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Optimizing the requirements engineering process: A case study of I/O list management in Integrated Automation Systems

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Who is presenting

Satyanarayana Kokkula (Satya)

Associate Professor in Systems Engineering
University of South-Eastern Norway

Research interests

- Testing and verification, Systems Engineering, Product development, Robust design, Crash mechanics and Numerical simulations

Work Experience as

Specialist Engineer, Structural Analysis at FMC Kongsberg Subsea AS (2006 - 2016)
Assistant Systems Engineer at TATA Consultancy Services, Pune, India (2001 - 2002)



Educational Background

PhD in Structural Engineering, NTNU (2002 - 2005)
M.Tech in Applied Mechanics, Indian Institute of Technology (IIT) Delhi, India (1999 - 2000)



Agenda

- Introduction
- Problem Statement
- Stakeholder involvement
- IAS Case Study
- Solution
- Conclusions





Company

IAS vendor within the maritime industry

- Employees > 6500

The author of this thesis is working within the LNG carrier segment.



Case background

Introduction



- The major Asian shipyards are the main customers of *The company's IAS for LNG vessels*.
- These shipyards have, over the last years, experienced decreased activity due to the loss of investment in the oil industry





- The decreased activity affects *The company* in terms of reduced contract price, as the shipyards are demanding for IAS at a lower price.
- Under the increased cost pressure, *The company* has a need to optimize their current way of working.



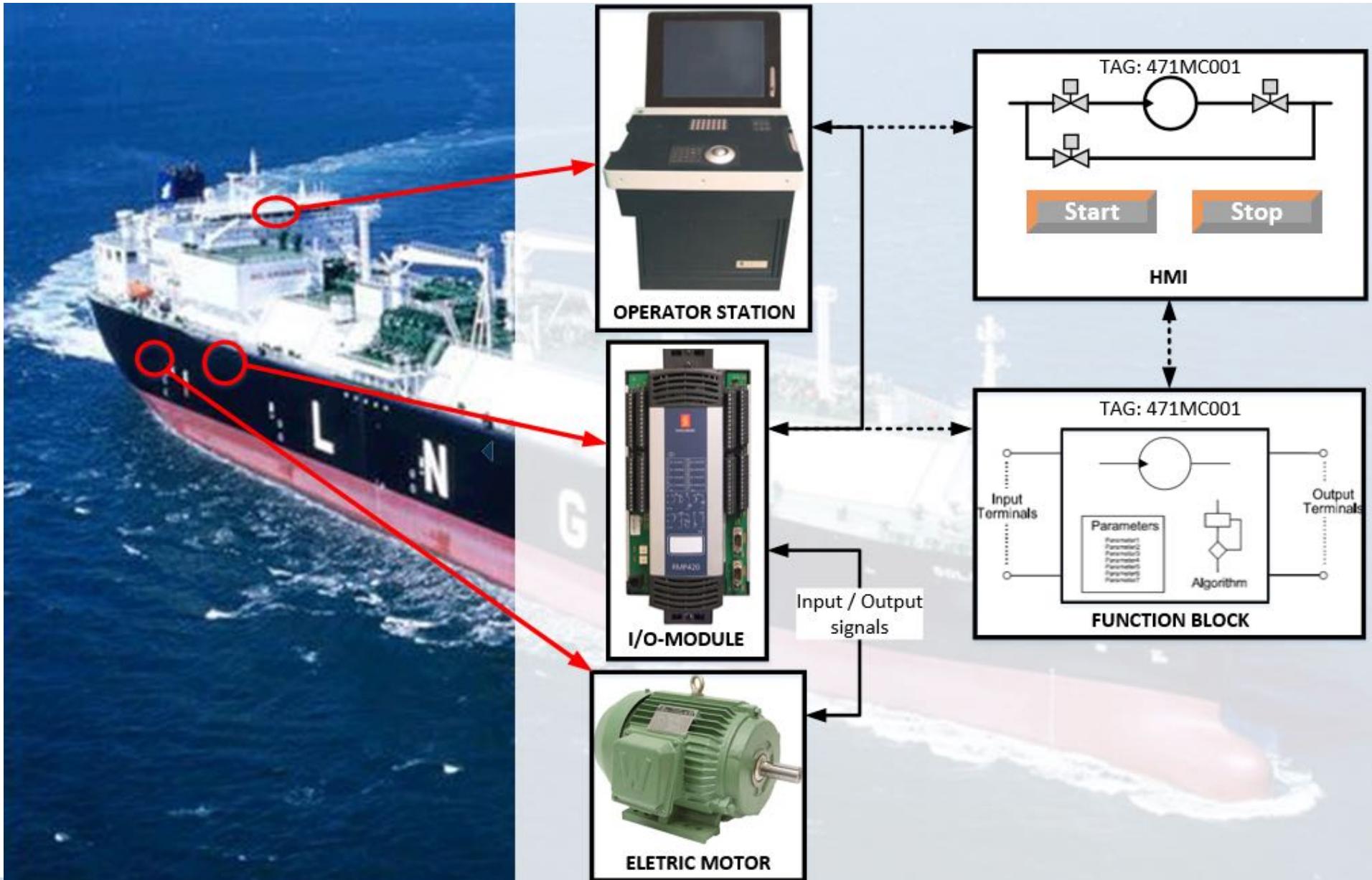
Integrated Automation System (IAS)

Introduction



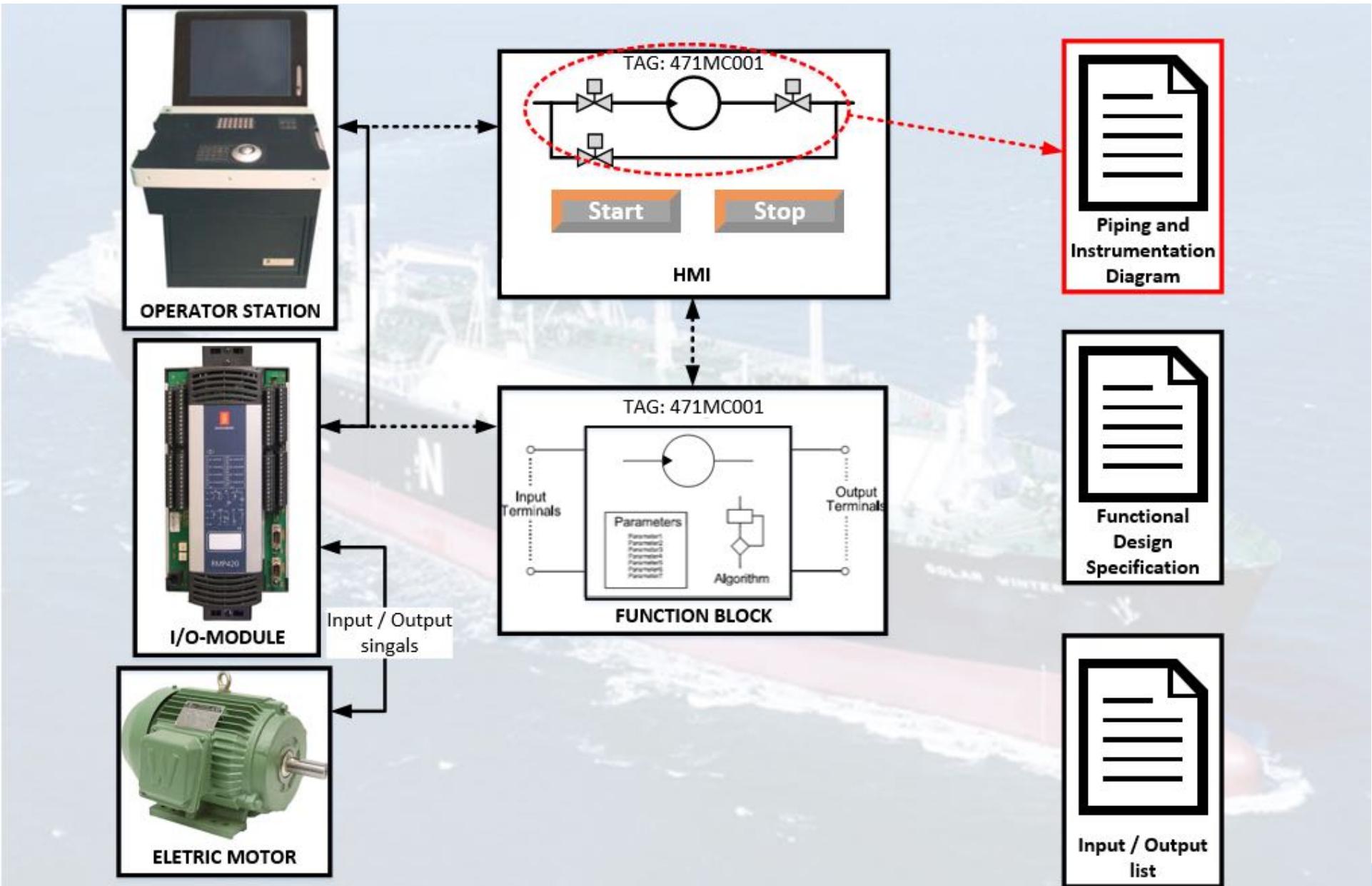
Integrated Automation System (IAS)

