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Automation in inland navigation

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Administrator CCNR

CCNR
CENTRAL COMMISSION
FOR THE NAVIGATION OF THE RHINE

CCNR

- Governs navigation on the Rhine
- Oldest international organisation (200 years)
- Based on Mannheim Convention (150 years)
- 5 member states, 11 observer states and 5 observing international organisations
- Intensive participation of industry via numerous recognized international associations
- Guaranteeing freedom of navigation and promoting navigation on the Rhine
- Binding regulations (traffic / vessel operation, technical requirements for vessels, crew qualification, manning)
- Political, organisational, technical and social innovator (example of late: regulatory framework for LNG)
- Strategy (sustainable inland navigation, vision of zero emissions, cooperation with EU, …)

The Rhine

- ***Some two thirds of IWT in EU***

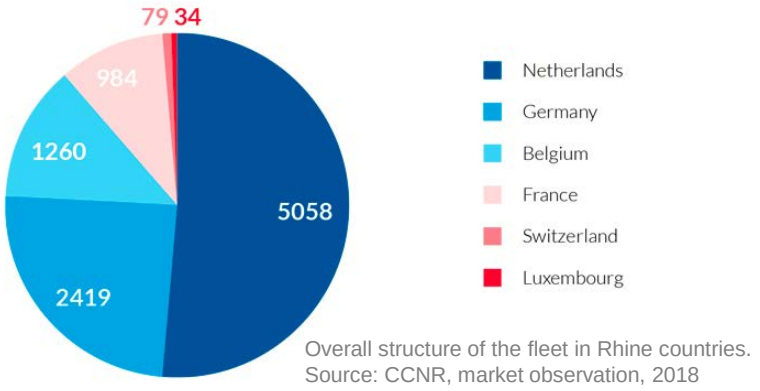
  (330 million tons/year, 2 million TEU/year, > 50% international freight in corridor)

- ***Probably most innovative inland navigation fleet worldwide***

Particularities of inland navigation

- More than 13,000 inland vessels registered in the Rhine and Danube basins in 2017

- 300 vessels per day on lower Rhine



Overall structure of the fleet in Rhine countries.
Source: CCNR, market observation, 2018

- Navigation in enclosed and confined surroundings, transiting of locks, water levels, bridge clearances, vessel manoeuvrability
=> very different from those of maritime navigation

- Inland navigation not regulated by IMO rules
=> national and international framework
(ships design and equipment; crew qualifications; ship operation)

Research and pilot projects in inland navigation

- Automated navigation covers a very wide range of technical solutions and use cases

⇒ ranging from simple navigation assistance to fully automated navigation.

- Several national and international research and pilot projects

⇒ Gaining experience is critical for evaluation of technical possibilities and expected advantages.

- Expectations

⇒ economic benefits with the reduction of operational costs + creation of new business models, such as commercially viable navigation on smaller inland waterways that today are not sufficiently used

⇒ increasing safety by reducing human errors.

KU LEUVEN

SEAFAR

BL L Blue Line Logistics

LAESSI

NOVIMAR VESSELTRAIN

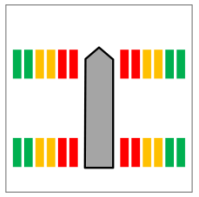
Advanced assistance system – research project LAESSI

LAESSI = *Guidance and assistance systems to increase the safety of navigation on inland waterways*

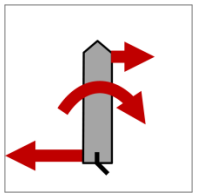
- DGNSS, AIS, ECDIS, VDES, Ultrasonic Distance Sensors, laserscanner, radar…
- Skipper more focused on the traffic / easier to recognize and classify possible dangerous situation

Assistance functions

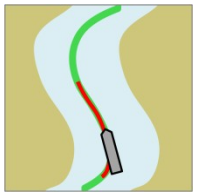
- Berthing assistant
  - Computation of distances in charts
  - Measuring of distances



- Conning display
  - Presentation of information about movement of vessel during maneuvering



- Track control assistant
  - Automatic guidance of vessel along a predefined track



