NAVIGATION WITH NATURE
- A PILOT ON THE CHINDWIN RIVER IN MYANMAR -

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Professor Emeritus Ports & Waterways
Delft University of Technology
Thanks to the co-authors

- M.F.M Yossef – Deltares
- M. van Wirdum – CoVadem Services
- J.H Laboyrie – CDR International BV
- B.J. van der Spek – CDR International BV
- L.Poelhekke – CDR International BV
Content of the presentation

• Working with Nature
• Myanmar and the potential for Navigation with Nature
• Pilot Chindwin River Myanmar
• Challenges and perspectives
The state of the Rivers

- An astonishing decline in the size of wildlife populations in riverine and coastal systems has been observed
- Amongst the reasons cited are damming of rivers, agriculture and contamination
Working with Nature: What does it mean?

**Working with Nature** requires a shift in approach to:

- Focus on achieving project objectives in an ecosystem context rather than assessing consequences of a pre-defined design.
Working with nature in the Dutch context from forcing to following nature in water management

Excellent examples

- Room for Rivers
- The Sand Engine
Myanmar

- Largest country on South East Asian mainland
- 51 million people
- 135 ethnic groups
- GDP 70 Bn USD
- GDP growth 7 % p.y
- From late 80’s to early 2000’s, closed country
- Since 2011 Civilian Government.
Ayeyarwady River

- Originating in Himalayas
- Naturally navigable from Yangon to Myitkyina > 1400km
- Confluence with Chindwin River
- Ayeyarwady River forms Delta and connected to Yangon with Twante Channel
- Naturally braiding river, little training measures
Ayeyarwady River

- River characterized by high waters (May to Nov) and low waters (Nov to May)
- Max: >30,000m³/s
- Min: 2,000m³/s
- Water level differences >10m
- During dry season, very low waters
- Wet season: flooding
Ayeyawady River

- Very dynamic River
- Changing low water channel
- Continuous monitoring or surveying required
Restricted draft during the dry season

- Myitkyina – Bhamo 0.8 m
- Bhamo – Khata 1.1 m
- Khata – Mandalay 1.2 m
- Mandalay – Pyay 1.5 m
- Pyay – Hinthada 1.7 m
Navigation with Nature

Combine new philosophy and driving concepts and new technology to truly innovate responsible and sustainable ... a challenge in river engineering for navigation

Adapt the ship to the river and not the river to the ship ....
### Table A3.1: Yearly Losses and Causes of Vessel Accidents

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Unfair Waterway Condition</th>
<th>Lack of Vessel Strength</th>
<th>Careless Vessel Operator</th>
<th>Bad Weather Condition</th>
<th>Others</th>
<th>Number of Accident</th>
<th>Number of Vessel Sunk</th>
<th>Human Dead</th>
<th>Human Lost</th>
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<tbody>
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<td>9</td>
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<td>-</td>
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<td>0</td>
<td>1</td>
<td>12</td>
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<tr>
<td>2011</td>
<td>3</td>
<td>7</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>16</td>
<td>13</td>
<td>11</td>
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<tr>
<td>2012</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>15</td>
<td>12</td>
<td>16</td>
<td>6</td>
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<tr>
<td>2013</td>
<td>5</td>
<td>3</td>
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<td>1</td>
<td>6</td>
<td>21</td>
<td>10</td>
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<td>6</td>
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<td>1 April–30 June 2014</td>
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<td>0</td>
<td>3</td>
<td>2</td>
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<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>43</strong></td>
<td><strong>40</strong></td>
<td><strong>50</strong></td>
<td><strong>12</strong></td>
<td><strong>22</strong></td>
<td><strong>167</strong></td>
<td><strong>110</strong></td>
<td><strong>95</strong></td>
<td><strong>115</strong></td>
</tr>
</tbody>
</table>

Source: Directorate of Water Resources and Improvement of River Systems.

16 accidents, 10 vessels sunk and 21 humans reported dead or missing / year
Pilot Project Navigation with Nature®: a CoVadem application on the Chindwin River, Myanmar

**Project characteristics**

1. Respect for the rivers dynamic behaviour

2. Crowdsourcing of data and data analysis to provide real-time and forcasted water depths

3. Indication of danger and safe zones which allow for safe and more optimal navigation
Area for the pilot
400 km river stretch of the Chindwin River from Hkamti to Mawlaik

Partners in the pilot
CDR International
Deltares
CoVadem
Mandalay Technology

Funding
Netherlands Enterprise Agency (RVO)
Research partners

Supported by
DWIR, the Myanmar Directorate of Water Resources and Improvements of River Systems
Installation on board 10 test ships

