BLOCKCHAIN, INTERNET OF THINGS, ARTIFICIAL INTELLIGENCE

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FERNAND RUTTEN (DELOITTE) & PHILIPPE HEEREN (LAGA)
QUESTIONS & ANSWERS
The potential of blockchain technology in the maritime supply chain

**CARLAN V., KERKHOF J., SYS C., VANELSLANDER T.**

**BRUSSEL, 14TH SEPTEMBER 2018**
Rationale

- Growing trend on implementing ICT (digital) innovation in the supply chain
- Main characteristics:
  1. growing need for innovation
     - cost savings
     - increase the quality of products (and services), and
     - further growth opportunities
  2. technology (IT) push
  3. The dynamic global context
- Further integration of the supply chain, is blockchain a possible solution?
Blockchain (Distributed Data Ledger technology): definition

- An authonomous, distributed and open database that intermediates the change of cryptographic verified data blocks.
  - **Distributed database** that is operated through internet (Mougayar, 2016; Loklindt & Moeller, 2018) -> peer-to-peer consensus
  - Advanced **cryptographic** technics to ensure high security of data (Loklindt & Moeller, 2018)
Gartner Hype Cycle and Blockchain

Is disillusionment really around the corner?
VC investment in blockchain startups
Maritieme keten – Haven van Antwerpen

- Owner of the goods / shipper
- Customs broker
- Hinterland transport company
- Forwarder
- Shipping company
- Agent
- Terminal operating company
- Receiver of the goods
- Customs broker
- Hinterland transport company
- Shipping company
- Terminal operating company
- Government
- Financial institutes
- Insurance
- +1000 Distribution centres in the port
- +900 Logistics service providers
- 280 carriers
- 72 rail and barge operators (containers)
- 200 container terminals

Port of Antwerp
Maritime supply chain integration barriers

**Economical**
- Market competition and uncertainty
- Lack of investing stakeholders’ involvement
- Financial constraints

**Legal & political**
- Multiple jurisdictions involved: no consistent legal framework
- Challenge of information disclosure policy between partners in the supply chain
- Lack of governmental policies
- Lack of rewards and encouragement programs

**Technological**
- Incompatibility of operating and strategic goals
- Lack of methodology for blockchain technology implementation in sustainable supply chains
- Security challenge
- Immutability challenge of blockchain technology

**Cultural & managerial**
- Resistance to change
- Lack of customers’ awareness and tendency about blockchain technology
- Hesitation to convert to new systems
- Lack of management commitment and support
## Potential benefits of blockchain technology

<table>
<thead>
<tr>
<th>Digital economy benefits*</th>
<th>Blockchain (distributed ledger alone)</th>
<th>Blockchain+ (enabled through smart contracts and/or enhanced encryption tools**)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reduces cost to access/receive information</strong></td>
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<tr>
<td><strong>Reduces cost to send information</strong></td>
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<tr>
<td><strong>Avoid illicit transactions and/or their prejudice</strong></td>
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<td><strong>Avoid error correction</strong></td>
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<td><strong>Avoid information matching (benefit from automatic data matching – if applicable)</strong></td>
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<td><strong>Avoid information search</strong></td>
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<tr>
<td><strong>Efficient use of resources/assets</strong></td>
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</table>

<table>
<thead>
<tr>
<th>Community attendance benefits*</th>
<th>Blockchain (distributed ledger alone)</th>
<th>Blockchain+ (enabled through smart contracts and/or enhanced encryption tools**)</th>
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</thead>
<tbody>
<tr>
<td><strong>Access to broad (real-time) information</strong></td>
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<td><strong>Higher value-added services</strong></td>
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<td><strong>Compliance with standards and regulations</strong></td>
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*Carlan, V., Sys, C., Vanelslander, T., (2016)
**Halaburda (2018)
Intermediate conclusions

- ICT innovation in the supply chain is seen as the key for keeping competitive advantage
- Blockchain technology can help further integration if standardization is achieved
- Full blockchain benefits are enabled only in combination with other technologies
EXAMPLE OF BLOCKCHAIN PROJECT IN THE PORT
## Maritime Supply Chain Inefficiencies

