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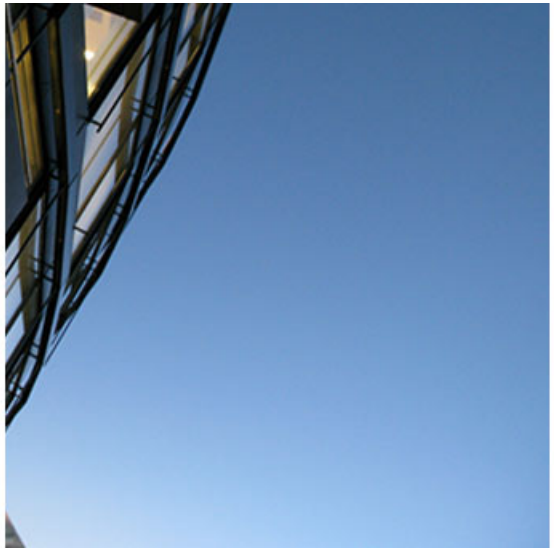

Evaluation of System Integration & Qualification strategies using the technical debt metaphor; a case study in Subsea System Development

INCOSE International Symposium, Edinburgh, Scotland 19.07.16

Peter S. Callister | Jonas Andersson

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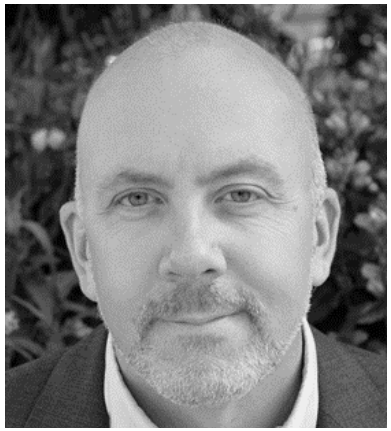
Who are we?



Jonas Andersson, Ph.D, CSEP

- Associate Professor, Norwegian Institute for Systems Engineering (NISE) at the University College of Southeast Norway
- Founder and Chief Creative Officer at Decisionware AB
- >20 years as lecturer, researcher and consultant in Systems Engineering and Engineering Management
- Supervisor for Peter Callister's Master project

Peter Callister

- BSc Industrial design engineering, BSc mechanical engineering and MSc Systems Engineering
- 2 years experience as System Integration and Test engineer at Aker Solutions
- Currently working as a Project Engineer in Aker Solutions Well Access Systems department in Tranby, Norway. Working with subsea system development
- Master thesis written in collaboration with Dr. Jonas Andersson, my supervisor from Buskerud University College.

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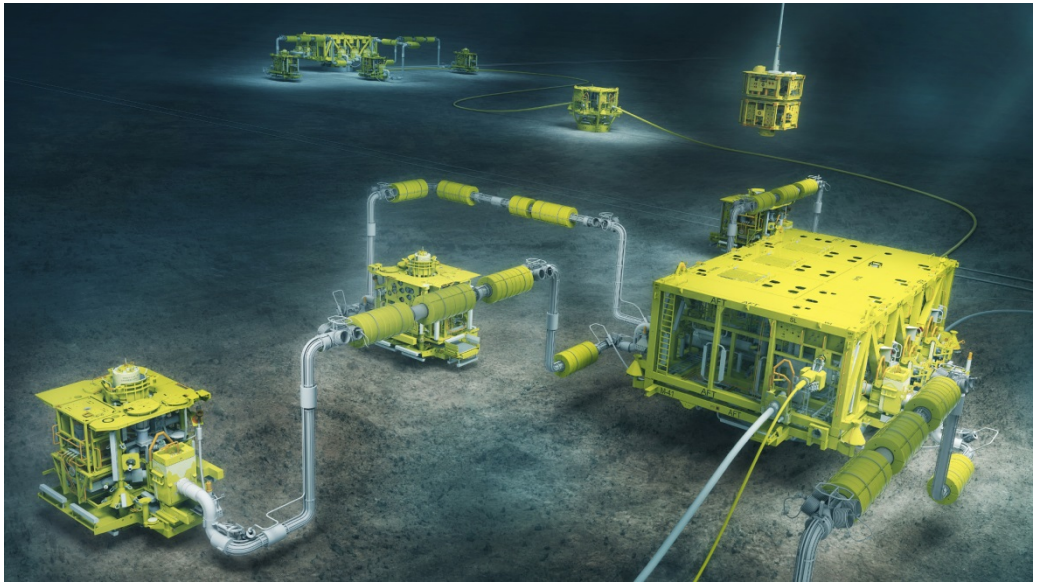
Subsea Projects



