ROTTERDAM SCHOOL OF MANAGEMENT
ERASMUS UNIVERSITY

PUBLIC-PRIVATE PARTNERSHIP FOR COORDINATED SUPPLY CHAIN RISK MANAGEMENT

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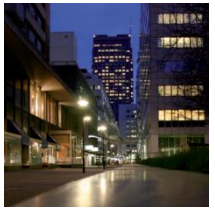
The business school that thinks
and lives in the future



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CONTENT

- Introduction to the CASSANDRA project
- The need for visibility
- Risk assessment by Business & Customs
- Alignment
- Case: Counterfeiting
- Multi-player sequential game model
- Conclusion

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CASSANDRA PROJECT

- Common assessment and analysis of risk in global supply chains
- 3 year project, from June 2011 to May 2014
- Part of the European Commission's Seventh Framework program for Security
- 26 consortium partners including freight forwarders, Customs, police, port community systems and IT solution providers
- www.cassandra-project.eu





CASSANDRA CONCEPT

CASSANDRA Data sharing

CASSANDRA Risk assessment

piggybacking

Supply Chain benefits

Reduction of administration costs and errors

Improved insight in performance and supply chain risks

Improved SC operational performance

Customs benefits

Better identification of secure and safe supply chains

Improved data for risk assessment

Improved efficiency

More focus on high risk flows

Improved effectiveness

General (Society) benefits

Corporate Social Responsibility: Trade facilitation, Carbon footprint, fair trade, …

NEED FOR VISIBILITY

- Buyer perspective:
  - Unclear origin and chain
  - Export declaration unknown *(Integrity project)*
- Logistics provider or carrier perspective:
  - Relevance for internal processes, compliance and security
  - Data quality is responsibility of information provider
  - Visibility → Extra service towards (buying) customer
- Customs perspective:
  - Security vs. facilitating legitimate trade
  - Entry Summary (security) declaration → Risk assessment
  - For risk assessment: Quality IN = Quality OUT

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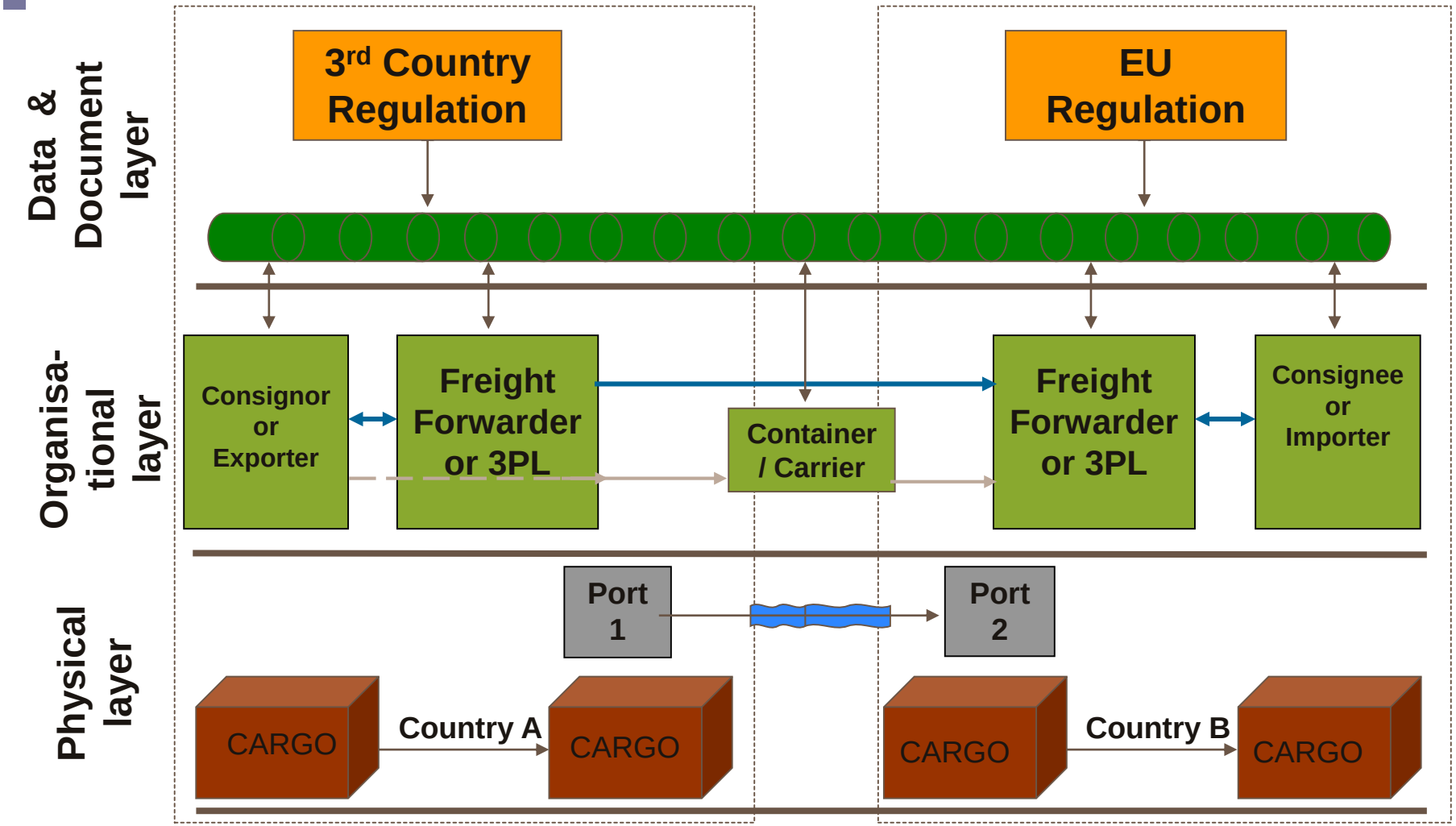
DATA PIPELINE CONCEPT

