

Smart Fairways

Co-design of future intelligent fairways in Finland

University of Turku

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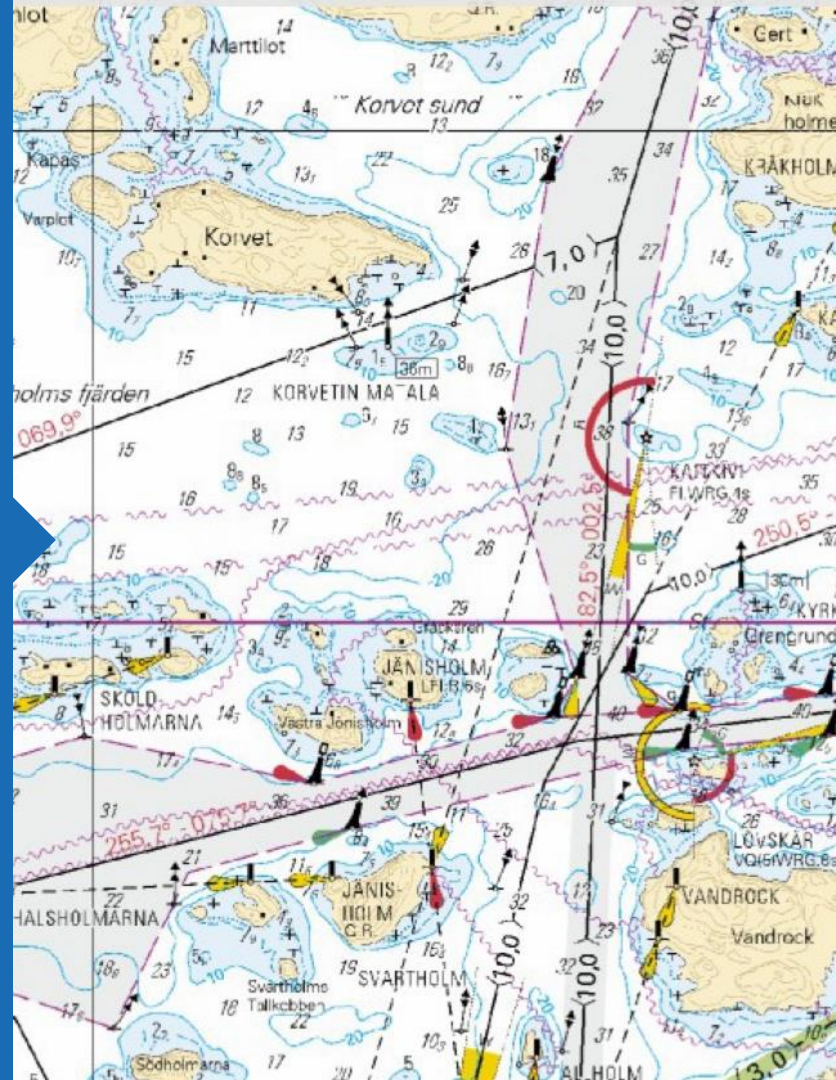


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Turku School of
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Background

- Digitalisation for more efficient and sustainable maritime, e.g. autonomous ships and digitalization in ports.
- Not much changes in the waterways itself
- Research project took up the challenge of development future smart fairways in Finland
- Key action plan for traffic automation by Ministry of Transport and Communications
 - Miettinen et al. (2021). Liikenteen automaation lainsäädäntö- ja toimenpidesuunnitelma.



Research Objective

Objective: to define the elements of the future fairway in Finland

What are the essential physical and digital services and infrastructure that help to improve transport safety, efficiency and reliability, and to reduce climate and environmental impacts in fairways?

Definition: *Fairway is a harbour approach channel, designed for safe navigation of vessels* (Gucma and Zalewski, 2020).

- It is used by various vessel types from commercial ships to leisure boats.
- Typically, fairways are governed and maintained by governmental authorities,
- several of the services are provided by state owned or private companies



Research approach

Delphi method (2020-2022)

- Research consortium
 - the authorities
 - maritime service providers
 - technology service providers and
 - universities
- Expertise
 - shipping and navigation
 - pilotage
 - maritime traffic management
 - nautical charting
 - meteorology and hydrology
 - marine technology
 - networking and telecommunications
 - information systems and digital technology
 - cyber security
 - AI ethics
 - maritime law
 - military, unmanned maritime systems
 - emergency services
 - maritime business

Research approach

1. Pre information collection from the experts

- questionnaire (n= 33)
- Semi-structured interviews (n=23)

