Smart Small Vessels
ARC SSV

Jukka-Pekka Sallinen

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Aker Arctic Technology Inc

Why Smart Small Vessels

- Opportunities with smart small vessels is still partly uncharted territory
  - Enable new services
- New business opportunities, new companies and whole new business sector to serve market
- Challenge of current situation with lack of real pilot cases and pioneering customers
- Provide design, building and operation as a service in order to penetrate market

Use cases

- similar pilot drone transportations
- As a part of public transportation system
- Ice management
- Shore area garbage collection

Solution - Small Smart vessels

- Aker Arctic Technology is focusing on autonomous technology, design and management; providing waterborne transportation as a service.
- Expertise in other fields are required:
  - *Shipyard: Expertise and know-how on building small vessels*
  - *Equipment supplier: propulsion, power generation/energy storage, auto-mooring etc.*
  - *Operator: Expertise on operating and maintaining small vessels*

Copyright

VesselERP

Complete ERP solution for cargo and passenger vessels

- Manage all operational vessel data in a single system
- Lower the costs by reducing manual work
- Utilize data to make better business decisions
- Automate environmental and authority reporting
- Optimize fleet efficiency and reduce emissions

VesselERP

Modules

- Timetable management
- Bunker orders and reporting
- Stevedoring management and reporting
- Environmental (MRV) and authority reporting (NSW)
- Vessel KPI reporting
- Fuel oil consumption action and follow-up

VesselERP

Modules

- Passenger management
  - Embarkment / disembarkment process
  - Cabin allocations
  - GDPR compliant
  - Official reports (passenger and safety list)
  - Cabin management and cleaning lists

VesselERP

Modules

- Cargo management
  - Manifest
  - Cargo map (positiong onboard)
  - Discharge calculation
  - Capacity reporting

VesselERP

Modules

- Port cost calculation with invoice control
  - Fairway dues
  - Stevedoring costs (loading, discharge, waiting time)
  - Mooring / unmooring
  - Towage and pilotage
  - Agency, waste management, other costs

VesselERP

Future development

- Stowage Planning
- Stevedore integration (resource planning and reporting)
- ELE monitoring and reporting tool
- Vessel performance reporting
- Vessel tracking
- Vessel Certificates

VesselERP

Future development

- Inspections and Audits
- Sea crew Resource Management
- Vessel Maintenance, Docking Plan
- Purchase / AMOS integration
- Traffic planning and simulation tool
- Agency Portal

VesselERP

Future development

- Vessel Capacity Management
- Lorry Driver Self-Service Check-In portal
- Cargo Claims Portal
- HR&Payroll module for SeaPersonell

MaaS of the Seas

Teemu Terttunen, COO

PROBLEM

For a person in a city wanting to travel by the sea, most often…

The product offering is limited and difficult to find

Each service is controlled **separately**

Prices are high and difficult to compare

SOLUTION

Bout - MaaS of the Seas is a platform that connects passengers with a number of maritime transportation services

The target is to:

CENTRALIZE
supply and demand
to one app

SIMPLIFY
purchases via a single user
model

GROW
the market of all parties

BOUT

CUSTOMERS

Primary users of the user-friendly mobile application are:

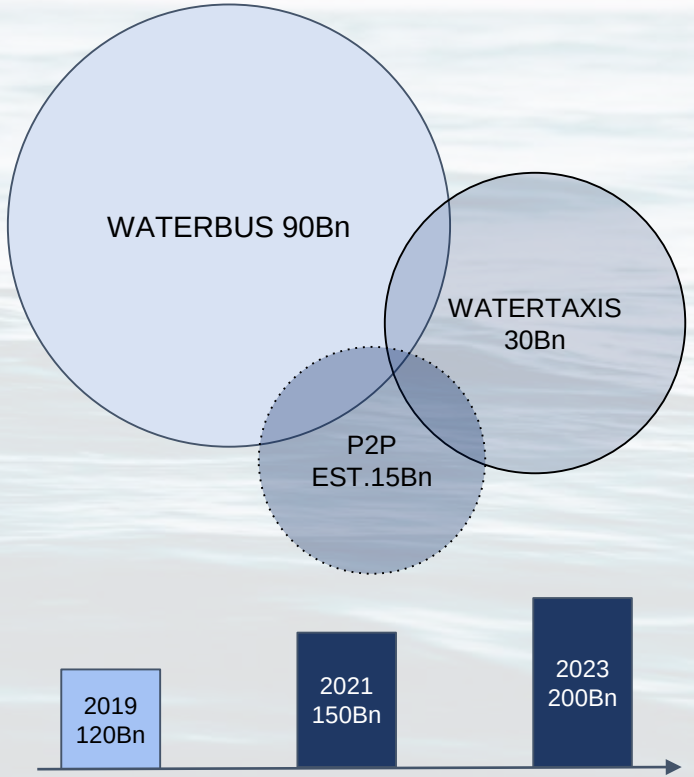
- Local citizens without a boat
- Tourists
- Commuters
- Hotels, restaurants & other services

MARKET SIZE

The market for Water transportation is estimated to be roughly **$150Bn in 2021**

Business Model

Bout collects a fee % of each fare ordered through the app, with the amount depending on the service provided



BOUT

FURTHER PLANS

2019:
Launch in June (Helsinki & Espoo)
Expansion to other cities in Finland during the summer
Our goal is to transport people worth of 1M€ this year

2020:
International launch in multiple cities

We are currently looking for funding and advisory to secure and accelerate our international growth

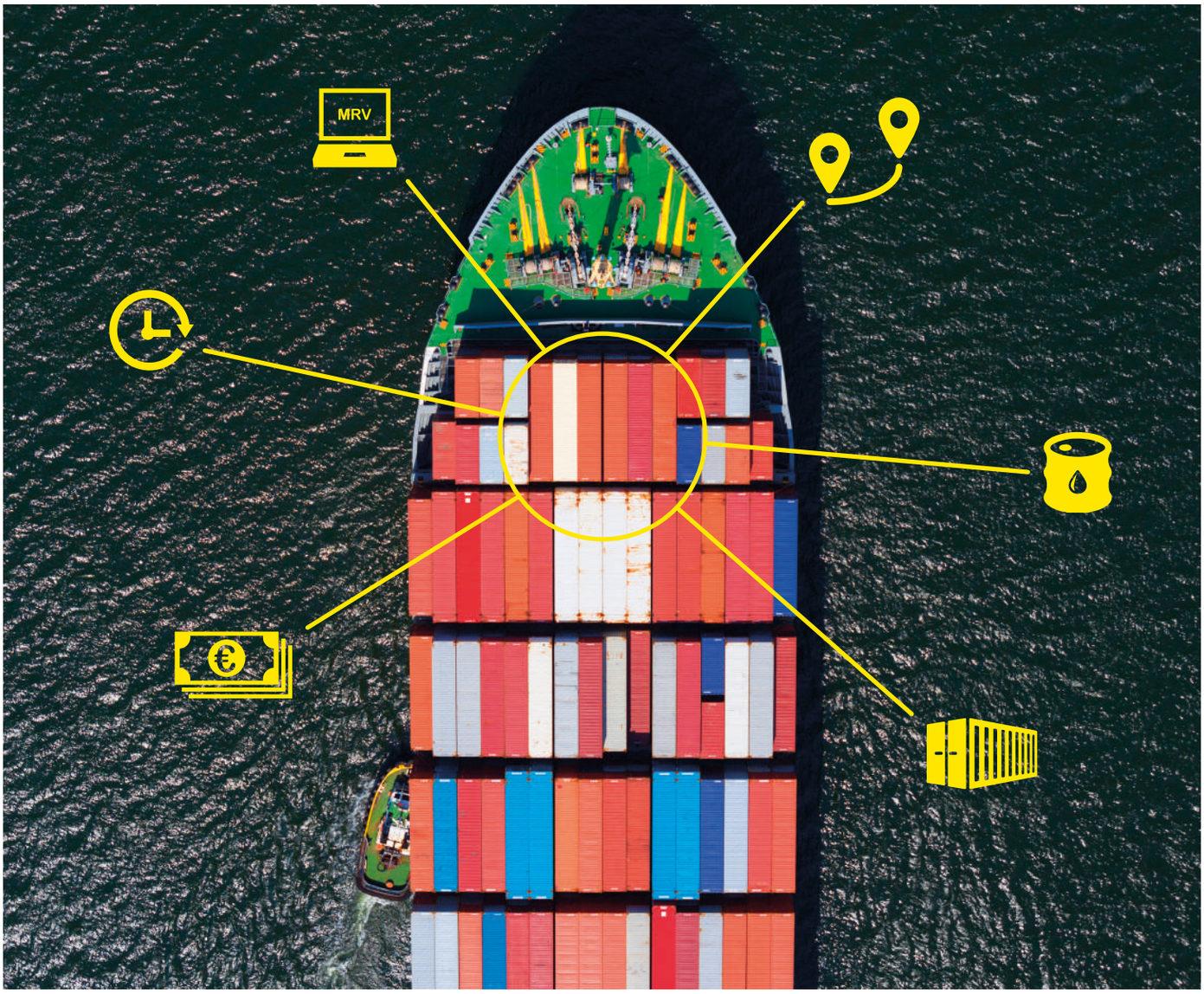
BOUT

Thank you for your attention!