Future Customs and International Trade Systems



Information pipeline model, by F. Heijmann and D. Hesketh

CURRENT RISK ASSESSMENT PRACTICE BY CUSTOMS

- Risk assessment for security in 2 stages:
  - Information analysis (based on ENS declaration)
  - Physical inspection

- Additional documentation can be required from business

- Information requirements on four different levels, in order of importance:
  1. Goods information
  2. Party information (all parties involved in the supply chain)
  3. Logistics information (container data, milestones, planning, integrity)
  4. Financial information

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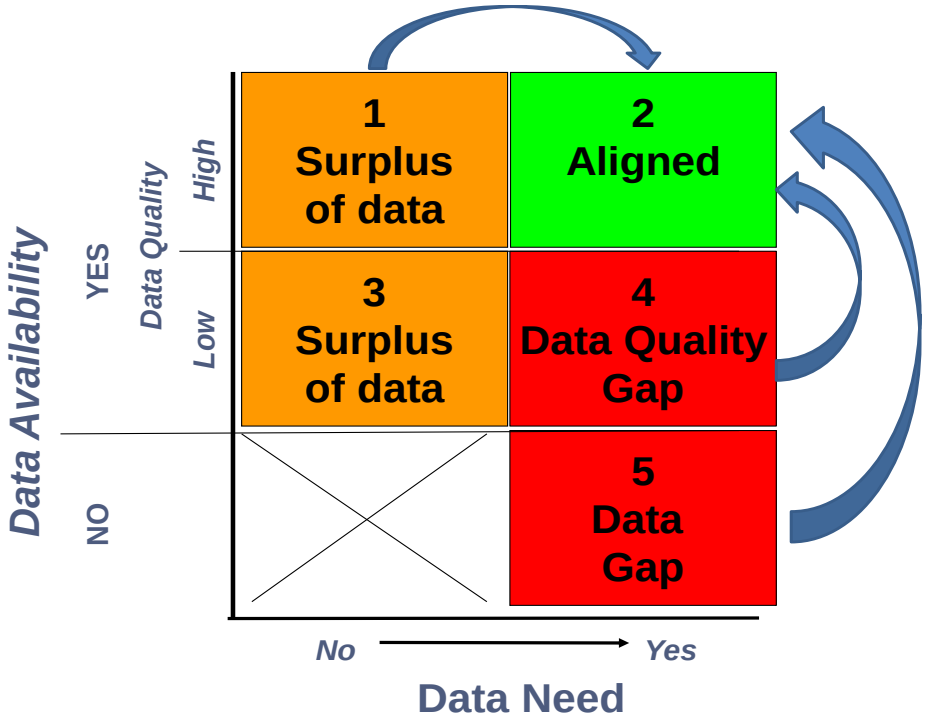
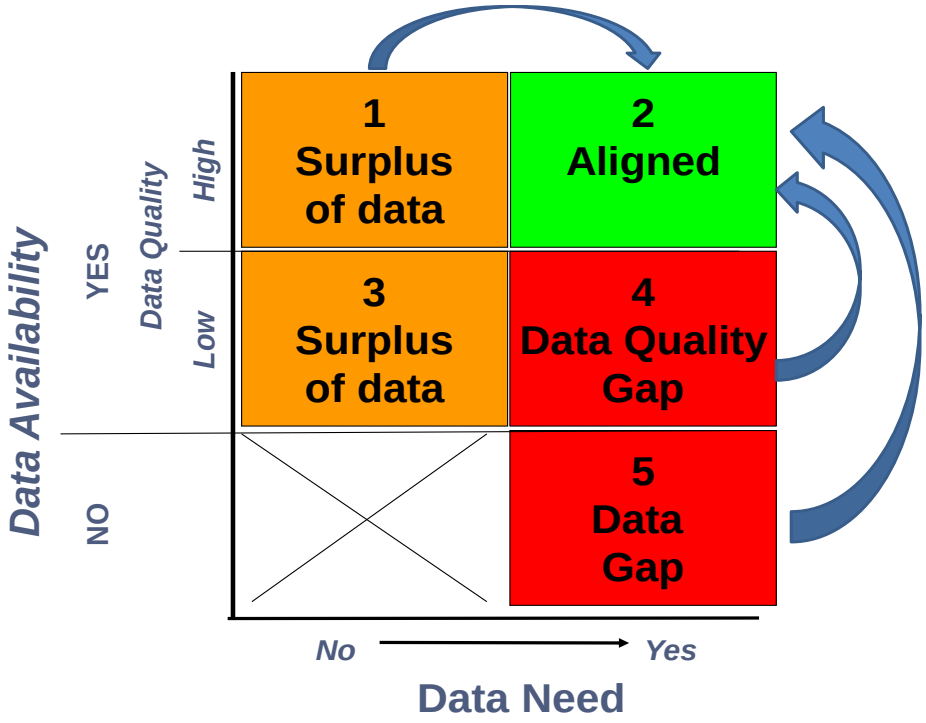
DATA QUALITY FOR CUSTOMS



Model of Possible states of data need, data availability and data quality

- First data availability depends on regulation (Annex 30A)
- Biggest challenge: type 4 Gap
  - Focus on ‘fitting the form’
  - Buyer – Seller relationship and ID
- Extra challenge: type 5 Gap
  - Requesting extra documentation

DATA QUALITY FOR BUSINESS



Model of Possible states of data need, data availability and data quality

- Data need depends on responsibility in the chain
- No interest in data surplus
- Biggest challenge: type 4 Gap
- Quality depends on:
  - Providing party
  - IT support & digitalisation

ALIGNING BUSINESS & CUSTOMS

- Aligning assessment of operational business risks and Customs risk can be a challenge, but..
- .. Improving data quality will support both assessments
- Both parties require, for their own purposes:
  - Goods information
  - Party information (all parties involved in the supply chain)
  - Logistics information (container data, milestones, integrity, planning)
  - Financial information

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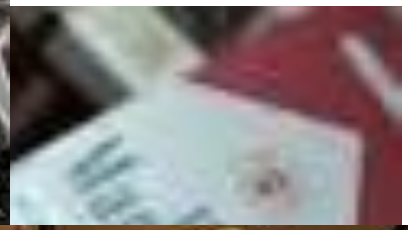
MOVING TO A COUNTERFEITING EXAMPLE

- So far
  - We talked about the need for visibility from a risk management perspective,
  - And the possibility of government – business cooperation to mitigate supply chain risk

- In the rest of this talk
  - We focus on counterfeiting risks as a major challenge in today's global supply chains
  - We study how the government – business cooperation might lead to risk mitigation









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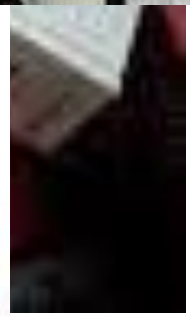

DEFINITION

- WTO 2011
  - "*Unauthorized representation of a registered trademark carried on goods identical to or similar to goods for which the trademark is registered, with a view to deceiving the purchaser into believing that he/she is buying the original goods*."

