Deployment ideation card

A. Operation

i Innovation potential

si Sustainable innovation potential

water transit element (within operation)	water transit element description	innovation triggers (insipiration)	challenges (potential systemic implications)
A1 Asset management	Activities and capabilities related to management of assets (i.e. ships) that are needed for passenger transport, including quality protection, care, finding applications, and end-of-life handling	i **Enabled self-repair service** — potential business model innovation si Closed loop through validation in various stages and channels — potential sustainable business model innovation si Asset and system design for return to manufacturer — potential sustainable business model innovation si Integrated impact assessment processes — potential sustainable business model innovation	Opting for low-cost repair and maintenance services can compromise vessel quality and shorten its lifespan — sustainability challenge Limited technological readiness among operators for handling advanced assets may hinder their ability to self-repair ships — system challenge Designing assets for various applications is at the cost of current operation optimization — sustainability challenge
A2 Maritime limitations	External conditions and maritime region specific implications that require adaptations in operational profile		Adapting the operation to specific maritime conditions reduces potential for reuse of system elements — sustainability challenge
A3 Operating costs	The cost structure related to operations, including but not limited to fuel and energy consumption, service, maintenance, asset downtime, penalties, labor and crew training	i User manuals and mandatory training included in cost price — potential business model innovation i Reduced labor costs through operation automation — potential business model innovation si Retained asset ownership to ensure quality maintenance — potential sustainable business model innovation	Operating costs may include penalties from the client (tender publisher) and depreciation without revenue during maintenance — financial challenge
A4 Passenger experience	The experience of water transit in terms of passenger satisfaction metrics such as comfort and safety	i Extra charge for clean and comfortable travel modes — potential business model innovation si Extra charge for sustainable travel modes — potential sustainable business model innovation	For linear routes (several stops along an urban waterfront) vessel speed is highly competitive — system challenge City-extended trans-river routes (from suburbs to urban area) yield low passenger volumes and require peak hour operations — system challenge
A5 Route design and scheduling	Three types of ferry routes: **linear**: multiple destinations along waterfront, zigzag or one-sided, **cross-river**: short distance crossing from one waterfront to the opposite side, **city-extended trans-river:** long distance connection between remote areas, and scheduling implications such as mooring time, demand, travel time and integration with alternative transportation planning	i Interior (re)design based on route type and travel-time spent — potential business model innovation i Scheduling based on inter-modal public transport planning — potential business model innovation i Cross-river routes to allow high frequency transport service — potential business model innovation	
A6 Charging system	The location and ease of connection of charging stations, charging time of the vessels and distance flexibility		Charging stations and necessary charging time reduces scheduling and distance flexibility — system challenge

Deployment interaction card

A. Operation

water transit element (within operation)	interacting elements (to consider)	interaction description
A1 Asset management	A3 C4 D2 D3	A1-A3: Design for modularity can facilitate retained asset ownership across various applications A1-C4: Creating technology readiness through training and ease of repair is part of asset management A1-D2: Management of the asset is either transferred or retained post-tender which influences buy-back or residual value A1-D3: The application of R-strategies depends on how the asset is managed and handled at end-of-life
A2 Maritime limitations	A4 F3	A2-A4: Passenger safety and comfort depend on external conditions and adaptation to them A2-F3: Maximizing safety and security of the water transit system requires consideration of various maritime conditions
A3 Operating costs	B B4 C3 C5	A3-B: Financial solutions can be spread over operating periods, which lowers operator capital investment but requires client funding to start-up the system A3-B4: Sustainability taxes and certification become more complex for electrified operations A3-C3: The level of system automation influences overall labor costs of the operation A3-C5: Electrifying vessels shifts the focus from manufacturing to operations, changing the fuel–energy balance and affecting operating costs
A4 Passenger experience	A2	A4-A2: Passenger safety and comfort depend on external conditions and adaptation to them
A5 Route design and scheduling	A6 B3 C1 E3 E4 F2	A5-B3: Ticket pricing may depend on how passengers use the transit system, which is influenced by route type and travel distance A5-A6: Charging time influences scheduling and connection to broader public transportation planning A5-C1 : The route type affects potential passenger numbers (**linear**: multiple destinations along waterfront, zigzag or one-sided, **cross-river**: short distance crossing from one waterfront to the opposite side, **city-extended trans-river:** long distance connection between remote areas) A5-E3: Terminal (re)location relies on the operation's route type (linear, cross-river, trans-river) A5-E4: Extending to new destinations affects route type and planning A5-F2: The extent of the ferry system's economic spill-over effects depends on how well the route design aligns with its objectives
A6 Charging system	A5 C1 E2	A6-A5: Charging time influences scheduling and connection to broader public transportation planning A6-C1: Charging stations and time affect potential passenger numbers in terms of location and connection flexibility A6-E2: Whether charging at the terminal is possible influences the shape of the overall charging system

