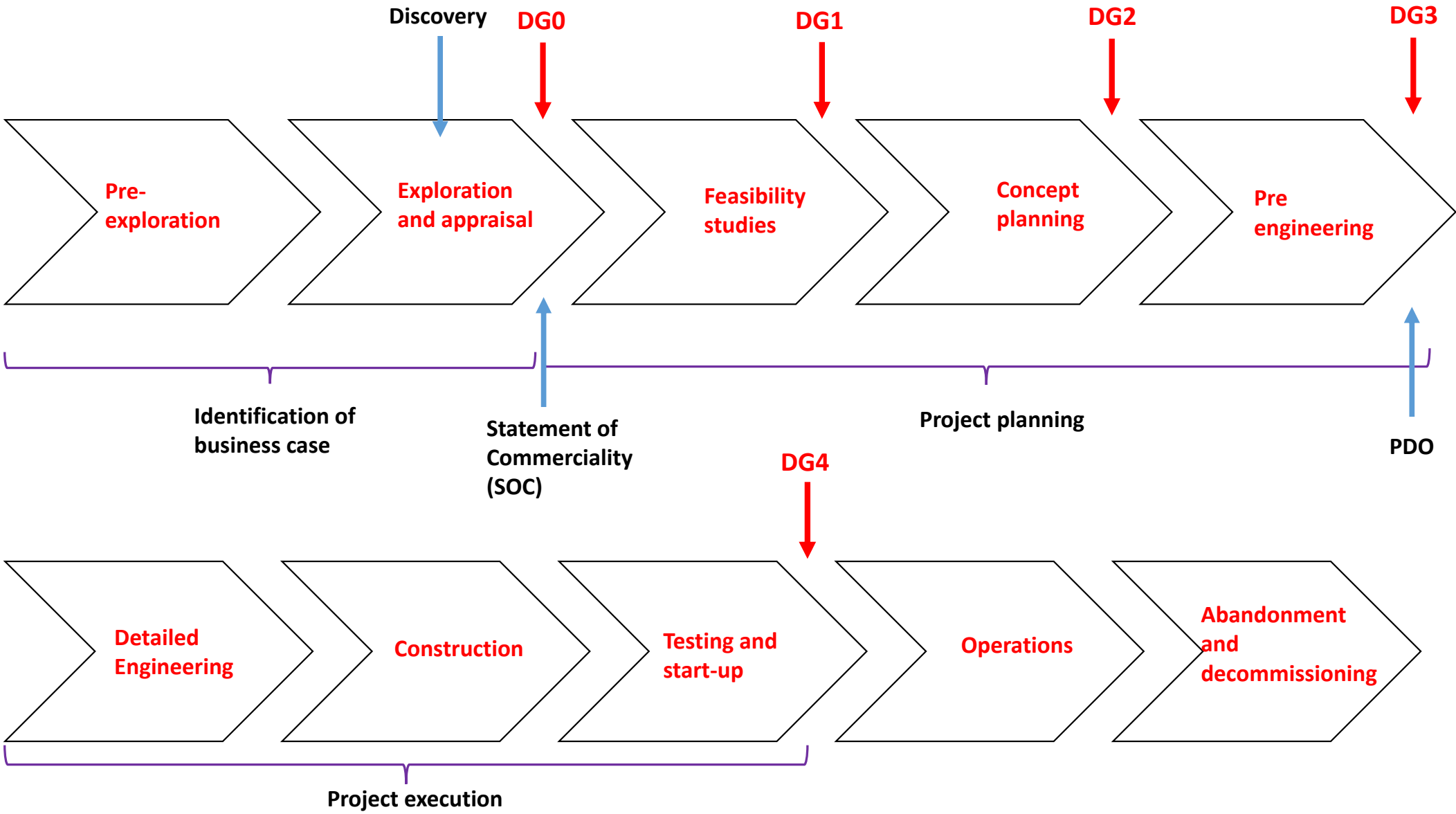
THE FIELD DEVELOPMENT PROCESS

Prof. Milan Stanko (NTNU)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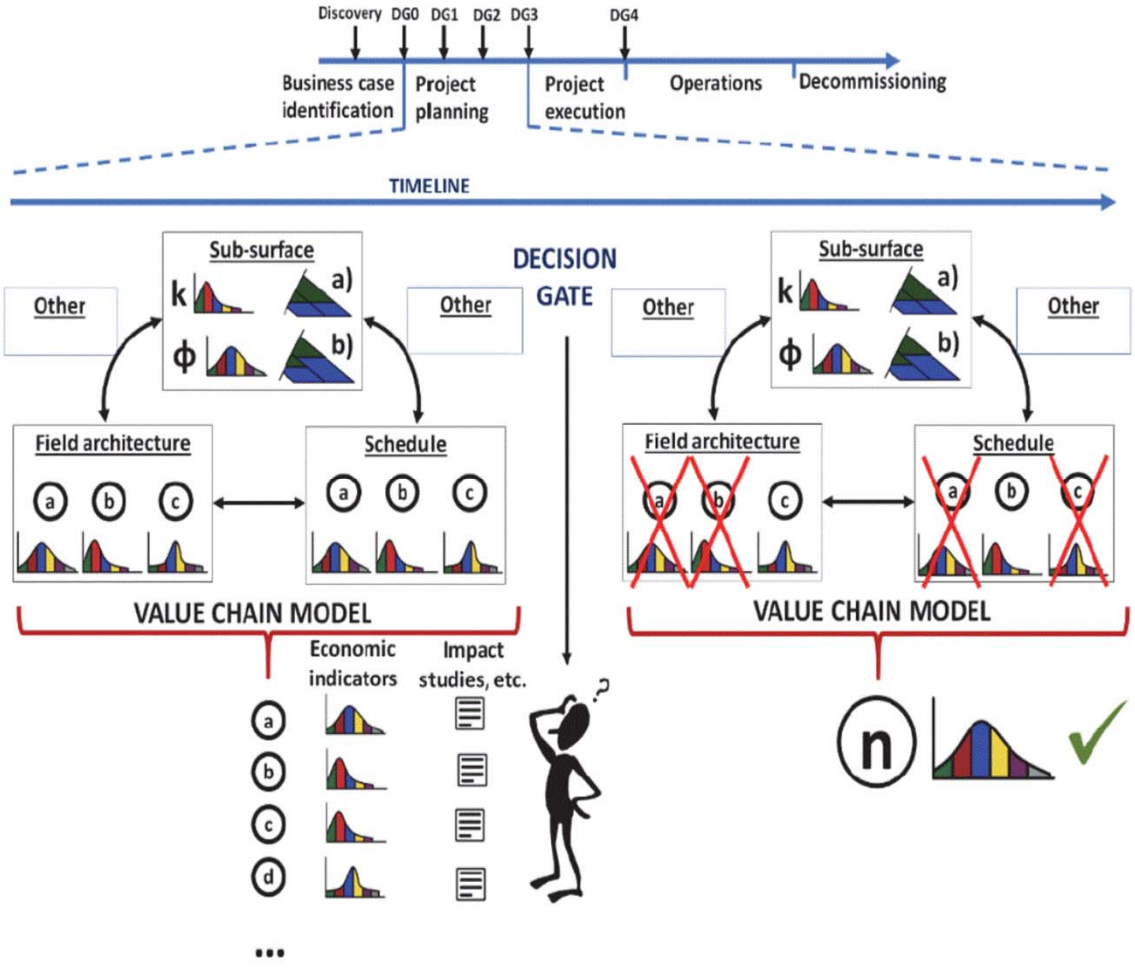
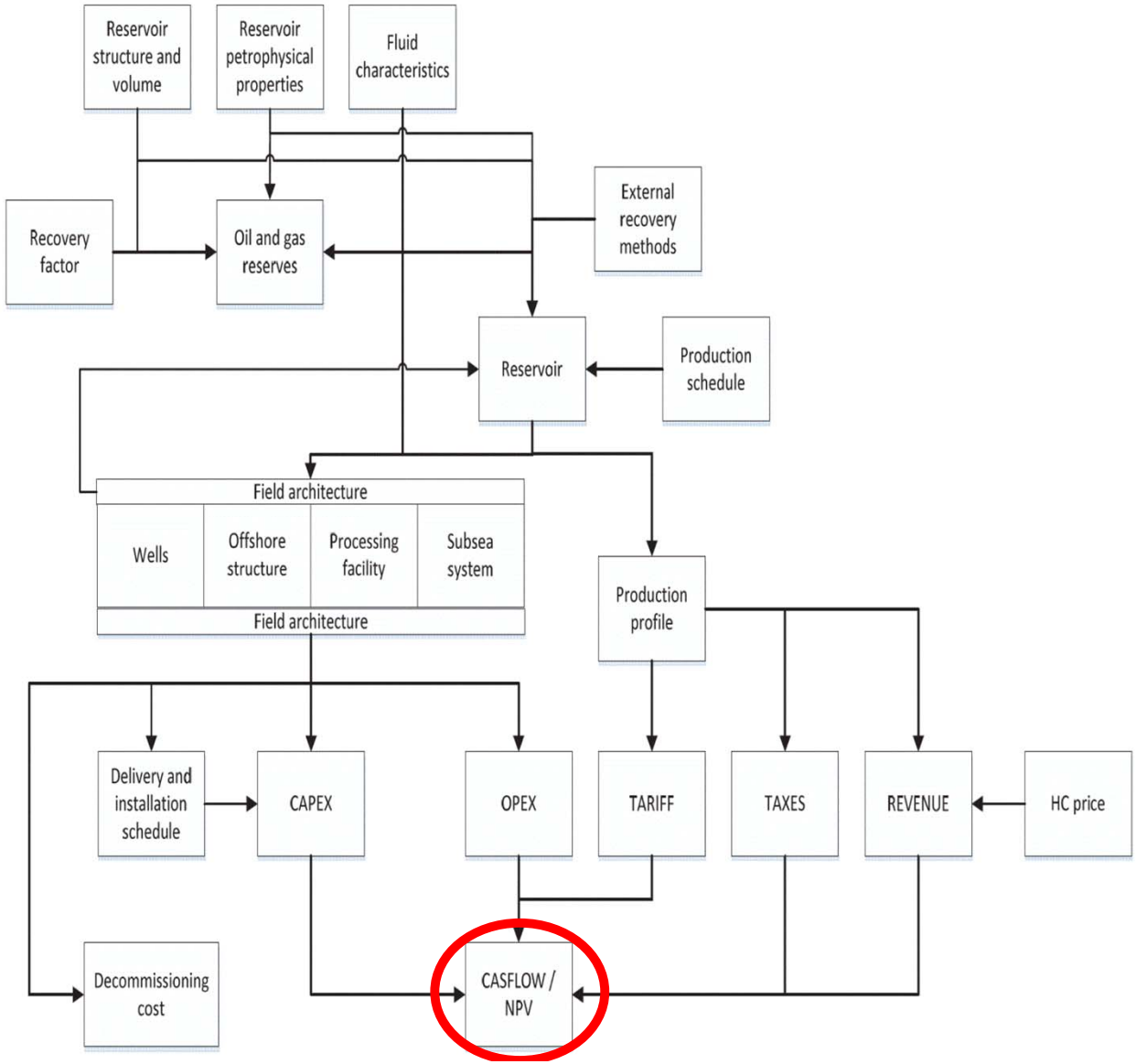
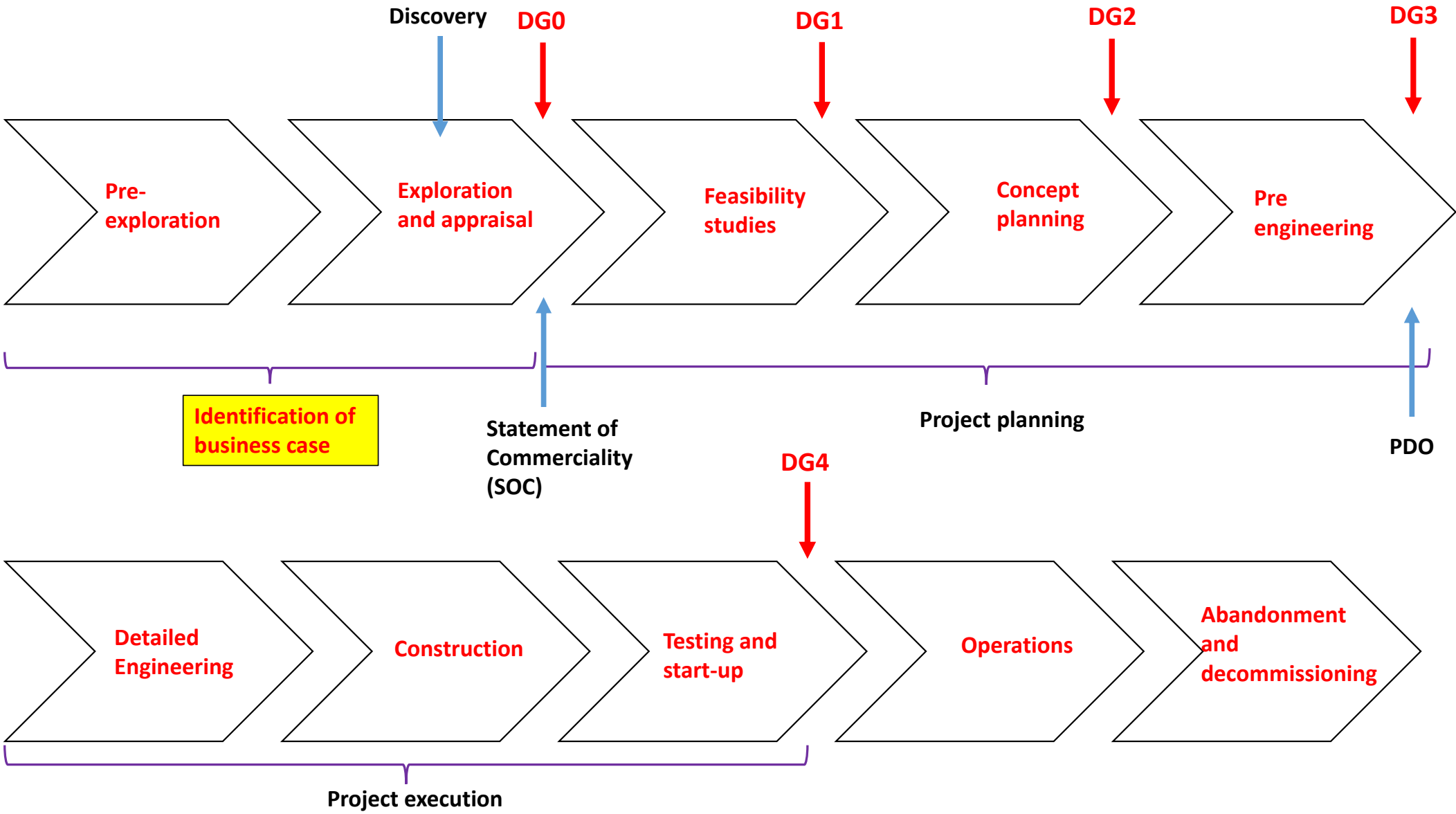
During the field development process a model of the value chain is made based on the disciplines involved and populated with information. Initially there are many alternatives and little information. As time progresses and