- Next to GPS also Echosounder equipment needs to be installed
- CoVadem box as server and portable CoVadem poles are developed for the equipment to be able to rotate between the ships that operate in a controlled rotation scheme
Water level at Monywa in July 2018

Water level at Monywa in January 2019 (same location)
Ongoing activities at present

- Preparation of an operational hydronamic SOBEK model
- Combining SOBEK, FEWS (Hydrologic Forecasting) and CoVadem to obtain a waterdepth forecasting system for the Chindwin River
- Adapting the CoVadem dashboard for the navigation on the Chindwin River
Challenges

- Big leap between what is and what can be, from depth measuring using sticks to the digital age where depths are available in an app through collective digital measurements

- Acceptance through the end users and ownership
Perspectives

- The study showed that there is a positive business case: more and better information leads to more efficient transport leads to cost saving

- Improved navigational safety

- The system can easily be upscaled to larger parts of the Myanmar river system
THANK YOU FOR YOUR ATTENTION
OPTIMIZING TIDAL WINDOW USING SHIP DATA RECORDS, AT THE MOUTH OF AMAZON RIVER, BRAZIL

Prof. Vinzon, Susana Beatriz
Yasmin Wakasa Góes
Leonardo de Almeida Leal
Diego Luiz Fonseca
Prof. Marcos Nicolas Gallo
Prof. Jean-David Caprace

Federal University of Rio de Janeiro
Brazil
Topics

- The navigation critical path
- Available information & analysis
- Results & discussion
- Conclusions and follow up
The navigation critical path

NAVIGATION CHART NORTH CHANNEL OF AMAZON RIVER

ALLOWED DRAFT 11.70m
The navigation critical path

UNCERTAINTIES IN THE WATER SURFACE

CURRENT NAUTICAL CHART

PREVIOUS NAUTICAL CHART (up to 2008)

MARÉ

Nas proximidades do ponto de coordenadas Lat. 1°34’N e Long. 49°13’W, o instante e alturas da maré podem ser estimados a partir da maré prevista para a estação Ponta do Céu. As alturas diárias da preamar e baixa-mar previstas para Ponta do Céu constam das Tábuas das Marés.

INSTANTE E ALTURA DA PREAMAR:
A preamar no ponto ocorre, aproximadamente, 4h e 10min, antes da ocorrência da preamar na estação Ponta do Céu. A altura estimada da preamar no ponto é igual a:

\[ 1,48 + 0,67 \times (X-2,21) \]  

X= altura preamar prevista Ponta do Céu.

INSTANTE E ALTURA DA BAIXA-MAR:
A baixa-mar no ponto ocorre, aproximadamente, 4h e 39min, antes da ocorrência da baixa-mar na estação Ponta do Céu. A altura estimada da baixa-mar no ponto é igual a:

\[ 1,48 + 0,67 \times (Y-2,21) \]  

Y= altura baixa-mar prevista Ponta do Céu.

A maré nas proximidades da Estação (Lat. 1°34’N e Long. 49°13’W), possui as seguintes características: A cota sobre o NR é aproximadamente 74% da respectiva cota da maré em Ponta do Céu. A preamar ocorre aproximadamente 2h e 35min antes da preamar em Ponta do Céu. A baixa-mar ocorre 3h e 36min antes da baixa-mar em Ponta do Céu. Exemplo: Se em um determinado dia, a hora da preamar em Ponta do Céu for às 15h e 00min com o valor 3,6m e a baixa-mar ocorrer às 21h e 36min com o valor 0,6m na região a preamar será às 12h e 25min (15h 00min-2h 35min) com o valor de 2,7m (3,6x0,74); e a baixa-mar será às 18h e 00min(21h 36min - 03h 36min) com o valor 0,4m (0,6 x 0,74).
The navigation critical path

UNCERTAINTIES IN THE WATER SURFACE

Reference Station

Mud belt
The navigation critical path
The navigation critical path

- Partially known (sparse tidal data) and complicated tidal wave propagation
- Unknown muddy bottom interface
- ~400 ships/year crossing the path
Available information & analysis

Data from ships (bulk cargo)

1. Collect reports from ships from 2016 to 2019 (~120)
2. Data processing (standardize time reference, units, etc)
3. Analyze minimum depths along the path and relate to the tide provided by a numerical model.