Introduction



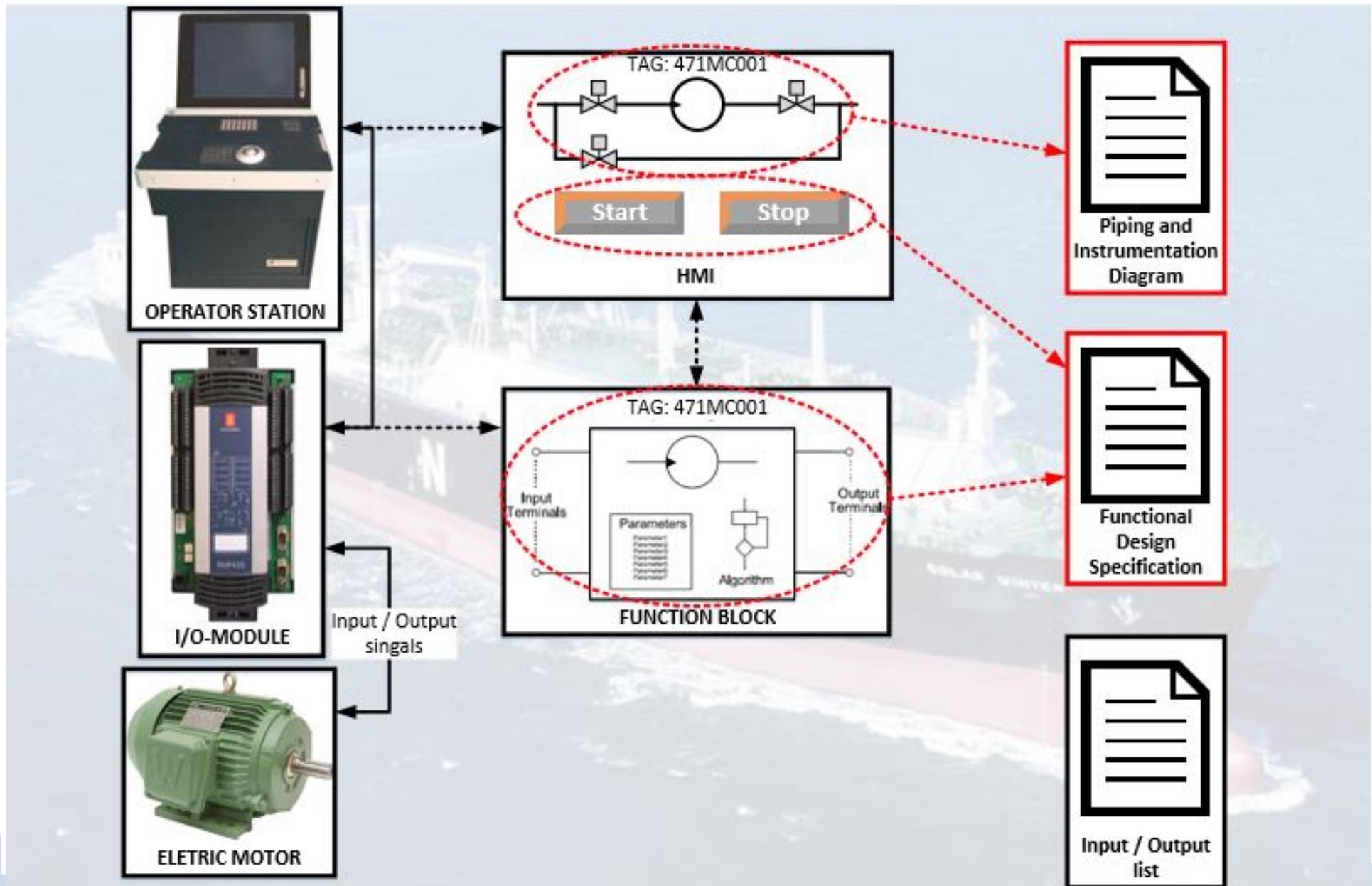
Requirements Documentation

Introduction



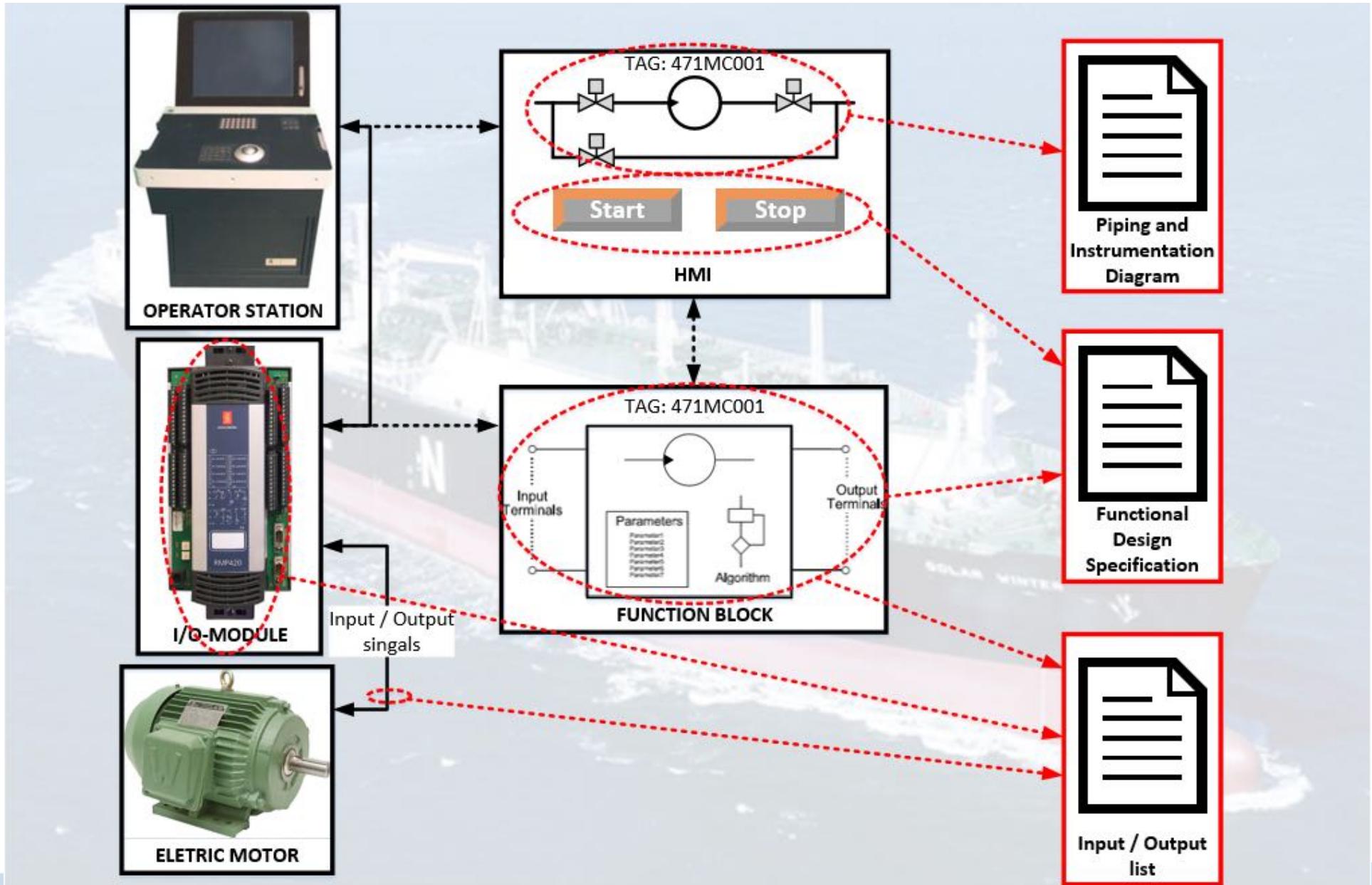
Requirements Documentation

Introduction



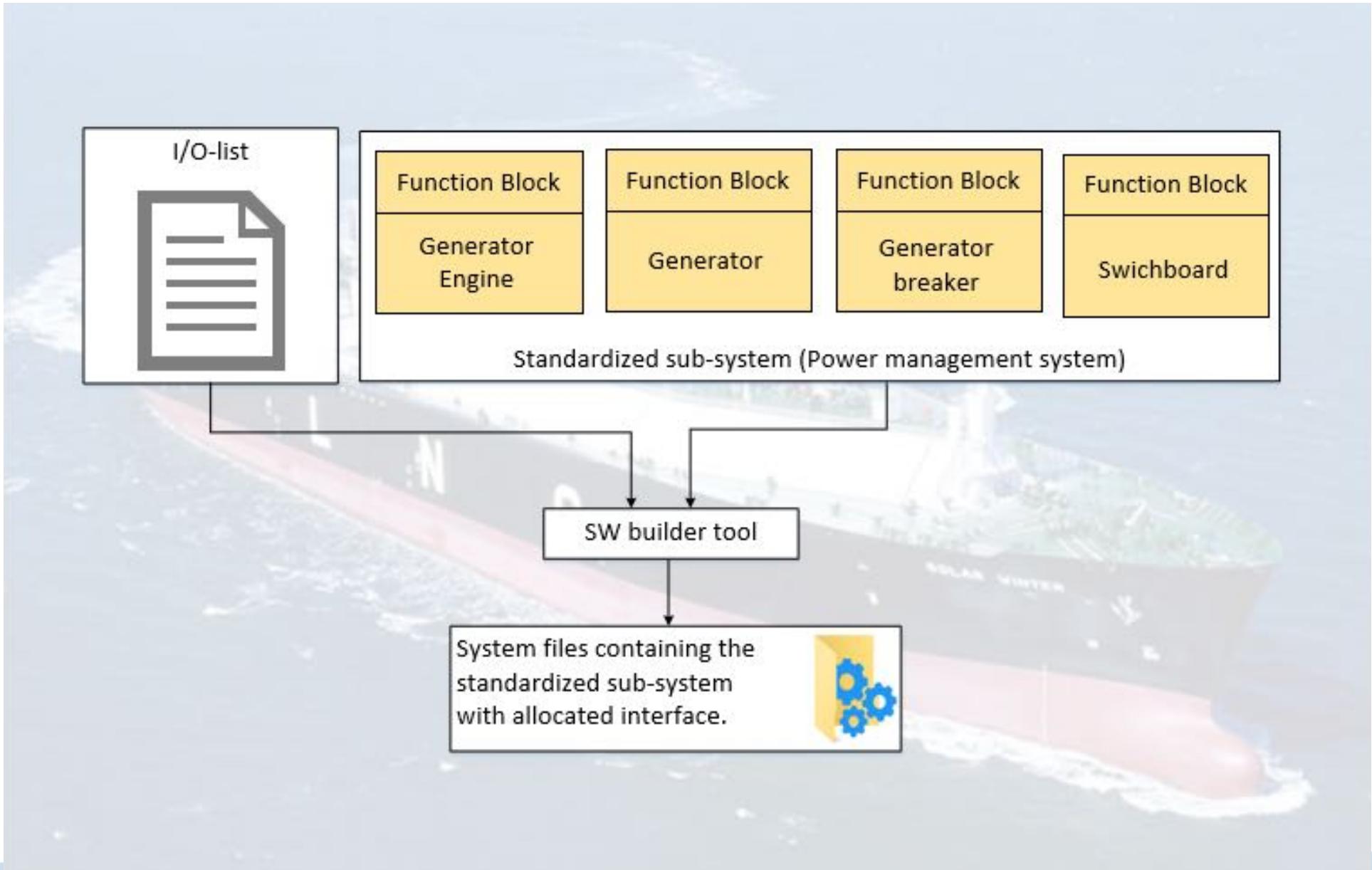
Requirements Documentation

Introduction



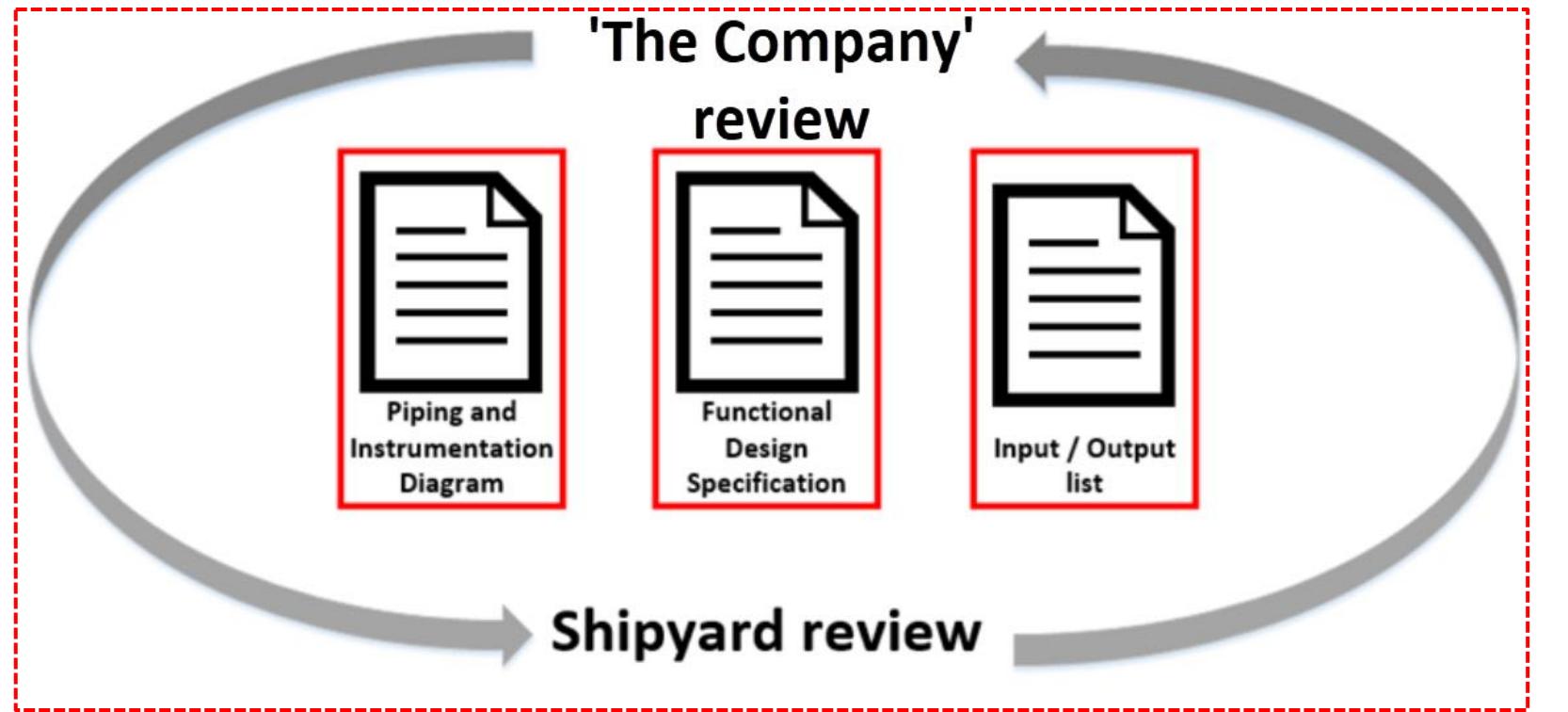
Software Production

Introduction



Software Production

Introduction





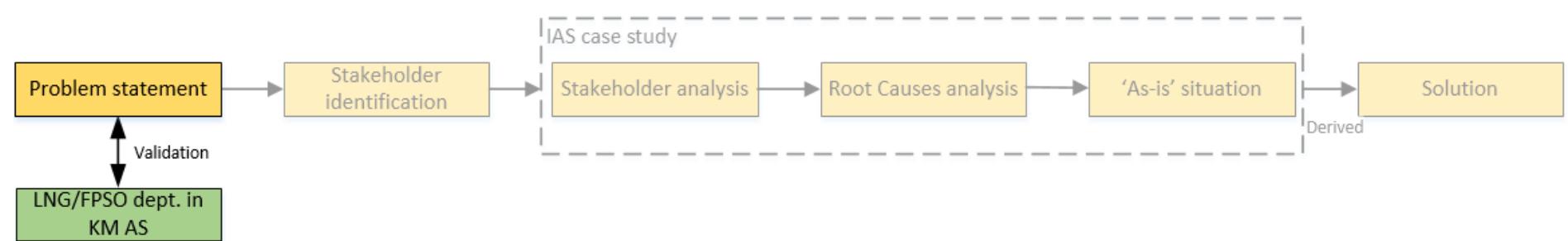
- A well performing RE process is found to be crucial to keep up with the increased complexity of the IAS delivery (Vyatkin, 2013).
- There has been a strong initiative within *The company* to improve the RE process in order to reduce the man-hours during an IAS delivery.

Problem Statement

Introduction



- what are the causes related to the I/O-list management delaying the software production?
- how to resolve the causes related to the I/O-list management for an optimized RE process ?