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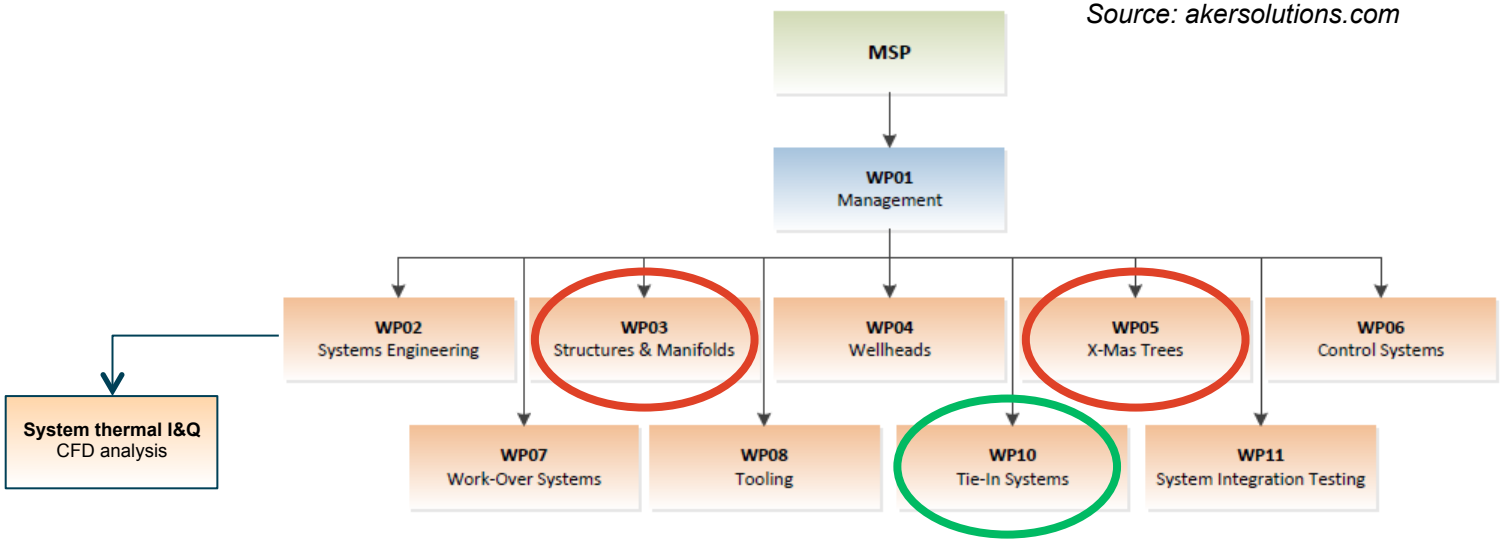

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Subsea thermal performance engineering

- Subsea systems are insulated to delay hydrate formation
- Thermal performance therefore a critical aspect of development
- As thermal performance requirements between sub projects varies considerably, different integration strategies must be employed in different Sub-projects (Work Packages)