For more information: info@bout.fi

Aava Software VesselERP Proven solution for vessel operations

AAVA SOFTWARE VESSEL ERP



AAVA Software VesselERP is the only ERP solution designed especially for the needs of ship management and operations.

ALREADY IN USE ON BOARD AND IN PORTS

Aava Software VesselERP and other Aava Software solutions are tailored to the individual needs of every customer. They can cover individual business areas or full-scale operating and production control systems. This is one of the reasons why the solutions are already in use on board and in ports.

AAVA SOFTWARE VESSEL ERP

Proven ERP solution digitalizing vessel operations

AAVA Software VesselERP is the only ERP solution designed especially for the needs of ship management and operations. It is already in use on board and in ports.

It has proven to be a reliable and easy-to-use tool. It is the most flexible ERP solution commercially available and is constantly being developed further for individual clients' needs.

Using Aava ERP solutions has increased clients' efficiency up to tens of percentages. It reduces manual work and helps avoid costly errors in data input and management.

The VesselERP increases transparency of business management. Reliable and exact information provided by the system yields better understanding of business and lowers risks.

Aava solutions are tailored to the individual needs of every customer.

Aava solutions are flexible and agile. They can cover individual business areas or full-scale operating and production control systems.

Solutions are easy to adapt to the customer's changing needs. It is also easy to expand solutions to cover new areas.

MULTIPLE FUNCTIONALITIES OF AAVA SOFTWARE VESSEL ERP

BUDGETING AND TC CALCULATION

- The solution establishes the total budget of the voyage.
- It calculates total costs. Versatile built-in reporting tools track costs in real time.

VOYAGE REPORTING

- The tool records shipping information, routes/lines, port calls, tug and pilot information, and information on bunker usage, including consumption and rebunkering.
- It maintains a stock balance for the bunker status of each ship, calculates emissions data and makes the required emissions conversions based on the given conversion parameters.

TIMETABLE FOLLOW-UP

- The tool records the time spent by cargo ships in ports, cargo discharging, loading and offshore operations.
- It compares master timetables to estimated and actual timetables.
- It logs causes for possible deviations from the schedule and provide the necessary reports for tracking.

VESSEL KPI REPORTING

- It gathers KPIs on fuel burned per mile or per ton, throttle settings at various points on a voyage, engine RPMs and exhaust gas analysis, vessel performance against hull conditions, cargo consumption, speed monitoring, stevedoring efficiency and bunker management from purchase to transfers to usage.

CARGO COST CONTROL

- The solution calculates the costs of cargo operations by comparing port costs to reported activities.
- The tool generates a cost estimate for future port invoices based on the ship's list of cargoes, contingent on the calculated price lists of the various parties.
- It calculates the differences between the budgeted and the actual costs and locates the costs to the correct accounts.

MRV REPORTING

- The tool creates official monitoring, reporting and verification (MRV) reports according to the requirements of the European Union's MRV regulation for ship owners and operators.
- The tool automatically receives the needed information from the fuel tanks and other chosen sources and processes it in the required way.

OTHER PORT ACTIVITIES

- VesselERP follows port activities like stevedoring, maintenance, tugboat and pilot usage, work hours and breaks.
- All port agents can record their information directly to the VesselERP using each user group's own, tailored user interface on any device.

BUNKER MANAGEMENT WITH FIFO CALCULATION

- The solution helps optimize the bunker procurement plan for the vessel. The effective plans include bunkering ports selection, bunkering amounts determination, and ship speeds adjustment and weight.
- VesselERP manages records for rebunkering, consumption, inventory and transfer events. It manages bunker balance automatically with the first in, first out (FIFO) calculation for bunker costs in real time.
- The solution manages bunker requests and includes order processes.

PASSENGER LIST MANAGEMENT

- The solution manages passenger information.
- Staff can view real time passenger information during the journey.

GDPR COMPLIANT

- The solution is compliant with the EU's General Data Protection Regulation (GDPR).
- All requirements are already met when the regulation becomes enforceable in May 2018.

CARGO DATA MANAGEMENT

- The solution records information on cargo and cargo volume.
- The record includes information about manifests, loading and discharging, cargo deficiencies and remarks to discharge port

OFF TRAFFIC INFORMATION

- The solution tracks layout, docking and off-hire information for capacity management and cost tracking.
- The solution can be integrated into any other company software using open API.

PROVEN VESSEL ERP

“

Finnlines
a Grimaldi Group company

FINNLINES

Finnlines, a leading shipping operator of ro-ro and passenger services in the Baltic Sea and the North Sea, uses AAVA Software VesselERP on its fleet of 21 ships. Finnlines is a part of the Grimaldi group.

“

finnsteve

FINNSTEVE

Finnsteve companies are together a full-service port operator providing all required services for port operations. Finnsteve companies, a part of the Finnlines Group, use AAVA software in all ports where they operate in Finland.

AAVA SOFTWARE

AAVA TECHNOLOGY

- Enterprise software and operating and production management systems are tailored to the individual needs of every customer.
- Aava solutions are flexible and agile. They can cover individual business areas or full-scale operating and production control systems.
- Solutions are easy to adapt to the customer's changing needs. It is also easy to expand solutions to cover new areas.
- With Aava, the customer manages a single system with the company's entire information management needs without any additional integration.
- Solutions can be used wherever they are on a mobile site.
- Solutions can also be used in environments in which there is no constant Internet connection.
- Aava solutions are based on the Aava software platform, a unique award-winning data management system.

AAVA'S WORK IS BASED ON THE CUSTOMERS' NEEDS

- Aava is familiar with the customer's business and processes, modeling them and generating a system that meets the customer's needs.
- Solutions are sold at a fixed project cost, which includes all the work done in the project.

AAVA SOFTWARE

- Aava Software develops and delivers enterprise software for companies.
- Expertise in the special needs of ship management and operations
- A Finnish company with 10 years of experience

