

# FL3DMS

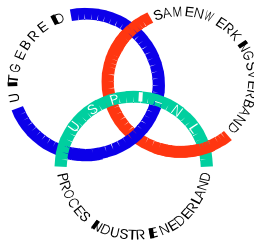
## Facility Lifecycle 3D Model Standard

Foundation for the digital twin  
Update for MB meeting June 2024



# Agenda

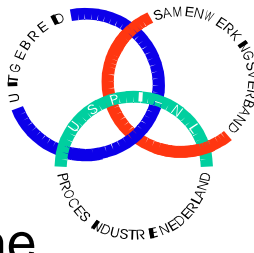
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1. Objectives & participants
2. Deliverables of FL3DMS
  - a) FL3DMS general deliverables
  - b) FL3DMS Lifecycle Guide
3. What's next?

# Terms of Reference - Objectives

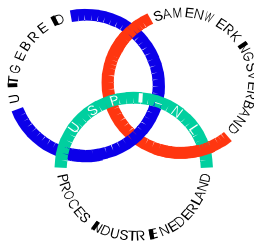
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- To create a **practical specification** for 3D models to be used by **Owner Operators** in the contracts with **EPCs**, to optimize the return on the investment in a 3D model
- Capture **current best practice** of owner-operators to **optimize the value of the 3D model throughout the execution of a capital project** and subsequently in the **operate phase**
- Enable the creation of a “**digital twin**”, allowing real time data to be projected upon the 3D model
- The specification will in the first instance be applicable to **proprietary 3D modelling systems**, but may evolve into a **neutral format** over time
- The standard is software platform agnostic

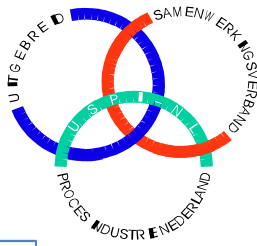
# FL3DMS Participants

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- Owner Operators: Equinor, bp, ExxonMobil, Shell, TotalEnergies, Yara
- EPCs / Contractors: McDermott, Baker Hughes, Technip Energies, Fluor
- Software Providers: AVEVA, Bentley, Hexagon, Talent Swarm
- Service Providers: Cohesive
- MoU Partners: IOGP-CFIHOS (JIP-36), DEXPI, Standards Norway

# FL3DMS - Current Deliverables Available for Use



## 3D Model Specification

- Requirements Document Content
  - 3D model configuration & content
  - 3D model deliverables & handover
- 3D Model content requirements matrix
  - Defining content classes to be included in models
- Release 1.2 will be fully *requirements management enabled*. Requirements are numbered individually and written in compliance with IOGPs requirements guide.

FL3DMS Table 5.1: Facility 3D Model Content Requirement Matrix

No.	3D Discipline	CH205 Discipline (Item ID)	3D Model Content Requirement	Requirement		Object Representation	
				As Built	Exact	Generic	As Built
1	Architectural	Architectural Engineering	Buildings and rooms	X	X	X	1:50
2	Architectural	Architectural Engineering	External and internal walls, ceilings, and floors	X	X	X	1:50
3	Architectural	Architectural Engineering	Roof and flat ceilings, floor, door and window	X	X	X	1:50
4	Architectural	Architectural Engineering	Removable architectural elements (panels)	X	X	X	1:50
5	Architectural	Architectural Engineering	Internal use and elevators cases	X	X	X	1:50
6	Architectural	Architectural Engineering	All types architectural objects	X	X	X	1:50
7	Architectural	Architectural Engineering	Weather cladding and louvers	X	X	X	1:50
8	Architectural	Architectural Engineering	Thermal, solar, rain, wind and noise screens	X	X	X	1:50
9	Architectural	Architectural Engineering	External and internal floor and ceiling	X	X	X	1:50
10	Civil	Civil Engineering	Demotechnical site plan	X	X	X	1:50
11	Civil	Civil Engineering	Foundations, embankment plans	X	X	X	1:50
12	Civil	Civil Engineering	Access roads for maintenance and fire fighting	X	X	X	1:50
13	Civil	Civil Engineering	Construction routes	X	X	X	1:50