<table>
<thead>
<tr>
<th>EMPRESA: CARGILL</th>
<th>Preamar no Ponto H</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAVIO: MV DOGAN 05/01/2018</td>
<td>05/01/2018 13:15</td>
</tr>
<tr>
<td>CALADO (m): 10,17</td>
<td>STATUS: Baixa-mar no Ponto H</td>
</tr>
<tr>
<td>SENTIDO: SAINDO</td>
<td>CARREGADO</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Profundidade (m)</th>
<th>Calado (m)</th>
<th>Velocidade (nós)</th>
<th>Latitude (°)</th>
<th>Longitude (°)</th>
<th>Data e Hora (UTC)</th>
<th>UKC (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12,47</td>
<td>10,17</td>
<td>7,2</td>
<td>1,34</td>
<td>49,34</td>
<td>05/01/2018 13:20</td>
<td>2,3</td>
</tr>
<tr>
<td>12,47</td>
<td>10,17</td>
<td>7,8</td>
<td>1,36</td>
<td>49,31</td>
<td>05/01/2018 13:40</td>
<td>2,3</td>
</tr>
</tbody>
</table>
Available information & analysis

Hydrodynamic Numerical Model

- calibrated with coastal tidal gauge stations
- verified the tidal phase with some off shore measurements
Available information & analysis

Ship tracks

Numerical model grade for tidal information
Available information & analysis

Total Depth = Squat + Draft + UKC

\[ Squat = C_B \left( \frac{SOG^{2.08}}{20} \left( \frac{ShipBeam \times Draft}{7.04ShipBeam C_B^{0.85}} \right) (UKC + Draft) \right)^{0.81} \]
Available information & analysis

Prototype test (depth and maneuvering on muddy bottom)

UKC along the mud belt (ECDIS)
Pitch of the Ship & ecobathymeter differences

UKC informed by ships & Bathymetry (200 kHz)
Results

Minimum Depth along the path

- Allowed draft
- all
- full load

frequency (%)

Minimum depth along path (m)

0  5  10  15  20  25  30  35  40  45  50

9,5  10  10,5  11  11,5  12  12,5  13  13,5  14
Differences between the **High Tide** time and **Ship** time at each position of the ship along the path.
Minimum Depth Vs High Tide position along the path, according to tidal amplitude at the beginning of the passage
Results

Depth along the path, without tide
Results

Depth along the path, without tide

- Total depth
- Total depth - tide

Graph showing variations in depth along the path (km) with distance along the path (km), indicating critical paths in the nautical chart and from this analysis.
Conclusions and follow up

- Data reported by the ships allowed to identify a **better tidal window** and a **more realistic bathymetry**
- **Critical path looks shorter** than in the Nautical Chart (~1970)
- The new knowledge of the extension of the path and the tidal phase may improve the predictability of the available depth, allowing a new increase in the draft (now 11.7m)
Conclusions and follow up

- Results are consistent with the existing data, but **numerical model needs improvements**.

- Reports from the ships could be improved (more data reported, less errors, etc), but **new prototype tests are being planned**.

- **Prototype tests** also aim for collecting data on **controllability and maneuvering** on the muddy layers.

- Data collection on tides and bottom mud layers wait for $$$
THANKS FOR YOUR ATTENTION!
susana@oceanica.ufrj.br
CONTRIBUTION OF BLOCKCHAIN-TECHNOLOGY TO SECURE AND EFFICIENT INFORMATION SHARING IN DANUBE WATERWAY TRANSPORT

Authors: Dr. Lisa-Maria Putz, Thomas Berger, Eva Jung, Dr. Oliver Schauer

University of Applied Sciences Upper Austria
Quiz
European Waterways

Which country in Europe has the highest amount of kilometers of waterways?

• Netherlands
• Germany
• France
• Italy
The Economical Value of the Rhine-Main-Danube Corridor
The International Waterway of the Danube

10 riparian countries

How many riparian states has the Danube?

Germany
Austria
Slovakia
Hungary
Croatia
Serbia
Romania
Bulgaria
Moldawia
Ukraine
The International Waterway of the Danube

How many riparian states are in the EU /Schengen?

Quelle: Wikimedia Commons

Germany
Austria
Slovakia
Hungary
Logistics background for Inland Waterway Transports

Intermodal or combined transport using the example of container transport

Transshipment requires longer distances for inland waterway transport to become profitable → many cross boarder transports
Administrative barriers along the Danube

Travelling from the beginning of the Danube to the end in the black sea

52 forms have to be completed **manually**
many redundant information (e.g. name of ship, 40 times)

- Many transports are cross-boarder transports
- Less than half of the Danube countries are EU /Schengen countries
- Controls are carried out by several authorities in each country
- Controls -> require (still) manual paperwork

🤔 Blockchain might be a solution?
What is a Blockchain?