MOTIVATION

- The economic and social impact of counterfeiting activities is considerable.
- The CIB (2011) estimates show that counterfeiting accounts for 5-7% of world trade, making it worth $600bn per annum.
- Customs seizure of counterfeit products entering US reached some 14841 seizures in 2009, worth $260m.
- Counterfeiting
  - Increases Law enforcement costs
  - Reduces tax revenues
  - Funds organized crimes and terrorism
  - Undermines reputations
  - Damages customer-confidence
  - It even KILLS (15% of pharmaceuticals imported to the US are counterfeits containing unapproved substances.)

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CUSTOMS' PROCEDURE TOWARDS COUNTERFEITING

- Customs' Procedure
- Customs seizure of counterfeit products entering US reached some 14841 seizures in 2009, worth $260m.
- In 2012, EU customs authorities opened almost 91.000 detention cases for a total of nearly 40 million articles. The domestic retail value of the detained articles represented almost 1 billion Euros.

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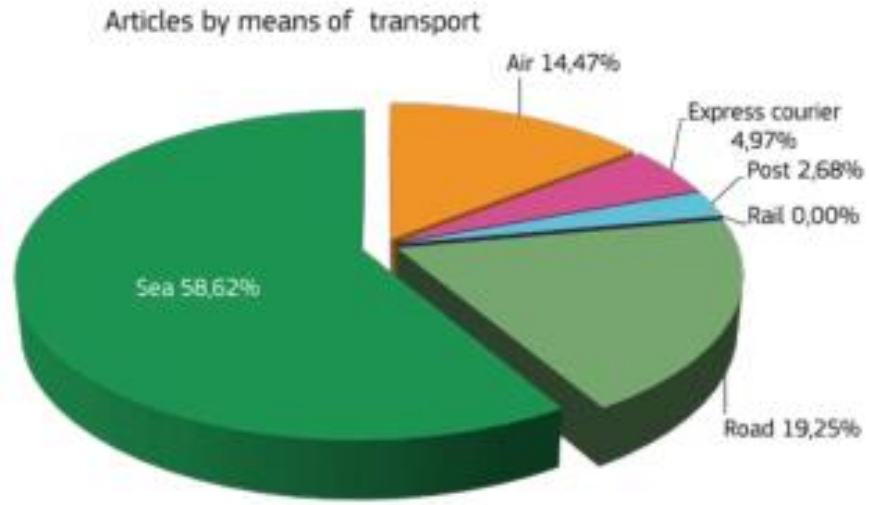
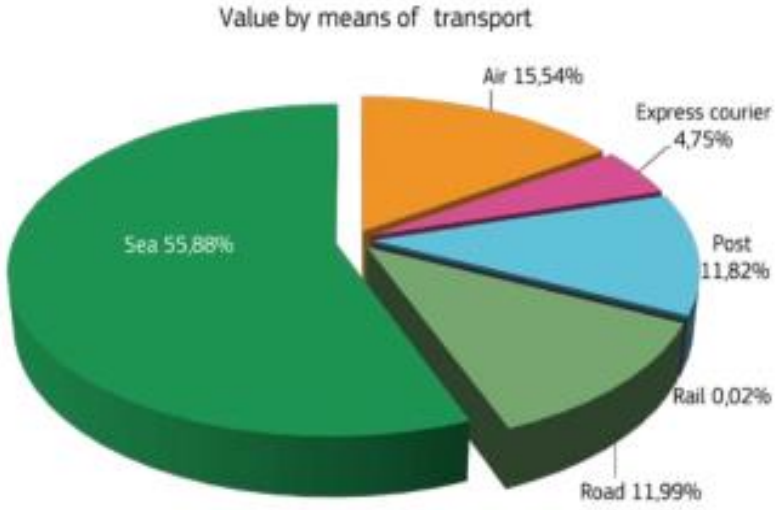
COUNTERFEIT SEIZURES