Source: pet.hw.ac.uk

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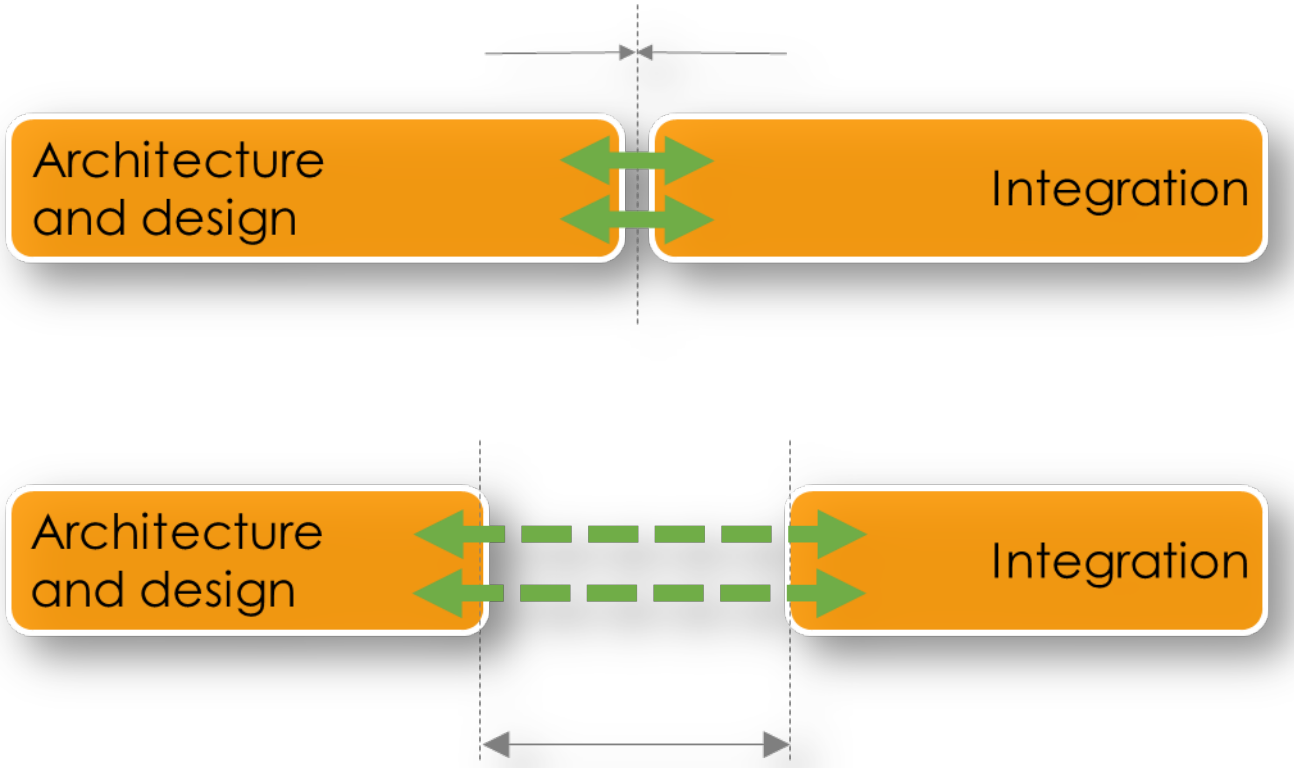
The problem

- Problems related to (unwanted) system emergence and requirements non-conformance in subsea development projects are often identified late (after design freeze) resulting in costly remedies and project delays
- In the studied subsea development project, it was found that different integration approaches was used for integration and qualification of subsea systems thermal performance for different parts of the total system.
- Also, the results of implementing of these strategies differed significantly between different sub projects.
- A gap existed between thermal architecture and design activities, and Integration & Qualification activities.
- The System Integrator inherited the developed system based on a frozen design, and was furthermore not included in earlier development activities

The “waterfall” approach



- Delimits the toolbox to essentially test based verification
- Prevents integration input on design

Illustration by courtesy of Jonas Andersson and Decisionware AB

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The idea!

- Question: Can effect and efficiency of (earlier) Integration and Qualification (I&Q) strategies be measured using the technical Debt metaphor?
- Hypothesis: Early integration activities positively affect the level of Technical Debt in the system?
- Objective: Reduce the level of unintentional Technical Debt in the architectural phase of system development

