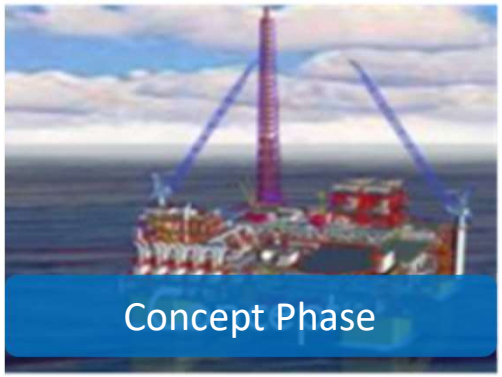
FL3DMS

Facility Lifecycle 3D Model Standard

Foundation for the digital twin



Agenda

1. Objectives & ways of working

2. Release 1.1 – what's in FL3DMS?

3. Release 1.2 – what are we working on now?

4. Working groups
   a) 3D Model Specification Document and Implementation guide
   b) Data Model
   c) Lifecycle As Built Best Practice Guide

5. Name change to L3Dex

Objectives and Ways of Working

FL3DMS Objectives

- To create a **practical process and energy industry standard** 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, including best practices for **keeping 3D models As Built throughout the asset lifecycle**
- Enable the creation of a "**digital twin**", allowing real time data to be projected upon the 3D model
- The specification will initially be software neutral and **applicable to proprietary 3D modelling systems**, but may evolve into a neutral format over time

FL3DMS Working method

- **Monthly team teleconference** of 90 minutes to update on progress and align content
- **On and off-line work** on content by work groups and individual contributors, ad hoc as required
- **Annual Face to Face meeting** for 2-3 days
- **Participants**
  - Owner Operators: Equinor, bp, ExxonMobil, Shell, TotalEnergies
  - EPCs / Contractors: McDermott, Baker Hughes, Technip Energies
  - Software Providers: AVEVA, Bentley, Hexagon, Talent Swarm
  - Service Providers: Digital Construction Works (DCW)
  - MoU Partners: IOGP-CFIHOS (JIP-36), DEXPI
- **MOU Partners**
  - Current: CFIHOS and DEXPI
  - Planned: CII AWP, **Standards Norway**, **buildingSMART**

Release 1.1 – what's in FL3DMS?

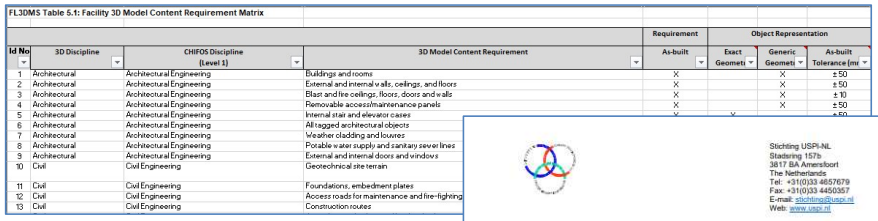
- FL3DMS specification deliverables
- FL3DMS table of content
- FL3DMS specification Rev 1.1
- FL3DMS business case for standardizing and maintaining 3D models

FL3DMS specification content

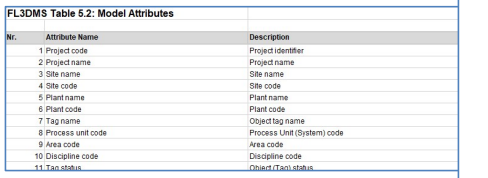
- **General sections**
  - Foreword
  - Introduction
  - Applicable standards
  - Abbreviations, Terms & Definitions

- **Requirements sections**
  - 3D model configuration
  - 3D model content
  - 3D model deliverables & handover

