes U.S. imports, exports, plus transshipments.

SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, based on data from the American Association of Port Authorities, available at www.aapa-ports.org, as of November 2006.

Retrospective analysis of US port capacity utilization in 2002 showed moderate congestion, since only the Californian and south-east ports had over 85% utilization rates (which demands extremely efficient supply chain management). On this basis, in 2005 the US Maritime Administration produced some forecasts for 2010 based on a detailed 16-point questionnaire (Department of Transportation [2005, p. 53]) and assuming 3 to 4% annual growth in US maritime trade which projected that 14 out of the 16 ports analyzed would experience over 50% growth in the space of 8 years, and noted that the US Chamber of Commerce [2003, p. 3] forecast considerably higher growth rates. Three years after that study, it has to be said that the latter were right, given the 9.4% annual growth experienced over the last four years. Even so, the State Department's future mapping (Map 2) remains resolutely optimistic since, according to the forecasts (based on an unrealistic hypothesis of a doubling of growth between 2002 and 2020), congestion will increase significantly, and even lead to around a 50% deficit in capacity in California.

Map 2. US port activities and capacities in 2002 and forecasts for 2010 (US Department of Transportation [2005, pp. 26 and 29])



Finally, looking ahead, attention is focusing on southern California, with the US currently investing massively in the port of Ensenada in Mexico (only 76,000 boxes in 2006 but 100% growth in two years; and even the port of Lazaro Cardenas: 132,000 TEU in 2006 and 200% growth) not only to avoid the anticipated congestion problems but also to secure their territory 'indirectly' by creating 'external' enclaves nearby¹. One of the scenarios which shows possible ways to get round the 100% scanning law (raised in the final part of this report) echoes this potential diversion strategy.

¹ 'Canadian and Mexican ports, linked to the US by rail, are already starting to emerge as attractive solutions and, generally speaking, shippers who have to handle transpacific flows are exploring all the alternatives to US Pacific ports, and have been doing so since September 2002' (*Les Echos* [2008, P. 4]).

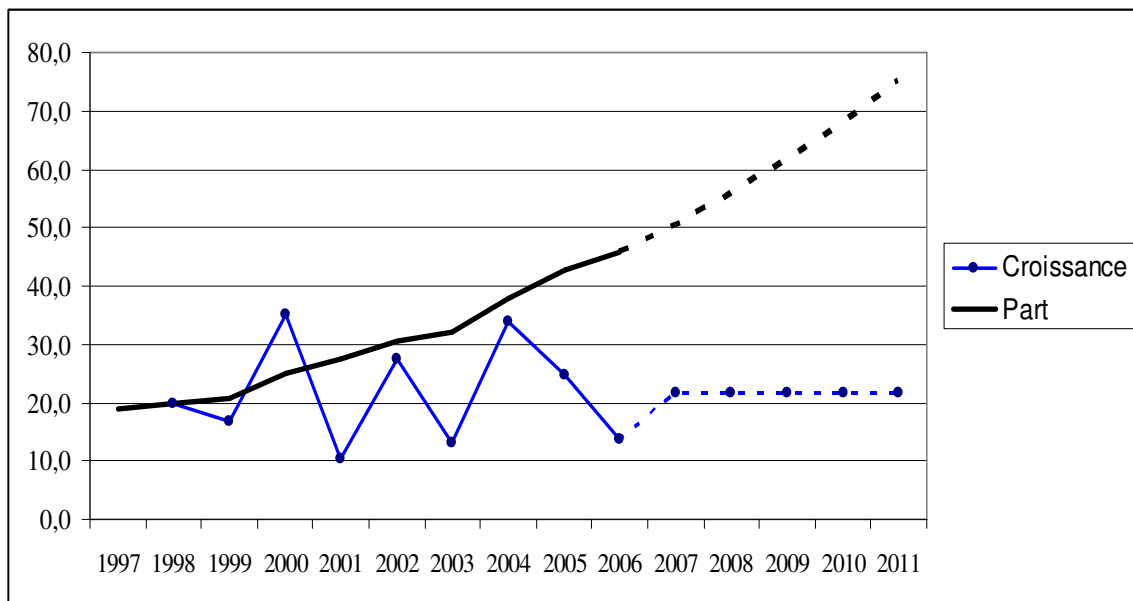
2.4 – Prospective analysis of trade

In terms of US-China trade dynamics, four potential scenarios may be envisaged: continuation of the trend seen in the last decade (Scenario 1), China and Hong Kong are viewed as a single ensemble (Scenario 2), Chinese plus Hong Kong growth converges towards the world average (10%) at the end of the period (Scenario 3) and, finally, Chinese plus Hong Kong growth is assessed on the basis of market shares (and no longer of levels) which avoids having to fix a final growth rate in advance and eases the cyclical developments in the container market (Scenario 4).

Scenario 1: Growth trend = 75% share for China in 2011

Average annual growth in the number of Chinese containers imported by the US was 21.7% a year in 1997-2006 (Graph 3), with huge fluctuations (including an extremely strong downturn in 2007, at just +0.2% growth; *Les Echos* [2008, p. 4]), a rate twice that of the global growth of imports (10.2% per year; without China it would have been 5.4% per year). This incredible relative growth dates quite precisely to 1997 (20% growth and 20% US market share for China, with two peaks approaching 35% in 2000 and 2004), and impacts on the relative market share from the year 2000 only.

Graph 3. China's share in US container imports
(predictions shown as a dotted line)



At this furious rate of growth, China (at 20% a year against an average 10%) is set to account for three quarters of all containers arriving in the United States in 2011, even if this rate might not be achieved quite so quickly as the gain in market share (against 100) follows a logistics curve (relative deceleration after a phase of very strong growth). Based on this extrapolation (even minimized), it is evident that the US 100% scanning law would essentially be relevant to Asia. In other words, by 2012 (the projected date of entry into force of the law), the logistics process and corresponding port reorganizations (new supply chain management) would almost exclusively concern the Pacific, in other words the key Asian and US West Coast ports, and to a much lesser extent those of the East Coast of the United States and a few European megaports.

Nevertheless, a number of checks suggest that these quasi-exponential dynamics will not persist in the medium term, and that an alternative, more balanced, scenario, is needed. What would be the main buffers?

- First, a slowdown in world market growth, which has been particularly strong since the start of the decade. Three indicators point to this:

* the relatively weak growth in the number of US container imports in 2006 (just 6%, against 10% and 13% the previous years; but with Chinese growth of 14%, 25% and 34% respectively);

* the need to combine China and Hong Kong after 2004 following their rapprochement. However, it has been demonstrated that Hong Kong's share (still recorded separately from that of China) in US imports fell dramatically from that date (transfer of traffic), thus overvaluing China's growth. Hence the need to envisage a scenario considering China and Hong Kong as a single entity;

* finally, the reversal in global American growth in 2007 (plus 0.2% for containers) and the low (or even zero) growth forecast for 2008 which will automatically have an impact on world trade, even if container traffic is relatively less affected than other sectors. In fact, the US has probably been in recession for a number of months, and the dynamics of US demand will be slowed down long term even if this recession is short. China could therefore re-centre itself on Asia, a possible driver of world growth (hypothesis of an at least partial decoupling).

