DUTCH NAVAL DESIGN

WINNING. DRIVEN. PARTNERSHIP.

Background and status

Michel Janssen

COMMIT/AMS

09 sept.'24

Doelstelling DND

- Uitbouwen van Gouden Maritieme Ecosysteem
- Bundelen van capaciteiten en kennis
- Gezamelijke focus aanbrengen en regie voeren
- Samenwerken op het gebied van onderzoek & ontwikkeling van militaire platformtechnologie
- Bijdragen aan:
  - KIA Veiligheid en Missiegedreven Topsectoren & Innovatie Beleid
  - Maritiem Masterplan
  - Sectoragenda Maritieme Maakindustrie / Smart Maritime

ROADMAPPING

Perspectieven

Strategisch perspectief

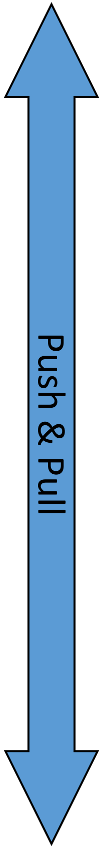
- Een bovenste laag waarin vanuit een strategisch perspectief naar het onderwerp van de roadmap wordt gekeken. In dit perspectief staat de **'waarom-vraag'** centraal. Deze laag beschrijft de strategie, de trends en de drivers met betrekking tot het roadmap onderwerp.

Functioneel perspectief

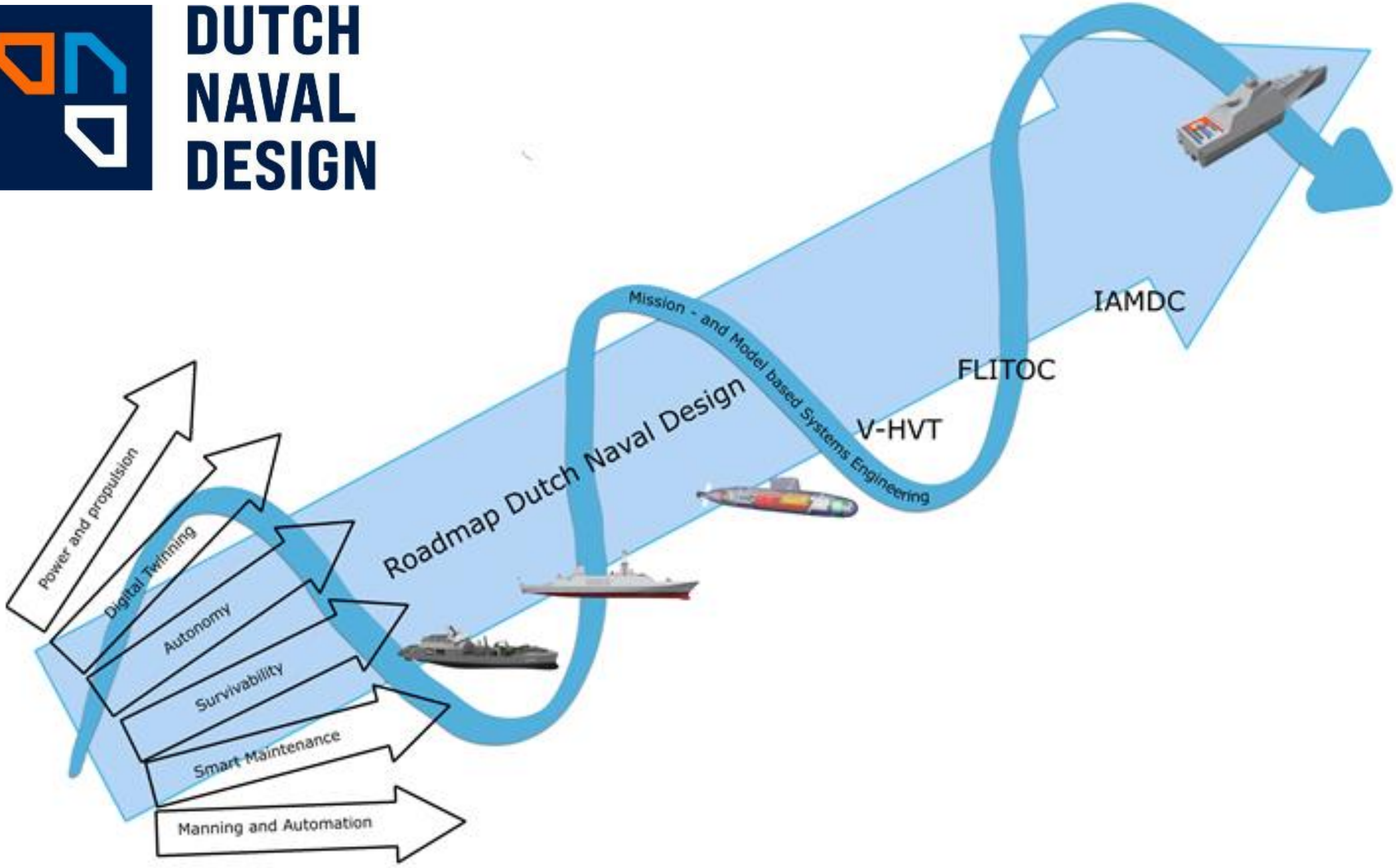
- Een middelste laag waarin vanuit een functioneel perspectief naar het onderwerp van de roadmap wordt gekeken. Dit perspectief gaat in op de **'wat-vraag**': Welke systemen, diensten en/of producten kunnen er worden ontwikkeld om tegemoet te komen aan de strategie, trends en drivers uit de toplaag?

Instrumenteel perspectief

- Een onderste laag met een instrumenteel perspectief. Dit perspectief beantwoord de **'hoe-vraag**'. Hoe kunnen de systemen diensten en/of producten –worden ontwikkeld? Welke technologieën, kennis en andere resources zijn hiervoor nodig?



DUTCH NAVAL DESIGN



DUTCH NAVAL DESIGN

In 2050, a decisive operational effect is achieved by intensifying cooperation within the Golden Ecosystem of Dutch Naval Construction in the field of military maritime platform techniques. The new flagship of the Dutch Navy - as a carrier, integrator of, and interactor with the weapons and sensors - continues to play a crucial role. The military maritime fleet consists of a combination of manned and unmanned (remotely controlled and/or autonomous) platforms. Together they form a military capability with which the State achieves operational effects at a great distance and over a large area at reduced personal risk.

WINNING DRIVEN PARTNERSHIP

MISSION & MODEL BASED SYSTEMS +
Concurrent design in a complex ecosystem

REDUCED MANNING TECHNOLOGIES +
Enabling the low/no crew vessel

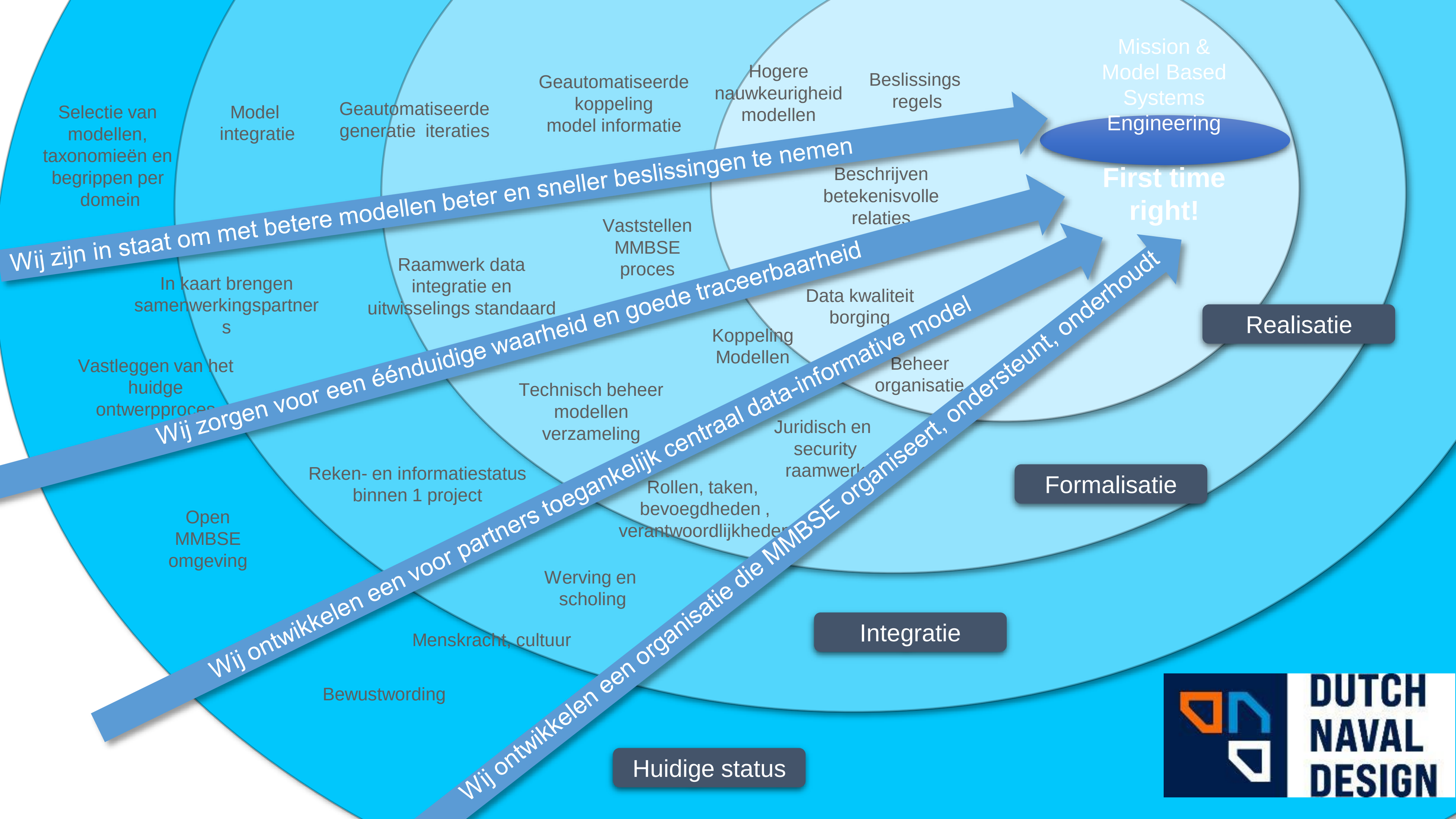
SMART MAINTENANCE +
Predictive and condition-based maintenance

ENERGY & MOBILITY +
Hybrid signatures, integration and dispersion

DIGITAL TWIN +
Predictive and real time analysis & decision support

SURVIVABILITY +
Materials, counter measures and combat readiness

AUTONOMY +
The networked system of systems



Mission &
Model Based
Systems
Engineering
First time
right!
Selectie van modellen, taxonomieën en begrippen per domein
Model integratie
Geautomatiseerde generatie iteraties
Geautomatiseerde koppeling model informatie
Hogere nauwkeurigheid modellen
Beslissings regels
Beschrijven betekenisvolle relaties
Vaststellen MMBSE proces
Raamwerk data integratie en uitwisselings standaard
In kaart brengen samenwerkingspartners
Data kwaliteit borging
Koppeling Modellen
Beheer organisatie
Vastleggen van het huidige ontwerpproces
Technisch beheer modellen verzameling
Juridisch en security raamwerk
Reken- en informatiestatus binnen 1 project
Rollen, taken, bevoegdheden , verantwoordlijkheden
Open MMBSE omgeving
Werving en scholing
Menskracht, cultuur
Bewustwording
Wij zijn in staat om met betere modellen beter en sneller beslissingen te nemen
Wij zorgen voor een éénduidige waarheid en goede traceerbaarheid
Wij ontwikkelen een voor partners toegankelijk centraal data-informative model
Wij ontwikkelen een organisatie die MMBSE organiseert, ondersteunt, onderhoudt
Realisatie
Formalisatie
Integratie
Huidige status
DUTCH
NAVAL
DESIGN

