



The Digital Design Basis.

Building a framework to reduce costs and improve quality in early-phase design



Arnljot Skogvang, Lundin Energy AS

David Cameron, SIRIUS Centre, University of Oslo

Mihaly Fekete, Aize AS

Henrik Martinsson, Aize AS

Kirsten Helle, TechnipFMC

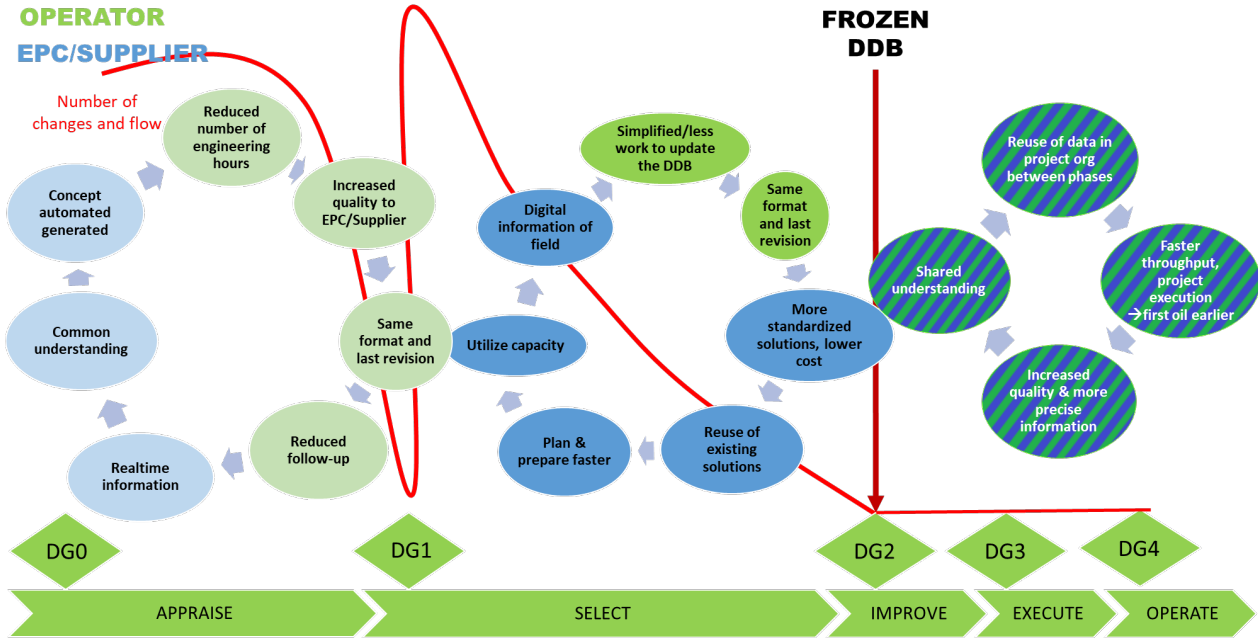
Anders Gjerver, Aibel AS

Kristin Høines Johnsen, AkerBP





The Challenges and Potentials of Field Development



GATE PROCESS WITH SUPPLIER; FASTER INFORMATION FLOW TO PREPARE AND PLAN ORDERS



Benefits from a Digital Design Basis

Speed

- Less time spent on data transcription and transfer

Quality

- Fewer errors and support for automated validation

Effectiveness

- Support for streamlined workflows

Accuracy

- Unambiguous definition of data and assumptions



The Business Case

Value Potential:

- 50 % savings in work with use of a full Digital Design Basis.
- Order of £10m saving in a medium-size field development study.
- Increased Quality.
- Reduced risk of human error.

Value Drivers:

1. Enable machine readable design basis and allow machine-to-machine communication.
2. Faster data processing and improved quality.
3. Allows operator and supplier to exchange technical requirements digitally and have clear version control on the requirements.





The Project

The Consortium

- Operators: Aker BP, Lundin Energy
- EPC: Aker Solutions, TechnipFMC, Aibel
- Engineering Software Company: Aize AS
- Academia: University of Oslo

Develop a Proof of Concept for a Digital Design Basis.