decisions are taken, the model is expanded, there is more information but less flexibility.



Key performance indicators are computed with the value chain model and are used to take decisions in the decision gate process.

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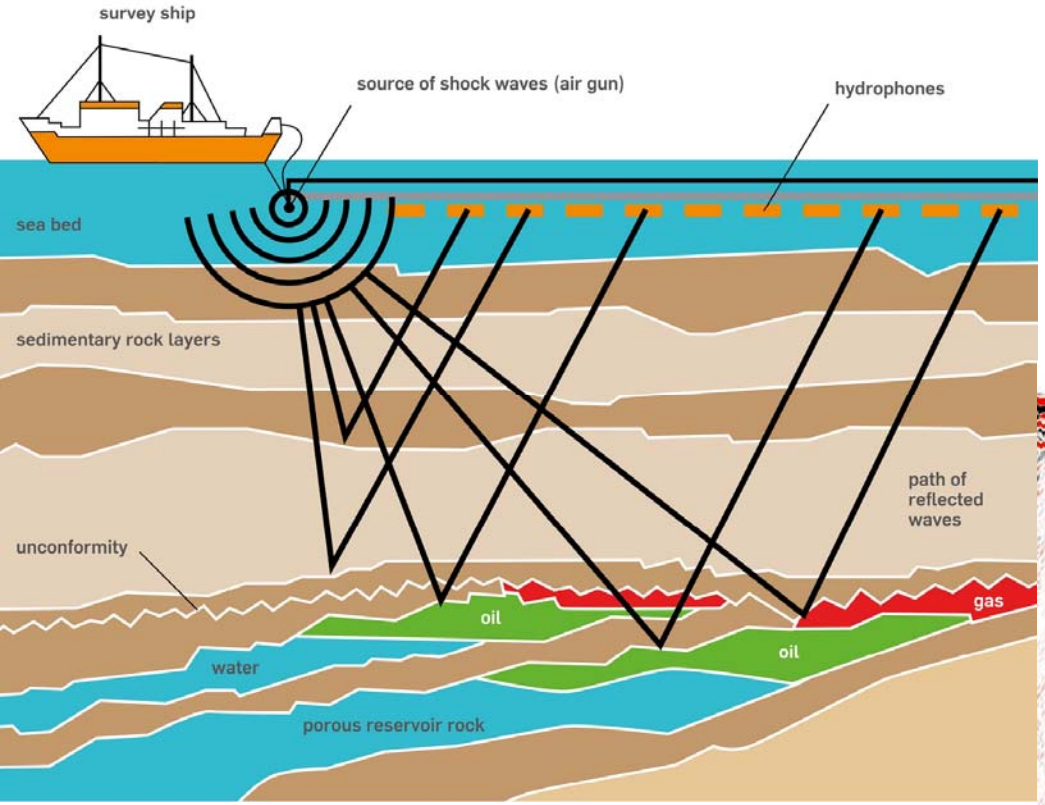
IDENTIFICATION OF BUSINESS CASE

The main goal of this stage is to prove economic potential of the discovery and quantify and reduce the uncertainty in the estimation of reserves.