FL3DMS Table 5.2: Model Attributes

No.	Attribute Name	Description
1	Project code	Project identifier
2	Project name	Project name
3	Site name	Site name
4	Site code	Site code
5	Plant name	Plant name
6	Plant code	Plant code
7	Tag name	Object tag name
8	Process unit code	Process Unit (System) code
9	Area code	Area code
10	Discipline code	Discipline code
11	Taggable	Check Tagged object

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**Facility Lifecycle 3D Model Standard (FL3DMS)**  
Specification Document

Document Title	FL3DMS Specification Document
Document Number	FL3D-001
Document Revision	1.0
Document Status	Version for release
Issue Date	29 October 2021

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## Facility 3D Model Lifecycle Business case

- Value of standardisation, Value of lifecycle management
- Cost of upkeep throughout asset life

## 3D Model Lifecycle Management Guide

- To enable organisations to manage their 3D models better

All deliverables are available for free - contact [stichting@uspi.nl](mailto:stichting@uspi.nl)

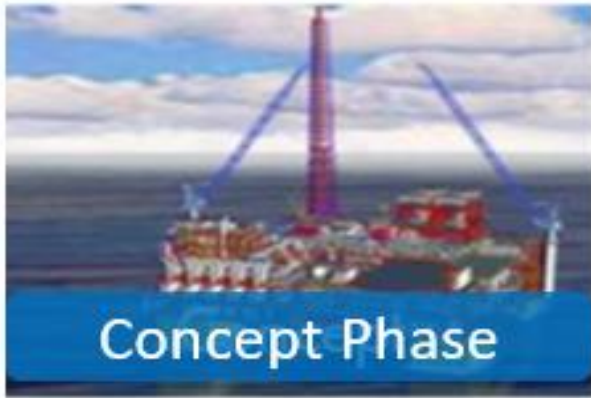
**Results of the business case**

**Financial benefits – numbers**

Phase/Activity	Serial Category / Not TCO	Saving in activity est. %	Saving in activity max. %	% TCO saving min	% TCO saving max	Notes	Hypothetical average savings at an asset with CapEx of \$500 Million
Greenfield	Concept engineering	0.3%	0.0%	0.0%	0.00%	Spans already realised, e.g. layout optimisation	\$ -
	FEED	0.6%	10.0%	13.0%	0.12%	From reuse of FEED 3D model in Detailed Design, using 3D catalogue	\$ 350,761
	Detailed design	2.0%	2.1%	3.4%	0.09%	From easier integration of 3D models from package vendors*	\$ 280,978
	Procurement	3.7%	0.0%	0.0%	0.00%	Spans already realised, e.g. generation of bill of material	\$ -
Brownfield	Construction	8.7%	3.0%	6.0%	0.24%	From 3D with workpackages identified in 3D model	\$ 1,915,522
	Repairs and maintenance	37.0%	3.0%	7.0%	0.23%	From ability to access single asset for planning, training, turnaround dist.	\$ 4,219,180
	Brownfield Concept, Feed & Outfall Design	2.8%	1.0%	10.0%	0.08%	From assistance of laser scans and real-time 3D model	\$ 956,750
	Brownfield Procurement	5.3%	0.0%	0.0%	0.00%	Spans already realised, e.g. generation of bill of material	\$ -
	Brownfield Construction	8.3%	3.0%	6.0%	0.24%	From 3D with workpackages identified in 3D model	\$ 1,815,565
	Other operational costs	48.3%	0.0%	0.0%	0.00%	3D model not used to manage these costs	\$ -
Decommissioning	1.13%	0.3%	3.0%	0.03%	From assistance of laser scans and real-time 3D model	\$ 58,911	
<b>Full life</b>	<b>Total unrealised value</b>			<b>1.31%</b>	<b>2.84%*</b>	<b>Omits value of application, as this requires more than 3D model standard.</b>	<b>\$ 9,652,620</b>

