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 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 Promote innovation Initiate and moderate innovation networks</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 Large - internal R&amp;D capability Small – open for innovation networks Other should innovate Equipment testing First mover concern Performance improvement</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>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>
</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>
</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>
</tr>
</tbody>
</table>

### Six innovation networks

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

**PUBLICLY FUNDED**

- Designed centralized
- Designed decentralized
- Emergent
- Experts’ forum
- Informal
### Triad

<table>
<thead>
<tr>
<th>Formation</th>
<th>Management and organization</th>
<th>Evolution</th>
<th>Performance</th>
</tr>
</thead>
</table>
| **Owner driven** | Emergent, Formal, Exploit structural holes | Time limited | Successful in achieving objectives | **Triad**
| Fast and affordable access to knowledge and technologies | Exploration with fit for exploitation | Allow flexibility for partners to establish new triads | Acknowledge learning as success criteria |
| **Engine maker and shipyard driven** | Easy to manage | Can initiate new networks to add more competences | |
| Access new knowledge, technologies, and market segments | Governance based on openness, flat structure, and good relationship management | | |
| Suppliers: Test technology, understand user's needs, get sales with large customer | Trust driven by network size, previous experiences, and personal relations | | |
| | Equal distribution of knowledge and information | | |

### Centralized

<table>
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<tr>
<th>Formation</th>
<th>Management and organization</th>
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</thead>
</table>
| **Owner driven** | Formal agreements in exploration at engine maker and shipyard driven networks | Engine maker and shipyard driven | Indirect measurement of success | **Centralized**
| Fast and affordable access to knowledge and technologies | Informal agreements for scouting and testing and formal agreements for new builds in exploitation at owner driven network | Long term | Objectives met in most cases |
| **Engine maker and shipyard driven** | Strong ties between central organization and individual partner. Little or none formal relationships between the partners (structural holes) | Growing in number of partners | Suppliers may delay the process because of lack of resources and uncertain sales |
| Access new knowledge, technologies, and market segments | Ideas and needs shared with partners who are expected to come up with solutions | | |
| Suppliers: Test technology, understand user's needs, get sales with large customer | R&D unit/entity is coordinator | | |
| | Engine maker and shipyard protects IPR through patenting. Owner protects IPR by being first on the market | | |

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**Formation - Triad**

1. **Owner driven**
   - 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

2. **Engine maker and shipyard driven**
   - Informal agreements for scouting and testing and formal agreements for new builds in exploitation at owner driven network
   - Growing in number of partners
   - Suppliers may delay the process because of lack of resources and uncertain sales

3. **Suppliers**
   - Ideas and needs shared with partners who are expected to come up with solutions
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**Management and organization - Triad**

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3. **Suppliers**
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Publicly funded Formation

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Management and organization</th>
<th>Evolution</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access public funding</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>Support development of solutions and industry’s innovation and networking capabilities</td>
<td>Designed centralised, designed decentralised, and emergent</td>
<td>Emergent will continue if positive experience with results and management</td>
<td>Succeed network commercialisation of network results is not captured and disseminated</td>
</tr>
<tr>
<td>Top-down and bottom-up generation of topics</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>Relevance of topics depends on individuals</td>
<td>Work-package driven</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rules for formation in top-down could negatively affect enthusiasm</td>
<td>Complex and bureaucratic organization hinders innovation. Heavy management apparatus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative effect of imposed collaboration</td>
<td>Natural stability is very sensitive to quality of governance and operational management</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 centralised, designed decentralised, 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.

Three types for exploration:
- Designed.
- Decentralized.
- Emergent.

Three types for development:
- Designed.
- Centralized.
- Emergent.

Horizontal Formation

<table>
<thead>
<tr>
<th>Formation</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: 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>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>Prevention of opportunistic behavior</td>
<td>Each member involved in project management, participation in projects, and decision making</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classification society initiates formation and manages the network</td>
<td>Top management and work groups jointly make decisions about strategic development of network</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Members with different market specializations</td>
<td>Efficient knowledge flow due to short distances between the nodes and teams</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>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>
<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</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></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>Light management and strong governance</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

- 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>Incremental</th>
<th>Breakthrough</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connect for breakthroughs</td>
<td>Triad</td>
</tr>
<tr>
<td>Centralized</td>
<td>Publicly funded</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pure incremental</th>
<th>Incremental</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experts' forum</td>
<td>Rejuvenate for breakthrough</td>
</tr>
<tr>
<td></td>
<td>Triad</td>
</tr>
<tr>
<td></td>
<td>Horizontal</td>
</tr>
<tr>
<td></td>
<td>Informal</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural holes</td>
<td>Structural holes</td>
</tr>
</tbody>
</table>

NEW Partners
OLD Partners
Utilization of maritime innovation networks

Innovation process

| Connectivity between different types of maritime innovation networks |
|-------------|---------------|-------------|-------------|-------------|
| CENTRALIZED (Engine maker) | CENTRALIZED (Shipyard) | CENTRALIZED (Owner) | CENTRALIZED (Engine maker) |
| EXPERT FORUM | HORIZONTAL | INFORMAL | TRAD |
| PUBLICLY FUNDED (Designed) | PUBLICLY FUNDED (Emergent) |

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>Stakeholders</th>
<th>Centralized</th>
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<th>Publicly funded</th>
<th>Horizontal</th>
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<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>
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<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>
<td>●</td>
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<tr>
<td>Insurers</td>
<td>●</td>
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<tr>
<td>Ports</td>
<td>●</td>
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<td>Universities and institutes</td>
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<td>●</td>
<td>●</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industry associations</td>
<td>●</td>
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<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, trusting, trust, transparency, efficient R&D and communications

EACH NETWORK MEMBER

GOVERNANCE
- Planning
- Strategy
- Controlling
- Controlling progress

Focusing on PARTNER SELECTION ENABLING CONTROL POSITION

NETWORKING, COMPETENCIES AND CAPABILITIES
- Networking
- Development of core competencies

TOP MANAGEMENT
- Build innovations and networking mechanisms
- Implementation of open innovation

OPEN INNOVATION
- Attaching ideas
- Flow of innovation

OPERATIONAL MANAGEMENT
- Operational management
- Marketing
- Transfer of innovation
- Performance

Focus on PERFORMANCE

ACTIVITIES
- Innovation processes
- Knowledge flows
- Network identity
- Intellectual property

INNOVATION LEVERAGE

LEAD ORGANIZATION INTEGRATION/COORDINATOR

7/10/2015