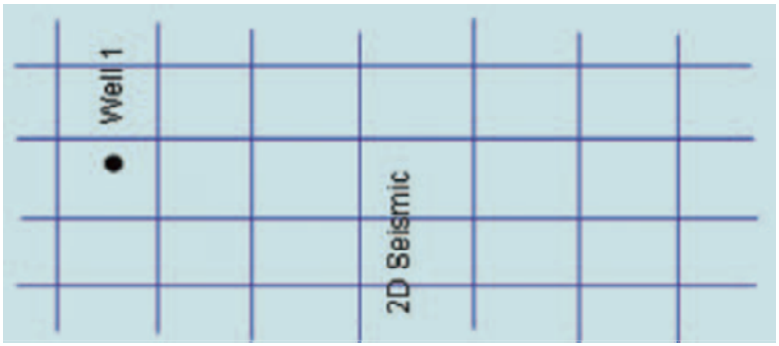
IDENTIFICATION OF BUSINESS CASE - TASKS

- Pre-exploration – scouting: collecting information on areas of interests. Technical, political, geological, geographical, social, environmental considerations are taken into account. E.g. expected size of reserves, political regime, government stability, technical challenges of the area, taxation regime, personnel security, environmental sensitivity, previous experience in the region, etc.
- Getting pre-exploration access – The exploration license (usually non-exclusive). In the NCS only seismic and shallow wells are allowed. This is usually done by specialized companies selling data to oil companies. Area: 500 Km^2
- Identify prospects.

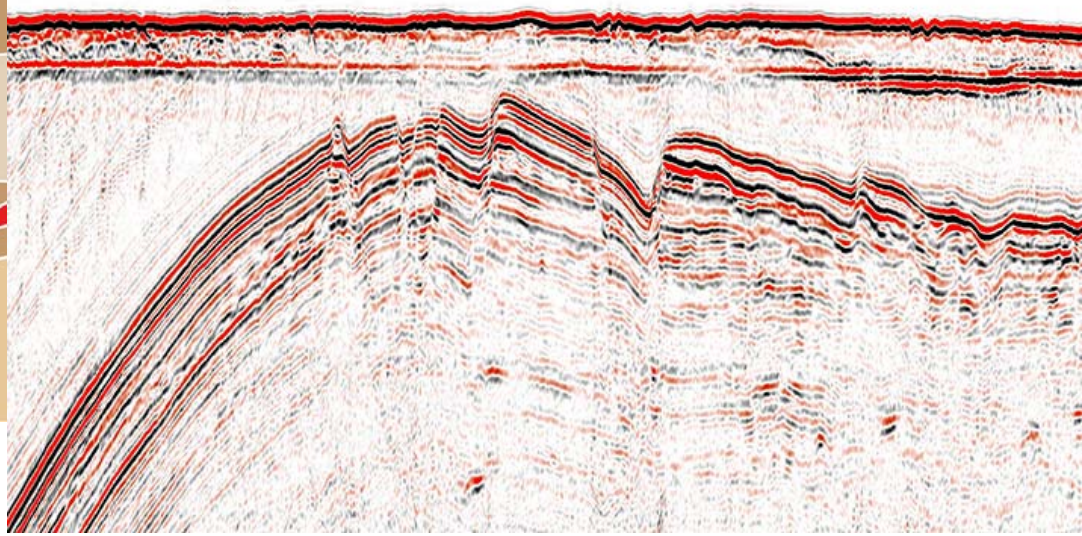
IDENTIFICATION OF BUSINESS CASE - TASKS



Ref: https://krisenergy.com/company/about-oil-and-gas/exploration/

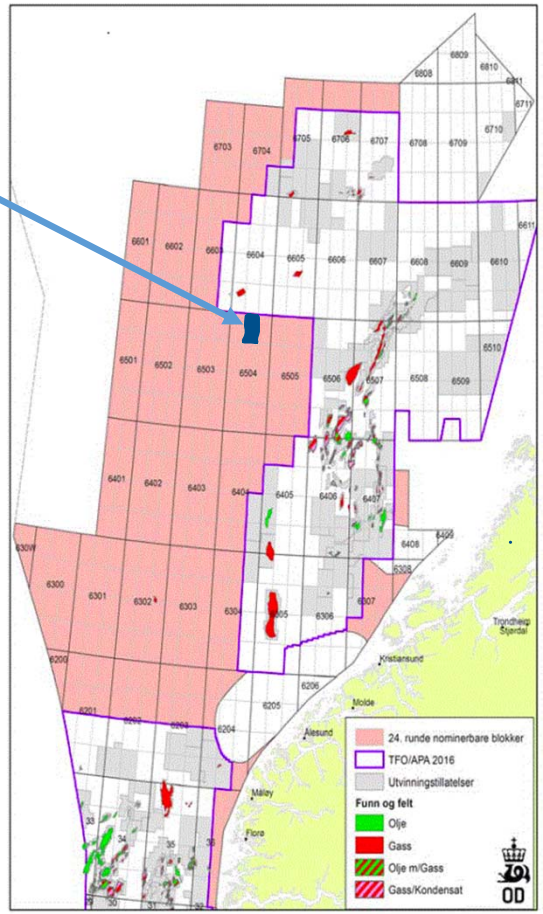


Seismic exploration



IDENTIFICATION OF BUSINESS CASE - TASKS

Ca 500 km^2



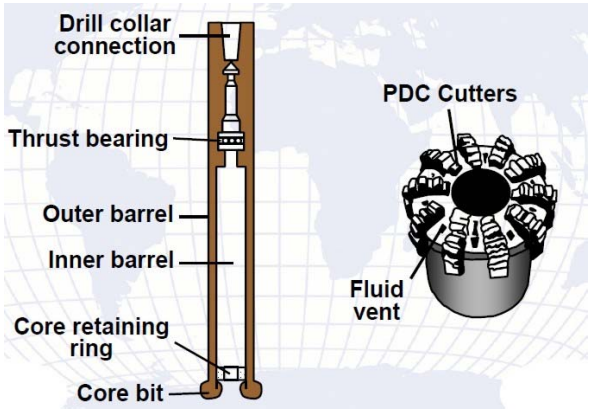
Ref: NPD

- Apply and obtain exclusive production license (6 years, possible to extend for 30 years). In the NCS: Licensing rounds (frontier areas) or Awards in predefined areas (APA). The current fees (if inactive) are 34 000 NOK/km^2 for the first year, 68 000 NOK/km^2 for the second year and 137 000 NOK/km^2 per year thereafter.

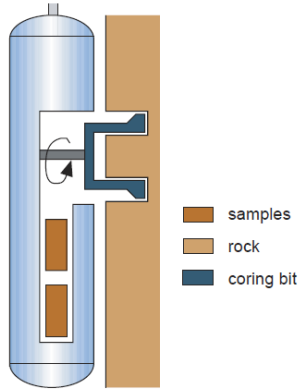
IDENTIFICATION OF BUSINESS CASE - TASKS

- Exploration. Perform geological studies, geophysical surveys, seismic, exploration drilling (Well cores, wall cores, cuttings samples, fluid samples, wireline logs, productivity test).

- Discovery!



Ref: https://www.spec2000.net/09-coremethods.htm



Ref: Hydrocarbon exploration and production, Jahn et al.

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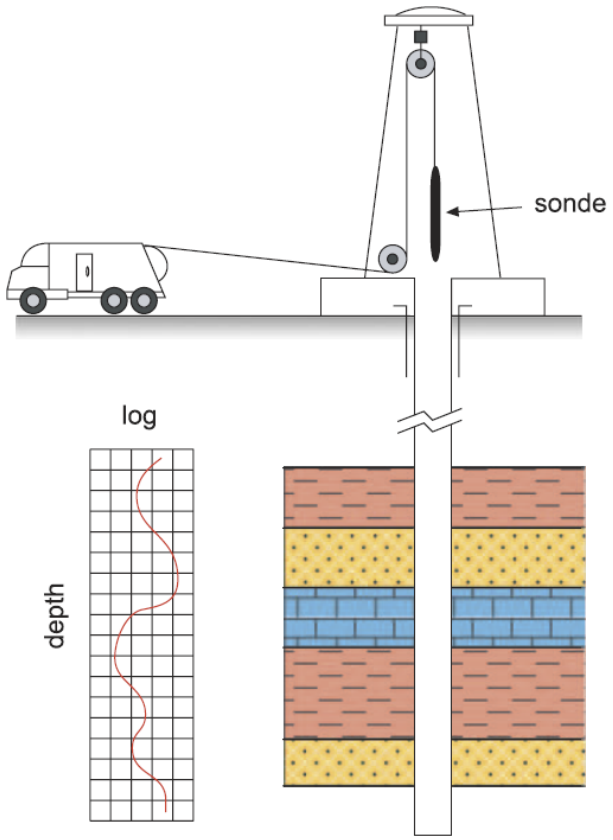

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IDENTIFICATION OF BUSINESS CASE - TASKS

