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 Promote innovation Initiate and moderate innovation networks</td>
<td>Insurers Novelty accepted if coming from respectful owner and shipyard with good historical operational record New instruments to calculate risk of novel technologies</td>
</tr>
<tr>
<td>Owners, charterers, and operators</td>
<td>Drive innovation Large - internal R&amp;D capability Small – open for innovation networks Other should innovate Equipment testing First mover concern Performance improvement</td>
<td>Ports Service providers embrace process and technological innovations to improve efficiency Port authorities embrace innovation to create attractive conditions for users and service providers Hinder innovation if do not monitor compliance with environmental regulations</td>
</tr>
<tr>
<td>Designers</td>
<td>Design to satisfy multiple physical, regulatory, and economical requirements</td>
<td>Universities and institutes Cradle of knowledge and creativity Strong influence on innovation in industry 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 Promote and finance collaborative innovation activities</td>
</tr>
<tr>
<td>Shipyards</td>
<td>Contemporary model – design, engineer, and build vessels Technology push, but opening for networked innovation strategies with early involvement of owners</td>
<td></td>
</tr>
</tbody>
</table>

### Six innovation networks

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

**PUBLICLY FUNDED**

- Designed centralized
- Designed decentralized
- Emergent
- Experts’ forum
- Informal
Formation | Management and organization | Evolution | Performance
---|---|---|---
User-driven
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

Centralized

User-driven
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

Engine maker and shipyard driven
Strong ties between central organization and individual partner. Little or none formal relationships between the partners (structural holes)

Suppliers
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

Indirect measurement of success

Engine maker and shipyard driven
Long term
Growing in number of partners

Owner
Time limited
Disband into dyads

Structural holes

Untapped potential of structural holes

Networking capabilities not regarded as KPI

Formation | Management and organization | Evolution | Performance
---|---|---|---
Emergent
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

Time limited

Allow flexibility for partners to establish new triads

Can initiate new networks to add more competences

Successful in achieving objectives

Acknowledging learning as success criteria

Triad

Formation | Management and organization | Evolution | Performance
---|---|---|---
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

Time limited

Allow flexibility for partners to establish new triads

Can initiate new networks to add more competences

Successful in achieving objectives

Acknowledging learning as success criteria
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

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

Horizontal
# Experts’ forum

<table>
<thead>
<tr>
<th>Formation</th>
<th>Management and organization</th>
<th>Evolution</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Founder</strong>&lt;br&gt;Seek for expert opinion and advice about regulation</td>
<td>Closed, designed, and decentralized&lt;br&gt;Experts are organized within working groups&lt;br&gt;Governing body sets topics&lt;br&gt;Knowledge sharing intensive within groups. Information sharing in joint meetings. Little or no formal relationships between working groups (structural holes)&lt;br&gt;Power of single member rooted in technical competency</td>
<td>Permanent network with temporary groups and members</td>
<td>Advise to regulators&lt;br&gt;Ideas and initiatives for formation of publicly funded networks&lt;br&gt;Influence on formation on innovation projects in industry not captured</td>
</tr>
<tr>
<td><strong>Expert</strong>&lt;br&gt;Recognition of personal achievements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Participating organization</strong>&lt;br&gt;Access to knowledge and influence on regulators</td>
<td></td>
<td></td>
<td></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&lt;br&gt;Partners chosen on technical competences, prestige, expected quality of contribution and added value&lt;br&gt;No contract involved. Trust is guarded and publicly funded behavior prohibited by personal relationships and accepted norms of behavior&lt;br&gt;Mutual benefit for all members is expected</td>
<td>Decentralized&lt;br&gt;Different stakeholders&lt;br&gt;Informal because too much bureaucracy can hinder innovation&lt;br&gt;Light management and strong governance</td>
<td>Successful to get to formal collaboration in exploitation</td>
<td>Result in commercial projects&lt;br&gt;Deep insight in short time frames</td>
</tr>
</tbody>
</table>

---
Utilization of maritime innovation networks

**Uncertainty**

Networking activity

<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>

**Innovativeness**

<table>
<thead>
<tr>
<th>NEW Partners</th>
<th>Incremental</th>
<th>Breakthrough</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Connect for breakthroughs</td>
<td>Triad</td>
</tr>
<tr>
<td></td>
<td>Centralized</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Publicly funded</td>
<td></td>
</tr>
<tr>
<td>OLD Partners</td>
<td>Pure incremental</td>
<td>Incremental for breakthrough</td>
</tr>
<tr>
<td></td>
<td>Experts’ forum</td>
<td>Triad</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Horizontal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Informal</td>
</tr>
<tr>
<td>YES</td>
<td>Structural holes</td>
<td></td>
</tr>
<tr>
<td>NO</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Utilization of maritime innovation networks

Innovation process

Connectivity between different types of maritime innovation networks

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

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

Advanced collaborative networks disband, industry closes up again

Utilization of maritime innovation networks

Stakeholder participation

<table>
<thead>
<tr>
<th></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)

Each network member:
- Governance
  - Strategic
  - Planning
  - Leadership
  - Staffing
  - Controlling/Accounting
- Networking competencies and capabilities
  - Embedded within whole organization
- Operational management
  - Innovation
  - Idea generation
  - Idea cultivation
  - Idea selection
  - Innovation implementation
- Activities
  - Innovation orientation
  - Knowledge flows
  - Network identity
  - Awareness

Focus on:
- Partner selection
  - Enabling control position
- Top management
  - Build innovation and networking capabilities
  - Avoid cycles of stagnation and innovation
- Open innovation
  - Attracting (having)
  - Flow of innovation

Lead organization:
- Integration coordinator

GOD INNOVATION NETWORK MANAGEMENT PRACTICE
- Respect,
- Trust,
- Openness,
- Transparency,
- Efficient R&D and communication.