<table>
<thead>
<tr>
<th>Inefficiencies</th>
<th>Shipper</th>
<th>Freight forwarder</th>
<th>Customs declarant</th>
<th>Shipping line</th>
<th>Terminal operator</th>
<th>Road</th>
<th>Rail</th>
<th>IWW (barge operator)</th>
<th>Hinterland transport</th>
<th>Receiver of the goods</th>
<th>Port Authority</th>
<th>Customs</th>
<th>Harbor master, piloting etc.</th>
<th>Others (e.g. Police, Sanitary and veterinary authorities)</th>
<th>Agent</th>
<th>Financial institutes</th>
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<td><strong>Financial flow</strong></td>
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</table>

X: Inefficient

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**Note:** The table highlights the inefficiencies in the maritime supply chain process by categorizing them under Time, Document flow, Information flow, Cargo related, and Financial flow. Each category lists the inefficiencies and their respective affectees (Shipper, Freight forwarder, etc.). The table uses an X to indicate inefficiencies and is designed to show where processes are inefficient across different stakeholders and authorities.
PILOT CASE: PHYTOSANITARY CERTIFICATE

A declaration used in international commerce for shipments of plants and plant products. Certificate issued by the National Plant Protection Organisation of the exporting country to be presented to the NPPO of the importing country.
PILOT CASE: STAKEHOLDERS

Directe stakeholders

- T&G
- New Zealand Apples
- BELFRUCO

Indirecte stakeholders

- Ministry for Primary Industries
  Manatū Ahu Matua
- Port@pp
- Port of Antwerp
- T-Mining
PILOT CASE: PROCESS FLOW
PILOT CASE: BLOCKCHAIN INFRASTRUCTURE

- Enza fruit
- FAVV
  - Web application
  - Blockchain node
  - Port of Antwerp infrastructure

- SEA-invest
- Belfruco
  - Web application
  - Blockchain node
  - SEA-Invest infrastructure

- NZ MPI
- Exporter
  - Web application
  - Blockchain node
  - OneStop PCS infrastructure

- T-Mining infrastructure
Big potential and open for any type of certificate or authorisation

• **Thresholds**
  - legislation
  - global aspect
  - commercial risk
  - time to market
### Challenge: From Pilot to Practice

<table>
<thead>
<tr>
<th>Reference</th>
<th>Created By</th>
<th>Owned By</th>
<th>Type</th>
<th>Status</th>
<th>Action</th>
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<td>Exporter</td>
<td>FAVV</td>
<td>ephyto</td>
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<td>Exporter</td>
<td>FAVV</td>
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<td>EN18686 JOSEPHINE MAERSK 843N</td>
<td>Exporter</td>
<td>FAVV</td>
<td>ephyto</td>
<td>Created</td>
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</tr>
</tbody>
</table>
Best in-class examples for digital solutions, related to customs

Steven Schutter – Marketing Manager NxtPort
14/09/2018
Waze is a navigation app...
But primarily a data platform where data from all connected users such as location, speed, accidents, obstacles ... are being shared anonymously with all other users, allowing to adjust behaviour dynamically
Just imagine...

Imagine what processes we could improve if we had the right DATA gathered, analysed, shared and applied properly.
Complex supply chain ecosystem lacking an integrated information flow

Silo’s have been optimized resulting in sub optimization of the supply chain.

“up to 50% of the cost of moving a container is related to paperwork”

“a simple shipment can go through nearly 30 people and organizations, including more than 200 different interactions and communications”

source: NYT March 4, 2017; Forbes March 5, 2017
Connections in the traditional supply chain

2 parties = 1 connection
3 parties = 2 connections
4 parties = 6 connections
8 parties = 28 connections
30 parties = 435 connections
The profit paradigm

Sub-optimized E2E flow despite efforts in optimizing company processes/scale and in point2point communication

- Fragmented supply chain
- Paper based + data duplication
- Non coordinated

- No transparency
- Errors
- Inefficiency + capacity underutilisation

30 people and organizations, including more than 200 different interactions
50% of the cost of moving a container is related to paperwork
43% overall truck efficiency. 24% running empty / 57% average loading
4-5 stack moves before picked by transporter
NxtPort