- Dezentralized data
- Based on the internet
- Data processing in real-time

Why should we use it?
- Transparency (tracking of products)
- Trustless (Consens Algorithmus – Proof-of-Work)
- No information can be changed (in general)
- No central authority needed (e.g. banks)
- Encrypted
- No trusted third party needed
- Blockchain in 2 minutes

Data base structures
Examples for Uses of Blockchains

**Financial transactions** - Direct transaction without transferring money (bitcoin.org)

**government** (land register)

**Healthcare** - Security of data

**Transport, Tracking and Tracing** of containers, reduction of paper transaction - [IBM & Maersk](#)

**Tourism** - TUI already adopting blockchain technology in its booking, reservation and payment systems (Sixtin, 2017)
When to use a Blockchain?
How can the Blockchain support to reduce administrative barriers on the Danube?

Current situation
- Manual documents during cross-border controls with inland vessels
- Redundancy
- More than 20% of transport costs due to administrative barriers

Blockchain for Inland Waterway Transport
- Develop an own, separated blockchain for the involved stakeholders (i.e. shippers, authorities) along the Danube
- Pre-define that each stakeholder receives the needed information

Benefits of the Blockchain
- Data security and non-und Nicht-Manipulation
- Transactions cannot be changed
- Transparency
- Reduction of redundancy (e.g. same data 40 times)
- High potential for a decrease of administrative barriers

What might be hindering the introduction of the blockchain?
- Cross-border cooperation between the member states needed
- National regulatory (might be different)
- Trust of companies
Blockchain – Technology Hype or Disrupt Technology in the Logistics Sector?

![Blockchain Plans Pie Chart]

Q: What are your organization's plans in terms of blockchain?
Base: Total answering, excludes DK, n = 3,138
ID: 355300

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Inland waterways as sustainable mode of transport

**bulk freight capacity**
1 convoy with four pushed lighters: 7,000 net tons
175 railway wagons at 40 net tons each
280 trucks at 25 net tons each

Source: via donau

Low utilization rate & sustainability → High potential for inland waterway

**external costs**
- climate gases
- air pollutants
- noise
- accidents

Source: PLANCO Consulting & Bundesanstalt für Gewässerkunde 2007

**infrastructure costs**

Source: PLANCO Consulting & Bundesanstalt für Gewässerkunde 2007

14
European Waterways

France: longest waterways in Europe (8.800 km)

Netherlands: most dense waterways (6.000 km, serving all parts of the country)

2/3 of European waterway transports include the Rhine

Rhine-Main-Danube-Corridor is the most important inland waterway in Europe
CONTAINER LOGISTICS IN PARAGUAY, TERPORT CASE

Author: José Grau
EGIP-UBA
Objectives

• Place Paraguay in the Parana/Paraguay waterway
• Identify the Dredging and beaconing works
• Describe Container Logistics in Paraguay
• Identify opportunities and challenges
• Container terminal example – TERPORT case
Parana/Paraguay Waterway
National tenders for dredging in the last years


Critical zones for navigation in the Paraguay River
Container Ports

- TERPORT I
- TERPORT II
- Caacupemi
- San José
- Fénix
- Puerto Seguro Fluvial
- Villeta
- Puerto de Pilar
Transshipment ports
2011-2018 Paraguay’s container movement
2018 Container movement (FULL) classified by SC
Some examples of Paraguay’s container ports
Opportunities & Challenges

- Great growth in terms of container movement
- Construction of new ports and modification of existing ones
- Navigation management
- Dredging and beaconing Works
- New road access needed
- Land use management (in order to avoid residential areas development near ports)
TERPORT II case

- Inaugurated in Oct/18
- 200m quay wall
- 2 fixed cranes 45x33
- 2 RTG’s
- 1.700 m² warehouse
- 7.000 m² CFS area
- 75.000 m² container yard
- 40m US$ investment
- Capacity of 45,000 TEUs
TERPORT II - Phase 3
Conclusions

• The Parana/Paraguay waterway is essential for Paraguay’s container transport.

• From confluence to Rio de la Plata (Argentina), the guaranteed depth and the aids to navigation are well maintained through a concession. From confluence on, there is no regular maintenance of the guaranteed depth and the aids to navigation.

• Despite all mentioned, container logistics in Paraguay has shown in the last years that it has great potential due to developments in terms of container movement.

• However, actions must be implemented in order to guarantee the growth in the next years of this type of cargo.
THANK YOU FOR YOUR ATTENDANCE
CYBERSECURITY IN INLAND NAVIGATION

Gernot Pauli
Chief Engineer

I INTRODUCTION

Cyber risks a reality for PIANC community

Exposure to cyber risks

Automation and process information

Interconnections

Crew size
First of all – THANK YOU!

Thank you!