Aava Software

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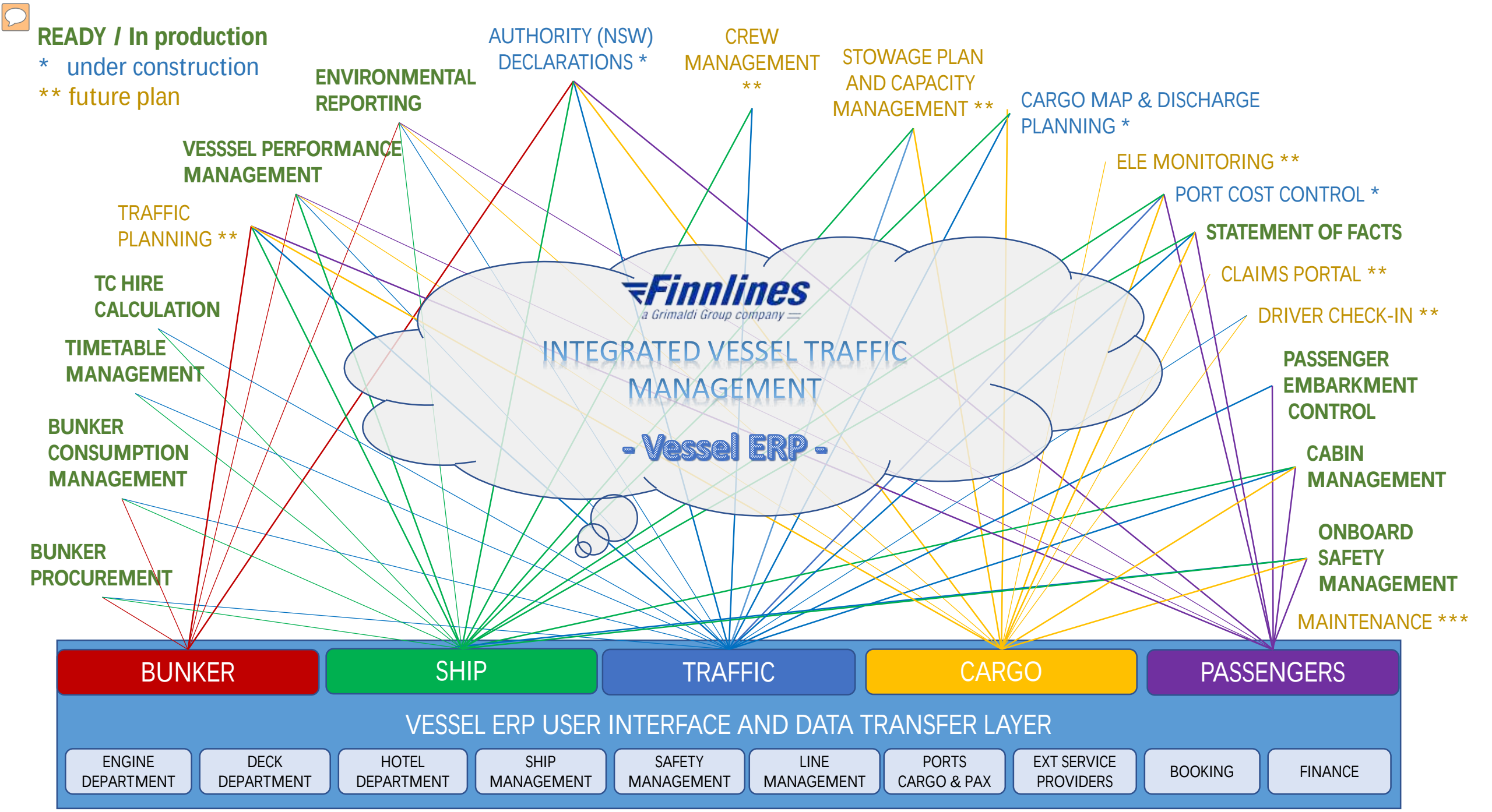
READY / In production
* under construction
** future plan
ENVIRONMENTAL REPORTING
AUTHORITY (NSW) DECLARATIONS *
CREW MANAGEMENT **
STOWAGE PLAN AND CAPACITY MANAGEMENT **
CARGO MAP & DISCHARGE PLANNING *
VESSSEL PERFORMANCE MANAGEMENT
ELE MONITORING **
PORT COST CONTROL *
TRAFFIC PLANNING **
STATEMENT OF FACTS
TC HIRE CALCULATION
CLAIMS PORTAL **
DRIVER CHECK-IN **
TIMETABLE MANAGEMENT
PASSENGER EMBARKMENT CONTROL
BUNKER CONSUMPTION MANAGEMENT
CABIN MANAGEMENT
BUNKER PROCUREMENT
ONBOARD SAFETY MANAGEMENT
MAINTENANCE ***
Finnlines
a Grimaldi Group company
INTEGRATED VESSEL TRAFFIC MANAGEMENT
- Vessel ERP -
BUNKER
SHIP
TRAFFIC
CARGO
PASSENGERS
VESSEL ERP USER INTERFACE AND DATA TRANSFER LAYER
ENGINE DEPARTMENT
DECK DEPARTMENT
HOTEL DEPARTMENT
SHIP MANAGEMENT
SAFETY MANAGEMENT
LINE MANAGEMENT
PORTS CARGO & PAX
EXT SERVICE PROVIDERS
BOOKING
FINANCE

8.5.2019 / rkr

VesselERP-system Integrations

- Timetables from Atlas (Finnlines Cargo Booking/Documentation/Invoicing-system)
- Export Bookings from Atlas
- Export Manifests from Atlas
- Loaded Units with stowage position/PositionData from Stevedoring companies (Finnsteve ,LHG)
- EstimatedDischargeDateTime to Atlas
- StowagePosition(Deck and Lane) to Atlas
- Preliminary PassengerList from eBooking (Finnlines Passenger Booking System)
- Checked-In Passengers from eBooking/PortOperations-module
- Checked-In Cargo Drivers from Atlas-system
- Bunker consumtion /inventory to accounting system
- Estimated port/stevedoring costs to accounting system
- MRV XML report to Authority
- NSW XML reporting to FI,DE,PL,DK

Finnlines
a Grimaldi Group company

Flexbaltic – Flexible winter navigation in the Baltic Sea

Challenge

- **The icebreaker fleet both in Finland and in Sweden is coming to its renewal stage**
- Climate change affects the future ice conditions in the Baltic Sea
- The tightening energy efficiency targets and other environmental requirements affect the future merchant fleet
  - Energy efficiency demands from EEDI
    - Reduced combustion engine power in merchant vessels
  - IMO's emission reduction policies
    - Zero emission technologies
- The ice breaking assistance need is changing in the future
- The new ice breaker fleet must be able to operate also in the summer period to enhance income for the investment

Benefit, market potential, and international business

- Cost efficient management of winter navigation assistance increase the competence of the overall Finnish economy
- New icebreaker concepts can also be built for export
  - Co-operation in technology development with Swedish authorities increase attraction of Finnish solutions when Sweden decides its icebreaker fleet renewal
- The technology developed for the multipurpose icebreakers can be utilized in polar icebreakers
- The new technological innovations developed for icebreakers can also be utilized for merchant vessels
- In addition to ship yards, ship design, and system and component manufacturing are expected to benefit from the project results

Solution

- Envisioning future scenarios and facing practical needs for winter navigation in the Baltic Sea
  - foreseeing future ice conditions and predicting trade trends in waterborne transportation
  - updating ice operation capabilities of merchant vessels
  - current icebreaking fleet will be updated and optimized to fulfill the future service needs
  - Technological gaps will be identified to enable an efficient and safe winter navigation policy
- Achieving an efficient and flexible service for winter navigation assistance
  - Further developing the system for icebreaker coordination
  - Developing the icebreaker cooperation between Finland, Sweden, Russia and Estonia
  - Evaluating the future need for ice breaker assistance
  - Developing new ways to more accurately predict the ice conditions
- New tools will be developed for designing new icebreaker concept
  - Hull and propulsion opitimization
    - Combined CFD and ice models
    - Underwater noise prediction methods
  - Use of batteries, fuel cells, wind energy, etc. instead of fossil fuels
  - Route optimization in winter navigation

Low-emission Arctic expedition cruise liner

Project idea

3.6.2019

Jaakko Heinonen, Tuomas Sipilä

Target

- To create innovations for arctic cruise liners
  - CO2 emission reduction 70% compared to level of 2010
  - Black carbon reduction to zero
  - Implementing the circular economy concept
  - To ensure safe and competitiveness cruising
- Keep Finland as a forerunner in cruiser markets and enable new cruiser orders to Finland
- Enable technology export regarding products and services

Main tasks

Ice-CFD modelling

Improving the energy-efficiency

- Propulsion effeciency
- Ice performance vs safe operations

Emission reduction

- Alternative fuels
- Electrification / hybrid solutions
- Utilization of waste energy
- Route optimization

Defining required support services

- Bunkering of fuels
- Data connections
- Waste management
- Charging of batteries
- Hydrogen production with renewables and delivery

Development of eco-friendly ship concept

- Arctic cruise liner pilot with energy-efficient ship hull design
- Safety, tourism, data collection and utilization
- Safe-return-to-port

Safe operations in the Arctic

Noise modelling

Consortium

- So far:
  - Elomatic Oy
  - Helsinki Shipyard Oy (Arctech)
  - ABB Marine and Ports
  - EVAC Oy
  - VTT
- Ongoing discussions with
  - DNV-GL
  - Ship owners

1. INTRO
2. SOLUTION
3. PARTNERS
4. BUDGET
5. MARKET POTENTIAL

1. Intro

- Practically all the cruise ships face stability problems durign their life cycle.
- The stability margins are getting smaller and each dry-docking adds weight especially on the upper decks.
- Added weight means weaker stability and more fuel consumption.

2. Solution

- We need to put emphasis on finding light, durable and ecological materials and solutions which can reduce the overall weight of a cruise ship.
- The easiest way is to find effective solutions in a cabin since the volume is always large.
- The same solutions should be used in newbuilding projects and public spaces.

