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Case Study in an IoT Consultancy

Early Validation using Architectural Overviews

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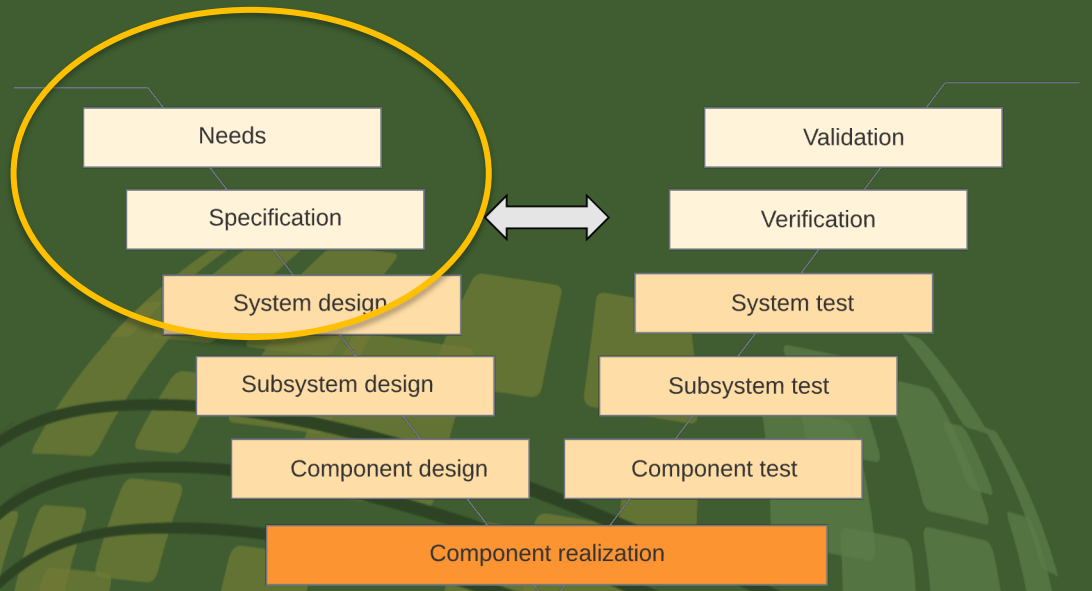
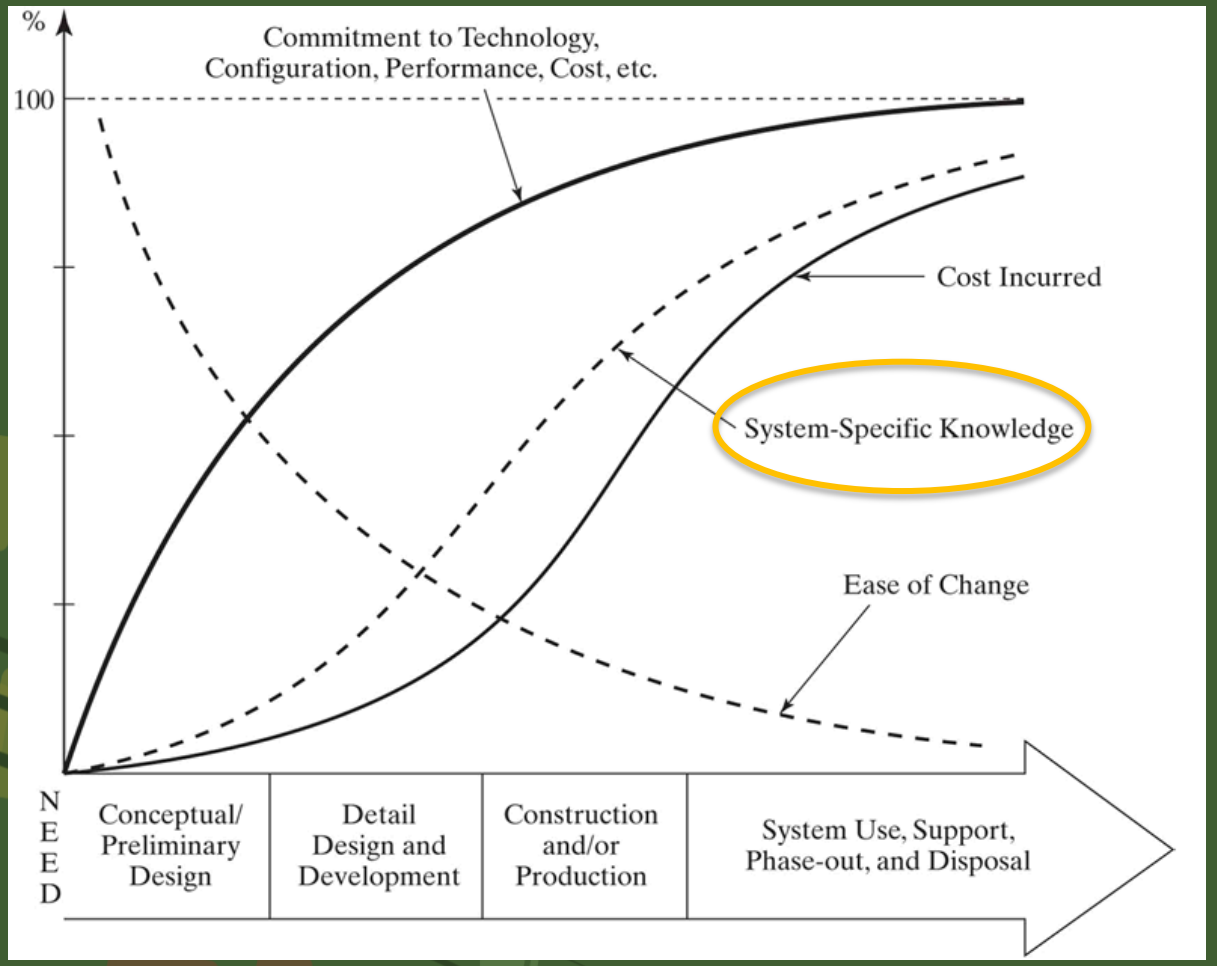
Systems Visualizations / Conceptual Models



V model adapted from gaudisite.nl

Capture and share systems-specific knowledge in the early phase of systems development using abstract visualizations to communicate to a wide variety of stakeholders

