Maritime Innovation Networks

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Publication date:
2015

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

Link back to DTU Orbit

Citation (APA):
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>Financials</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>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>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>
<td>Equipment testing</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</td>
<td>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>
<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>Formal agreements in exploration at engine maker and shipyard driven networks, informal agreements for scouting and testing formal agreements for new builds in exploitation at owner driven network</td>
<td>Indirect measurement of success</td>
</tr>
<tr>
<td>Engine maker and shipyard driven</td>
<td>Access new knowledge, technologies, and market segments</td>
<td>Strong ties between central organization and individual partner. 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>Suppliers</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>Networking capabilities not regarded as KPI</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, Easy to manage</td>
<td>Time limited</td>
<td>Successful in achieving objectives</td>
</tr>
<tr>
<td>Partners chosen on complementarity of competences</td>
<td>Governance based on openness, flat structure, and good relationship management</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>Trust driven by network size, previous experiences, and personal relations</td>
<td>Can initiate new networks to add more competences</td>
<td></td>
</tr>
<tr>
<td>Clear commercial interest from all partners</td>
<td>Equal distribution of knowledge and information</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Formation Diagram:**

- **Owner driven:** Engine maker and shipyard driven
- **Engine maker and shipyard driven:** Suppliers
- **Suppliers:** Test technology, understand user's needs, get sales with large customer

**Performance Diagram:**

- **Engine maker and shipyard driven:** Long term
- **Owner driven:** Time limited
- **Suppliers:** Disband into dyads
- **Networking capabilities:** not regarded as KPI

**Triad Diagram:**

- **Emergent, Formal, Exploit structural holes:** Exploration with fit for exploitation
- **Partners chosen on complementarity of competences:** Easy to manage
- **Occasional satellite members:** Governance based on openness, flat structure, and good relationship management
- **Clear commercial interest from all partners:** Trust driven by network size, previous experiences, and personal relations
- **Equal distribution of knowledge and information:** Can initiate new networks to add more competences

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**Centralized and Triad Diagrams:**

- Centralized: Formation, Management and organization, Evolution, Performance
- Triad: Formation, Management and organization, Evolution, Performance
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>Support development of solutions and industry’s innovation and networking capabilities</td>
<td>Designed are time limited</td>
</tr>
<tr>
<td>Public funds</td>
<td>Top-down and bottom-up generation of topics</td>
<td>Relevance of topics depends on individuals</td>
<td>Emergent will continue if positive experience with results and management</td>
</tr>
<tr>
<td>Rules for formation in top-down could negatively affect enthusiasm</td>
<td>Work-package driven</td>
<td>Complex and bureaucratic organization hinders innovation</td>
<td>Partners from work packages may establish new exploitative networks</td>
</tr>
<tr>
<td>Negative effect of imposed collaboration</td>
<td>Designed in centralized, designed decentralized, and emergent</td>
<td>Designed types for exploration, Emergent types for development (more open)</td>
<td>Natural stability is very sensitive to quality of governance and operational management</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Formations</th>
<th>Management and organization</th>
<th>Evolution</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very rare and found in the development phase of innovation process</td>
<td>Decentralized with formal agreements</td>
<td>Positive experience spurs new projects and admission of new members.</td>
<td>Small improvements</td>
</tr>
<tr>
<td>Reasons</td>
<td>Simple and flat management structure due to small size</td>
<td>Small incremental steps increase trust and improve networking capabilities</td>
<td>Main achievement is that competitors learn to work with each other</td>
</tr>
<tr>
<td>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.</td>
<td>Each member involved in project management, participation in projects, and decision making</td>
<td>Efficient knowledge flow due to short distances between the nodes and teams</td>
<td></td>
</tr>
<tr>
<td>Prevention of opportunistic behavior</td>
<td>Top management and work groups jointly make decisions about strategic development of network</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classification society initiates formation and manages the network</td>
<td>Members with different market specializations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fully committed top management</td>
<td></td>
<td></td>
<td></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>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></td>
</tr>
<tr>
<td>Participating organization</td>
<td>Access to knowledge and influence on regulators</td>
<td>Knowledge sharing intensive within groups. Information sharing in joint meetings. Little or no formal relationships between working groups (structural holes)</td>
<td>Power of single member rooted in technical competency</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>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>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

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>
</tbody>
</table>

NO

Structural holes
Utilization of maritime innovation networks

Innovation process

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

Connectivity between different types of maritime innovation networks

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>
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<tr>
<td>Shipyards</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Financiers</td>
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<td>●</td>
<td>●</td>
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<td>●</td>
<td>●</td>
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<tr>
<td>Insurers</td>
<td>●</td>
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<tr>
<td>Ports</td>
<td>●</td>
<td></td>
<td>●</td>
<td>●</td>
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<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>
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</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 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)

GOOD INNOVATION NETWORK MANAGEMENT PRACTICE
Respect, learning, trust, transparency, efficient R&D and communications

EACH NETWORK MEMBER
GOVERNANCE
- Planning
- Policy
- Risk
- Staffing
- Controlling/Accounting
- Controlling patterns and activities

NETWORKING COMPETENCES AND CAPABILITIES
- Exist within whole organisation

OPERATIONAL MANAGEMENT
- Innovation promotion
- Idea enrichment
- Marketing
- Transfer of results to mainstream

TOP MANAGEMENT
- Builds innovation and knowledge generation
- Enables the flow of innovation

OPEN INNOVATION
- Attracts "hot spots"
- Flow of innovation

ACTIVE INNOVATION LEADERSHIP
- Lead organisation and coordination

FOCUS ON
- Partner selection
- Enabling control position
- Performance

LEAD ORGANISATION INTERGRATION COORDINATOR

7/10/2015