Value from standardising and using the 3D model for the asset lifecycle: 1.3% - 2.8% of TCO  
 Cost of maintaining the 3D model for the full life of the asset: 0.5% of TCO  
**Business case for standardising and using the 3D model for the asset lifecycle: 0.8% - 2.3% of TCO**

TCO = Total asset lifecycle cost, i.e. CAPEX + OPEX



Concept Phase



Design Phase



Construction Phase



Operating Phase

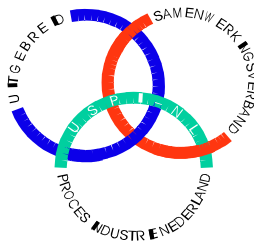
# 3D Model Lifecycle Management Guide

Document Number: F-GU-001

- Development of the Lifecycle Management Guide began in January 2023, with the draft version complete by November.
- Team members who collaborated to develop the guide:
  - Bisi Obawole - BP
  - Bjorn Berli - Seacons
  - Brian Hughes - Aveva
  - David Ayeni - Cohesive
  - Eric-Pascal Duchemin – Total Energies
  - Ivan Swindull - Exxonmobil
  - Tony Beamish - Shell
  - Vinayak Navada - Shell
- Background data was received from:
  - Exxon Mobil
  - Shell
  - Total Energies

Thanks to all the participants and their companies for the generous use of their time and information.

# 3D Model Lifecycle Management Guide: Why? What? How?



## Why?

The objective of the guide is to enable asset owners to manage and use their 3D models evergreen for the full facility lifecycle, optimizing the business value of the 3D model.

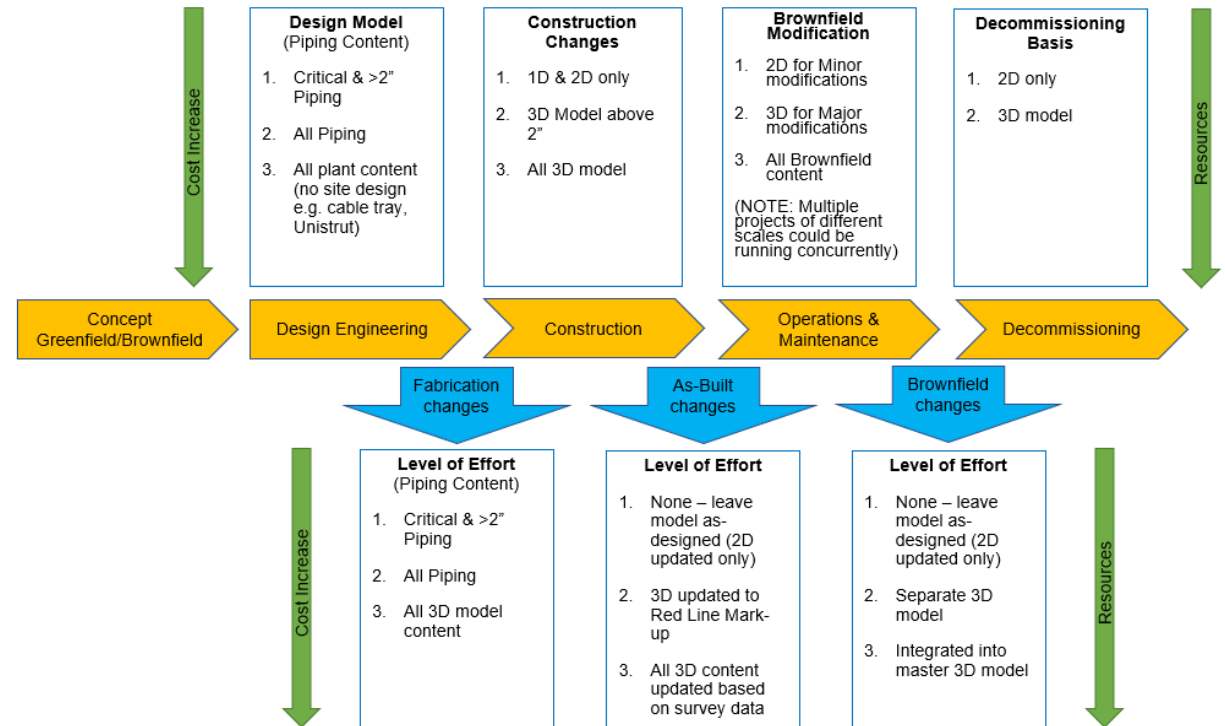
## What?