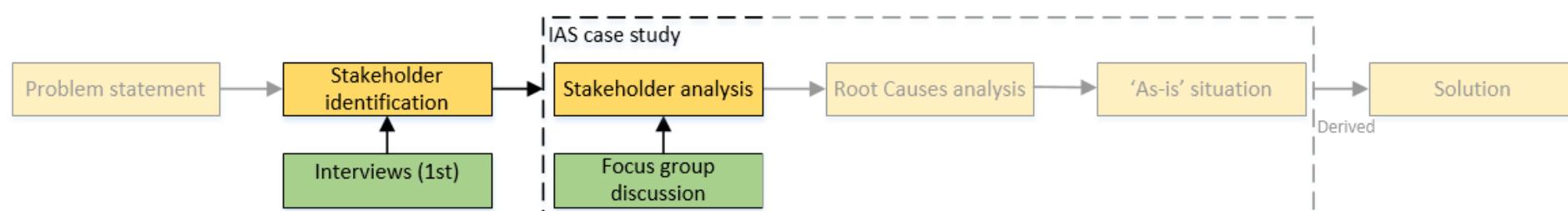


Stakeholder Identification & Analysis

Stakeholder
Involvement

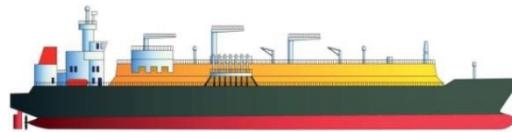


Stakeholder	Who	Interaction with IAS
Users	End-customer (Ship owner/operators)	Contractual, Fault tracing, signal overview
	Service Engineer (<i>The Company</i>)	Fault tracing, signal overview, corrections
	Commissioning Engineer (<i>The Company</i>)	Loop testing, system check
	Shipyard Commissioning Engineer	Loop testing, checklist
Developers	Project Engineer (<i>The Company</i>)	Main user. I/O list management, System design and implementation
	Lead Engineer (<i>The Company</i>)	Domain experts, System verification
	Project Manager (<i>The Company</i>)	Contractual
Legislators	Class-society	System approval
Decision-makers	Sales personal (<i>The Company</i>)	Quotation and selling to proposed solution
	Department manager (<i>The Company</i>)	Recourses and approval of proposed solution
Customer	Shipyard Design Team	Main user. I/O list management, System design
	3 rd part sub-vendors (satellite stakeholder)	Provides requirements of signals characteristics & <u>amount</u> of signals

