Maritime Innovation Networks

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Maritime Innovation Networks

Zoran Perunović
Mads Christoffersen
Sofia Fürstenberg

Need for collaboration for innovation

About the study

Grant
• Danish Maritime Foundation

Team
• DTU Executive School of Business
• Maersk Maritime Technology

Duration
• Two years

Method
• Exploratory qualitative multiple-case study

Data
• Interviews with more than 100 key informants at 40 maritime organizations
• Analysis of numerous internal company materials, industry reports, publicly available reports about more than 30 innovation networks
• Articles from newspapers and magazines
• Extensive literature review of more than 50 academic journal articles

Turbulent environment for innovation

Market
• Discrepancy between the dynamics of the global trade and the shipping industry
• Trade specialization of ships
• Unpredictable fuel prices
• Efficiency of the existing fleet (Buy or retrofit decision)

Regulations
• Enforcement dates
• Variations in regulations in different regions and countries
• Lack of compliance control

Technology
• Customized solutions for retrofit projects due to the fleet variety
• Myriad of unproven technologies and suppliers
• Contradictory solutions
• Incompatible and uncomplementary technologies
• Scalability of technologies for large capacities
### Stakeholders and innovation

<table>
<thead>
<tr>
<th>Regulators</th>
<th>Drive innovation</th>
<th>Focused on profit and vessel's liquidity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>National could hinder innovation</td>
<td>Indifferent towards innovation</td>
</tr>
<tr>
<td>Classification societies</td>
<td>Repository of knowledge</td>
<td>Insurers</td>
</tr>
<tr>
<td></td>
<td>Promote innovation</td>
<td>New instruments to calculate risk of novel technologies</td>
</tr>
<tr>
<td></td>
<td>Initiate and moderate innovation networks</td>
<td></td>
</tr>
<tr>
<td>Owners, charterers, and operators</td>
<td>Drive innovation</td>
<td>Ports</td>
</tr>
<tr>
<td></td>
<td>Large - internal R&amp;D capability</td>
<td>Service providers embrace process and technological innovations to improve efficiency</td>
</tr>
<tr>
<td></td>
<td>Small – open for innovation networks</td>
<td>Port authorities embrace innovation to create attractive conditions for users and service providers</td>
</tr>
<tr>
<td></td>
<td>Other should innovate</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment testing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>First mover concern</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Performance improvement</td>
<td></td>
</tr>
<tr>
<td>Designers</td>
<td>Design to satisfy multiple physical, regulatory, and economical requirements</td>
<td>Universities and institutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cradle of knowledge and creativity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strong influence on innovation in industry</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Present in every innovation network</td>
</tr>
<tr>
<td>Equipment and technology suppliers</td>
<td>Strong R&amp;D, innovation, and networking capabilities</td>
<td>Industry associations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Promote and finance collaborative innovation activities</td>
</tr>
<tr>
<td>Shipyards</td>
<td>Contemporary model – design, engineer, and build vessels</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technology push, but opening for networked innovation strategies with early involvement of owners</td>
<td></td>
</tr>
</tbody>
</table>

### Six innovation networks

#### Centralized

**PUBLICLY FUNDED**

- Designed centralized

#### Triad

- Designed decentralized

#### Horizontal

- Emergent

#### Experts’ forum

- Informal
### Centralized

**Formation**
- Owner driven
  - Fast and affordable access to knowledge and technologies
  - Formed when needed
- Engine maker and shipyard driven
  - Access to new knowledge, technologies, and market segments
- Suppliers
  - Test technology, understand user's needs, get sales with large customer

**Management and organization**
- Formal agreements in exploration at engine maker and shipyard networks
- Informal agreements for scouting and testing and formal agreements for new builds in exploitation at owner driven network
- Strong ties between central organization and individual parts: Little or none formal relationships between the partners (structural holes)
- Ideas and needs shared with partners who are expected to come up with solutions
- R&D unit/entity is coordinator
- Engine maker and shipyard protects IPR through patenting. Owner protects IPR by being first on the market

**Evolution**
- Indirect measurement of success
- Objectives met in most cases
- Suppliers may delay the process because of lack of resources and uncertain sales
- Untapped potential of structural holes
- Networking capabilities not regarded as KPI

**Performance**
- Strong ties between central organization and individual parts. Little or none formal relationships between the partners (structural holes)
- Time limited
- Disband into dyads
- Networking capabilities not regarded as KPI

### Triad

**Formation**
- Emerge on recognized business opportunity
- Partners chosen on complementarity of competences
- Occasional satellite members
- Clear commercial interest from all partners

**Management and organization**
- Emergent, Formal, Exploit structural holes
- Exploration with fit for exploitation
- Easy to manage
- Governance based on openness, flat structure, and good relationship management
- Trust driven by network size, previous experiences and personal relations
- Equal distribution of knowledge and information

