33rd Annual INCOSE international symposium

hybrid event

Honolulu, HI, USA
July 15 - 20, 2023

Coping with Verification in Complex Engineered Product Development

Agenda


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Introduction
Research
Literature Review
Case Study
Discussion and Conclusion

Introduction

Background

- Increased demand for company resources
- Difficult to hire sufficient qualified employees
- The company verification process is resource and time consuming

Problem

- Bottlenecks in company test process
- Lacking product test coverage
- Late error and undesired system behavior discovery

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Research Questions

- RQ1: Which “best practices” for verification are reported in the literature?
- RQ2: What does the literature suggest about changes to the current testing practice in the Company?
- RQ3: Which changes can help the Company improve the identification of errors before acceptance testing?

Research Methods

- Systems Engineering
  - Literature Review
  - Industry-as-Laboratory
  - Survey

- RQ1
- RQ2
- RQ3

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Literature Review (1/3)

Early verification

- Early verification can remove defects early and thus reduce the risk and cost of development

Metrics

- MoE, MoP, TPM

Requirements

- The realization of systems requires feasible requirements
- Verification becomes unreliable without correct, complete and consistent requirements

Literature Review (2/3)

Agile approach

- Agile embraces continuous change and focuses on delivery of value to the customer while coping with changes
- Test-driven development (TDD) is one of the approaches suggested

Configuration management

- Complex systems with long life cycles will experience changes
- Managing the changes requires adequate management of all configurations of a system during its lifecycle

Literature Review (3/3)

Traceability

- Traceability is required to trace root cause errors, performance deficiencies, sufficient functionality, and the source of changes

Testing and Integration

- Cooperation between design and integration engineers early in the development process is important to effectively remove errors and achieve successful integration