THANK YOU FOR THE EXCELLENT TEAM WORK ON THE REPORT

I OVERVIEW

Structure of the report

1 GENERAL ASPECTS – PURPOSE AND SCOPE

2 WIDER CONTEXT: CYBERPREPAREDNESS ACROSS INDUSTRY

3 CYBERRISKS AND MITIGATION MEASURES

4 POSSIBLE FUTURE TECHNOLOGIES AND RISKS

5 RECOMMENDATIONS FOR FOLLOW-UP
I GENERAL ASPECTS - SCOPE

Purpose
- Provide an overview and stimulate feedback on
  - Cyberrisks
  - Mitigation measures
- Raise awareness for cybersecurity in inland navigation
- Allow for informed decision for follow-up

I Sources and methods of attacks

Attack = intentional damage (i.e. hacking)

Targeted
= (with an aim specific to the operator)
Techniques include
• Brute force attacks
• Denial of service
• Infiltrating the supply chain

Untargeted
= general spread of computer viruses
Techniques include
• Malware
• Social engineering
• Phishing

Attacks on board

Attacks on infrastructure
(including IT infrastructure)

Source: BIMCO = Baltic and International Maritime Council
1 GENERAL ASPECTS - SCOPE

Sources and methods of attacks

First category: Cyberattacks on board

POTENTIAL IMPACTS

- Loss of control of navigation, propulsion or steering systems
  - Risk of collision with vessel or infrastructure

- Loss of other control systems, i.e. cargo management systems
  - Risk of destabilisation or sinking

- Incidents involving dangerous cargo
  - Risk of explosion, fire, leaks and damage

Second category: Attacks on infrastructure (including IT infrastructure)

POTENTIAL IMPACTS

- Loss of control of locks and sluices or moving infrastructure (i.e. pivot bridges)
  - Risk of flooding or impass of waterway sections, risk of collision

- Corruption or sabotage of data on which safe operations depend (e.g. navigational warnings)
  - Risk of collision or accidents

- Corruption or sabotage of data involving dangerous cargos
  - Risk of explosion, fire, leaks and damage
WIDER CONTEXT: CYBERPREPAREDNESS ACROSS INDUSTRY

Shipping industry behind others

**IMO:** ‘urgent need to raise awareness’ (June 2016)

Despite an increasing number of cybersecurity incidents, the level of awareness seems to remain low within the sector.

**ENISA:** underlines difficulties
- High complexity of ICT Systems within the Shipping Industry: interaction of many different systems
- Use of industry-specific technology
- Long life in service of vessels (compared to e.g. computer software)
- Consequent rolling replacement of parts, but not of whole on-board systems

**Lloyd’s Register:** Multiple, interconnected systems call for risk-management rather than prescriptive regulations

**IMO:** Rapidly changing technologies and threats make it difficult to address cyberrisks through technical standards alone

Need for risk-management approach within existing security practices

ENISA = European Union Agency for Network and Information Security
Ensuring adequate procedures

- Ensuring IT industry-standard security countermeasures are in place, such as:
  - Access control systems
  - VPNs, anti-virus software and firewalls
  - contingency plans
  - Segregation of safety-critical equipment from other on-board systems and communications
  - Segregation between navigation equipment and vessel control systems
  - Monitoring of data activity
  - Cyberhygiene
  - Reporting and sharing of cyber incidents

1. VESSEL CONTROL
2. NAVIGATION
3. INFRASTRUCTURE CONTROL SYSTEMS
4. INFORMATION REPORTING/EXCHANGE
5. NETWORK INFRASTRUCTURE

Systems Concerning transport logistics, law enforcement, cargo and fleet management incl. dangerous cargo

Vessel Tracking and Tracking (Inland AIS), Inland ECDIS, Electronic Ship Reporting (ERI), radar, notices to skippers (NtS)

Lock and bridge management, traffic planning, ...

Bespoke industry web portals, distributed devices

Propulsion and machinery management, power control systems, wheelhouse systems, fuel, battery and cargo handling, ...
4 POSSIBLE FUTURE TECHNOLOGIES AND RISKS

Future technologies

- Automated / Autonomous vessels
  
  **RISK** Removal of crew removes an element of monitoring which might be needed in the event of a cyberattack

- Combining information on infrastructure, people, vessels, management, operations and cargo
- Greater integration of information across all modes of transport and between shippers and logistics service providers and inland waterway transport operators

  **RISK** With greater interconnectivity comes greater risk that cybervulnerabilities are overlooked

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5 RECOMMENDATIONS FOR FOLLOW-UP

Recommendations for Follow-up

If the increase in occurrences and intensity of attacks is not met with improved defences, a backlash against digitalisation could occur, with large negative implications for inland navigation.