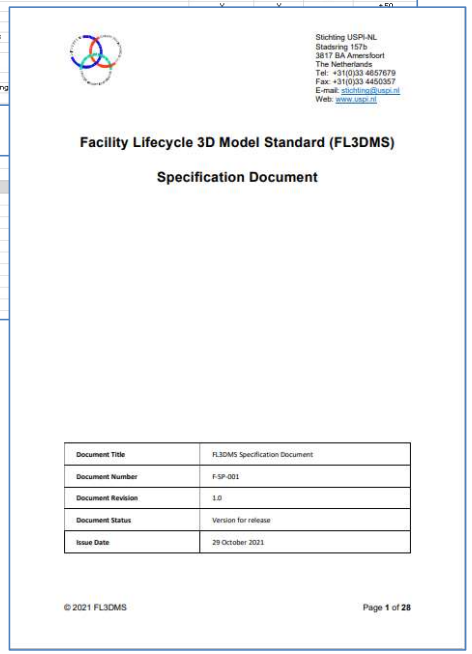
- **Tables**
  - 5.1: Facility 3D Model Content Requirement Matrix
  - 5.2: Model Attributes
  - Note: These are also made available as spreadsheets


FL3DMS Table 5.1: Facility 3D Model Content Requirement Matrix

Id No	3D Discipline	CHIFOS Discipline (Level 1)	3D Model Content Requirement	Requirement	Object Representation		
				As-built	Exact Geometri	Generic Geometri	As-built Tolerance (mr
1	Architectural	Architectural Engineering	Buildings and rooms	X		X	± 50
2	Architectural	Architectural Engineering	External and internal walls, ceilings, and floors	X		X	± 50
3	Architectural	Architectural Engineering	Blast and fire ceilings, floors, doors and walls	X		X	± 10
4	Architectural	Architectural Engineering	Removable access/maintenance panels	X		X	± 50
5	Architectural	Architectural Engineering	Internal stair and elevator cases	X	X		± 50
6	Architectural	Architectural Engineering	All tagged architectural objects				
7	Architectural	Architectural Engineering	Weather cladding and louvres				
8	Architectural	Architectural Engineering	Potable water supply and sanitary sewer lines				
9	Architectural	Architectural Engineering	External and internal doors and windows				
10	Civil	Civil Engineering	Geotechnical site terrain				
11	Civil	Civil Engineering	Foundations, embedment plates				
12	Civil	Civil Engineering	Access roads for maintenance and fire-fighting				
13	Civil	Civil Engineering	Construction routes				


FL3DMS Table 5.2: Model Attributes

Nr.	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	Tag status	Object (Tag) status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Facility Lifecycle 3D Model Standard (FL3DMS)

Specification Document

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

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FL3DMS specification document – TOC preview

FL3DMS specification Rev 1.1

- Unique numbering format for individual requirements agreed
- Rules to be applied for unique numbering developed
- Developed management tool in Excel for managing the unique numbering in subsequent revisions
- Unique numbering implemented in specification document without changing the actual content
- This was enabled by the approach used for revision 1.0 to reference each requirement individually by a combination of section number and additional numbering

4.1.1 Plant Grid System and Datum Point

a. [FSP001-0001-01] The overall plant grid lines/system(s) developed by Contractor and approved by Company during project execution shall be defined in the 3D Model.

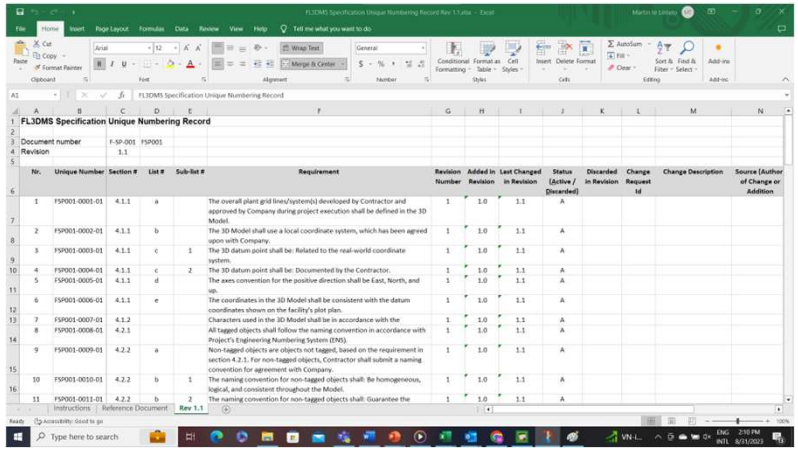
b. [FSP001-0002-01] The 3D Model shall use a local coordinate system, which has been agreed upon with Company.

c. The 3D datum point shall be:

   1. [FSP001-0003-01] Related to the real-world coordinate system.
   2. [FSP001-0004-01] Documented by the Contractor.

d. [FSP001-0005-01] The axes convention for the positive direction shall be East, North, and up.

e. [FSP001-0006-01] The coordinates in the 3D Model shall be consistent with the datum coordinates shown on the facility's plot plan.