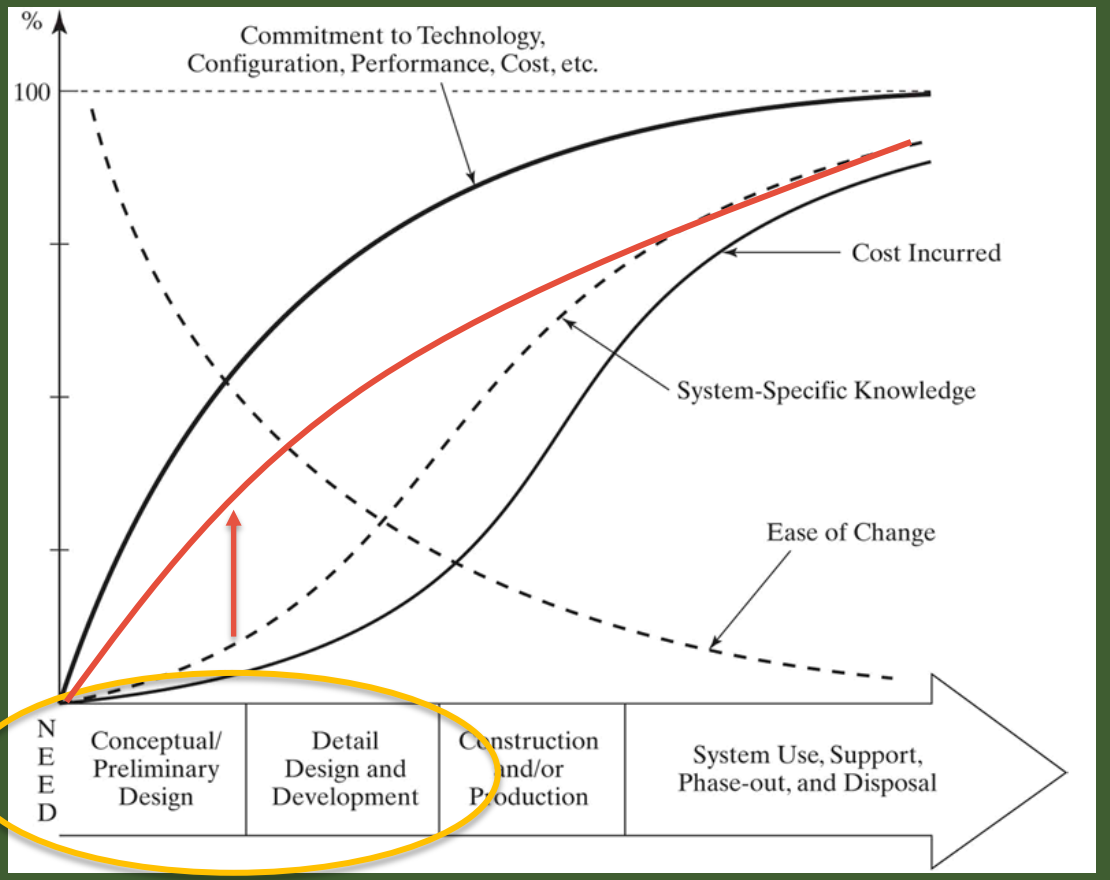
Challenges in early systems development



Blanchard and Fabrycky (2014)

Using visualizations in early phase SE

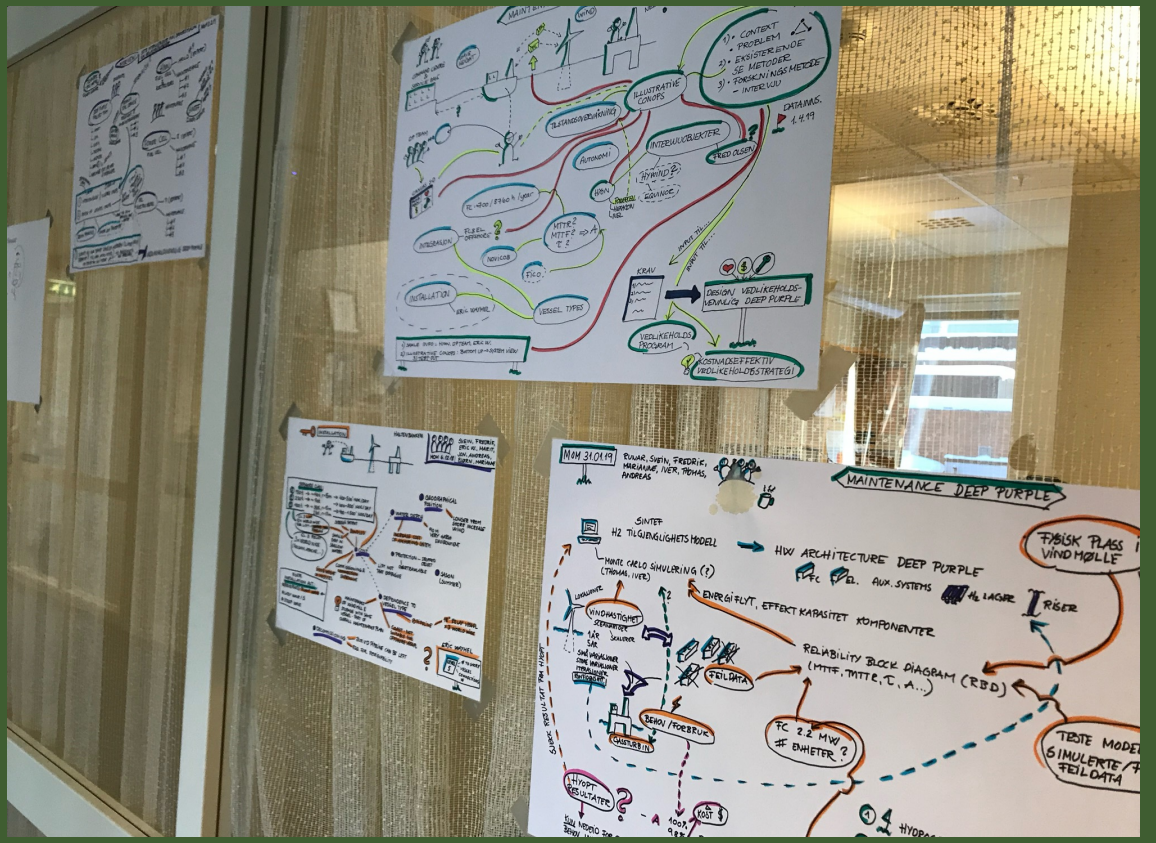
- Supports **rapid learning** and **early** validation of systems knowledge
- Strive to **capture** and **share systems knowledge**
- Provide a **shared mental model** and increase the **system understanding** between people



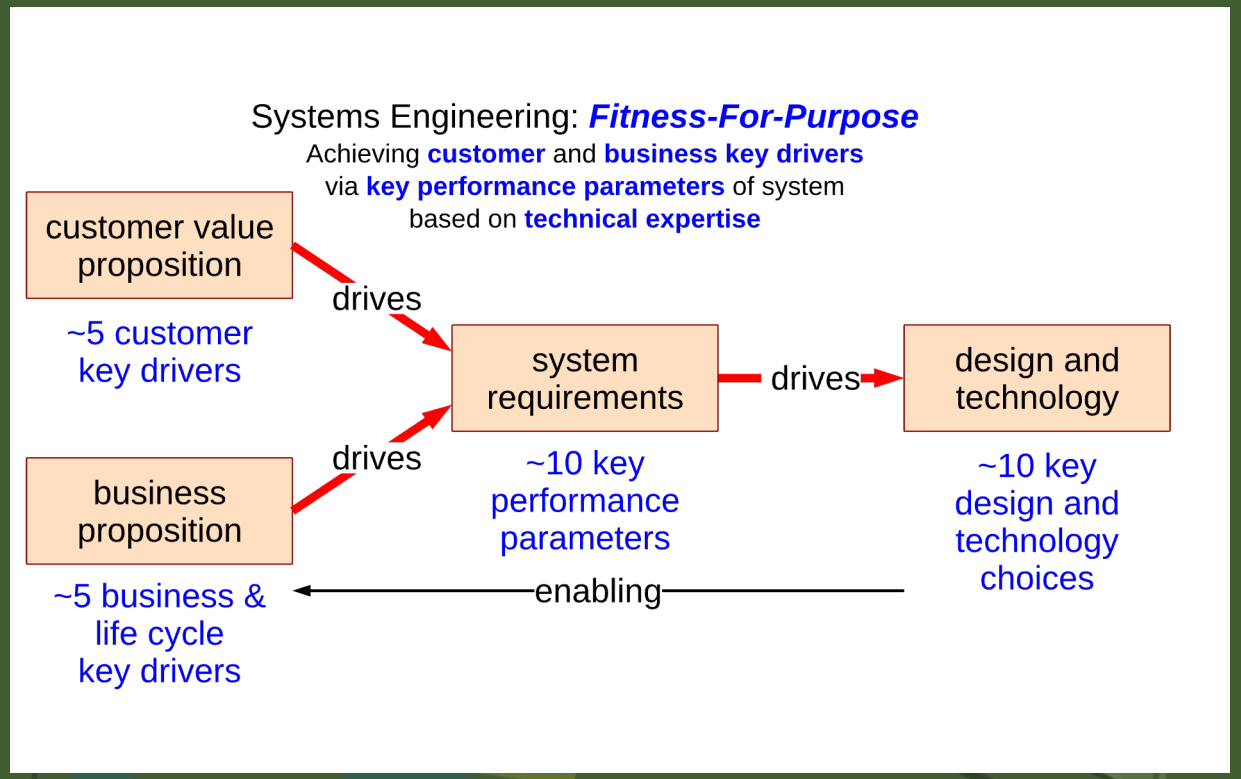
Blanchard and Fabrycky (2014)