- Secondly, economic history shows that the unit values of the goods traded could not remain the same while one country (in this case China) scales the ladder of economic development. This should translate into a change in the structure of US-bound Chinese exports, in other words more sophisticated goods which are less easily containerized and a greater number of services.

- Thirdly, the main outcome of China's economic development should be a slight polarization on exports but with internal growth 'relays', in other words domestic demand (investment and consumption). The export rate could, therefore, only fall as was the case two decades ago for the Asian Tigers.

- Fourthly, monetary developments appear inescapable in the medium term. This of course refers to the revaluation of the Yuan against the US dollar² (already underway, particularly in real terms). This reduction in the under-valuation of the currency associated with the growth in the share of tradable goods due to industrialization (Balassa-Samuelson effect) should promote a change in growth strategy particularly since new political measures will undoubtedly be taken under US pressure.

- Fifthly, the rapid development of other emerging countries which base their growth on an "extrovert" strategy. This is the main argument likely to qualify the impact of these main buffers, i.e. the role of export relay which should be taken up by India and a number of countries in South-East Asia, stabilizing exports towards the United States at a very high level. There could therefore be no diminishing of US dependence on Asia, and its corollary in terms of container imports.

What is the alternative? On the basis of our statistical series, it is difficult to envisage a moving average over the last three years rather than over the last decade because China's average annual growth (US-bound containers) between 2004 and 2006 was 24%, or more than the 22% average of the last decade (though there is a marked underlying fall: 34% in 2004,

² A parallel may be drawn with Japanese-American economic history in the period 1970-80, which was characterized by a change in the nature of the goods produced and exported by the Japanese pursuant to the progressive revaluation of the yen.

25% in 2005 and “only” 14% in 2006). Moreover, we remain over 20% even taking a moving average over five years.

Summing up, without detailing the three other scenarios (see below), it appears that the share enjoyed by China (plus Hong Kong) in US imports of maritime containers will increase in the coming years (despite flagging in 2007 (+0.2% growth only) and probably again in 2008). What is more, two scenarios point to a weakening in this share from 2009, which should approach 50% at the end of 2011, i.e. today’s level. The following table summarizes the above scenarios.

Table 3. Scenarios showing the evolution of China’s share in US-bound maritime containers (at the end of 2011)

Scenario	Hypothesis	Growth in 2011	Share at end of 2011
1	Growth trend: the dynamics of the last ten years continues (China alone, 78% with Hong Kong)	21.7%	75%
2	Growth trend for China + Hong Kong together	18%	70%
3a	Chinese plus Hong Kong dynamics converges towards average growth at the end of the period (fixed <i>a priori</i> : 10.2%): linear estimate	10.2%	57%
3b	Chinese plus Hong Kong dynamics converges towards average growth at the end of the period: second-degree polynomial estimate	10.2%	51%
4a	Chinese plus Hong Kong dynamics in terms of market shares (and no longer of levels) continues: linear estimate	+4.8%	64%
4b	Chinese plus Hong Kong in terms of market shares (and no longer of levels) continues: second-degree polynomial estimate	-4.3%	50%

These scenarios cannot, *a priori*, be placed in a strict hierarchy. While the first two are strictly “statistical” (with a preference for the second, however, since China and Hong Kong now form one and the same country), the other two are more ‘economic’ and show the divergence in expert opinions. However, based on the range of arguments set out following the first scenario (reevaluation of the Yuan, change in the structure and content of exports, international political pressures, neighbouring Asian countries as relays, slowdown of US growth), a small consensus would tend to lean towards a polynomial estimate, which takes better account of recent dynamics (and thus of the container market cycles), i.e. scenarios 3b and 4b. It remains to be seen if world growth over the next five years will be as dynamic as in the past with a “downturn” for China (Scenario 4b) or whether China really is not a country like the others (3b).

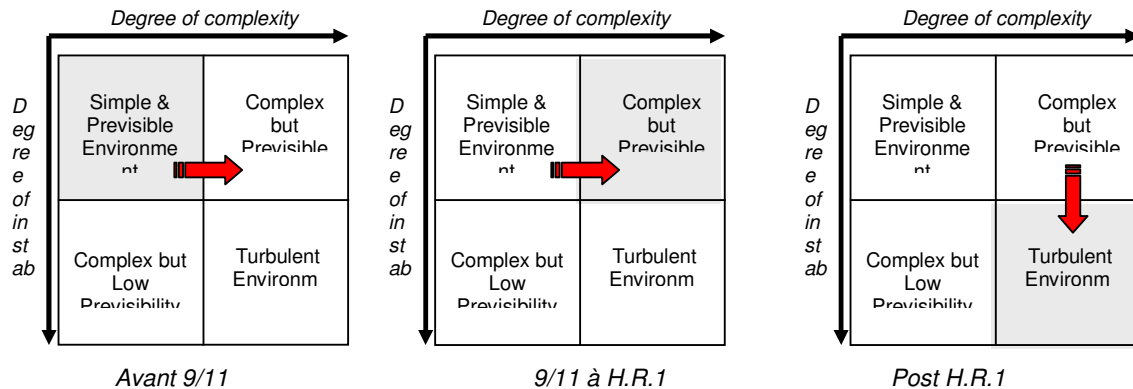
To demonstrate the difficulty of predicting these trade developments (and shares) once more, we should recall the US Department of Transportation [2005] traffic forecasts for 2002-2020. These were markedly pessimistic, as they put overall growth (internal and external) at a total of 50% over the next 20 years, with, however, a doubling in external traffic (i.e. 100%), while actual growth in 2002-2006 alone had already hit 43%.

III – MICRO-ECONOMIC ANALYSIS OF THE ACTORS INVOLVED IN SECURING THE LOGISTICS CHAIN

3.1 – Maritime container scanning market and economic perspectives

3.1.1 – Sectoral analysis: key technical-industrial opportunities

Figure 1. Forecast evolution of the competitive environment in the scanning sector – situation before/after 9/11 and H.R. 1