3D Model Standardisation Business Case

Background

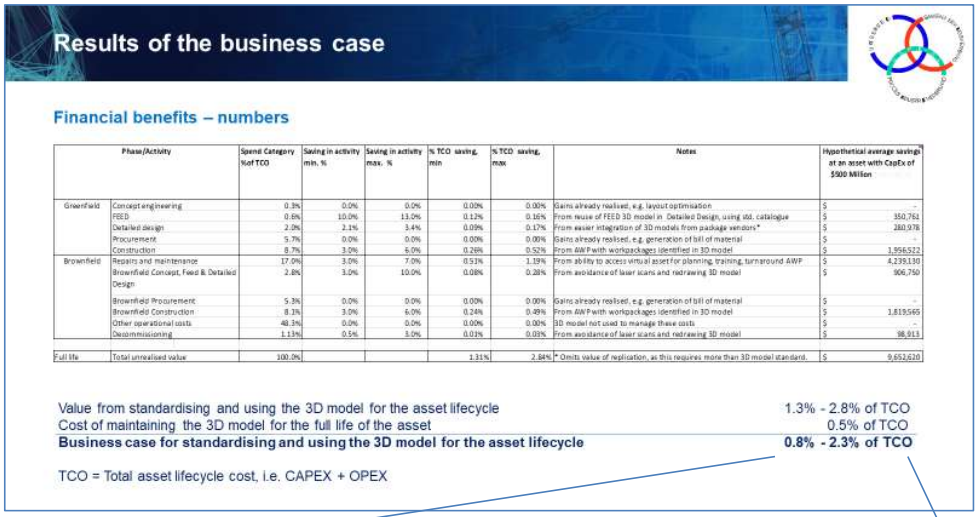
After the transition from project phase to operating of a facility, the native 3D model/data is rarely maintained and often not used to its full potential.

Project delivery benefits

- Makes life easier – faster integration of packages, replication
- Makes delivery more cost effective (reduced rework, better resource planning)
- Enables advanced work packaging

Operations benefits

- Enables remote working - reduces HSSE exposure, costs and time for repairs (unplanned downtime)
- Reduces rework – avoids laser scans, accelerates Brownfield projects
- Facilitates maintenance and integrity management – turnarounds, corrosion isometrics, cathodic protection
- Higher employee satisfaction – training time reduced, consistency, modern workforce demands digital solutions
- Foundation for digital twin integration of supporting IT systems incl. remote monitoring systems
- Economy of scale benefits from standardisation



Results of the business case

Financial benefits – numbers

Phase/Activity		Spend Category %of TCO	Saving in activity min. %	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%	0.00%	Gains already realised, e.g. layout optimisation	$ -
	FEED	0.6%	10.0%	13.0%	0.12%	0.16%	From reuse of FEED 3D model in Detailed Design, using std. catalogue	$ 350,761
	Detailed design	2.0%	2.1%	3.4%	0.09%	0.17%	From easier integration of 3D models from package vendors*	$ 280,978
	Procurement	5.7%	0.0%	0.0%	0.00%	0.00%	Gains already realised, e.g. generation of bill of material	$ -
	Construction	8.7%	3.0%	6.0%	0.26%	0.52%	From AWP with workpackages identified in 3D model	$ 1,956,522
Brownfield	Repairs and maintenance	17.0%	3.0%	7.0%	0.51%	1.19%	From ability to access virtual asset for planning, training, turnaround AWP	$ 4,239,130
	Brownfield Concept, Feed & Detailed Design	2.8%	3.0%	10.0%	0.08%	0.28%	From avoidance of laser scans and redrawing 3D model	$ 906,750
	Brownfield Procurement	5.3%	0.0%	0.0%	0.00%	0.00%	Gains already realised, e.g. generation of bill of material	$ -
	Brownfield Construction	8.1%	3.0%	6.0%	0.24%	0.49%	From AWP with workpackages identified in 3D model	$ 1,819,565
	Other operational costs	48.3%	0.0%	0.0%	0.00%	0.00%	3D model not used to manage these costs	$ -
	Decommissioning	1.13%	0.5%	1.0%	0.01%	0.03%	From avoidance of laser scans and redrawing 3D model	$ 98,913
Full life	Total unrealised value	100.0%			1.31%	2.84%	* Omits value of replication, as this requires more than 3D model standard.	$ 9,652,620