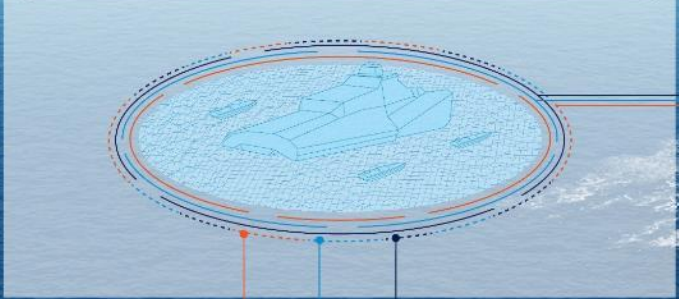
MISSION & MODEL BASED SYSTEMS ENGINEERING

DUTCH NAVAL DESIGN

In 2050, the golden ecosystem, a unique partnership between the Dutch MoD, knowledge institutes and industry, has designed the next generation fleet for the future. At the core lies a novel Mission and Model Based Systems Engineering approach. This enables a wide array of partners to work together in a singular, model based, digital environment to design, optimize, detail and specify an operationally effective future fleet of manned Flexships and autonomous UxV's. This M&MBSE approach has proven to be key to faster development and delivery of this fleet.

CONCURRENT DESIGN ECOSYSTEM

GENERATE >> INVESTIGATE >> DECIDE & CHOOSE >> ADJUST



MISSION SUCCESS & OPERATIONAL EXCELLENCE DELIVERED FASTER

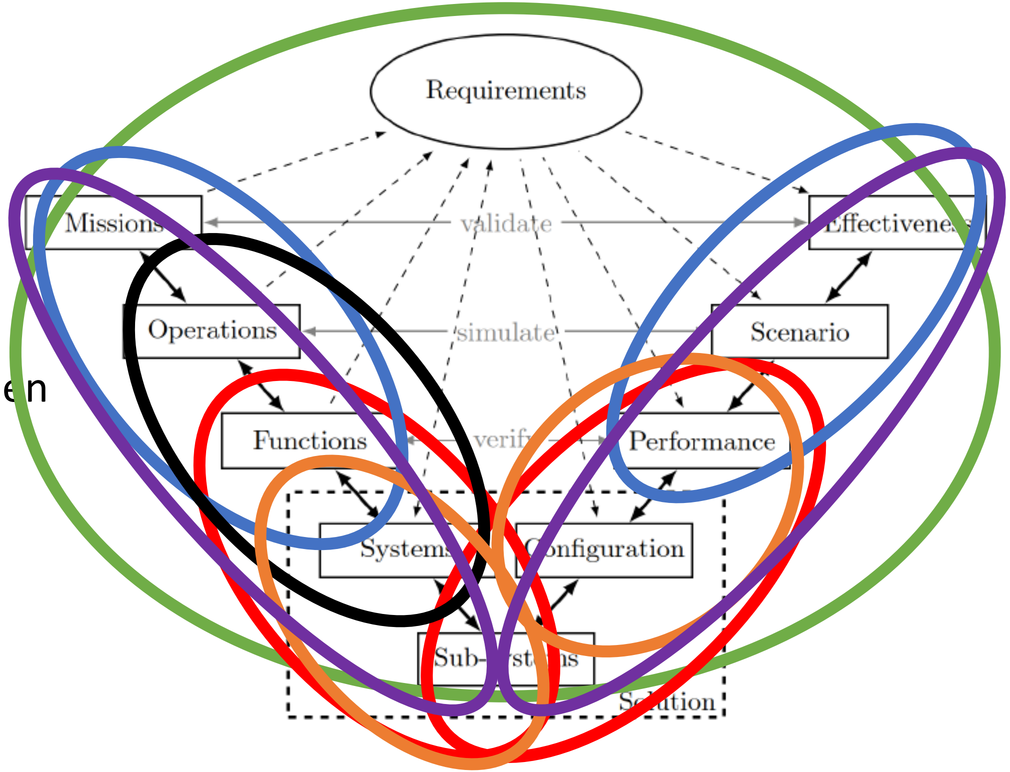
INDUSTRY	GOVERNMENT	KNOWLEDGE INSTITUTES

Pilots

Welke pilots?

1. Koudwatersysteem
2. Modelleren en simuleren van missies en effectiviteit
3. Integraal doorrekenen ontwerp
4. Vertaling taken, functies ⇔ systemen
5. Omgeving voor Informatie Uitwisseling
6. Verkennen, analyseren en leren

+ DSNS opdracht voor ontwerp van unmanned surface vessel via MBSE




Questions?

38/5/6 Workshop deelnemers
Dutch Naval Design

ADSE CONSULTING AND ENGINEERING
CGI
enginia
DEMCON
DAMEN NAVAL
de Haas MAASSLUIS
Capgemini
RH MARINE
hullvane
DiManEx
RHEA GROUP
THALES
Royal IHC
Nevesbu NAVAL ARCHITECTS & MARINE ENGINEERS
SkyDec
DNV
VIRO
MASTERSHIP
copernicos
TKF CONNECTIVITY SOLUTIONS
WÄRTSILÄ
VR Owl
Verebus ENGINEERING
VHT VAN HALTEREN TECHNOLOGIES
RINA
Ridderflex
RENK
RED GREEN SYSTEM NAVAL ARCHITECTS
InterDam
OCEANS X
JULES DOCK
THE IP COMPANY WIRELESS SITUATIONAL AWARENESS
HENSOLDT
Floorganise
FUGRO
Fokker SERVICES GROUP
EDORADO PREMIUM ELECTRIC POWERBOATS

MIND MILITARY INNOVATION BY DOING
Defensie NEDERLANDSE DEFENSIE ACADEMIE
Koninklijke Marine

NMC

TNO ESI Powered by industry and academia
MARIN BETTER SHIPS, BLUE OCEANS
TU Delft
nlr
TNO

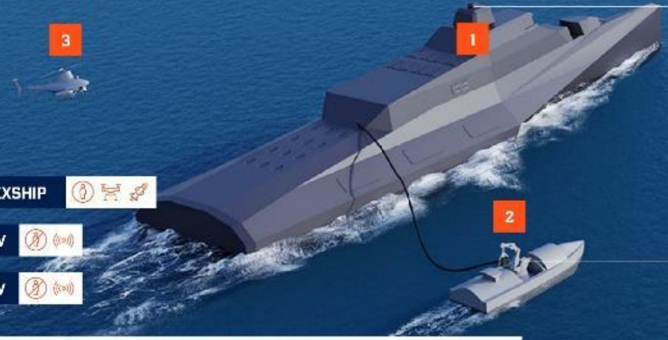
Vision Flexship

- https://www.youtube.com/watch?v=dygJjHvBuDk

REDUCED MANNING TECHNOLOGIES

DUTCH NAVAL DESIGN

In 2050, the Flexship sails with a significantly reduced crew. This reduction will also be driven by advances in robotics, connectivity technology and human machine interfacing. One operator will be responsible for, and oversee, processes that used to take multiple trained staff. Supported by a combination of technologies, operations like Replenishment At Sea (RAS), Launch & Recovery (L&R) or tasks on the flight deck will be significantly less taxing for on-board personnel than in the past.



1 FLEXSHIP

2 USV

3 UAV

UNMANNED | MANNED | DRONE PLATFORM | WEAPONS PLATFORM | SENSOR

REDUCED MANNING OPPORTUNITIES

CONNECTIVITY

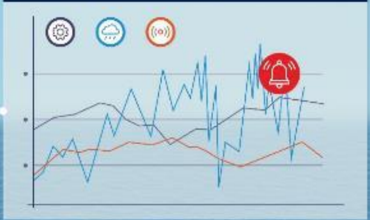
ROBOTICS

SMART MAINTENANCE

DUTCH NAVAL DESIGN

In 2050, predictive and condition-based smart maintenance is practiced. This starts in the design phase of a ship. The M&MBSE approach safeguards serviceability over the entirety of the product lifecycle. Data from Digital Twin models is combined with additional relevant data sets to train predictive maintenance models.
These models are at the core of the Logistical Control Tower (LCT) from which the entire fleet is monitored.
The LCT is at the center of all maintenance and ancillary logistic activity, such as additive manufacturing processes.
The LCT can also guide on-board personnel through the maintenance process, using XR applications.

CONDITION MONITORING



ADDITIVE MANUFACTURING

XR ASSISTED MAINTENANCE

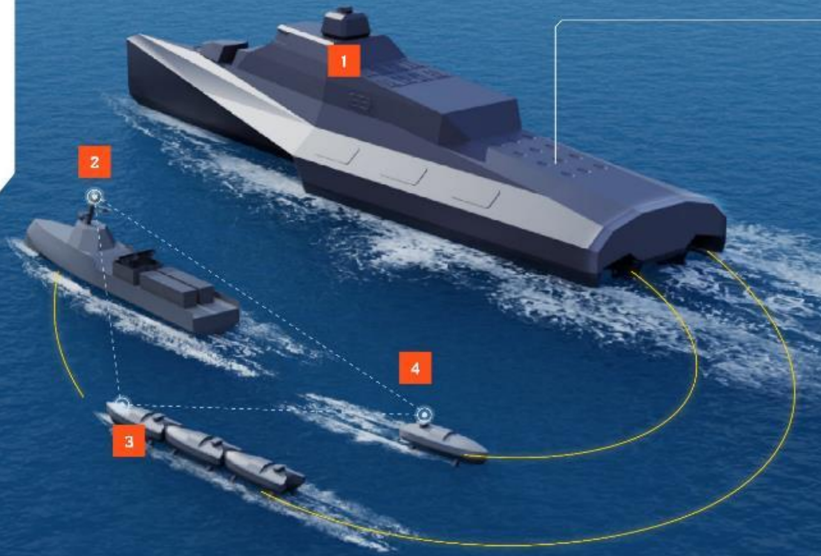
DIGITAL TWIN

LOGISTIC CONTROL TOWER

ENERGY & MOBILITY

DUTCH NAVAL DESIGN

In 2050, the Flexship, with a mix of hybrid energy systems on board, is not operating alone. Posting ahead are several USV's with innovative hull shapes and capabilities tailored for to their individual tasks. The energy systems, dispersion, integration and networking capabilities of the Flexship and her UxV's offer many strategic advantages and amplify the capabilities of each individual member and of the fleet. These capabilities make the Flexship a true master of disguise.



1 FLEXSHIP

2 MICAN

3 USV

4 AUTONOMOUS UXV NETWORK

UNMANNED | MANNED | ELECTRIC PROPULSION | SURVEILLANCE CAPABILITY | ENERGY TRANSPORTER | INTEGRATION/DISPERSION | MODULAR ENERGY COMPONENTS

MODULAR ENERGY COMPONENTS

SIGNATURE ENGINEERING

HULL TYPES

SURVIVABILITY

DUTCH NAVAL DESIGN

In 2050, the Flexship has a Signature Manage-ment System (SMS) which assesses the situation and acts accordingly. Able to detect a wide range of incoming threats, the ship's own signature is adjusted for successful deployment of counter-measures, such as a set of unmanned USV's to perform deceptive countermeasures. Through hit point management, activation of impact reducing (meta)materials and other countermeasures, impact of threats is mitigated as much as possi-ble. However, the ship may still absorbs an impact. The following battle damage assessment (BDA) is done using Digital Twin technology and is then weighed with the mission objectives to determine priorities for battle damage repair.