3.1.2 – Summary of main scanner manufacturers and administrators

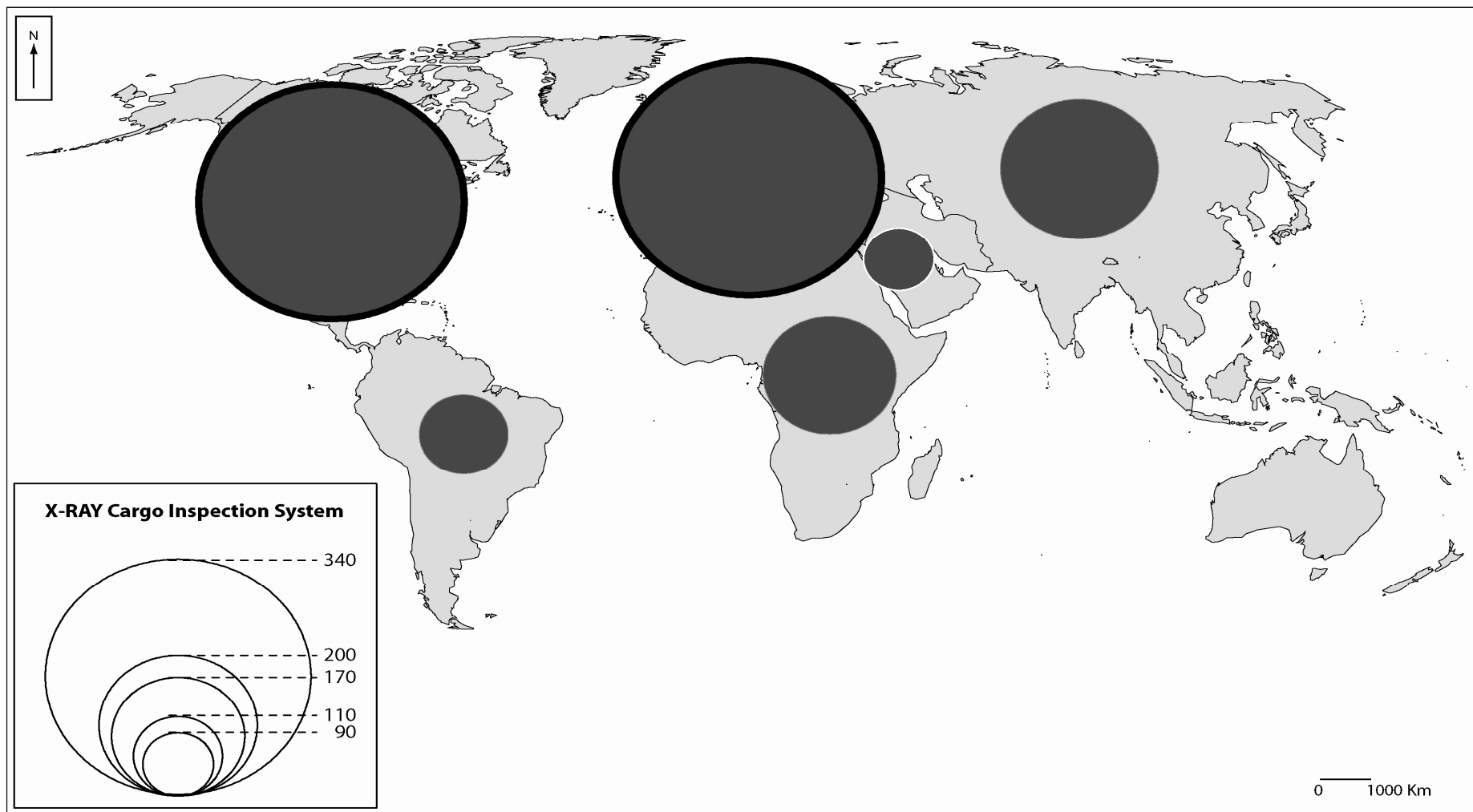
An industry with a world oligopoly

Among the biggest and most innovative are the European firm Smiths Detection, the Chinese Nucotech and the Americans SAIC and Rapiscan. This list, by no means exhaustive, delimits the key (privileged) zones in the world scanning market. Post 9/11, security has become a global issue, but the operational realities of the market continue to concentrate on the three key production and trading zones of South-East Asia/China, US/Caribbean and continental Europe/Mediterranean basin.

The above enterprises all have a relatively similar industrial profile, being part of large industrial and technological groups with one branch specializing in imaging and scanning containers. The proposed technological solutions relate to the safety/security of goods, persons and infrastructures. The clients are both military, public government services and private enterprises specialized in supplying safety/security services.

In this sense, we have to accept that the scanning sector giants are in direct competition on the big growth markets of the developed and strong growth economies. Brazil is the only large Latin American country abundantly supplied with scanners. With up-to-date, programmed scanner equipment Dakar, Abidjan, Durban are exceptions in Africa. In Asia, and particularly on the Indian sub-continent, investment opportunities remain wide open with technological solutions adapted to the port and modal interfaces of each country, even each region concerned (Gutierrez, Hintsa [2006]). Targeting these emerging markets is all the more interesting as solutions to control international containerized flows could appear on internal platforms which would round out future port interface systems (Map 3).

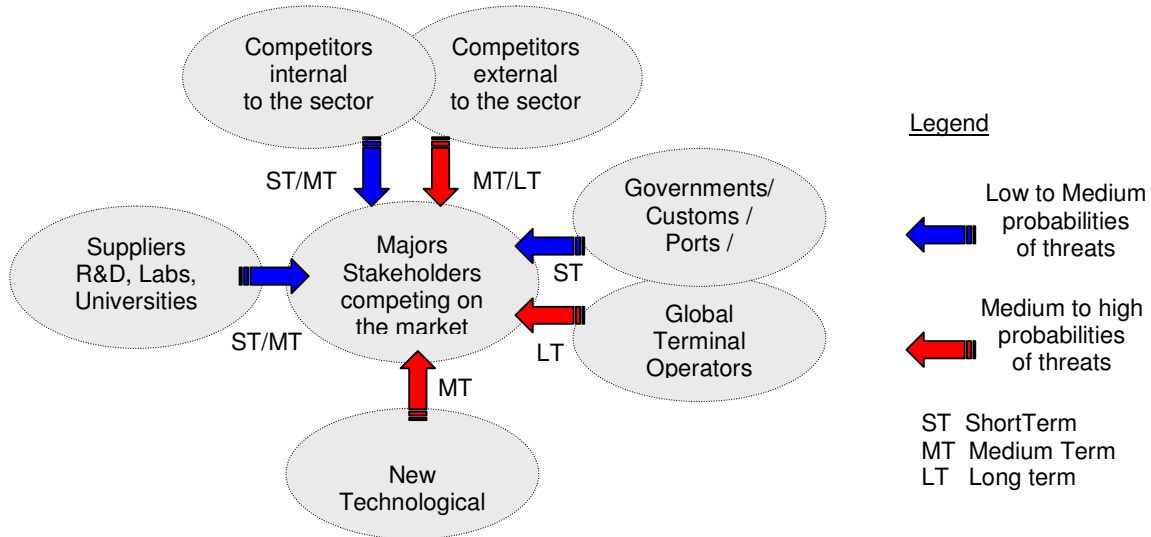
Map 3. Number of operational scanners in the world (by continent) at the end of 2007: 1250



Forces and constraints: current and future challenges of a strongly growing market

Figure 2 below demonstrates the main forces and constraints on the competitive environment of the sector in the form of a Porter's diamond.

Figure 2 –Porter's diamond: Forces and constraints on the maritime container scanning market



3.1.3 –Technological revolution and strategic opportunities

3.1.4 –Market structure, between scanning equipment manufacturers and service providers

Of the 1,250 scanning units distributed throughout the world at the start of 2008, a very high proportion is used by Customs staff and supervisory staff designated by the sovereign public authorities. The required skills and the resources allocated to the Customs services allow them to operate and manage the control materials directly. In most developed countries, Customs are in charge of operating the services and do not make direct use of specialized companies. Around 95% of all scanners remain under the control of national Customs services with regular skills updating and staff training in conjunction with the support programmes offered by manufacturers.