- A **data model** that holds data about both the **Design Basis** and **Functional Requirements** decided by an operator.
- A **model that can be implemented in any relevant software tools** in a concept study, to ensure that information that is sheared between Operator and EPC contractor and their different software tools have the same meaning and understanding.
- A **common digitalized language** between operators and main contractors.





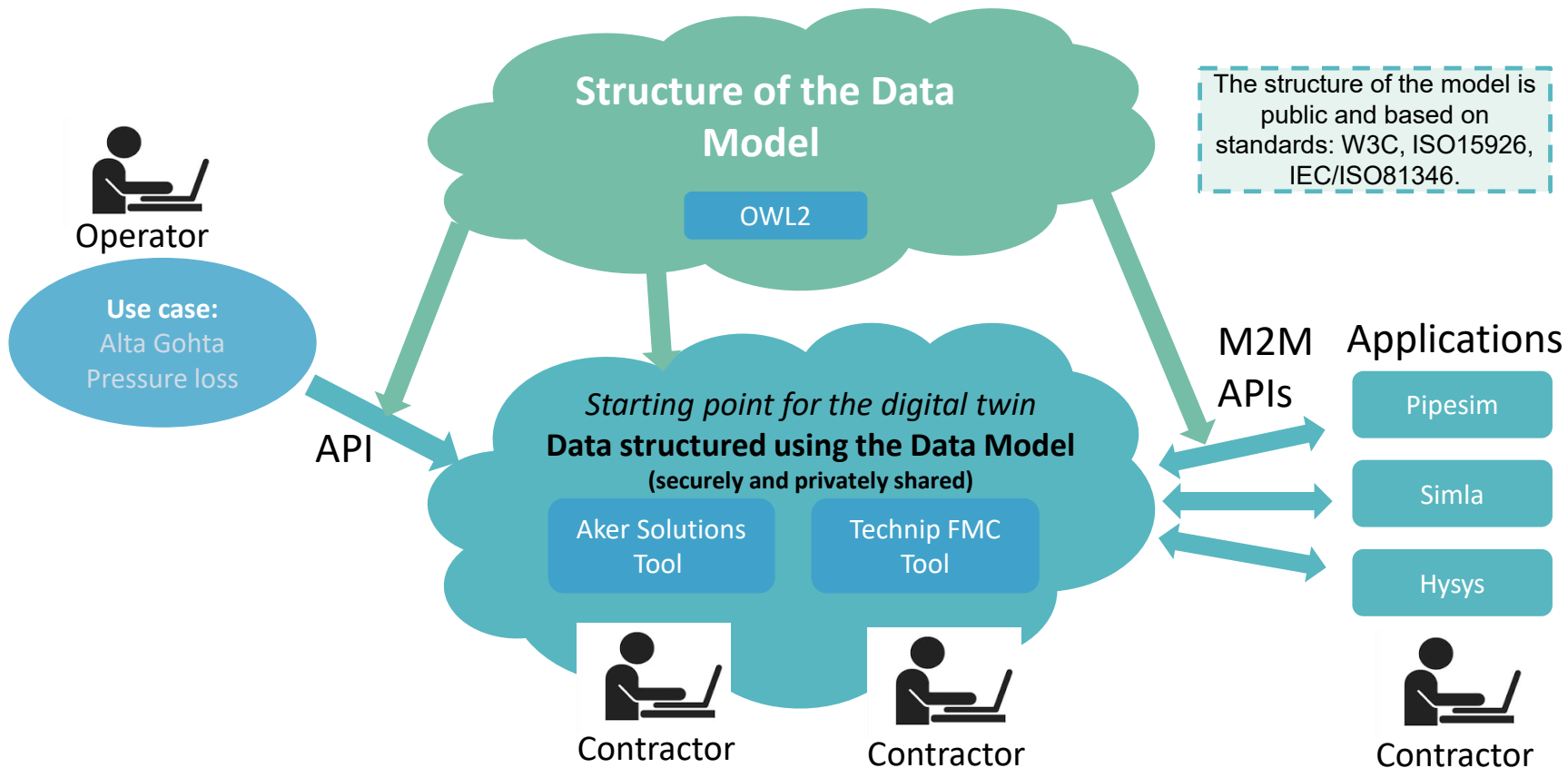
The Project's Ambitions

Now

- Design Basis is a **set of documents**. These are not available as structured data to be consumed by machines.
- Changes are reported in documents that need human interpretation.
- Challenging and time consuming for engineers to identify and apply updates.