- We focus on containerized sea transport





- Reference: European Commission, Report on EU customs enforcement of intellectual property: Results at the EU border 2012 rights

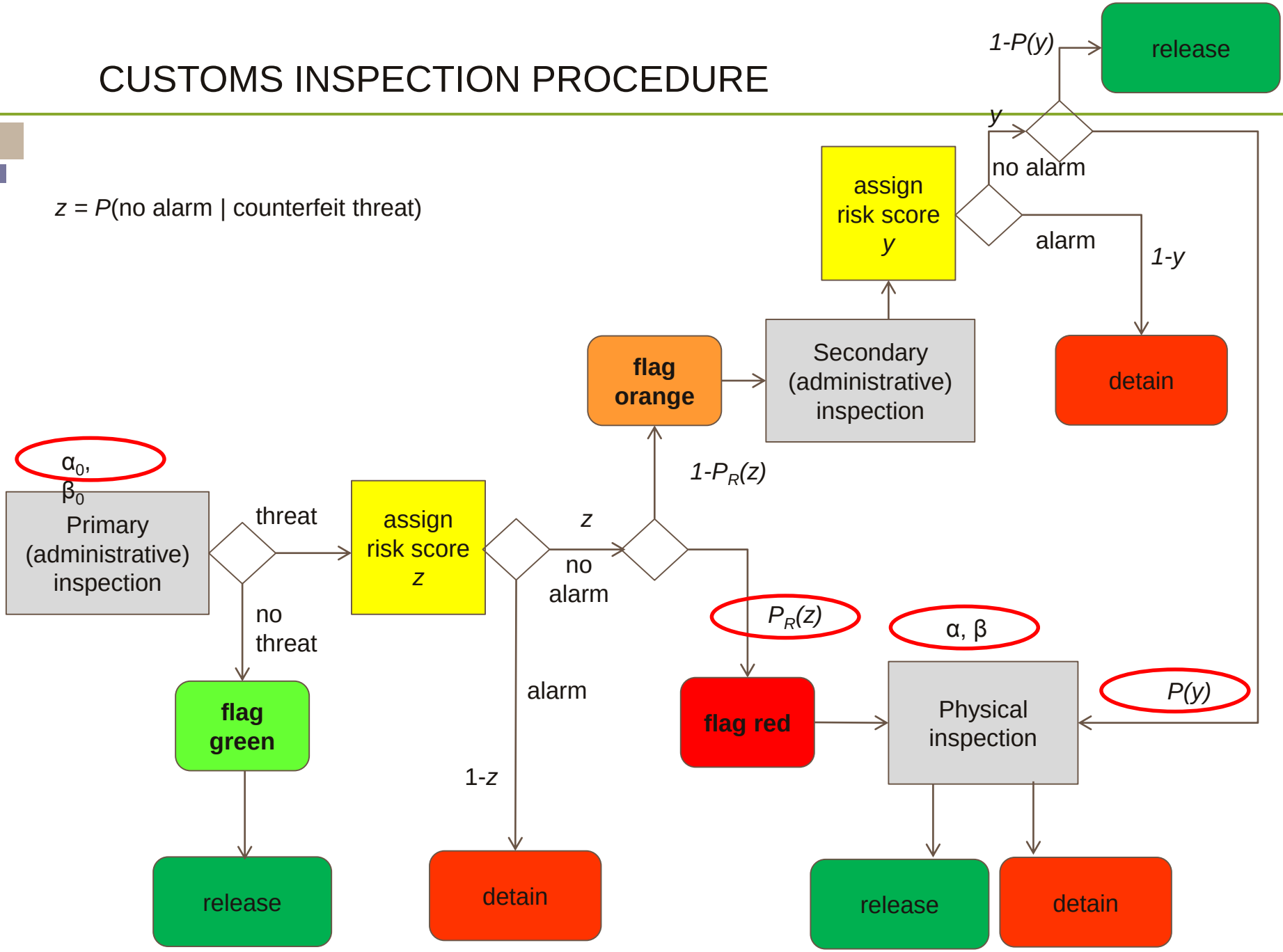
HOW DETRIMENTAL PHYSICAL INSPECTION COULD BE?