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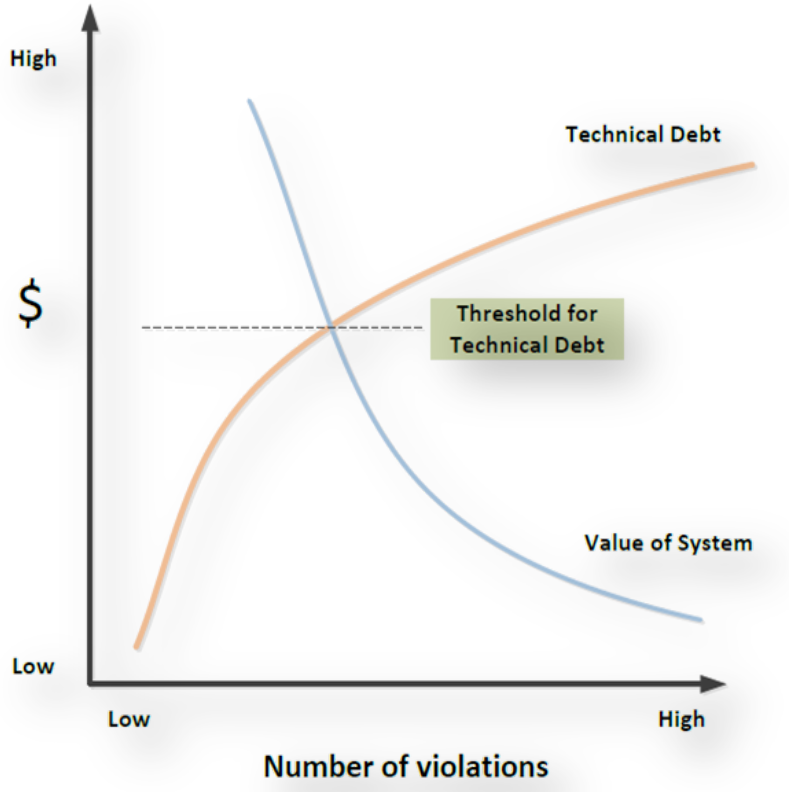
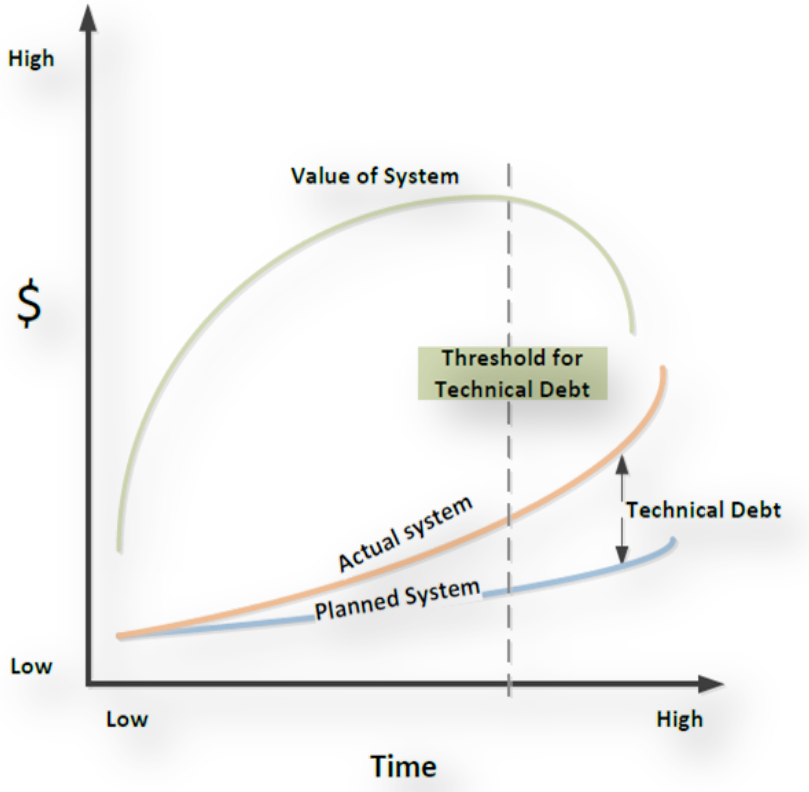
Technical debt metaphor: what is it?

- A metaphor established by Ward Cunningham, used mainly within software system development, which describes the cost and time accumulated due to deviations from intended design.