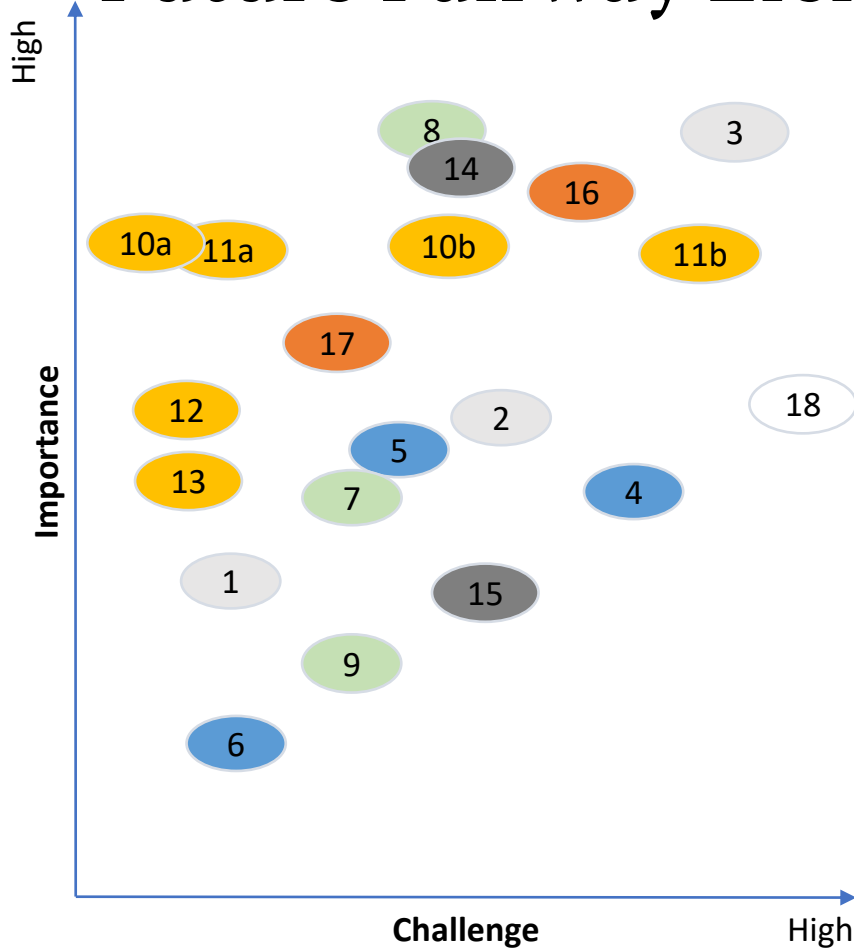
2. Workshop (n=25)

- An initial list of future fairway's elements extracted with Traficom.
- Experts commented, added the list of elements, and evaluated the importance and challenges related to each of the element.

3. Verification phase

- The result plotted in a diagram (challenge vs. importance)
- Comments
Via separate meetings and email discussions
- Improved version of the diagram was constructed based on the comments
- Description of the elements

Future Fairway Elements



CORE INFRASTRUCTURE

- 1 Aids to Navigation
- 2 Electronic position finding aids
- 3 Communication systems

FAIRWAY INFORMATION

- 4 Digital twin of the physical infra (static)
- 5 Navigational charts and nautical publications
- 6 Dynamic navigational warnings

WEATHER AND SEA STATE

- 7 Realtime weather and sea state info for the area
- 8 .. for a certain location and the planned route
- 9 Climate change information

NAVIGATION & SEAFARING SERVICES

- 10 a) VTS services, b) enhanced VTS
- 11 a) Pilotage, b) remote pilotage
- 12 Ice breaking
- 13 Tug services

