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Transitioning from technical 2D drawings to 3D models: a case study at defense systems

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Introduction

- Student Paper – Master thesis, University of South-Eastern Norway, Kongsberg.

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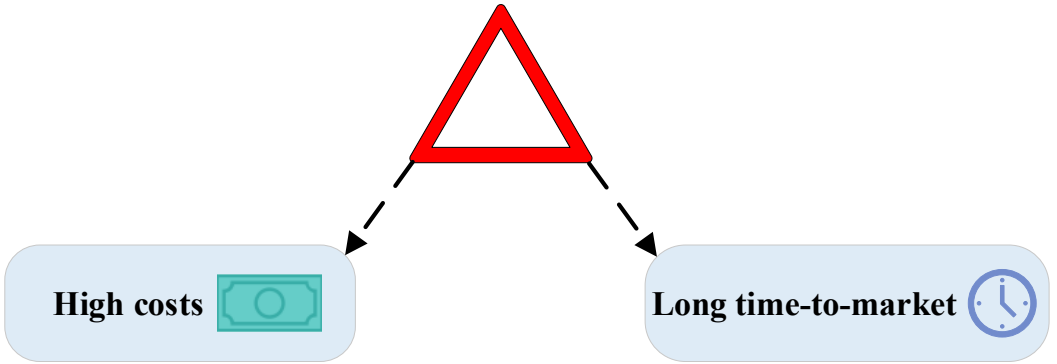
Introduction - Background

- Kongsberg Defence & Aerospace
  - From deep sea to outer space
  - World-leading supplier with more than 20,000 delivered Remote Weapon Station systems to 18 different nations
- Case study in the defense and aerospace industry

Introduction - Problem

- The current design process is ineffective in terms of both time-to-market and cost
  - 3D model -> Technical 2D drawings
- The handover from the mechanical engineering department needs to be fast and require low effort
  - High variability on the system
  - High demand of customization



Introduction - Solution

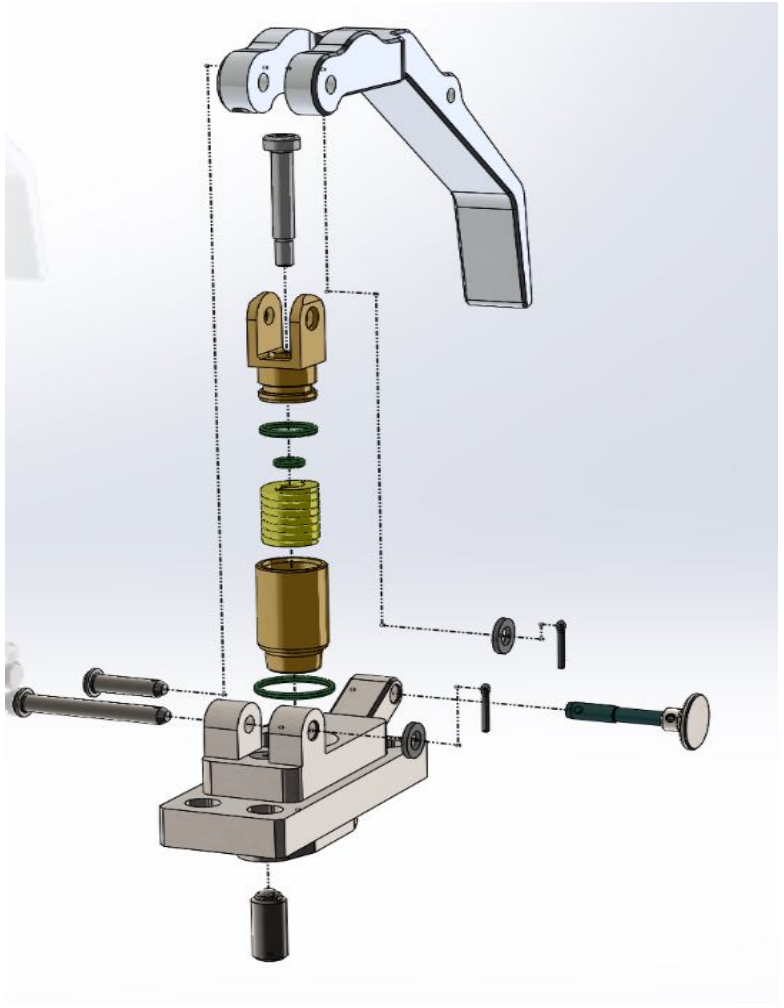
- The goal of this study was to improve KDA's competitive ability
  - Reduce time-to-market & costs
  - Streamline the design process
- Model-based definition
  - The technical documentation handover resides in the 3D model
- Study the current processes and examine what material that should be included in the handover

Introduction - Research Questions

- In this study, we ask the following questions:
  - What competences and tools do KDA and its mechanical manufacturing suppliers need to use the MBD technique?
  - What investments does KDA need to make for the transition to an MBD approach?
  - What cost and time benefits may KDA expect from an MBD approach?