- 1 FLEXSHIP
- 2 USV 1
- 3 USV 2
- 4 USV 3

SUSCEPTIBILITY

PREVENT HIT — SIGNATURE MANAGEMENT

HITPOINT MANAGEMENT

VULNERABILITY

CONFINE DAMAGE — BRACE FOR IMPACT

DAMAGE CONTROL FOR WEAPON EFFECTS

INNOVATIVE ASSESSMENT, FIRE FIGHTING AND RECOVERBILITY FOR BATTLE DAMAGE

UNMANNED | MANNED | DRONE PLATFORM | WEAPONS PLATFORM | DECOY | DECEPTION | CHAFF/FLARE | META MATERIAL

AUTONOMY

DUTCH
NAVAL
DESIGN

In 2050, crewed vessels are operating in accompanied by a networked system of UxV's. This fleet of autonomous assets functions as the eyes and ears of the taskforce far beyond the horizon, underwater, on the surface and in the air. The UxV's do so without any need for human/operator interference. In other words, the UxV's autonomously work together, explore, navigate, and interpret their environment, think of possible actions, choose and execute their decisions. Weapon systems on deployed autonomous assets remain a human responsibility.

DIGITAL TWIN

DUTCH NAVAL DESIGN

In 2050, Digital Twins (DT) are ubiquitous within the operation. DT's run at component and system levels and, when connected, can even transcend to ship and fleet levels. Sensor networks - present on assets such as navy ships and drones - feed the DT models with near real-time data, enabling better predictive analysis and decision support. They are used to make decisions concerning maintenance, mission planning, battle damage assessment, shipbuilding, autonomy and more. As such, they are in many regards conditional to the success of any operation.

AUTONOMY

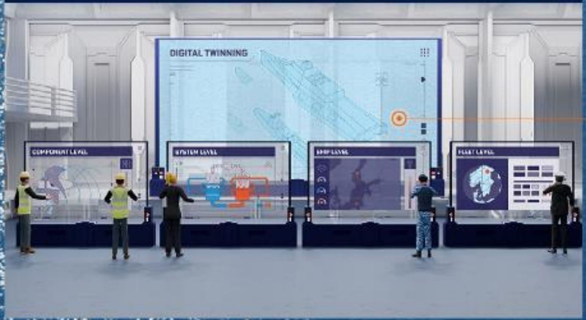
ENERGY & MOBILITY

M&MBSE

REDUCED MANNING TECHNOLOGIES

SMART MAINTENANCE

PREDICTIVE ANAYSIS



SURVIVABILITY

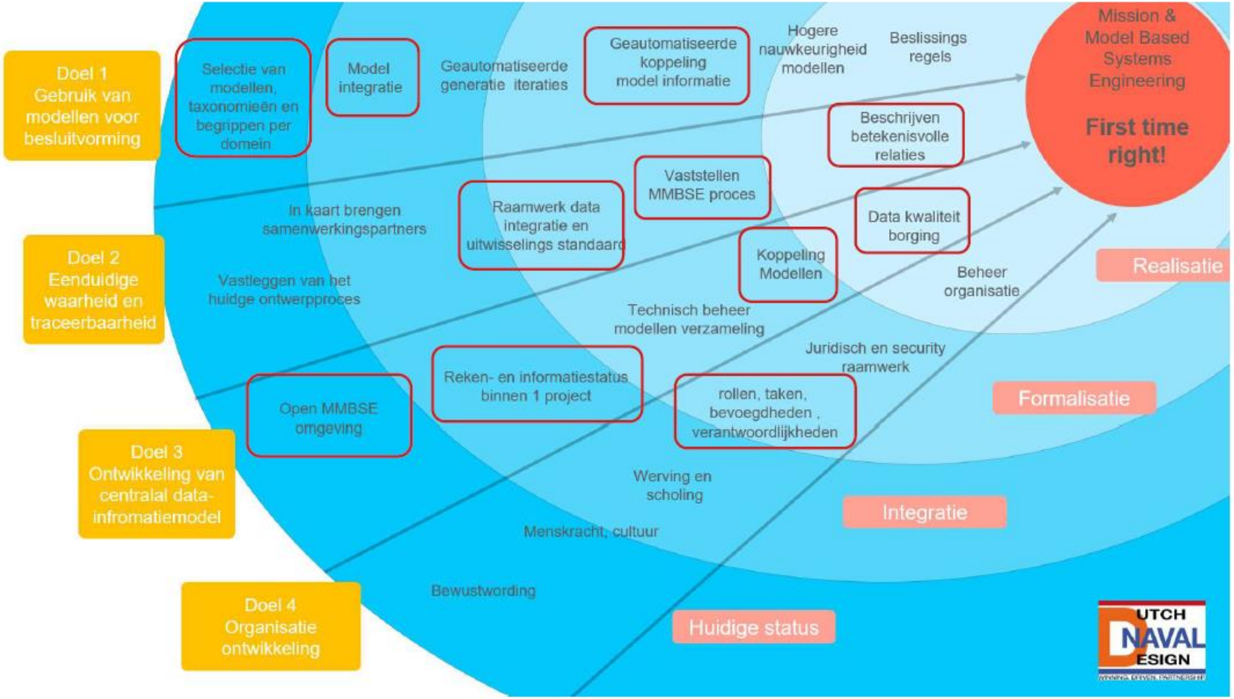
Dutch Naval Design: Mission & MBSE

Report on Pilot 1

Participants

- Starion Group
  - Gwendolyn Kolfschoten
  - Paloma Maestro Redondo
  - Belén González Rodríguez
  - Vasileios Sideris
  - Sam Gerené
- DAMEN Naval
  - Koen Audenaert
  - Simon Bedert
  - Koen Droste
- AVR MARITIME
  - Arthur Vrijdag
- ADSE
  - Rick Nelen
  - Ilja Achterberg
  - Maarten Deul

- Can Model Based Systems Engineering help us make better decisions and designs in early phases of a projects lifecycle?



DUTCH NAVAL DESIGN

STARION DAMEN NAVAL ADSE CONSULTING AND ENGINEERING AVR MARITIME Consultancy and Training Concurrent Design Facility

Wat is Missie & Model Based Systems Engineering?

Missie

Model Based

Systems Engineering

Digitalisering

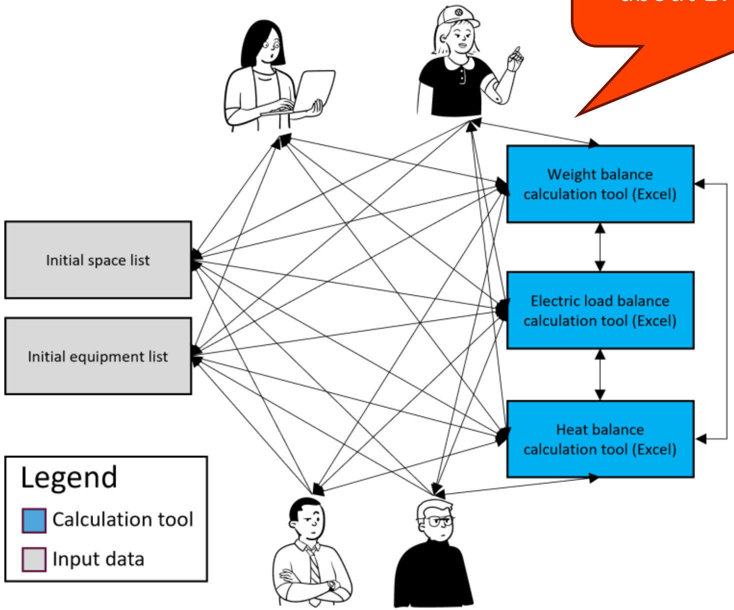
Document-centrisch
- Presentaties en documenten leidend gedurende ontwerp
- Design artefacten opgeslagen in tools/databases
- Informatie is verspreid

Model-centrisch
- Modellen leidend gedurende ontwerp, documentatie is afgeleide
- Multi-user, tool-gebaseerd
- "Connected" informatie

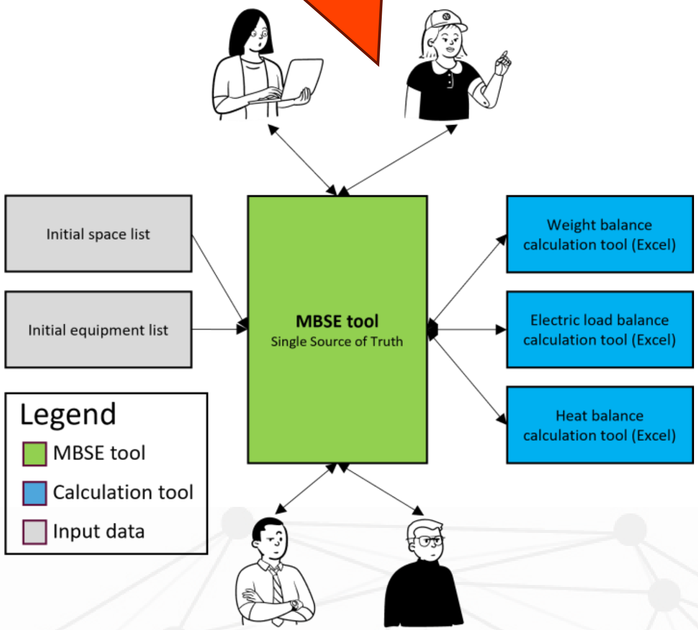
Unclassified

It is a Transition

If one parameter changes, we need to change it in about 17 spreadsheets & tools



If one parameter changes we only change it in the single point of truth and synchronize all other tools



=> Synchronize and connect domain-specific calculation models through a centralized 'single source of truth' (i.e. the 'model' in Model Based Systems Engineering)

Pilot 1 ; ‘just start doing’ and learn.