- Bridge collision warning system
  - Height monitoring of vessel

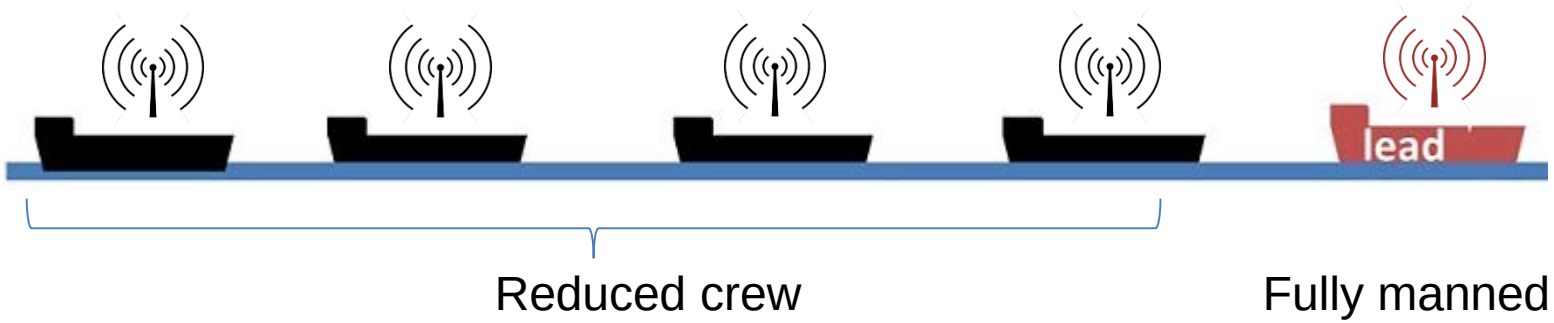
Sources: Dr Sandler, Pittsburgh 2017

MS Jenny
Test area „Main“,
Final demonstration

Sources: LAESSI, Würzburg, March 2018

Vessel train

NOVIMAR
VESSELTRAIN



- Analogy with platooning developped in road sector
- Convoy without physical links
- Collecting experience with pilot vessels

Machine learning

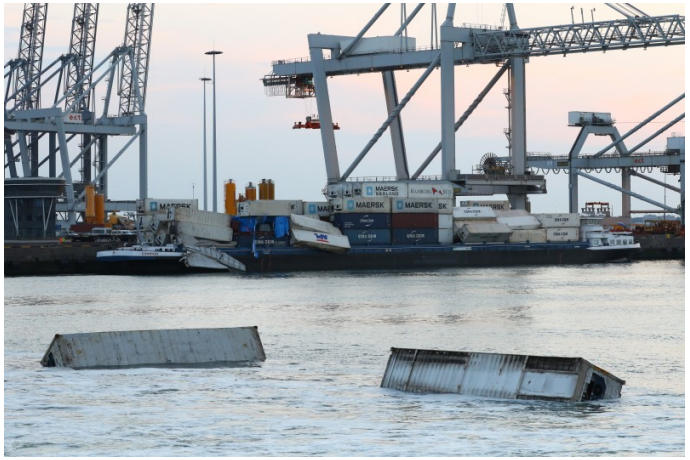
Real-world
From existing manned vessels (Position Navigation Time)
AIS data, cameras, radar, sensors…

Simulation
From simulators, e.g. those developed for training

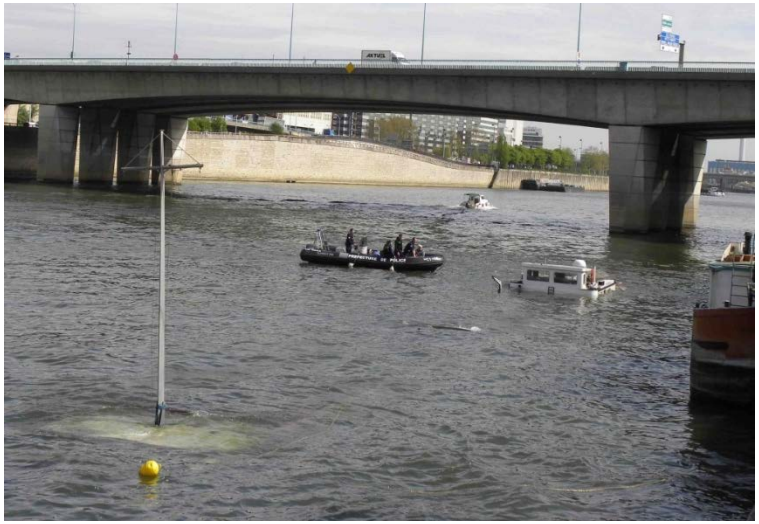
Machine learning

Predictive model
for automated vessel

What radar does not show but sensors should detect



Floating objects or underwater obstacles



Use of blue pannel
(not connected yet to AIS devices)

