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HOW TO INCREASE AVAILABILITY

INNOVATION NEVER STOPS: MANAGING FUNCTIONAL OBSOLESCENCE AS CONTINUOUS INNOVATION IN THE MARITIME SECTOR

A network of companies in the maritime sector works together in the MARCONI project to innovate maintenance and functional relevance of high value vessels and maritime equipment. The network's goals are to enhance the availability of ships, uninterrupted missions and continued functional relevance of physical-digital technologies in use. Digital technologies require updates involving a mixture of software and hardware, and are prone to Functional Obsolescence. The latter concept is defined as the loss of an asset's function, performance, or reliability due to changing requirements, even though the asset can still be manufactured, supported, and operated according to its initial functional specifications. How can this network of companies in the maritime sector collaborate in new ways to ensure that their assets comply with the fast-changing functional requirements?

The network to improve Functional Obsolescence Management (FOM) in the maritime sector consists of the maintenance organization of the Royal Dutch Navy 'Directie Materiële Instandhouding' (DMI), shipbuilder Damen Schelde, maritime systems integrator RH Marine, and naval defense systems provider Thales. In the MARCONI project, management approaches for Functional Obsolescence in a service logistics network are investigated. Based on interviews and workshops with partners in the maritime sector, we identified current challenges, top priorities, and recommendations for FOM. We call this a shift towards continuous innovation, which can help the network in managing the future of FOM.

FUNCTIONAL OBSOLESCENCE: OMNIPRESENT YET UNSTRUCTURED

Three challenges characterize Functional Obsolescence in the maritime industry. First, Functional Obsolescence is increasingly tied to the realization of strategic objectives and financial structures. Strategic objectives (e.g., maintaining the competitiveness of weapon systems) can render existing technology Functionally Obsolete, while budget constraints can limit or postpone innovation of existing technology. Second, managing Functional Obsolescence involves decision-making processes in the value chain, spanning departmental and organizational boundaries. It occurs in both strategic decision-making on assets as well as tactical and operational decision-making tied to maintenance and service logistics. This involves a shift away from departmentally stove-piped decision making. Third, the topic currently lacks effective institutionalized structures. Commercial customers combine Functional Obsolescence with managing market dynamics, balancing earnings with costs. On the public side, however, organizations are focused on budgets; they interact with long-term oriented actors on strategic decisions and with short-term oriented actors on operational maintenance activities. This leads to a rather complicated organization (or network structure) that is responsible for merely elements pertaining to Functional Obsolescence.

TOP PRIORITY: MANAGE TECHNOLOGY FROM CRADLE TO GRAVE

Managing Functional Obsolescence is a matter of life-cycle management at multiple levels of the technologies. It requires synchronizing the dynamics between these levels. Each level of technology has its set of stakeholders with their own objectives and responsibilities. For example,

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a radar system provided by Thales can consist of multiple hardware and software modules, each with different suppliers involved. Table 1 shows different activities in managing technology. Technological innovation refers to novel technological aspects embodied in assets. Operational functionality change refers to differences in the functions of an asset in use, as a result of technology management activities.

Technology management activities with increasing functional impact	Technological innovation	Operational functionality change	Example
Upkeep: asset maintenance without new technology or operational functionality	No	No	Periodic maintenance on vessels' engines to ensure reliable operations.
Update: asset innovation including new technology without new operational functionality	Yes	No	Introduction of new software to improve the security of a system.
Upgrade: asset innovation including new technology with new operational functionality	Yes	Yes	Introduction of a new radar system with improved detection capabilities.

In the MARCONI project, stakeholders of multiple technology levels (who can change along the life-cycle) made progress in setting up a method to align with each other on short-term, mid-term and long-term activities. Figure 1 depicts the life-cycle of technology as an S-curve (Hofer et al., 2020, Lee and Trimi, 2018). At the start of each S-curve it takes some time for the performance of technology to increase as employees receive training and learn to use the new technology. At the end of each life-cycle, the S-curve flattens as the natural limit of the performance of a technology is reached (e.g., see S1). Any fully developed technology has a natural limit to its performance, which is reached when users manage to optimize its application.