- Model a small, but representative system using various (well established) MBSE methodologies and tools
- Vary system configuration, boundary conditions and requirements as would happen during a real project
- Assess how theoretically claimed *success factors/benefits* of MBSE hold in real life

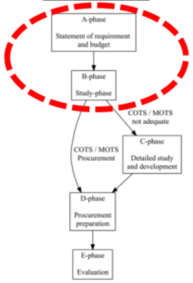
Aanpak (3)

Focus: inventarisatie waar de grootste verbeteringen & bijdrages mogelijk en nuttig zijn

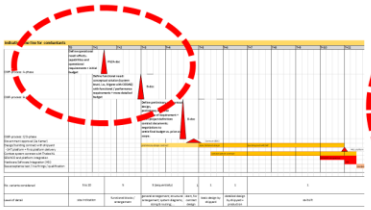
Uitkomst
- Vroege fases (A- & B-fase van DMP)
- Hele schip
- Hele *“systems engineering V”*

First time right → identificeer en reduceer risico’s veel eerder dan nu

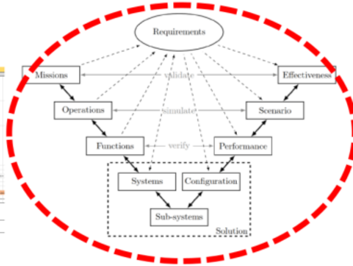
Besluitvorming



Project



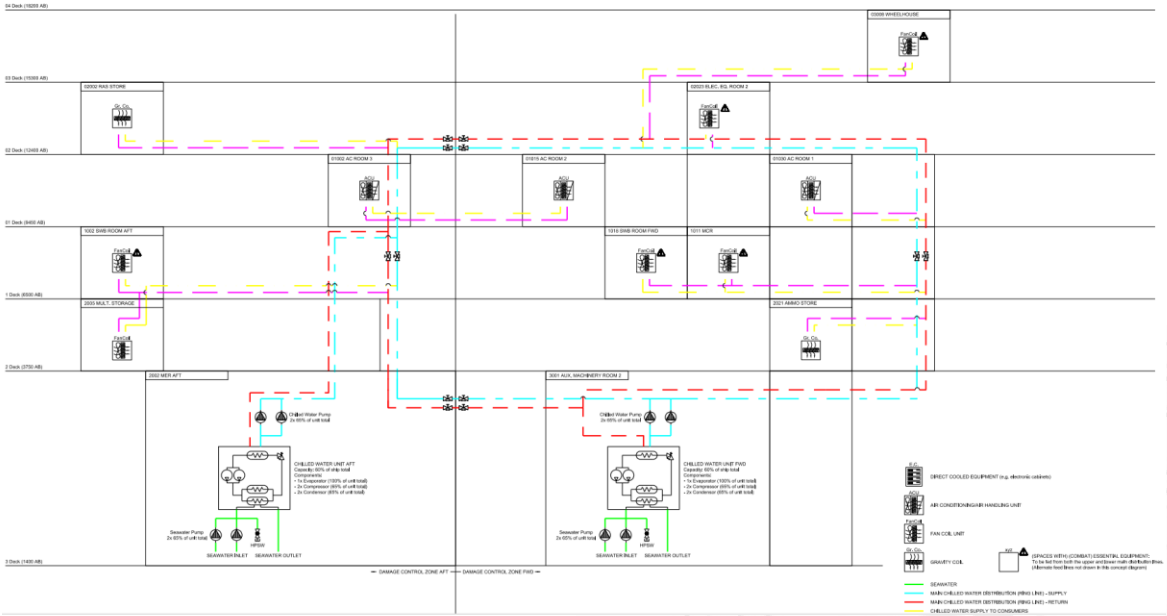
Ontwerp, specificatie, engineering en bouw



STARION DAMEN NAVAL ADSE CONSULTING AND ENGINEERING AVR MARITIME Consultancy and Training Concurrent Design Facility

System of Interest; Chilled Water System

- A small scale chilled water system, representing physical concepts for
  - Equipment (to be cooled and cooling-)
  - Spaces, decks, zones



Mission Requirements

R01. The total installed cooling power shall be larger than the calculated cooling load (calculated by HVAC calculation sheet) increased by a future growth margin of 10%.

R02. With one chilled water plant out of operation, the remaining capacity shall be sufficient to cover 100% of the cooling load of combat-essential equipment, and 50% of the remaining equipment.

R03. The cooling capacity of the chilled water units shall be identical.

R04. The capacity of each SW cooling pump shall match 65% of the cooling capacity of the associated chilled water plant.

R05. The capacity of each SW cooling pump shall be identical.

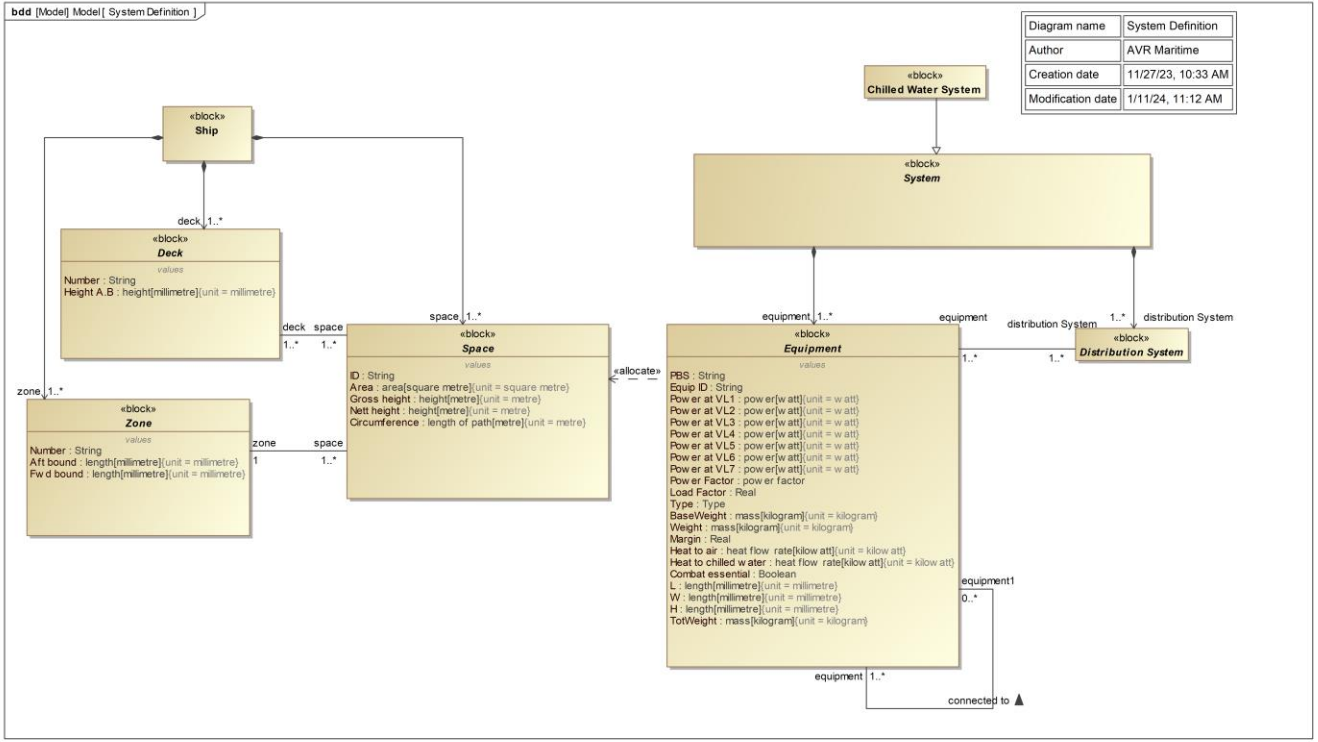
R06. The capacity of each CW circulation pump shall match 65% of the cooling capacity of the associated chilled water plant.

R07. The capacity of each CW circulation pump shall be identical.

R08. Each damage control zone shall be fitted with at least one chilled water plant.

Design Pattern

- Shows what information is required to facilitate use in activity scope
- Based on experience from DAMEN
- FYI: the metamodel already includes **58** unique data fields for this limited scope



STARION DAMEN NAVAL ADSE CONSULTING AND ENGINEERING AVR MARITIME Consultancy and Training Concurrent Design Facility

Design Mutations (Playbook)

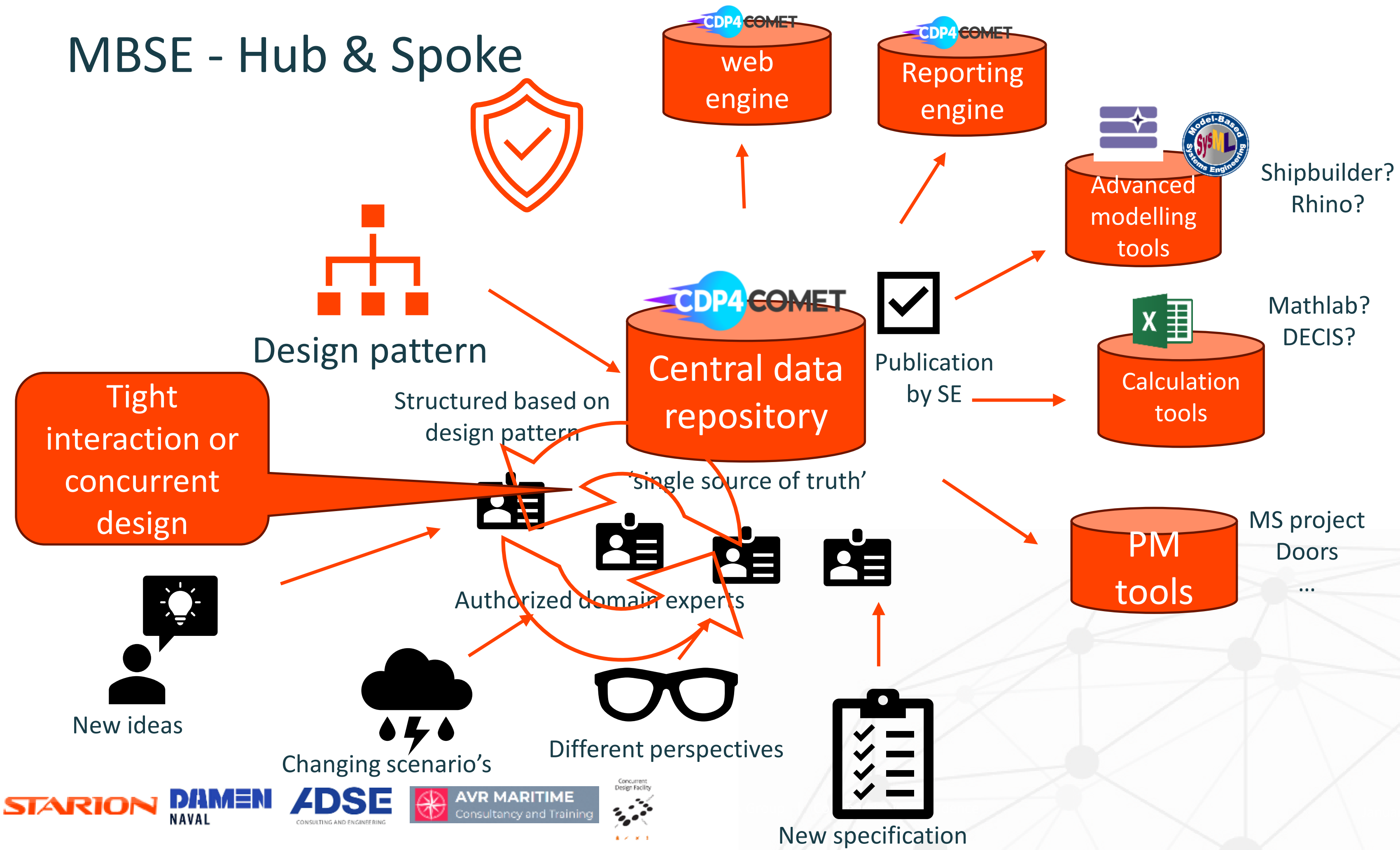
- A - Consumer set mutations:
  - A1- The configuration of the conning system (BSMI 6431) will be replaced completely
  - A2- A water-mist system (BSMI 1517) and associated equipment will be added
  - A3- Part of the bridge hardware (part of BSMI 6443) will be physically moved (reassigned to a new space)
- B - Ship configuration mutations
  - B1 - A space will be moved from 01- to 02-deck
- C - Model mutations:
  - C1 - The *mass* property will be split into three sub-values for all existing equipment
  - C2 - A new property will be introduced (cost)
- D - External factors
  - D1 - Environmental conditions will be changed
  - D2- Capacity requirement *R02* will be changed.