Risk assessment and need of guidelines

- Adequate cyberrisk assessment in shipping companies and by infrastructure managers encouraged
- Support for common standards for secure technologies currently used in inland navigation
- Some guidelines appear to be helpful to address specificities of inland navigation and impact on exposure to cyberrisks

Training of crew members and onshore operators

Establishing comprehensive training and awareness programme, conducting threat and risk assessments, taking into account the individuality of every ship

...
General conclusions

- ICT in inland navigation offering tremendous opportunities – at the same time, creating new and very profound risks to all aspects of inland navigation
- All feasible measures for mitigating these risks to be implemented and continuously improved
- Contingency plans to be implemented with procedures on how to manage situations where the integrity of ICT systems has been compromised due to cyberattacks

Evolving domains of safety

- 1838 First regulations for dangerous goods
- 1950 Rhine Police Regulations (RPR)
- 1904 Vessel Inspections Regulations (RVIR)
- 2000 First regulation on emissions from IWW vessels
- 1996 Waste Convention (CDNI)

Digital environment new safety domain for inland navigation
Inland navigation must get ready to manage cybersecurity
International cooperation needed for managing cyber risks
Cross border data exchange requires cross border cybersecurity management
Cybersecurity strategy needed, encompassing all IN stakeholders

PIANC is promoting digitalisation of inland navigation (RIS, Smart Shipping ...)
Can PIANC afford to stay away from managing cybersecurity in inland navigation?

Thanks for your attention!
USING AUGMENTED REALITY TO TRANSFER KNOWLEDGE ABOUT INLAND WATERWAY LOGISTICS

Author: Dr. Lisa-Maria Putz, MA BSc

University of Applied Sciences Upper Austria
Reorganisation of freight transport needed

- The transport sector contributes around 25% of total EU-28 greenhouse gas emissions
- Around 71% of European freight transport is carried out by truck, around 6% by inland waterway
- Road transport causes substantial negative externalities
- European Commission (White Paper 2011) calls for a 60% cut in transport emissions by 2050
- Modal shift towards environmentally friendly transport modes is a major strategy to achieve these goals
23% of CO2 emissions worldwide are related to the transport sector

What can we do to reduce the emissions of the transport sector?

- Make transport more efficient (e.g. bundeling, green ports, alternative fuels, electronic vehicles)
- Reduce the amount of transport (e.g. change individual shopping behavior)
- Shift to more sustainable transport modes (e.g. from roads to railway & inland waterways, underground post)
Inland Waterway Transport
An Alternative to Road Transport

1. Inland Waterway Transport is the most eco-friendly transport mode
2. High potential
   1. Less utilization rate than road transport (e.g. around 10-20 % utilization on Danube)
   2. Hardly any congestions - freight volume carried by highways is limited
   3. less bottlenecks due to capacity problems
   4. very few accidents , very few thefts (low external costs)
   5. no driving bans
   6. no fees for use of waterways
3. ... but also challenges due to geographical access, complex system,...

Goal of EU : Increase the share of railway & inland waterway transport instead of increasing the share of road transport
CO2 Emissions per Freight Transport Mode

- **Ship**: 8 g CO2/tkm
- **Train**: 35 g CO2/tkm
- **Truck**: 110 g CO2/tkm
- **Airplane**: 665 g CO2/tkm

Specific CO2 emissions per tonne/km and per mode of transport.

Inland vessels: little bit less than trains.

23% of CO2 emissions worldwide are related to the transport sector.
People’s knowledge (?) about transport

Do you think there are better ways to deliver goods than transporting it by trucks?

- Trains: 94.5%
- Ships: 23.3%
- Airplanes: 7.3%
- Cars/transporter: 0.9%
- No statement: 0.3%

Multiple answers possible
Source: PwC survey (n = 500)

Do you regard following transport media as environmentally friendly?

- Trucks: 83% Yes, 7% No, rather unfriendly, 10% Don’t know
- Airplanes: 80% Yes, 11% No, rather unfriendly, 9% Don’t know
- Ships: 63% Yes, 21% No, rather unfriendly, 16% Don’t know
- Trains: 86% Yes, 8% No, rather unfriendly, 8% Don’t know

Source: PwC survey (n = 500)

People consider trains as more sustainable than inland navigation

Source: PricewaterhouseCoopers (2008)
The current situation of (Sustainable) Transport Education

Responsibility of logistics/transport experts: strategic / operational decision about used transport mode & route

- General education:
  - Logistics / Transportation is hardly covered in schools / universities

- Specialization on logistics:
  - Transportation is hardly covered
  - Sustainability aspects are mainly excluded

- Specialization on transport:
  - partly covered: mainly road, air & (partly) maritime
  - Less than 5-10% of units for railway & inland waterways in Europe
  - Sustainability aspects mainly excluded

How can people consider sustainable transport actions if they do not know about it?
Our goal: raise awareness on the subject of sustainable transport systems & individual transport behavior
das RETRans bitte durch REWWay ersetzen und LOGISTIFY hinzufügen
Putz Lisa-Maria; 18/09/2019
Why augmented reality? Why Logistify?