Figure 3 – Interrelations between the key categories of actors on the market in securing flows of international goods

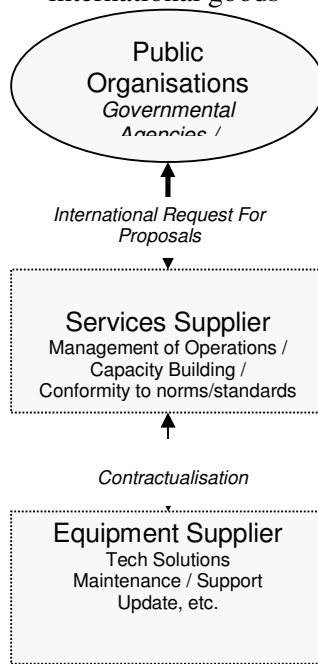
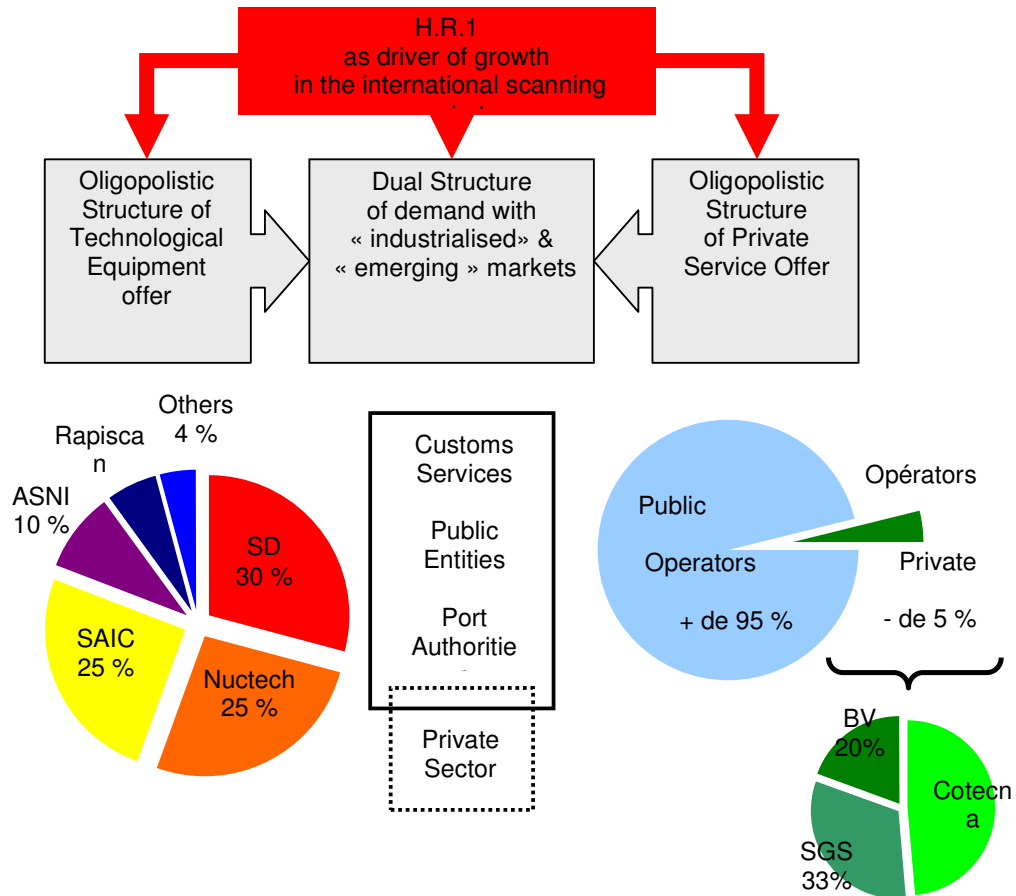


Figure 4. Summary of the competitive structure of the world market in scanning



3.2 – Port surveys

What is required here is a study from a ‘point zero’ which gives an account of the operational introduction of 100% scanning on export in the view of port authorities, port operators (handling staff, freight agents and maritime companies) and Customs services themselves as vectors of these operations on containers.

3.2.1 – Methodology and standard questionnaire

3.2.1.1 – Data collection from port authorities and port Customs services

Data has been collected from port authorities and port Customs services to respond to the following key question: **“How do you feel about the 100% scanning law adopted by the US Congress in July 2007?”**

The basic idea was to meet a significant number of port authorities and port Customs services individually or in groups. We were able to meet representatives *in situ* in the course of multiple trips to ten big maritime ports and four representative international institutions (UNCTAD, World Bank, European Commission and WCO) between November 2007 and March 2008, and obtain detailed information from at least that many (in particular from two out of the three pilot ports dedicated to 100% scanning: Southampton and Port Qasim).

1. Le Havre (LH): *Direction régionale des douanes et droits indirects du Havre* (Le Havre regional directorate for Customs and indirect taxes) and *Direction de l'Exploitation du Port Autonome du Havre* (directorate operating the autonomous port of Le Havre);
2. Rotterdam (RD): Port of Rotterdam (“Strategy Port Infrastructure and Maritime Affairs” department);
3. Rio de Janeiro (RIO): Directorate-general of Customs, Rio de Janeiro port authority;
4. Dakar (DAK): Directorate-general of the port of Dakar (and quality-security manager), Directorate-general for Customs (and computer security manager);
5. Dubai (DP): Jebel Ali, DP World “Strategy and Communication” port authority, Dubai Customs (Executive Director and Marketing Manager);
6. Montevideo (MV): Montevideo port authority (ANP); National Customs directorate, logistics directorate, National school of Customs;
7. Casablanca (CA): Port captain’s office (Directorate of the Police and Safety department), National Port Agency (ANP), Casablanca port regional Customs directorate;
8. Hong Kong (HK): Marine Department of the Government of Hong Kong, Special Inspection Unit of the Port and Maritime Command of the Customs & Excise Department;
9. Singapore (SG): Maritime Security Department – Policy Division of the Port Authority of Singapore, International & Planning Branch of the Singapore Customs;
10. Abidjan (AB): Secretariat-general of the Autonomous Port of Abidjan, Directorate of economic studies, planning and development of the Autonomous Port of Abidjan, Secretariat-general of the Port of Abidjan community, *Société d'Exploitation du Terminal de Vridi* (SETV: private company running Vridi terminal) and management directorate of the company BIVAC SCAN CI.

These port visits were supplemented by various other on-site interviews with a range of bodies which we considered relevant initially to supply, position and inform our study into the impact on international trade of the US law on 100% scanning of maritime containers before loading in maritime ports for export to the United States. These were:

- in Washington D.C., U. S. Customs and Border Protection (WDC CBP), the Embassy of France (Customs Attaché at the Embassy of France in Washington), the World Bank Group and the United States Government Accountability Office (GAO);
- in Geneva, UNCTAD;
- at Roissy-Charles de Gaulle airport, the Air France (AF) safety department;
- and on the French site of Eurotunnel in Coquelles, the Channel Tunnel Customs division.