Burning vessel

Progressive approach taking into account the human factor

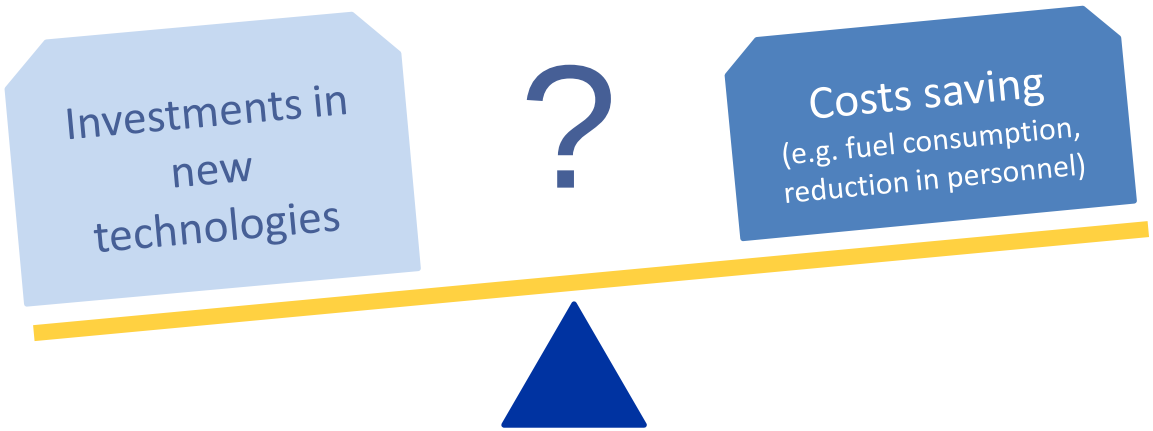
⇒ Non automated and automated vessels on the same waterways (e.g. voice communication challenges)

⇒ Automation of tasks is likely to turn the boatmaster into a mere observer and inhibit, in a certain way, the development of his skills + Intuition of the boatmaster might be in contradiction with decisions taken by automated systems

⇒ Automated vessels but with monitoring and fall-back involving humans

⇒ Critical *scenarii*:

- Collision / ability to stop autonomous vessel
- Fire on board (only automatic fire-fighting systems?)
- …



CCNR international definition of levels of automation in inland navigation

Level	Name	Vessel command	Monitoring of and responding to navigational environment	Fall-back performance of dynamic navigation tasks
0	NO AUTOMATION			
1	STEERING ASSISTANCE			
2	PARTIAL AUTOMATION			
3	CONDITIONAL AUTOMATION			
4	HIGH AUTOMATION			
5	AUTONOMOUS = FULL AUTOMATION			

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Full text available on CCNR website

https://www.ccr-zkr.org/files/documents/AutomatisationNav/NoteAutomatisation_en.pdf

=> Subject to context specific execution, **remote control is possible**
(vessel command, monitoring of and response to environment or fallback performance)

=> It may have an influence on crew requirements (number or qualification)

Conclusions

Automation in inland navigation covers a very wide range of technical solutions and use cases

⇒ exponential number of pilot projects + testing areas in Europe

CCNR has developed an international definition of levels of automation (taking into account the specificities of inland navigation)

⇒ structured framework for a shared understanding of automated navigation

On-going deep analysis on the regulatory framework based on boatmaster's responsibilities (e.g. responsibilities shared between boatmaster and system manufacturer)

Progressive approach taking into account the human factor

⇒ People not as afterthought, but in center

⇒ Not technology driven, but human needs driven

Sustainability => high automation should only be implemented if it supports sustainability of inland navigation (economic, social and environment)

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THANKS