The guide provides a high-level overview to asset owners, of the commitment required to develop and maintain a 3D model from 'cradle to grave'.

## How?

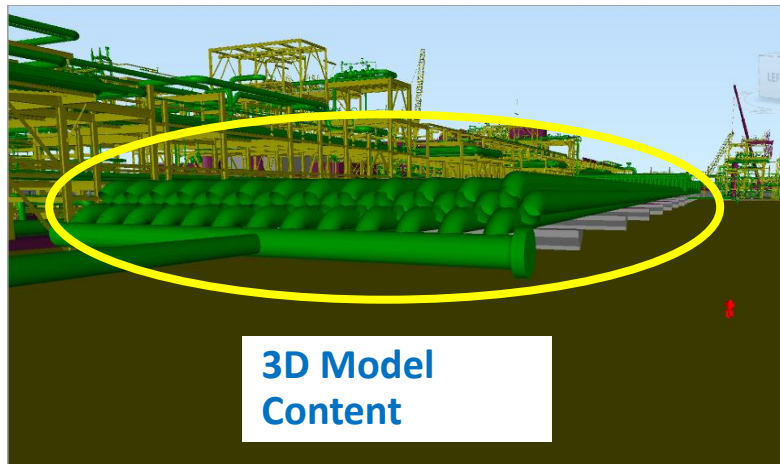
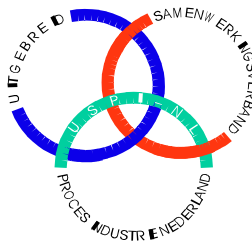
It outlines options for the development of 3D models such that the Owner can make an educated decision as to what they require for their facility, including:

- 3D model application selection.
- 3D model intent, ownership, hosting and support.
- Contracting strategy impact.
- 3D model deliverables development, review and data validation.
- Construction and as-built processes for evergreening the 3D model.
- Operational use of the 3D model.
- Benefits of an evergreen 3D model

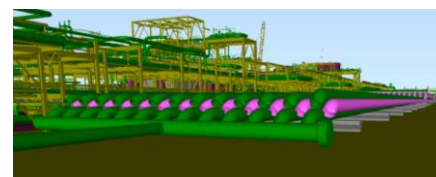
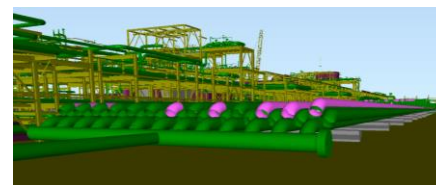
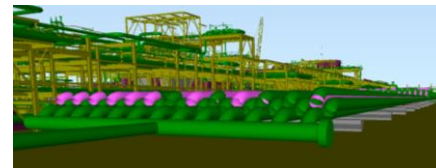
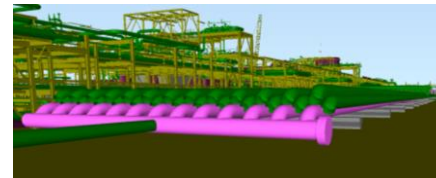




# 3D Model Lifecycle Management Guide



- The Owner should ensure multiyear commitment to maintain the 3D model of the facility, based on a firm business case.
- A Digital Twin 3D model should be an accurate representation of the "as-is" facility to be a reliable source of truth reflecting the plant layout. This is key for operations and maintenance, and future Brownfield modifications.