**Evolution**
- Time limited
- Allow flexibility for partners to establish new triads
- Can initiate new networks to add more competences

**Performance**
- Successful in achieving objectives
- Acknowledge learning as success criteria
### Publicly funded Formation

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Management and organization</th>
<th>Evolution</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public funds</td>
<td>Access public funding</td>
<td>Support development of solutions and industry’s innovation and networking capabilities</td>
<td>Predominantly incremental improvements or conceptual studies with occasional validation through testing</td>
</tr>
<tr>
<td>Top-down and bottom-up generation of topics</td>
<td>Relevance of topics depends on individuals</td>
<td>Complex and bureaucratic organization hinders innovation. Heavy management apparatus</td>
<td>Successful commercialization of network results is not captured and disseminated</td>
</tr>
<tr>
<td>Rules for formation in top-down could negatively affect enthusiasm</td>
<td>Natural stability is very sensitive to quality of governance and operational management</td>
<td>Designed are time limited</td>
<td>Universities benefit from academic publications</td>
</tr>
<tr>
<td>Negative effect of imposed collaboration</td>
<td>Designed are time limited</td>
<td>Emergent will continue if positive experience with results and management</td>
<td>No established measures to capture and follow improvement of members’ innovation and networking competences and capabilities and commercialization of solutions</td>
</tr>
</tbody>
</table>

### Horizontal Formations

<table>
<thead>
<tr>
<th>Formation</th>
<th>Management and organization</th>
<th>Evolution</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very rare and found in the development phase of innovation process</td>
<td>Decentralized with formal agreements</td>
<td>Positive experience spurs new projects and admission of new members.</td>
<td>Small improvements</td>
</tr>
<tr>
<td>Reasons</td>
<td>Simple and flat management structure due to small size</td>
<td>Small incremental steps increase trust and improve networking capabilities</td>
<td>Main achievement is that competitors learn to work with each other</td>
</tr>
<tr>
<td>Pulling joint experience, effort, and resources to make business case for everyone, to build networking capability, and inability to develop environmental solutions alone. Primarily focused on shared learning about operational experience.</td>
<td>Each member involved in project management, participation in projects, and decision making</td>
<td>Top management and work groups jointly make decisions about strategic development of network</td>
<td></td>
</tr>
<tr>
<td>Prevention of opportunistic behavior</td>
<td>Efficient knowledge flow due to short distances between the nodes and teams</td>
<td>Efficient knowledge flow due to short distances between the nodes and teams</td>
<td></td>
</tr>
<tr>
<td>Classification society initiates formation and manages the network</td>
<td>Members with different market specializations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fully committed top management</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Experts’ forum

<table>
<thead>
<tr>
<th>Formations</th>
<th>Management and organization</th>
<th>Evolution</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Founder</td>
<td>Closed, designed, and decentralized</td>
<td>Experts are organized within working groups</td>
<td>Permanent network with temporary groups and members</td>
</tr>
<tr>
<td>Expert</td>
<td>Governing body sets topics</td>
<td>Knowledge sharing intensive within groups. Information sharing in joint meetings. Little or no formal relationships between working groups (structural holes)</td>
<td>Power of single member rooted in technical competency</td>
</tr>
<tr>
<td>Participating organization</td>
<td></td>
<td></td>
<td>Influence on formation on innovation projects in industry not captured</td>
</tr>
</tbody>
</table>

**Informal**

<table>
<thead>
<tr>
<th>Formations</th>
<th>Management and organization</th>
<th>Evolution</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based on initiatives-developed from personal relationships</td>
<td>Decentralized</td>
<td>Successful to get to formal collaboration in exploitation</td>
<td>Result in commercial projects</td>
</tr>
<tr>
<td>Partners chosen on technical competences, prestige, expected quality of contribution and added value</td>
<td>Different stakeholders</td>
<td></td>
<td>Deep insight in short time frames</td>
</tr>
<tr>
<td>No contract involved. Trust is guarded and publicly funded behavior prohibited by personal relationships and accepted norms of behavior</td>
<td>Informal because too much bureaucracy can hinder innovation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mutual benefit for all members is expected</td>
<td>Light management and strong governance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Utilization of maritime innovation networks

Uncertainty

<table>
<thead>
<tr>
<th>Low</th>
<th>TECHNOLOGICAL UNCERTAINTY</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>MARKET UNCERTAINTY</td>
<td>High</td>
</tr>
<tr>
<td>High</td>
<td>REGULATORY UNCERTAINTY</td>
<td>Low</td>
</tr>
</tbody>
</table>

