

## **CONCEPT OF A HYBRID APPROACH TO PROJECT MANAGEMENT IN SHIPBUILDING**

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Ship design has long been recognised as one of the most complex engineering processes due to its interdisciplinary nature and long life cycle.

The existing project management methodology in shipbuilding, the traditional ship design spiral (TDS) by J. H. Evans [Evans, 1959], is becoming outdated and requires digital adaptation. It has become iconic because it presents design as an iterative process. The integration of systems engineering (SE), Model-Based Systems Engineering (MBSE) methods, and Agile approaches [Beck et al, 2001] opens up new opportunities for improving the efficiency and manageability of shipbuilding projects. The study analyses modern technologies used in project management in software and civil engineering, including MBSE, Digital Twin and Agile System Engineering (Agile SE) principles as a more flexible form of systems engineering [INCOSE, 2015].

The hybrid concept can be formulated as the integration of TDS with modern methodologies for managing complex engineering systems, namely MBSE, Digital Twin, and Agile SE principles. The advantages and disadvantages of each component of the hybrid concept were analysed. It is shown that a hybrid approach can significantly improve the efficiency of design processes, reduce time and ensure flexibility in rapidly changing conditions. It is noted that the transition to a hybrid concept (especially Agile SE) in shipbuilding requires changes in management, organisational implementation of MBSE and Digital Twin, as well as adherence to the architectural discipline of modularity.

An analysis of literary sources on the research topic and a comparison of project approaches based on key criteria were conducted. The analysis shows an increase in the number of works supporting digitalisation in engineering fields, particularly in shipbuilding.

The implementation of the hybrid TSP / Agile SE / MBSE / Digital Twin approach involves the following stages:

- Initiation and architectural hypotheses: the scope of tasks (capability epics) and system ‘stories’ (user stories) are determined; alternative architectures with interfaces for optional modules are developed;
- Competitive prototyping: parallel prototypes/models are launched for key risks (module compatibility, etc.); the results are promptly entered into the model;
- Integration increments: every 6–8 weeks – system demonstrations (model in the loop, HIL/software stands), clarification of requirements and agreements with suppliers/shipyards;
- Architectural solutions for modularity: standardised foundation locations and connectors for connecting systems are developed, reserves for mass and centering are established, and module certification test templates are created;

– An updated spiral is formed: sequential stages of the TSP are integrated with the MBSE architecture; each iteration reduces uncertainty; V-links provide the ability to verify requirements [Dahlke et al., 2023].

The results confirm the following:

1. Evans' TDS remains valuable as a structural basis for systematic ship design.
2. Modern digital technologies (MBSE, PLM, Digital Twin) reinforce the spiral, increasing traceability and adaptability. The ship design spiral and flexible systems development can be successfully integrated to create a more effective design methodology.
3. The use of Agile SE in shipbuilding enables faster iterations, flexibility, and greater team engagement.
4. A hybrid approach combines the best aspects of classical and digital design, reducing risks and increasing the robustness of solutions.
5. Significant productivity improvements: integrated approaches demonstrate significant improvements in design efficiency, stakeholder satisfaction and project outcomes, with the potential benefits far outweighing the risks.
6. Growth in industry adoption: Leading shipbuilders are increasingly adopting integrated approaches with positive results. Navantia, Rolls-Royce, and Hyundai demonstrate the real-world effectiveness of SE and Agile integration.
7. The effectiveness of the agile approach will be greatest for complex, integrated ship projects (passenger, car-passenger and high-speed car-passenger ships, gas or oil processing ships, ships for transporting large and heavy cargo, multi-purpose rescue, diving and other ships).

**References:** 1. Evans, J.H. (1959) Basic Design Concepts. Journal of the American Society of Naval Engineers, Vol. 71(4), pp. 671–678. 2. Beck, K., Beedle, M., van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., ... & Thomas, D. (2001). «Manifesto for Agile Software Development». Available at: <https://agilemanifesto.org/>. 3. INCOSE. (2015). Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities. 4th ed. Wiley, 2015. Available at: <https://www.incose.org/products-and-publications/publications/se-handbook> <https://download.e-bookshelf.de/download/0003/6422/62/L-G-0003642262-0007580512.pdf>. 4. Dahlke, P. & Mantwill, F. (2023): Towards Agile Systems Engineering in Early Stage Design for Complex Naval Vessels. Available at: [https://www.designsociety.org/download-publication/46878/towards\\_agile\\_systems\\_engineering\\_in\\_early\\_stage\\_design\\_for\\_complex\\_naval\\_vessels](https://www.designsociety.org/download-publication/46878/towards_agile_systems_engineering_in_early_stage_design_for_complex_naval_vessels)