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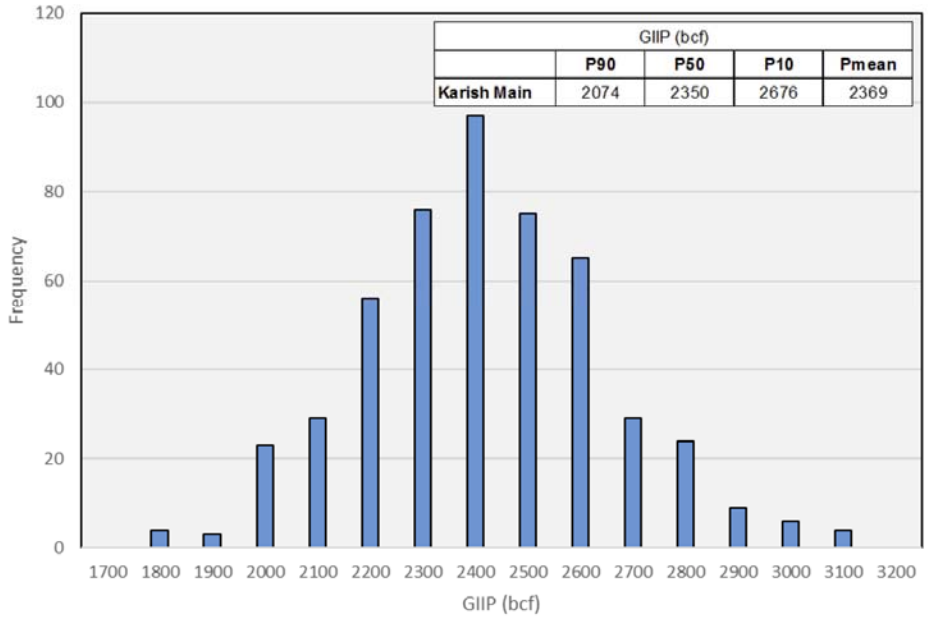
- Discovery!

https://www.youtube.com/watch?v=Qd7F8T0IVXU

IDENTIFICATION OF BUSINESS CASE - TASKS

- Assessment of the discovery and the associated uncertainty. Risk management:
  - o Probabilistic reserve estimation. Identify and assess additional segments.



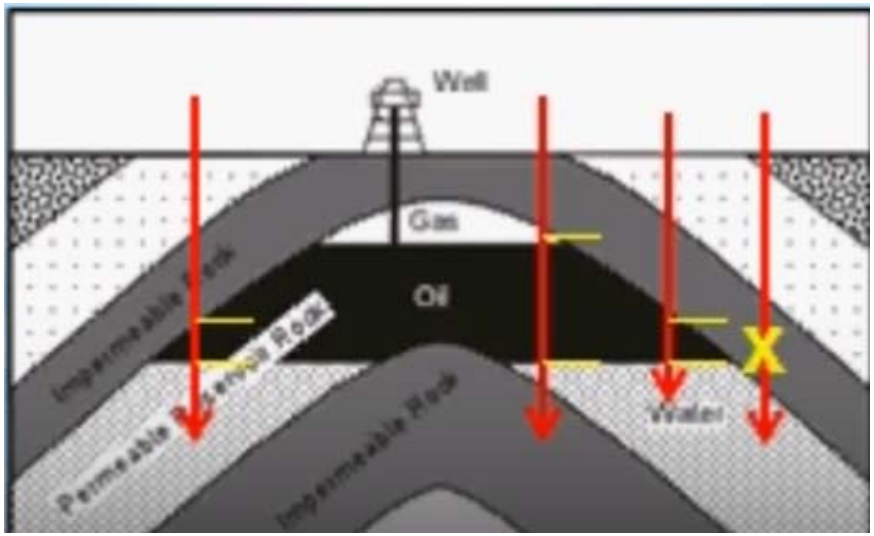
Ref: PDO Karish and Tanin. Energean

IDENTIFICATION OF BUSINESS CASE - TASKS

- Assessment of the discovery and the associated uncertainty. Risk management:
  - Probabilistic reserve estimation. Identify and assess additional segments.
  - Perform simplified economic valuation of the resources.
  - Field appraisal to reduce uncertainty: more exploration wells and seismic to determine for example: fault communication, reservoir extent, aquifer behavior, location of water oil contact or gas oil contact.

IDENTIFICATION OF BUSINESS CASE - TASKS

- Appraisal

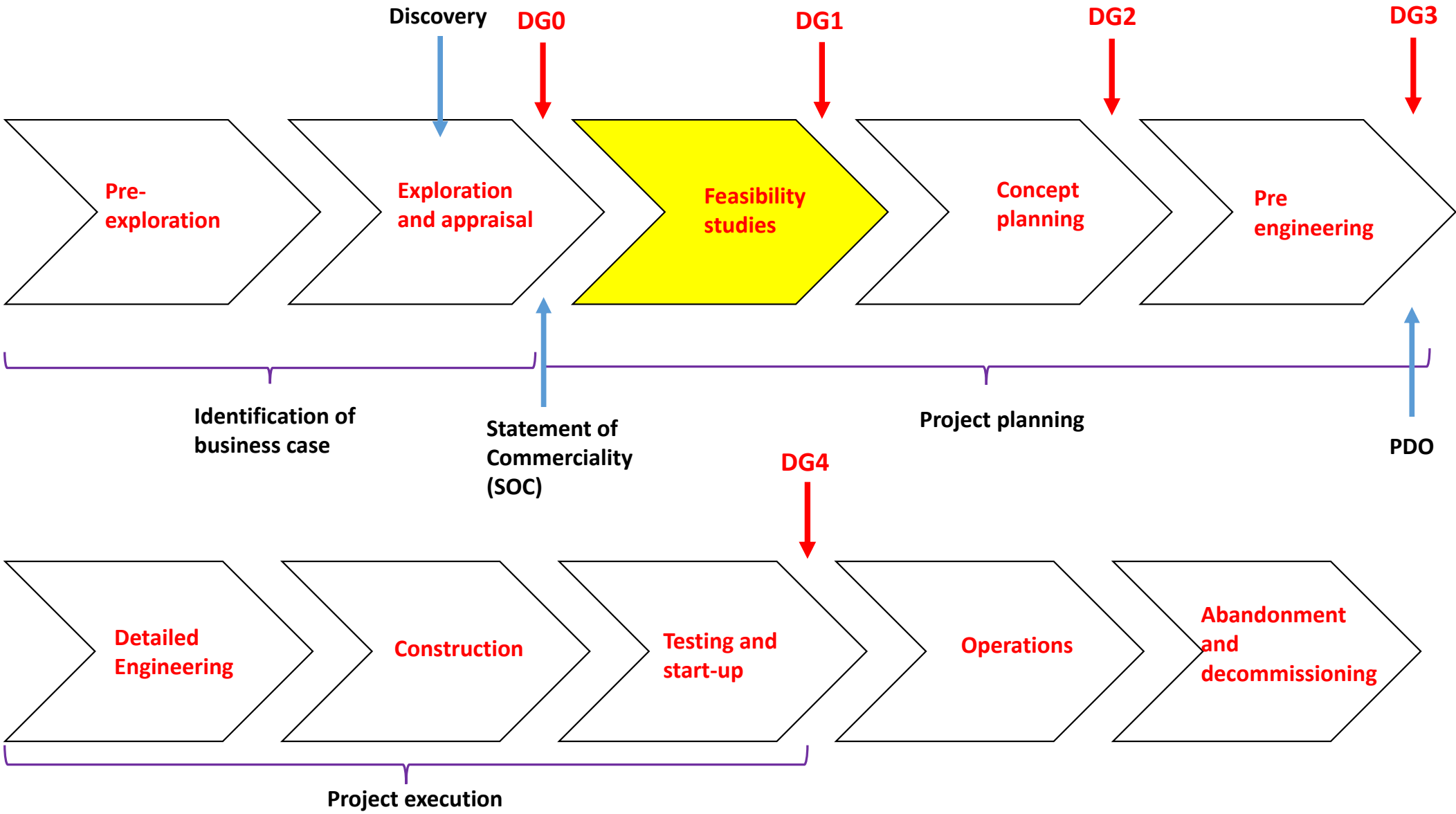


Ref: https://www.youtube.com/watch?v=-e9jjnsquGI

IDENTIFICATION OF BUSINESS CASE - TASKS

DG0:

- Issue a SOC (Statement of Commerciality) and proceed with development.
- Continue with more appraisal
- Sell the discovery.
- Do nothing (wait)
- Relinquish to the government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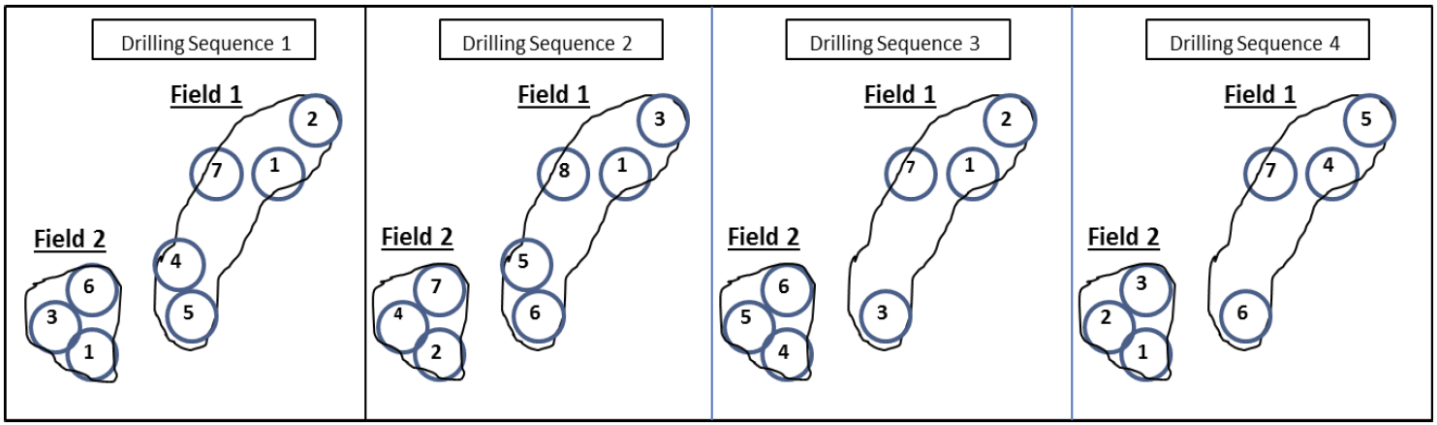
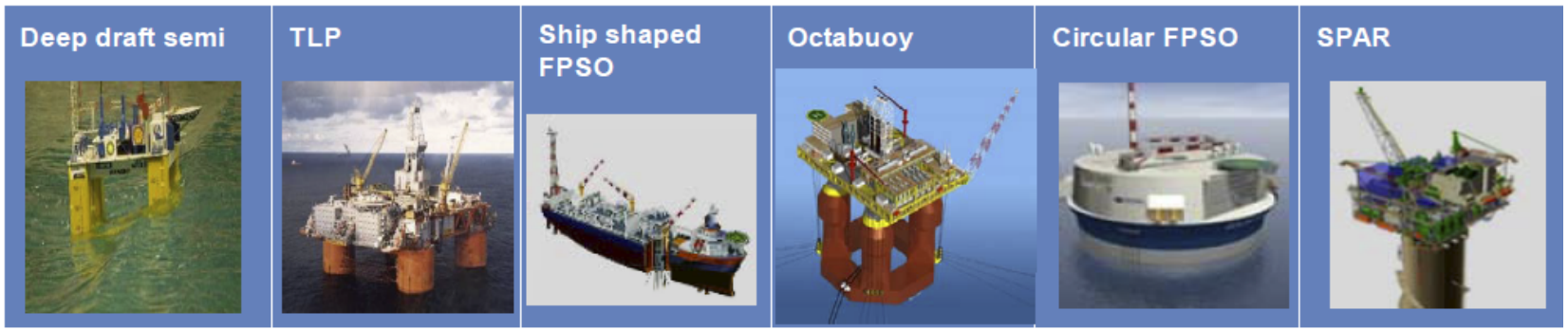
FEASIBILITY STUDIES - TASKS

OBJECTIVE: Justify further development of the project, finding one or more concepts that are technically, commercially and organizationally feasible

- Define objectives of the development in line with the corporate strategy.
- Establish feasible development scenarios.
- Create a project timeline and a workplan.

FEASIBILITY STUDIES - TASKS

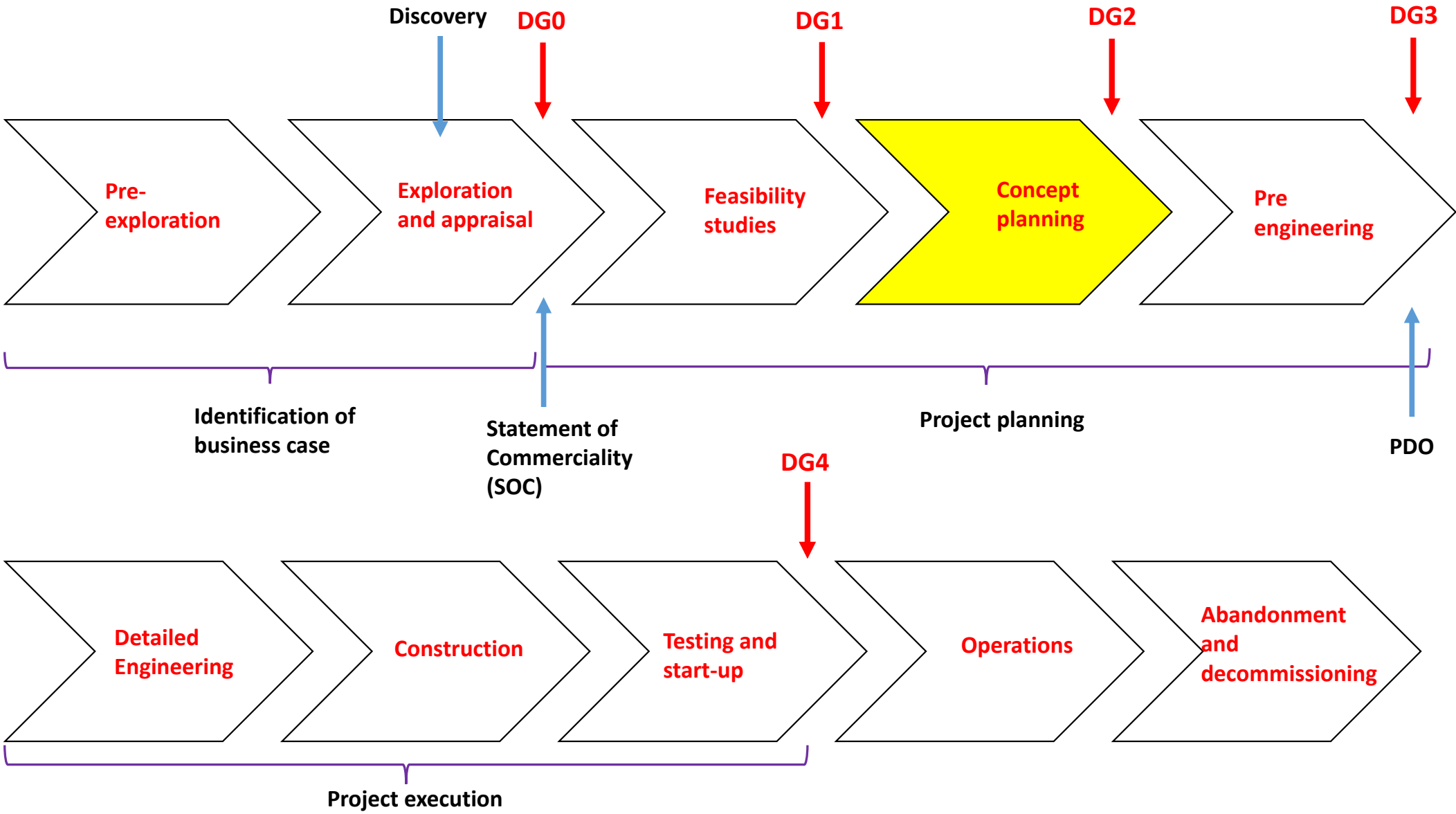




Ref: UTC 2017, Strategies, methods and tools for development of subsea fields, Skogvang and Løken.