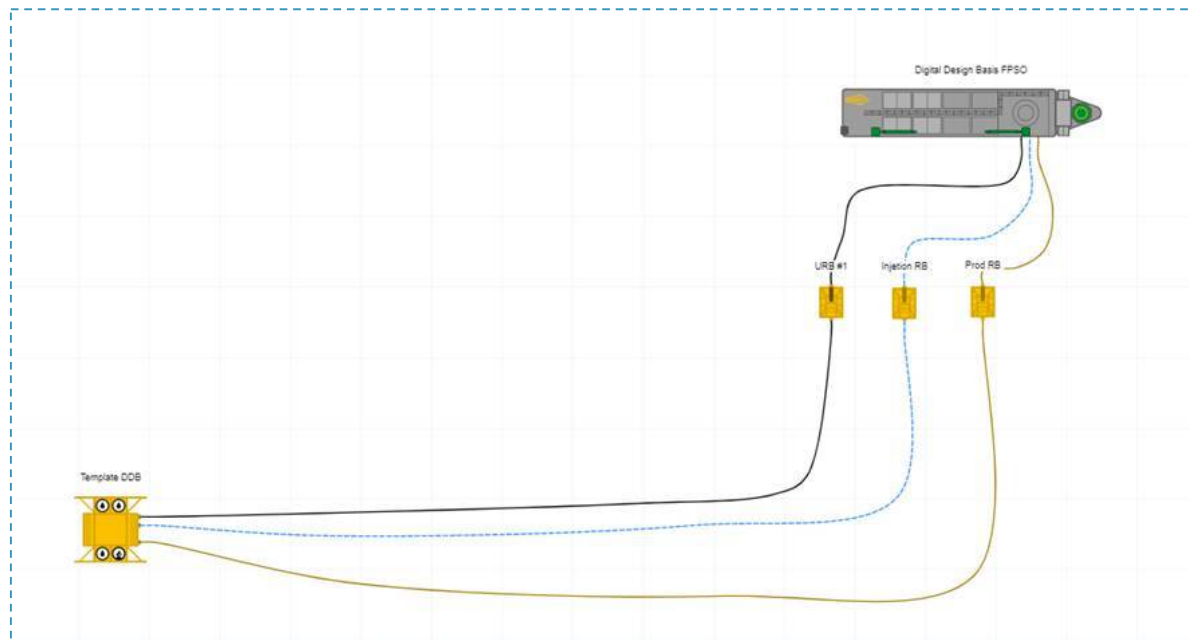
With the DDB

- Automatic processes replace manual work:
 - A **common data model** holds structured data for Basis of Design and Functional Requirements.
 - This data can be consumed by all relevant software applications in a study through API's based on the **data model**.
 - Data can be shared between applications without human intervention.





The Digital Design Basis starts with a field layout from the operator. The model allows us to structure the rest of the DDB data and requirements around the technical systems in the layout.





The DDB starts with a definition of the field development, including descriptive text.

Digital Design Basis Demo Application
?
JOHN SMITH
OIL COMPANY

Oil and Gas Project
VO7
PUBLISH
EXPORT PAYLOAD

Project Information

- Reservoirs
- Process
- Wells
- Facilities
- Main Systems

Project Information

PROJECT NAME
Oil and Gas Project

OWNERS

Oil and Gas Company

OPERATOR

Oil and Gas Operator

LICENSE

Petroleum Production License

Information derived from NPD.