MBSE process

- Conops & functional decomposition
- Requirements, System architecture, design pattern, product tree
- Baseline model, populate with data, exchange with Capella and EA (SysML)
- Automate requirements verification
- Experiment with mutations, changes, calculate impact on requirements & budgets, Identify trade-offs

STARION DAMEN NAVAL ADSE CONSULTING AND ENGINEERING AVR MARITIME Consultancy and Training Concurrent Design Facility

MBSE - Hub & Spoke



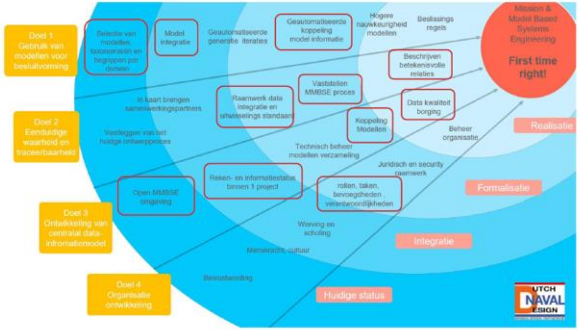
MMBSE SuccessFactors

- ✓ Consistency
- ✓ Flexibility
- ✓ Efficiency
- ✓ Ownership
- ✓ Traceability
- ✓ Monitor & log changes
- ✓ Trade-offs

Can Model Based Systems Engineering help us make better decisions and designs in early phases of a projects lifecycle?

✓ - Use of Models in Decision making
  - facilitates Concurrent Design
  - Fits in existing Design Spiral approach

✓ - Single Truth and traceability
  - CDP4-COMET as Hub
  - Capella and ‘SysML’ , Excel
  - Adapters



✓ - Development of a central Data informationmodel
  - Digital Continuity, ‘Upstream’, ‘Downstream’

✓ - Organizational development
  - Investment Upfront and Benefits
  - Datamanagement, Baselining, Project Management

STARION DAMEN NAVAL ADSE CONSULTING AND ENGINEERING AVR MARITIME Consultancy and Training Concurrent Design Facility

Lessons from this setup;

MBSE facilitates better, faster, design work in Concept Design Phase

Designer(s) are in the lead.

Benefit due to; preparatory work in Setting up models, Design Pattern

Create common understanding;

Central MBSE Data-Hub is Key, can be in one tool

CDP4-COMET serves this purpose

Connecting to other Tools depends on availability of Adapters

Observe Learning Curve

Tool Training

Lessons for DND Roadmaps

- Design Pattern thinking helps to build common understanding
- Design Mutations
  - Baselining
- Learning Curve on methodology and tools to be observed
  - Training

stariongroup.eu

Digital continuity

Generic life cycle (ISO/IEC/IEEE 15288:2015)

Concept stage	Development stage	Production stage	Utilization stage	Retirement stage
			Support stage	

Lessons learned

In the Transition; MMBSE and CD requires an Investment upfront;

- Design Pattern (Meta-Model) creation
- Margins and Budget philosophy
- Training and Support on thinking in models and systems
- Align and embed in Project Management Organization

And that will reap Benefits;

- Higher maturity of design work products for subsequent steps
- Reuse and Repeat possible; higher benefits on subsequent projects

Added Value of connecting modelling Tools

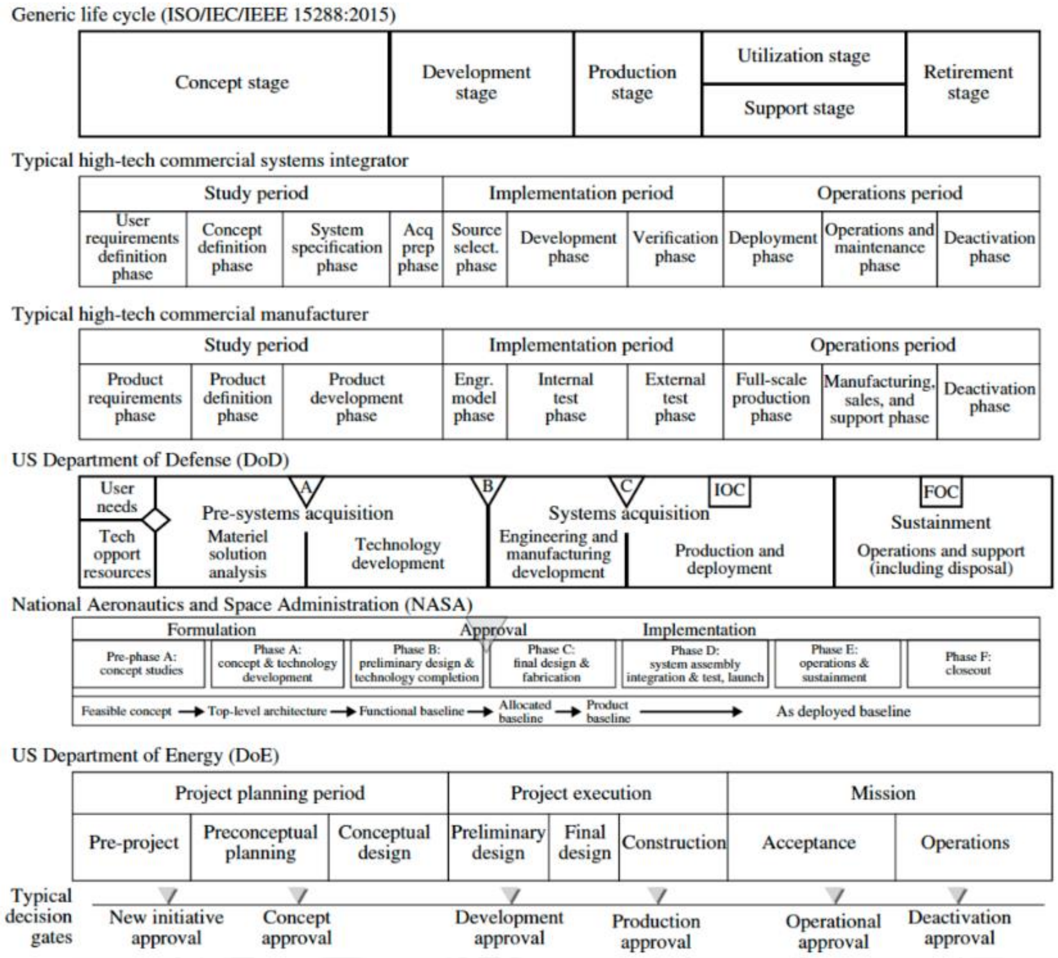
There is no Tool that serves all needs of all parties in all lifecycle phases

So an ecosystem of Tools

- Supports Single Source of Control of Models
  - Facilitates Concurrent Design => Speed, Iteration Management
- Enables organizations to use their own tools
- Makes best use of specific advantages of Tools
- Helps Data Risk Mitigation

System Engineering

- Requirements are the backbone
- Architectures
- Breakdowns (requirements, functional, logical, physical and work)
- Phase approach/stage gates
- Reviews
- Iterations



STARION DAMEN NAVAL ADSE CONSULTING AND ENGINEERING AVR MARITIME Consultancy and Training Concurrent Design Facility

MBSE case study:

Fugro Pioneer Methanol Conversie

STARION DAMEN NAVAL ADSE CONSULTING AND ENGINEERING AVR MARITIME Consultancy and Training Concurrent Design Facility

Agenda

Introductie Case Study

Model opzet in COMET

Resultaten

Case Study: Fugro Pioneer Methanol Conversie

- Doelstelling: Creëren van een “zero-emissions” schip
- Eisen:
  - Methanol specifieke systemen
  - Afmetingen
  - Power Output
  - Stabiliteit
  - Endurance

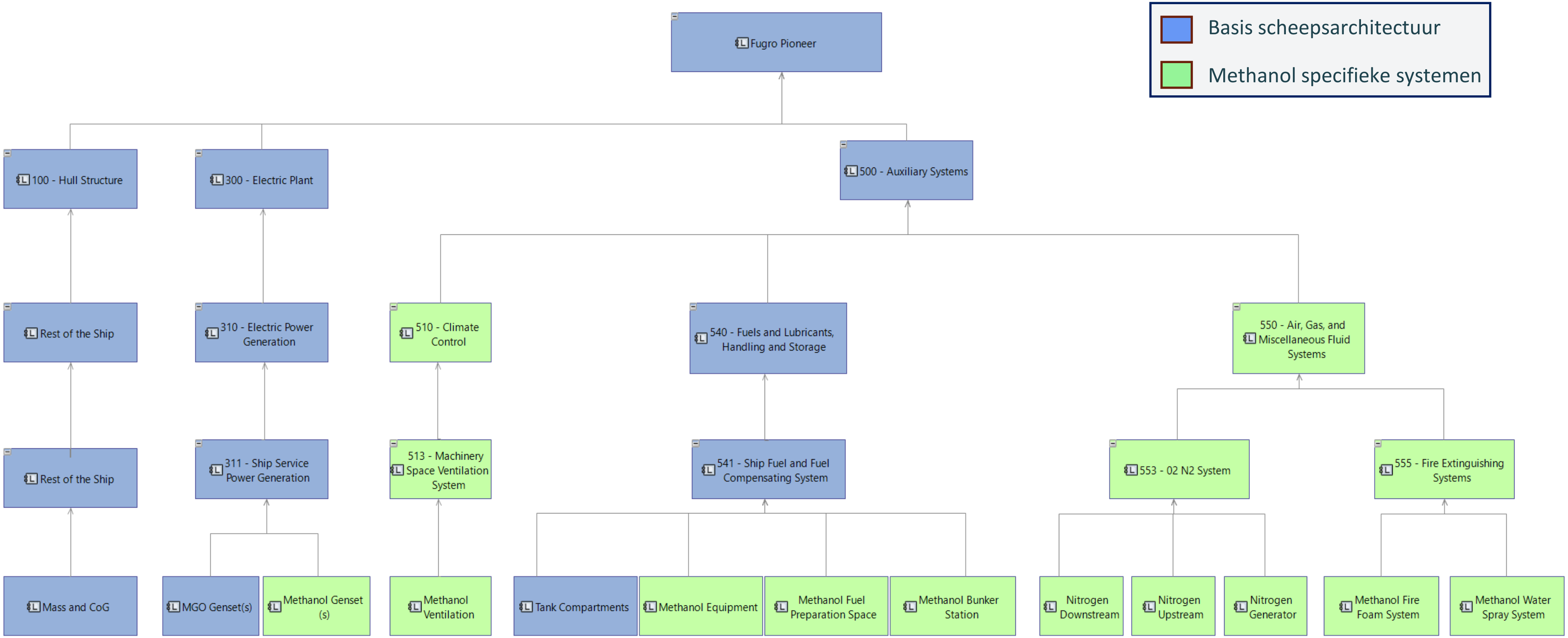
System Requirements

Dimensional Constraints		
☑ R09-Length	R09 - Length	The vessel shall have a length of 53.7m.
☑ R10-Breadth	R10 - Breadth	The vessel shall have a breadth of 12.5m
Endurance Requirements		
☐ R01-EnduranceMeOH	R01 - Endurance MeOH	The vessel shall have an operating endurance of at least 4 weeks (28 days) when running on methanol (MeOH).
☑ R02-EnduranceMGO	R02 - Endurance MGO	The vessel shall have an operating endurance of at least 65 days when running on Marine Gas Oil (MGO).
Fuel and Storage Systems		
▪ R11-FPS	R11 - Fuel Preparation Space	The vessel shall include one fuel preparation space (FPS)
▪ R12-BS	R12 - Bunker Space	The vessel shall include one bunker station (BS) space.
☐ R13-MeOH_storage_tanks	R13 - MeOH storage tanks	The vessel shall have a minimum of 2 methanol (MeOH) storage tanks.
▪ R14-MeOH_service_tank	R14 - MeOH service tank	The vessel shall have a minimum of 1 methanol (MeOH) service tank.
Power and Propulsion Requirements		
☐ R03-MethanolPower	R03 - Methanol Generating Power	At least 2 out of the 4 diesel gensets shall be converted to run on methanol (MeOH).
☑ R04-PowerOutput	R04 - Power Output	The vessel's power output shall be at least 4 units of 372 kW, maintaining the same performance as before the conversion.
Stability and Safety Requirements		
☑ R05-Draft	R05 - Draft	The vessel shall not exceed a maximum extreme draft of 3.1m.
☑ R06-GM	R06 - Min. GM	The vessel shall maintain a minimum GM (metacentric height) of 1.293m for stability.
☑ R07-Trim	R07 - Max. Trim	The vessel shall not exceed the maximum allowable trim og 0.131m.
☑ R08-List	R08 - Max. heeling angle	The vessel shall not exceed the maximum allowable heeling angle (list) of 0.5 degrees.