Using visualizations in early phase SE

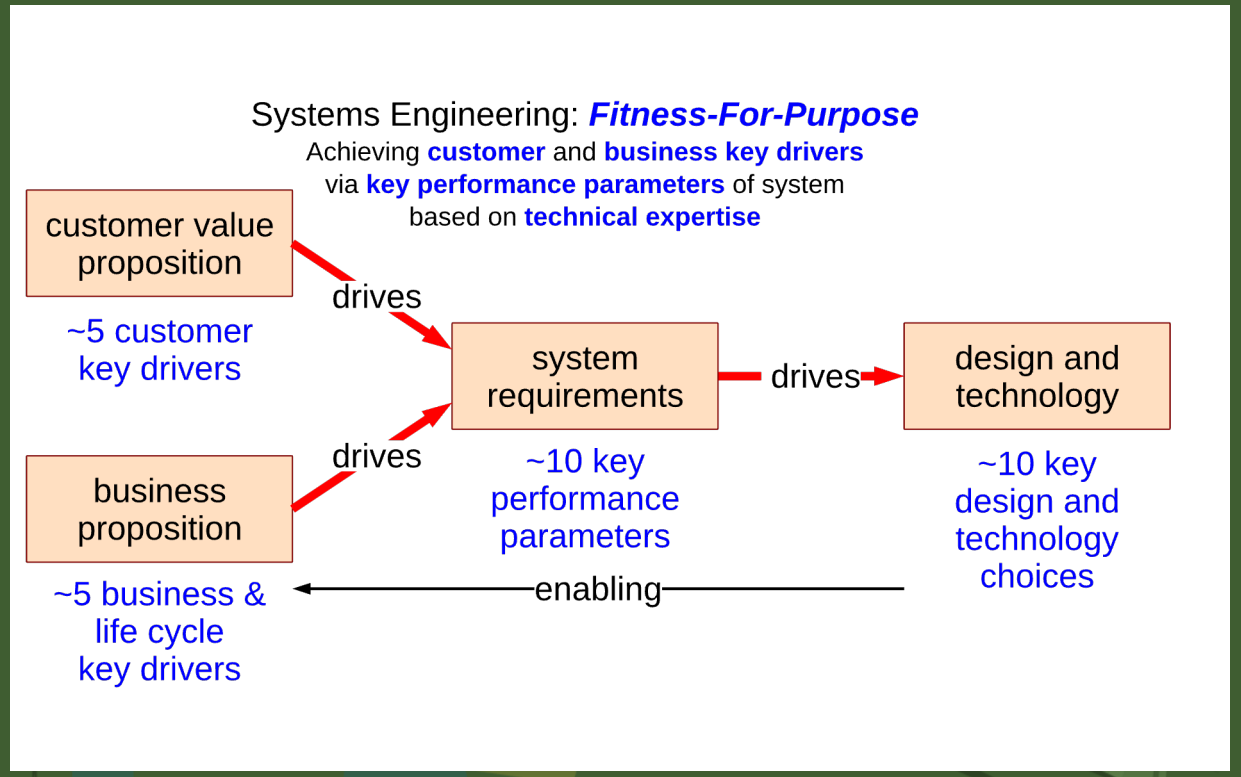
- **Abstraction** of system viewpoints for a **wide variety of stakeholders**
- The need of graphical representation will **change over time**
- The viewpoint needs to provide **value** for that **specific project**
- Depends on the **people** in the team, **their knowledge**, the system, and the stakeholders



Communicate systems-specific knowledge



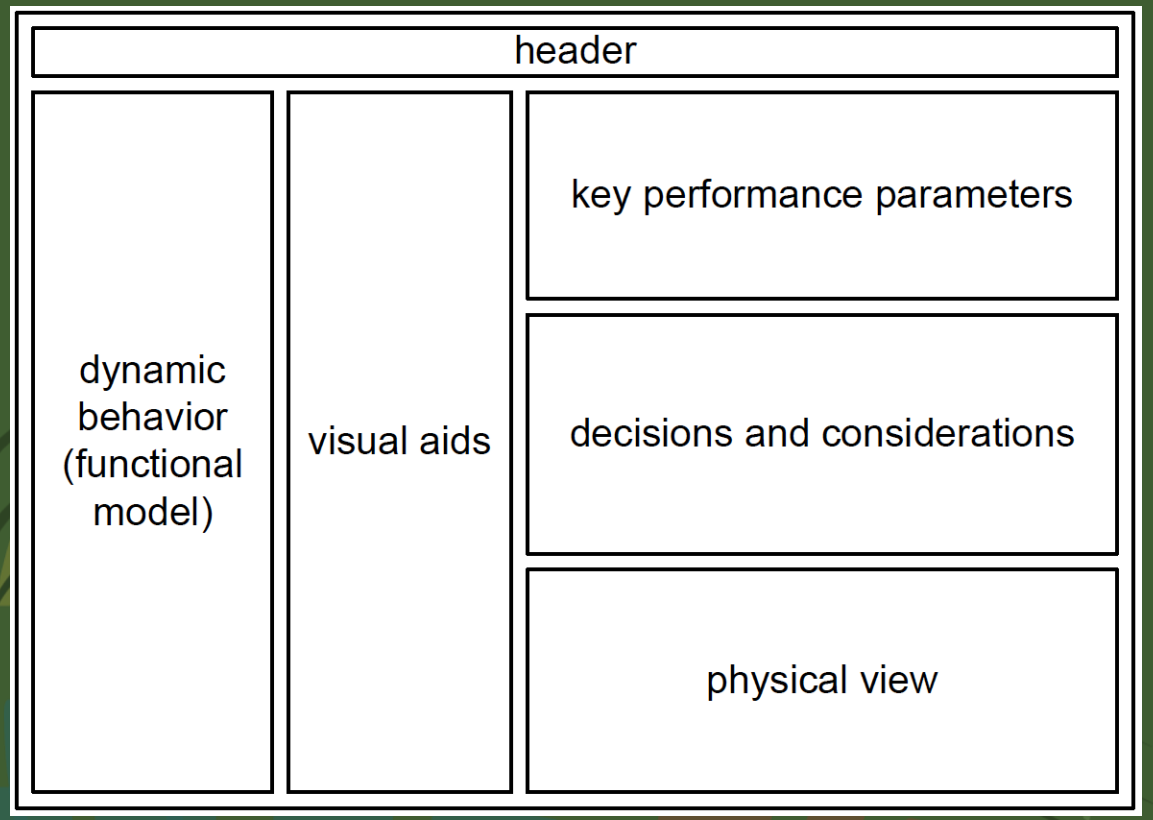
Examples of techniques for visualizations