- Some facts (Port of Rotterdam)
  - 9.3 million containers throughput (1000 in one hour)
  - 369 million tons of goods
  - 3 million Bills of Lading

  - The congestion that results from inspection can be detrimental to trade.
  - Cost of delay per day might be 0.5% of the value of the containers.
  - A day of pipeline inventory would, require $174 million per year to finance.

CUSTOMS INSPECTION PROCEDURE

$z = P(\text{no alarm} \mid \text{counterfeit threat})$



RESEARCH QUESTIONS

- To provide a modeling framework to understand the economic trade-offs embedded in container inspection decisions with respect to counterfeit risks. Then using this framework, we aim to investigate:
  - Should rights-owner invest in Customs inspection facilities to hinder counterfeit products from entering legitimate supply chains?
  - How would investment in SC visibility affect counterfeit inspection and detection rates?

BASIC MODEL

- We model this problem as multi-player sequential game.
- We model counterfeiter as a rational agent who has the means to infiltrate a container with counterfeit products.
- Customs acts as a leader and decides its primary and physical inspection policies and inspection errors considering the impacts it can have on the trade.

BASIC MODEL: PHYSICAL INSPECTION

- The benefit to the counterfeiters is the sum of the benefit gained by counterfeit items escaping Customs inspection and the perturbation caused in the flow of genuine products. If counterfeit products are detained then the counterfeiter is penalized and this penalty is subtracted from the total profit. This is given as follows

$$\max_{\gamma\in[0,1]} \pi_c(\theta_O) = (1-y)[\gamma(1-\beta)L_f + (1-\gamma)\alpha\mathbb{E}\{L_d\}] + y\big[(1-\mathbb{P}\{y\})\gamma L_e + \mathbb{P}\{y\}\Big[\gamma\Big[(1-\beta)L_f + \beta L_e\Big] + (1-\gamma)\Big[\alpha\mathbb{E}\{L_d\} + \mathbb{E}\{L_w\}\Big]\Big]\big]$$

- Customs objective function is to minimize the profit that counterfeit can have

$$\min_{\mathbb{P}\{y|y\in[0,1]\},\alpha,\beta} \pi_r = (1-y)[\gamma(1-\beta)L_f + (1-\gamma)\alpha\mathbb{E}\{L_d\}] + y\big[(1-\mathbb{P}\{y\})\gamma L_e + \mathbb{P}\{y\}\Big[\gamma\Big[(1-\beta)L_f + \beta L_e\Big] + (1-\gamma)\Big[\alpha\mathbb{E}\{L_d\} + \mathbb{E}\{L_w\}\Big]\Big]\big]$$

- Customs capacity consideration

$$\#\text{ of containers in physical inspection} + \#\text{ of detained containers} \leq n_0$$

BASIC MODEL: PRIMARY (ADMINISTRATIVE) INSPECTION

- The benefit to the counterfeiters

$$\max_{\gamma\in[0,1]} \Pi_c = (1-z)\left[(1-\gamma)\alpha_0\mathbb{E}\{L_d\} + \gamma(1-\beta_0)L_f\right]$$

$$+z\left[\mathbb{P}_R\{z\}\left[\alpha_0(1-\gamma)(\mathbb{E}\{L_w\} + \alpha\mathbb{E}\{L_d\}) + (1-\beta_0)\gamma(\beta L_e + (1-\beta)L_f)\right] + (1-\mathbb{P}_R\{z\})\pi_c(\theta_O)\right]$$

- Customs objective function

$$\min_{\mathbb{P}_R\{z\},\alpha,\beta} \Pi_c = (1-z)\left[(1-\gamma)\alpha_0\mathbb{E}\{L_d\} + \gamma(1-\beta_0)L_f\right]$$

$$+z\left[\mathbb{P}_R\{z\}\left[\alpha_0(1-\gamma)(\mathbb{E}\{L_w\} + \alpha\mathbb{E}\{L_d\}) + (1-\beta_0)\gamma(\beta L_e + (1-\beta)L_f)\right] + (1-\mathbb{P}_R\{z\})\pi_c(\theta_O)\right]$$

- Customs processing time should not exceed a certain threshold.