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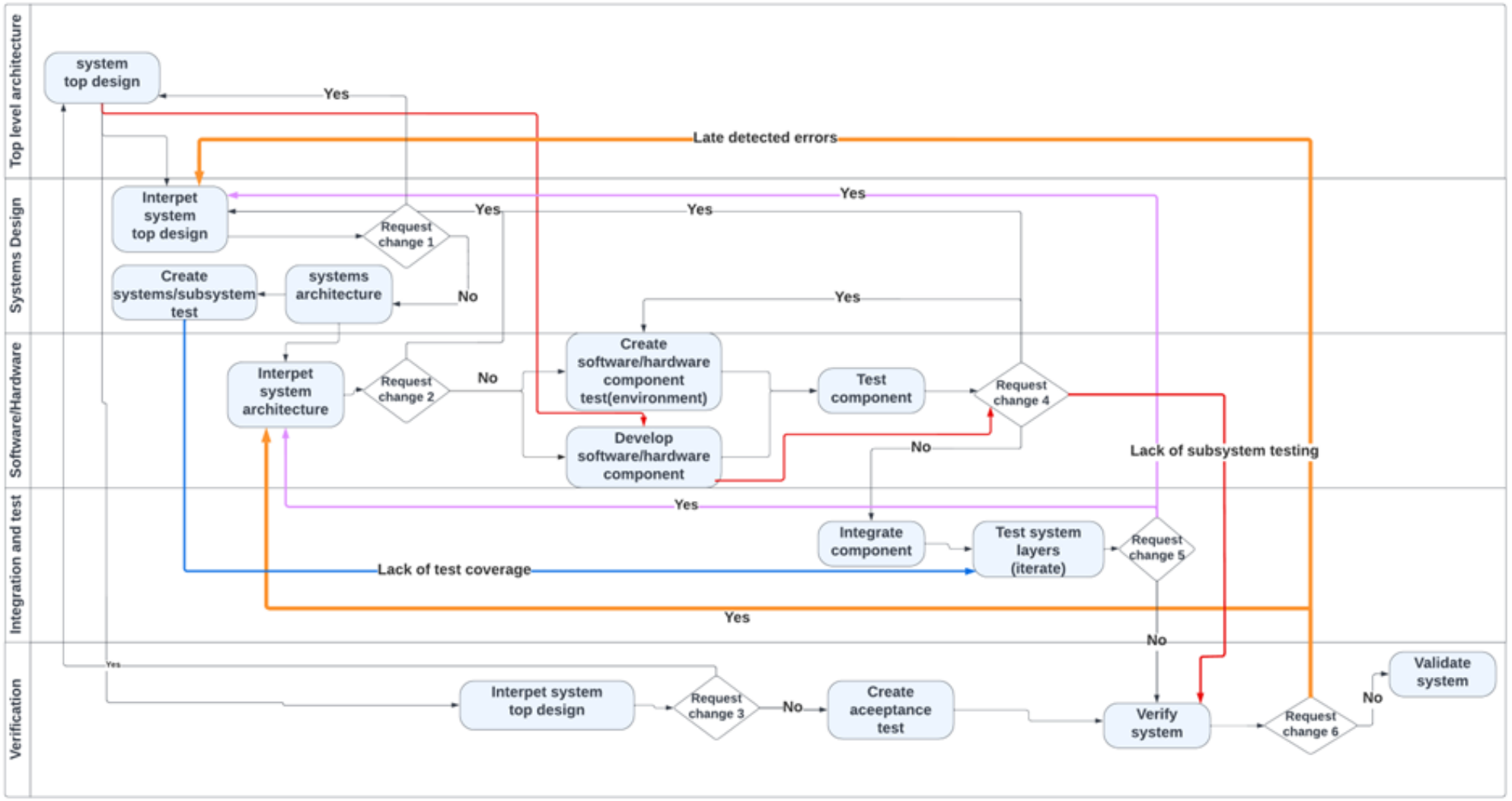
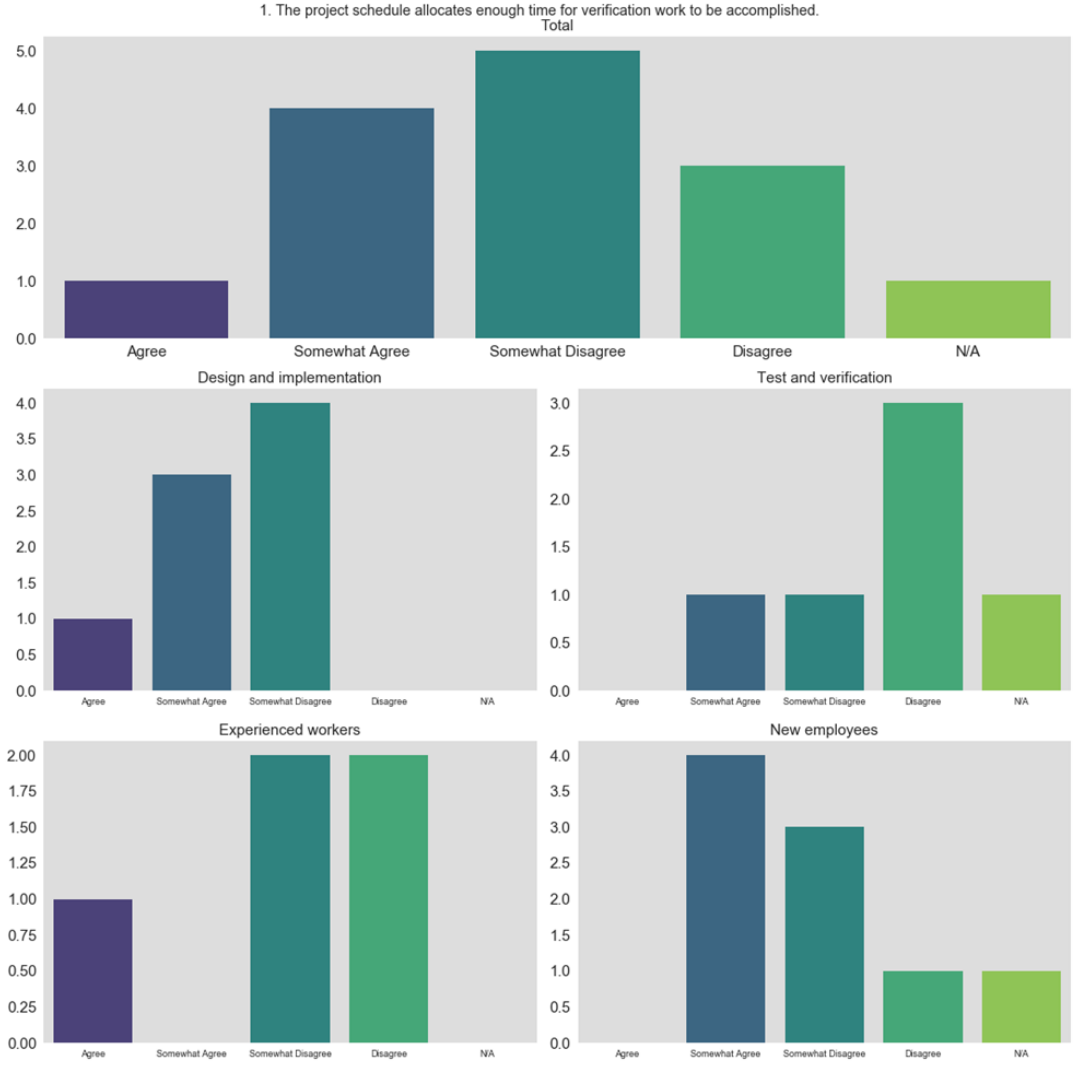
Case Company Work Process



Work Process Findings

- Process shortcuts
- Late verification feedback
- Lack of verification arenas
- Missing focus on integration testing