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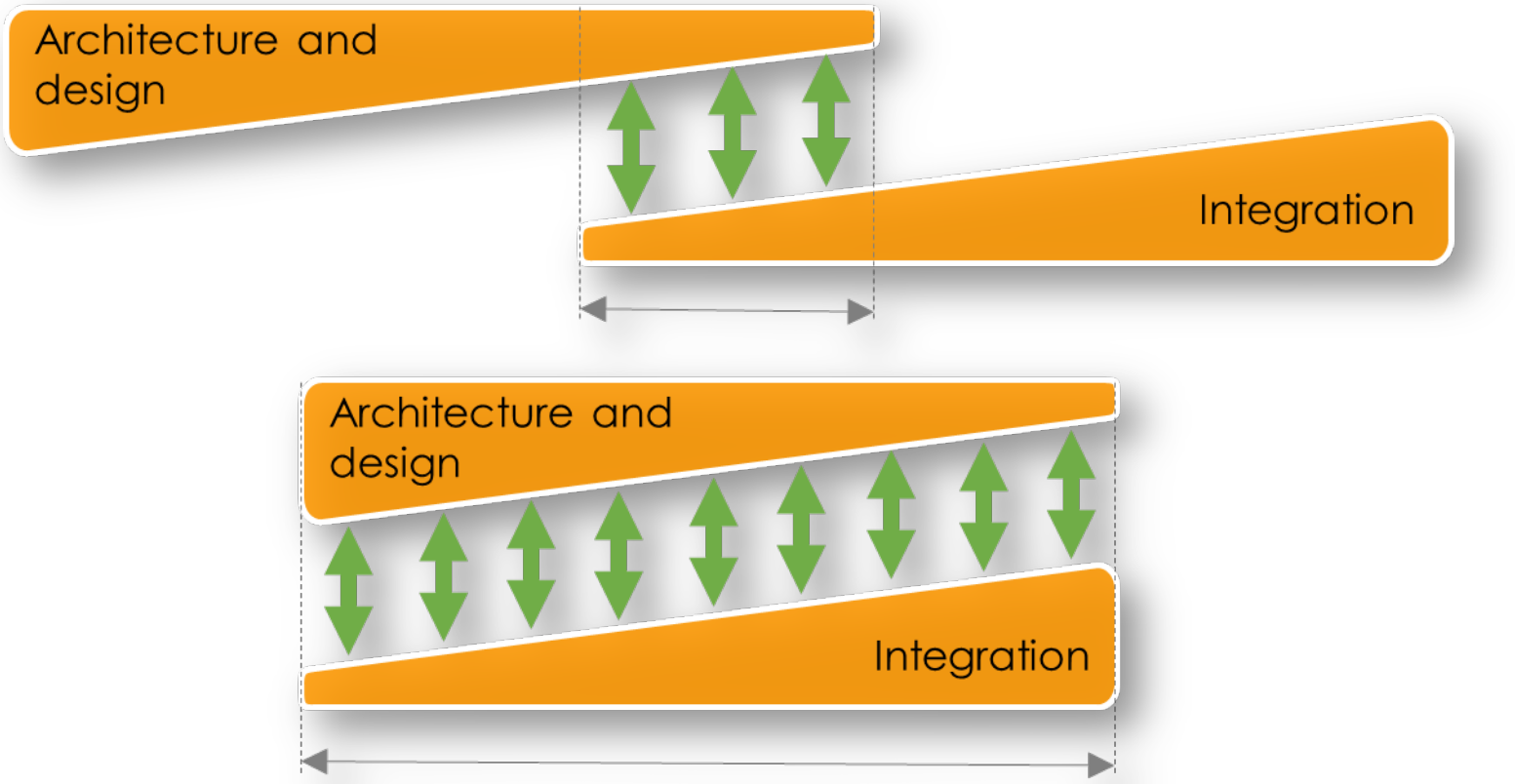
Lifecycle process-orientation of development!



- **Methods for integration can be shared with system architecture and design, e.g. simulation and analysis**
- **Systems integration can influence and challenge design**

Illustration by courtesy of Jonas Andersson and Decisionware AB

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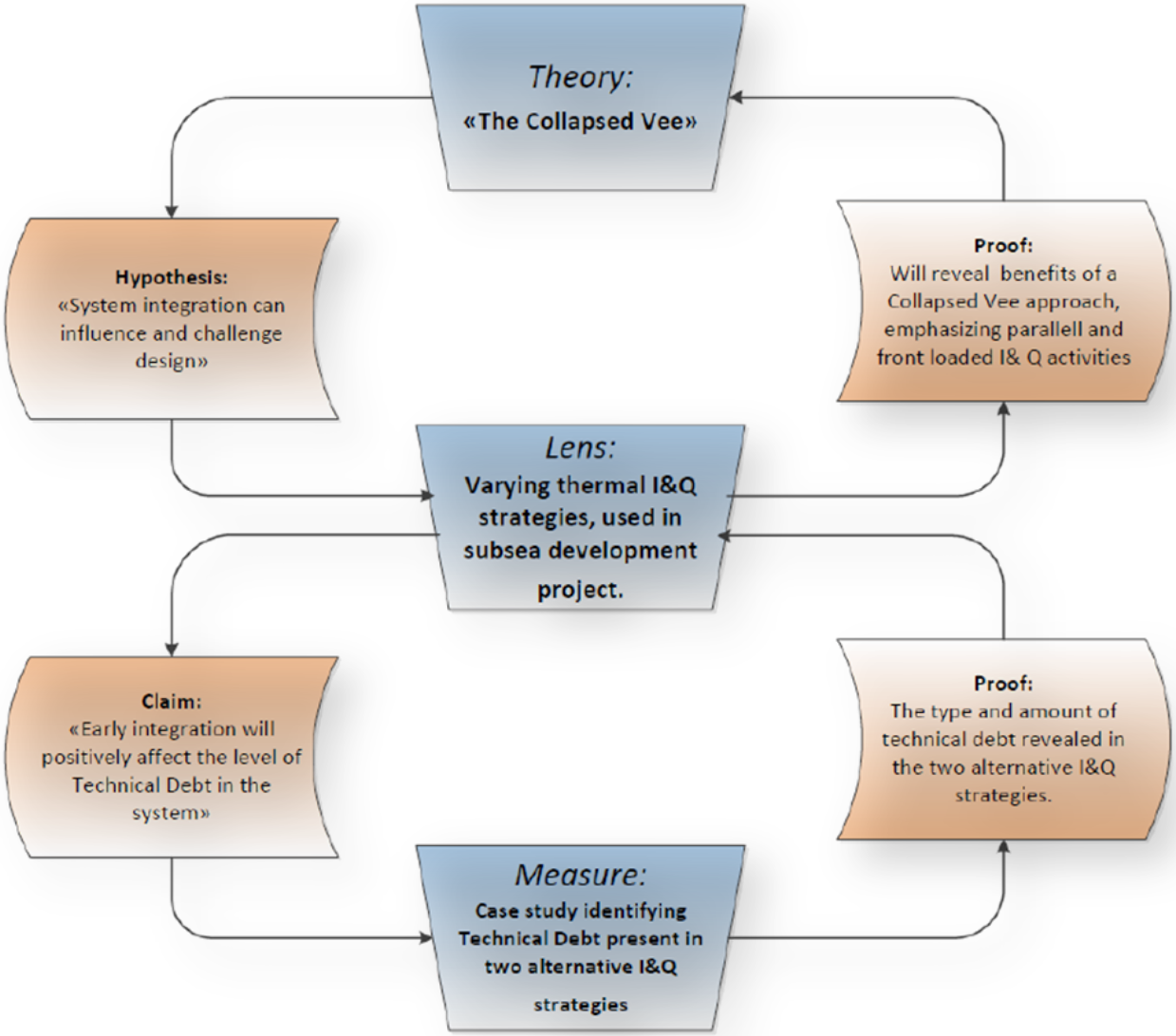
Research approach