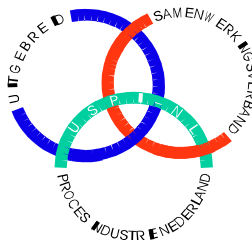


**If the 3D model is not maintained, it is unclear what is real!**

- In this example an un-maintained 3D model does not represent the physical plant. The model was not as-built or purged of study content.
- The master 3D model consists of four different Slug-catcher options, as clouded on the left, and shown highlighted individually on the right.
- The model has not been as-built and the 'STUDY' areas from previous Brownfield projects have not been removed.
- Future use of the model will require the contractor to 'sanitise' the content based on survey data, to identify what is installed on site.



# FL3DMS Roadmap and next steps



## The FL3DMS Roadmap – what is it?

- The roadmap is our master plan. It has 28 deliverables of which 6 have been delivered in releases 1.0, 1.1 and 1.2. What's next?

### ▪ Release 1.3

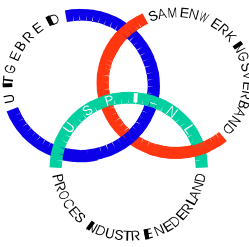
- FL3DMS Implementation Guide.
- Data Model - requirements for AWP
- Requirements for 3D models from licensors / JV partners / modules & packaged units / equipment sub-contractors
- Improved As Built Requirements.
- Corrosion Management.
- Planning data

### ▪ Release 1.4

- Integration w other design tools
- Align content requirements objects with CFIHOS classes
- Requirement filter for different project types, scopes and phases