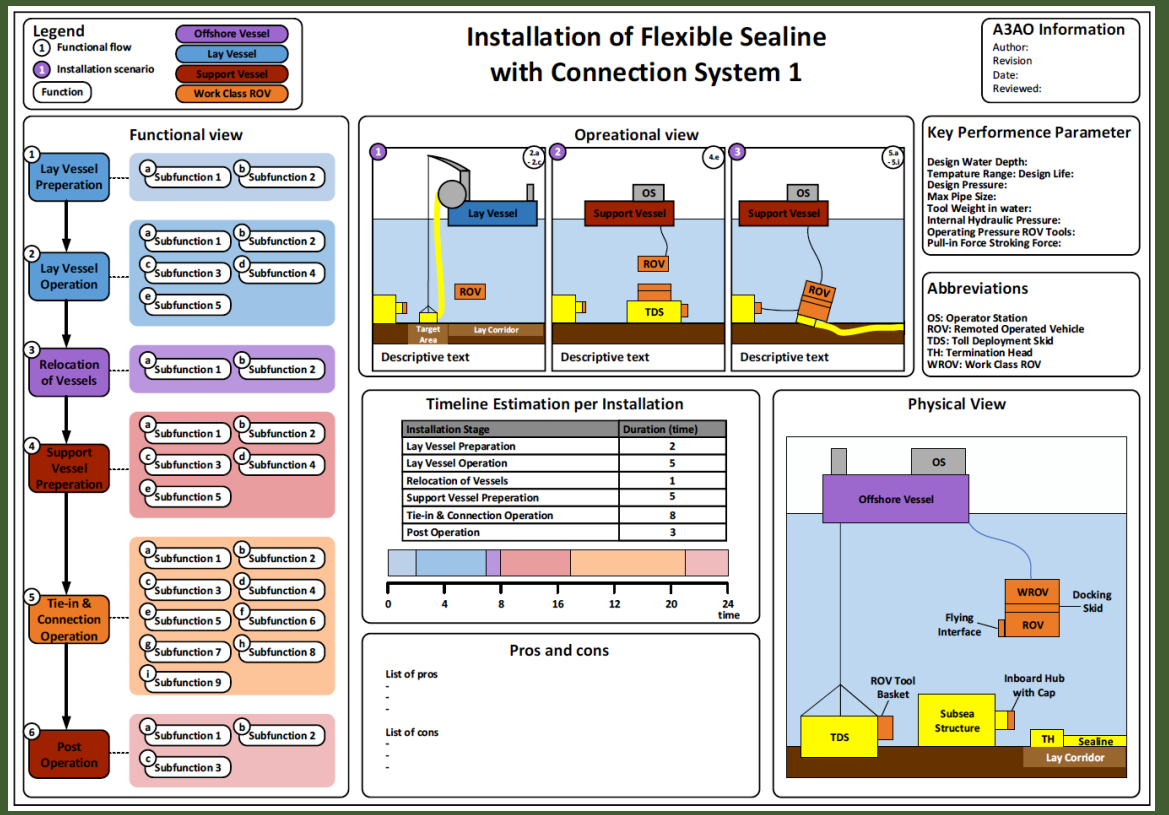
Systemigram
Stakeholder mapping
Key driver mapping
Key Driver Graph
Illustrative ConOps
Top-level-design
Architectural Overviews (A3AO)

Architectural Overviews (A3AO)

Muller, Wee, and Moberg (2015)



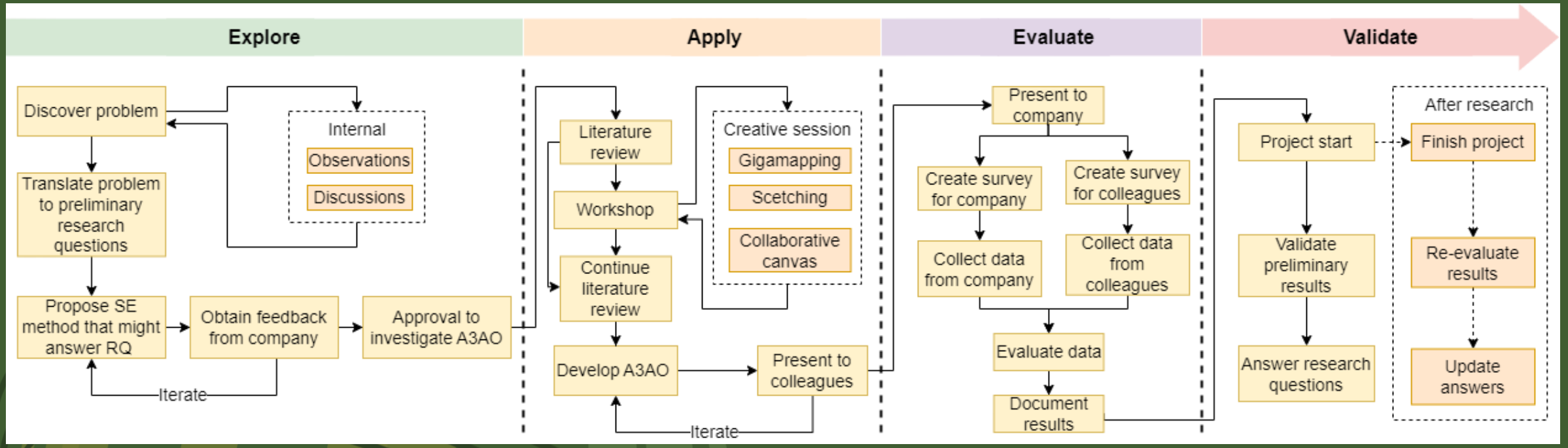
Haugland & Engen (2021)



Master student research on A3AO

- Small and Medium Sized Enterprise
- IoT system
- Tender phase
- Field visits and workshops with customer

