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
• 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 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>Initiate and moderate innovation networks</td>
<td>Insurers</td>
</tr>
<tr>
<td>Owners, charterers, and operators</td>
<td>Drive innovation</td>
<td>Large – internal R&amp;D capability</td>
<td>Small – open for innovation networks</td>
<td>Other should innovate</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</td>
<td>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</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>
</tr>
</tbody>
</table>

### Six innovation networks

#### Centralized

- Design: Centralized
- Structure: Triad
- Funder: Publicly Funded

#### Triad

- Design: Decentralized
- Structure: Horizonal
- Funder: Expert’s forum

#### Emergent

- Design: Emergent
- Structure: Informal
- Funder: Society
Formation | Management and organization | Evolution | Performance
---|---|---|---
Owner driven | User-driven | Engine maker and shipyard driven | Indirect measurement of success
Fast and affordable access to knowledge and technologies | Formal agreements in exploration at engine maker and shipyard driven networks, informal agreements for scouting and testing and formal agreements for new build in exploitation at owner driven network | Strong ties between central organization and individual partner, little or none formal relationships between the partners (structural holes) | Objectives met in most cases
Formed when needed | Informal agreements for new build in exploitation at owner driven network | Ideas and needs shared with partners who are expected to come up with solutions | Suppliers may delay the process because of lack of resources and uncertain sales
Engine maker and shipyard driven | Suppliers | >R&D unit/entity is coordinator | Untapped potential of structural holes
Access new knowledge, technologies, and market segments | Engine maker and shipyard protect IPR through patenting, Owner protects IPR by being first on the market | Networking capabilities not regarded as KPI
Licensee | Owner driven | Time limited | Triad
Licensee | Owner driven | Disband into dyads
Licensee | Owner driven | Emerge on recognized business opportunity
Owner driven | Owner driven | Time limited

Triad

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

Centralized

Triad

Formation | Management and organization | Evolution | Performance
---|---|---|---
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Centralized
Publicly funded

<table>
<thead>
<tr>
<th>Formation</th>
<th>Management and organization</th>
<th>Evolution</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stakeholders</td>
<td>Access public funding</td>
<td>Three variants</td>
<td>Designed are time limited</td>
</tr>
<tr>
<td>Public funds</td>
<td>Support development of solutions and industry’s innovation and networking capabilities</td>
<td>Designed centralized, designed decentralized, and emergent</td>
<td>Emergent will continue if positive experience with results and management</td>
</tr>
<tr>
<td>Top-down and bottom-up generation of topics</td>
<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>
</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>Work-package driven</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>Components and network outcomes</td>
<td>Horizontal</td>
</tr>
</tbody>
</table>
## 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></td>
<td>Seek for expert opinion and advice about regulation</td>
<td>Closed, designed, and decentralized</td>
<td></td>
</tr>
<tr>
<td><strong>Expert</strong></td>
<td>Recognition of personal achievements</td>
<td>Experts are organized within working groups</td>
<td></td>
</tr>
<tr>
<td><strong>Participating organization</strong></td>
<td>Access to knowledge and influence on regulators</td>
<td>Governing body sets topics</td>
<td></td>
</tr>
<tr>
<td></td>
<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>
</tr>
<tr>
<td></td>
<td></td>
<td>Power of single member rooted in technical competency</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Permanent network with temporary groups and members</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Advise to regulators</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ideas and initiatives for formation of publicly funded networks</td>
</tr>
<tr>
<td></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>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 competence, 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

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>
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</tbody>
</table>

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>Incremental</td>
</tr>
<tr>
<td>Publicly funded</td>
<td>Rejuvenate for breakthrough</td>
</tr>
<tr>
<td>Pure incremental</td>
<td>Triad</td>
</tr>
<tr>
<td>Experts' forum</td>
<td>Horizontal</td>
</tr>
<tr>
<td>YES</td>
<td>Informal</td>
</tr>
<tr>
<td>NO</td>
<td>Structural holes</td>
</tr>
</tbody>
</table>
Utilization of maritime innovation networks

Innovation process

Connectivity between different types of maritime innovation networks

Centralized (Engine maker)
Centralized (Engine maker)
Centralized (Engine maker)
Centralized (Shipyard)
Centralized (Shipyard)
Centralized (Shipyard)
Centralized (Owner)
Centralized (Owner)
Centralized (Owner)

Triad
Triad
Triad

Publicly funded (Designed)
Publicly funded (Designed)
Publicly funded (Emergent)

Exploration
Development
Exploitation

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>Expert forum</th>
<th>Informal</th>
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<tbody>
<tr>
<td>Regulators</td>
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<td>●</td>
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<tr>
<td>Classification society</td>
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<td>●</td>
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<tr>
<td>Owners, charterers, operators</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Designers</td>
<td>●</td>
<td>●</td>
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<td>●</td>
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<tr>
<td>Equipment and technology suppliers</td>
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<tr>
<td>Shipyards</td>
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<td>●</td>
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<tr>
<td>Financiers</td>
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<td>Insurers</td>
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<td>Ports</td>
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<tr>
<td>Universities and institutes</td>
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<td>●</td>
</tr>
<tr>
<td>Industry associations</td>
<td>●</td>
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</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 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)