3. Partners

- Existing marine material suppliers
- Material suppliers outside the industry
- Shipyards
- TurnKey-suppliers
- Naval architects and designers
- Universities / Colleges
- Research Insititutes (VTT)
- Business Finland

4. Project Budget

- 1 MEUR, 2 years

5. Market potential for Finnish companies

- Hundreds of millions

MAKINEN

Norsepower Rotor Sails

Introduction

Auxiliary Wind Propulsion

- Depending on wind conditions up to 50% of service power is replaced with wind propulsion
  → HYBRID system
  - Average savings depend on configuration and on the wind conditions of the route / route area
- Norsepower's technology is well suited to:
  - Tankers
  - Bulk cargo vessels
  - Ro-Ro, Ropax, Ferries, Short Route Ferries
  - Cruise ships
- Compatible with all other ways to save fuel

Future concepts with Rotor Sails

Rolls-Royce, Autonomous bulker (Naples Sept. 2018)

Benefits for wind propulsion:

- Optimized hull form to improve wind flow
- Autonomous operation with 100% system integration
- No superstructures to disturb the wind flow
- No crew on board means no visibility limitations
- Low free board causes less flow disturbance
- Slow steaming

Norsepower Oy Ltd

Jarkko Väinämö

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HELSINGIN KAUPPAKORKEAKOULU
HELSINKI SCHOOL OF ECONOMICS

Smart Mobility -haastekilpailun työpaja 3.6.2019 VTT

Itämeren kaasumarkkina – mikä on kansallinen innovaatiostrategia

Professori (emeritus) Arto Lahti
Aalto Yliopisto

Arto Lahti

- Professor Arto Lahti, Aalto University is a man of action, worked in practice e.g. in Kone and The Federation of Finnish Technology Industries, and been a presidential candidate for Finland.
- He has been a board member in 30 SMEs and a specialist for e.g. Ministry of Finance, Council of Nordic Governments, and tens of cities; for OKO Bank, Electrolux and TeliaSonera; and for 300 growth firms in 10 EU-nations.
- He has written 103 books of e.g. IO, strategic marketing, growth firms, globalization, public governance, and firm valuation.
- He has been chairman for Finland's Federation of Scholarly Association of Management and for many others.
- The book just published:
- Innovation competition in global markets and Schumpeter's entrepreneur, LAP LAMBERT Academic Publishing GmbH & Co.
- German Hidden Champions: The EU's best option in global B2B markets!, LAP LAMBERT Academic Publishing GmbH & Co.

Globalisaatio ei ole lopullinen olotila vaan prosessi, jonka alkuna pidetään löytöretkiä.

- **Globalisaatio on prosessi**. Mikään maa ei voi lyödä rajoja kiinni. Talous, liberalismi ja demokratia nivoutuvat yhteen. Mittakaavaetu on Yhdysvaltojen ja Kiinan talouden voima. Suomen etu voi olla vain joustavat pienen mittakaavan ratkaisut.
- **Kasvavan epävarmuus** haastaa talouden tasapainon ja teoriat.
  Galbraith, John Kenneth (1977) The Age of Uncertainty, Boston: Houghton Mifflin.
- Yrityksen menestyksen avain on **kokonaistehokkuus (MFP = Multi Factor Productivity)** ja jatkuva parantaminen (re-engineering), jolloin tuote ja prosessit uudistuvat pienin askelin.
- Suomi on eräs maailman energiaintensiivisimpiä maita (per capita
- Suomen energiamix uudistuu kohti kestävän kehityksen mallia. On tärkeä myös etsiä MFP-kasvua myös fossiilisten primäärienergian lähteiden uudelleenarvioinnilla. Maakaasu voi tarjota monia etuja, joita ei ole riittävästi otettu huomioon.

By 2030, the EU will depend on imports of natural gas to meet 86% of demand

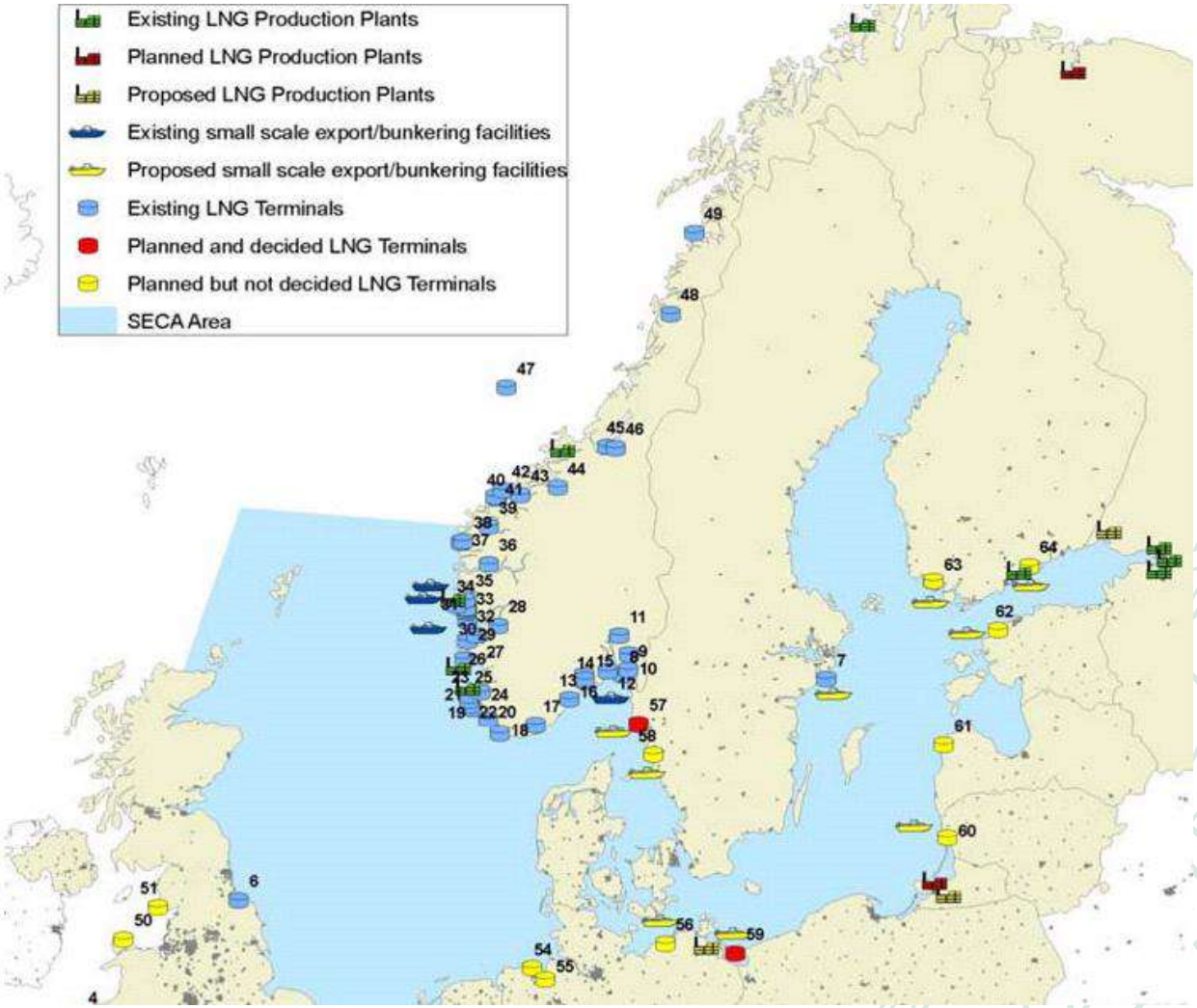
- Worldwide the reserves-to-production ratio of gas is estimated at 65 years. The leading regions in the ratio are: Middle East 100 years, Africa 88 years, Russia 80 years, and Central and South America 52 years.
- Russia owns 27.2% of the world's gas reserves. The major part of gas is located in the Middle East (Iran 15.8%, Qatar 14.7%, Saudi Arabia 3.9%, United Arab Emirates 3.5%, Iraq 1.8%, and Kuwait 0.9%) 40% of the total.
- Consumption of natural gas worldwide will increase 63% until 2030. Gas consumption in Asia expands rapidly. Until 2030 the EU will almost totally downsize its own natural gas production (conventional production).