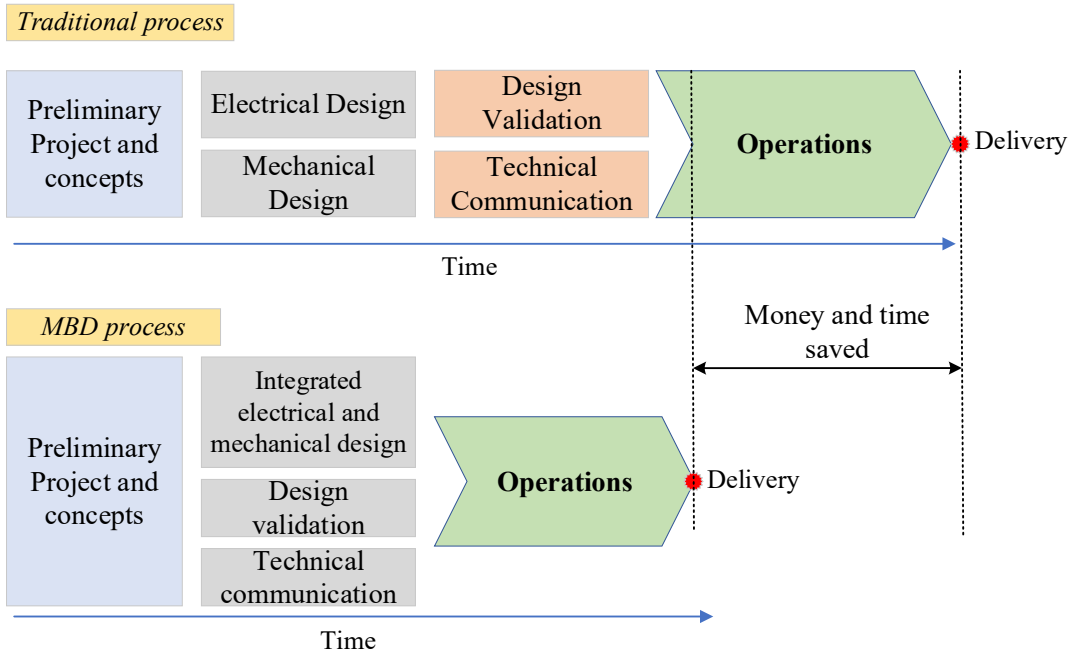
Case Project

- Case: Azimuth manual release
  - Its function is to enable the operator to manually rotate the RWS along the azimuth axis when the servo system is disabled.



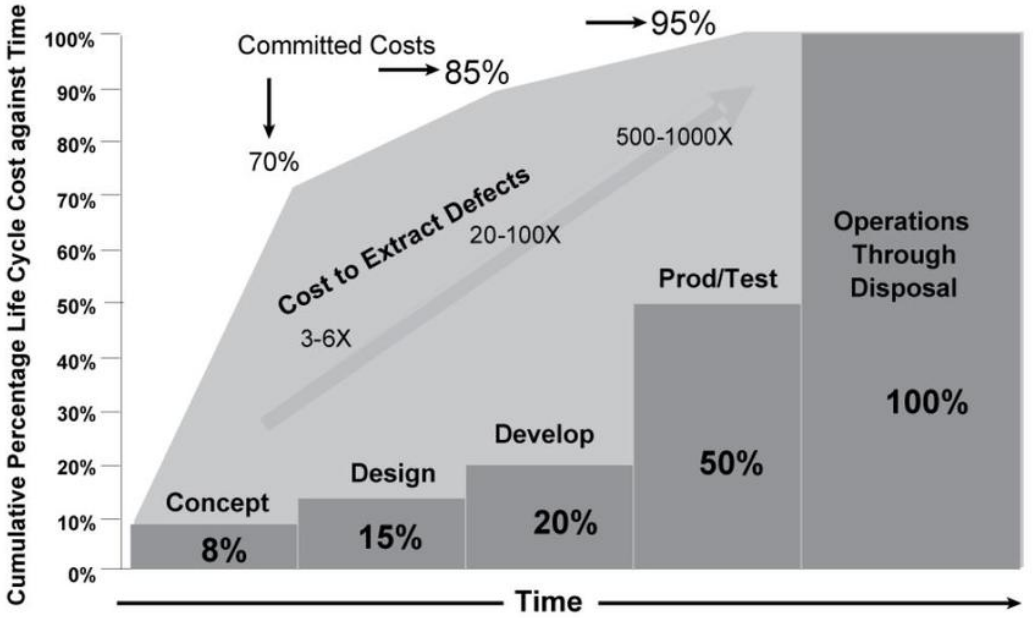
Model-based Definition

- Model-based definition
  - The 3D model is the governing document
  - Geometric dimensioning, tolerancing, and other technical properties are assigned to the 3D model
  - Eliminates the need of technical 2D drawings