CHARACTERIZATION OF THE OPTIMAL PHYSICAL INSPECTION POLICY

$\mathbb{P}\{y\}$ can be optimally characterized as follows:

- if $0 \leq y < y^*$ then $\mathbb{P}\{y\} = 0$
- if $y^* \leq y < 1$ we have

$$\mathbb{P}\{y\} = \frac{\gamma(L_e - L_f)}{\gamma(1-\beta)(L_e - L_f) - (1-\gamma)[\alpha\mathbb{E}\{L_d\} + \mathbb{E}\{L_w\}]}\left(1 - \frac{y^*}{y}\right)$$

Moreover, Customs space availability constraint is binding in the optimal solution provided that counterfeiters benefit, $\pi_c^* > 0$.

CHARACTERIZATION OF THE OPTIMAL PHYSICAL INSPECTION POLICY

$\mathbb{P}_R\{z\}$ can be optimally characterised as follows:

- if $0 \leq z < z_R^*$ then $\mathbb{P}_R\{z\} = 0$
- if $z_R^* \leq z < 1$ we have

$$\mathbb{P}_R\{z\} = \frac{\Gamma_1 - \pi_c(\theta_O)}{\Gamma_2 - \pi_c(\theta_O)}\left(1 - \frac{z^*}{z}\right)$$