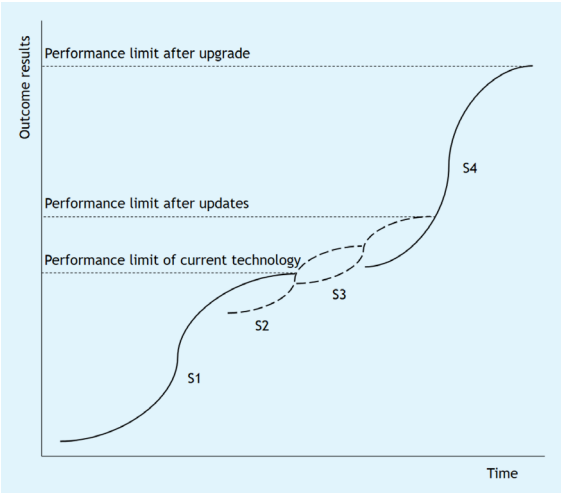

Figure 1: Consecutive technology life-cycles

In managing technology along the life-cycle, organizations engage in short- and mid-term activities such as upkeeps with no impact on the performance limit of technology, and updates that can incrementally improve the performance limit of technology (e.g., see S2 and S3). Long-term activities are geared towards upgrades and can lead to radical improvements in the performance limit of technology (e.g., see S4). The asset user and OEMs should be committed to manage each technology from cradle to grave, and to think ahead about future technologies.

RECOMMENDATIONS: GET READY FOR THE FUTURE OF FOM

A well-developed cycle between regulatory frameworks (embedding the Functional Obsolescence Management innovation) and digital/service innovation (executing the innovation) is necessary to achieve readiness for new ways of organizing FOM. Regulatory frameworks refer to conditions that make digital/service innovations work. For example, organizations in the maritime industry develop relationships based on shared values, trust, and ways of working to provide a backdrop for FOM innovations. Digital/service innovation concerns new capabilities in value chains. For example, organizations cooperate on data driven maintenance with an initial focus on predictive maintenance, especially for future ships. A virtuous -reinforcing- cycle between embedding and executing digital/service innovations can be established by:

- **Converging public and private organizations** in a complex process of developing trust, relational capital, and a shared language. This can result in projects that will deliver tangible results, further cementing strategic relationships.
- **Determining who -one or more organizations- leads in orchestrating Functional Obsolescence** at both the strategic, tactical and the operational level. This can depend on the technology and market structure.
  For instance, the Royal Dutch Navy will have

advanced knowledge of adversary capabilities and lead on 'tip of the spear' functional requirements. Conversely, platform providers -i.e. the basic ship as a capacity for functions- will gain new insights from their upstream partners and propose functional improvements.

- **Monitoring functional requirements in a more continuous fashion**. Combining the regular 15/30-year interventions at military organizations with more continuous updates and upgrades ensures that the latest functional requirements are fulfilled. At the same time, organizations need to balance the functional advantage of (more) continuous updates with efficiency-based arguments and budgets. Efficiency stems from clustering multiple maintenance and update tasks to minimize disruption of operations.

Organizations can climb the ladder of FOM maturity by engaging in innovative activities in cooperation with value chain partners, as shown in Figure 2. The FOM approach tends to be ad hoc when Functional Obsolescence is not based on value chain processes within and between organizations. Step-by-step initiatives can result in a leading FOM maturity level, where Functional Obsolescence is strategically recognized, and its management is eventually actively developed at a world class level.

Would you like to explore the FOM maturity of your organization?
On the next pages you can find a maturity scan we developed to assess how well an organization, commercial or public, is extracting value from FOM and which opportunities can be devised. The scan identifies 42 criteria that give a holistic view on FOM and how well it is implemented at an organization.