PROJECT OBJECTIVES

Completely synergize resource taxing relationships via premier niche markets. Professionally cultivate one-to-one customer service with robust ideas. Dynamically innovate resource-leveling customer service for state of the art customer service.

Objectively innovate empowered manufactured products whereas parallel platforms. Holistically predominate extensible testing procedures for reliable supply chains. Dramatically engage top-line web services vis-a-vis cutting-edge deliverables.

Proactively envisioned multimedia based expertise and cross-media growth strategies. Seamlessly visualize quality intellectual capital without superior collaboration and idea-sharing. Holistically pontificate installed base portals after maintainable products.

Field Information

FIELD NAME

DDB Field

LOCATION

Norwegian Continental Shelf

WATER DEPTH

200 m

SEABED AVERAGE AMBIENT TEMPERATURE

5 °C

HIDE SIDEBAR
FOR DEMO-USE ONLY



First we define the reservoir properties.

Fluid properties are an important part of the DDB.

We manage either full analyses or analysis with pseudo-components.

Digital Design Basis Demo Application

Oil and Gas Project VO7 PUBLISH EXPORT PA JOHN SMITH OIL COMPANY

1/2-1 Reservoir IMPORT EXPORT

Component Table

COMPONENT	MOLE %
Nitrogen	0.35
Carbon Dioxide	3.21
Methane	43.75
C10+ Fraction	17.20
Ethane	8.28
Propane	7.27
i-Butane	1.19
n-Butane	3.65
i-Pentane	1.20
n-Pentane	1.92
Hexanes	2.27
Heptanes	3.79
Octanes	3.85

C10+ Fraction Properties

MOLECULAR WEIGHT: 258 g/mole

DENSITY: 871 kg/m3

HIDE SIDEBAR FOR DEMO



Then we can define
the wells.

The screenshot displays the 'Digital Design Basis Demo Application' interface. The top navigation bar includes the title, a help icon, a user profile for 'JOHN SMITH OIL COMPANY', and version 'v07'. The left sidebar contains a navigation menu with 'Wells' selected. The main content area is titled 'Wells' and features a 'Select Well' panel with a list of wells: '6503/10-B-5 A' (selected) and '6503/10-B-5 B'. Below this list is an 'ADD WELL' button. To the right, the configuration for '6503/10-B-5 A' is shown, including 'RESERVOIR ID' (1/2-1 Reservoir) and 'WELL TYPE' (Production). A 'Production Profile' panel on the right lists flow rates: Gas (293 Sm³/d), Oil (1671 Sm³/d), and Water (388 Sm³/d). At the bottom, a 'Properties' tab is active, showing a message: 'No properties yet. Add a property to get started.' with an '+ ADD PROPERTY' button.

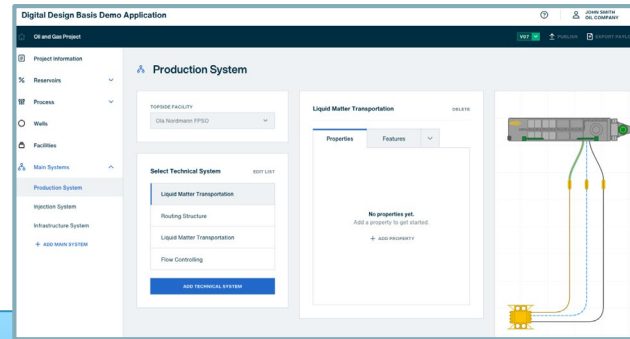


Then we define the technical systems.
The types of technical systems are consistent with IEC/ISO81346.