- Augmented reality allows users to merge the real with the virtual world in a playful manner.
- Interactive components help the player to understand complex logistics solutions.
- Augmented reality is frequently used in educational settings.

- Logistify is an innovative and interactive learning app, which is used to transfer knowledge about logistics.
- Few teaching units deal with the topic of transport in general – Logistify is used to tackle the lack of knowledge concerning inland waterway logistics and transport in general.
- The app has successfully been used within the projects REWWay and RETrans to train various age groups with different educational backgrounds.
LOGISTIFY: learn about sustainable transport topics in a gamified way and enhance the attractiveness of the logistics/transport sector
LOGISTIFY App

- Augmented Reality Educational App

- To be downloaded **free of charge**.

- Three different Games
  - Game 1: Mode Choice
  - Game 2: Supply Chains
  - Game 3: Logistics Jobs

- **Aim**: learn about sustainable transport topics in a gamified way and enhance the attractiveness of the logistics/transport sector

Information about transport in general, but especially inland waterway logistics is hardly transferred in teaching units.
Game I: Mode choice

• The player has to choose the most appropriate mode of transport considering:
  1. the type of goods,
  2. the amount of goods and
  3. the distance between consignor and consignee.

• The game plan appears static or as a augmented reality environment.

• For each correct answer the player gets up to 2000 points, which helps to create a competition among the players.
Game II: Supply Chains

- The player has to choose the correct order of the given supply chain steps.

- Cards, which contain possible steps of a supply chain are needed to play this game.

- After choosing the right step, the card is scanned using augmented reality and a green frame appears.
Game III: Logistics Jobs

- A variety of logistics jobs are presented in this game (e.g. boatman, logistics manager,...).

- The game is structured similarly to a WhatsApp-Chat.

- The player has to read the chat carefully and answer questions about the job to continue the chat.
What we offer: Research and Education in Inland Waterway Logistics

• Developing customized educational- and service offers (high quality and up-to-date teaching and learning and materials) that can integrate inland navigation into logistics education

• Creating a competence center for inland waterway transport at the Port of Enns that offers workshops to raise acceptance of the Danube as environmentally friendly way of transport
Online education platforms

RERoad, RERail & REECOTrans will be available in English in August 2019
REWWay is already available in English
An invitation:

- Logistify can be downloaded free of charge at the Google PlayStore

- We look back to great experiences with all age groups

You are invited to use our educational platforms: www.rewway.at

- If you are interested: we organize Transport School Labs at your location
Inland waterways as sustainable mode of transport

**bulk freight capacity**
- 1 convoy with four pushed lighters: 7,000 net tons
- 175 railway wagons at 40 net tons each
- 280 trucks at 25 net tons each

Source: via donau

**external costs**

Source: PLANCO Consulting & Bundesanstalt für Gewässerkunde 2007

**infrastructure costs**

Source: PLANCO Consulting & Bundesanstalt für Gewässerkunde 2007

Low utilization rate & sustainability → High potential for inland waterway
Industrial and touristic reappropriation of the Sambre in Hautmont

Marie-Laure KRESEC - EnVu2
Vincent AZEMARD - BRLingénierie
The Sambre river: a structural element of territorial coherence and dynamism

Sambre River is the shortest trip to reach Paris from northern Europe

A river for yachting and for the transports
Hautmont: a territory under reconstruction

The city of a hundred chimneys: an important industrial square, in the heart of the former mining territories

From fire to water represents the end of the rich industrial life of the 1970s on the banks of the river, the resumption of port activities, the port, ship maintenance and repair, the development of activities around the Sambre

From water to urban construction: with the development of port activities, the development of the city is now a consequence
Hautmont port pole

Creation of a whole industrial and touristic site around 3 goals:

- River Tourism development
- Industrial rebirth
- New relationship between Hautmont people and their river

The port site is compound with:
- The port itself (60 boats and 3 Freycinet barges) : built in 2013
- The STPS factory (old industrial building) convert in storage and ship repairing and maintenance area, with truck and train connection (HUB)
- The Port center, in charge of the port boaters and the local activities around the river
Detail of the boat storage, maintenance and repairing hall

Before rehabilitation

Fully rehabilitated, and coupled to a dock and a logistics area
Detail of the boat storage, maintenance and repairing hall
Perspective and development

The creation of a "Brand Village", on the banks of the river, with the creation of more than 400 jobs, for an opening in 2020-2021.