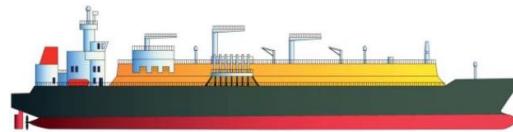


IAS deliveries

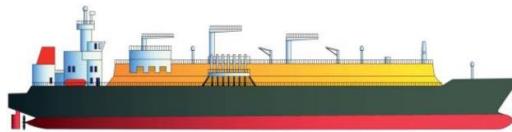
IAS Case Study



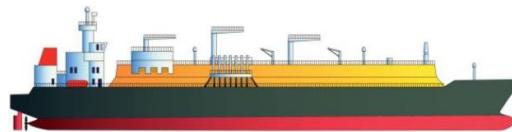
1. LNG Carrier



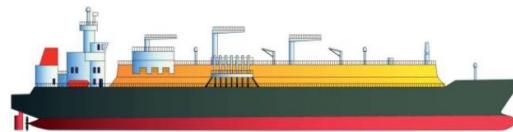
2. LNG Carrier



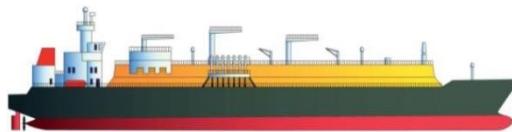
3. LNG Carrier



4. LNG Carrier

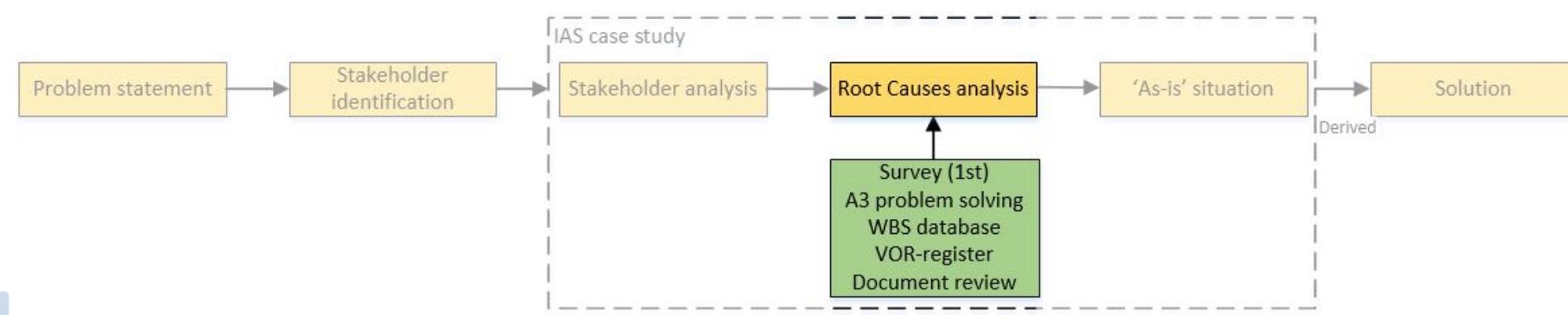


5. LNG Carrier



6. FSRU

- Not older than 3 years in order to include the latest technology

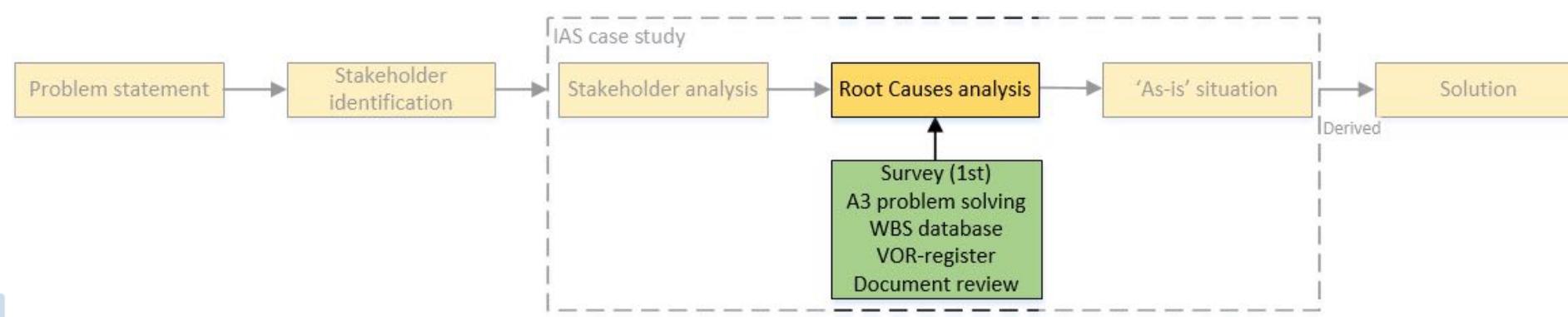


Internal RE maturity

IAS Case Study



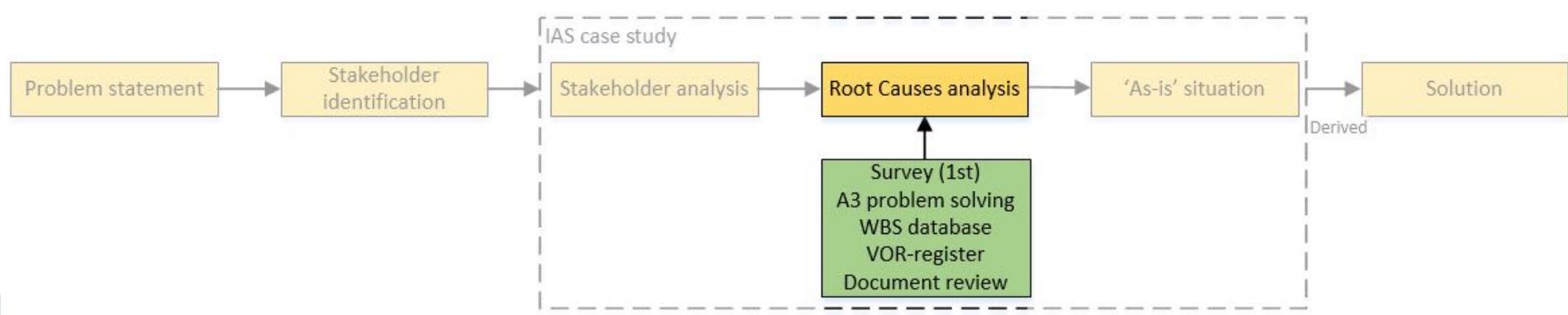
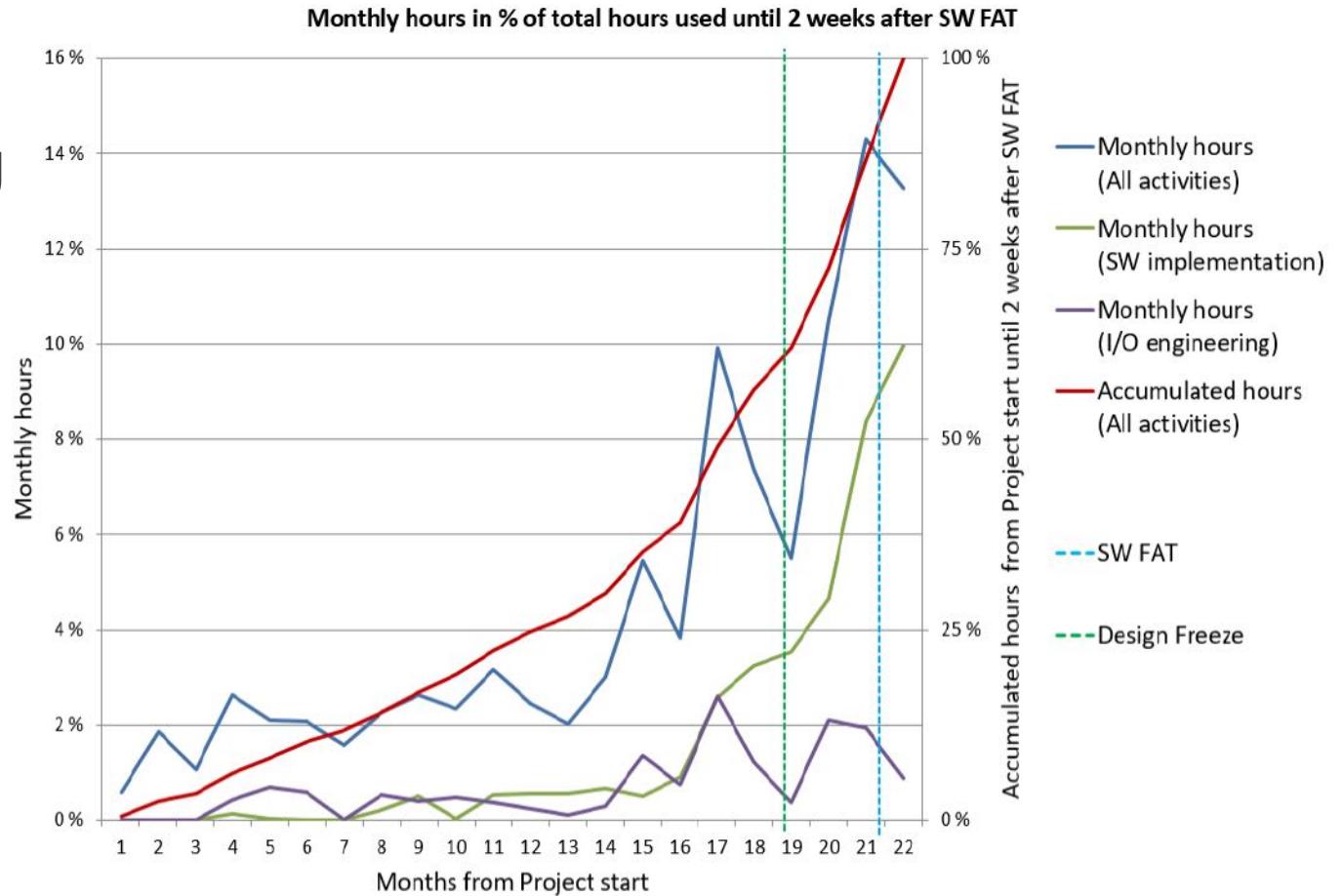
- 8 out of the 23 CIP analyses related to the IAS-SW production process and I/O list management.
 - lack of competence (19%)