FEASIBILITY STUDIES - TASKS

- Identify possible technology gaps and blockers.
- Identify the needs for new technology.
- Identify added value opportunities.
- Cost evaluation for all options (at this stage, cost figures are ±40% uncertain)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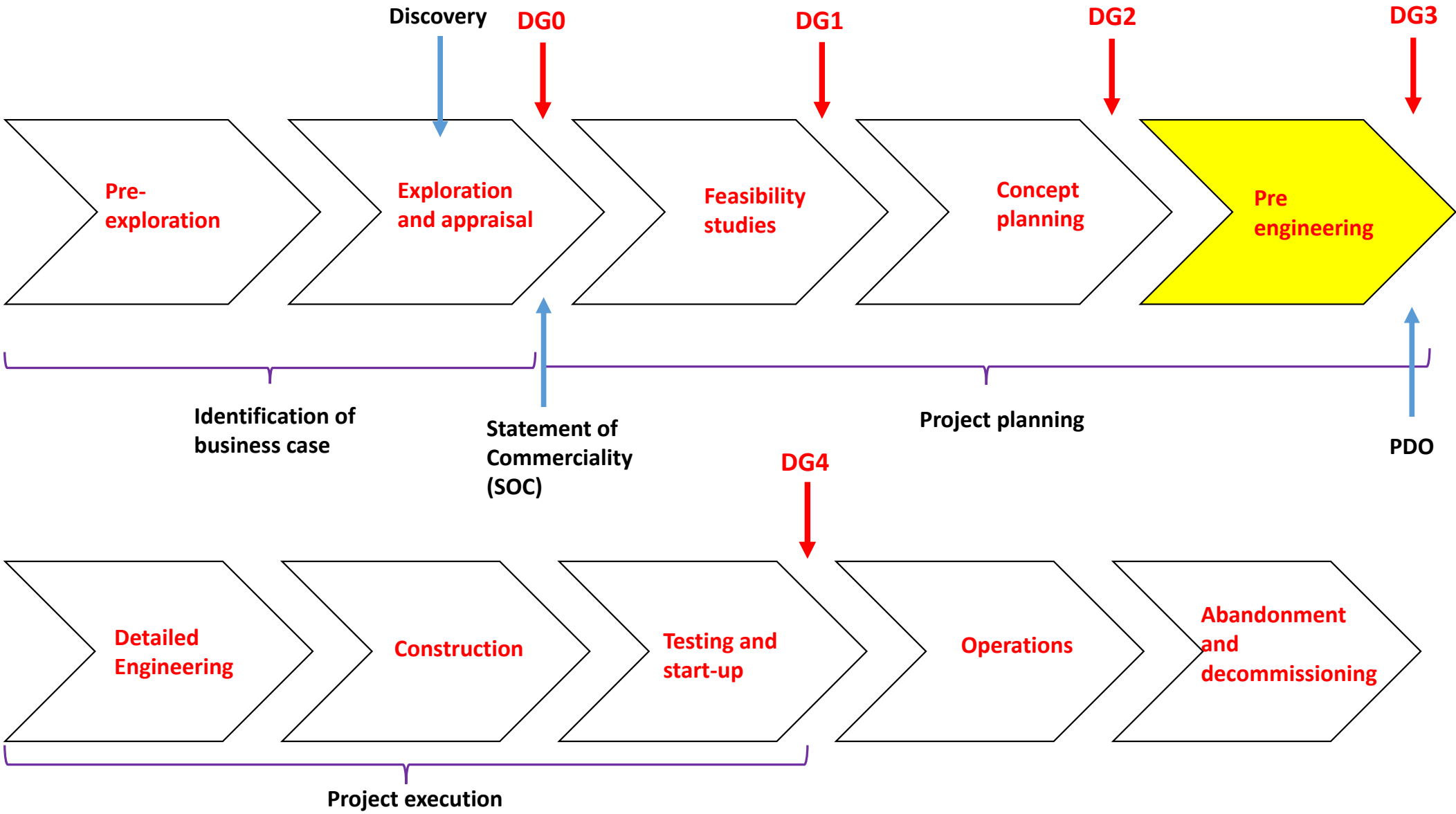
CONCEPT PLANNING - TASKS

OBJECTIVE: Identify development concepts, rank them and select and document a viable concept (Base Case Scenario).

- Evaluate and compare alternatives for development and screen out non-viable options.
- Elaborate a Project Execution Plan (PEP) which describes the project and management system.
- Define the commercial aspects, legislation, agreements, licensing, financing, marketing and supply, taxes.

CONCEPT PLANNING - TASKS

- Create and refine a static and a dynamic model of reservoir. **Define the depletion and production strategy.**
- Define an HSE program
- **Flow assurance evaluation.** Identification of challenges related with fluid properties, multiphase handling and driving pressure.
- Drilling and well planning
- Pre-design of facilities
- Planning of operations, start-up and maintenance
- Cost and manpower estimates of the best viable concept.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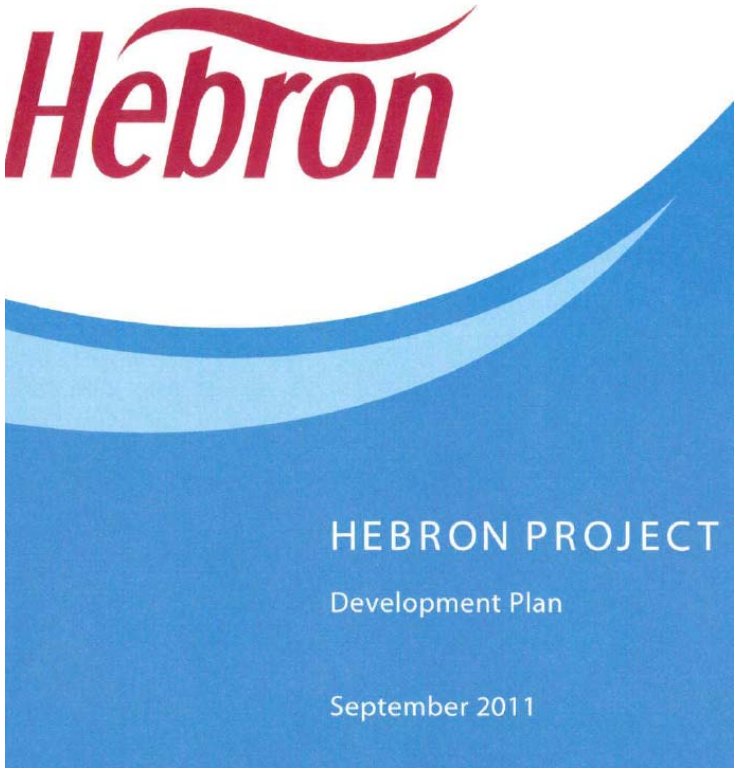
PRE-ENGINEERING - TASKS

OBJECTIVE: Further mature, define and document the development solution based on the selected concept.

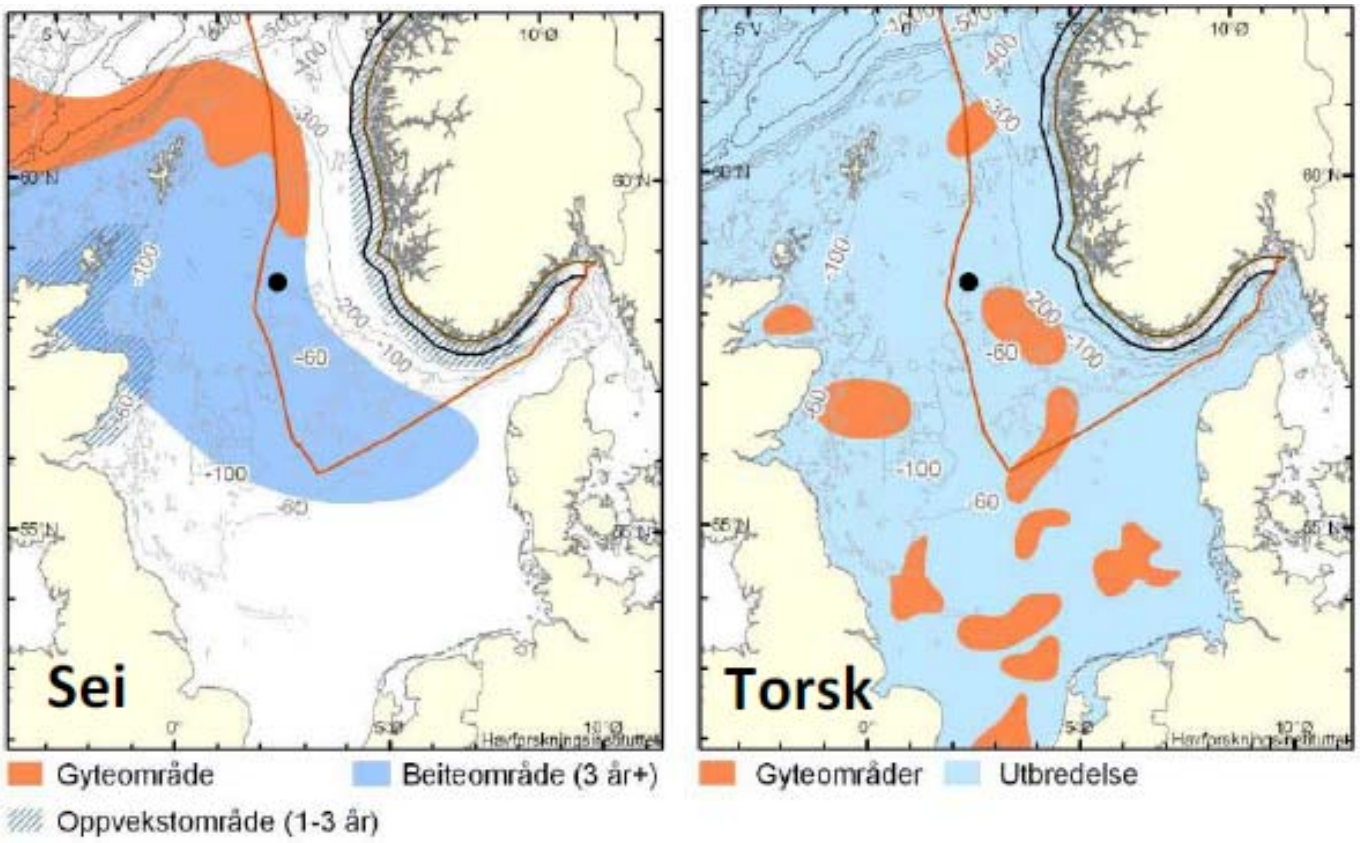
- Selection of the final technical solution. Decide and define all remaining critical technical alternatives.
- Execute Front End Engineering Design (FEED) Studies: determine technical requirements (arranged in packages) for the project based on the final solution chosen. Estimate cost of each package.
- Plan and prepare the execution phase.