OPEN PLATFORM enabling DIGITAL BUSINESS through CO-CREATION

MARKETPLACE OF AVAILABLE API’s AND APP’s

CO-CREATED SOLUTIONS (APP’s) targeting # actors & cargo types

API ENABLING DATA BACKBONE WITH SOLID SHARING LOGIC

1 connection

1 connection

1 connection

Private Company

Customs

Other Authorities
Connections in a NxtPort supported Supply Chain

NxtPort Common Data sharing Backbone

n parties = 1 connection
Multiple Communities Powered by NxtPort

C-point
Powered by NxtPort

APICS Loket
BTS / (RTS)
eBalie

RoRo
VISIGIP
BulkChain
eBalie+
Portcall +
...

Rx/SeaPort
Port@pp
Port+
Cpoint/PoA
Port+

NxtPort
Data Management Policy

Private Company
1 connection

Customs
1 connection

Other Authorities
1 connection

Combase

NxtPort

eECD App
...
...

Eclic
European Chemical Logistics Information Council

公安部

Cpoint/PoA
Port+

Portcall +
eBalie+
BulkChain
VISIGIP
RoRo
Rx/SeaPort
Port@pp
Port+
Cpoint/PoA
Port+

Data Management Policy

NxtPort

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Building the Port of the Future

Multiple Communities Powered by NxtPort
Solutions Domains & multiple Communities

# CARGO TYPES
- Containers
- RoRo
- Breakbulk
- Liquid Bulk
- Dry Bulk

# ACTORS
- Shippers / Consignee (Industry/Retail)
- Deep sea Carrier / Shipping Agent
  - Terminal
  - Forwarder
- Logistics operator
- Barge operator
- Rail operator
- Trucking company
- Authorities / Customs
NxtPort API’s and Solutions: www.nxtport.com

Secure container release
Together with T-Mining, NxtPort is improving security throughout the process of releasing a container by using blockchain technology. In the first phase of this project, a PIN code will be generated on an app. In the next phases, this project will evolve into a state where there no longer is a need for a PIN code.

VGM for eCMR applications
Container weight is useful info for a lot of partners in the chain. Instead of passing it on between each other, we provide a service to implement this data directly into your systems.

[IMPORT] Digital re-use of cargo information for customs declarations
A lot of data that is used to ship goods overseas, the principal needs to send out transport instructions to one or more transport companies. NxtPort wants to standardize these instructions between all parties, resulting in significant gains in time and costs.

Standardized transport instructions
In the process of transporting goods overseas, the principal needs to send out transport instructions to one or more transport companies. NxtPort wants to standardize these instructions between all parties, resulting in significant gains in time and costs.

Arrival at exit (I5S07)
Whenever a container declared for export in the hinterland arrives at the terminal, the terminal operator has to notify customs authorities of this event. NxtPort is working on a solution to facilitate this process.

Export Manifest (I5S47)
Every time a ship is loaded and leaves the port, the law requires the different ship’s agents to send in a report on what goods have left the port to customs. NxtPort will help them automate these messages.

Next mode of transport
NxtPort will provide data about what cargo will be transported with what mode of transport (train, truck, and barge) and when. This will improve the way terminals organize their stacks and reduce inefficiencies between terminals and hinterland transporters.

Track & Trace
Getting an overview of what the status is of specific goods that are being transported is difficult nowadays. Information is scattered around the supply chain, which makes it hard to gather, let alone to implement it in your own systems. With this business case, NxtPort provides an easy solution.

Master data
Being a part of the supply chain involved in delivering goods overseas involves a lot of data sharing. In many cases, master data is used throughout multiple stages in the supply chain. NxtPort collects this master data and makes it available for everyone who is supposed to have access to these data.

CCRM
In order for a container to be released from a terminal, 3 green lights are required. One of these green lights is the confirmation of customs that the container can be released. NxtPort will provide a way to consult this status or to have this status pushed to you.