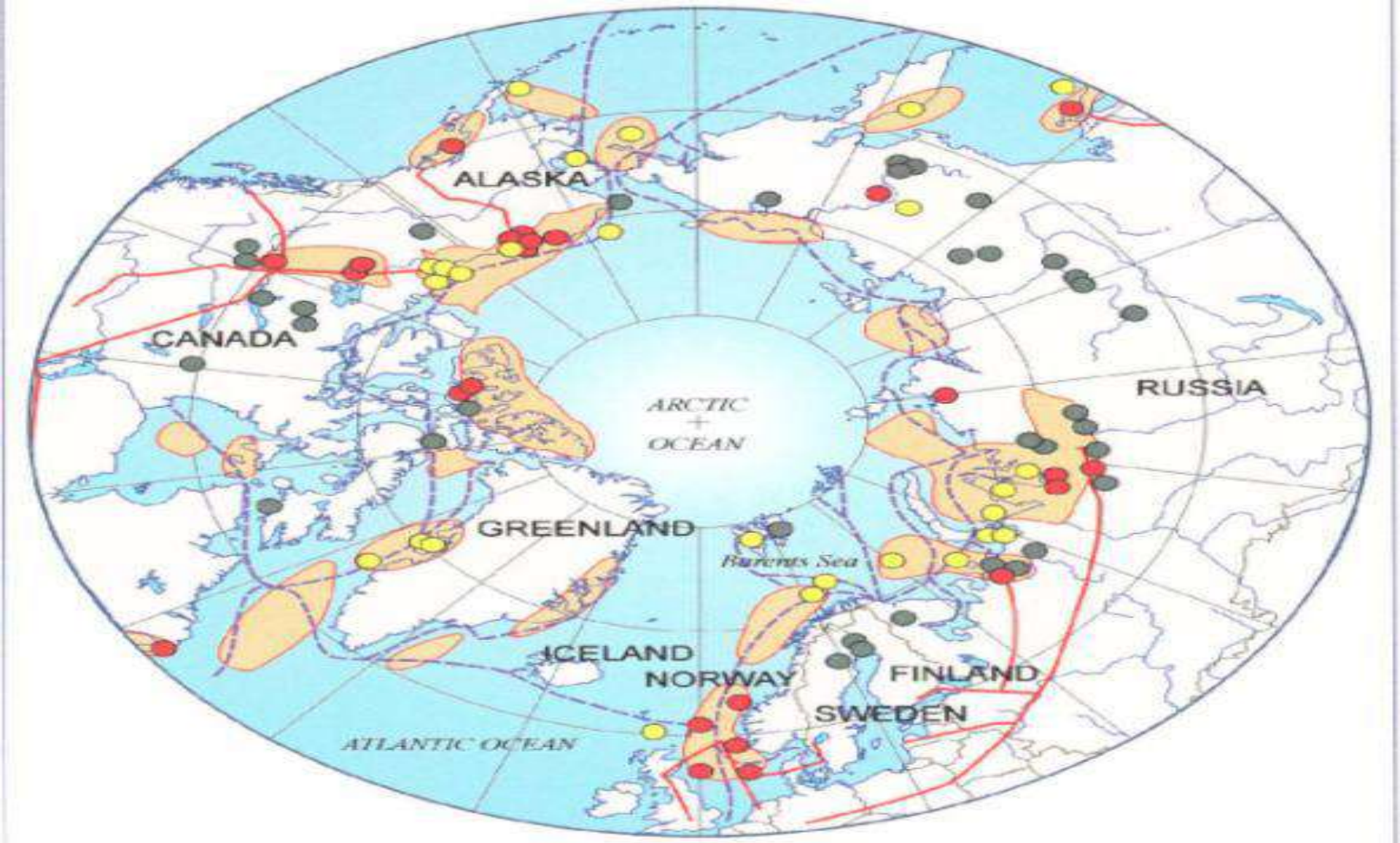
Natural gas as the fuel (LNG) is the best substitute for coal in the OECD Europe

- According to the IEO, the industrial sector will account for 43% of world natural gas consumption in 2030. With world oil prices remaining high, natural gas (LNG) is projected to displace liquids in the industrial sector. Natural-gas-fired generation is less carbon-intensive and more cost-competitive than oil- or coal-fired generation of electricity.
- The OECD Europe is projected to rely increasingly on imports to meet natural gas demand, with a growing percentage of traded natural gas coming in the form of LNG. Growth in natural gas use for power generation accounts for the majority of total incremental gas use to 2030.
- In China and India, natural gas is a minor fuel in the overall energy mix. The US is the large producer and consumer of natural gas. Natural gas consumption in Asia expands.

Baltic LNG Infra

Existing LNG Infrastructure




ALASKA
CANADA
ARCTIC
OCEAN
RUSSIA
GREENLAND
Barents Sea
ICELAND
NORWAY
FINLAND
SWEDEN
ATLANTIC OCEAN
Oil and gas production
Oil and gas exploration
Mining activities
Oil and gas prospectiveareas
Possible Sea transport routes
Oil and gas pipelines
Source: Arctic Flora and Fauna
improved by Wärtsilä
WÄRTSILÄ
14.01.02

We know the Extreme

Team Arctic Finland 2019-2021 – strategic sales and R&D project support

Anu Vaahtera, anu.vaahtera@gaia.fi, +358 50 563 0326
Gaia Consulting Oy

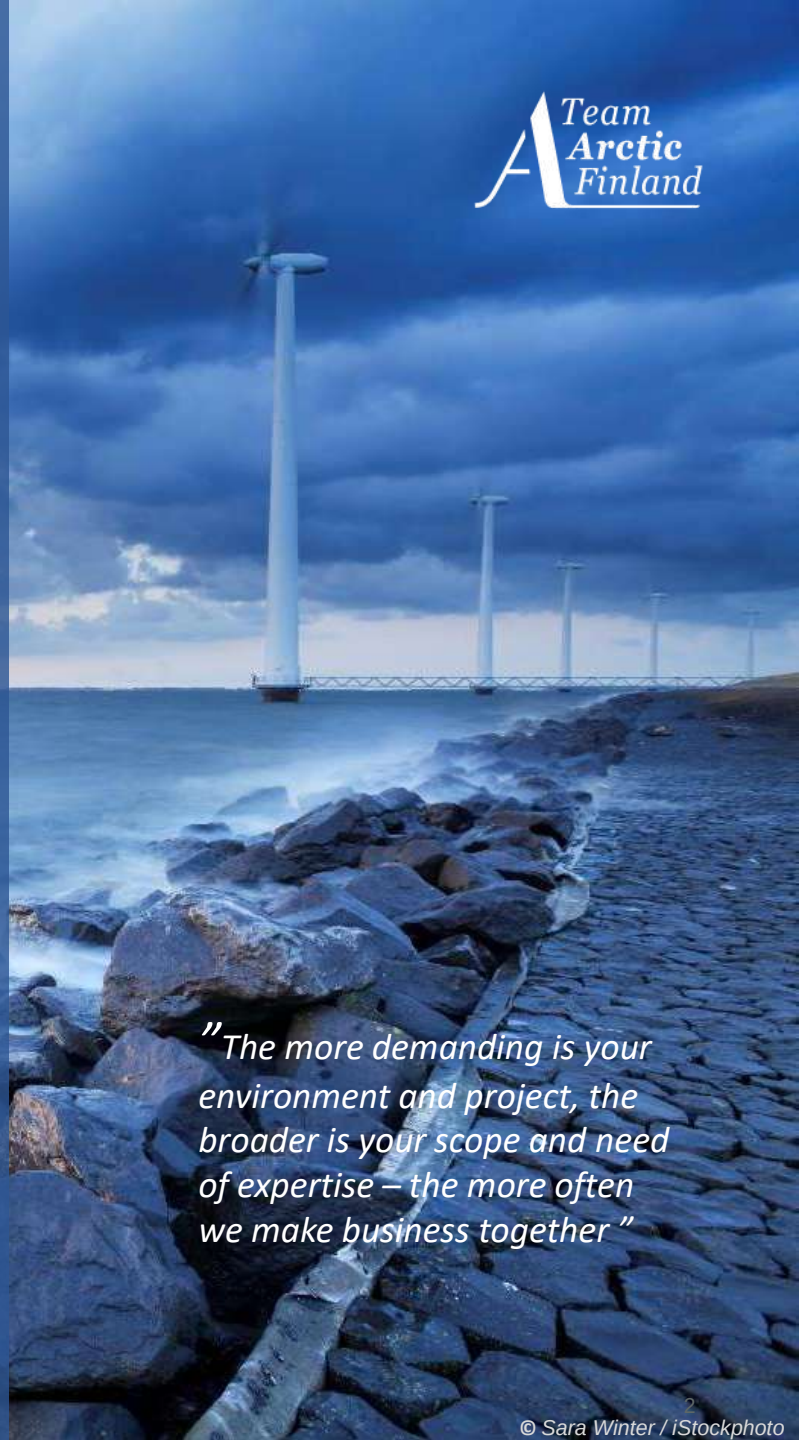
June 3rd, 2019

Team Arctic Finland

We know the arctic and much more

Strong experience of extreme environments brought organizations together to establish the unique Team Arctic Finland.