PRE-ENGINEERING - TASKS

- Prepare for submission of the application to the authorities.
- Perform the Environmental impact assessment.
- Establish the basis for awarding contracts.
- Issue:
  - Plan for development and operations
  - Plan for installation and operations of facilities for transport and utilization of petroleum (PIO)
  - Impact assessment report

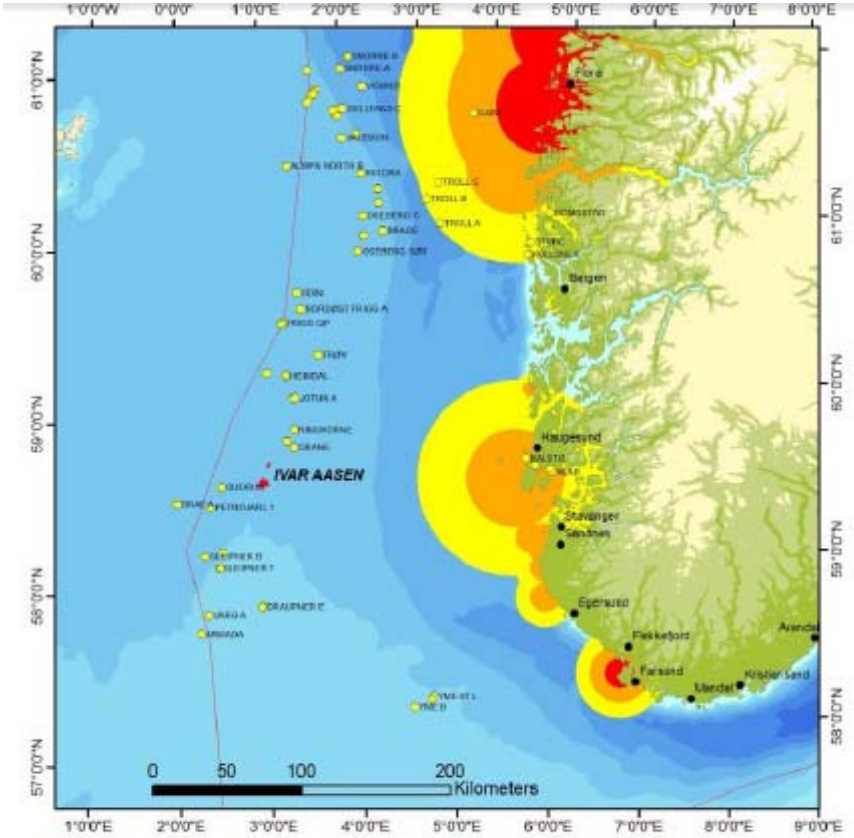


PRE-ENGINEERING - TASKS



Ref: PDO Ivar Aasen. Det Norske

PRE-ENGINEERING - TASKS



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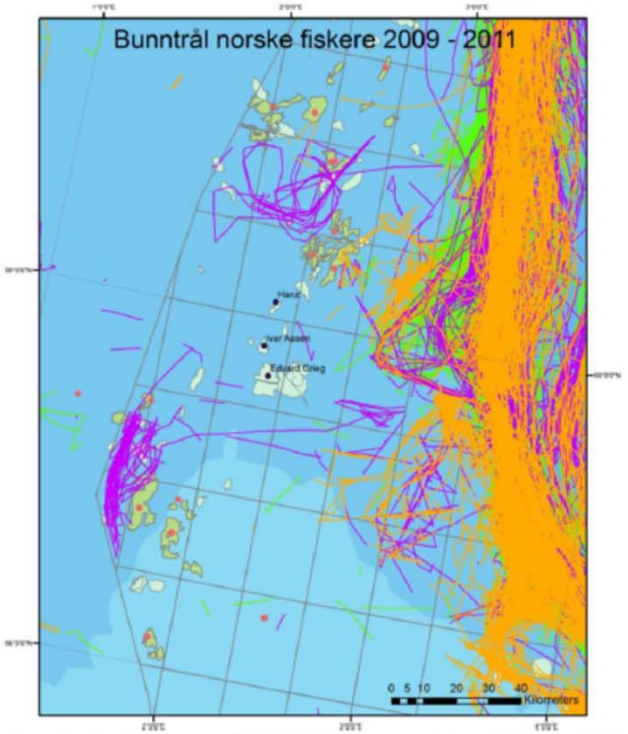
Figur 18. Svært viktige (rød), viktige (oransje) og nokså viktige (gule) leveområder for sjøfugl langs kysten av Nordsjøen i hekketiden. Kartet markerer buffersoner rundt de viktige hekkelokalitetene (NINA)

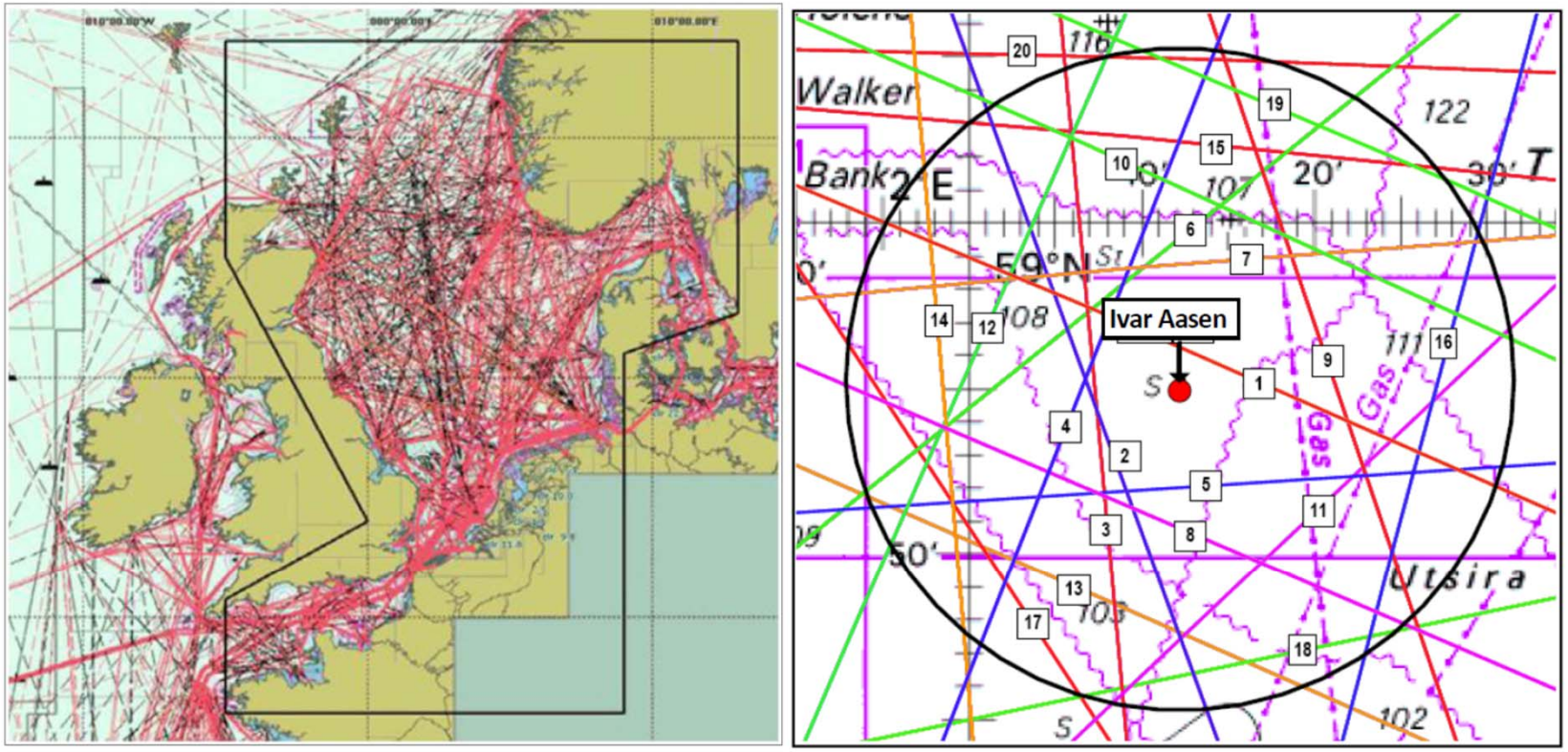
PRE-ENGINEERING - TASKS



Ref: PDO Ivar Aasen. Det Norske

Figur 23. Registrert norsk fiskeriaktivitet med bunntrål i området omkring Aasen i 2009 (grønn), 2010 (fiolett) og 2011 (oransje). Figur utarbeidet på grunnlag av data fra Fiskeridirektoratets satellittsporing av større fiskefartøyer