PORT ARRIVAL & DEPARTURE RELATED SERVICES

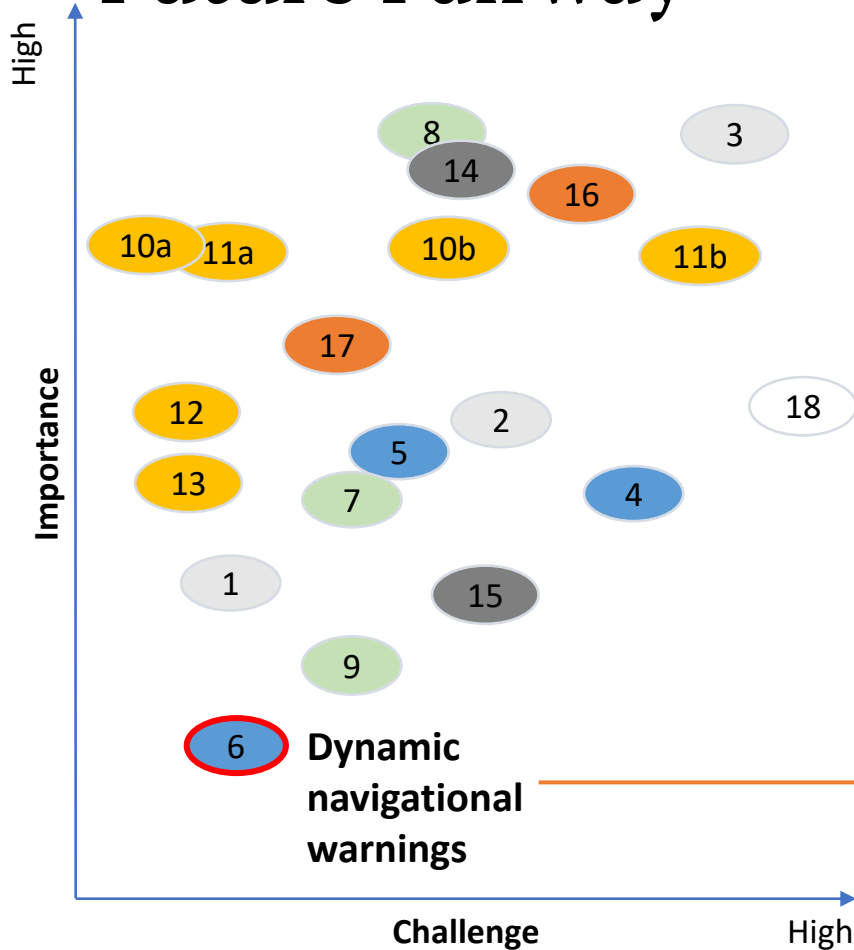
- 14 Port just-in-time
- 15 Administrative services: customs & boarder guard

OTHER

- 16 Support for the emergency services, SAR,
- 17 Sustainability information & services
- 18 Situational picture

Future Fairway

FAIRWAY INFORMATION

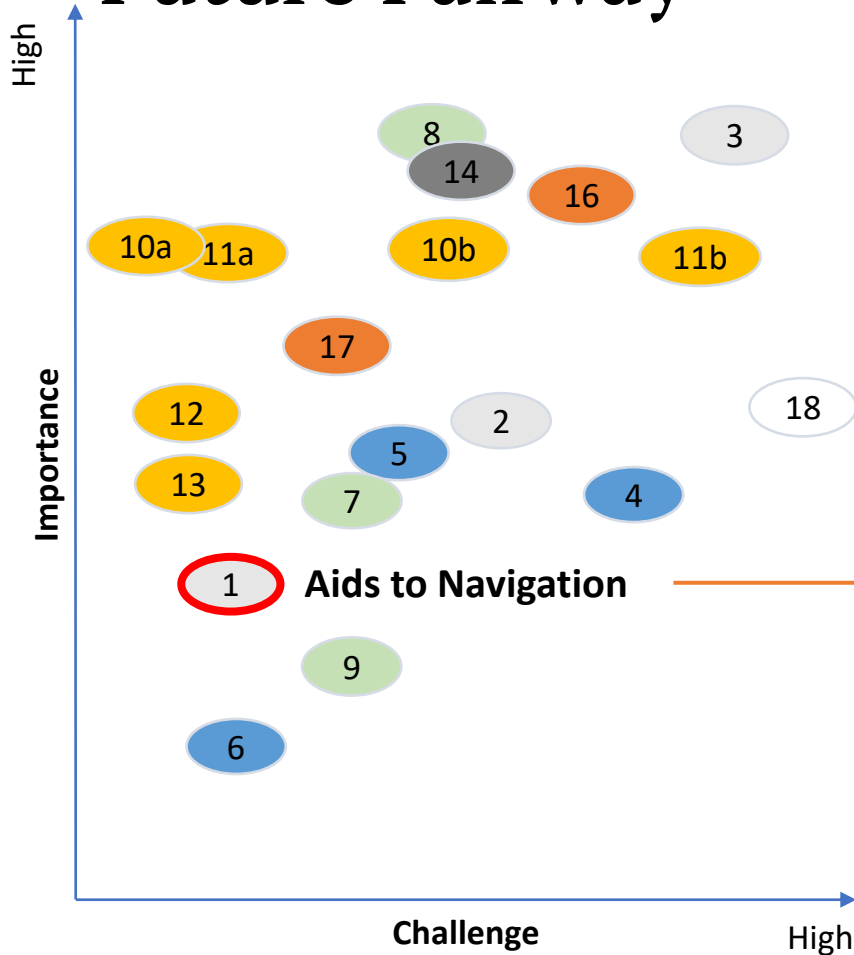


6 Dynamic navigational warnings

Navigational, meteorological and safety warning messages to ships digitally (S-124, AIS ASM)

