Maritime Innovation Networks

Perunovic, Zoran; Christoffersen, Mads ; Fürstenberg, Sofia

Publication date:
2015

Document Version
Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Citation (APA):
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
• Mærsk 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 uncomplementery technologies
• Scalability of technologies for large capacities
Stakeholders and innovation

<table>
<thead>
<tr>
<th>Regulators</th>
<th>Drive innovation</th>
<th>National could hinder innovation</th>
<th>Financiers</th>
<th>Focused on profit and vessel’s liquidity</th>
<th>Indifferent towards innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Classification</td>
<td>Repository of knowledge</td>
<td>Promote innovation</td>
<td>Initiate and moderate innovation networks</td>
<td>Insurers</td>
<td>Novelty accepted if coming from respectful owner and shipyard with good historical operational record</td>
</tr>
<tr>
<td>societies</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Owners, charters,</td>
<td>Drive innovation</td>
<td>Large - internal R&amp;D capability</td>
<td>Small – open for innovation networks</td>
<td>Ports</td>
<td>Service providers embrace process and technological innovations to improve efficiency</td>
</tr>
<tr>
<td>and operators</td>
<td></td>
<td>Other should innovate</td>
<td>Equipment testing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Performance improvement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Designers</td>
<td>Design to satisfy</td>
<td>multiple physical, regulatory,</td>
<td>and economical requirements</td>
<td>Universities</td>
<td>Cradle of knowledge and creativity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and economical requirements</td>
<td></td>
<td>institutes</td>
<td></td>
</tr>
<tr>
<td>Equipment and</td>
<td>Strong R&amp;D, innovation, and networking capabilities</td>
<td>Industry associations</td>
<td></td>
<td>Promote and finance collaborative innovation activities</td>
<td></td>
</tr>
<tr>
<td>technology</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>suppliers</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shipyards</td>
<td>Contemporary model – design, engineer, and build vessels</td>
<td>Technology push, but opening for networked innovation strategies with early involvement of owners</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Six innovation networks

- **Centralized**
- **Triad**
- **Horizontal**

**PUBLICLY FUNDED**

- Designed centralized
- Designed decentralized
- 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 customers.

**Management and organization**
- Formal agreements in exploration at engine maker and shipyard driven 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 partner; 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**
- Engine maker and shipyard driven: Long term; Growing in number of partners.
- Owner: Time limited; Disband into dyads.

**Performance**
- 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.

---

**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.

---

**Diagram**

- Centralized
- Triad
Publicly funded

Formation

Management and organization

Evolution

Performance

Stakeholders
Access public funding

Public funds
Support development of solutions and industry’s innovation and networking capabilities.

Top-down and bottom-up generation of topics
Relevance of topics depends on individuals

Rules for formation in top-down could negatively affect enthusiasm

Negative effect of imposed collaboration

Three variants
Designed centralized, designed decentralized, and emergent

Designed types for exploration, Emergent types for development (more open)

Work-package driven

Complex and bureaucratic organization hinders innovation. Heavy management apparatus

Natural stability is very sensitive to quality of governance and operational management

Designed are time limited

Emergent will continue if positive experience with results and management

Partners from work packages may establish new exploitative networks

Predominantly incremental improvements or conceptual studies with occasional validation through testing

Successful commercialization of network results is not captured and disseminated

Universities benefit from academic publications

No established measures to capture and follow improvement of members’ innovation and networking competences and capabilities and commercialization of solutions

Horizontal

Formation

Management and organization

Evolution

Performance

Very rare and found in the development phase of innovation process

Reasons
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.

Prevention of opportunistic behavior
Classification society initiates formation and manages the network
Members with different market specializations

Fully committed top management

Decentralized with formal agreements

Simple and flat management structure due to small size

Each member involved in project management, participation in projects, and decision making

Top management and work groups jointly make decisions about strategic development of network

Efficient knowledge flow due to short distances between the nodes and teams

Positive experience spurs new projects and admission of new members.

Small incremental steps increase trust and improve networking capabilities

Small improvements

Main achievement is that competitors learn to work with each other
## Experts’ forum

<table>
<thead>
<tr>
<th>Formation</th>
<th>Management and organization</th>
<th>Evolution</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Founder</td>
<td>Seek for expert opinion and advice about regulation</td>
<td>Experts are organized within working groups</td>
<td>Permanent network with temporary groups and members</td>
</tr>
<tr>
<td>Expert</td>
<td>Recognition of personal achievements</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>
</tr>
<tr>
<td>Participating organization</td>
<td>Access to knowledge and influence on regulators</td>
<td>Power of single member rooted in technical competency</td>
<td>Influence on formation on innovation projects in industry not captured</td>
</tr>
</tbody>
</table>

Informal

<table>
<thead>
<tr>
<th>Formation</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>Light management and strong governance</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></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Utilization of maritime innovation networks

**Uncertainty**

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

**Networking activity**

Utilization of maritime innovation networks

**Innovativeness**

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

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural holes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NEW Partners</th>
<th>OLD Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incremental</td>
<td>Incremental</td>
</tr>
<tr>
<td>Pure incremental</td>
<td>Rejuvenate for breakthrough</td>
</tr>
<tr>
<td>Experts’ forum</td>
<td>Triad</td>
</tr>
<tr>
<td>Horizontal</td>
<td>Informal</td>
</tr>
</tbody>
</table>
Utilization of maritime innovation networks

Innovation process

- CENTRALIZED (Engine maker)
- EXPERT FORUM
- PUBLICLY FUNDED (Designed)
- TRIAD

Connectivity between different types of maritime innovation networks

- CENTRALIZED (Engine maker)
- HORIZONTAL
- PUBLICLY FUNDED (Designed)
- PUBLICLY FUNDED (Emergent)
- TRIAD

EXPLORATION

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

DEVELOPMENT

- Advanced collaborative networks disband

EXPLOITATION

- Industry closes up again

Stakeholder participation

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Centralized</th>
<th>Triad</th>
<th>Publicly funded</th>
<th>Horizontal</th>
<th>Experts’ 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>
<td>●</td>
<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>
</tr>
<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>
</tr>
<tr>
<td>Financiers</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Insurers</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<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.

---

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)