3.2.1.2 – Drafting and structure of the standard questionnaire

The team (University of Le Havre, French Customs in Le Havre, Autonomous Port of Le Havre, SOGET and Normandy Business School) established a methodology for the collection of qualitative data by means of standard questionnaires in French and English (as applicable), through interviews structured into 6 main axes or sections:

1. Port dynamics;
2. Technology;
3. Governance;
4. Human Resources (HR);
5. Financial;
6. Procedure.

To carry out interviews with the port authorities and Customs services, we drew up a comprehensive 60-question standard questionnaire (plus one additional introductory question), as set out below.

I – Port dynamics

2 - How many containers enter your port each year (2007)? Each month? Daily?

Ports selected	Annual traffic (TEU)	Theoretical monthly traffic (TEU)	Theoretical daily traffic (TEU)
Casablanca	705,000	58,750	1,931
Dakar	360,000	30,000	986
Le Havre	2,635,000, including 1,123,000 on import in 2007	219,583	7219
Montevideo	597,000	49,750	1,635
Rio de Janeiro	350,000	29,166	958
Rotterdam	10,718,000	893,166	29,364
Dubai - Jebel Ali	12,000,000	1,000,000	32,876
Hong Kong	23,989,000	Between 1,583,000 and 2,122,000	Not specified
Singapore	Over 27,000,000	Not specified	Not specified
Abidjan	600,000	Not specified	Not specified
Eurotunnel – French site	1,400,000 in heavy goods transport in the two directions, France to UK and reverse	Not specified	1,775 in heavy goods transport 6 freight trains, i.e. 96 freight wagons

3 – What percentage of those containers are US-bound

Ports selected	(US-bound) export container traffic (TEU)	(US-bound) export containers as a percentage of total traffic	Container imports from the US (TEU) (2007)
Casablanca	0	0%	(no direct containerized links)
Dakar	0	0%	244 (10 months/ 2007)
Le Havre	150,000 (2007)	12% (2007)	Not specified
Montevideo	Not specified	Not specified	Not specified
Rio de Janeiro	42,000 (2007)	12% (2007)	Not specified
Rotterdam	408,000 (2006)	8.7% (2006)	421,098 (2006)
Dubai - Jebel Ali	22,000 (2006)	1% (2006)	Not specified
Hong Kong	Not specified	Not specified	Not specified
Singapore	Estimated at 375,000 and 4% of the total		
Abidjan	A little over 4,000 after a peak of 8,200 in 2004	Between 0.6 and 1.6% (between 1996 and 2007)	(no direct containerized lines US-Abidjan)
Eurotunnel – France	<i>Not applicable</i>	<i>Not applicable</i>	<i>Not applicable</i>

II - Technology

7 – How many scanners do you have?

The replies received from the ten port communities visited (no information for Hong Kong and Singapore) reveal that each port currently has a minimum of 1 scanner (3 out of 10 cases), with a maximum of 12 scanners by port and an operational total of 34 scanners in the selection of ports visited. These figures should be placed in perspective against the estimated total of 1,250 scanners currently operational throughout the world, dedicated to non-intrusive inspections.

Ports selected	Number of scanners currently available
Casablanca	2, including 1 relocatable (6 MeV) 1 movable (4.5 MeV) currently on loan to the port of Tangiers
Dakar	2
Le Havre	1
Montevideo	1
Rio de Janeiro	2
Rotterdam	3 including: 1 fixed high energy X-ray (at Maasvlakte) 1 relocatable medium energy X-ray (at Waal-Eemhaven) 1 “movable X-ray” (currently being phased out).
Dubai - Jebel Ali	2 including 1 fixed and 1 movable (+1 movable scanner in Port Rashid), with 8 on order.
Hong Kong	8 in total.
Singapore	12 in total.
Abidjan	1 fixed
Eurotunnel – France	<i>1 fixed</i>

3.2.3 – Exchanges of experience: perspectives and cost analysis

3.2.3.1 – Overall perspective on the 100% scanning issue

- a. the first major question is the issue of the potential blocking of port installations as a result of these controls;
- b. another uncertainty is the reaction of port handling staff (dockers) to handling containers identified by Customs services as high risk;
- c. the financial aspect of 100% scanning, or more precisely the issue of financing in ports outside the US, remains key: “*who is to finance the actual, i.e. operational, establishment of 100% scanning and the on-site maintenance involved in the procedures?*”;
- d. another point raised a number of times is the direct transmission of data and the capacity for (quasi) real-time processing and analysis of the images scanned in foreign ports (as mentioned by the National Targeting Center, for instance) in the face of the anticipated increase (+5% a year) in numbers of US-bound containers based on 2007 trends, giving around 11.5 million extra containers by 2012 (a total of 30 million, see part I);

3.2.3.2 – Southampton pilot port

Hong Kong is the only port to date to have had some embryonic experience of 100% scanning, over the past two years. The process which has applied in Southampton since 2007 is a double system combining the Megaport (radiation detector in relation with the US Department of Energy) and 100% scanning (Department of Homeland Security). The control centre is not an ISPS area but a mechanism prior to entering the terminals (Programme Cyclamen is the UK standard for imports). It envisages managing 1.8 million TEU annually on this basis.

In terms of the financial package, the Americans are paying each experimental pilot (Southampton and the two other pilots in Port Qasim and Puerto Cortes) around USD 14 million.

3.2.3.3 – Sectoral benchmarking of current practices

Besides the sectoral security practices proposed in the Roissy-Charles de Gaulle airport environment (in the case of Air France) and by French Customs operating on the French side of the fixed Channel Tunnel rail link (operated by Eurotunnel), it is possible to select and compare certain approaches by integrating the perspectives suggested by UNCTAD. The broad lines of these sectoral approaches agree on the following questions:

- as regards the images produced by non-intrusive detection controls by scanner, the perspective of data confidentiality, improvement of the quality of the image and the quality of its analysis by operators;
- data transmission from scans between the different sites from the perspective of the technologies, and the sharing or proposed essential and useful pooling of information and practices;
- the service companies involved in safety and security processes from the perspective of their specific role, their integration and their sometimes difficult relationships with the indispensable Customs partner;
- differentiated national practices in terms of safety, divergent conceptions, new practices currently being introduced, the need to reinforce standardization (going as far as

- certification: ISO 28000) and major problems of dysfunctions caused by variant practices, and the need to harmonize practices;
- how to handle alerts, improve operational arrangements and their impacts on traffic flows and congestion of terminal installations.