Deployment ideation card

B. Financing

i Innovation potential

si Sustainable innovation potential

water transit element (within financing)	water transit element description	innovation triggers (insipiration)	challenges (potential systemic implications)
B1 Extended revenue stream	Any alternative revenue streams beyond ticket fares and client subsidies, such as combo tickets, bonuses, or retail income	i Commercial advertising on ship exterior — potential business model innovation	
B2 Supplier network	Suppliers involved across the entire system, including manufacturing, resource supply, maintenance, facilities, and other constructions	si Sustainability requirements for supplier partnerships — potential sustainable business model innovation si Facilitating and scaling the energy transition through suppliers — potential sustainable business model innovation	There are currently few sustainability-oriented suppliers and resource channels available — sustainability challenge
B3 Ticket fare	Price charged to passengers to access and use the water transit service	i Dynamic pricing — potential business model innovation	The client (i.e. Province) sets a pricing ceiling on public transportation to keep it affordable for the general public — financial challenge
B4 Legal implications	Certifications, regulatory requirements, compliance obligations, and taxes involved in the financing and deployment of a water transit system	si Unsustainable fuel tax inclusion in overall cost calculations — potential sustainable business model innovation	Acquiring green certification for specific system or asset elements may come at the expense of quality in other areas — sustainability challenge Since regulations are socially constructed, the sustainable transition they drive is inherently dependent on public opinion — sustainability challenge
B5 Evaluation metrics	Criteria for evaluation of partnerships and collaborations based on financial risk	i Standard financial maturity criteria to assess partnerships — potential business model innovation	

Deployment interaction card

B. Financing

water transit element (within financing)	interacting elements (to consider)	interaction description
B1 Extended revenue stream	D1	B1-D1: Extended revenue stream through long depreciation schedules for electric vessels
B2 Supplier network	B5 C5 D3 D5	B2-B5: The choice of supplier network may be influenced by partner evaluation metrics B2-C5: Fleet electrification requires transitioning to new supplier networks B2-D3: Integration of R-strategies involves assessment of sustainable practices across system components including supplier networks B2-D5: Integrating circular economy principles into the system requires supplier collaboration to enable scalability and reduce adoption barriers
B3 Ticket fare	A5 C1	B3-A5: Ticket pricing may depend on how passengers use the transit system, which is influenced by route type and travel distance B3-C1: Passenger numbers and their cultural implications could influence ticket pricing
B4 Legal implications	A3 C4 C5 F3	B4-A3: Sustainability taxes and certification become more complex for electrified operations B4-C4: To justify sustainability and market hybrid or electric vessels, green certification needs to be acquired B4-C5: Fleet electrification changes overall impact assessment, which influences how compliance with sustainability regulations is approached B4-F3: Compliance to maritime safety regulations contributes to system safety and security
B5 Evaluation metrics	B2	B5-B2: The choice of supplier network may be influenced by partner evaluation metrics

Deployment ideation card

C. Fleet

i Innovation potential

si Sustainable innovation potential

water transit element (within fleet)	water transit element description	innovation triggers (insipiration)	challenges (potential systemic implications)
C1 **Passenger numbers**	The patronage, or total number of passengers using the water transit service, potentially in comparison with alternative (competing) public transport modes		Creating space for bikes and battery systems in electric or hybrid vessels requires trade-offs in passenger capacity (financial challenge)
C2 **Expert availability**	Availability of expertise in specific innovation and sustainability areas, such as vessel electrification		Experts drive the energy transition through sustainable innovation, but they are scarcely available (sustainability challenge)
C3 **System automation**	Development of software and hardware to automate processes like fault detection and sailing operations across diverse maritime applications	i Lock on software settings to protect advanced systems (potential business model innovation) i Self-diagnosing systems to improve accessible vessel care (potential business model innovation)	Operation automation might limit future employment opportunities (sustainability challenge)
C4 **Vessel design**	All aspects related to design processes and outcomes in vessel development, such as emissions, crew ease of handling, modularity, electrification, interior/exterior design and engine design	i Ship design aimed at uncomplicated operation (potential business model innovation) si Modular ship design to support multiple and varying tenders (potential sustainable business model innovation) si Ship design for multicultural market acceptance (potential sustainable business model innovation)	
C5 **Electrification**	The process of partially or fully electrifying the fleet and its operating system		Electrifying ships makes it more challenging to assess the full environmental impact over the product lifecycle (sustainability challenge) Creating an electric fleet carries the risk of redundant asset production to compensate for vessel charging times (sustainability challenge)