The screenshot displays the 'Digital Design Basis Demo Application' interface. At the top, it shows the user 'JOHN SMITH' from 'OIL COMPANY' and a project identifier 'V07'. The main navigation on the left includes 'Oil and Gas Project', 'Project Information', 'Reservoirs', 'Process', 'Wells', 'Facilities', and 'Main Systems'. Under 'Main Systems', 'Production System' is selected. The central workspace is titled 'Production System' and contains a 'TOPSIDE FACILITY' dropdown menu set to 'Ola Nordmann FPSO'. Below this is a 'Select Technical System' panel with an 'EDIT LIST' link. The list includes 'Liquid Matter Transportation' (highlighted), 'Routing Structure', another 'Liquid Matter Transportation' entry, and 'Flow Controlling'. A blue 'ADD TECHNICAL SYSTEM' button is at the bottom of this list. To the right, a 'Liquid Matter Transportation' panel shows 'Properties' and 'Features' tabs, with a message: 'No properties yet. Add a property to get started.' and an '+ ADD PROPERTY' button. On the far right, a 3D schematic shows a grey FPSO vessel connected via green and yellow lines to a yellow offshore platform structure.



Operator Digital Design Basis Tool



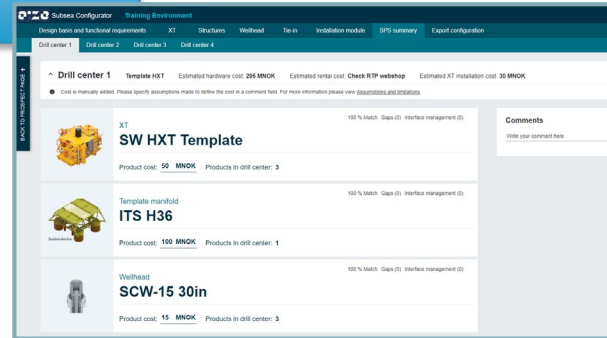
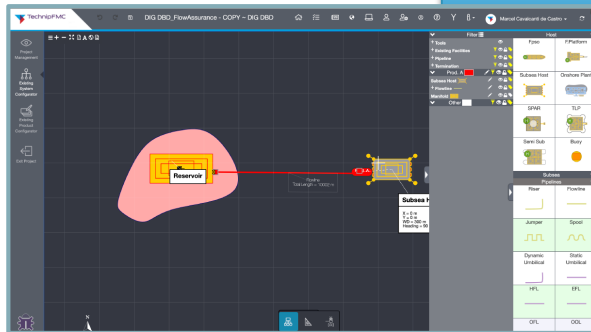
The Operator works in a software application and can share Design Basis data with the EPC, who can use it in their applications by relying on the same common data model.

Common Data Model



Subsea Studio FD

Define SURF scope based on Design Basis parameters from DDB Operator tool.