VGM: tare weight information
Easy access to a container’s last known tare weight

Standardized pre-announcements
Transport companies are asked to do a pre-announcement every time they pick up goods from a terminal. NxtPort wants to standardize the way these pre-announcements take place, regardless of which terminal you are visiting.

Nautical chain & ETA / ATA
The awareness that the nautical chain needs to be considered as a whole is growing. Therefore, NxtPort is working on solutions to improve the efficiencies between all players in the chain instead of only between players that are connected in the chain. A good example of such a solution is a service that allows to better predict ETA’s and share ETA’s of ships.
B2G - Customs & other Authorities

Import Consignment Data API
- Re-use the information about the cargo digitally in your own software. Avoid rekeying, human errors, wrong formats and misinterpretations. All information is available digitally, based on unique identifiers of the cargo.

CCRM API
- The CCRM API allows you to quickly check if a container has been cleared or selected for inspection by Customs Authorities.

VISI@P
- Visibility app for the inspections at the Grens Inspectie Post

The Arrival at Exit API
- The Arrival at Exit API unbounds the terminal operator to send each Arrival at Exit of an export container to Customs.

Export Manifest API
- Every time a ship is loaded and leaves the port, the law requires the different ship's agents to send a report on what goods have left the port to customs. NxtPort's Export Manifest API will help them automate these messages.

Bulkchain
- A full featured application and a complete suite of API's allowing for a digitization of all Breakbulk activities.

FAVV ePhyto
- Phytosanitary certificates are transferred via blockchain technology and the document flow is automated by means of so-called "Smart Contracts" to make document flows safer and more efficient.

Digital emergency procedure
- Emergency workaround in case direct communication with the PLDA application of customs is temporary not available.
Questions ?
DIGITAL CUSTOMS NEXT GEN
Next Gen. AEO
The power of disruptive technologies
Fernand Rutten (Deloitte) – Philippe Heeren (Laga)
AEO – C2B partnership through IT
Business works together with the customs authorities toward the common objective of supply chain security

Trust-based control framework
Benchmarking global supply chain security and trusted trader programmes
Focus on the benefits
Benchmarking Study
Global supply chain security and trusted trader programs

Desired benefits vs. actual benefits

**Top 12 Desired Benefits**
1. Priority treatment in Customs clearance
2. Enhancements in supply chain security
3. Reduced audits
4. Fewer delayed shipments
5. Simplified administrative processes
6. Improved relations with Customs and other government authorities
7. Reduction in processing time for on-time shipments
8. Mutual recognition with other country programs
9. Retained relationships with business partners that participate in such programs
10. Lower costs due to inspections, demurrage, etc.
11. Company brand protection
12. Acceptance of export declarations without Customs inspection

**Top 12 Actual Benefits**
1. Simplified administrative processes
2. Reduced audits
3. Fewer delayed shipments
4. Enhancements to supply chain security
5. Priority treatment in Customs clearance
6. Improved relations with customs and other government authorities
7. Lower costs due to inspections, demurrage, etc.
8. Reduction in processing time for on-time shipments
9. Access to Customs security specialists
10. Acceptance of export declarations without Customs inspection
11. Company brand protection
12. Retained relationships with business partners that participate in such programs

- Conducted end of 2017
- 120 global respondents
- Almost 50/50 EMEA / Americas
- 72% participates in a program
Benchmarking Study
Global supply chain security and trusted trader programs

• Conducted end of 2017
• +120 global respondents
• Almost 50/50 EMEA / Americas
• 72% participates in a program

Desired benefits vs. actual benefits

Respondents reported these top challenges to maintaining program participation:

- Difficulty quantifying the program’s return on investment
- Cost of maintenance
- Lack of sufficient resources to effectively manage the program
- Unrealized benefits
- Program changes
- Maintaining eligibility
- Organizational restructuring or separation
- Lack of upper management support
- Lack of guidance or expertise to fully realize the benefits
- Difficulty in resolving issues associated with program requirements
- Difficulty in resolving issues associated with program requirements

57% of respondents reported that the challenges of maintaining their company’s participation in one or more of these programs over the past three years have not changed.
How the New ‘Disruptive’ Technologies will drive the Next Gen. AEO challenges

RPA
IoT
AI
Blockchain
Let the Robot replace your recurring and repetitivative work

RPA to automate bookings and upload of supply chain documents

Segregation of duty
AI and Machine Learning
Artificial intelligence - AI and virtual reality
Predictive modelling in the supply chain

Improve **efficiency**, e.g. in the loading process, in the delivery process

Improve **safety and security**

AI / VR can be used to **classify goods** or **perform customs inspections**
Trade Master Data. How can I control it? How can Artificial Intelligence help me?