 - lack of standardization (16%)
 - poor documentation (16%)
- The lack of competence, standardization and documentation related to the I/O list management affects the RE process performance.
- In the above 8 cases the following mitigation strategies are applied:
 - improvement of procedures/documentation
 - increasing the focus on standardization
 - increasing the focus on front-end engineering



Late changes

- 34% of the total I/O-list engineering activities occurred after the design freeze
- It can be seen that major changes to the I/O-list are still occurring after design freeze

IAS Case Study

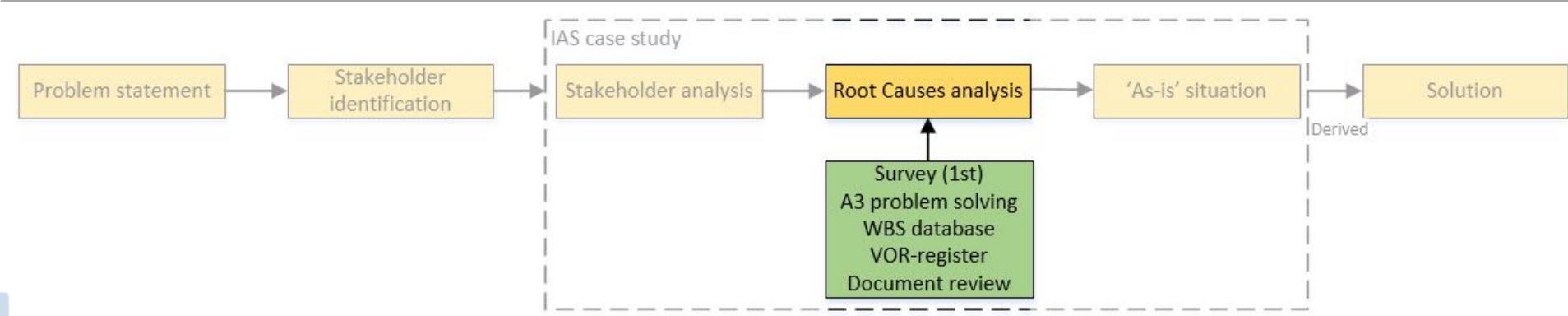


Late changes

IAS Case Study

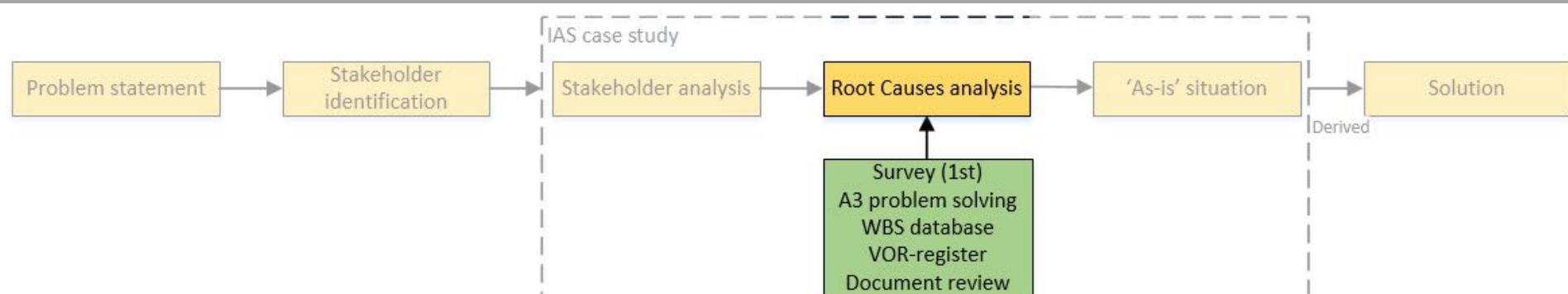
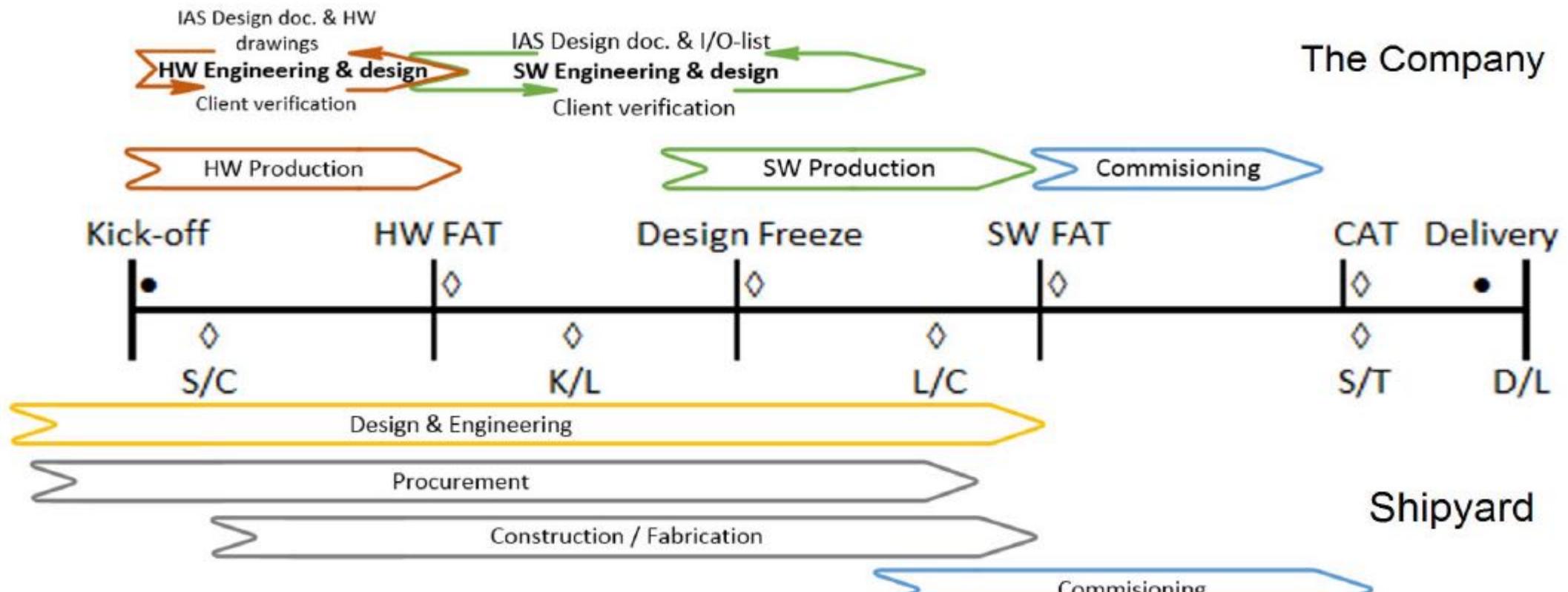