Case Company Survey



Survey Findings

- Missing regression testing at system level
- Insufficient analysis
- Usefulness of documentation
- Schedule
- Measurements and monitoring
- Process improvements
- Team structure
- Configuration management

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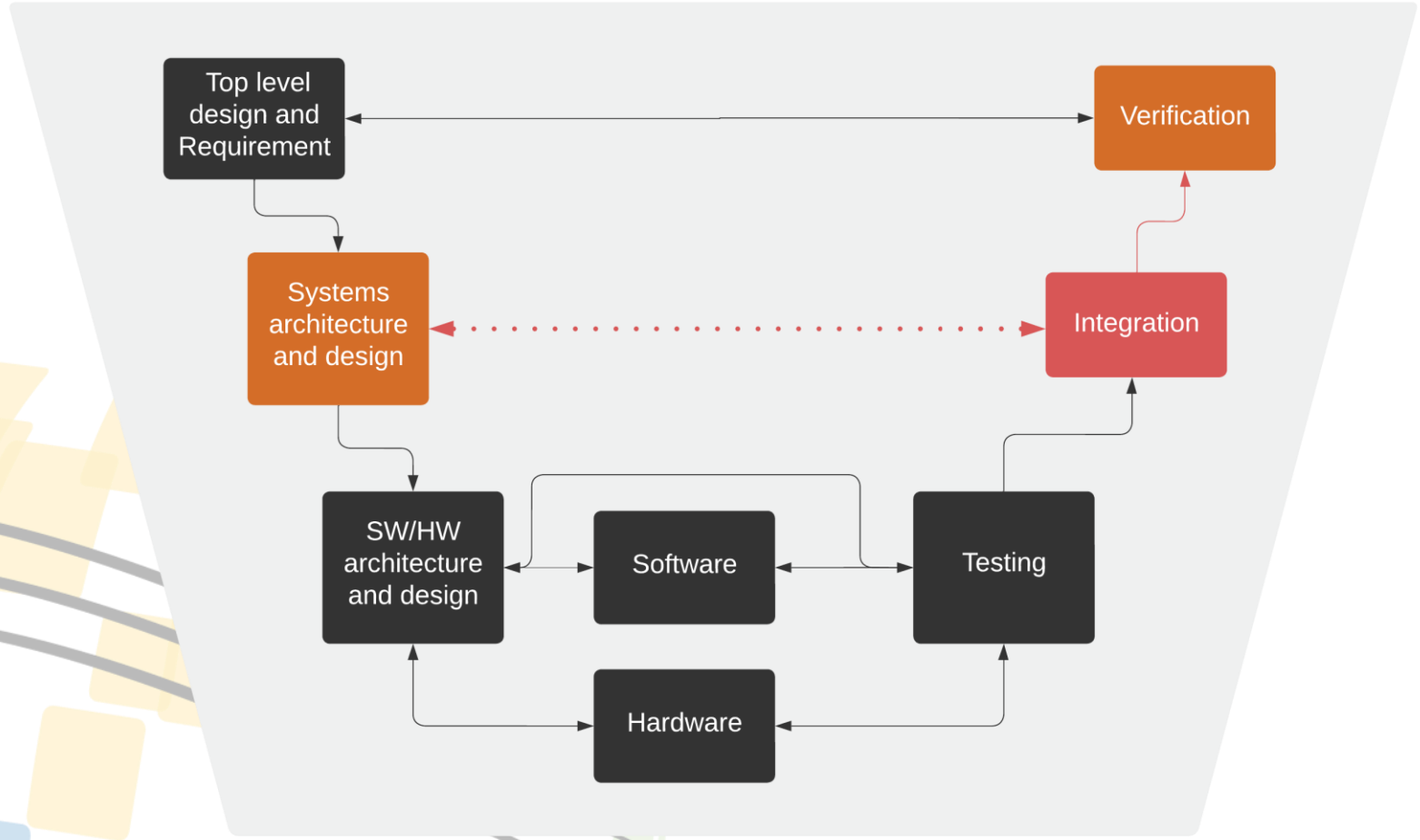
Discussion

- RQ1: Early verification, metrics, requirements, agile approach, configuration management, traceability, testing and integration
- RQ2: The company follows many of the recommended processes. The most noticeable deviations are system analysis (req vs SOI), available test arenas fit for purpose, and communication across « silos »
- RQ3: Follow its processes and use metrics

Conclusion


Top level design and Requirement
Verification
Systems architecture and design
Integration
SW/HW architecture and design
Software
Testing
Hardware

Conclusion

- Insufficient verification activity scheduled
  - Reinforce its process
- Insufficient testing (integration and regression)
  - Available test arenas
- Insufficient test result analysis
  - Utilizing data and sharing information
- Insufficient measurements and monitoring
  - Enforce

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