where

$$\Gamma_1 = \gamma(1-\beta)L_f + (1-\gamma)\alpha_1\mathbb{E}\{L_d\}$$

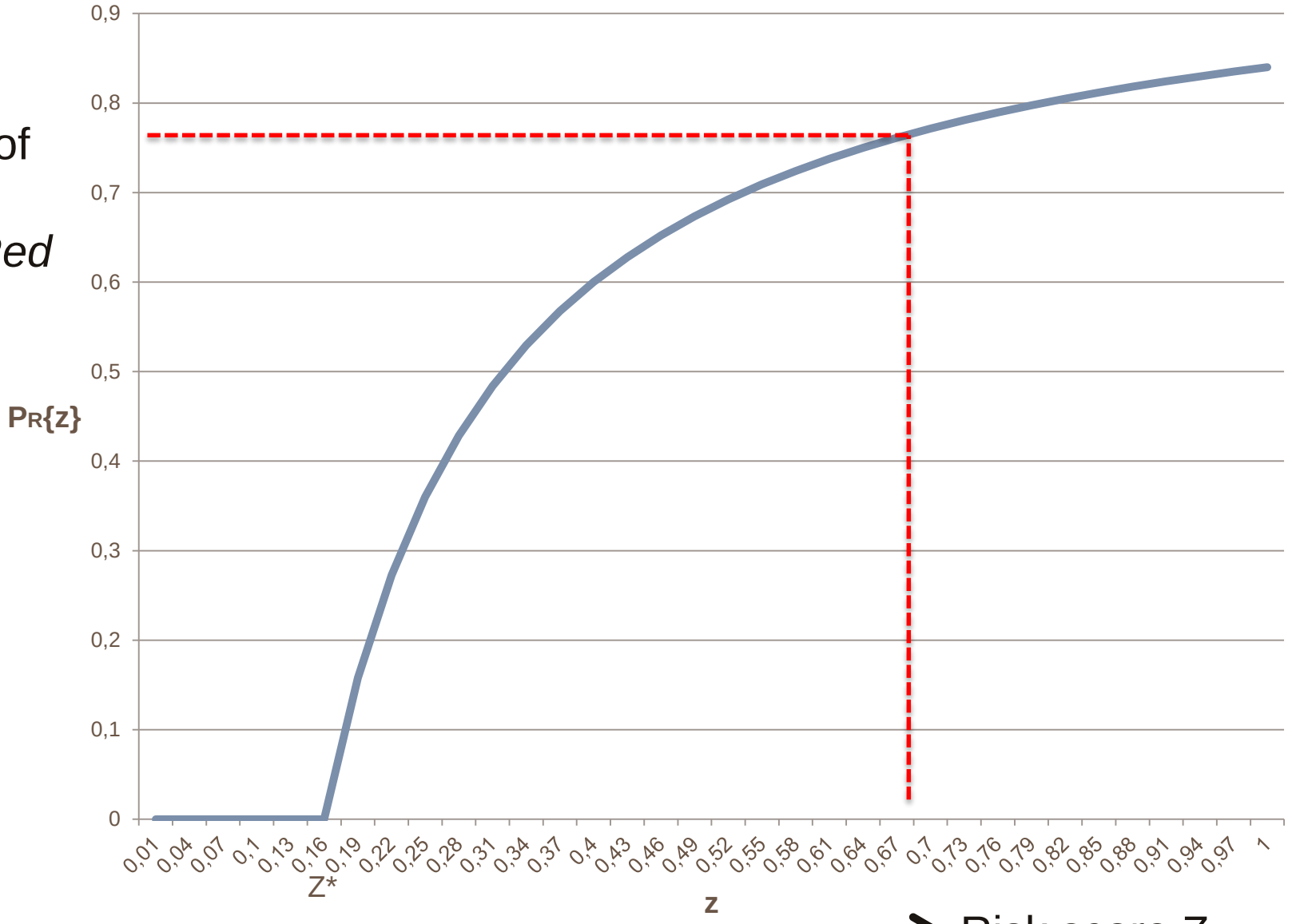
and

$$\Gamma_2 = \alpha_0(1-\gamma)(\mathbb{E}\{L_w\} + \alpha\mathbb{E}\{L_d\}) + (1-\beta_0)\gamma(\beta L_e + (1-\beta)L_f)$$

Moreover, Customs processing time constraint for primary inspection is binding in the optimal solution provided that counterfeiters benefit, $\pi_c^* > 0$.

CHARACTERIZATION OF THE OPTIMAL PHYSICAL INSPECTION POLICY

Percentage of containers flagged as *Red*



Risk score Z

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PRINCIPAL-AGENT MODELING

ec.europa.eu/commission_2010-2014/semeta/headlines/news/2010/07/20100715_en.htm

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EUROPEAN COMMISSION AND BRITISH AMERICAN TOBACCO SIGN AGREEMENT TO COMBAT ILLICIT TRADE IN TOBACCO

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Today the European Commission announced a multi-year agreement with British American Tobacco (BAT) to work together in tackling the illicit trade in tobacco products. Under the legally binding agreement, BAT will work with the European Commission, its anti-fraud office OLAF, and Member States' law enforcement authorities to help in the fight against contraband and counterfeit cigarettes. The Agreement includes substantial payments by BAT to the Commission and Member States, totalling USD 200 million (EUR 134 million) over the next 20 years. It should make a significant contribution to the EU's efforts to fight the illicit tobacco trade, which robs the EU and Member States of billions of euros every year.

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INVESTMENT IN CUSTOMS INSPECTION FACILITIES