Waarom MBSE?

- Koppelen van engineering tools
- Concurrent Design
- Meerdere design opties in één model
- Automatische Eisen verificatie
- Korte design iteraties

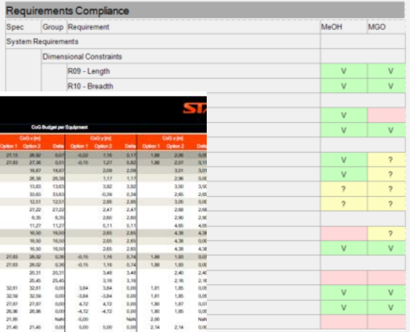
Model Architectuur

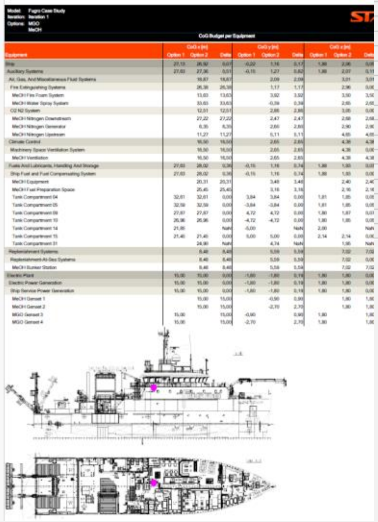


Design Iteratie

COMET model (3 design options)

Eisen verificatie





Massa balans en zwaartepunt berekening

Tank arrangement data →

← Tank Capacity & Weight parameters

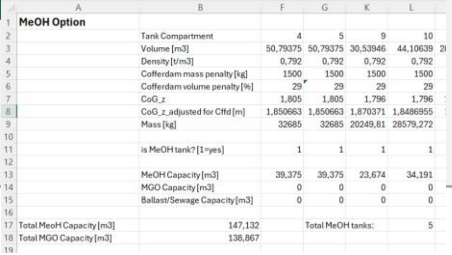
Tank Capacity + E-system specs →

← Endurance parameters

Center of gravity & weight data →

← Stability parameters

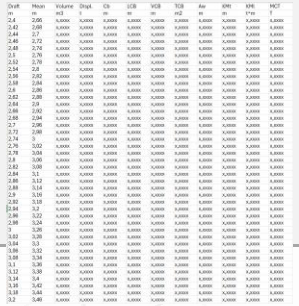
Tank arrangement calculations



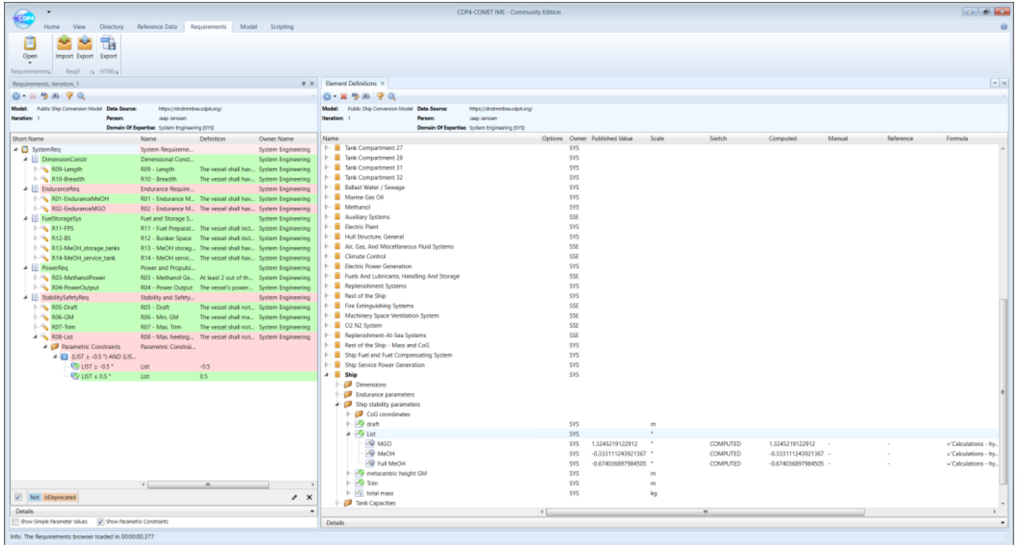
	A	B	F	G	K	L
1	MeOH Option					
2		Tank Compartment	4	5	9	10
3		Volume [m3]	50,79375	50,79375	30,53946	44,10639
4		Density [t/m3]	0,792	0,792	0,792	0,792
5		Cofferdam mass penalty [kg]	1500	1500	1500	1500
6		Cofferdam volume penalty [%]	29	29	29	29
7		CoG_z	1,805	1,805	1,796	1,796
8		CoG_z_adjusted for Cffd [m]	1,850663	1,850663	1,870371	1,8486955
9		Mass [kg]	32685	32685	20249,81	28579,272
10						
11		is MeOH tank? [1=yes]	1	1	1	1
12						
13		MeOH Capacity [m3]	39,375	39,375	23,674	34,191
14		MGO Capacity [m3]	0	0	0	0
15		Ballast/Sewage Capacity [m3]	0	0	0	0
16						
17	Total MeoH Capacity [m3]	147,132		Total MeOH tanks:		5
18	Total MGO Capacity [m3]	138,867				
19						

Ship Endurance Calculations

Hydrostatics Model



Automatische Eisen Verificatie



[CDP4 COMET's Requirements Verification Case Study Ship Conversion to Methanol (youtube.com)]

STARION DAMEN NAVAL ADSE CONSULTING AND ENGINEERING AVR MARITIME Consultancy and Training Concurrent Design Facility

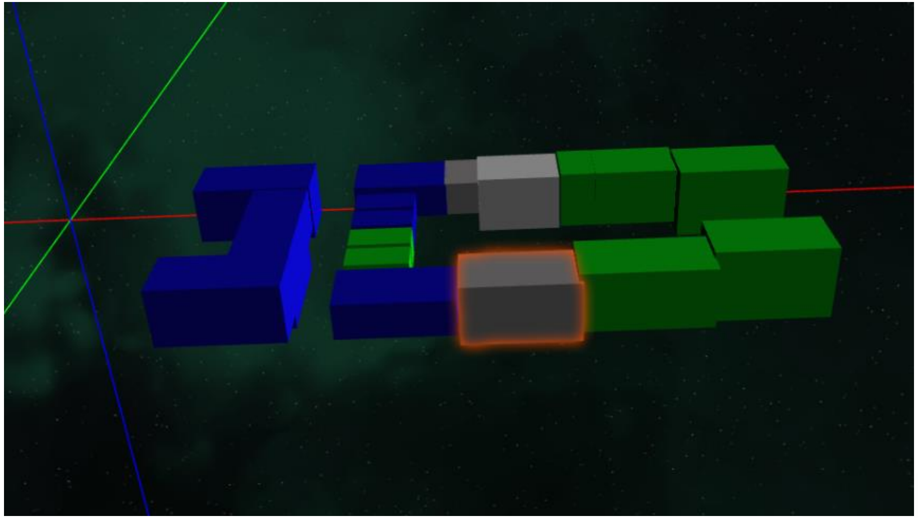
Resultaten na "eerste" iteratie

Requirements Compliance

Spec	Group	Requirement	Full MeOH	MeOH	MGO
System Requirements					
	Dimensional Constraints				
		R09 - Length	V	V	V
		R10 - Breadth	V	V	V
	Endurance Requirements				
		R01 - Endurance MeOH	V	V	
		R02 - Endurance MGO		V	V
	Fuel and Storage Systems				
		R11 - Fuel Preparation Space	V	V	?
		R12 - Bunker Space	V	V	?
		R13 - MeOH storage tanks	V	V	
		R14 - MeOH service tank	V	V	?
	Power and Propulsion Requirements				
		R03 - Methanol Generating Powe	V	V	
		R04 - Power Output	V	V	V
	Stability and Safety Requirements				
		R05 - Draft	V	V	V
		R06 - Min. GM	V	V	V
		R07 - Max. Trim			V
		R08 - Max. heeling angle			V

Volledig Methanol	Conversie	Origineel	Parametric Constraint
53.7m	53.7m	53.7m	= 53.7m
12.5m	12.5m	12.5m	= 12.5m
56.6 days	32.7 days	0 days	>= 28 days
0 days	73.1 days	162.2 days	>= 65 days
1	1	-	= 1
1	1	-	= 1
12	5	0	>= 2
1	1	-	= 1
4	2	0	>= 2 MeoH gensets
1488 kW	1488 kW	1488 kW	>= 1488 kW
3.1 m	3.16 m	3.1 m	<= 3.1 m
1.719 m	1.713 m	1.734 m	>= 1.293 m
-0.099 m	-0.025 m	-0.011 m	<= 0.131 m
-2.482 deg	-2.124 deg	0.165 deg	-0.5 deg < x < 0.5 deg

3D-Viewer: Demo



CDP4 COMET's 3D Viewer Case Study Ship Conversion to Methanol (youtube.com)

Betekenis

- Kleine investering: opzet model
- Inzichtelijk maken van impact op eisen
- Prioriteren van engineering tijd

Thank you

STARION

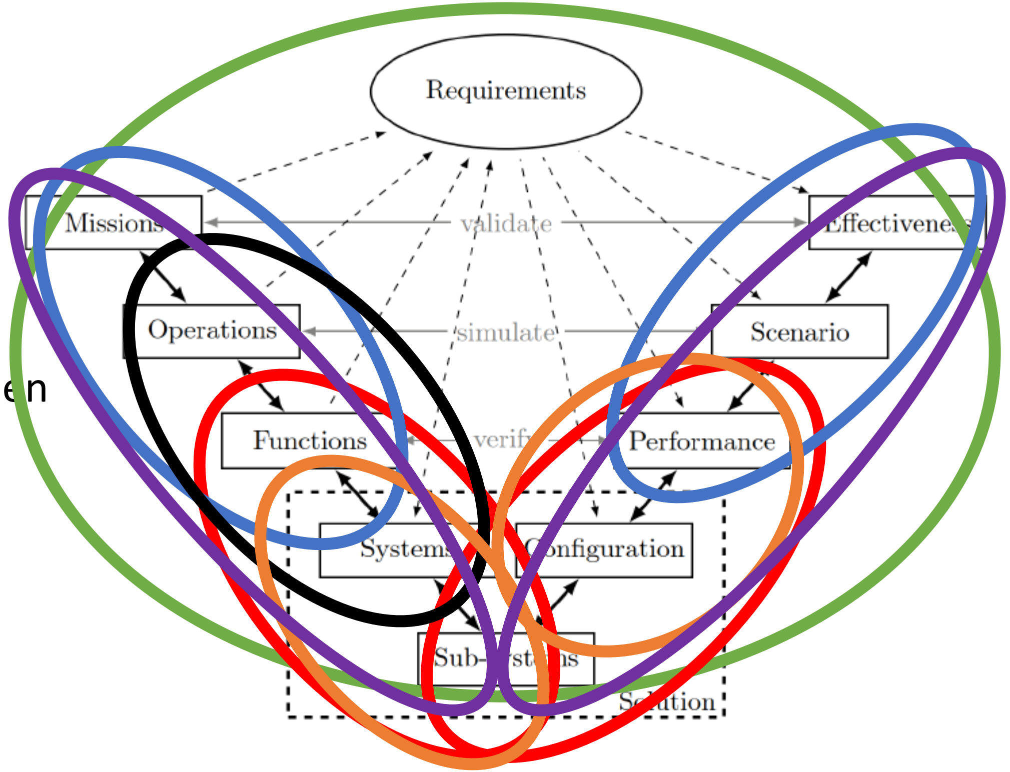
M&MBSE bij AMS

Pilots

Welke pilots?

