Maritime Innovation Networks

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Maritime Innovation Networks

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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 (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 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 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>Owners, charterers, and operators</td>
<td>Small – open for innovation networks</td>
<td>Other should innovate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Owners, charterers, and operators</td>
<td>Equipment testing</td>
<td>First mover concern</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Owners, charterers, and operators</td>
<td>Performance improvement</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>Cradle of knowledge and creativity Strong influence on innovation in industry Present in every innovation network</td>
<td></td>
</tr>
<tr>
<td>Equipment and technology suppliers</td>
<td>Strong R&amp;D, innovation, and networking capabilities</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 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**
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
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
Engine maker and shipyard driven
Long term
Growing in number of partners
Owner
Time limited
Disband into dyads
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

Centralized

**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
Acknowledge learning as success criteria

Triad
Publicly funded

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Management and organization</th>
<th>Evolution</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support development of solutions and industry’s innovation and networking capabilities</td>
<td>Three variants</td>
<td>Designed are time limited</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>Designed centralized, designed decentralized, and emergent</td>
<td>Emergent will continue if positive experience with results and management</td>
<td>Successful commercialization of network results is not captured and disseminated</td>
</tr>
<tr>
<td>Relevance of topics depends on individuals</td>
<td>Designed types for exploration, Emergent types for development (more open)</td>
<td>Partners from work packages may establish new exploitative networks</td>
<td>Universities benefit from academic publications</td>
</tr>
<tr>
<td>Rules for formation in top-down could negatively affect enthusiasm</td>
<td>Work-package driven</td>
<td></td>
<td>No established measures to capture and follow improvement of members’ innovation and networking competences and capabilities and commercialization of solutions</td>
</tr>
<tr>
<td>Negative effect of imposed collaboration</td>
<td>Complex and bureaucratic organization hinders innovation. Heavy management apparatus</td>
<td>Natural stability is very sensitive to quality of governance and operational management</td>
<td></td>
</tr>
</tbody>
</table>

**Formation**

- Very rare and found in the development phase of innovation process
- Reason: 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>Seek for expert opinion and advice about regulation</td>
<td>Experts are organized within working groups</td>
<td>Advise to regulators</td>
</tr>
<tr>
<td>Expert</td>
<td>Recognition of personal achievements</td>
<td>Governing body sets topics</td>
<td>Ideas and initiatives for formation of publicly funded networks</td>
</tr>
<tr>
<td>Participating organization</td>
<td>Knowledge sharing intensive within groups. Information sharing in joint meetings. Little or no formal relationships between working groups (structural holes)</td>
<td>Permanent network with temporary groups and members</td>
<td>Influence on formation on innovation projects in industry not captured</td>
</tr>
<tr>
<td>Access to knowledge and influence on regulators</td>
<td>Power of single member rooted in technical competency</td>
<td>Permanent network with temporary groups and members</td>
<td>Performance</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>Light management and strong governance</td>
<td></td>
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</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**

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**Innovativeness**

<table>
<thead>
<tr>
<th><strong>NEW Partners</strong></th>
<th>Incremental Connect for breakthroughs</th>
<th>Breakthrough Triad</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Centralized</td>
<td>Triad</td>
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<tr>
<td></td>
<td>Publicly funded</td>
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<table>
<thead>
<tr>
<th><strong>OLD</strong></th>
<th>Pure incremental Experts’ forum</th>
<th>Incremental Rejuvenate for breakthrough</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Triad</td>
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<tr>
<td></td>
<td></td>
<td>Horizontal</td>
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<td></td>
<td>Informal</td>
</tr>
</tbody>
</table>

| YES Structural holes | NO |
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**
- **Horizon**
- **Centralized** (Shipyard)
- **Centralized** (Engine maker)
- **Centralized** (Owner)
- **Publicly funded** (Emergent)
- **Publicly funded** (Designed)
- **Expert forum**
- **Informal**

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

- **Exploration**
- **Development**
- **Exploitation**

Advanced collaborative and final-user driven forms emerge to qualify promising technology
Advanced collaborative networks disband
Industry closes up again

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**Utilization of maritime innovation networks**

**Stakeholder participation**

<table>
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<th>Stakeholder</th>
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<tr>
<td>Classification society</td>
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<td>Owners, charterers, operators</td>
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<td>Designers</td>
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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 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)