3.2.3.4 – Cost analysis

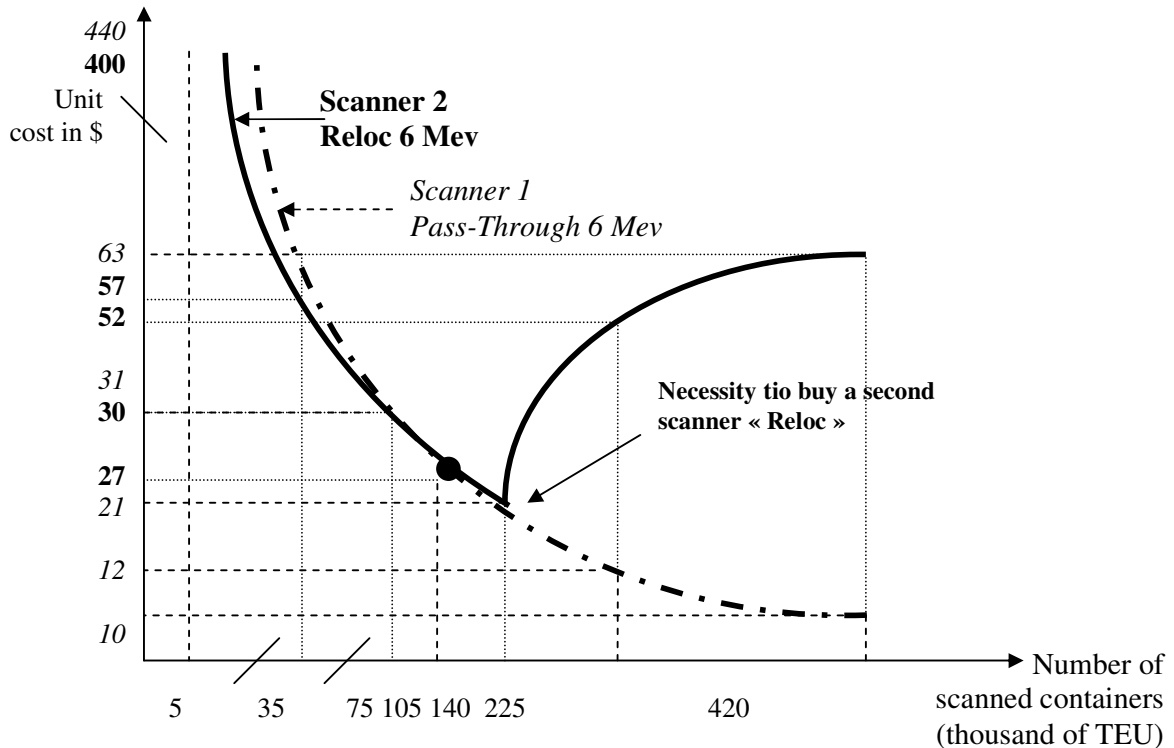
As a preliminary initial cost analysis, our interviews with experts (manufacturers and administrators) provide an approximate quantification of the unit cost per scanned container. Obviously, depending on the quality, performance and use of the material, and the size of the specific port site (in terms of traffic), the overall cost of the scanned container will be different.

Table 4. Unit cost of scanned TEU container in USD by type of scanner

Number of containers scanned per year	Scanner 1: pass-through scanner 6 Mev	Scanner 2: relocatable fixed scanner 6 Mev Double Tunnel
5,000	440	400
35,000	63	57
75,000	31	30
105,000	21	27
140,000	20	21
225,000	12	52
420,000	10	63

If even more containers were scanned annually, e.g. 420,000 containers scanned over the year, the unit cost could fall below USD 10 in the case of the pass-through scanner, while the relocatable scanner is no longer competitive above 150,000 boxes as a second machine is needed to scan such a volume. This explains the break in the curve showing the unit price of scanning for this type of scanner (Graph 4), contrasting to the linear curve of the pass-through scanner.

Graph 4. Approximate estimate of the direct unit cost of a scanned TEU container as a function of overall activity



These curves give a very approximate (theoretical and prospective) image of reality. The introduction of an ultramodern risk-management system linked to the scanner will probably generate an additional cost of around USD 3 per scanned container (for 150,000 TEU annually; or around USD 15 for 35,000 TEU). There is an immediate return on the investment in this powerful risk analysis as it can considerably reduce the number of containers which have to be scanned (with a potential 100% screening and 50% scanning, for instance). Once again, it is absolutely essential to consider the scanning of containers as a complementary tool to effective risk analysis.

There remains the question and the cost of image interpretation when it is not carried out in the port of origin due to a lack of competent staff. A somewhat futuristic calculation may be carried out, i.e. how many Customs officers and/or other imaging operators would the Americans have to employ within the Targeting Center if their partners were to content themselves with scanning the containers in the port of origin then sending the encrypted, non-interpreted image (the H.R. 1 law does not actually require analysis of the image) by secure means to the United States? Assuming that an image is 10 megabytes and that an operator can interpret 10 images per hour (or 1,600 per year based on 8-hour days, 200 days per year), an operator could analyze 16,000 images per year (it is easy to imagine the colossal database required). At over 18 million US-bound containers today (and potentially 30 million in 2012), this would amount to employing 1,125 staff at the Washington nerve centre (1,875 in 2012). By way of comparison, around fifty staff are currently dedicated to interpreting images from the 59 CSI ports, with 5 to 10 images are received each week from each CSI port.

IV –IMPACT OF THE ‘100% SCANNING LAW’: POTENTIAL SCENARIOS

At this stage of the study, it is important to demonstrate several potential scenarios by combining the main results of the previous macro- and micro-economic sections with the latest scientific findings and information from readings, interviews and on-the-spot meetings.

4.1 – Potential macro-economic impacts of the application of the US law

A number of scenarios may be developed as regards the capacity of ports to scan 100% of containers:

- Scenario 1 (Status quo): no port is capable of applying this law;
- Scenario 2 (‘triadic’ concentration): no port apart from a few Asian and European megaports;
- Scenario 3a (Polarization): all major European and Asian ports and a few ports in middle-income and developing countries;
- Scenario 3b (Dedicated polarization): all major European and Asian ports and some ports in middle-income countries and developing countries, but only for the United States;
- Scenario 4a (Networking): all of the world’s major ports;
- Scenario 4b (Dedicated networking): all of the world’s major ports but only for the United States.

It remains to anticipate the main consequences of achieving each of these scenarios. Five impacts are studied below, relating to:

- the logistics chain: this is clearly the heart of the problem, i.e. reconciling the security imperatives (very much strengthened through the SFI) and the traffic facilitation imperatives (notoriously complicated through the SFI due to the extra cost generated and the port reorganization required);

- the developed countries: these are the most concerned as the most interested, the US market being too large to be neglected ;

- the developing countries: these are not least concerned as, even if they export little to the United States, apart from Thailand (over 400,000 TEU in 2006), Vietnam and Costa Rica which are crucial growth relays for the world along economy along with middle-income countries and countries in transition, the challenge for these countries is huge as they face with the danger of a twofold marginalization: lack of critical mass and lack of direct access to “rich” countries by sea;

- US policy: it gives the orders which created such a shock last summer. Considered by most as utopian in its desire to apply 100% scanning by 1 July 2012, it may also be viewed as a tremendous technological booster, as a unilateral framework of standards (i.e. contrary to the SAFE framework which abolished any possibility of “supplementary national criteria” (Schmitz [2008, p. 10]) unless national security is threatened (GATS Article XIVa)), which is premature, and a way of transferring the costs of US security to its key partners in the hope that they accept and follow this path. Numerous reorientations are, however, possible, not to mention the electoral uncertainties and terrorist contingencies;

- international organizations finally: starting with the World Customs Organization, whose first prerogative is the control of goods and standardization of practices internationally, but also the World Bank, IMF and European Commission (Kovacs [2008]) which concentrate on the facilitation of world trade and which look unfavourably on this potential brake on the rapid movement of goods.