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

Business case

0.8-2.3% of Total Cost of Ownership (OPEX & CAPEX)
is typically lost on a project and asset portfolio by

- not using 3D Model during operations and
- not standardising 3D model development

Release 1.2 – what are we working on now?

- Planned for December 2023

FL3DMS Release 1.2 Scope

- Update the FL3DMS specification document
  - Requirement management - Changes suggested by Shell's technical writer
  - Additional changes as highlighted in the change request overview
  - Removing table 5.1 from the specification

- Content Requirement Matrix (table 5.1)
  - Adding new proposed objects to the matrix
  - Add unique numbering scheme to the matrix
    Note: Decision needs to be made on how to manage the unique numbering. Preference is to include this in the unique numbering tool developed for the FL3DMS specification document or to create a similar tool specific for the content requirement matrix
  - Standards Norway has already done work on this incl. the unique numbering part
  - Actual way of working with them on this will be determined in a meeting with them

The FL3DMS Working Teams

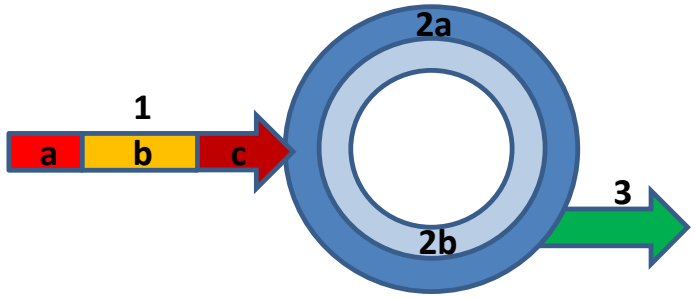
- Team 1: Requirements Management - Better Specifications, Standards Norway Alignment & Implementation guide
- Team 2: Data Model - Current focus on AWP
- Team 3: Lifecycle As Built Best Practice Guide – How to maintain your 3D model As Built

Team 1 - Specification & Implementation Guide

1. **Specification: Requirements Management - Make wording the standard more concise and easier for EPC contractors to Implement. :**
   1. V1.1. introduced unique requirement identifiers
   2. V1.2 will improve requirement language
   3. CFIHOS and FL3DMS teams were trained in June on requirements writing in accordance with IOGPs Requirements Writing Guide.
   4. See the recording on MSTeams or Requirements 101 recordings on YouTube
   5. Comments on all requirements complete and currently being implemented

2. **Alignment with MOU partner Standards Norway TZ04**
   1. Will issue jointly managed table of 3D Model requirements with our MOU partner Standards Norway
   2. Objective is use of the FL3DMS standard on the Norwegian shelf and rapid feedback from multiple users on improvements

3. **Implementation Guide**



1. **Preparation phase prior to 3D model development**
   a. Architecture: (1) Distribution of information; (2) Contract models
   b. Specification & Contracting
   c. Configuration template
2. **Content development phase**
   a. Regular handover (e.g. quarterly) for integration in OO landscape
   b. 30-60-90 integrated reviews
3. **Final handover**
   a. Including as-built check methods