Future Fairway

CORE INFRASTRUCTURE

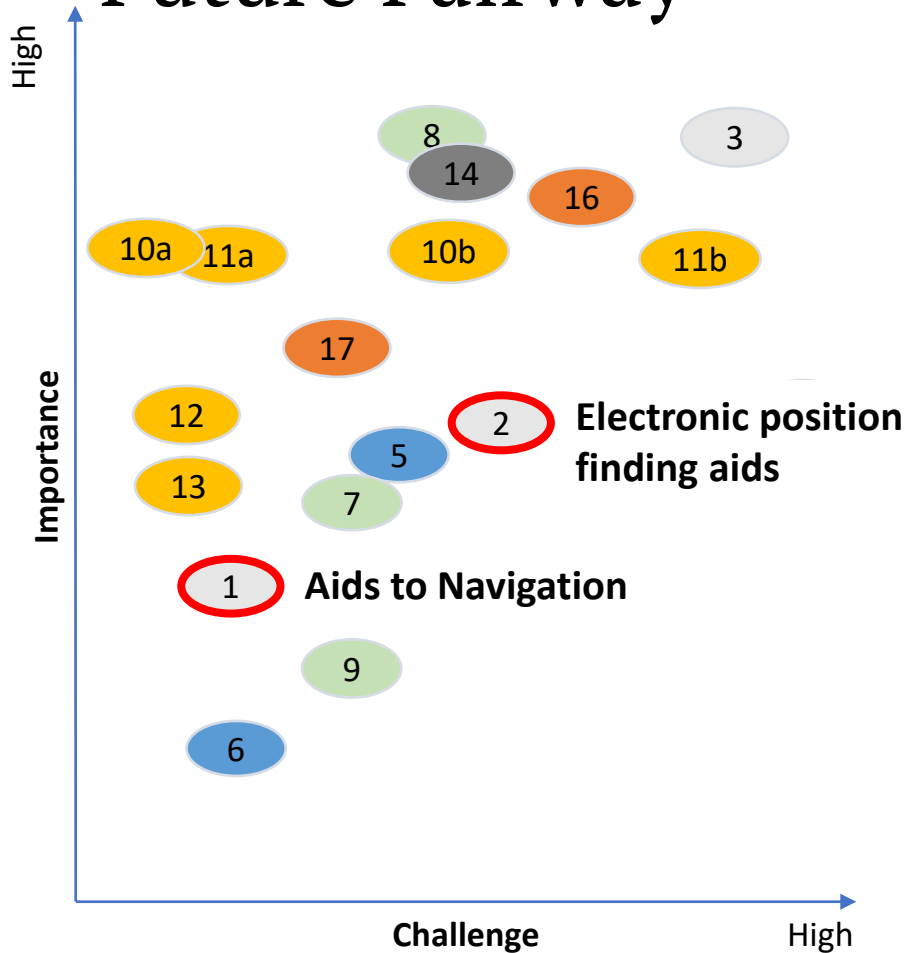


1 Aids to Navigation

- Physical and virtual Aids to Navigation
- Sensors for e.g. dynamic weather, traffic and sea state information, traffic control, AIS
- Remote control to adjust brightness
- Enables provision of other elements

