Software concepts for sustainable material management in shipbuilding

Examples from S4M

S4M SUSTAINABLE MATERIAL MANAGEMENT MATURITY MODEL

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Overview of software concepts to identified challenges in operational sustainability

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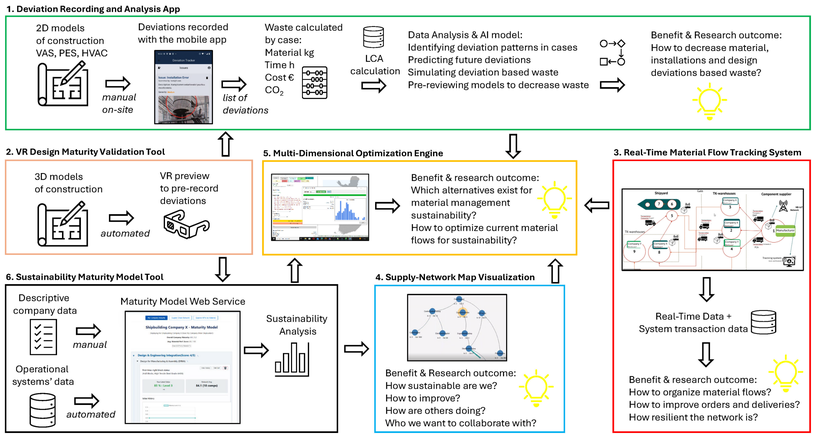
Some emergent challenges identified in practice:

- Material orders are submitted prematurely.
- The capacity of the manufacturer is ordered to the maximum.
- Manufacturers have challenges to coordinate production.
- Materials remain in storage for an extended period.
- Material deliveries are not received promptly by the installer.
- Supplier buffer is limited.
- Material locations are uncertain after the logistic hub.



- Modifications to materials are not carried over to subsequent projects.
- The overall impact of material, design and installation deviations is unclear.
- The amount of installation rework is considerable e.g. due to late design changes.
- In last mile operations, material lifts can be a bottleneck.
- Late discovery of material defects.
- Material-related transactions are not visible to other supply-chain actors.
- Information and tools for selecting and monitoring material suppliers, manufacturers, and installers are limited.

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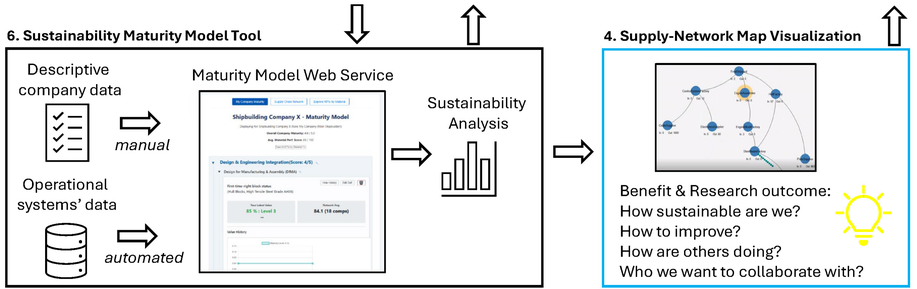
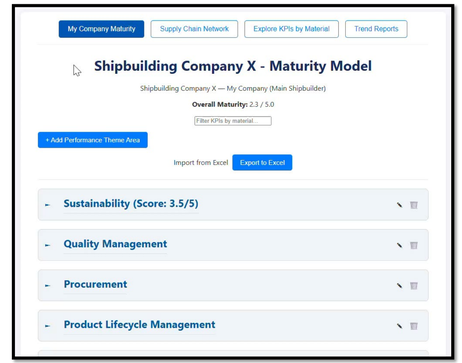
S4M digital maturity model as a collection of services

- Collective and company-specific insights based on the S4M maturity model data
- Locally run AI-driven analysis of future sustainability development areas
- Enables network and supply chain mapping, simulation and optimization
- Data immutability, traceability and transparency decisions are central
- Option to invitation-based relations and blockchain-based verifications
- Digital supply chain platforms characteristics determine whether sustainability-related uncertainty decreases or increases *