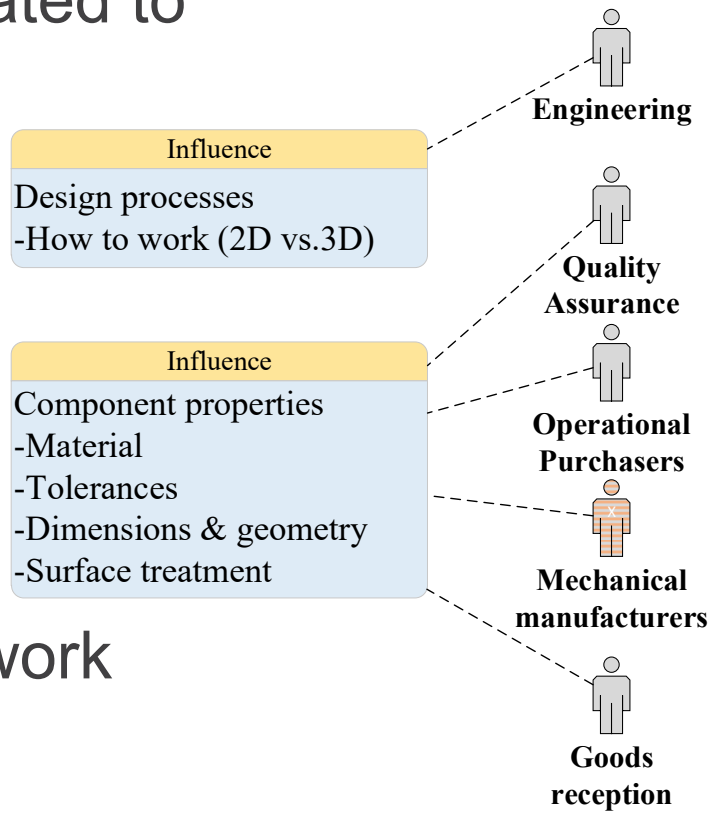
Model-based Definition Benefits

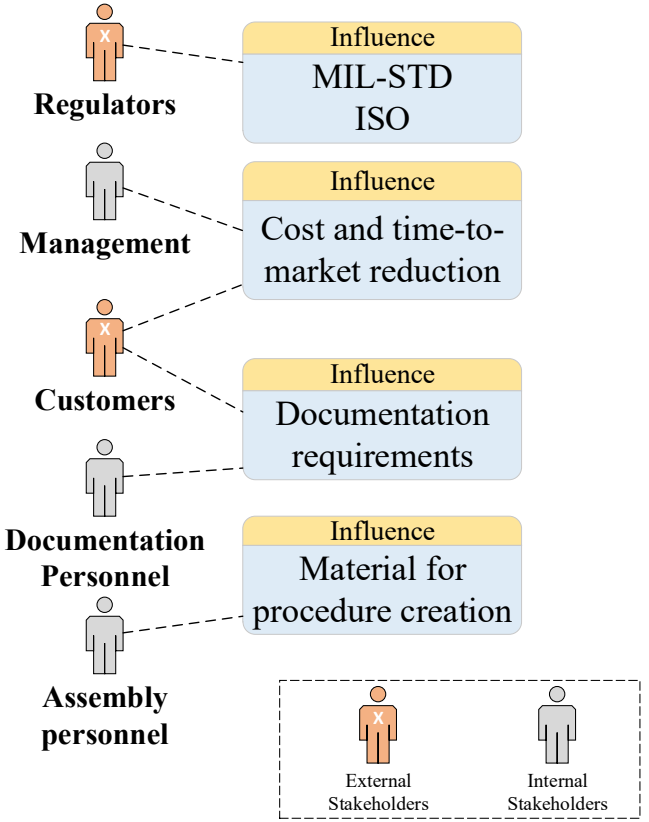
- Enables parallel work
- Structures component property data in one location -> downstream possibilities
- Enables early validation -> Rapid prototyping
- Rich file format -> automated processes