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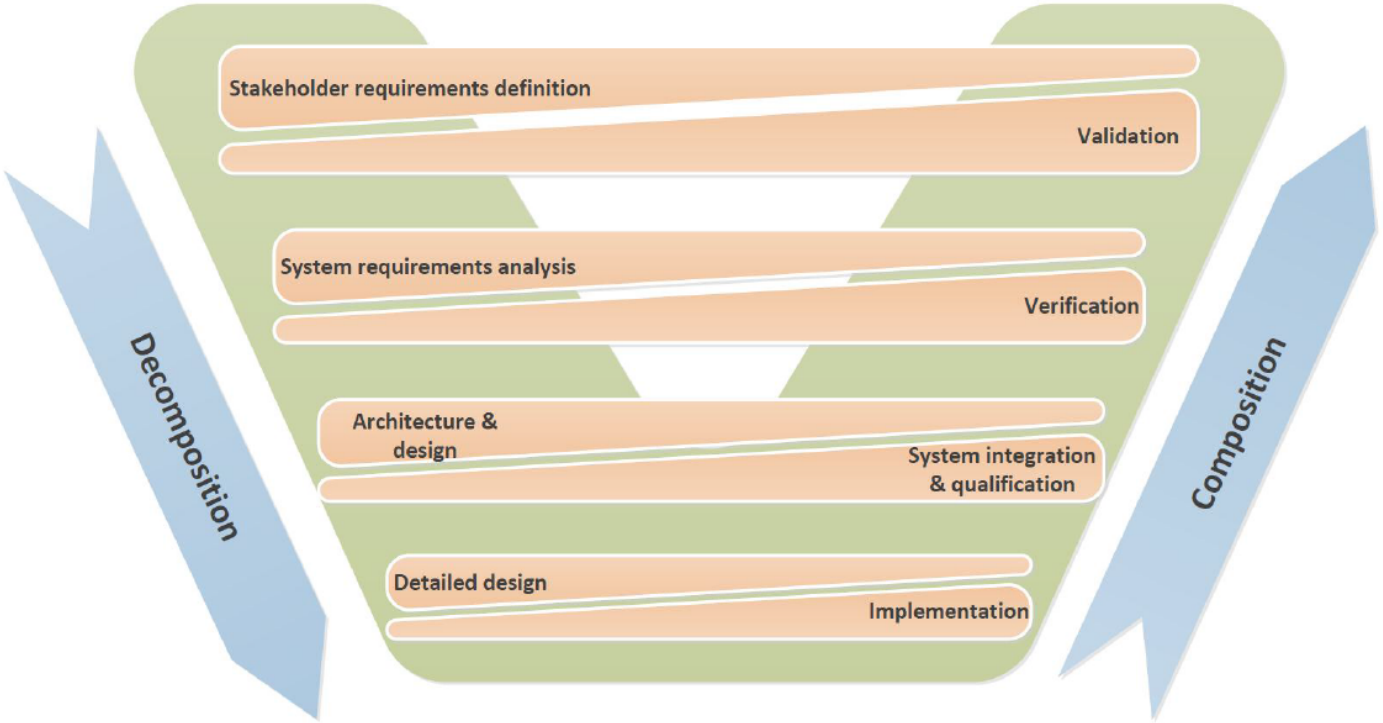
The Collapsed Vee

