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
- 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>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 societies</td>
<td>Repository of knowledge</td>
<td>Promote innovation</td>
<td>Insurers</td>
<td>Novelty accepted if coming from respectful owner and shipyard with good historical operational record</td>
<td>New instruments to calculate risk of novel technologies</td>
</tr>
<tr>
<td>Owners, charterers, and operators</td>
<td>Drive innovation</td>
<td>Large - internal R&amp;D capability</td>
<td>Ports</td>
<td>Service providers embrace process and technological innovations to improve efficiency</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>Equipment testing</td>
<td></td>
<td>Hinder innovation if do not monitor compliance with environmental regulations</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Performance improvement</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Designers</td>
<td>Design to satisfy multiple physical, regulatory, and economical requirements</td>
<td>Universities and institutes</td>
<td>Universities and institutes</td>
<td>Cradle of knowledge and creativity</td>
<td>Strong influence on innovation in industry</td>
</tr>
<tr>
<td>Equipment and technology suppliers</td>
<td>Strong R&amp;D, innovation, and networking capabilities</td>
<td>Industry associations</td>
<td>Industry associations</td>
<td>Promote and finance collaborative innovation activities</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

<table>
<thead>
<tr>
<th>Formation</th>
<th>Management and organization</th>
<th>Evolution</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner driven</td>
<td>Fast and affordable access to knowledge and technologies</td>
<td>Formed when needed</td>
<td>Indirect measurement of success</td>
</tr>
<tr>
<td>Owner driven</td>
<td>Strong ties between central organization and individual partner</td>
<td>Little or none formal relationships between the partners (structural holes)</td>
<td>Suppliers may delay the process because of lack of resources and uncertain sales</td>
</tr>
<tr>
<td>Supplier</td>
<td>Test technology, understand user's needs, get sales with large customer</td>
<td>Ideas and needs shared with partners who are expected to come up with solutions</td>
<td>R&amp;D unit/entity is coordinator</td>
</tr>
<tr>
<td>Supplier</td>
<td>Engine maker and shipyard protects IPR through patenting</td>
<td>Owner protects IPR by being first on the market</td>
<td></td>
</tr>
</tbody>
</table>

Triad

<table>
<thead>
<tr>
<th>Formation</th>
<th>Management and organization</th>
<th>Evolution</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergent, Formal, Exploit structural holes</td>
<td>Exploration with fit for exploitation</td>
<td>Time limited</td>
<td>Successful in achieving objectives</td>
</tr>
<tr>
<td>Partners chosen on complementarity of competences</td>
<td>Easy to manage</td>
<td>Allow flexibility for partners to establish new triads</td>
<td>Acknowledge learning as success criteria</td>
</tr>
<tr>
<td>Occasional satellite members</td>
<td>Governance based on openness, flat structure, and good relationship management</td>
<td>Can initiate new networks to add more competences</td>
<td></td>
</tr>
<tr>
<td>Clear commercial interest from all partners</td>
<td>Trust driven by network size, previous experiences, and personal relations</td>
<td>Equal distribution of knowledge and information</td>
<td></td>
</tr>
</tbody>
</table>

Knowledge sharing for innovation: Knowledge exchange is crucial for innovation and development within the network.
Publicly funded
Formation
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

Management and organization
Three variants
- Designed centralized, designed decentralized, and emergent
- Designed types for exploration, Emergent types for development
- Work-package driven
- Complex and bureaucratic organization hinders innovation. Heavy management apparatus
- Natural stability is very sensitive to quality of governance and operational management

Evolution
Designed are time limited
Emergent will continue if positive experience with results and management
Partners from work packages may establish new exploitative networks

Performance
Predominantly incremental improvements or conceptual studies with exceptional 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
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

Management and organization
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

Evolution
Positive experience spurs new projects and admission of new members.
Small incremental steps increase trust and improve networking capabilities

Performance
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>Closed, designed, and</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>decentralized</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expert</td>
<td>Experts are organized within working groups</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Governing body sets topics</td>
<td></td>
<td>Advising regulators</td>
</tr>
<tr>
<td></td>
<td>Knowledge sharing intensive within groups. Information sharing in joint meetings. Little or no formal relationships between working groups (structural holes)</td>
<td></td>
<td>Ideas and initiatives for formation of publicly funded networks</td>
</tr>
<tr>
<td></td>
<td>Power of single member rooted in technical competency</td>
<td></td>
<td>Influence on formation of innovation projects in industry not captured</td>
</tr>
</tbody>
</table>

Participating organization: Access to knowledge and influence on regulators

- **Formation:** Seek expert opinion and advice about regulation
- **Evolution:** Recognize personal achievements
- **Performance:** Advise to regulators

---

### Informal

<table>
<thead>
<tr>
<th>Formation</th>
<th>Management and organization</th>
<th>Evolution</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Decentralized</td>
<td></td>
<td>Result in commercial projects</td>
</tr>
<tr>
<td></td>
<td>Different stakeholders</td>
<td></td>
<td>Deep insight in short time frames</td>
</tr>
<tr>
<td></td>
<td>Informal because too much bureaucracy can hinder innovation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Light management and strong governance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Formation:** Based on initiatives developed from personal relationships
- **Evolution:** Successful to get to formal collaboration in exploitation
- **Performance:**
  - Result in commercial projects
  - Deep insight in short time frames

Participating organization: No contract involved. Trust is guarded and publicly funded behavior prohibited by personal relationships and accepted norms of behavior

- **Formation:** Mutual benefit for all members is expected
- **Evolution:**
  - Light management
  - Strong governance
- **Performance:**
  - Result in commercial projects
  - Deep insight in short time frames
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>

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>
<tr>
<td>OLD Partners</td>
<td>Pure incremental</td>
</tr>
<tr>
<td></td>
<td>Experts’ forum</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Breakthrough Triad</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incremental</td>
</tr>
<tr>
<td>Rejuvenate for breakthrough</td>
</tr>
<tr>
<td>Triad</td>
</tr>
<tr>
<td>Horizontal</td>
</tr>
<tr>
<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**

Centralized

- Engine maker
- Shipyard
- Owner

Informal

- Experts' forum

Publicly funded

- Designed
- Emergent

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

Connectivity between different types of maritime innovation networks

Exploration

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

Development

- TRAD

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>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 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
- Planning
- Priority setting
- Staffing
- Controlling/steering

Focus on Partner Selection, Enabling, Control Position

Networking Capabilities
- Shared with entire organization

Operational Management
- Idea generation
- Idea enrichment
- Marketing
- Transfer of results to mainstream

Focus on Performance

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

Innovation Leverag
- Lead, implementation, integration, coordination

Good Innovation Network Management Practice
- Respect, learning, trust, transparency, efficient R&D and communications