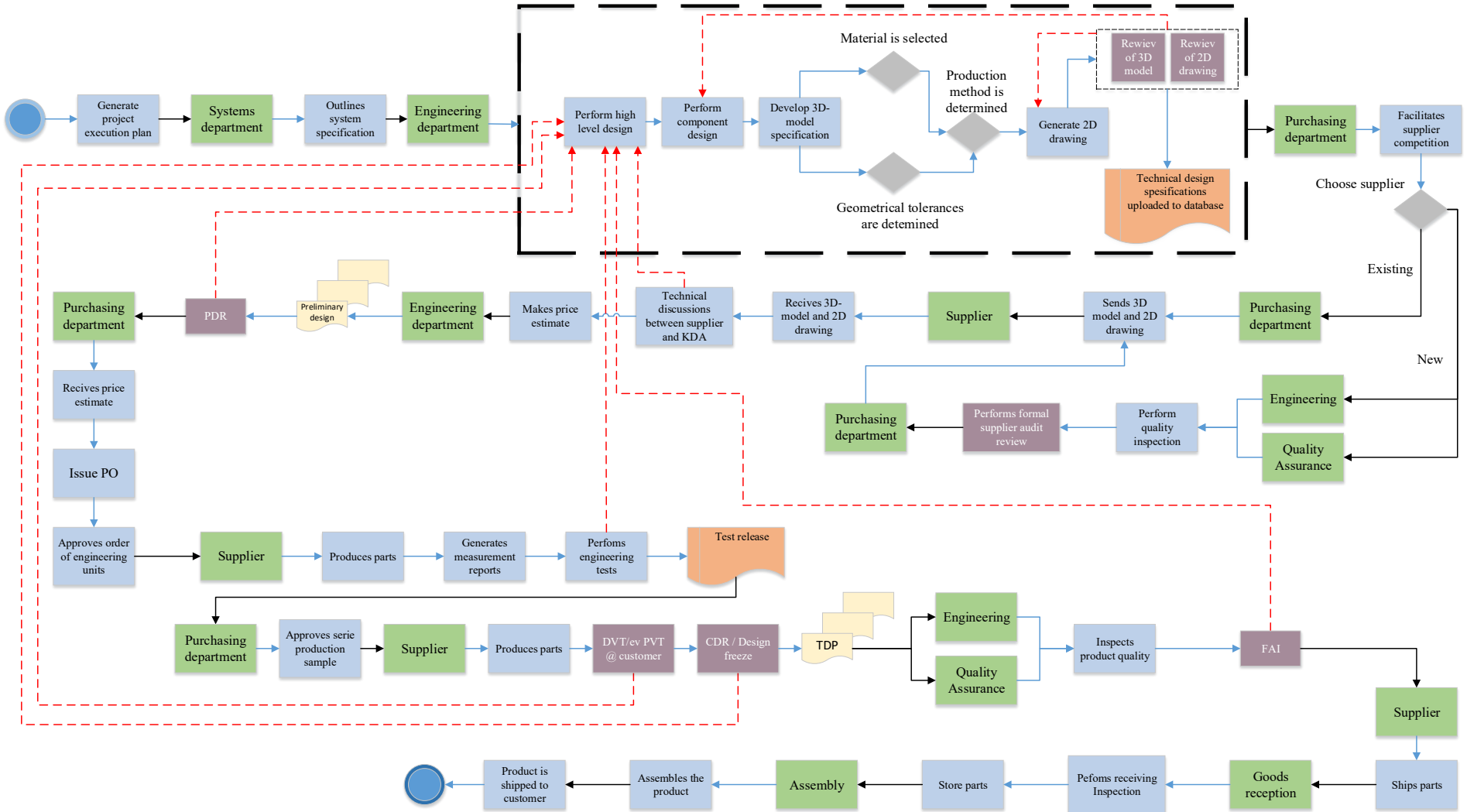
Stakeholders

- Identified stakeholders related to the current process
- Internal and external
- Interviews
- Foundation for the future work