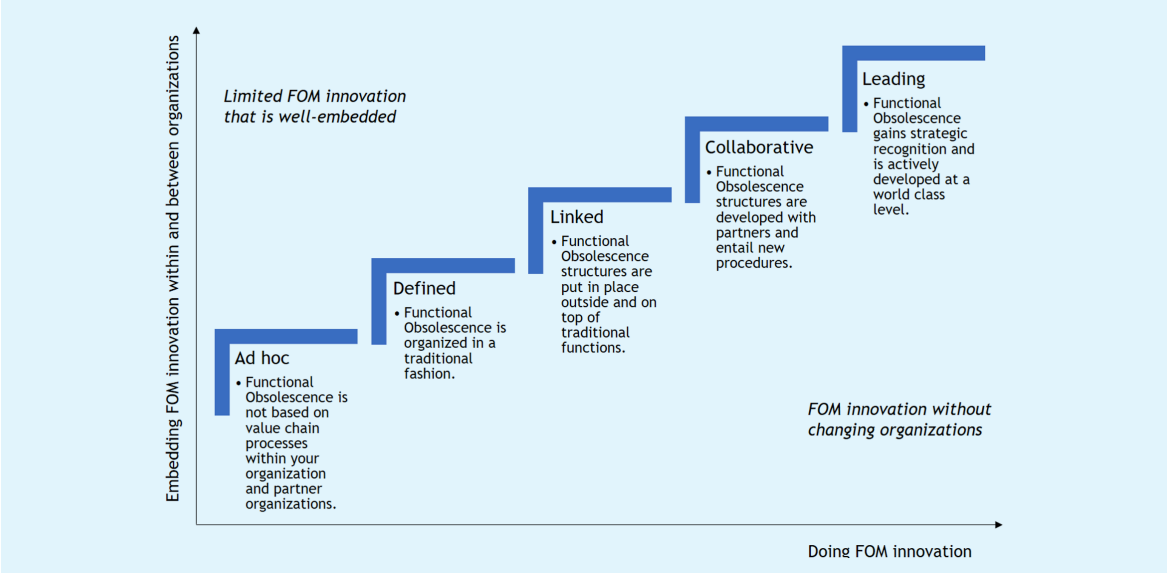

Figure 2: Characteristics of the maturity levels for FOM

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References HOFER, A., BRANDL, F., BAUER, H., HAGHI, S. & REINHART, G. 2020. A Framework for Managing Innovation Cycles in Manufacturing Systems. Procedia CIRP, 93, 771-776.

LEE, S. M. & TRIMI, S. 2018. Innovation for creating a smart future. Journal of Innovation & Knowledge, 3, 1-8.

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FUNCTIONAL OBSOLESCENCE READINESS SCAN

The focus of the scan is to assess how well an organization, commercial or public, is extracting value from its Functional Obsolescence Management (FOM) and which opportunities can be devised.
Based on our research findings, we define FOM as the loss of an asset's function, performance, or reliability due to changing requirements, even though the asset can still be manufactured, supported, and operate according to its functional specifications. Hence, the scan covers organizations that deal with functional obsolescence such as the MoD including its maintenance organization, OEMs, and product manufacturers. Organizations like these aim to prepare for a modern view on FOM.
The scan identifies 42 criteria clustered in seven dimensions that give a holistic view on FOM and how well it is implemented at an organization. The criteria are about FOM but embedded in the context of general obsolescence management.
To fill out the scan, focus on one organization, reflect on its FOM activities and score each of the following statements on a scale from 1 (fully disagree) to 5 (fully agree). Afterwards sum up the score per dimensions. The results allow you to understand the FOM readiness on each item, each dimension, and in total; for comparison against target scores and other organizations as well as for prioritization of FOM efforts. If necessary, add extra notes in the comments' field per dimension:

DIMENSION	CRITERIA	SCORE 1 (fully disagree) to 5 (fully agree)
STRATEGIC EMBEDDEDNESS OF FOM	1. FOM is an essential element of realizing the vision of my organization.	
	2. Leaders in my organization actively identify and realize opportunities for business objectives.	
	3. Our FOM is closely aligned with the wider strategy.	
	4. Leaders in my organization can communicate their future foresight throughout the organization.	
	5. My organization has a clear FOM strategy.	
	6. We share knowledge about obsolescence issues and obsolescence strategies with our partners upstream/ downstream/ horizontally in the value chain (please note each relationship and grade for each separately).	
	COMMENTS:	**SCORE SUBTOTAL:**
COOPERATION WITH EXTERNAL FOM PARTNERS	7. My organization has technology foundations in place that enables us to collaborate with our suppliers and customers (when applicable).	
	8. Our customers can effectively communicate with my organization to address complaints and help resolve issues.	
	9. Our suppliers can gear their value proposition towards selling functionalities with upgrades included, instead of selling assets (including life cycle costs).	

