Potential for the inland navigation fleet to adapt to changes in the water discharge

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Content

- Short general introduction
  - Marin: short survey of Marin in relation to IWT
  - Influence of climate change on river regime
  - Goal IWT

- Coping with lower water heights: the fleet
  - Important aspects deal with respect to navigation
    - 1. Continuous navigation
    - 2. Optimization of loading depth
    - 3. Follow defined depth contours
      - Consequences for the crew
    - 4. Increase the capacity of the fleet
    - 5. Design and build wider & lighter ships

- Recommendations
Marin and IWT: three main working fields

- Determination of feasibility of integrating ships in transport chains
  - Conceptual design of door to door transport chains and ships followed by
  - Design of ships
- Environmental impact (ships ↔ environment)
  - “CO2 optimal” ships
- Nautical safety and efficiency (MSCN)
PARNASSOS under wave pattern from RAPID

PARNASSOS, Double body

Model test

PARNASSOS under wave pattern from RAPID
Main conclusions on basis of climate scenarios

- On basis of the sensitivity analysis carried out the conclusion can be drawn that (starting from the most pessimistic dry scenario) at 2050 every year a dry period as happened in 2003 will take place.

"Klimaatverandering en binnenvaart", Effecten op de binnenvaart van meer extreem lage (en hoge) waterstanden op de Rijn, C.G. Bosschieter, Delft, December 2005

- Coping with dryer periods means:
  - More cargo capacity is required for transport during the period of lower water levels: this results in……..
### Impact of the year 2003 (Carpe Diem)

Total number of days in 2003 with less water height than 2.2 m

<table>
<thead>
<tr>
<th>Water Height</th>
<th>Count</th>
<th>Percentage</th>
<th>Total Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>from 2 to 2.2. m</td>
<td>58</td>
<td>60%</td>
<td>34.8</td>
</tr>
<tr>
<td>from 1.8 to 2 m</td>
<td>34</td>
<td>40%</td>
<td>13.6</td>
</tr>
<tr>
<td>from 1.6 to 1.8 m</td>
<td>28</td>
<td>35%</td>
<td>9.8</td>
</tr>
<tr>
<td>from 1.35 to 1.6 m</td>
<td>13</td>
<td>30%</td>
<td>3.9</td>
</tr>
<tr>
<td>less than 1.35 m</td>
<td>4</td>
<td>25%</td>
<td>1</td>
</tr>
<tr>
<td><strong>total</strong></td>
<td><strong>137</strong></td>
<td></td>
<td><strong>63.1</strong></td>
</tr>
</tbody>
</table>
1. Increasing the capacity by continuous navigation

- Full continuous navigation
  - More transport capacity due to shorter turn around times
  - Less time for loading and unloading (!), and
  - Costs of crew increase

- Challenges:
  - Availability of required extra crew members
  - How to decrease costs of personnel?
2. Optimization of loading depth
   - Two important independent aspects:
     - A. Low water prediction model
       - Accurate 48 hours prediction: +/- 10 cm
       - 72 hours prediction: +/- 15 cm
     - B. Accurate and continuous knowledge of depth contours on ECDIS (important up to Oestrich, km 515)
       - by frequent measurements by the fairway authorities
       - By info (position, depth) from nominated ships navigating on the river
3. Follow defined depth contours

- Radar system encompassing and integrating:
  - The own radar, electronic chart, AIS and accurate depth contours
- The ships follow defined **depth contours** for the own ships on the chart
- Coordination with other ships mainly on basis of AIS (traffic management)
- Interference with the navigation by the skipper: only when required i.e. by exception
Consequences for the crew

- Change in professional skills (cyberspace skipper)
  - More support by instruments
  - Change in required know how
    (Less craftsmanship required of skippers and crew …?)
- Shorter basic education in combination with frequent refreshment training
  - Training on simulators on periodic basis
- For the future: decrease cost of crew on basis of:
  More technical support and less physical work
Departure from a lock
4. Measures to increase transport capacity of fleet

- Intensify the possibilities to use **coupled units**:
  - Pushed by the own ship, or
- Consider the ongoing application of **pushed units**:
  - One push boat, **two** (or more) barges in front
  - Cargo can be discharged when convenient
    - Barges can be used as floating stock outside dry period
- Coupled units may have a very large capacity
- Challenge: optimization of lines of units (Fuel!)
5. Design wider & lighter ships with restricted draught

- Design wider and lighter ships: less draught
  - More cargo at lower water depths
  - Advantageous during low waters but less optimal for higher water levels:
    - Proper design under water ship very important
    - More volume by optimization of the lines
    - Restricted navigational area outside the Rhine
- Lighter ships: use components of composite on ship where possible
## Result of measures for capacity of fleet

<table>
<thead>
<tr>
<th>measure</th>
<th>effect on capacity</th>
<th>effect on costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>continuous navigation</td>
<td>30%</td>
<td>20%</td>
</tr>
<tr>
<td>optimization loading depth (up to the Oestrich)</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>increase loading capacity</td>
<td>15%</td>
<td>5%</td>
</tr>
<tr>
<td>design wider, lighter ships</td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td>overall effect</td>
<td>75%</td>
<td>40%</td>
</tr>
</tbody>
</table>
Main conclusion

- It is **not easy but possible** to cope with the changes imposed on inland navigation by climate, but a lot of work has to be done in the next decades.
- A survey of **recommendations** in this respect follows.
Recommendations for the industry

- Develop integrated Radar/ECDIS/AIS/Depth information such that in time only relevant information is shown
- Develop systems with coupled units to reduce waiting times on cargo
- Use in ship building as much composite components as possible to built lighter ships
Recommendations for the politics

- Intensify studies to **decrease the required number of crew** on board taking further automation and less physical work into account
- Stimulate and organize that **depth information** of various sources can be applied to optimize loading depth (RIS)
- **Shorten education** for inland vessel crew members and require **refresher courses** on simulators to keep skill up to date
Recommendations for R&D

- Make accurate **low water prediction model** and link this to the RIS server
- Make **fit for use design tools** for restricted water
- Develop **energy efficient coupled units**
- Develop **wider ships** with optimal performance
- Assist ship building industry in application of **composite materials**
- Develop **training modules** for skill training taking into account new developments as described
- Start working on the **unmanned bridge**
Artist impression of the Barge Truck
Thank you for your attention

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