Grouping	FL3DMS Roadmap Deliverable, based on milestone	Status
Alignment with other standards	Alignments with other standards. Include data model and data dictionary in FL3DMS. Grouping data standard (master/child) grouping. In which data should be registered in the 3D model, which data should be outside, how is it linked which standards is master for each object in the data model, e.g. CIPROD, FL3DMS, DCSF, CI AWP etc	Started
1.0 - Deliver Release 1.0 - Create Standard	FL3DMS Release 1.0. Define a first baseline 3D Model specifications based on the existing common standards of the project participants	Release 1.0 - Complete
1.0 - Deliver Release 1.0 - Define Business Case	Business Case. Define a business case for the standardisation and additional cases of 3D models to be used by standardisation of 3D model content	Release 1.0 - Complete
1.0 - Deliver Release 1.0 - Define Fully Requirements Management Enabled version of the 3D Model Standard	Fully Requirements Management Enabled version of the 3D Model Standard. Enhance FL3DMS Release 1.0 specifications with requirements pertaining to the standard to enable referencing an embodiment of individual requirements of the standard in other standards such as local country standards or corporate standards	Release 1.1
1.1 - Deliver Release 1.1 - Improve specification	Fully Requirements Management Enabled version of the 3D Model Standard. Enhance FL3DMS Release 1.1, specification topics (include tables, ease of use, incorporate feedback, etc.). Update to release 1.1 with all requirements numbered and rewritten in compliance with IOP Requirements writing guide. Change Request procedure agreed and being implemented. Create list and description of considered/aligned industry standards used in FL3DMS (assessment of IOP 3)	Release 1.2 about to be released
1.1 - Deliver Release 1.1 - Improve specification	As-Built Management Guide. Define a best practice guide and requirements for managing a 3D model over the asset life, i.e. how to enable Operational (OC) and Broadfield Engineering / Mac (BEC) related requirements concerning in a project WIP and operational As-Built use of 3D model.	Release 1.2 - Complete
1.1 - Deliver Release 1.1 - Improve specification	FL3DMS implementation guide. Create an implementation guide for the FL3DMS standard MIP3 product, based on the guidance documentation developed as part of AWP 1. Create an overview of FL3DMS deliverables (picture & text) with descriptions of each one. Define a best practice guide and data requirements for using the 3D model to include status and monitor progress. Enhance on what we already have done 1) implementation guide progressing. Lollipop model extended. Draft table of contents agreed. Content under development.	Release 1.3
Alignment with other standards	Data Model - requirements for AWP. Define data requirements to enable the use of the 3D model to support construction / referenced work packages as a identification of construction work areas, work packages etc. Based on work of CI AWP and the associated data specification. Define requirements for identification of commissioning systems within the 3D Model. Format to be agreed. Content director getting started. 3D related requirements for AWP defined and to be included. One related topic for the initial 3D Model got on the way.	Release 1.1
1.1 - Deliver Release 1.1 - Improve specification	Define clear requirements for integration of 3D model content from EPC Sub-Contractors (i.e. Purchase Order requirements that are a subset of the specification that can be used or corrected). Define program requirements, format for data and best practices and for integrating 3D models from licensors / JV partners / modules & packaged units / equipment sub-contractors. Different options include full native model or neutral format model based on an exchange.	Release 1.3
1.1 - Deliver Release 1.1 - Improve specification	Improved As-Built Requirements. Add a number of options for As-Built to be included dependent on digital maturity and needs of project using the model - i.e. dimensionally accurate, logically accurate, mapped to the contents of the model. Define clear requirements for each option and include them in the FL3DMS specification. To include requirements for capturing the model for the full lifecycle.	Release 1.1
1.1 - Deliver Release 1.1 - Improve specification	Corrosion Management. Define requirements to enable corrosion management operations with the 3D model, i.e. labelling of piping to identify corrosion sensitive areas and inspection points.	Release 1.1. QMS/IT to submit a change request to FL3DMS based on the experience that.
1.1 - Deliver Release 1.1 - Improve specification	Planning data. Define and develop a roadmap to a 4D standard. Schedule data already defined in AWP data area. AWP requirements to enable 4D planning to be addressed in implementation guide to help people understand what is required.	Release 1.1. Working already available from Terry
1.1 - Deliver Release 1.1 - Improve specification	Integration of other design tools e.g. to accommodate alignment with P&ID content or detailed equipment views. Define standardised 3D model footprint/contour engineering deliverables (see also the Tag, Line, Size of quantities). To standardise the interfaces between 3D models and other tools. Based on existing data from ODS and EPC, which will be assessed on level of similarity prior to providing this item. The lists will also be shared for inclusion in the CFIHOS EDC.	Release 1.4 - Submit to show Owner for consideration on whether to progress this activity
Alignment with other standards	Align content requirements objects to requirements table (include IT with the CFIHOS classes). To improve interface with CFIHOS and ability to populate CFIHOS data with data from 3D models. Map CFIHOS data to FL3DMS objects, do data analysis, and decide an alignment approach.	Release 1.1. This working group, supported by Trevor
1.1 - Deliver Release 1.1 - Improve specification	Define the level value packages from 3D Model. Define management and usage of 3D Models - e.g. based on type from Start Network, Engineer, etc. Initial operation on shaping their 3D Model (i.e. design management strategies based on data delivered as deliverables ODS - Shell Network, Engineer).	Release 1.1. The standard - are the requirements sufficient? Working already available from Terry
1.1 - Deliver Release 1.1 - Improve specification	Integration of heat exchangers. Define use case based requirements for health indicators / heat exchanger performance, and their integration with the 3D model. Based on existing data from ODS and EPC, which will be assessed on level of similarity prior to providing this item. The lists will also be shared for inclusion in the CFIHOS EDC.	Not started
1.1 - Deliver Release 1.1 - Improve specification	3D Model Reverse Engineering. Define a best practice guide and requirements for creating / reverse engineering 3D models in broadfield environments.	Not started
Alignment with other standards	Cooperation with WIP 3D. Set up a WIP with WIP 3D consortium to investigate possible integration of CFIHOS requirements with 3D open standards (VCD is standard for representing 3D models)	Not started
Alignment with other standards	Integration of GIS. Define requirements for integrating GIS data into the 3D model, in cooperation with the CI AWP modelling work team. Enhance and expand with volumes needed to include surface/height information.	Not started
1.1 - Deliver Release 1.1 - Improve specification	Define AWP user cases. Define user cases and requirements for 3D models to be used in AWP applications.	Not started
1.1 - Deliver Release 1.1 - Improve specification	Topology from 3D model. Define requirements to create a network topology based on the design and data of a 3D model. A topology network building tool is one of the nodes and vertices that connect the nodes. Can be used to link connectivity with a P&ID using ODS.	Not started
1.1 - Deliver Release 1.1 - Improve specification	Geographical Information System (GIS) Integration. Define an architectural and requirements table containing 3D models of different types e.g. facility with tubular, substructure or platform. i.e. how to combine various model data. Shell data and GIS data. Some example model independent facilities in GIS.	Not started
1.1 - Deliver Release 1.1 - Improve specification	Operational Planning. Define requirements to enable operational planning with 3D model (process routes, vessels, other safety related items, maintenance related items).	Not started
1.1 - Deliver Release 1.1 - Improve specification	Maintenance Planning. Define requirements to enable maintenance planning and management using 3D model, e.g. turnaround work packages, maintenance systems etc.	Not started
1.1 - Deliver Release 1.1 - Improve specification	To be added subsequent to AWP.	Not started
1.1 - Deliver Release 1.1 - Improve specification	Automation of design based on business rules. Define requirements to enable automation of design e.g. auto routing of pipes and valves, generation of drawing and fabrication specs. Should come after other topics like data model.	Not started
1.1 - Deliver Release 1.1 - Improve specification	Design Reuse/Reuse. Define a roadmap to facilitate reutilisation of 3D models from one facility project to another (e.g. for LNG liquefaction trains) based on a rich 3D data.	Not started
1.1 - Deliver Release 1.1 - Improve specification	Full application neutral 3D model data specification. Define an open source data model for application-neutral exchange of information models between software vendors (North Star; potentially gradual approach).	Not started