Team Arctic Finland has been **cooperating together since 2013** and has ever since strengthened the role of the Finnish companies as well as the Team Arctic Finland brand on **markets that have an arctic connection.**



Team Arctic Finland in 2017-2019

The brand is strong and the continuation of the brand has been encouraged by Business Finland

During 2017-2019 the project generated ~40 customer leads…

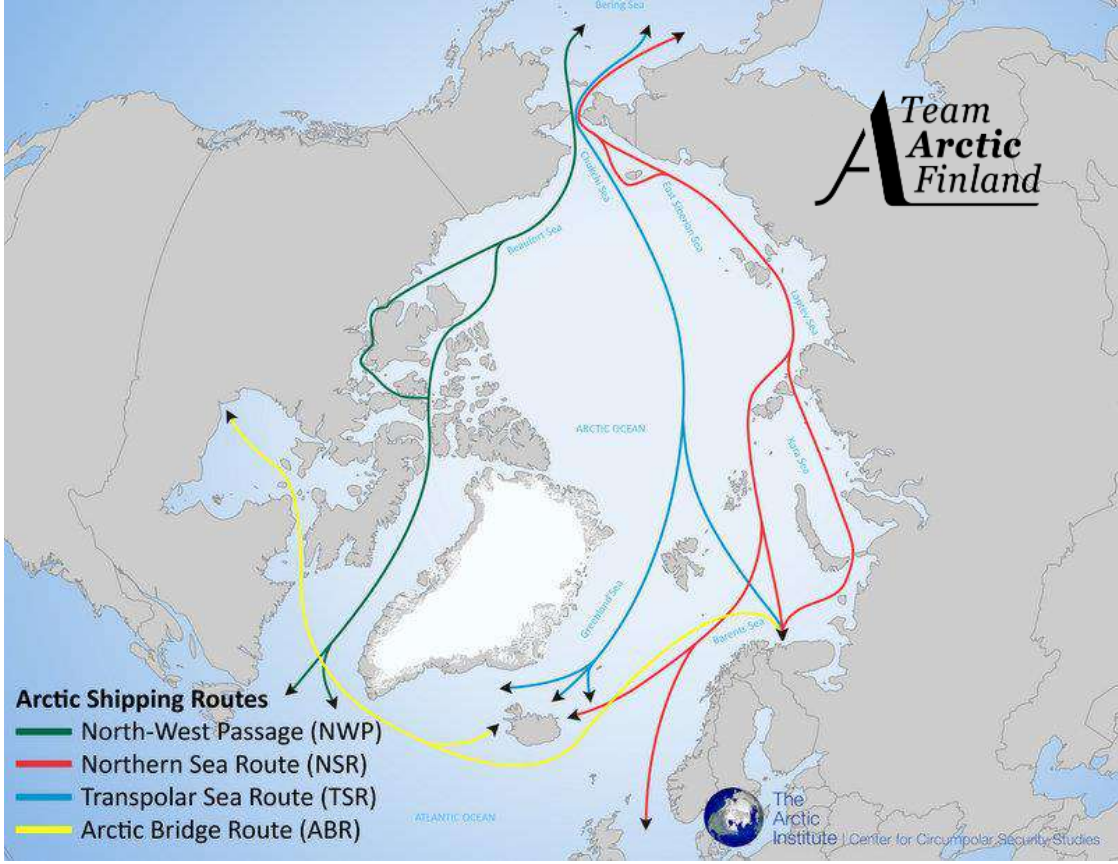
… good results but the breakthrough innovations are still behind the corner!

Team Arctic Finland mission for 2019-2021

Follow-up of operations and projects in the Northern sea routes and the infrastructure (logistics, terminals, ports)

Main customer segments are energy, mining and logistics

The project destinations have a connection to Northern sea routes but may not be directly in the Arctic



Target customers with active contacting	Sales meetings	Draft proposals	Proposals to boost innovations (co-creation)
22	**12**	**8**	**4**

Team Arctic Finland

Project Promise

Contacts to major global customers

Proposals to boost innovations (co-creation)

Market Intelligence

Promotion materials (i.e. website, video, presentation)

Access to the widely known Team Arctic Finland brand

Directed by the TAF Steering Group

Team Arctic Finland

Newcomers welcome !

Newcomers possible with significant brand impact in relation to the business concepts and acceptance by the Steering Group

Requirements: references, synergies and international credibility

gaia

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Zero-emission Arctic Operations Ecosystem

3.6.2019

Jaakko Heinonen, Tuomas Sipilä

Zero-emission Arctic operations innovation ecosystem

Vision: Zero-emission solutions for safe arctic operations by 2030

- Proposal to Business Finland's Smart Mobility research program

Arctic operations innovation ecosystem

The ecosystem creates a network of industry and research parties as well as stakeholders to develop solutions for

- energy-efficient and eco-friendly ships,
- Arctic smart shipping,
- maritime infrastructures and
- offshore solutions in cold regions.

The proposed ecosystem aims to increase the competiveness and export volume of the Finnish maritime industry in arctic technologies and services

- Estimated Arctic business potential regarding 15 year investment needs globally add up to a market of $1tn

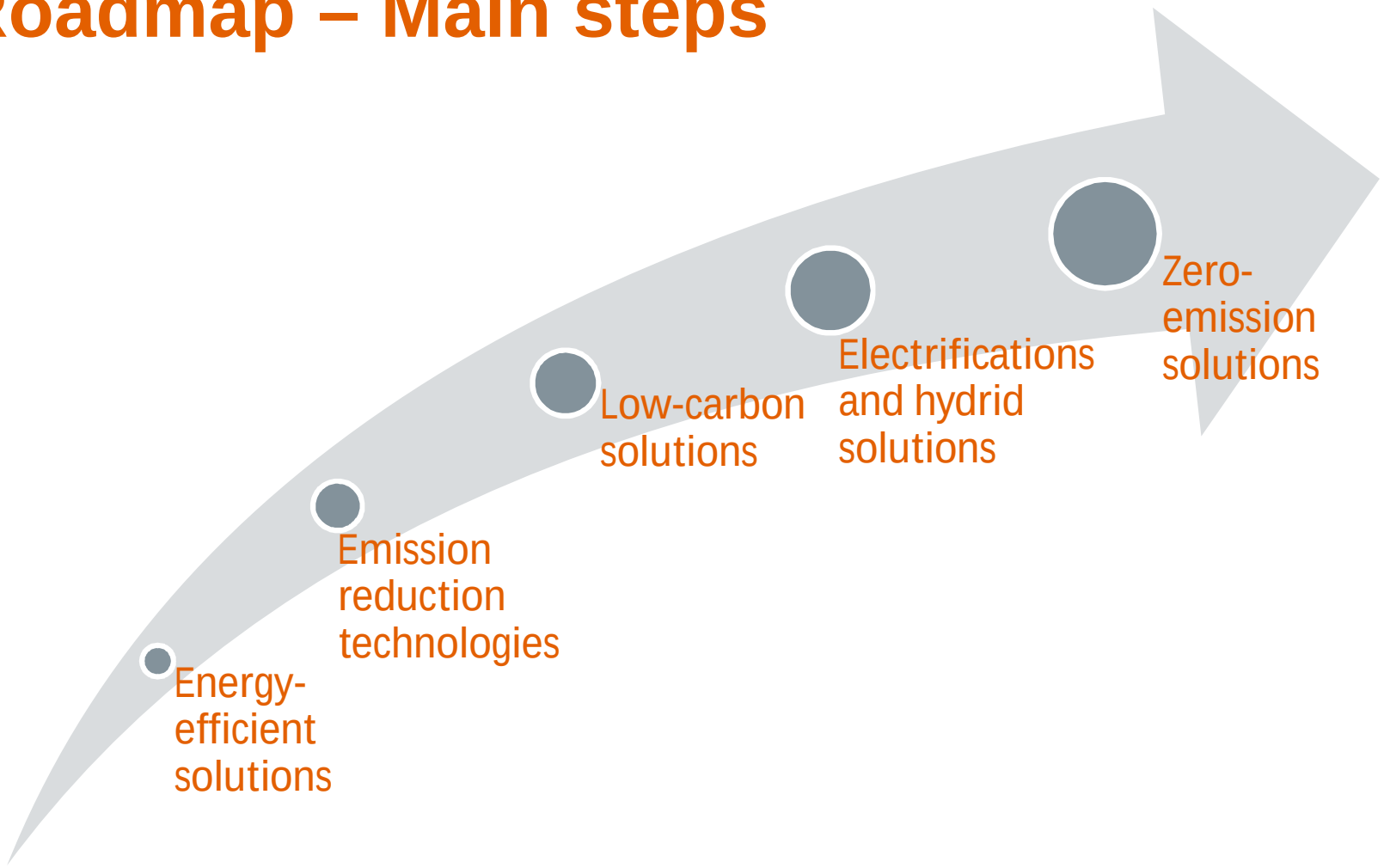
Background:

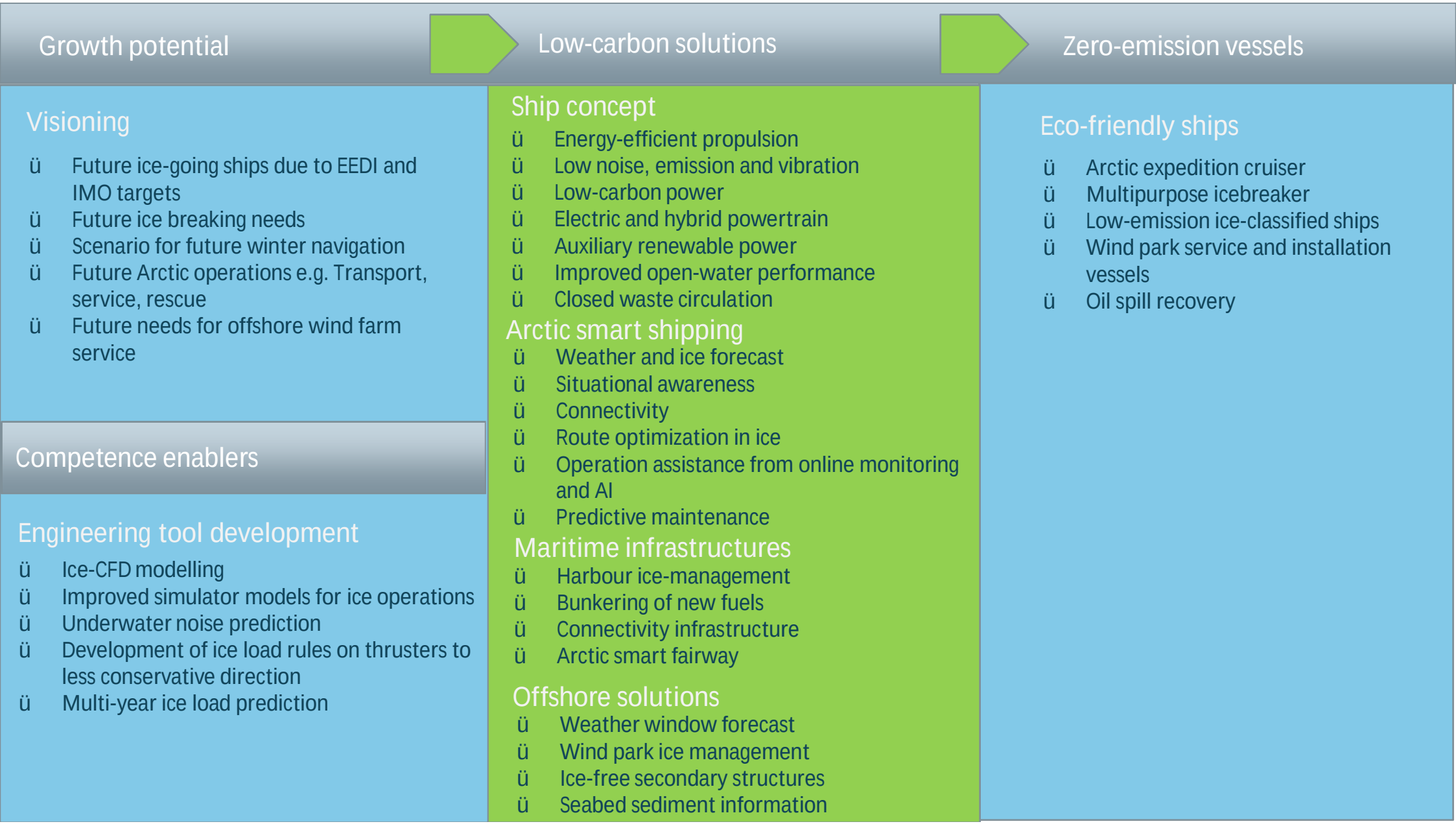
Main drivers to decarbonise maritime transport

- the Paris Agreement requires net zero emissions by the middle of the century
- IMO's strategy to reduce the total annual GHG emissions by at least 50% by 2050 compared to 2008
  - 40% reduction of carbon at 2030 and 70% at 2050, when comparing to the level of 2008
  - Reduction of carbon intensity by tightening the EEDI regulations
  - Aim for zero-emission solutions as soon as possible during the century
- The EU has agreed to cut its greenhouse gas (GHG) emissions by at least 80-95% by 2050
- Climate policy will require a shift away from petroleum

Reference: CNG and LNG for vehicles and ships - the facts

Roadmap – Main steps

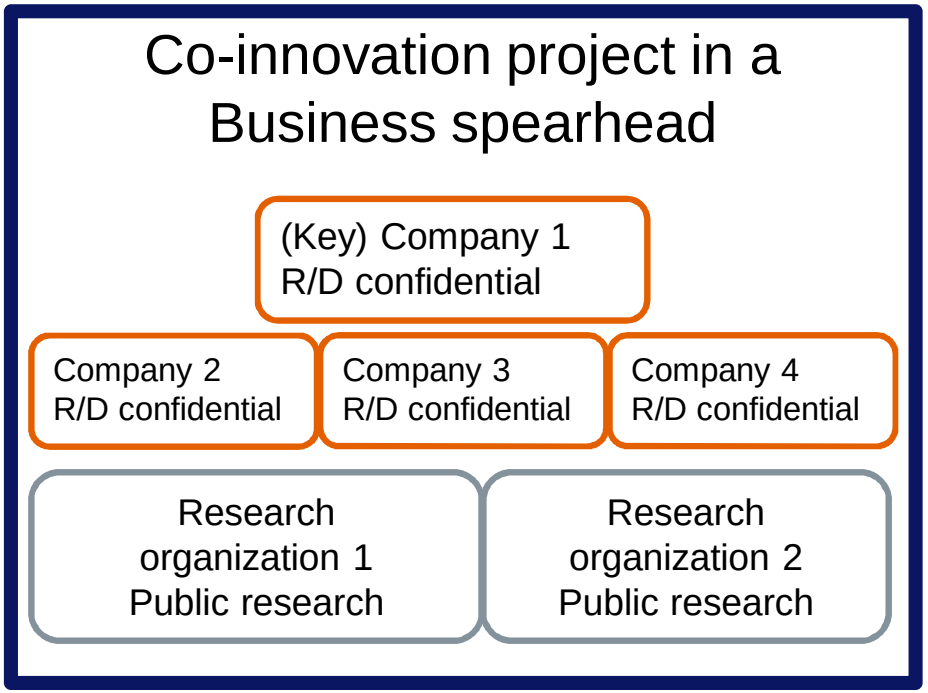



Growth potential
Low-carbon solutions
Zero-emission vessels
Visioning
ü Future ice-going ships due to EEDI and IMO targets
ü Future ice breaking needs
ü Scenario for future winter navigation
ü Future Arctic operations e.g. Transport, service, rescue
ü Future needs for offshore wind farm service
Competence enablers
Engineering tool development
ü Ice-CFD modelling
ü Improved simulator models for ice operations
ü Underwater noise prediction
ü Development of ice load rules on thrusters to less conservative direction
ü Multi-year ice load prediction
Ship concept
ü Energy-efficient propulsion
ü Low noise, emission and vibration
ü Low-carbon power
ü Electric and hybrid powertrain
ü Auxiliary renewable power
ü Improved open-water performance
ü Closed waste circulation
Arctic smart shipping
ü Weather and ice forecast
ü Situational awareness
ü Connectivity
ü Route optimization in ice
ü Operation assistance from online monitoring and AI
ü Predictive maintenance
Maritime infrastructures
ü Harbour ice-management
ü Bunkering of new fuels
ü Connectivity infrastructure
ü Arctic smart fairway
Offshore solutions
ü Weather window forecast
ü Wind park ice management
ü Ice-free secondary structures
ü Seabed sediment information
Eco-friendly ships
ü Arctic expedition cruiser
ü Multipurpose icebreaker
ü Low-emission ice-classified ships
ü Wind park service and installation vessels
ü Oil spill recovery