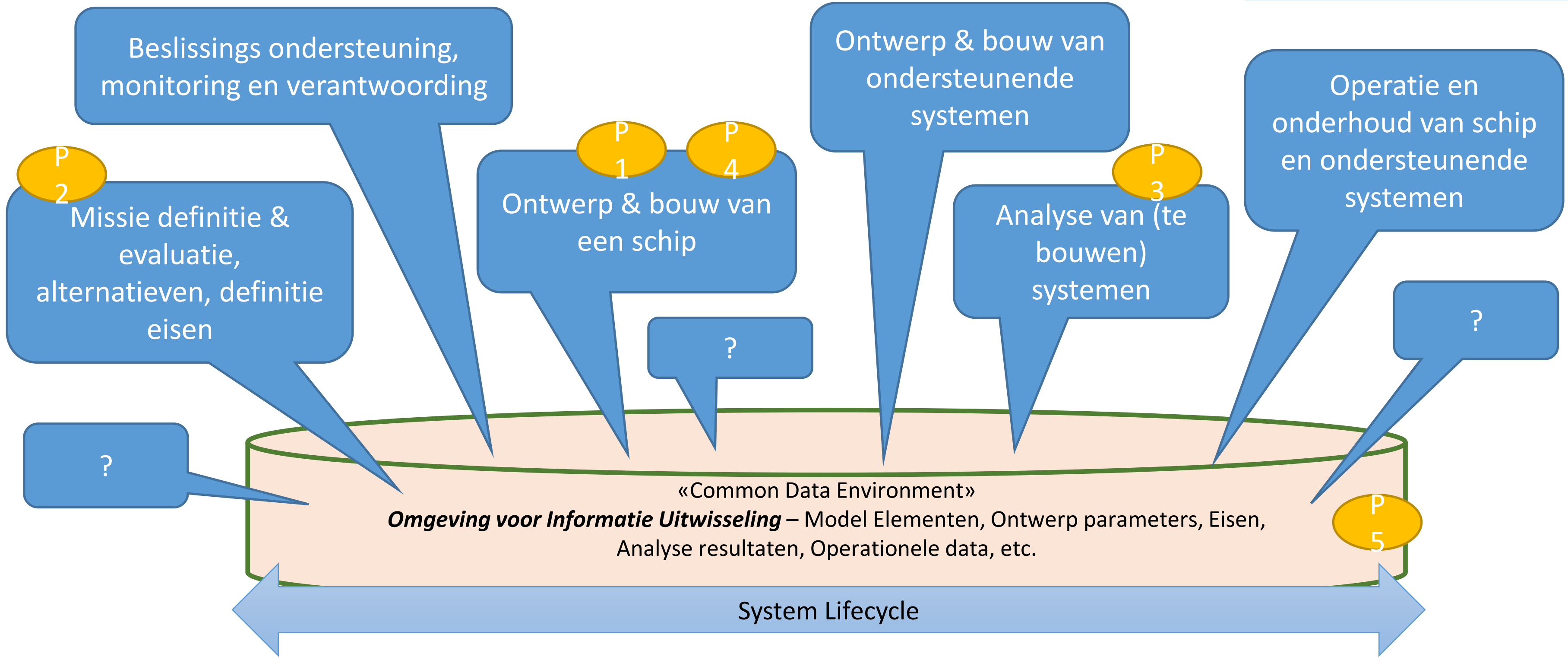
1. Koudwatersysteem
2. Modelleren en simuleren van missies en effectiviteit
3. Integraal doorrekenen ontwerp
4. Vertaling taken, functies ⇔ systemen
5. Omgeving voor Informatie Uitwisseling
6. Verkennen, analyseren en leren

+ DSNS contract voor ontwerp van unmanned surface vessel via MBSE

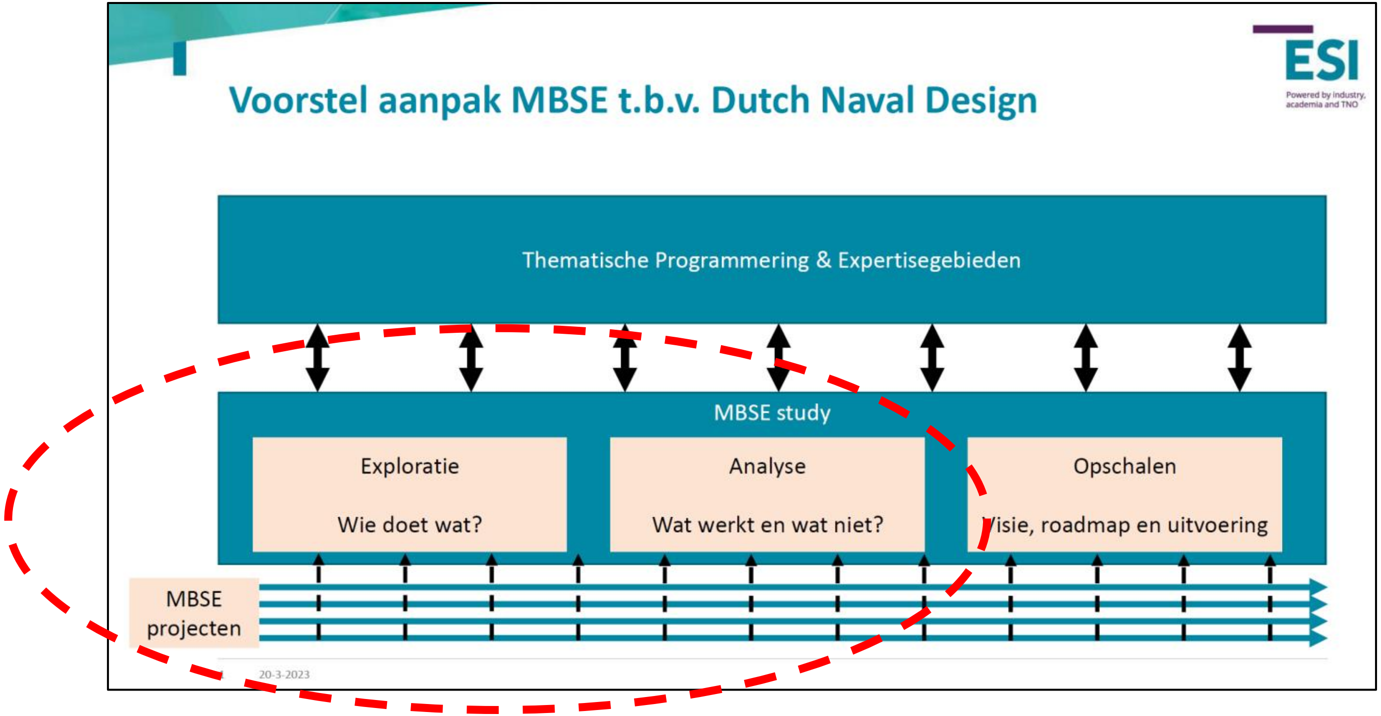


Pilot 5: Omgeving voor Informatie Uitwisseling

P1 – MBSE Cold Water System
P2 – Missie support
P3 – Schip Impact analyse
P4 – MBSE Autonoom Schip
P5 – Informatie Uitwisseling