Legend
Release 1.0
Release 1.1
Release 1.2
Release 1.3
Release 1.4
Started, no release associated
Started
To be started

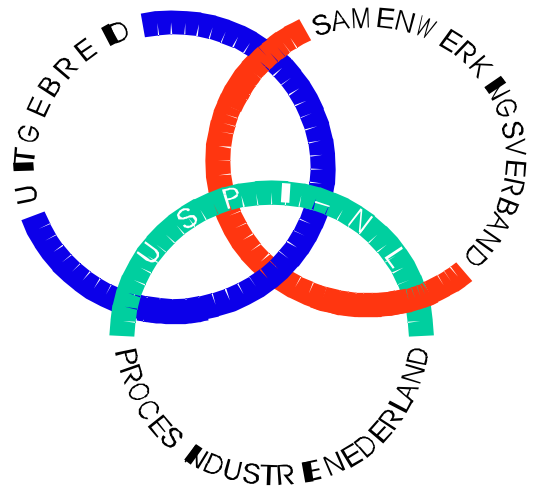


## – Catalogues and specifications

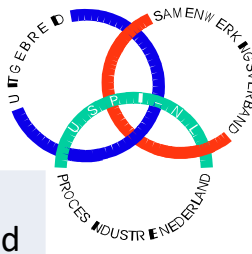
- Framing and positioning document in development
- Terms of Reference (ToR) for development and delivery of a standard catalogue

## – Marketing

- Objective is to create more awareness and use of the standard
- Communication channels are website, LinkedIn, YouTube and Conferences
- Key decision made in 2023 to share all parts of the standard for free to drive additional use