- The variation order request's (VOR) for the IAS case studies were analysed, which showed that 24% of the accepted and pending VORs was related to changes on interfaces and/or specified I/O-list.
- Changes to the I/O list after design freeze lead to increased cost for the shipyard.



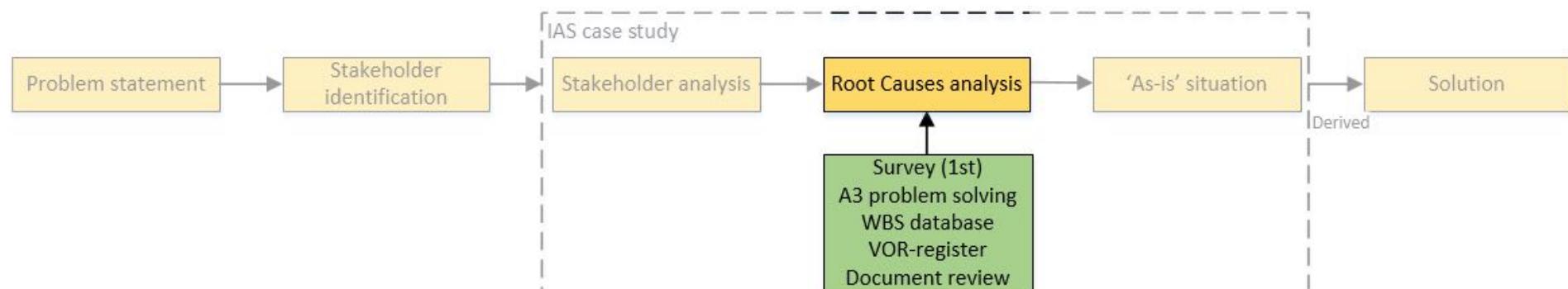
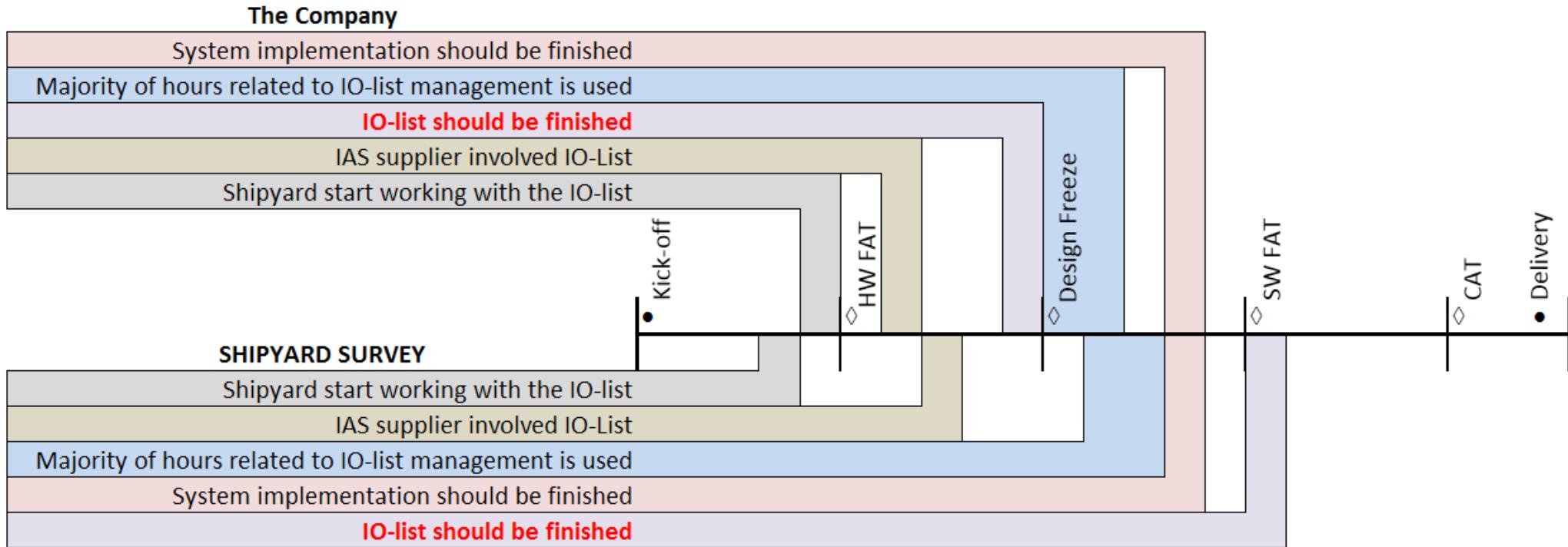
Milestones Inconsistency

IAS Case Study



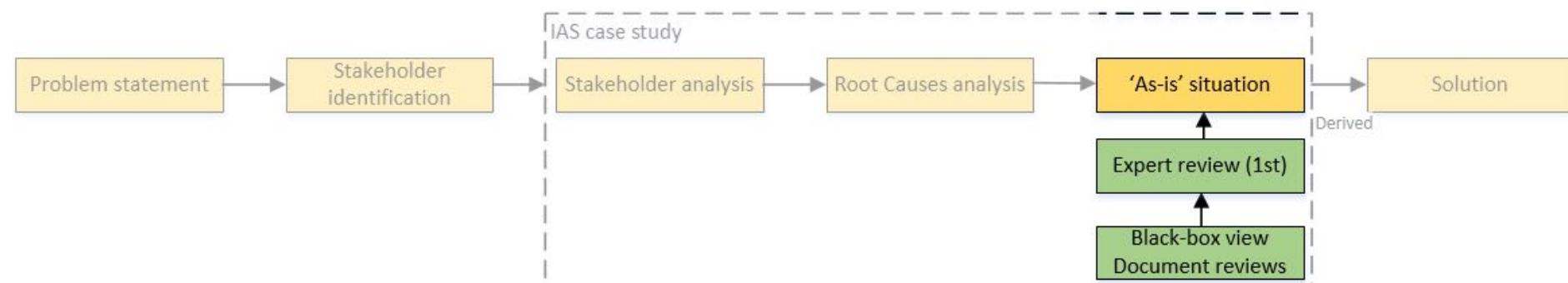
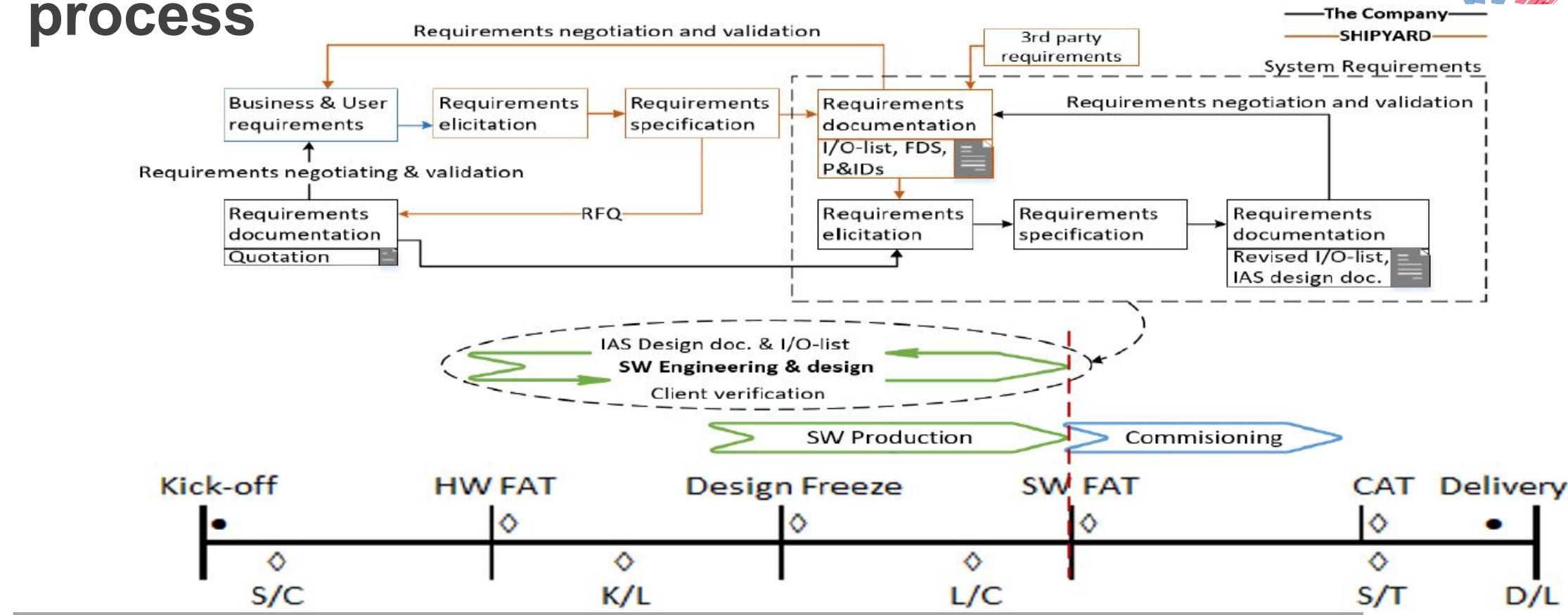
Design Freeze