The establishment of a housing program (73 units in three phases) under development in front of the floating port.

The acquisition by a property developer acquires from the site of the former abbey to offer a luxury hotel offer, complemented by a high-end catering offer.

The planning of the reopening of the Sambre (2021) with the reconstruction of two canal bridges (Vandencourt and Macquigny-Directed by VNF) under the impetus of the Hautmont territories for a complete reconquest of the Sambre and a reopening to Paris.

To prepare this reopening, the city of Hautmont bought a boat in July 2019 – ISARA - to discover the Sambre history, the biodiversity... The target audience are the population, the schools...
Thanks you for your attention
WHICH OBSTACLES FACE THE DEVELOPMENT OF WATERBORNE PUBLIC TRANSPORT SERVICES?

Author: Didier Baudry
Senior Inland Waterway Transportation Officer
Cerema
Cerema

The French agency for ecological transition and regional cohesion

Scientific and technical expertise, in support of the definition, implementation and evaluation of public policies on both national and local levels.

Nine fields of activity including the two fields infrastructure and transport with

Waterborne Transport.
Scope and knowledge

Scope:
**waterborne public transport services**
- All the year.
- Large range of hours.
- Relatively high frequency.

Knowledge:
- Green transport?
- Direct routes (competitive).
- On time (no traffic jams).
- Connections with the urban transport network.
- Possible complementarity with tourism (share time, additional source of revenue).
Dynamism, innovations, … but obstacles

- Bordeaux, hybrid engines.
- Nantes, Hydrogen energy.
- Calais, an innovative design of shuttle and stations to optimise the stopping time at stations.
- Lorient, electric energy storage in condensers.

Photo credit: Calais, Olivier Leclercq (photographer); other photos Cerema
Topics and methodology

Topics

- Obstacles.
- Focus on operating cost.

Methodology

we survey:

- Existing services but also new line services and projects.
- Public Authorities for Mobility and transport operators.

with:

- Questions (general to detailed)
- Detailed questions split by issues.
- A table to collect operating cost.

Limits

- Around ten responses (Ajaccio, Bordeaux, Calais, La Rochelle (2), Lille, Lorient, Marseille, Nantes and Toulon).
First finding: Unawareness

Unawareness

- Few services.
- Waterborne Public Transport Services are adapted to local conditions (no standard services).
- Unawareness of waterborne transport by Public Authorities for Mobility and Urban Transport Operators.
- Unawareness of Urban Public Transport by waterborne transport players.

Solutions

- Studies, dissemination (studies, data and information), benchmark, etc.
## Second finding: Regulatory obstacles

### Regulatory obstacles

- Three main regulations: Urban public transport (metro, bus, etc.), inland waterway transport and sea transport.
- "New" waterborne transport services / old regulations.
- Interpretation of regulations by different state authorities.
- Environment regulations (but necessary).
- No specific and old training scheme.

### Solution

- To study changes in regulations.
**Third finding: Technical obstacles**

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Technical obstacles, technical constraints</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct routes, « dedicated sites », few other navigations (in general).</td>
<td>Other navigations, other uses of waterways (cargo ships, cruisers, recreational boats, house boats, etc.).</td>
</tr>
<tr>
<td></td>
<td>Weather phenomena (swell, tide, flow, wind, freezing, …) and their consequences</td>
</tr>
<tr>
<td></td>
<td>Navigability of waterways: limited depth, bridges too low, strong currents, etc.</td>
</tr>
<tr>
<td></td>
<td>Needs: <strong>Availability</strong> of waterborne services all year long.</td>
</tr>
<tr>
<td>Solutions</td>
<td>Knowledge, dialogue with all stakeholders.</td>
</tr>
</tbody>
</table>

03/10/2019 Smart Rivers 2019 – C-8 - Recreation and passenger Transport
Calais, an example of technical constraints:

Photo: Olivier Leclercq
Focus on operating costs

— Few responses (five full tables).
— Different characteristics of line services, waterborne shuttles and navigating conditions.
— Rough estimate of operating costs (five services) from **14 to 27 € / km.** Very expensive in comparison to bus services.
— High salary cost from 45% to 73% of all costs (but in general a crew needs two people / one person for a bus).
— Electric energy less expensive than diesel fuel (fuel and also maintenance but without batteries).
— Station operating cost very variable (zero to expensive).
Conclusions, considerations for future work

- Waterborne public transport services are parts of urban transport services and suitable for environment.

- Knowledge and concertation.

- Improve regulations, potential source to enhance waterborne services.

- Optimise operating costs.

- Continue to innovate.

Thank you for your attention