The different potential scenarios are analyzed below with regard to the above impacts, and summarized in the following Table 5.

In the first Scenario (no port is capable of applying 100% scanning by 1 July 2012), the **status quo** prevails: current trends will be reinforced, i.e. a continuation of the remarkable Chinese dynamics backed by a dynamic scanner technology company” (Nuctech). The largely heterogeneous practices will promote those ports/countries which have been able to invest in security (in other words the developed countries) and will by default only penalize the developing countries. The fate of the “middle-income countries” varies by case, i.e. depending on the local quality of their risk analysis and their CSI certification. A number of options will be presented to the US Congress, not just on the 2012 deadline but probably in 2010 to amend a number of provisions: for instance, modulating the application date (potentially 2014, particularly as paragraph (4) of H.R. 1 gives the Secretary this possibility), while requiring an intermediate scanning rate (50%, for instance) coupled with efficient risk analysis. Three radical solutions would remain: completely abandoning the law, concluding bilateral agreements (with China in particular if 75% of the containers arriving in the United States originate from China in 2012), or conversion at all costs on the planned date and, since it will be impossible for all partners to meet the specifications, setting up nearby port enclaves with the necessary material and operational conditions which would be an alternative to the direct import into its territory of non-scanned containers. Massive investments (more traffic planned at Long Beach in 10 years’ time) in the Mexican port of Ensenada (a stone’s throw south of San Diego) testify to this desire to “diversify” the options and therefore the risks. Finally, we have every reason to believe, in the context of this Scenario, that international organizations (starting with the WCO) will favour a pragmatic approach by re-concentrating on what is feasible and operational (SAFE framework of standards; WCO [2008]; Kovacs [2008, p. 15]), i.e. a targeted risk analysis or even the introduction of a Megaport 2 guideline. The probability of this Scenario is strongest as things stand. It also leaves the most doors open in policy terms.

The second Scenario, the **‘triadic’ concentration**, may be associated with a fairly strong probability. It would be characterized by the appearance of a number of avant-garde ports which have staked their bets on technology and the logistics reorganization required by the United States (*ad hoc* terminals). This limited club of ultra-secure ports combining risk analysis and 100% scanning (or a similar amount, around 50% for instance) would establish their world logistics dominance thanks to this positive differentiation which would make them essential hubs (bringing to mind Head’s “Gravity for Beginners” [2003]). A “plurilateral approach” would therefore prevail over a “multilateral approach” (Wilson, Otsuki [2005]) at the expense of other world ports, in particular in developing countries: CSI ports (Annex 2) would be able to claim targeted exemptions. Heightened risk analysis, with a direct link with US intelligence services, could therefore determine in advance the level of scanning required (30%, 50%, or more) depending on the seriousness of the information intercepted. The ports would therefore have to increase their scanning capacity (in other words a higher percentage of containers, even up to 100%) depending on the nature of the potential threat (system of indicators). International organizations would only be able to advocate an extension of port certification (less binding), a single international framework and multilateral negotiations.

The third Scenario, although less probable, cannot be ruled out entirely. It involves **polarization**, in other words the appearance of around fifteen “hub” ports either with terminals dedicated to the United States (**Scenario 3b**) or without them (**Scenario 3a**: complete, uniform port reorganization). This asymmetric technical-logistic expertise would of course be to the advantage of the developed countries and to the detriment of developing countries, although a few rare network heads could emerge in South America, South-East Asia and possibly Africa, if only to promote optimization of the world logistics chain and, more or less directly, improve commercial trade flows (while avoiding too many diversions of traffic and thus reducing

medium-distance cabotage). The framework of international standards could therefore only be strengthened as it would be considered an imperative intermediate step to the sought-after certification. Support, even aid, from international organizations could therefore help some ports which make colossal efforts to catch up.

There remains the fourth and final Scenario, and the most utopian: **networking**. It would involve a revolution in both ways of thinking and above all in logistics which would go hand-in-hand with conversion to the 100% scanning law of a large proportion of the big world ports with dedicated terminals (**Scenario 4b**) or of all major ports in the world (around 40) (**Scenario 4a**). This multi-actor networked economy (of developed countries and a good number of the larger developing countries, with four to five multi-modal platforms per continent) would mean sharing the logistics dominance of the countries which are today leaders in the maritime security field. The US law would therefore certainly gain ground, at least at the level of the OECD (and in the European Union in particular), and would probably become the new framework of standards internationally. In view of the current scanner technology and NICT in general, port congestion, the lack of trained imaging operators, and of course the financial constraints, the likelihood of this Scenario occurring remains infinitesimal.

The occurrence of these scenarios is therefore a direct function of technical-logistic and managerial trends which are described in detail in the next section.

Table 5. Potential macro-economic impacts of the application of the US ‘100% scanning’ law on 1 July 2012

Impacts on Scenarios (ports)	logistics chain	developed countries (number)	developing countries (number)	US policy	international organizations	Probability
1 <i>None</i>	Status quo (strengthening of current trends) Largely heterogeneous practices	“First mover advantage” of precursors (0 countries)	Not penalized but “avoided” (0 countries)	- Abandoning the law - Deferral: 2014? - 50% scanning - Bilateral agreement (China) - Nearby enclaves	- Preferential risk analysis - Towards Megaport 2?	Strong
2 <i>Megaports</i>	‘Triadic’ concentration: strong hub ports (incentive for transshipments) Port terminals dedicated to the US	Limited club of leaders: positive differentiation of secure ports (ca. 10 countries)	Marginalized (0 countries)	- Time limit granted to CSI ports - Targeted exemptions	- Strengthening existing provisions - Alert mechanism graduated according to risk	Fairly strong
3a <i>Many</i>	Polarization: “hub” ports Technical-logistic expertise	Strengthened positions (ca. 20 countries)	A few network heads (cabotage) (ca. 5 countries)	- Modulated application	- Support - Communication	Very low
3b <i>Many dedicated</i>	Polarization: “hub” ports Port terminals dedicated to the US Technical-logistic expertise	Points of passage required (ca. 15 countries)	One or two network heads (2 - 3 countries)	- Time limit awarded to CSI ports - Targeted exemptions	- Strengthening existing provisions - Communication	Low
4a <i>All</i>	Networking: networked economy Port reorganizations Organizational innovations	Loss of the competitive advantage acquired in recent years (ca. 30 countries)	Several continental platforms (ca. 10 countries)	- Strict application	- Development of a new framework of standards: SFI	Tiny
4b <i>All dedicated</i>	Networking: networked economy Port terminals dedicated to the US Organizational innovations	Shared logistic dominance (ca. 25 countries)	One or two continental platforms (5)	- Modulated application	- New standards if EU follows suit	Marginal

4.2 –Technical-logistic developments underlying the potential scenarios

Three key dimensions need to be taken into account to examine the probability of realizing the above scenarios analyzed.