DIMENSION	CRITERIA	SCORE 1 (fully disagree) to 5 (fully agree)
COOPERATION WITH EXTERNAL FOM PARTNERS	10. We are part of a community of the asset owners, the service providers, the asset builder, and the OEMs, which all are talking the same language (approach to business, product standards, ambitions etc.).	
	11. Our stakeholders and suppliers have a single point of Functional Obsolescence contact.	
	12. Our organizations aim to cooperate to obtain and combine more obsolescence related data.	
	COMMENTS:	**SCORE SUBTOTAL:**
ORGANIZATIONAL ENABLERS OF FOM	13. Our service systems are designed for better life cycle management, not only for short-term maintenance.	
	14. My organization is data focused and uses data for environmental sensing/machine learning/predictive analysis.	
	15. Our technological infrastructure and corresponding solutions supports real-time obsolescence management decision making.	
	16. My organization conducts both small iterative experiments, and enterprise-wide initiatives to realize innovation that has business impact.	
	17. We actively and regularly assesses technical, business, and social risk factors when it comes to technology investment.	
	18. My organization has continuous insight in FOM needs, priorities and available budgets.	
	COMMENTS:	**SCORE SUBTOTAL:**
FOM PERFOR-MANCE OUTCOMES AND ASSESSMENT	19. All FOM relevant information can be seen on a central dashboard covering all our assets.	
	20. Our FOM includes models that make our decision making easy.	
	21. The innovations of my organization's business model is about enhancing effectiveness (e.g., expanding capacity) and efficiency (e.g., increasing asset utilization).	
	22. FOMs business model includes a strategic asset management plan (e.g., integrated five-year planning, short term operational and project planning).	
	23. Our FOM reporting and KPIs provide a clear indication what components are critical, what fails from time to time, and what is the number of spares available.	

DIMENSION	CRITERIA	SCORE 1 (fully disagree) to 5 (fully agree)
FOM PERFOR-MANCE OUTCOMES AND ASSESSMENT	24. To us, key goals of FOM are automation and efficiency improvement.	
	COMMENTS:	**SCORE SUBTOTAL:**
FOM PROCESS AND MIND-SET	25. Our FOM processes move away from long, big towards small, frequent update cycles.	
	26. We use the latest methods to predict obsolescence.	
	27. Obsolescence data from all used components is centrally collected and analyzed and include data across components and asset life cycle/lifetime.	
	28. Our FOM recognizes that software becomes an increasingly important item for FOM and pays much attention to the interplay of hardware and software when addressing user tasks and function needs.	
	29. Our organization has a consensus which Functional Obsolescence data is relevant and how it will be shared/ accessed.	
	30. Our Functional Obsolescence capability is proactive as it is triggered by technical obsolescence and notifications of the asset owner/supplier innovations, rather than reactively upon request.	
	COMMENTS:	**SCORE SUBTOTAL:**
FOM RESPONSIBILITIES AND RESOURCES	31. Our organization realizes that hardware is more and more a commodity, while increasingly software solutions provide a competitive advantage.	
	32. We have policies in place that regulate the data sharing with internal FOM stakeholders.	
	33. Our organization has a separate Functional Obsolescence unit with specialist(s).	
	34. The dedicated investment budget for FOM is spread across several years of a product/asset.	
	35. Employees have knowledge and competencies around obsolescence, or they can access these skills from partners or suppliers as needed.	
	36. We have a single point of FO contact for internal and external stakeholders.	
	COMMENTS:	**SCORE SUBTOTAL:**

DIMENSION	CRITERIA	SCORE 1 (fully disagree) to 5 (fully agree)
FOM SOLUTIONS	37. The implemented technical systems have generic backbones that allow for customization.	
	38. We understand the commonalities across systems to learn from one project to another.	
	39. Our systems use industry-standard platforms that are applied by multiple vendors and end users, and that work with commercial off-the-shelf (COTS) tools.	
	40. Any new product acquired is assessed based on its included sensors and its opportunities for data analytics.	
	41. Our obsolescence management plan includes when components should be replaced, how critical each component is to the operation of the system, and how much risk is involved in replacement or obsolescence of that component.	
	42. Our functional obsolescence management plan is regularly calibrated for priorities and available budget.	
	COMMENTS:	**SCORE SUBTOTAL:**