Examples



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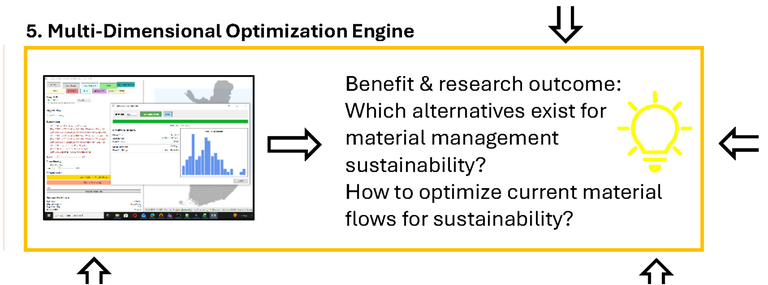
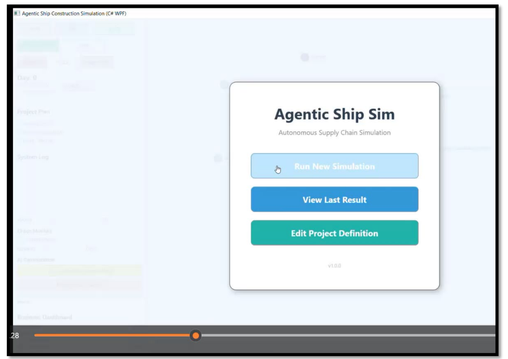
* Hina, M., & Islam, N. (2026). Dual Consequences of IT Artifact Characteristics in Reducing Sustainable Uncertainties: Implications for Decision-Making Within Digital Supply Chain Platforms. *Information & Management*, 104358.

Simulation and optimisation engine

- Simulate how effectively and sustainably will this specific network of companies operate, what alternatives exist and what if risks realize?
- Input: One project plan in natural language (.json) including tasks, materials and schedules.
- Generates the optimal network of companies using multi-dimensional optimization (strategies like cost, time and emissions-based).
- Combines agent-based modeling (ABM) for company behavior and discrete-event simulation (DES) for timing and scheduling dependencies
- Possibility to add network disturbances and analyze their effect to performance before business decisions.



Examples



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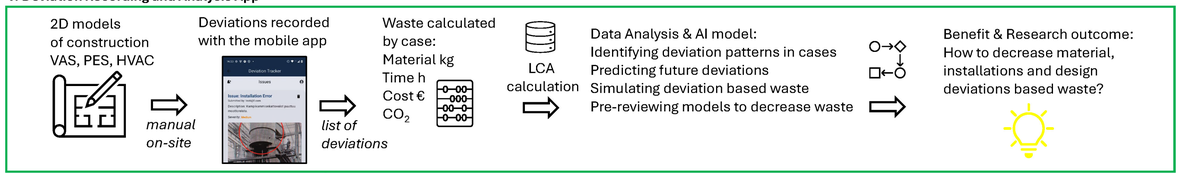
Deviations recording with mobile app on board

- Mobile app for recording material, design and installation deviations on board.
- Improves design quality, decreases rework and material waste especially in serial cruises
- Management dashboard and viewer for issue dissemination
- Analysis of deviation types and waste mechanisms allows calculation of sustainability impact, machine learning and preventive actions in the future
- Possible input into sustainability maturity model

1. Deviation Recording and Analysis App



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Examples

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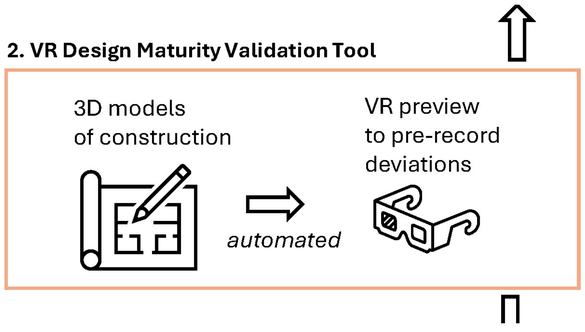
Deviations recording with VR based on 3D models

- VR application for recording material, design and installation deviations directly after 3D modelling.
- Multiple overlapping 3D files visibility on or off
- Provides a light version for multiple file formats running locally
- Improves design quality, decreases rework and material waste especially in serial cruises
- Possible deviation input into sustainability maturity model

2. VR Design Maturity Validation Tool



Examples

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Thank you!

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