IAS Case Study



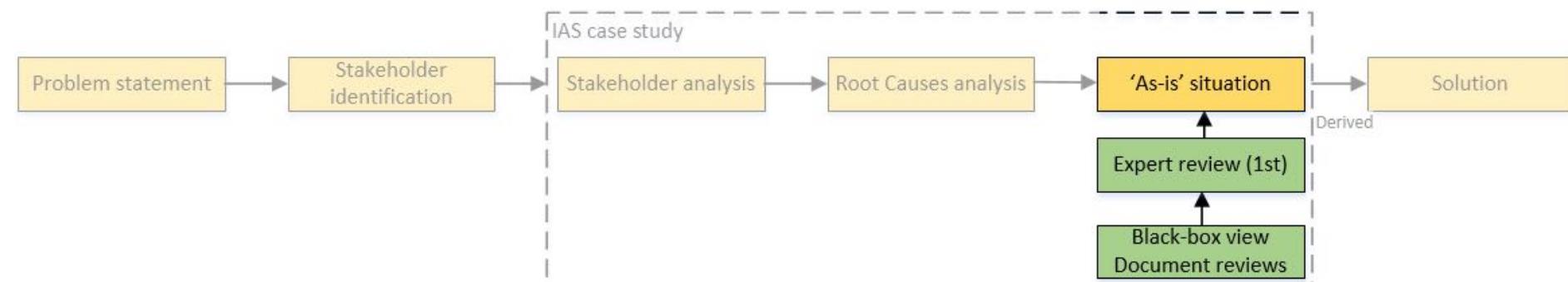
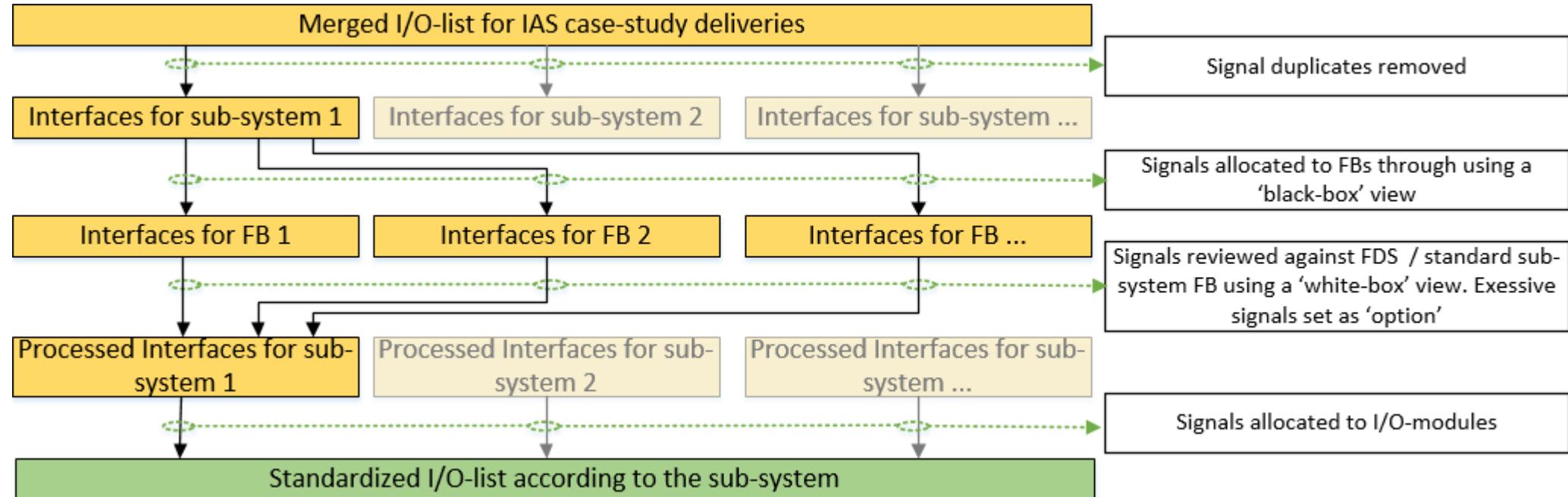
Current Requirements Engineering process