Master student research



Master student research: Explore

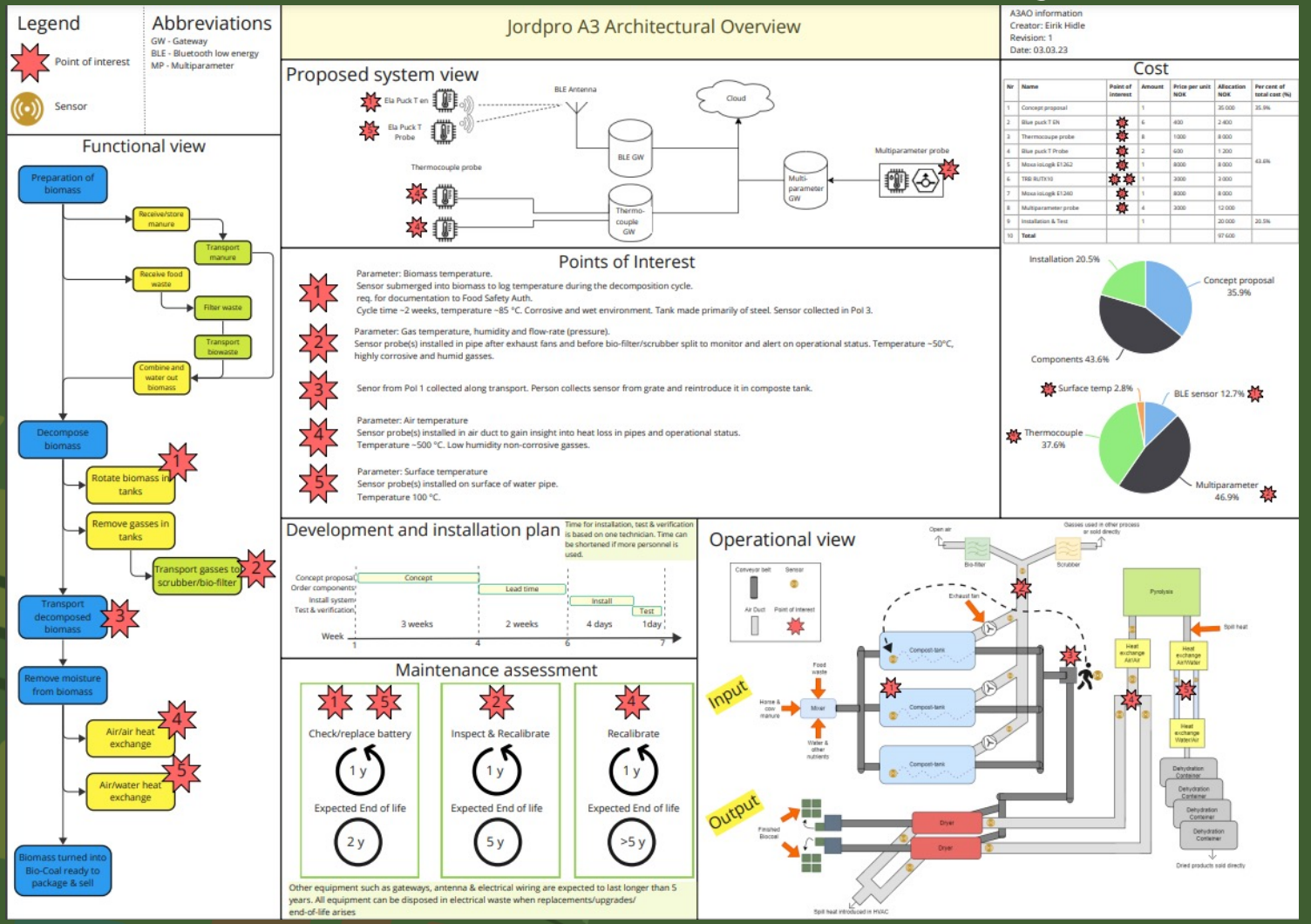
Problem and aim

- Technical knowledge gap between stakeholders in the tender phase
- Investigate if A3AOs can bridge the knowledge gap

Research Questions

- How can A3AOs improve Sensorhouse's early validation and communication in tender processes?
  - How can A3AOs be used to avoid miscommunication with customers?
  - What are the benefits of using A3AOs in workshops and tender processes?
  - What may be the challenges with the A3AO modelling format for tender processes?

Master student research: Apply



Jordpro A3 Architectural Overview

A3AO information
Creator: Eirik Hidle
Revision: 1
Date: 03.03.23

Legend

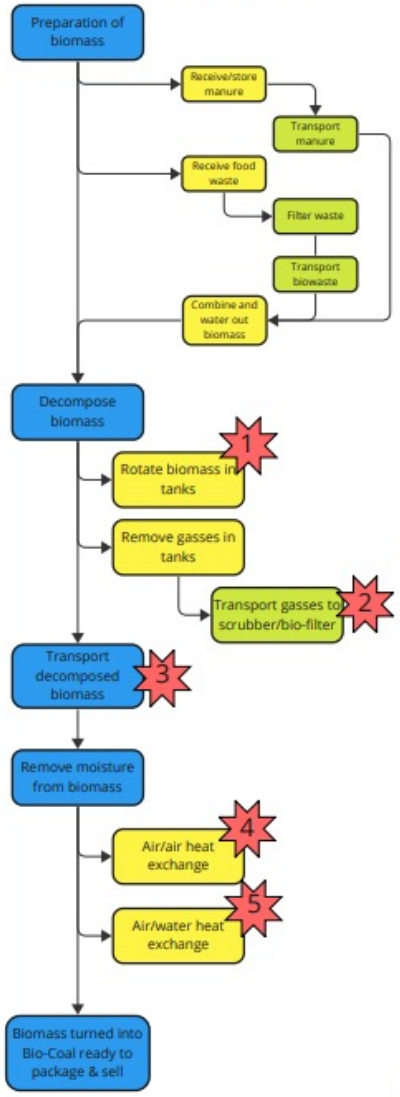
Point of interest

Sensor

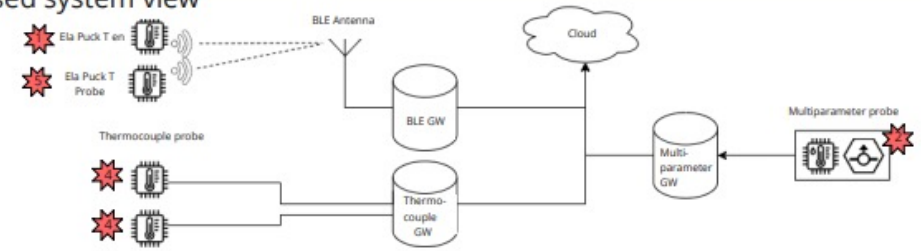
Abbreviations

GW - Gateway
BLE - Bluetooth low energy
MP - Multiparameter

Functional view



Proposed system view



Points of Interest

1 Parameter: Biomass temperature.
Sensor submerged into biomass to log temperature during the decomposition cycle.
req. for documentation to Food Safety Auth.
Cycle time ~2 weeks, temperature ~85 °C. Corrosive and wet environment. Tank made primarily of steel. Sensor collected in PoI 3.

2 Parameter: Gas temperature, humidity and flow-rate (pressure).
Sensor probe(s) installed in pipe after exhaust fans and before bio-filter/scrubber split to monitor and alert on operational status. Temperature ~50°C, highly corrosive and humid gasses.

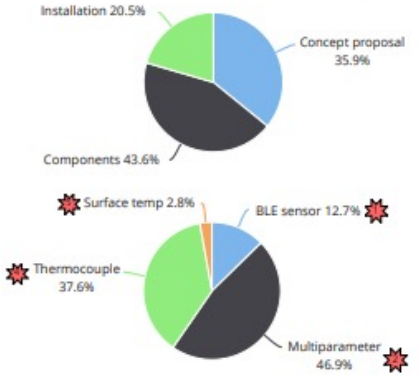
3 Senor from PoI 1 collected along transport. Person collects sensor from grate and reintroduce it in composte tank.

4 Parameter: Air temperature
Sensor probe(s) installed in air duct to gain insight into heat loss in pipes and operational status.
Temperature ~500 °C. Low humidity non-corrosive gasses.