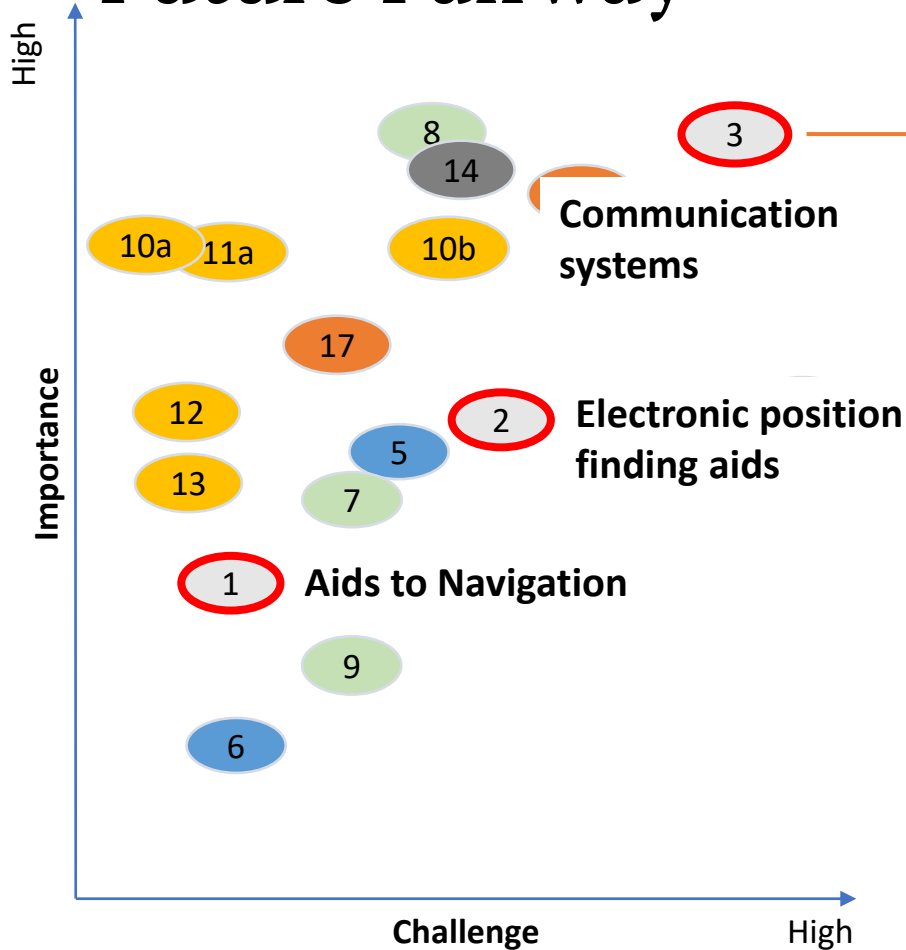
Future Fairway

CORE INFRASTRUCTURE



- Provide vessels with absolute position information that can be displayed in electronic nautical charts (GNSS, R-mode and e-Racon)
- Improved interference detection, integrity and accuracy
- Physical and virtual Aids to Navigation
- Sensors for e.g. AIS, dynamic weather, traffic and sea state information, traffic control
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Future Fairway