Business visions and roadmap
Business and technology enablers
Arctic Operations Ecosystem
Exploring R&D needs for new business opportunities
Support companies for new co-operation activities, pilots etc.
Networking and information exchange
Business spearhead 1:
Co-innovation project 1
Co-innovation project 2
Business spearhead 2:
Co-innovation project 1
Co-innovation project 2
Co-innovation project 3
Business spearhead 3
Co-innovation project 1
Co-innovation project 2
Business spearhead 4
Co-innovation project 1

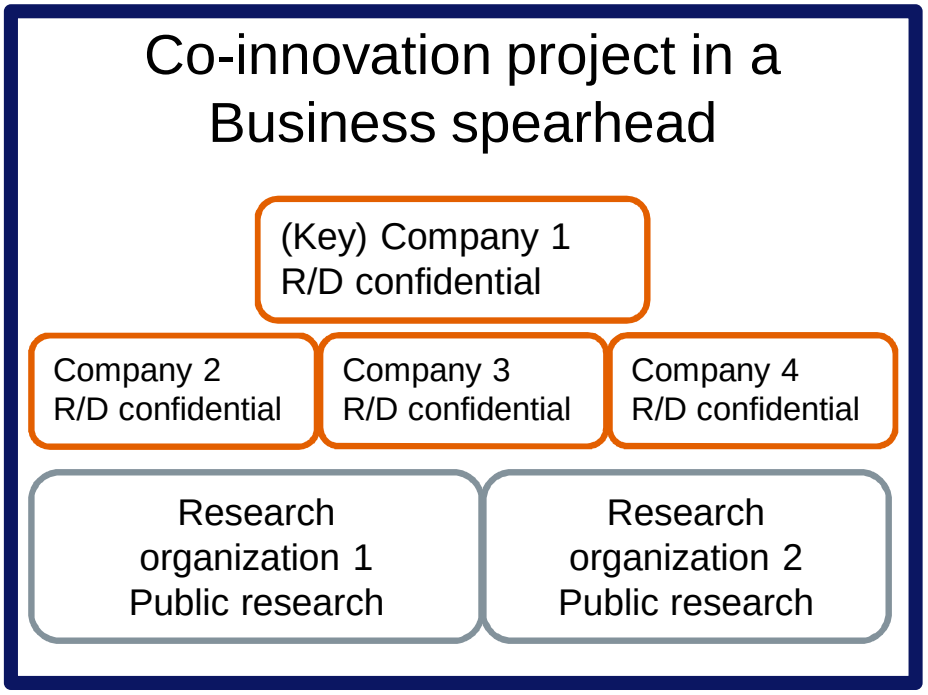
Co-innovation projects

- Develop technologies/services to fill gaps in the business spearhead
- At least three companies
  - Company R/D projects are confidential
- Research projects are public
- Strong co-operation between the companies and research organizations
  - Research will support the company R/D projects
- Funding applications can refer to ecosystem and business spearhead

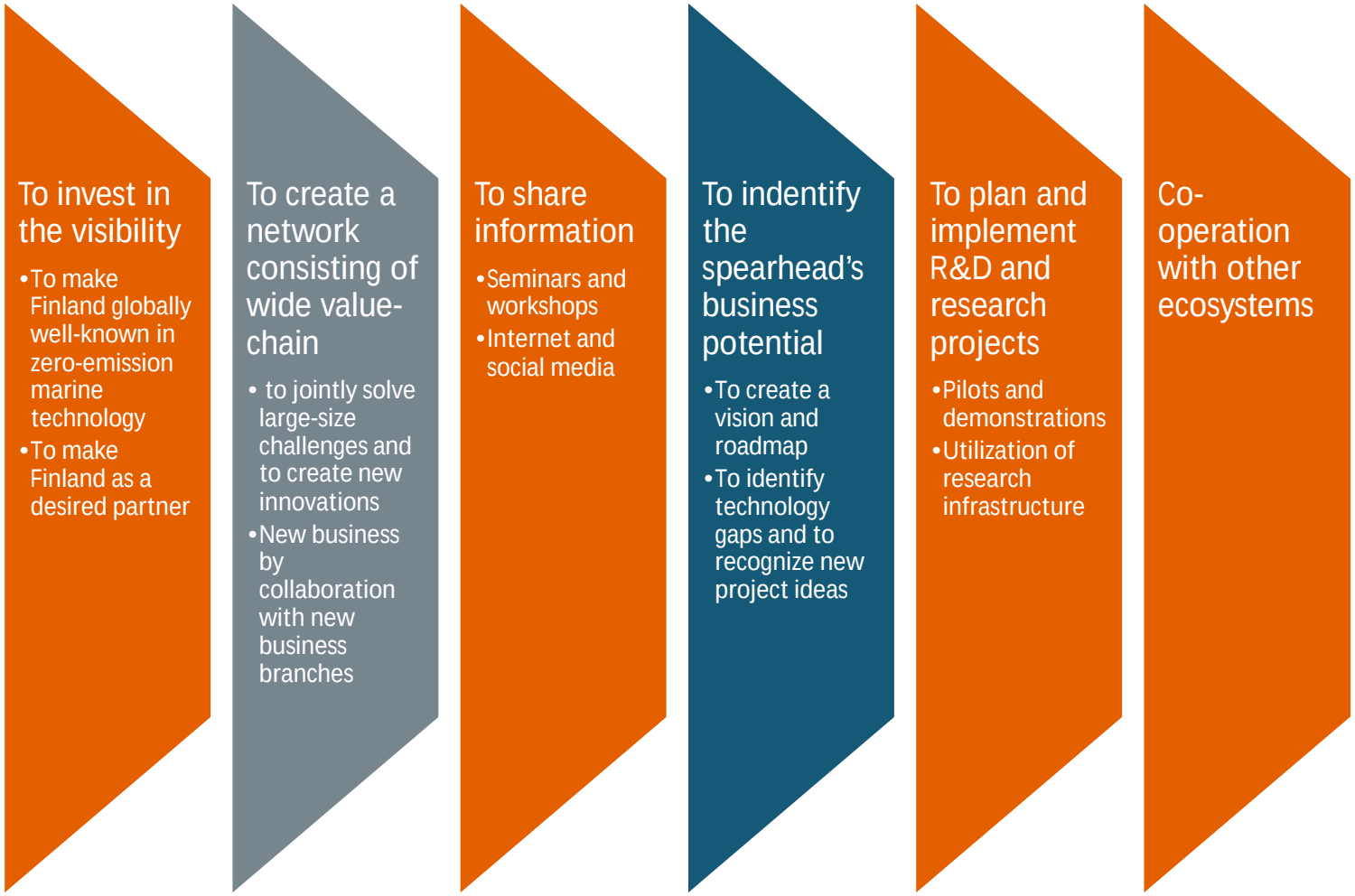


Example of Co-innovation budget

- Total budget 1 M€, duration 2 years
- Companies 500 k€
  - 4 companies, e.g. each 125 k€
  - Business Finland supports:
    - big company max 40%
    - Midcap max 40%
    - Small max 50%
- Public research max 500 k€
  - Collective company funding min 10%



Ecosystem tasks and benefits



Steering board tasks

- Member companies and research parties
  - Consortium agreement
- Meetings twice per year
- Approval the projects to be included in the ecosystem
  - Target setting, including international collaboration
  - Evaluation of the results
- Advisory board
  - Authorities
  - Experts (national and globally important persons)