‘My material data base is 1 mio materials big’

‘Our customs expert is leaving us soon, how do we capture and save the knowledge?’

‘We have NO correct HTS codes in our (ERP) system(s)’

‘We have 200 new material numbers every day!!’

‘Our HTS and ECCN codes are outdated and not maintained’
Artificial Intelligence Classification Automation. How does it work?

### ACQUISITION
- **MANUAL**
  - Material that requires classification

### PROCESSING
- **MANUAL**
  - The Classification Engineer gathers as much information as possible (product sheets, intranet) to make a sound judgement
  - Based on his/her experience the Classification Engineer tries to classify the material

- **AUTOMATED**
  - Pre-processing & Cleansing
  - Enrichment

#### Classification Engine
- Using RPA the data extracted is enriched with as much information as possible (product sheets, intranet) to feed into the Machine Learning component
- The Machine Learning solution – trained by Classification Experts tries to classify the material. In addition, it returns a number that reflects the confidence level linked to the suggested classification code

### OUTPUT & FEEDBACK
- If the Classification Engineer is certain, a classification is entered
- If the Classification Engineer is not entirely certain, he will ask another expert for support

#### AUTOMATED
- Automated classification
- Remediation
- Manual classification
- Re-train model

### RESULT
- The material is classified

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10 Jaar AEO / 10 ans AEO
Following up on the chain

Internet of things

Temperature
Humidity
Movement (shocks)
...

Combined with AI powered predictive analytics, risks can be managed (e.g. risk of theft, risk of damage)

Combined with blockchain, secure follow-up on goods can be ensured
Blockchain based solutions to store and share certificates via QR code link.
(Belgian) customs blockchains
Exchange of customs records through blockchain

- **Certificate of origin** on blockchain
- **Certificates tracking and verification** for NAFTA / CAFTA
What is customs doing on these New Technologies

Customs authorities’ involvement

Bill of Lading in the blockchain

Netherlands Port of Rotterdam

USA U.S. Customs and Border Protection

Peru Customs

UK HMRC

BE Port of Antwerp authorities

COMESA Common Market for Eastern and Southern Africa

Dubai / UAE Customs

Singapore customs

Electronic certificate of origin (eCOs) on the blockchain.

Electronic phytosanitary certificates on the blockchain

Electronic phytosanitary certificates on the blockchain

Bill of Lading in the blockchain

Port of Antwerp/ NxtPort/ T-mining/ Enzafruit

IBM/Maersk active customs authorities

COMESA customs collaboration

HM Revenue & Customs for border controls

Customs authorities actively participate and lead the way
ALREADY TODAY
Conclusions
Next Gen. AEO?

Real-life examples of technology applications in supply chain
ALREADY TODAY

- **Artificial intelligence** is used to automate and improve the classification process
- **Virtual reality** and **artificial intelligence** is used to visualize data and apply predictive analytics
- Non-stop transparency on customs-relevant data through **blockchain** technology
- **Artificial intelligence** combined with **robotics** to improve data quality
- **Internet of things** combined with **blockchain** to track and trace goods

Technologies lead to Digital transformation
ALREADY TODAY

- Automate and link the physical, documentary, financial flows in the supply chain and restore **trust**
- Exponential technologies **improve and ensure security and efficiency** in the supply chain → importance of **data quality**
- Authorities use exponential technologies + push **economic operators to use** exponential technologies
- Exponential technologies are (becoming) an **integral part of trusted trader programmes** like AEO → condition to get authorized

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THANK YOU!

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THANK YOU!