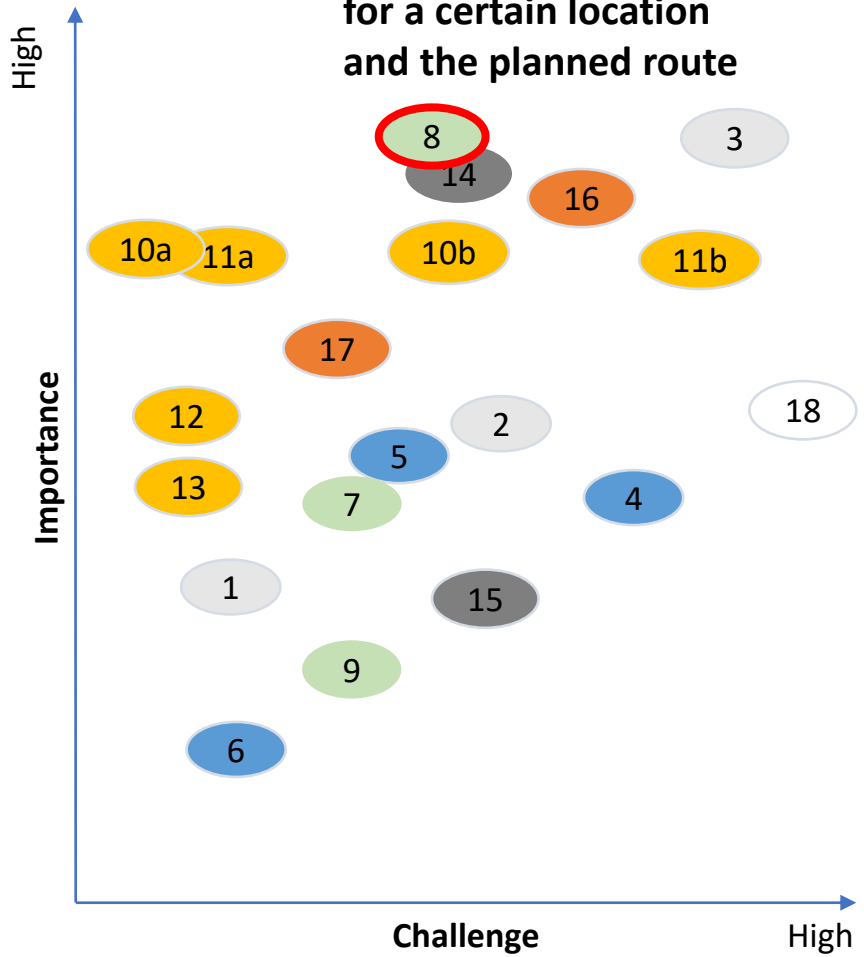


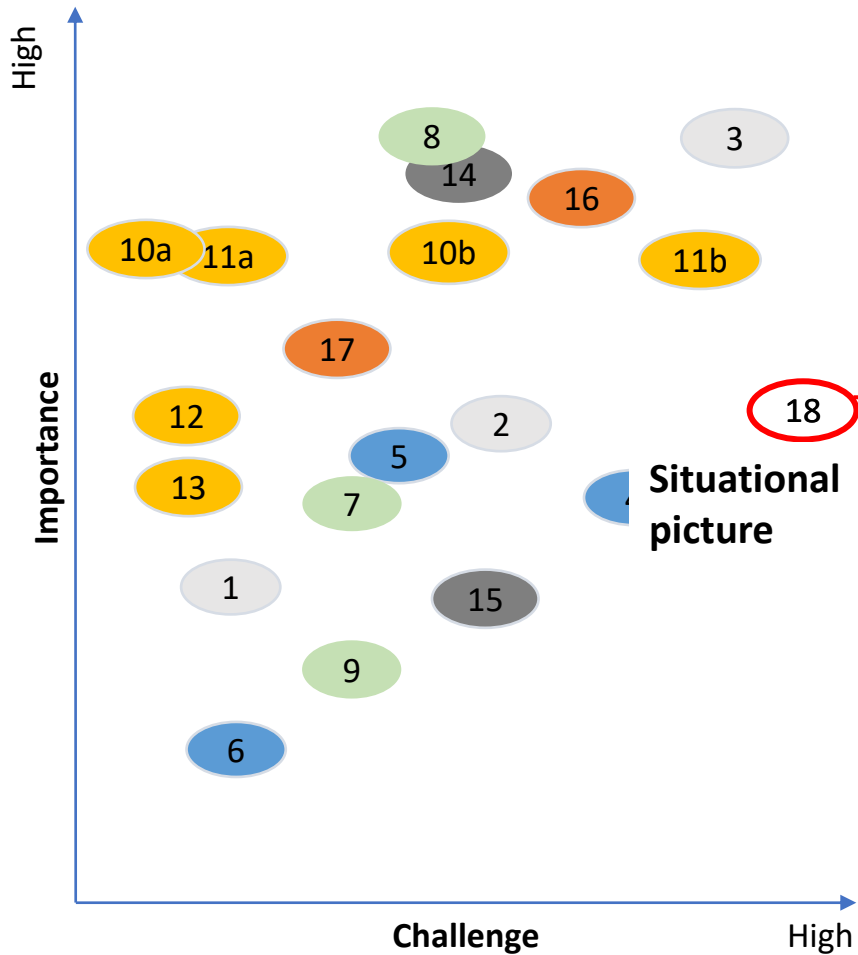
CORE INFRASTRUCTURE

- Dedicated maritime systems: VDES (VHF data exchange system), autonomous maritime radio devices on VHF
- Mobile networks and satellite: 4G/5G, Iridium, Non-geostationary (NGSO) satellites
- User and Service registry
- Provide vessels with absolute position information that can be displayed in electronic nautical charts (GNSS, R-mode and e-Racon)
- Improved interference detection, integrity and accuracy
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**Weather and sea state
for a certain location
and the planned route**