PANAMA

Operation Tiger I

9 Countries
25 Right Holders
3.6 Million counterfeit goods discovered

Operation Tiger II

12 Countries
30 Right Holders
6.7 Million counterfeit goods discovered

MOROCCO

Operation Max 55

8 Countries
12 Right Holders
1.8 Million counterfeit goods discovered

BENIN

Operation Fred 60

17 Countries
14 Right Holders
43 Million counterfeit goods discovered

INVESTMENT IN CUSTOMS INSPECTION FACILITIES

- The Customs Problem
  - Customs is offered an investment I in her inspection facilities and is asked to adapt inspection errors in return.
  - With our modeling we can find a threshold for investment level above which Customs accept the offer and reject it otherwise.

INVESTMENT IN BUSINESS DATA AVAILABILITY

INVESTMENT IN BUSINESS DATA AVAILABILITY

- The main advantage here is that Customs can perform a more accurate risk assessment

- We can again show that there is threshold for Customs to admit the investment offer given by private sectors like in the case of British Tabacco

$$\underbrace{\text{delay cost} + \text{counterfeiting induced costs}}_{\text{before visibility}} \geq \text{investment} + \underbrace{\text{delay cost} + \text{counterfeiting induced costs}}_{\text{after visibility}}$$

delay cost refers to the extra waiting and detention costs

counterfeiting induced costs represents the portion of costs incurred by counterfeiting products slipping out of physical inspection process without being detected

CONCLUSION

- Risk assessment between business and government can be aligned on the data level
- Cooperation can result in mitigated risks
- The model can support investment decisions for supply chain visibility and risk management