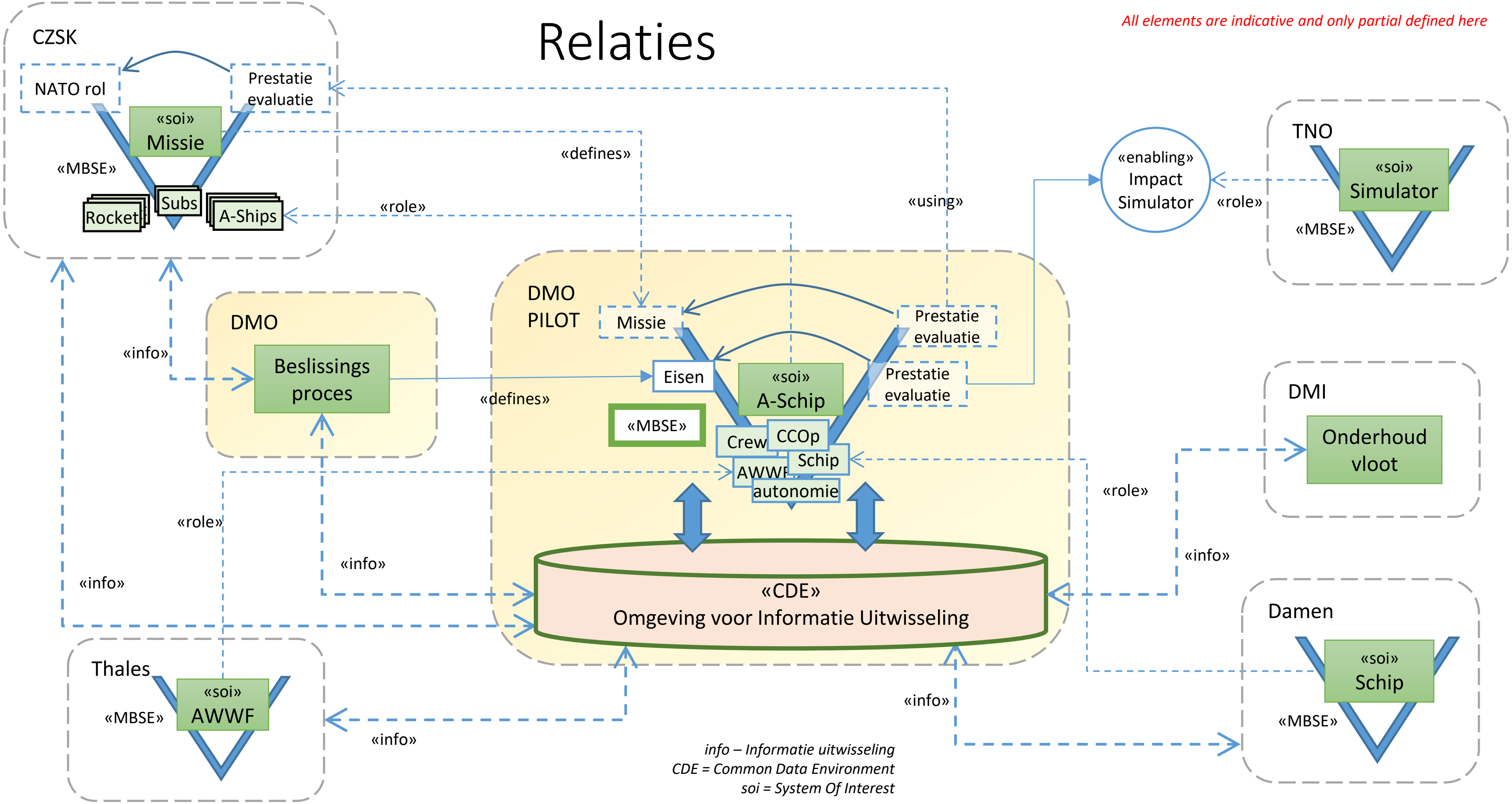


Pilot 6 – meer detail

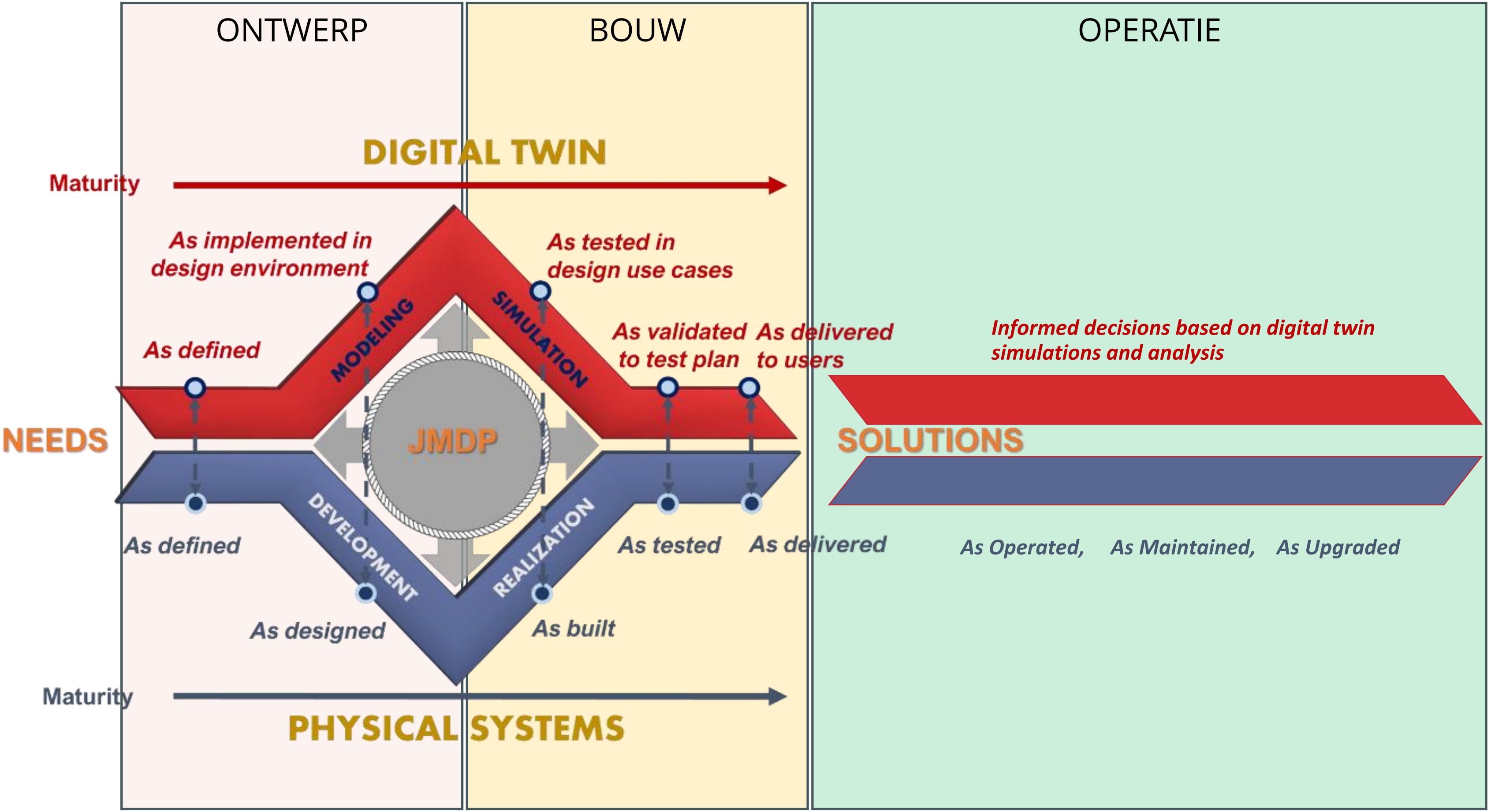


Relaties

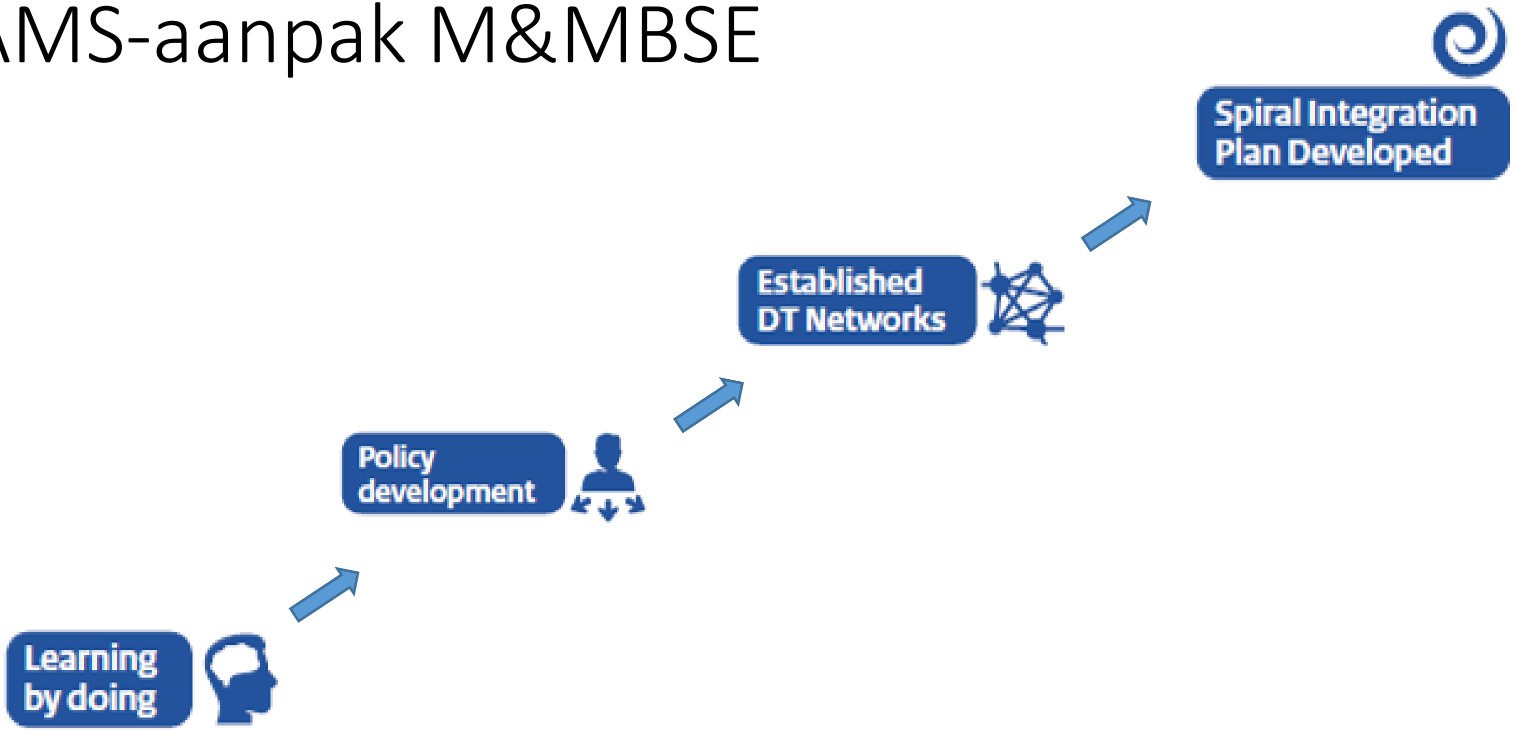
All elements are indicative and only partial defined here



info – Informatie uitwisseling
CDE = Common Data Environment
soi = System Of Interest


ONTWERP
BOUW
OPERATIE
DIGITAL TWIN
Maturity
As implemented in design environment
As tested in design use cases
MODELING
SIMULATION
As defined
As validated to test plan
As delivered to users
Informed decisions based on digital twin simulations and analysis
NEEDS
JMDP
SOLUTIONS
DEVELOPMENT
REALIZATION
As defined
As tested
As delivered
As Operated, As Maintained, As Upgraded
As designed
As built
Maturity
PHYSICAL SYSTEMS

AMS-aanpak M&MBSE



Maritiem Masterplan

Mariël van der Linden

mariel@maritiemmasterplan.nl
06 4609 2341

MARITIEM
MASTERPLAN
NET ZERO 2030

Gehoord

Belang digitalisering en modulair ontwerpen:

- Ontwerp
- Bouw
- Operatie
- Samenwerken

Eenduidige taal en eenduidige aanpak

MARITIEM MASTERPLAN
NET ZERO 2030

Gezien

Voorbeeld Digitaal Samenwerken bij refit:

- Digitaal modelleren
- Meerdere databronnen
- Ter verificatie

Eenduidige taal en eenduidige aanpak

MARITIEM MASTERPLAN
NET ZERO 2030

Digitaal Samenwerken – JMDP

Eenduidige taal & eenduidige aanpak

WAT – Taal & modellen, methoden

Standaardiseren WAT je met elkaar **uitwisselt,** dezelfde taal spreken.

Open informatie standaarden

Referentie architecturen

Digitale modellen van scheepssystemen

HOE – Digitale ruimte

HOE uitwisseling van informatie tussen partijen veilig **georganiseerd wordt.**

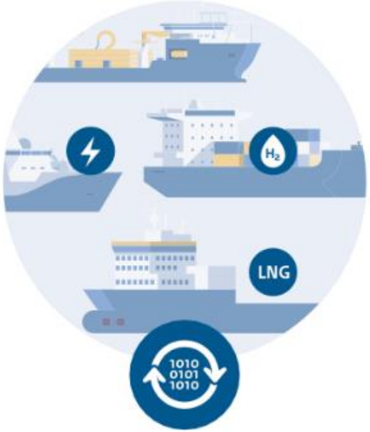
Afsprakenstelsel

Federatief data-deel infrastructuur

Versterkend voor KWALITEIT, EFFECTIVITEIT, EFFICIENCY en VEILIGHEID

MARITIEM MASTERPLAN NET ZERO 2030

Sector Agenda



Maritiem
Masterplan

Digitaal Samenwerken - JMDP blijft!

...is straks waar mogelijk ook faciliterend voor

Werf van de
toekomst

Smart
Maritime

Robotisering
wind op zee

Nucleaire
voortstuwing van
schepen

MARITIEM
MASTERPLAN
NET ZERO 2030