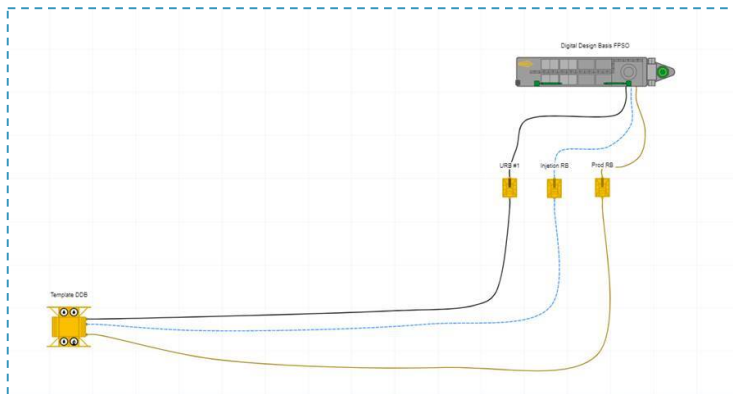


Subsea Configurator

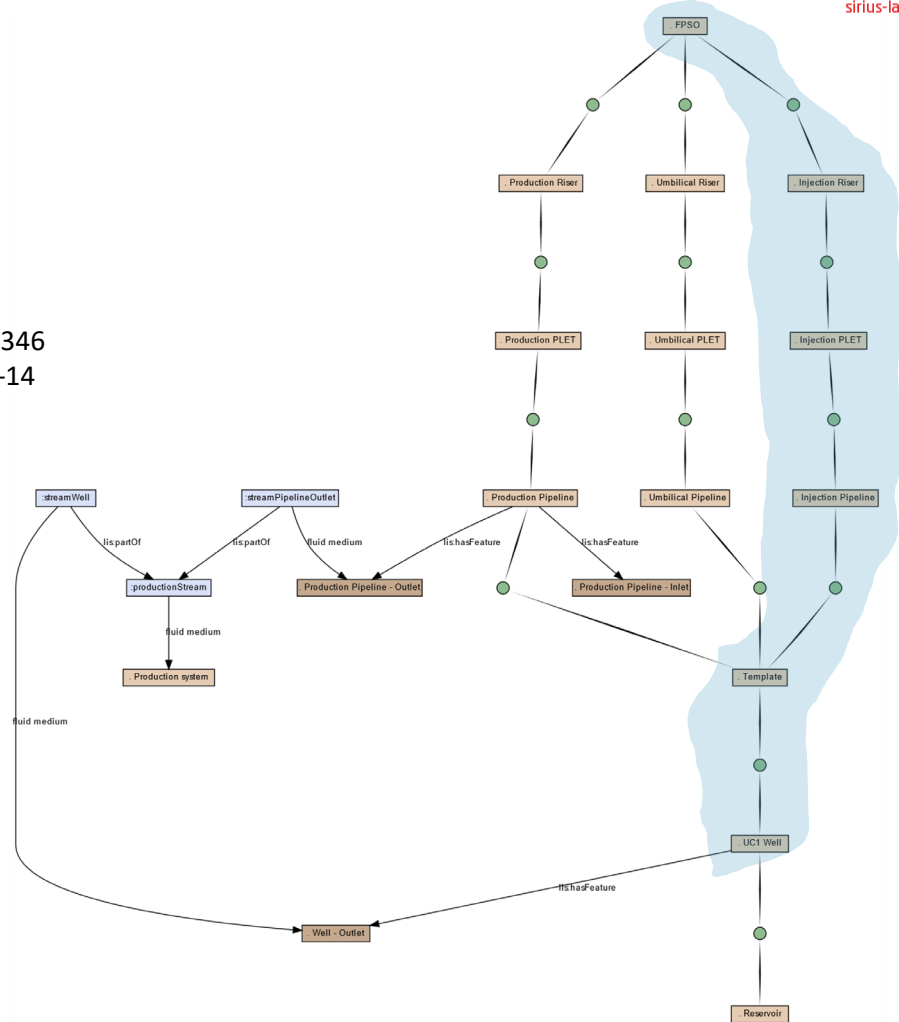
Define SPS scope based on Design Basis parameters from DDB Operator tool.



The Digital Design Basis model is built around a breakdown into standard **technical systems** (IEC/ISO81346, READI and O&G RDS)
The model reflects the topology of the field layout.



IEC/ISO81346
ISO15026-14
OWL, RDF



READI

<https://readi-ijp.org/reference-designation-system-for-oil-and-gas/>



Lessons Learned and Observations

- It was possible to implement a DDB model using W3C semantic standards (OWL, RDF), public reusable ontologies (e.g. ChEBI) and ISO15926.
- Tooling and software was all open-source.
- The data model is open-source (and will be shared soon) – but not the data!
- The IEC/ISO81346 system breakdown approach from READI could be used.
- Consistency of units of measurement remains a challenge in all interoperability. Need agreement about quantity types and unit representation.
- We looked here at parameters, i.e. requirements that can be reduced to a number, not functional requirements per se.
 - Transforming textual requirements to numbers, bits and bytes is hard.
- We have been able to link in fluid properties into the common data model.



Conclusions

- A consortium of operators and competing EPC companies demonstrated that a common data model can be used to capture and share design basis data in early phase development.
- Semantic modelling made this representation possible and allowed data to be entered in a structured way and be consumed by engineering applications.
- We need to have more projects like this, where consortia along the supply chain work with academia and software vendors to agree on interoperability standards by working on real, non-trivial problems.
- The lessons from this project have been taken up in further, ambitious initiatives by each of the partners.