Deployment interaction card

C. Fleet

water transit element (within fleet)	interacting elements (to consider)	interaction description
C1 **Passenger numbers**	A5 A6 B3 E1 E5	C1-A5: The route type affects potential passenger numbers (**linear**: multiple destinations along waterfront, zigzag or one-sided, **cross-river**: short distance crossing from one waterfront to the opposite side, **city-extended trans-river:** long distance connection between remote areas) C1-A6: Charging stations and time affect potential passenger numbers in terms of location and connection flexibility C1-B3: Passenger numbers and their cultural implications could influence ticket pricing C1-C4: Including a battery system in the vessel design, interacts with passenger numbers because of space, weight and speed limitations C1-E1: Terminal design may influence time spent at the terminal and in turn passenger numbers C1-E5: Terminal marketing influences outreach to passengers
C2 **Expert availability**	C4	C2-C4: An innovative mindset and presence of expertise on the client-side influence how vessels are designed
C3 **System automation**	A3 F1 F3	C3-A3: The level of system automation influences overall labor costs of the operation C3-F1: The level of system automation affects required crew size and skill level C3-F3: Automation of (part of) the system can contribute to maximizing transit safety and security
C4 **Vessel design**	A1 B4 C1 C2 C5 D2 D4 D5 E1 E3 F3	C4-A1: Creating technology readiness through training and ease of repair is part of asset management C4-B4: To justify sustainability and market hybrid or electric vessels, green certification needs to be acquired C4-C1: Including a battery system in the vessel design, interacts with passenger numbers because of space, weight and speed limitations C4-C2: An innovative mindset and presence of expertise on the client-side influence how vessels are designed C4-C5: Electrifying the fleet requires vessel innovation C4-D2: The extent to which ferries can be used for other maritime regions influences their post-tender value C4-D4: Vessel design can facilitate use across various tender types C4-D5: Integrating circular economy principles interacts with the sustainability of vessel design processes C4-E1: Vessel design and capabilities affect the terminal's docking requirements C4-E3: Vessel operational capabilities influence terminal (re)location options and decisions C4-F3: Design decisions may influence safety and security during transit or unexpected situations
C5 **Electrification**	A3 B4 C4 D1 D4 E3	C5-A3: Electrifying vessels shifts the focus from manufacturing to operations, changing the fuel–energy balance and affecting operating costs C5-B4: Fleet electrification changes overall impact assessment, which influences how compliance with sustainability regulations is approached C5-C4: Electrifying the fleet requires vessel innovation C5-D4: First-adopter risk and accessibility can be more prominent in *green* tenders C5-D1: Extended revenue stream through long depreciation schedules for electric vessels C5-E3: The electrification of the system may impact terminal location and potentially require relocation to optimize route efficiency and travel distances

Deployment ideation card

D. Tender

i Innovation potential

si Sustainable innovation potential

water transit element (within tender)	water transit element description	innovation triggers (insipiration)	challenges (potential systemic implications)
D1 Extended tender value	Added value that may be created, captured or delivered from extending the tender period	si: Longer tenders to reduce risk and extend revenue stream — potential sustainable business model innovation	Extending tender periods increases the likelihood that operators will postpone component replacement and maintenance — sustainability challenge
D2 Post-tender value	Added value that may be created, captured or delivered at the end of, or after the tender period	i: Retained ownership and buy-back programs — potential business model innovation si: Retained ownership for improved circularity and material reuse — potential sustainable business model innovation	Capturing residual asset value post-tender - through circular practices like reuse or recycling - relies on shifting vessel ownership — sustainability challenge
D3 R-strategy integration	Integration of an R-strategy into the system, prioritized as follows (from highest to lowest): refuse, reduce, reuse, repair, refurbish, remanufacture, and recycle	si: In-house processing facilities for returned vessels (lifetime extension) — potential sustainable business model innovation si: Design for disassembly (reduced waste stream) — potential sustainable business model innovation	Applying R-strategies to the system is reliant on key suppliers and channels, as well as available information and knowledge — sustainability challenge
D4 Tender type	Tender types can vary depending on factors such as maritime regions (e.g. distance), political ambitions (e.g. green tenders), tender publisher (e.g. commercial or public) or climate conditions	i: Ferries for seagoing and long-distance — potential business model innovation si: Green fleet containing 90% electric, 10% hybrid/diesel vessels — potential sustainable business model innovation	Electrifying operations yields high client costs with low proof-of-concept, and no directly identifiable economic benefits — sustainability challenge
D5 Circular economy integration	Integration of circular economy principles such as reduced consumption and waste, longer product lifespans, product reuse, renewable energy consumption, and sustainable material use into the tender and deployment process	si: Functionality sales instead of asset sales — potential sustainable business model innovation	