Networking activity

Utilization of maritime innovation networks

Innovativeness

<table>
<thead>
<tr>
<th>NEW Partners</th>
<th>Incremental</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Connect for breakthroughs</td>
</tr>
<tr>
<td></td>
<td>Centralized</td>
</tr>
<tr>
<td></td>
<td>Publicly funded</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>OLD Partners</th>
<th>Incremental</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rejuvenate for breakthrough</td>
</tr>
<tr>
<td></td>
<td>Triad</td>
</tr>
<tr>
<td></td>
<td>Horizontal</td>
</tr>
<tr>
<td></td>
<td>Informal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YES</th>
<th>Structural holes</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO</td>
<td></td>
</tr>
</tbody>
</table>
Utilization of maritime innovation networks

Innovation process

Connectivity between different types of maritime innovation networks

- Centralized (Engine maker)
- Centralized (Shipyard)
- Centralized (Owner)
- Publicly funded (Designed)
- Publicly funded (Emergent)
- Triad
- Horizontal
- Expert forum

Exploration

- Closed and controlled environments
- Partner selection relies on existing ties and the social capital's mechanisms

Development

- Advanced collaborative and final-user driven forms emerge to qualify promising technology

Exploitation

- Advanced collaborative networks disband
- Industry closes up again

Utilization of maritime innovation networks

Stakeholder participation

<table>
<thead>
<tr>
<th>Stakeholder category</th>
<th>Centralized</th>
<th>Triad</th>
<th>Publicly funded</th>
<th>Horizontal</th>
<th>Expert forum</th>
<th>Informal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulators</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Classification society</td>
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<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Owners, charterers, operators</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Designers</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Equipment and technology suppliers</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Shipyards</td>
<td>●</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Financiers</td>
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<td>●</td>
<td>●</td>
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<td>Insurers</td>
<td>●</td>
<td></td>
<td>●</td>
<td>●</td>
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<td>●</td>
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<tr>
<td>Ports</td>
<td>●</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Universities and institutes</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Industry associations</td>
<td>●</td>
<td></td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
</tbody>
</table>
Utilization of maritime innovation networks

**Result**

Innovation networks are relatively new concepts to the industry

Significant innovation-related networking activity despite perceptions about the industry

Formed predominantly as reaction to regulations

Pursuit of incremental innovation

Dominance of closed networks

Abundance of structural holes in networks and work packages

Underrepresented stakeholders

Lack of understanding of values and risks of different types of innovation networks

Different facets of performance of are undermined

Underdeveloped innovation capability on organizational level

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Utilization of maritime innovation networks

**Performance**

- Performance = Network dynamics + Member dynamics

- Network dynamics = f[design (social capital, structural holes, knowledge flow) + management (leverage, appropriability, coherence)]

- Member dynamics = f(top management governance, open organizational culture, networking capabilities, innovation capability, absorptive capacity)
Unleashing the potential or maritime innovation networks (1/3)

- **Understand benefits and risks of innovation in networks**
- **Use networks to create standards and influence regulations**
  - Create early
  - Use horizontal, experts’ forums, and emergent publicly funded
- **More breakthroughs**
  - Open and decentralized networks in exploration
  - New partners from maritime and other industries
  - Improved connectivity between members and work packages

Unleashing the potential or maritime innovation networks (2/3)

**Enhance holistic and life-cycle approaches**
- Activate broad set of stakeholders to capture the needs of the entire value chain
- Involve customers of centralized networks early in the process

**New measurement system for capturing value**
- **At network level** (Technology readiness maturation index, Number of patents, Objective achievement, Knowledge receiving/giving ratio, Commercialization probability, Actual commercialization (could be several years after disbanding of network), Number of successor and partnership networks created)
- **At organizational level** (Technology readiness maturation index, Knowledge receiving/giving ratio, New ideas gained/internalized ratio, Number of patents, Commercialization probability, Number of new contacts established (customers, complementary stakeholders, competitors)
Unleashing the potential or maritime innovation networks (3/3)

GOOD INNOVATION NETWORK MANAGEMENT PRACTICE
Respect, learning, trust, transparency, efficient R&D and communications

EACH NETWORK MEMBER

GOVERNANCE
- Strategy
- Planning
- Policy
- Staffing
- Controlling/monitoring
- Monitoring partner and activities

NETWORKING COMPETENCIES AND CAPABILITIES
- Structured within whole organization

OPERATIONAL MANAGEMENT
- Development
- Idea enrichment
- Marketing
- Transfer of results to non-core processes

Activities
- Innovation promotion
- Knowledge flows
- Network identity
- Appropriability

INNOVATION LEADERSHIP
- Lead integration
- Integration coordinator

LEAD INNOVATION - ENABLED CONTROL POSITION

TOP MANAGEMENT
- Builds innovation and networking capabilities
- Internal to external innovation

OPEN INNOVATION
- Attaching patients
- Flow of innovation
- Interaction