- A tailored adaptation of the original Vee lifecycle model
- Emphasizing the need for early system Integration & Qualification
- Combines lifecycle and lifecycle process perspectives



The collapsed Vee visualization by courtesy of Jonas Andersson and Decisionware AB

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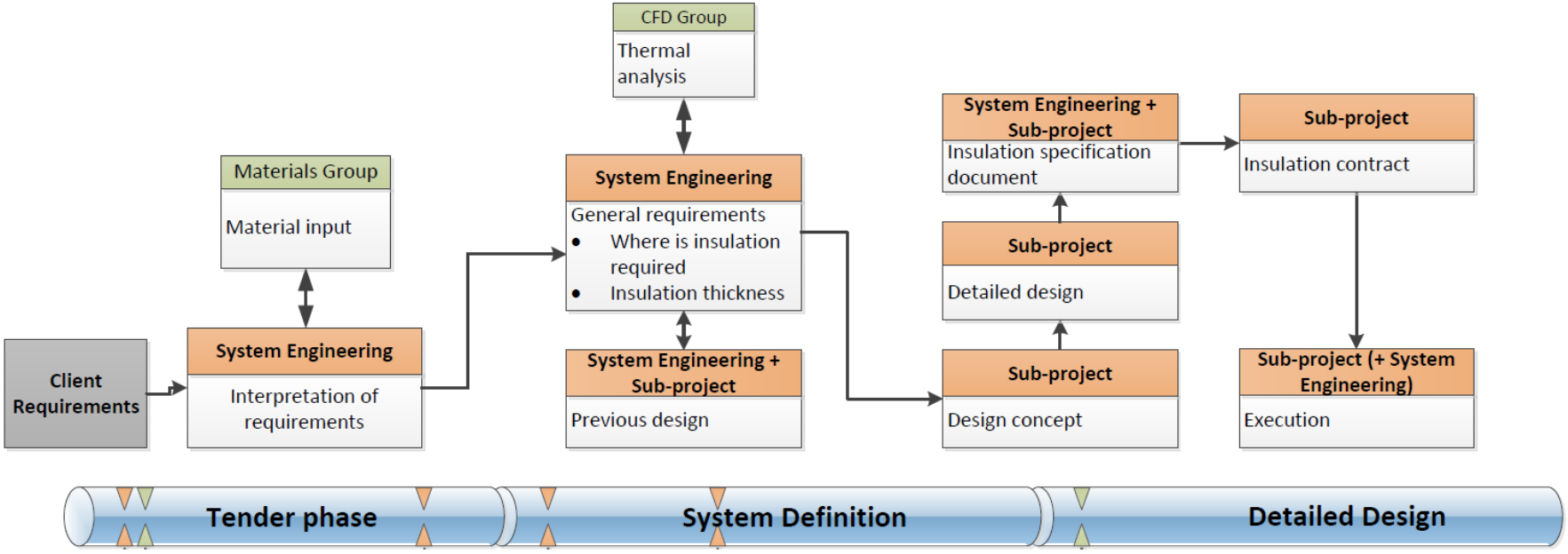
The Case Study

- Data collection by Interviews and analysis of lessons-learned.
- Two sub-projects with different integration strategies compared to a third “reference” sub-project.
- Evidence of Technical Debt in several phases of system development:
  - Tender phase → *Tactical debt***
  - System definition phase → *Design debt***