Deployment interaction card

D. Tender

water transit element (within tender)	interacting elements (to consider)	interaction description
D1 Extended tender value	B B1 C5 E4	D1-B: The tender period influences the extent of financial risk D1-B1: Extended revenue stream through long depreciation schedules for electric vessels D1-C5: Extended revenue stream through long depreciation schedules for electric vessels D1-E4: The inclusion of partner collaborations for extended destinations influences the extent of value derived from extending the tender
D2 Post-tender value	A1 D3 C3 F4	D2-A1: Management of the asset is either transferred or retained post-tender which influences buy-back or residual value D2-D3: The asset's post-tender value influences the extent to which R-strategies, such as refurbishment or repurposing, can be integrated D2-C4: The extent to which ferries can be used for other maritime regions influences their post-tender value D2-F4: The extent to which ferries can be used for other applications, such as freight transport, influences their post-tender value
D3 R-strategy integration	A1 D2 B2	D3-A1: The application of R-strategies depends on how the asset is managed and handled at end-of-life D3-D2: The asset's post-tender value influences the extent to which R-strategies, such as refurbishment or repurposing, can be integrated D3-B2: Integration of R-strategies involves assessment of sustainable practices across system components including supplier networks
D4 Tender type	C4 C5 E1	D4-C4:Vessel design can facilitate use across various tender types D4-C5: First-adopter risk and accessibility can be more prominent in *green* tenders D4-E1: Terminal design is influenced by external factors, including the maritime region
D5 Circular economy integration	B2 C4 F1	D5-B2: Integrating circular economy principles into the system requires supplier collaboration to enable scalability and reduce adoption barriers D5-C4: Integrating circular economy principles interacts with the sustainability of vessel design processes D5-F1: Social demand for zero-emission systems and affordable green transport can drive circular economy integration

Area development ideation card

E. Terminal

i Innovation potential

si Sustainable innovation potential

water transit element (within terminal)	water transit element description	innovation triggers (insipiration)	challenges (potential systemic implications)
E1 Terminal design	The shape of the terminal in terms of its water, ship, and land-side connections, along with its facilities and visual design	i Integrated retail offer to extend revenue streams to terminal — potential business model innovation	The municipality, which has a limited budget, owns the terminals and is therefore responsible for their design and development — sustainability challenge
E2 Terminal charging	Charging facilities at the terminal, how they are shaped and their implications for the fleet or the system overall	si Matched mooring time with charging time (i.e. Copenhagen ferries) — potential sustainable business model innovation	Connecting remote inhabitants is limited by maritime and charging challenges because terminal distances increase — social challenge Green energy is not universally or constantly available — sustainability challenge
E3 Terminal (re)location	The geographical location of the terminals, and/or their potential relocation to facilitate route changes	i Advisory group partnerships to realize terminal (re)locations — potential business model innovation	Habitual use patterns of water transit users hinder terminal relocation — social challenge The municipality owns the terminals but has a limited budget and unclear or complex responsibility for terminal (re)location — financial challenge
E4 Extended destinations	Alternative transit system destinations, such as cruise terminals or touristic sites, in addition to existing public transportation stops	i Collaboration with partners such as cruises and malls — potential business model innovation i Combo-tickets in partnership with touristic destinations — potential business model innovation	Extending water transit to touristic destinations, increases dependence on external factors and therefore ticket sales volatility — financial challenge
E5 Terminal marketing	Marketing of the water transit system at and around the terminals, as well as through additional channels such as television advertisements	i Increased marketing at terminal and brand presence — potential business model innovation	Who owns and carries financial responsibility terminal marketing can be ambiguous — system challenge