IAS Case Study



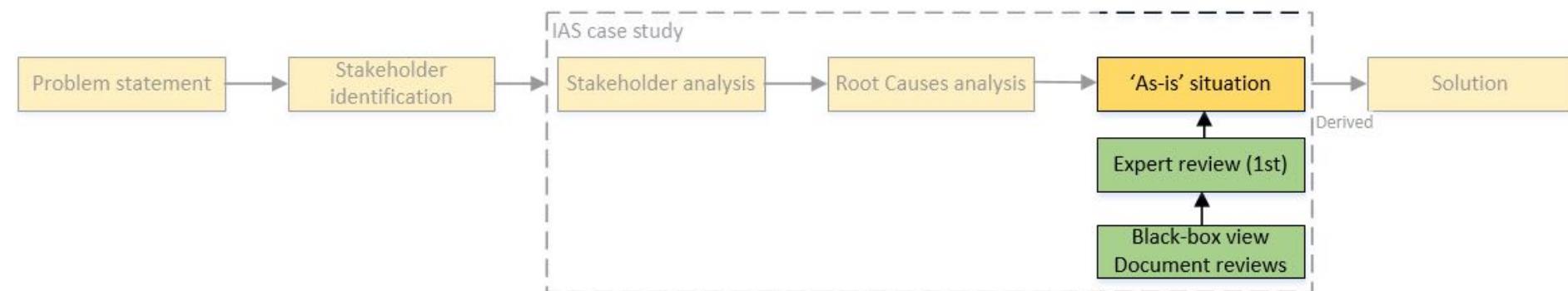
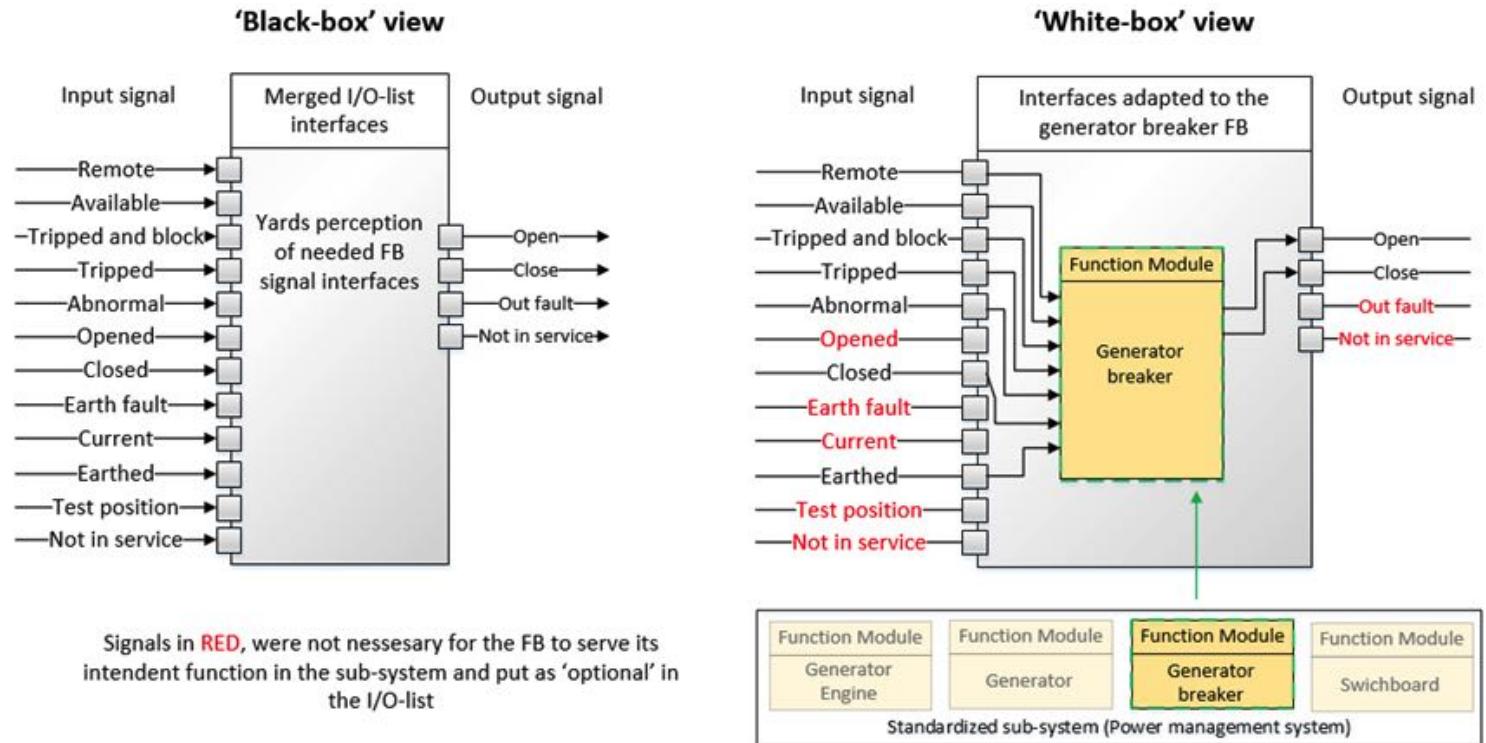
Standardization of I/O list

IAS Case Study



Standardization of I/O list

IAS Case Study



Findings

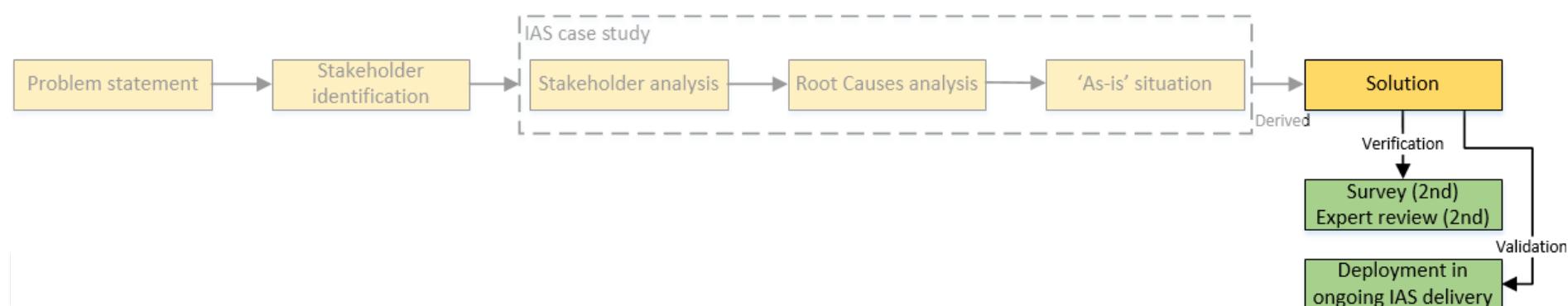
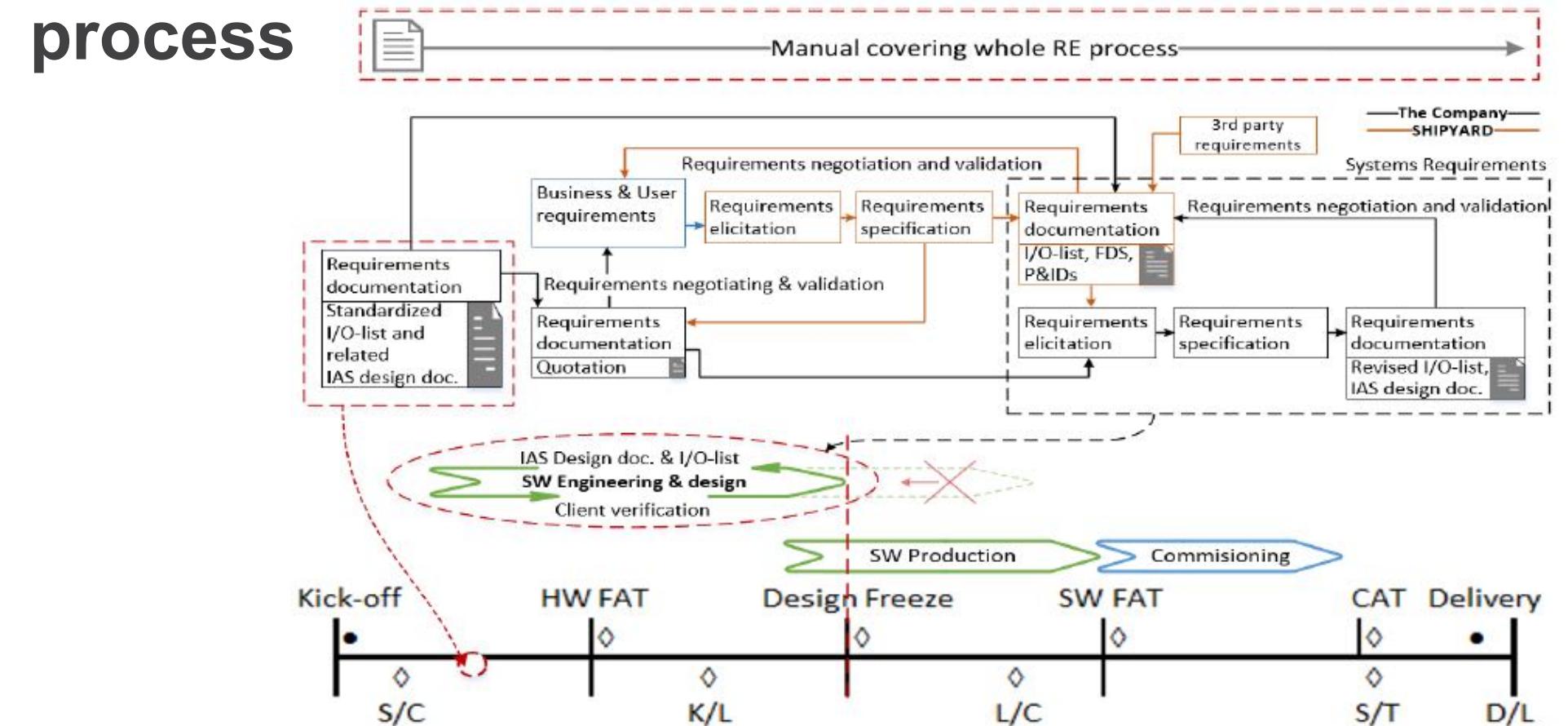
IAS Case Study



- The shipyards ownership of the I/O-list management process is currently causing late initiation of the I/O-list iterations.
- Lack of knowledge and standardization of the current RE process causes inconsistency in the requirements documentation
- It is proven that major changes to the I/O-list occurs after the design freeze causes additional SW engineering.
- The most time consuming work related to the I/O list for the IAS vendor is modification and corrections on the I/O-list after design freeze.
- There is an urgent need for improvement of internal procedures and system standardization. The lack of internal procedures causes an increased use of engineering hours.

Optimized Requirements Engineering process

Solution



Conclusions



The findings show that the I/O-list management delayed the IAS-SW production, due to the lack of ownership to the requirements documentation and the lack of standardization of RE process.

By optimizing the RE process, *The company* have been able to gain more ownership of the I/O list management process.

By implementing the standardized I/O-list management process, a reduction in 40% man-hours was realized.





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