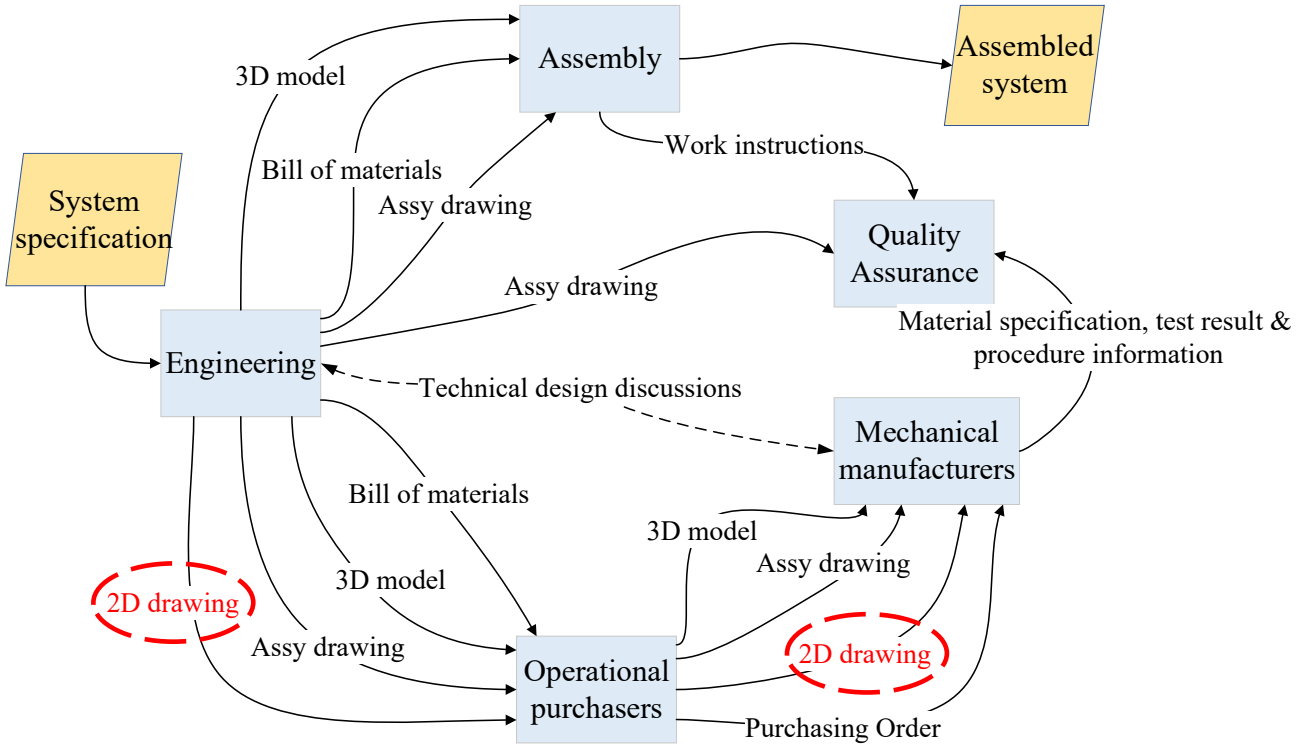


Process Flow



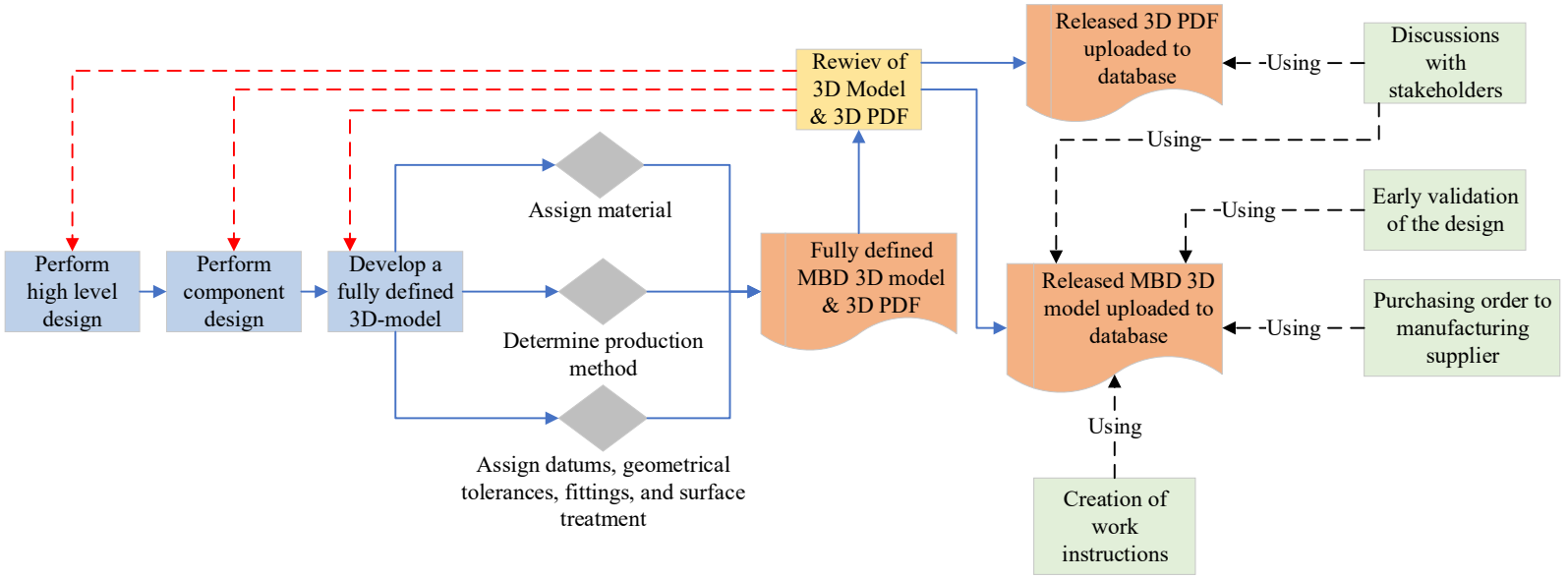
Technical Information Flow

- Mapping of the current technical information flow
- Limited use of technical 2D drawings today
- Several stakeholders involved