** Tom et al, 2013

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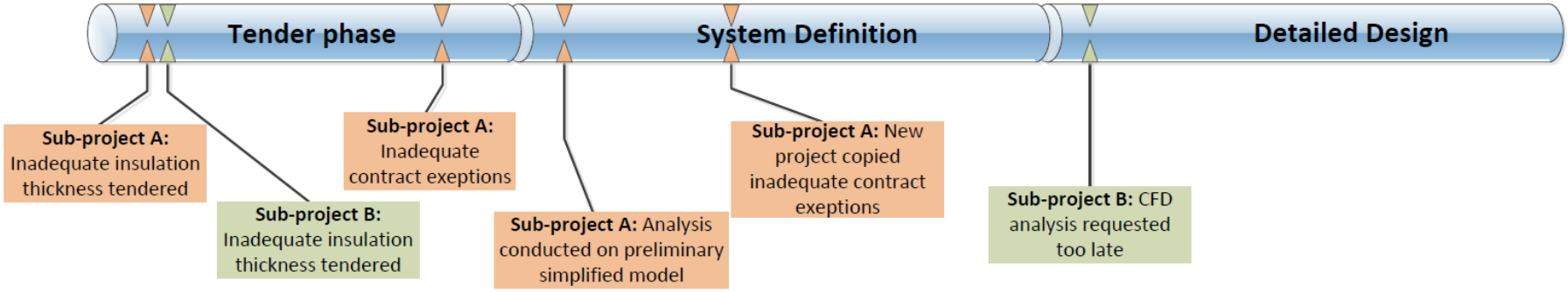
Case study results/findings

- Substantial higher level of Technical Debt in sub-projects that postpone integration activities.
- Higher level of inadvertent technical debt related to integration strategies conducted late in the development lifecycle
- The sub-projects that include the Systems Integrator in earlier development activities have a greater likelihood of developing systems that adhere to thermal requirements (i.e. less Technical Debt).



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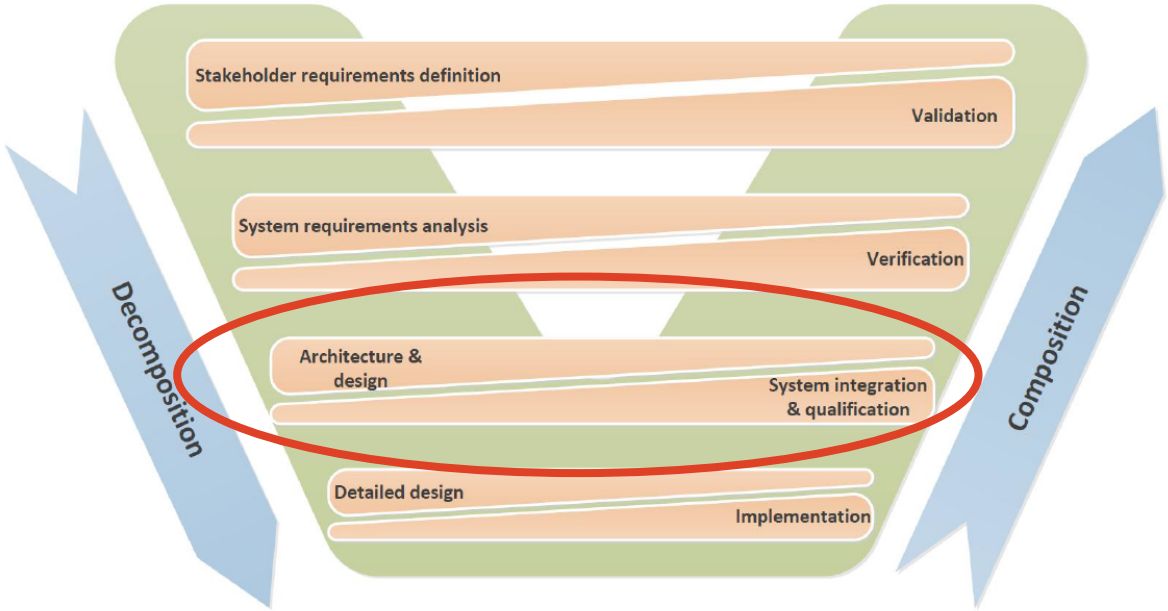
Improvements to thermal management process

- Standardization of thermal design tool packages
  - Same I&Q analysis tools used for sub-systems and complete systems alike
- New role; System insulation coordinator
  - Stakeholder communication with System Integrators and the end customer
- Standardization of thermal development methodology for sub-systems, and complete system enabling early I&Q across Sub-projects



The collapsed Vee visualization by courtesy of Jonas Andersson and Decisionware AB

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Conclusions

- Conducting I&Q activities in parallel with system architecture and design provides value compared to current approach.
- Sub–projects that include system integrators early in development process performs better regarding to thermal performance.
- Technical debt is found to be a useful tool for communicating the consequences of postponing integration activities.
- Findings also indicate that the issues are caused by the lack of a cross functional work process for thermal I&Q.

Questions?

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Q&A

Source: http://lunchstriper.no/

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