Improved sensors in port areas and fairways
Crowdsourcing
Utilization of AI



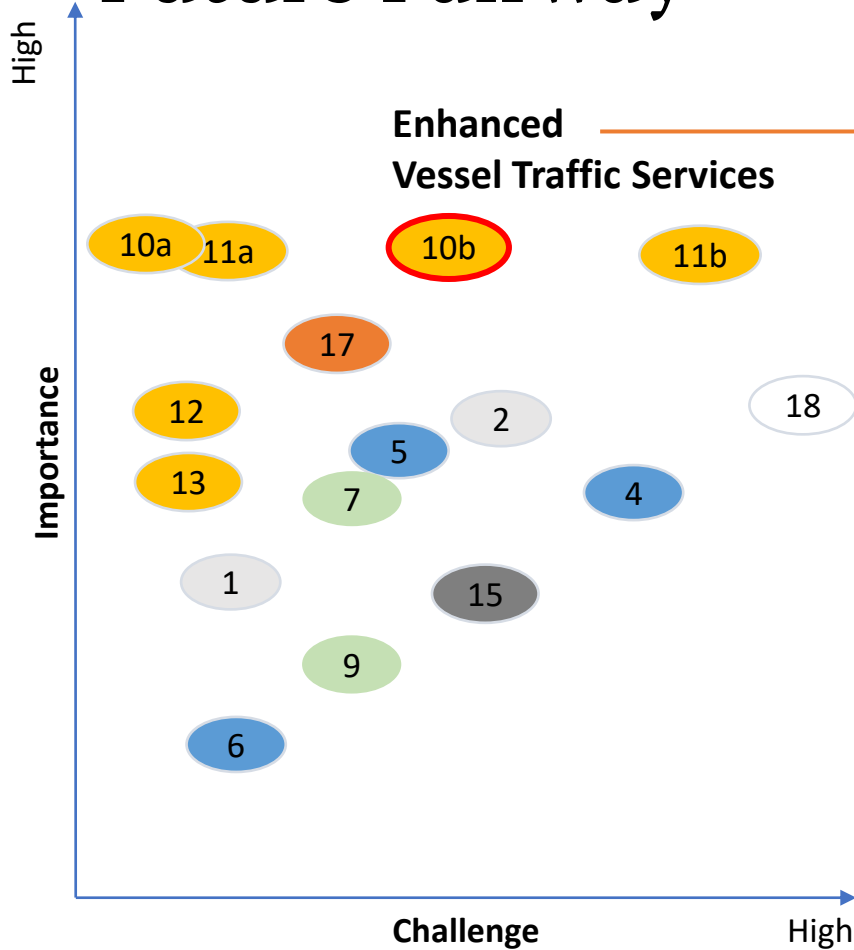


Situational picture

Collects and presents all relevant information on the conditions, traffic etc. in an understandable format for the user.
Predictive measures for avoiding collisions, hazards, and exceptional situations.
BUT, needs to be user and context dependent

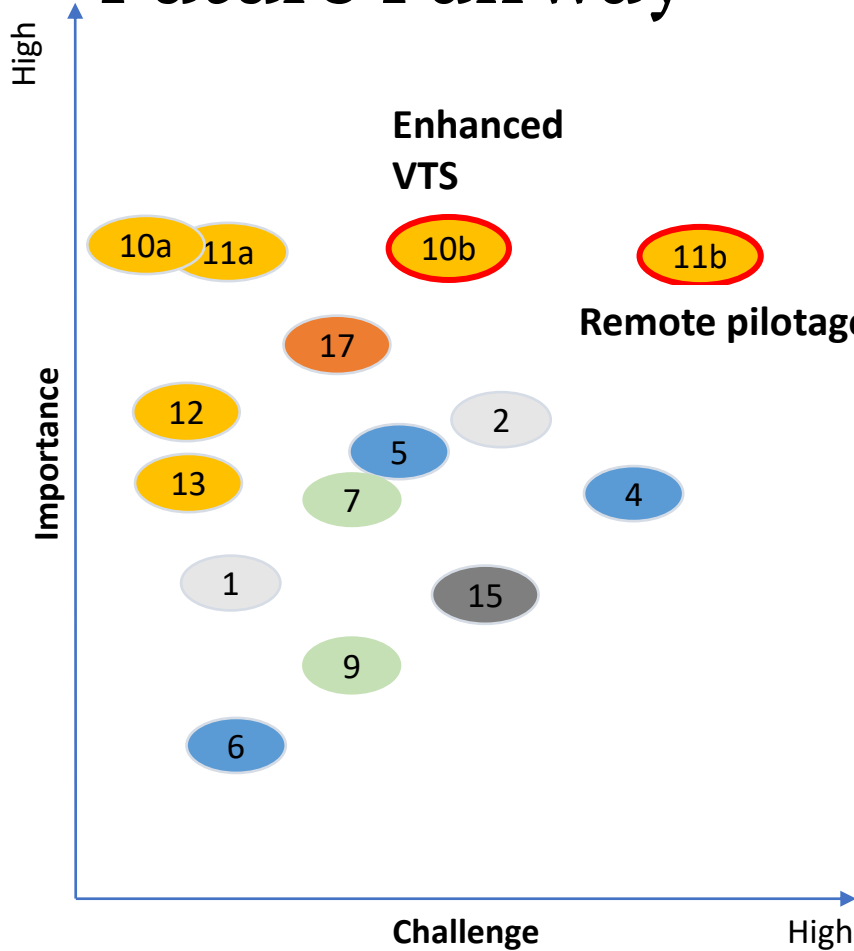
Future Fairway

Active navigation assistance, e.g. accurate position and movement of ships, oncoming and intersecting traffic, anomalies on seas.



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An alternative to normal pilotage service

Remote pilotage

Partners

- Tugs, Ice breakers, FTIA
- Providers of
 - remote pilotage station equipment
 - extra equipment & service for vessel
 - mobile networks
 - shipmaster qualifications
 - pilot education

Requirements from other elements

- Fairway core infra & info, weather info, VTS, port services

Content/service

- Alternative to normal pilotage service
- Main target is to ensure navigational safety
- Service is provided without pilot entering the ship
- Time savings and more flexibility in timetables for vessels
- When implemented correctly improves efficiency and safety.