Team 2 scope: Data Model and integration with other data standards

Scope

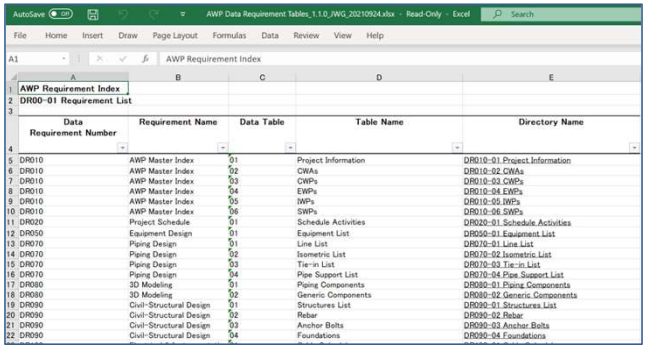
- Data Model
  - Use property groupings & rules to define content requirements
  - Use references to foreign objects to capture source & mastership
  - Separate the structure and the content
- Define different “data contract scopes” required for different Use Cases
- Key data interfaces
  - To other data sets with properties
- Rules to be developed for 3D data model
  - What is natively (defined) in 3D model and what is referred to
  - Define ownership of entities, relationships & properties between data standards
- Data Model team Decisions
  - Use same (logical) modeling method as CFIHOS
  - Create a separate Data Model for content 3D model

Current Activities

- Focus on definition of data requirement for enabling Advance Work Packaging, in collaboration with CII AWP Team
  (Mikitaka Hayashi & Eric Dechoz)

Team 2 CII AWP Data Requirements – The Past, The Present and The Future

Current AWP Data Requirement



CFIHOS Data Models

MIMOSA CCOM Class Diagram

ISO Standards BIM, Digital Twin

AWPBOK, PMBOK, DMBOK

Add Relationships

Step 1

Step 2

Metadata Standardization

AWP Conceptual Data Models

Common Conceptual Data Models

AWP Data Dictionary

Integrated Data Models

Specifications & Guidelines

AWP Reference Data Library

AWP Data Specifications

Execution Procedures

Execution Guidelines

Interoperability & Data Mapping

Full Digital Project Execution

Team 2 Data Model & integration w CFIHOS & CII – AWP standard

A Construction_Assembly is an arrangement of components resulting from the design and construction/fabrication activities. To enable construction/fabrication, the arrangement of components is specified in erection and fabrication documents. A Construction_Assembly can be prefabricated as a whole (see Material_Assembly_Type) to make the erection on site quicker..

Examples: “construction work pack scope assembly”, “module”, “steel structure to support a vessel”, a “piping isometric”, “piping spool”, “steel assembly mark”

Remarks:

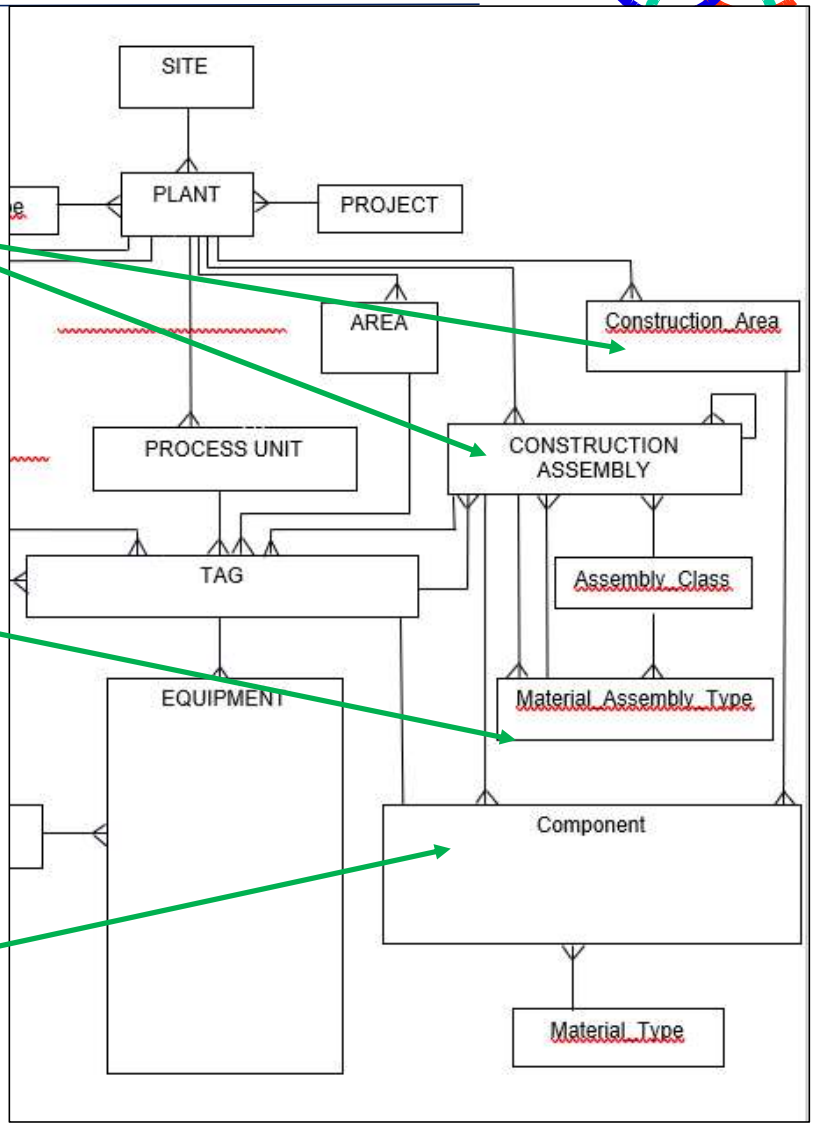
- The reflexive relation allows one to decompose an assembly in sub-assemblies.
- Construction_Assembly entity is required to track the progress of engineering documents required for erection/fabrication.