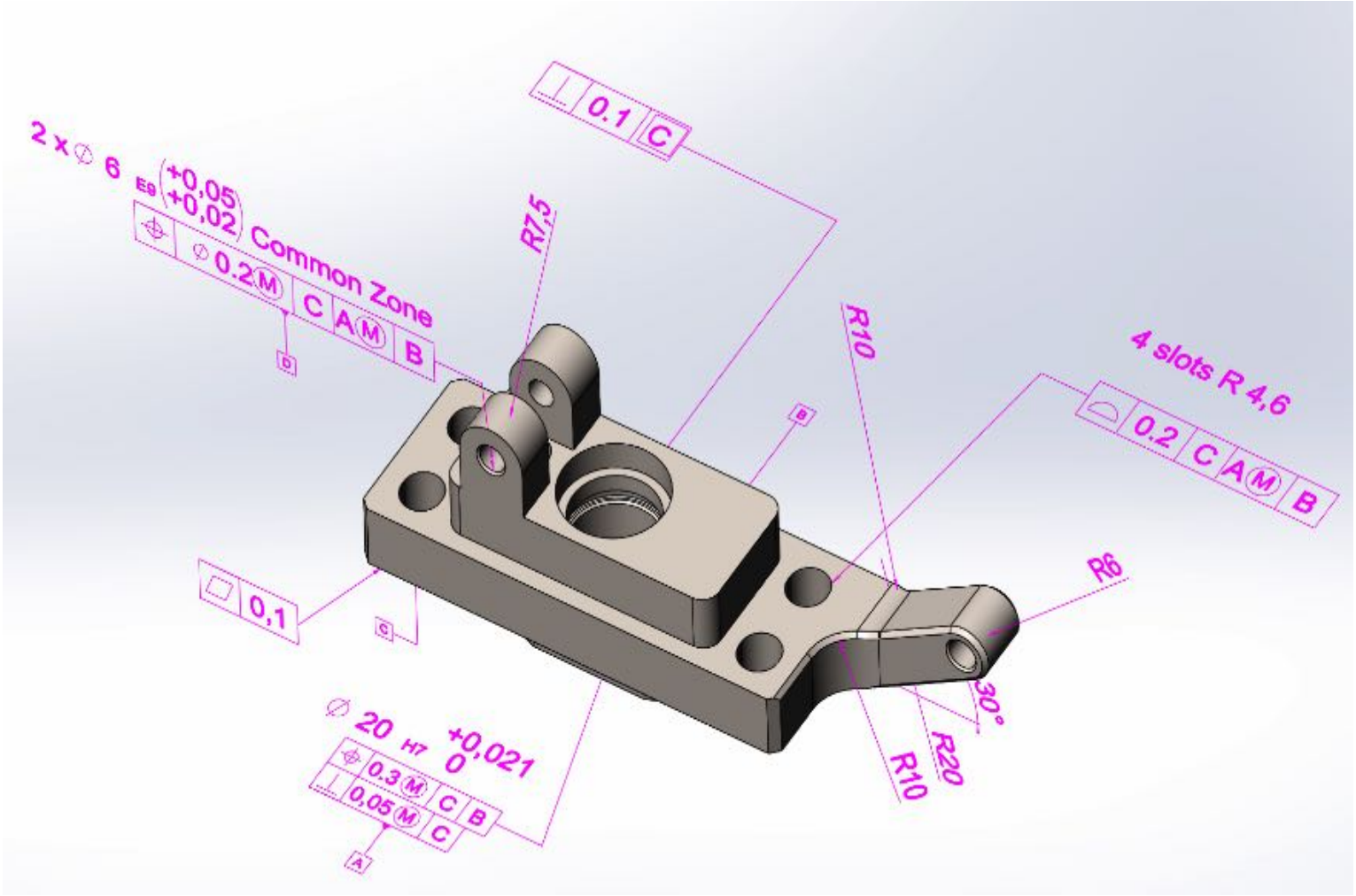


To-be Process

- The envisioned process facilitate:
  - Early validation of the design
  - Early creation of work instructions
  - The mechanical manufacturers to examine the component in a more effective way
  - Technical discussions with stakeholders that do not possess a CAD Software license



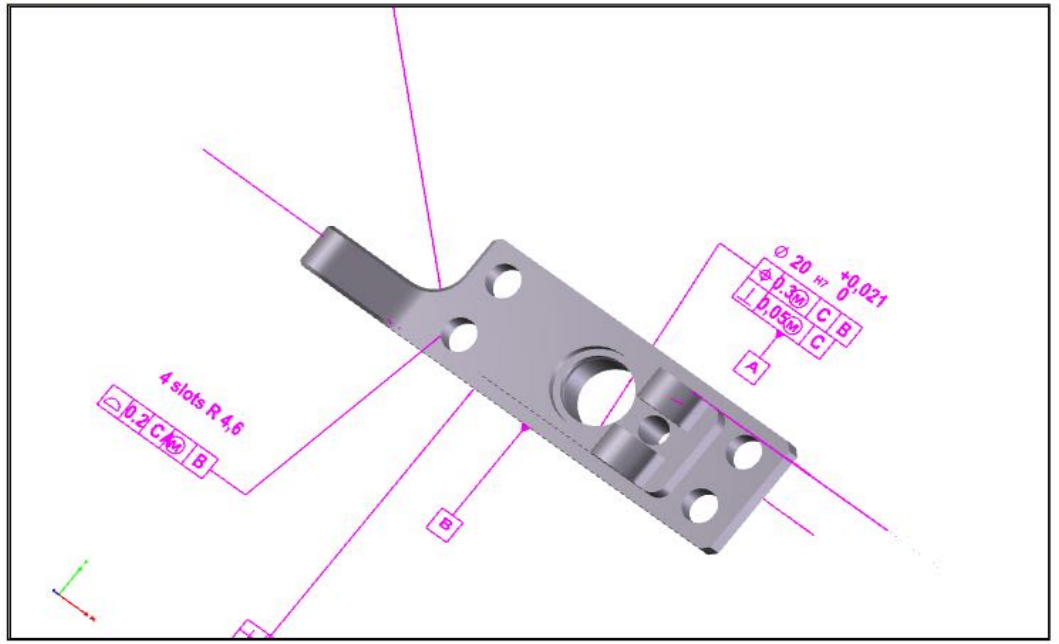
MBD 3D Model


2 x ⌀ 6 E9 +0,05 +0,02
Common Zone
⌖ ⌀ 0.2 M C A M B
0.1 C
R7,5
R10
4 slots R 4,6
0.2 C A M B
R6
0,1
⌀ 20 H7 +0,021 0
⌖ 0.3 M C B
⊥ 0,05 M C
R10
R20
30°