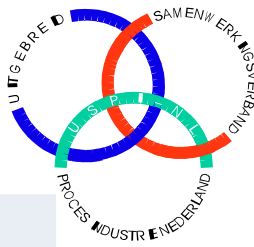


# Top-5 roadmap items



1 Alignment with other standards	Include <b>data model and data dictionary in FL3DMS</b> , showing data standard mastership/mapping. I.e. which data should be registered in the 3D model, which data should sit outside, how is it linked. Which standard is master for each object in the data model , e.g. CFIHOS, FL3DMS, DEXPI, CII AWP, etc.)
2 Improve MVP1 specification	Create an <b>implementation guide for the FL3DMS standard MVP1</b> product, based on the guidance documentation developed as part of MVP 1. Create an overview of the FL3DMS deliverables (picture & text) with descriptions of each one. Define a best practice guide and data requirements for using the 3D model to visualize status and monitor progress. Enhance on what we already have (item 1)
3 Enable new use cases	Define a best practice guide and requirements for managing a 3D model over the asset life. I.e. how to <b>enable Operational (OO) and Brownfield Engineering / MoC (EPC) related requirements</b> concurrently (i.e. project WIP and operational As Built use of 3D model).
4 Improve MVP1 specification	<b>Enhance FL3DMS MVP1 specification</b> topics (review tables, ease of use, incorporate feedback, etc.). Update to release 1.1 Create list and description of considered/ <b>aligned industry standards used in FL3DMS</b> (extensions of MVP 1) This includes <b>3D model interface formats</b>
5 Alignment with other standards	Define data requirements to <b>enable the use of the 3D model to support construction / advanced work packaging</b> e.g. identification of construction work areas, work packages etc. Based on the work of CII AWP and the associated data specification Define requirements for identification of commissioning Systems within the 3D Model

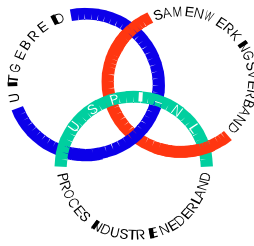
# Roadmap items ranked 6 through 10



6	Enable new use cases	Define <b>best practices and requirements for integrating 3D models</b> from packaged units / scope of sub-contractors. <b>Extend with model federation?</b>
7	Enable new use cases	Define use case based requirements for <b>reality capture / laser scanning and photogrammetry</b> , and their integration with the 3D model. Based on existing company standards. <b>Integrate in guide documents?</b>
8	Enable new use cases	<b>Define a roadmap to create an industry 3D catalogue &amp; associated specs.</b> I.e. an industry library of components & shapes for use in 3D models. This will enable easier reuse of 3D models through different stages of the facility lifecycle e.g. from FEED to detailed design; and replication (not MVP2 item, more of a North Star item)
9	Enable new use cases	Define requirements for <b>level of detail</b> definition of 3D models in different layers with different levels of detail e.g. to accommodate alignment with P&ID content or detailed equipment views
10	Enable new use cases	Define a best practice guide and requirements for <b>creating / reverse engineering 3D models in brownfield environments.</b> Relates to reality capture (item ranked 7 <sup>th</sup> ) <b>Integrate in guide documents?</b>

# Roadmap items ranked 11 through 15

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11	Enable new use cases	Define requirements to <b>enable operator training</b> with the 3D model (escape routes, switches, other safety related items, maintenance related items, etc.)
12	Enable new use cases	Define requirements to <b>enable maintenance planning and management using 3D model</b> , e.g. turnaround work packages, maintenance systems etc. To be added subsequent to AWP
13	Enable new use cases	Define use cases and requirements for <b>3D models in AR/VR virtual applications</b>
14	Enable new use cases	Define an approach/method and requirements for <b>combining 3D models of different types e.g. facility with subsea, subsurface or pipelines</b> . I.e. how to combine process model data, BIM data and GIS data.
15	Enable new use cases	Define an (open source) data <b>standard for application-neutral exchange of information models</b> between software vendors (North Star; potentially gradual approach)