A **material assembly type is** unique within a Construction_Assembly. A Construction_Assembly Instance of that type is prefabricated in a workshop, before being sent to the construction site. When a quantity of Material_Inventory_Type has been fabricated, it is made available within the Material_Inventory. E.g.:

- a piping spool.
- a steel piece mark: a generic assembly of materials created more than once and part of a Construction_Assembly steel structure.
- a module. A Construction_Assembly having only one Material_Assembly_Type is needed to track the module delivery and availability in the Material_Inventoty

For each **component**, the properties required in the 3D model (by propagating Primary keys):

- “construction area code”
- “module construction assembly code” (if the component is part of a module)
- “piping isometric code”/”piping spool code” (for component part of a piping isometric)
- “steel structure code”/“steel assembly mark code” (for component part of a steel structure
- “steel piecemark code” (when the component is a “steel assembly mark”)
- “tag name” for that component (if the component is Tagged)



Team 3 scope: Model Lifecycle Management Guide

Introduction

- The name Facility Lifecycle 3D Model Standard indicates that the specification is focused on the lifecycle use of 3D models. The objective of the Lifecycle Management guide is to enable owners of 3D models to manage and use their 3D models for the full asset lifecycle, thereby optimizing the business value generated from the 3D model.
- The guide provides information on the development and maintenance of 3D models for the lifetime of an asset, from 'cradle to grave'. The intention of this document is to help identify the 3D model scope for a project, based on the requirements for the initial layout build, the fabrication and construction, through the asset operational life, to the decommissioning phase.

Scope

This guide outlines options for the development of 3D models such that the owner may make an educated decision as to what they require for the 3D model of their asset. This includes:

- 3D model application.
- Hosting of the 3D model.
- Development of the 3D model.
- As-built process for the 3D model.
- Operational use of the 3D model.

Lifecycle Guide – Table of content

Table of Contents

Name Change to L3Dex

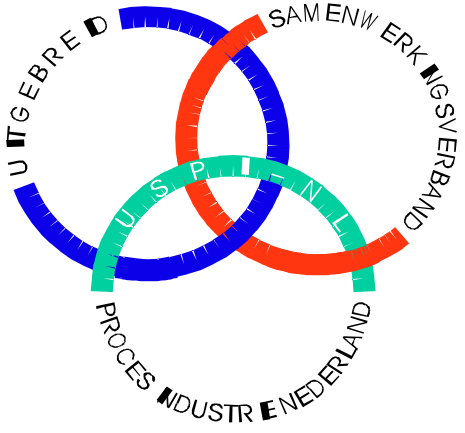
Renaming of FL3DMS to L3Dex

- Possible name change suggested during the FtF meeting in Frankfurt (May 2023)
  - Action deemed acceptable given the still limited number of participants

- Suggested names
  - L3D
  - **L3Dex**
  - FL3DMS

- L3Dex was chosen as the new name in a vote among participants
  - Uses the name L3D with the extension ex
  - Ex refers to experience, excellence and data exchange

- L3Dex will be used for both the project name and the deliverables from the project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SAMENWERKINGSVERBAND
PROCES INDUSTRIE NEDERLAND
USPILNL