3D PDF

KONGSBERG

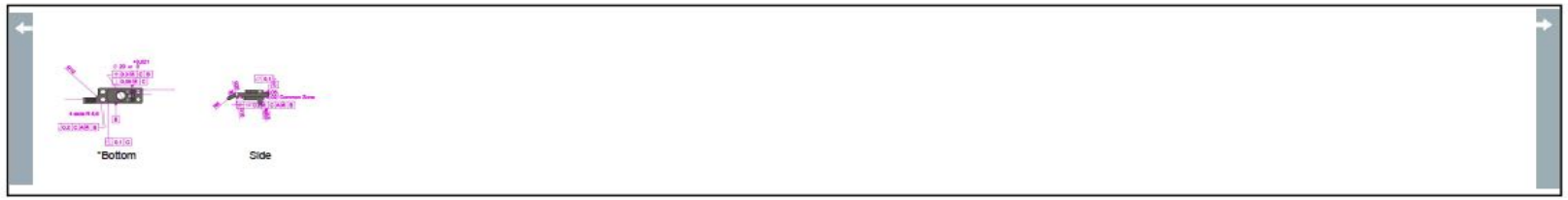
Part Number:		Date:	16.05.2018
Comments:	MBD Demonstration	Revision:	
Description	Azimuth Lock Housing	Material:	
		Designed by:	Martin Sandberg



FILLET RADII	0,1-0,3
ROUGHN µm	3,2
DIM. TOL	±0,2
ANG.TOL	±3°
SURFACE TREATMENT	See note 1
DEPARTMENT	DY4
Break all edges	(R ALT 45°) 0.1-0.5
THREAD TOOL	6g/6H ISO 965/1
	ALL DIM. INCLUDE SURFACE TREATMENT

Comments

The viewers can add comments in this section.

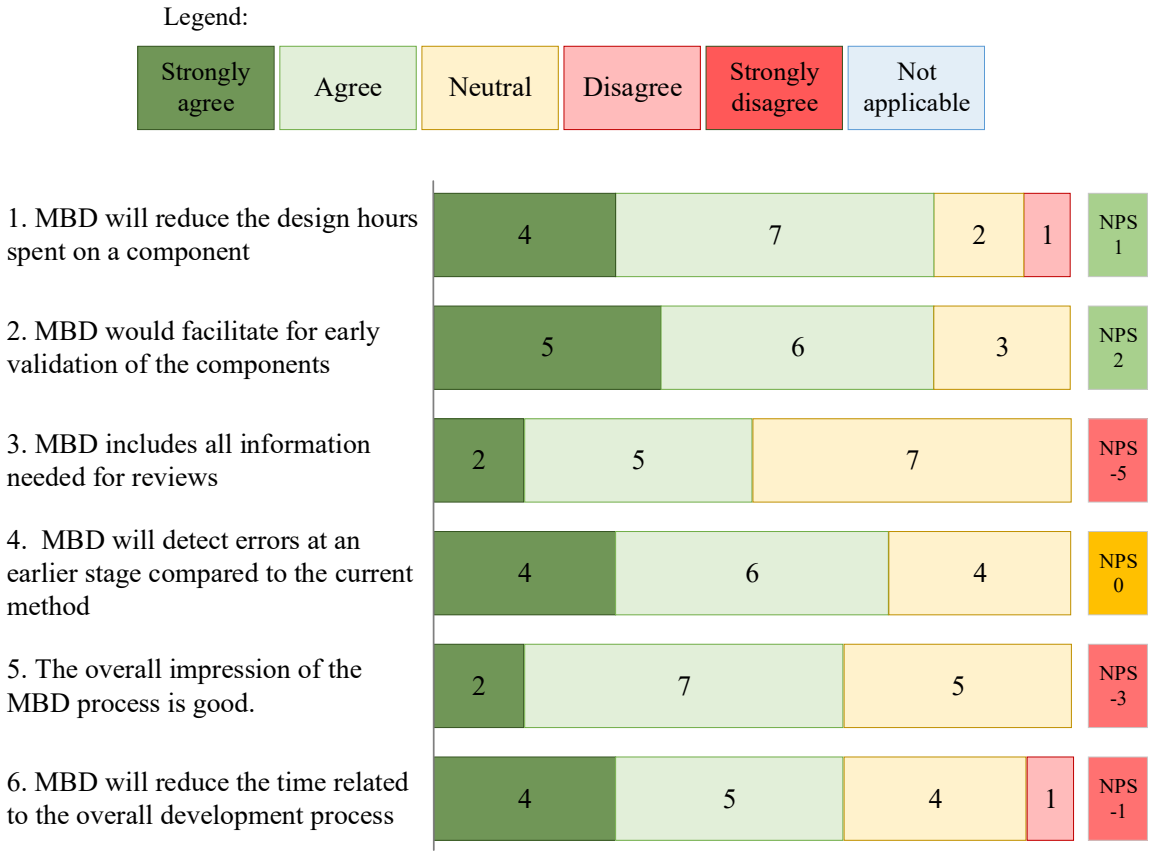


Findings

- The exclusion of the technical 2D drawings would not generate major changes in the development process
- The inclusion of MBD models in the purchasing order would be a help
  - enabling automated manufacturing
- A STEP file is unable to fully represent tolerances
  - the mechanical manufacturers must possess a SolidWorks license and competence in using the Software
- MBD will improve the quality of the assembly work instructions
  - Better understanding
  - Early start
- The engineers can spend more of their time on functional design work
- KDA would need to invest in MBD licenses to utilize the method

Evaluation

- Two-thirds (14) of the engineers answered the questionnaire
- The proportion of “neutral” opinions is rather high
- A larger evaluation including all engineers could be useful



Benefits

- Good overview and understanding
- Early validation
- More value adding activities for the engineers
- Open for early discussions with the suppliers
- Operations and production are brought in earlier

Concerns

- Traceability
- Software dependent models
- Training and adapting
- How will this play out in a large-scale?