5 Parameter: Surface temperature
Sensor probe(s) installed on surface of water pipe.
Temperature 100 °C.

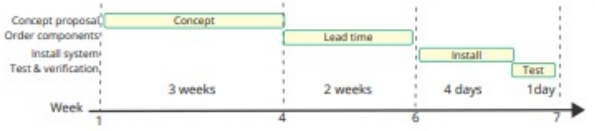
Cost

Nr	Name	Point of interest	Amount	Price per unit NOK	Allocation NOK	Per cent of total cost (%)
1	Concept proposal		1		35 000	35.9%
2	Blue puck T 6N	1	6	400	2 400	
3	Thermocoupe probe	4	8	1000	8 000	
4	Blue puck T Probe	4	2	600	1 200	
5	Moxa ioLogik E1262	5	1	8000	8 000	43.6%
6	TRB RUTX10	2 3	1	3000	3 000	
7	Moxa ioLogik E1240	1	1	8000	8 000	
8	Multiparameter probe	1	4	3000	12 000	
9	Installation & Test		1		20 000	20.5%
10	**Total**				97 600	



Development and installation plan

Time for installation, test & verification is based on one technician. Time can be shortened if more personnel is used.

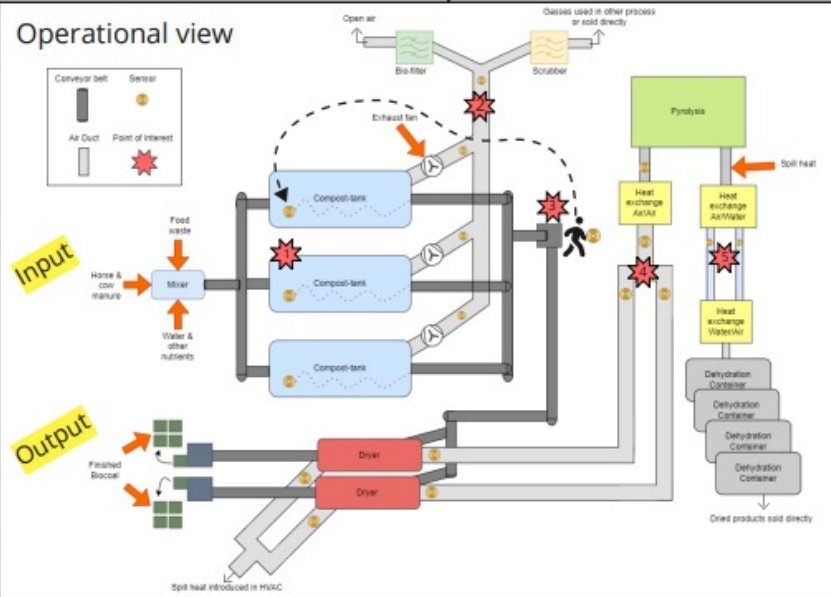


Maintenance assessment

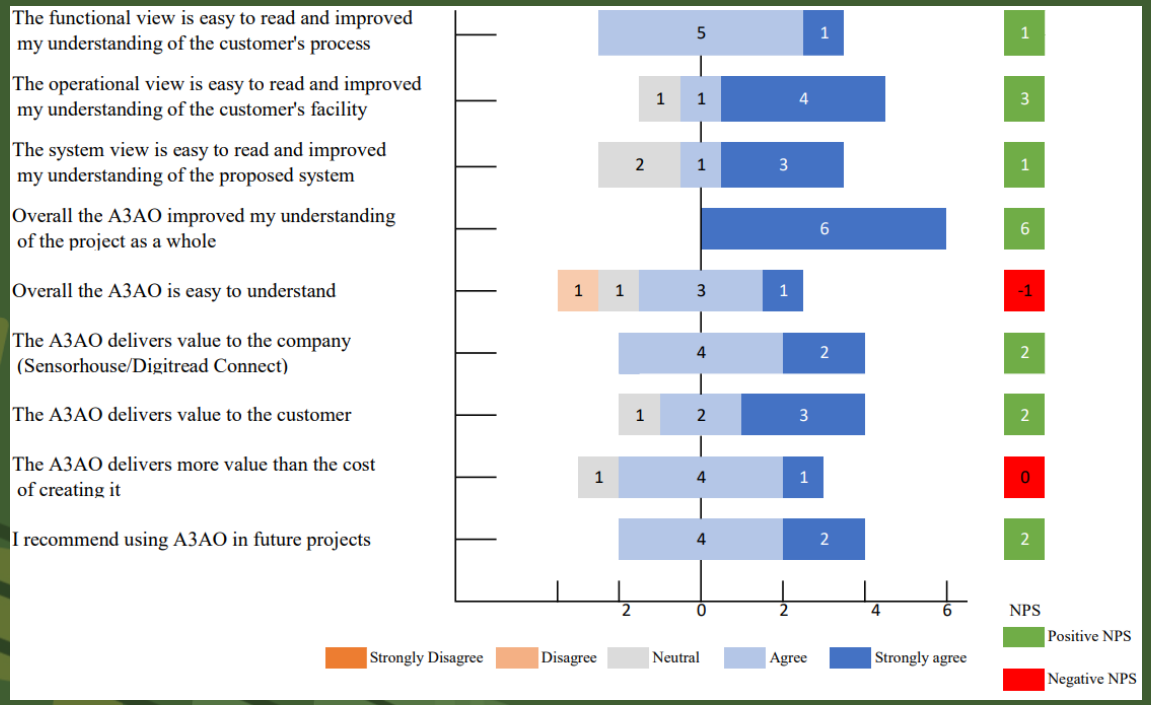
1 5	2	4
Check/replace battery	Inspect & Recalibrate	Recalibrate
1 y	1 y	1 y
Expected End of life	Expected End of life	Expected End of life
2 y	5 y	>5 y

Other equipment such as gateways, antenna & electrical wiring are expected to last longer than 5 years. All equipment can be disposed in electrical waste when replacements/upgrades/ end-of-life arises

Operational view



Master student research: Evaluate



Master student research: Evaluate

Pros

- A3AO gives a comprehensive overview of the system and project
- Points of Interest (the stars)
- Customer can clearly see if the company understands their process and facility
- Thought distillation for the team & map for discussions
- Ability to collect all critical information in one document.
- Easy to understand and evaluate the presented solution.

Cons

- Natural Flow
- Lacks motivation behind the different decisions
- Multi-site and more complex processes
- Cost
- Functionality
- Standardized illustrations and icons