Delivery channels

- Phone, email or browser-based pilot order system (European Maritime Single Window)
- Enables ordering & tracking the progress of the order.
- Operation of information exchange between ship and remote pilot and the quality of common situational awareness must be validated before commencing remote pilotage.

Customers / user groups

- Vessel's master has qualification for being remote piloted
- Ship's equipment is approved
- Offered to selected fairways
- Remote pilotage permit to different fairways easy to maintain

Finance

- Vessels pay a service fee, e.g. yearly fee or pay per use.
- Pilotage company's
 - operational costs lower (no transportation of pilots)
 - investment costs significant.
- Customer needs to invest
 - shipmaster qualification
 - extra equipment on board

Further development needs:

- Qualification requirements for ship master and pilots
- Technology in vessels and remote pilotage centres
- Availability of the service: selection of the fairways and the circumstances (weather, sea state, traffic)
- (Long term) service contract with the customer, which ensures also correct resourcing of the service.

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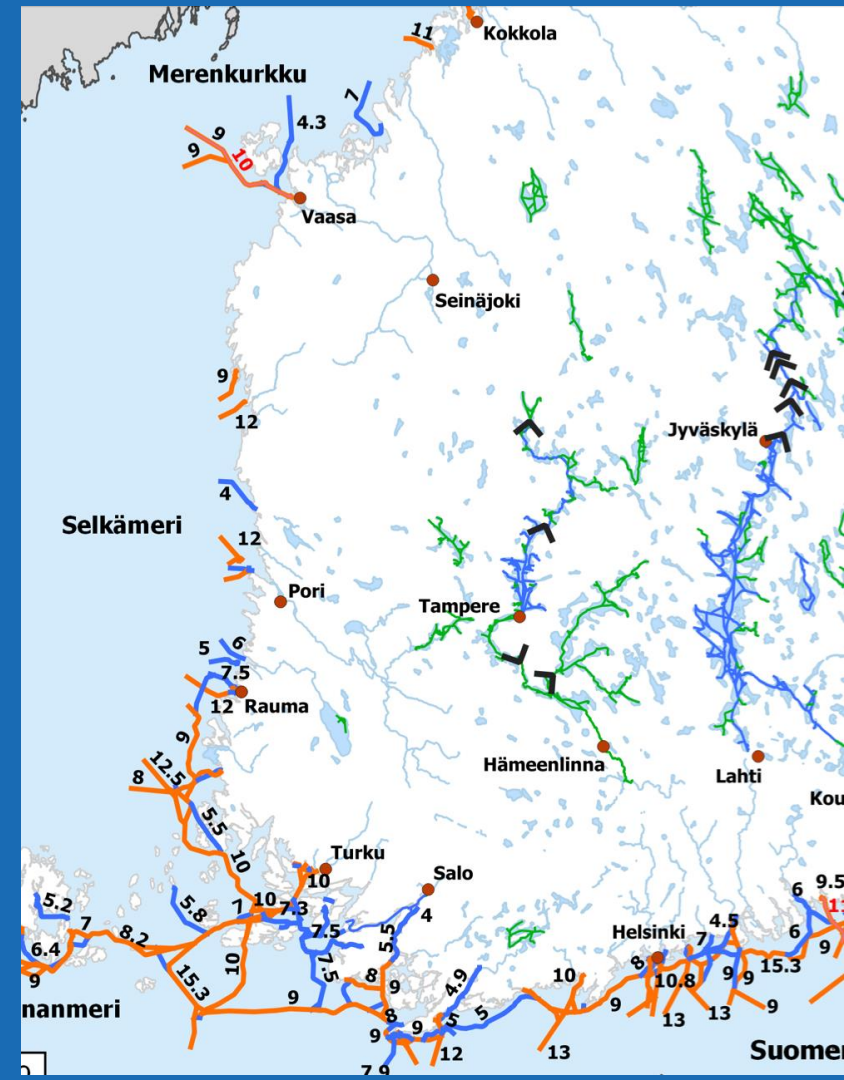
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Discussion

- In future, the fairways utilise different combinations of the elements, i.e. the level of smartness can vary
- Start by improving the infrastructure on most critical places:
 - Fairway crossings (with dense traffic, obstacles of vision)
 - Narrow places (e.g., straits with currents, areas limited by shallows or rocks)
 - Points of handover of responsibility
- Can we improve the safety of all fairway users?
Provide services outside fairways?



Thank You!

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