Area development interaction card

E. Terminal

water transit element (within terminal)	interacting elements (to consider)	interaction description
E1 Terminal design	C1 C4 D4 E4 F3	E1-C1: Terminal design may influence time spent at the terminal and in turn passenger numbers E1-C4: Vessel design and capabilities affect the terminal's docking requirements E1- D4: Terminal design is influenced by external factors, including the maritime region E1-E4: References to extended destinations may be included into the visual design of the terminal E1-F3: Terminal adjustments can be made to fit the operational profile of the fleet and facilitate safe mooring
E2 Terminal charging	A6	E2-A6: Whether charging at the terminal is possible influences the shape of the overall charging system
E3 Terminal (re)location	A5 C4 C5 F2	E3-A5: Terminal (re)location relies on the operation's route type (linear, cross-river, trans-river) E3-C4: Vessel operational capabilities influence terminal (re)location options and decisions E3-C5: The electrification of the system may impact terminal location and potentially require relocation to optimize route efficiency and travel distances E3-F2: Whether the terminal is directly connected to bike routes and other public transportation modes depends on the terminal locations
E4 Extended destinations	A5 D1 E1 F2	E4-A5: Extending to new destinations affects route type and planning E4-D1: The inclusion of partner collaborations for extended destinations influences the extent of value derived from extending the tender E4-E1: References to extended destinations may be included into the visual design of the terminal E4-F2: Extended destinations may pose opportunities for the water transit system to yield economic spill-over effects
E5 Terminal marketing	C1 F1 F2	E5-C1: Terminal marketing influences outreach to passengers E5-F1: Stakeholder initiatives and use implications may influence terminal marketing choices E5-F2: Highlighting intended or existing modal integration and spill-over effects at the terminal can enhance their effectiveness

Area development ideation card

F. Waterway & Waterfront

i Innovation potential

si Sustainable innovation potential

water transit element (within terminal)	water transit element description	innovation triggers (insipiration)	challenges (potential systemic implications)
F1 **Stakeholder use implications**	Consequences of stakeholder intentions for the water transit system, such as the pursuit of affordable, green public transportation or commercially oriented transit, and their associated use types, like operator technological knowledge		The Province, which aims to provide affordable public transport and can grant a waterway monopoly, has strong influence over ticket prices (financial challenge)
F2 **Last-mile modal integration and spill-over effects**	Integration of surface transportation modes with waterborne ones through (digital) accessibility and planning, with attention to the passenger experience in terms of last-mile connectivity and seamless transfers. Additionally, the water transit system can drive spill-over economic activity in nearby commercial areas through increased touristic appeal, residential, and real estate value.	i Partnerships with construction agencies to boost waterfront value (potential business model innovation) i Partners for inter-modal transport (e.g. e-bikes) (potential business model innovation)	
F3 **Safety and security**	Facilities, knowledge acquisition, design processes and other considerations aimed at ensuring maximum safety and security of the water transit system	i Provided training and information for safe crew operation (potential business model innovation)	Operators' lack of knowledge about hybrid or electric vessel technology can pose risks to operational safety (system challenge)
F4 **Ferries for freight**	Relieve of urban congestion by supporting fast delivery of high-value and time sensitive goods with the existing water transit system, for example, from and to business districts	i Freight transportation as an extra service and revenue stream (potential business model innovation)	

Area development interaction card

F. Waterway & Waterfront

water transit element (within terminal)	interacting elements (to consider)	interaction description
F1 **Stakeholder use implications**	C3 D5 E5	F1-C3: The level of system automation affects required operating crew size and skill level F1-D5: Social demand for zero-emission systems and affordable green transport can drive circular economy integration F1-E5: Stakeholder initiatives and use implications may influence terminal marketing choices
F2 **Last-mile modal integration and spill-over effects**	A5 E3 E4 E5	F2-A5: The extent of the ferry system's economic spill-over effects depends on how well the route design aligns with its objectives F2-E3: Whether the terminal is directly connected to bike routes and other public transportation modes depends on the terminal locations F2-E4: Extended destinations may pose opportunities for the water transit system to yield economic spill-over effects F2-E5: Highlighting intended or existing modal integration and spill-over effects at the terminal can enhance their effectiveness
F3 **Safety and security**	A2 B4 C3 C4 E1	F3-A2: Maximizing safety and security of the water transit system requires consideration of various maritime conditions F3-B4: Compliance to maritime safety regulations contributes to system safety and security F3-C3: Automation of (part of) the system can contribute to maximizing transit safety and security F3-C4: Design decisions may influence safety and security during transit or unexpected situations F3-E1: Terminal adjustments can be made to fit the operational profile of the fleet and facilitate safe mooring
F4 **Ferries for freight**	D2	F4-D2: The extent to which ferries can be used for other applications, such as freight transport, influences their post-tender value