Master student research: Conclusion

Research Questions

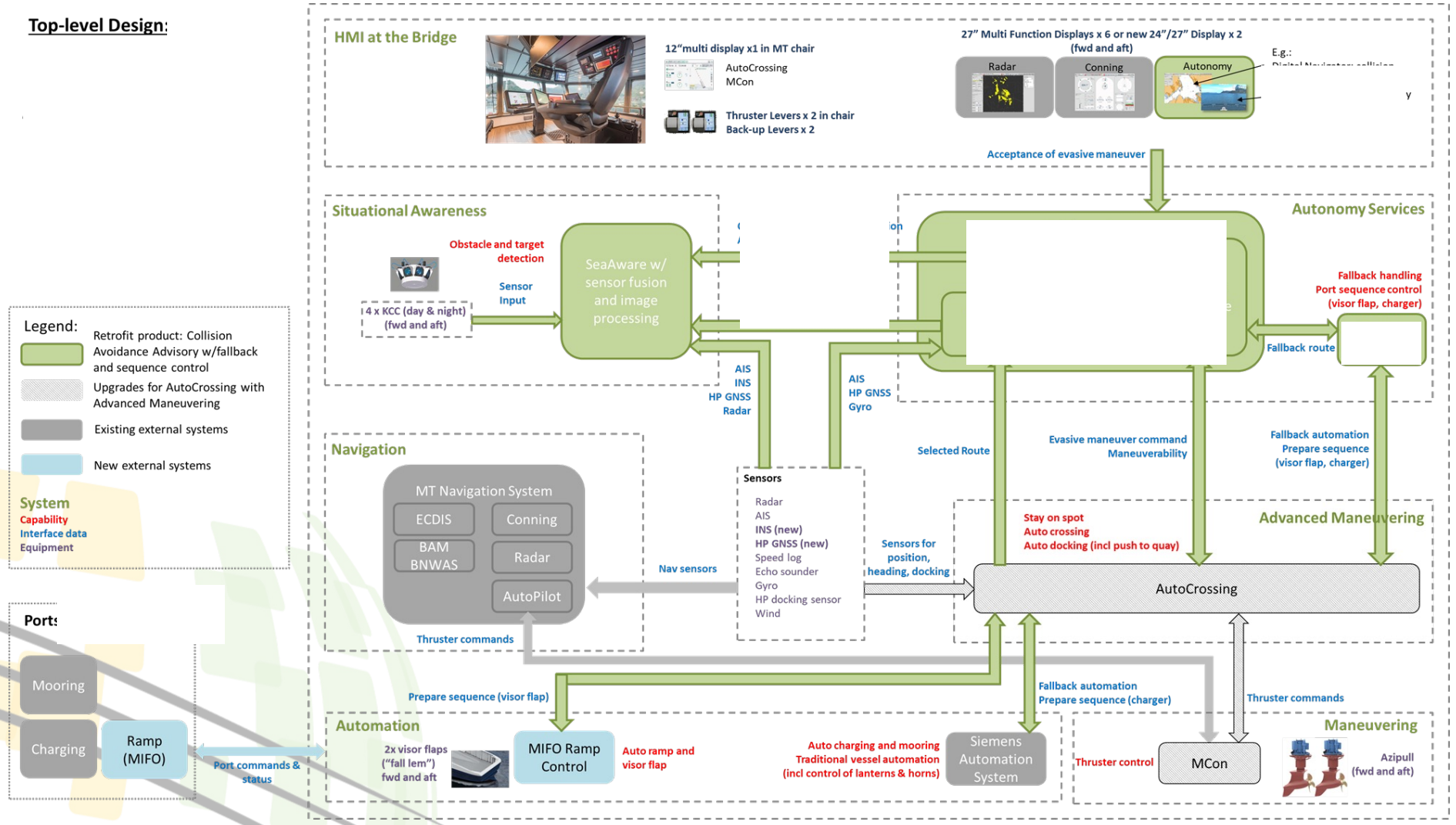
- How can A3AOs improve Sensorhouse's early validation and communication in tender processes?
  - How can A3AOs be used to avoid miscommunication with customers?
  - What are the benefits of using A3AOs in workshops and tender processes?
  - What may be the challenges with the A3AO modelling format for tender processes?

Main findings:

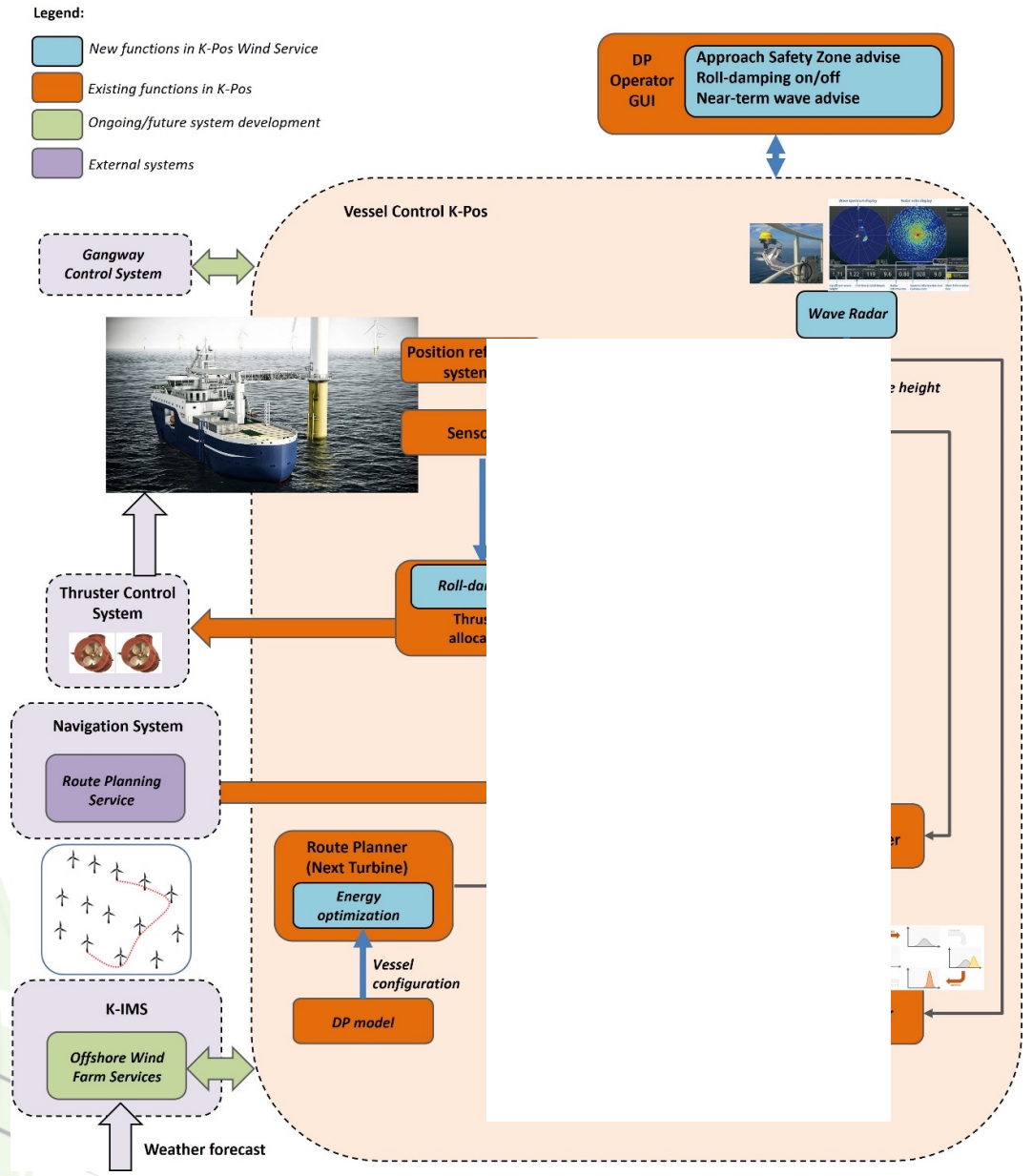
- The A3AO forces a limit on the amount of information, provides explicit systems-specific knowledge
- Co-creating parts of the A3AO with customers creates ownership and early validation
- A shared mental model and increased system-specific knowledge
- Time consuming compared to current way of working
- Requires skills for visualizations and a designerly touch
- A supplement and not a substitute to the tender report