Firstly, the first key factor is undoubtedly the technological dynamics (by 2012), in other words the technological revolution required at the level of the scanners themselves, in terms of modularity and performance (throughput or number of scans which may be carried out in one hour). The introduction of a fixed machine which may scan up to 200 containers an hour in the port of Ras Al Khaimah (Mina Saqr port in the United Arab Emirates) in 2008 (contract with Nuctech signed on 1 October 2006) shows that this technological leap is possible.

Secondly, (apart from feeding a stored memory to explain a misdemeanour *ex-post*) 100% scanning is of interest in itself only if all scans are interpreted scrupulously. This raises the question of the competence of the human resources (expertise of imaging operators) and of the interpretation software at their disposal, combined with an upstream risk analysis. Without a training policy, covering both initial and continuing training, 100% scanning will go unheeded or will take the shape of a simple transfer of images to the United States (transferring the risk and the burden of interpretation to Washington’s *National Targeting Center*).

Thirdly, massive and strategic investments (extension of dedicated terminal capacities, optimal organization of routes, traceability of containers from one end of the chain to the other, co-ordination between the actors involved, etc.) will be essential to ensure fluid traffic flow within the dedicated area ensuring that the “check lane” is not saturated and the terminal blocked. More than the technology or the training, the facilitation of the logistics chain demands a rethink of existing infrastructure in terms of intermodality and strategic location, requiring a relatively complex port reorganization. Underlying financial constraints result from the costs of setting up and operating this managerial transformation, and the many associated investments in infrastructure required.

It therefore remains to define how these three key factors will interact and, depending on how they evolve (large or small technological, managerial and organizational innovations), how they describe and correspond to the scenarios discussed above (Table 6).

Table 6. Key factors in achieving the potential scenarios

Productivity		of technology			
		very high		identical	
Investments		of human resources			
		high	identical	high	identical
infrastructure (port reorganization and logistics)	large	S4a	S4b	S3a	S2
	small	S3a or S3b	S3b or S2	S1	S1

- Combining these three dimensions produces eight hypothetical cases:
- the first is the ideal-type case, i.e. coupling the three innovations. Investment in infrastructure (and the associated port reorganization) thus goes hand-in-hand with the improved productivity of the machines (throughput) and human resources (interpretation), and 100% scanning can become a reality for all the world ports which are not prisoners of financial constraints. This is **Scenario 4a: Networking** of a large number of ports worldwide thanks to the diffusion of technology, convergence towards a framework of standards accepted by all and a new port organization logic.
 - Once the technological leap has been made, four more scenarios may be envisaged.
 - + Firstly, one whereby a large number of ports invest in infrastructure even if the human resources are not trained in an ideal way (**Scenario 4b: dedicated networking?**). This ensures scanning of all US-bound containers but the risk (problem of interpretation) is transferred to the United States.
 - + Secondly, the infrastructure investments and appropriate port reorganization are the preserve of the few (a small number of developed countries) due to the costs and the complexity of implementing 100% scanning (**Scenario 2: 'triadic' concentration**). Very disparate port situations emerge with largely heterogeneous practices within which ports which have been able to invest in human resources (with US supervision if necessary), operate powerful machines, with a terminal dedicated to the United States (**Scenario 3b: dedicated polarization**) or without (**Scenario 3a: polarization**), pull away from the rest.
 - If the technology does not evolve much between now and 2012 but the most powerful machines in existence today spread throughout the world, a large number of countries could envisage 100% scanning provided they make significant physical and human investments and put these to work on port reorganization (**Scenario 3b: dedicated polarization**). Unless human resources are made a priority, physical investments will not achieve anything and no SFI certification will be achieved; hence just a few megaports will emerge from the multitude (**Scenario 2: 'triadic' concentration**).
 - Finally, it goes without saying that with the same technology and low investments in infrastructure, gambling on human resources alone will not allow 100% scanning to be envisaged in any port whatsoever be (**Scenario 1: status quo**). This will also be true if nothing is done in terms of training (**Scenario 1: status quo**), quite apart from the fact that risk analysis alone would be questionable given the anticipated explosion in container traffic.

What is the likelihood of the above scenarios occurring? While not able or willing to vouch for the respective importance of these three factorial dynamics (infrastructure, technology and human resources), which are all looked at from a qualitative point of view, it would appear that certain scenarios stand out more than others. Combined with the latest scientific literature and having regard to the feedback from experience from the standard questionnaires, scenarios 3 and 4 appear more than unlikely by July 2012. There remain scenarios 1 (no port) and 2 (some megaports apply 100% scanning in 2012). Here again the uncertainties are too great, particularly at the technological level, and based on the feedback from the experience of three pilot ports (Southampton, Port Qasim and Puerto Cortes). Unless there is a major technological revolution which is very sparing in human resources (which cannot be completely ruled out), the response would therefore lie somewhere between scenarios 1 and 2, in other words the appearance of a few certified megaports through which all US-bound containers would transit and which would be capable of scanning 50% of them.

V – CONCLUSION

In one sense, the US 100% scanning law can be interpreted as both a veiled protectionist measure and/or an admission of weakness on the part of the Americans, but also as a desire to guard against any world terrorist risk (Richardson [2004], Grégoire-Blais [2004]) likely to affect the US logistics chain by ‘allocating’ (Niehaus [2002]), or even transferring, this risk to its partner countries as scanning is required to take place before loading.

The likely world port dualization [two-tier system?] will resemble an archipelago economy in which a few certified islands, which are secure and at the leading edge of technology, will attract container flows from around the world as obligatory points of passage. This polarization will be strengthened if the European Union goes down the same regulatory route as the US. This new unilateral framework of standards may however evolve between now and 2012 and be modified and/or deferred in time, even if the trend would be, as for airports (where it seemed absurd in 1990 to plan 100% scanning by 2000) for 100% scanning to one day become a reality. The question is therefore for whom (essentially Asia), and when?

On balance, to return to the notion of opportunity cost, the key issue is seeing the security imperatives significantly reduce the amount of port resources which could have been allocated directly to financing of sizable new infrastructures, primarily on US soil. The question of compensation by the US Government of this relative loss to port actors remains unanswered. The example of the US aviation sector, in which the US Government has just sent airlines a retroactive bill for expenditure required to upgrade airport terminals (six years after the event), tends to suggest that it will be private actors who will have to pay a large part of the additional costs linked to the application of the 100% scanning law (ports or Customs passing the direct and indirect cost of scanning on to operators in the shape of port or security taxes). It goes without saying that operators will therefore have the opportunity to pass on the equivalent of this additional cost to the final consumer, which will slow down international trade dynamics and consequently world growth (but to what extent and with what gain?). The question which still cannot be answered at present is the indirect cost of applying the 100% scanning law and, in parallel, the direct and indirect cost of a major terrorist act on the world logistics chain and more particularly the United States.