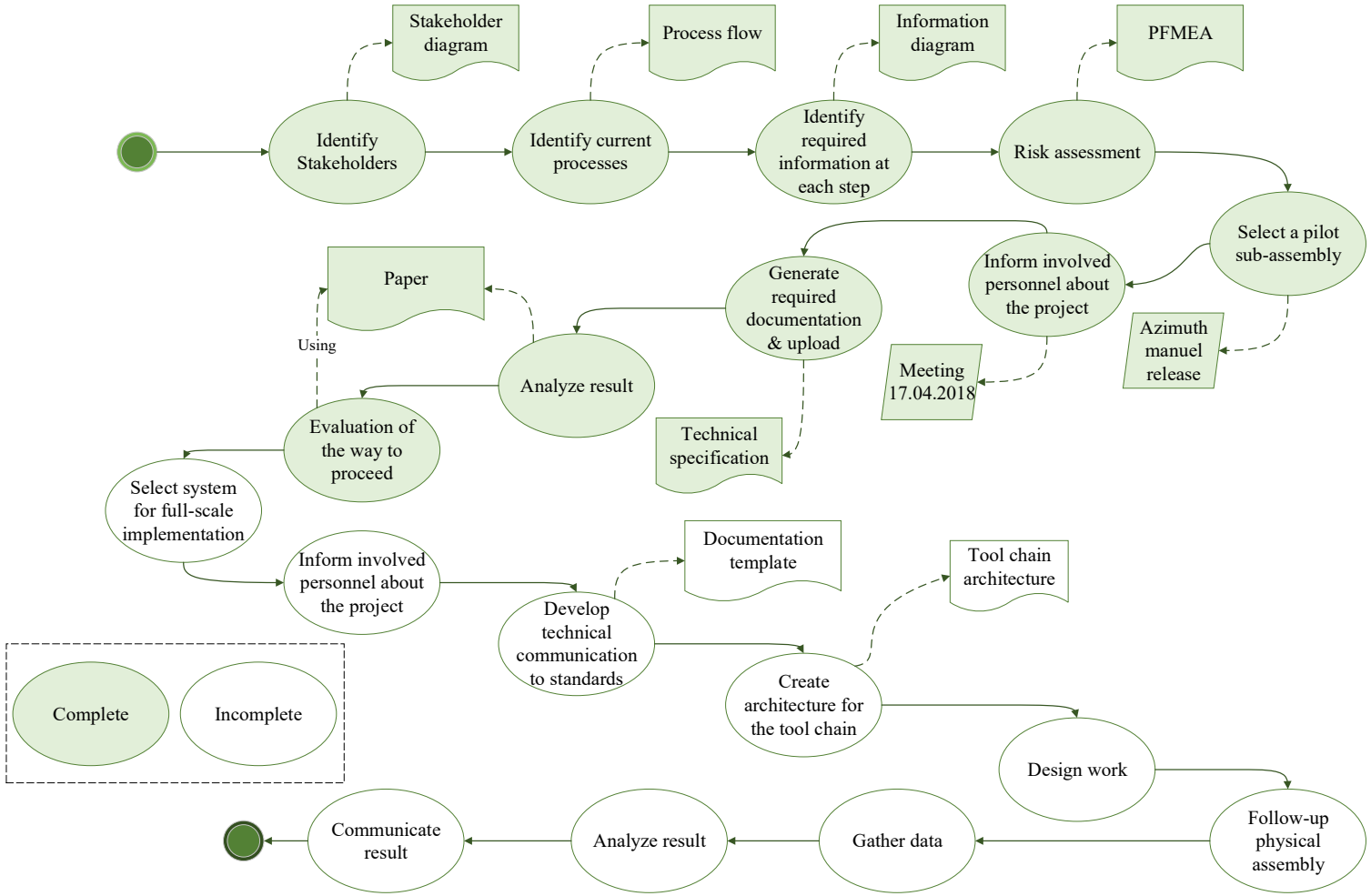
Cost Versus Value

- Difficult to measure value
  - Hard and soft elements
- Reduced risk
  - Validation
  - Mismatch; assemblies and 2D drawings vs 3D models
- Requires the same competencies as the current process

Recommendations

- Increase the engineers understanding of the model-based definition method. This should improve the overall impression of the method
- KDA should perform a full-scale study
- KDA should perform further studies with the aim of identifying an effective manner of designing their technical documentation and the traceability of it to fulfill the requirements related to the standards
- KDA should create an architecture for its tool chain and processes
  - Basis regarding which formats that should be used

Status of the Project



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