Example: Top Level Design

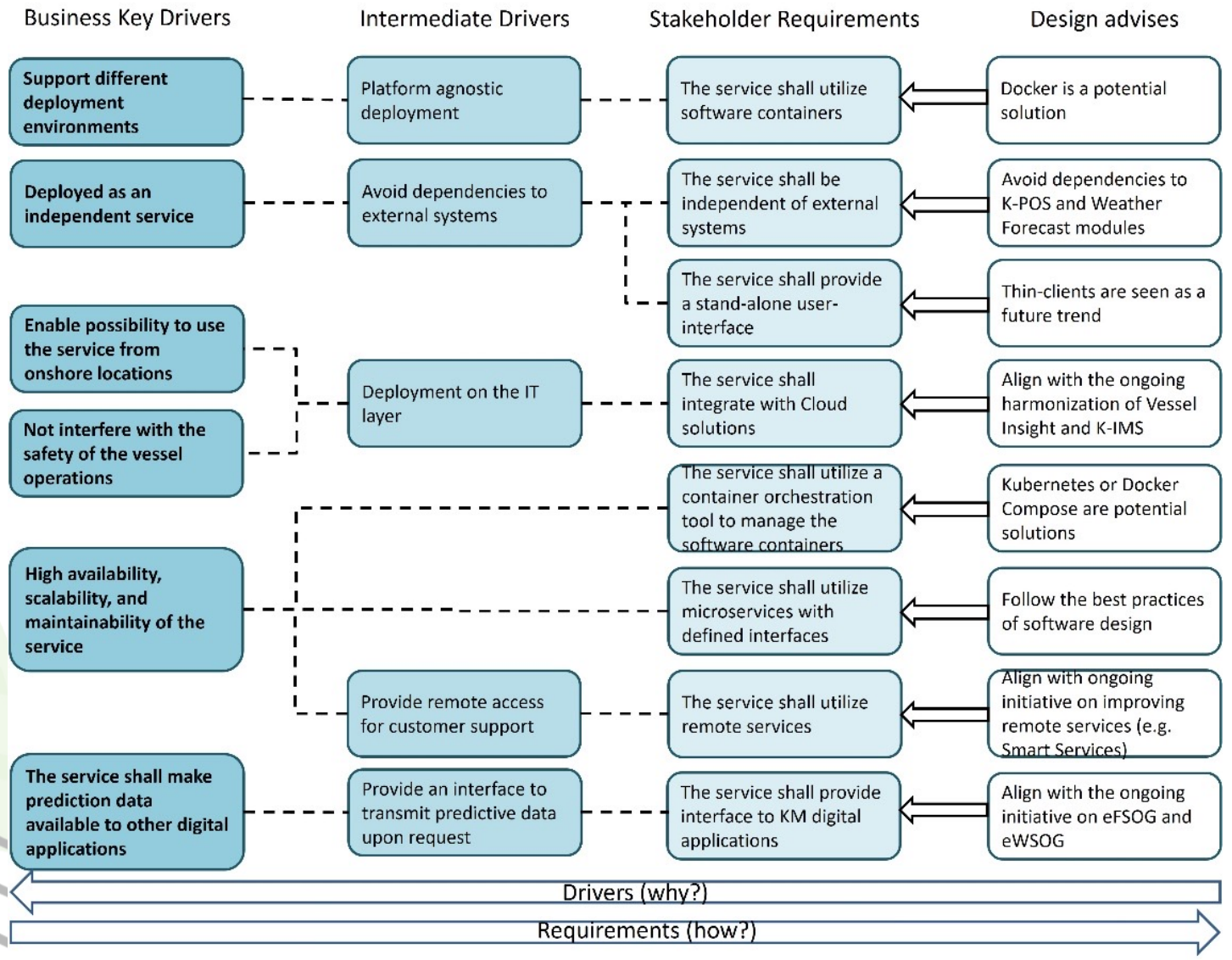
Top-level Design:



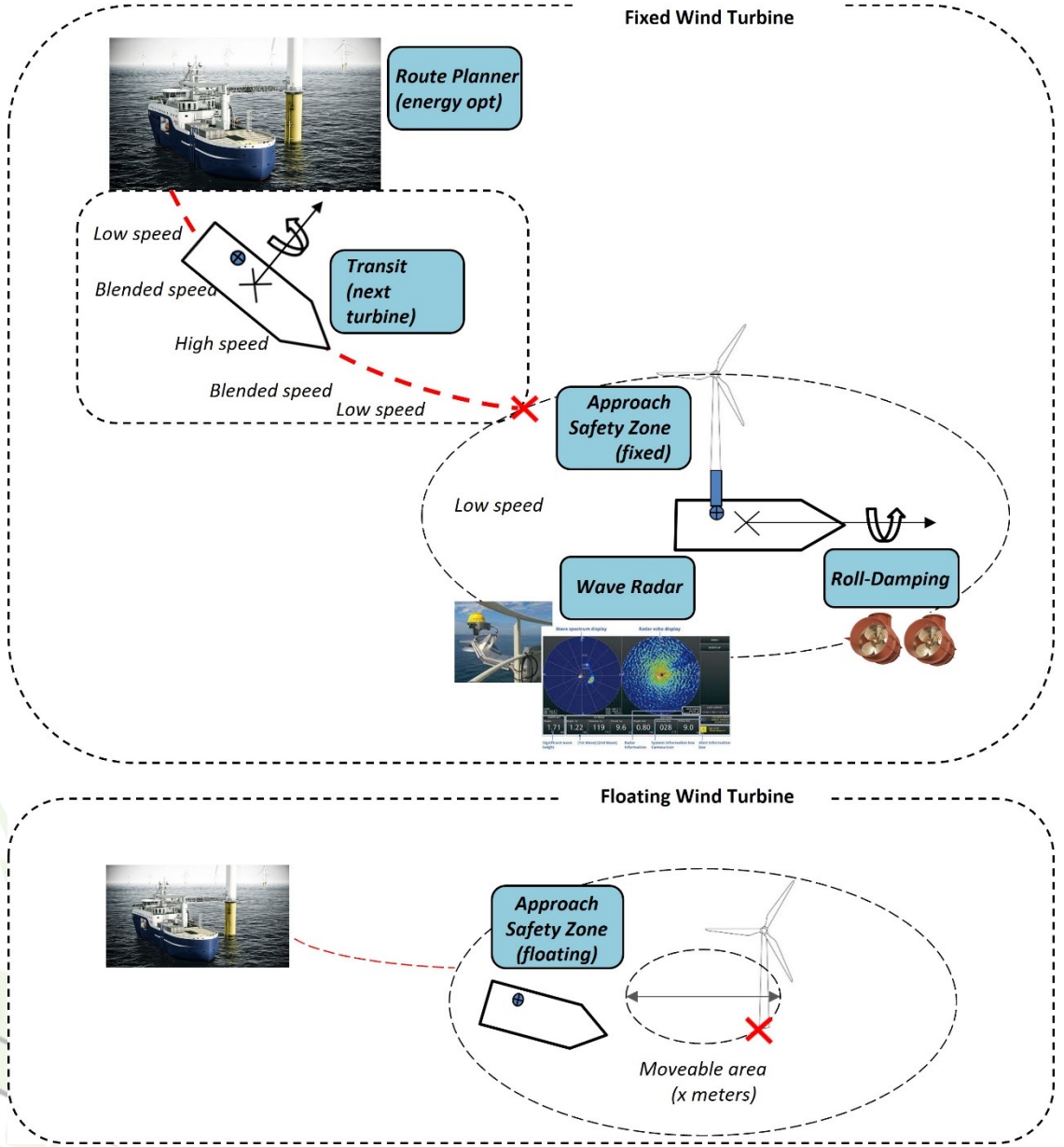
Example: Top Level Design



Example: Key Driver Graph



Example: Operational Context



Further reading

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