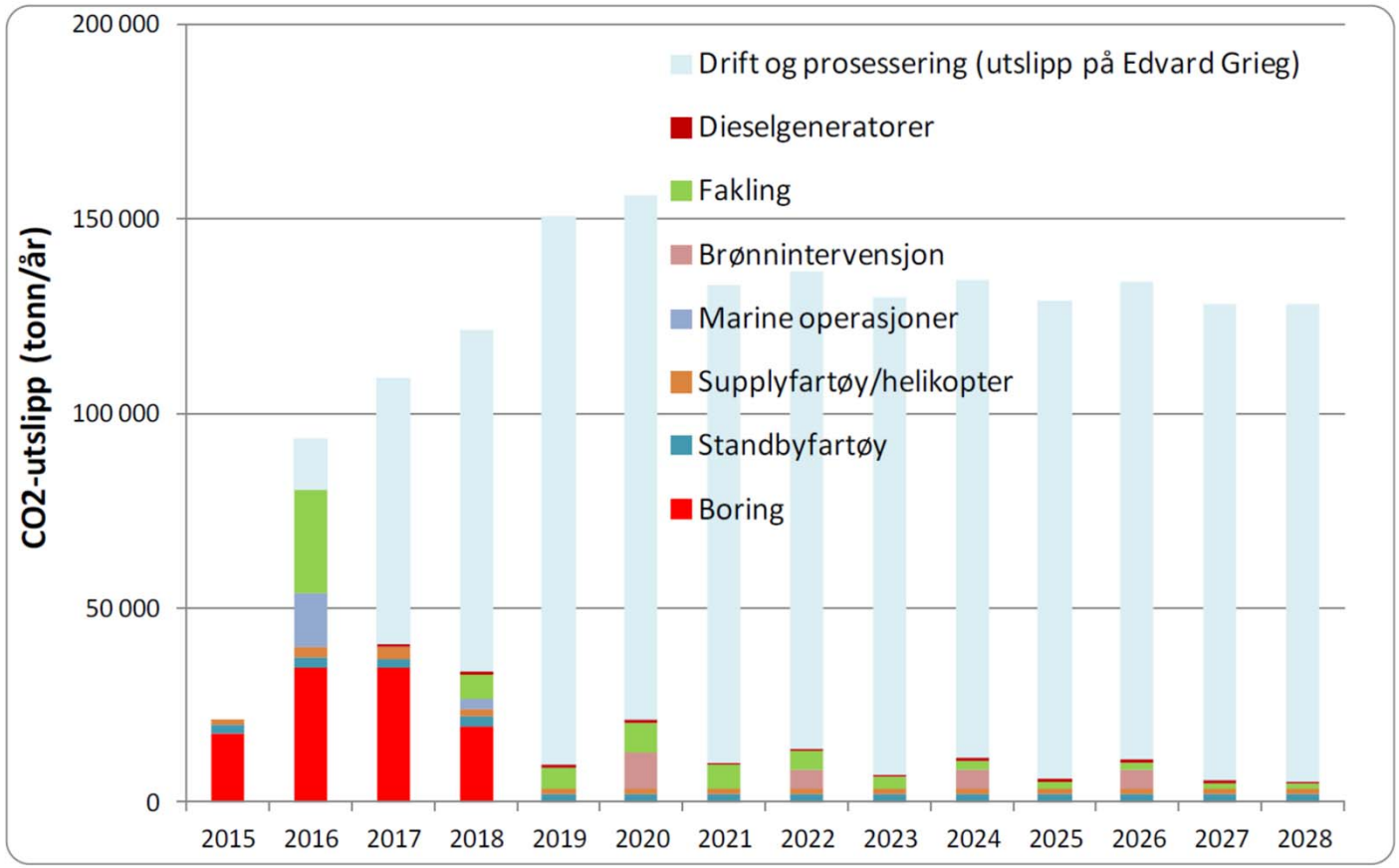
PRE-ENGINEERING - TASKS



Figur 24. Trafikkompleksitet i Nordsjøen (venstre) og skipsleder for handels- og offshorefartøy innenfor en radius på 10 nautiske mil fra Aasen (høyre)

Ref: PDO Ivar Aasen. Det Norske

PRE-ENGINEERING - TASKS



Figur 25. Samlede utslipp av CO_2 fra Aasenfeltet i perioden 2015 – 2028

Ref: PDO Ivar Aasen. Det Norske

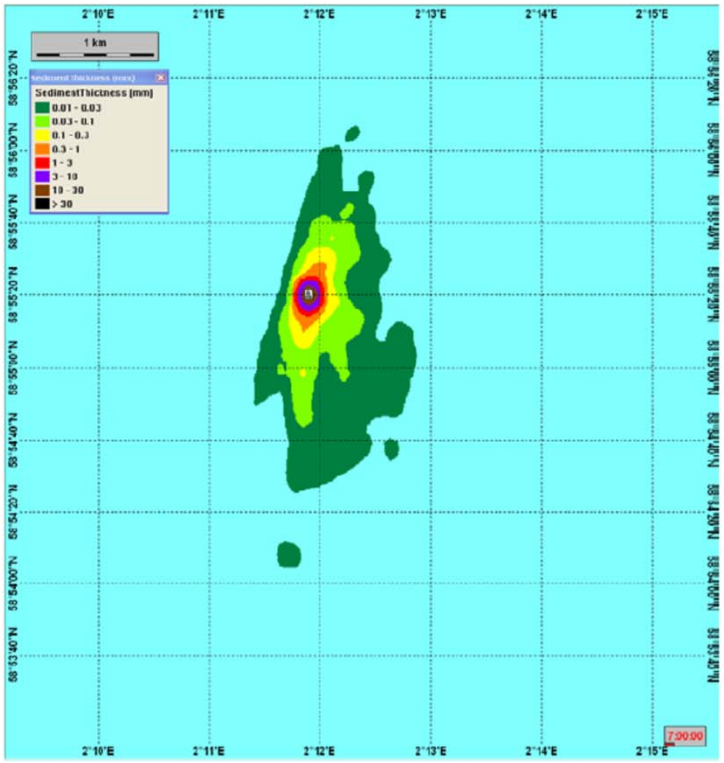
PRE-ENGINEERING - TASKS

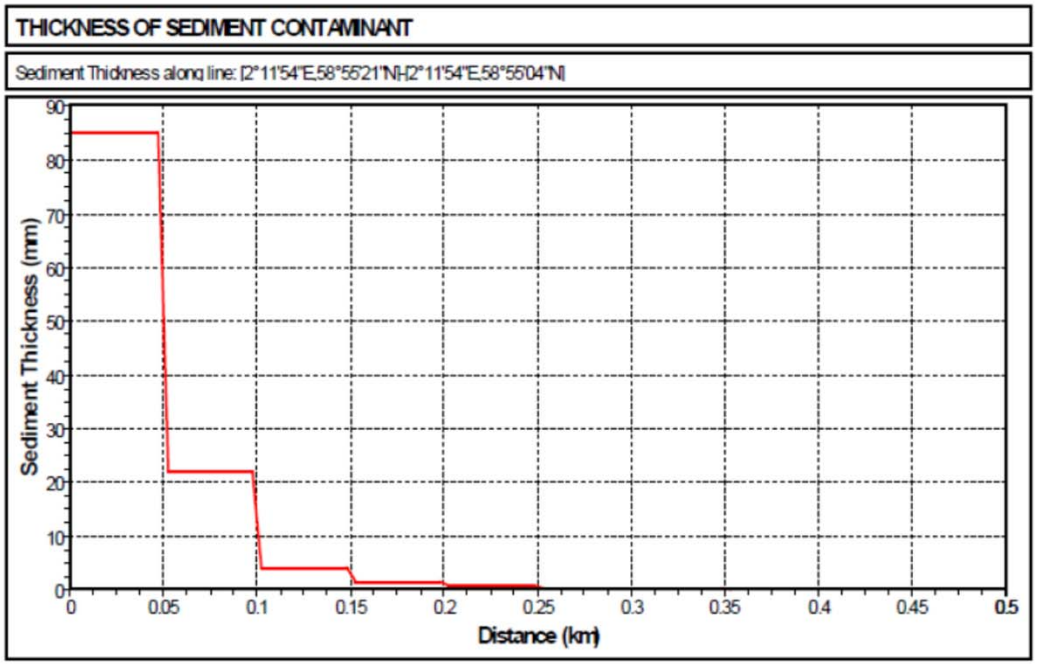
Tabell 5-1. Foreløpig oversikt over estimerte mengder kaks for typiske produksjonsbrønner på Aasen, West Cable og Hanz

Seksjon	Borevæske	Boret lengde (m)			Mengde borekaks (tonn)		
		Aasen	West Cable	Hanz	Aasen	West Cable	Hanz
36"	WBM	88	88	86	70	70	70
26"	WBM	370	370	400	150	150	160
17 ½"	OBM	1 550	1 020	990	310	205	200
12 ¼"	OBM	860	3 890	1 700	90	390	170
8 ½"	OBM	1 390	1 530	90	70	80	5
SUM (avrundet)		**4 300**	**6 900**	**3 300**	**690**	**895**	**605**
SUM WBM kaks					**220**	**220**	**230**
SUM OBM kaks					**470**	**675**	**375**

Ref: PDO Ivar Aasen. Det Norske

PRE-ENGINEERING - TASKS

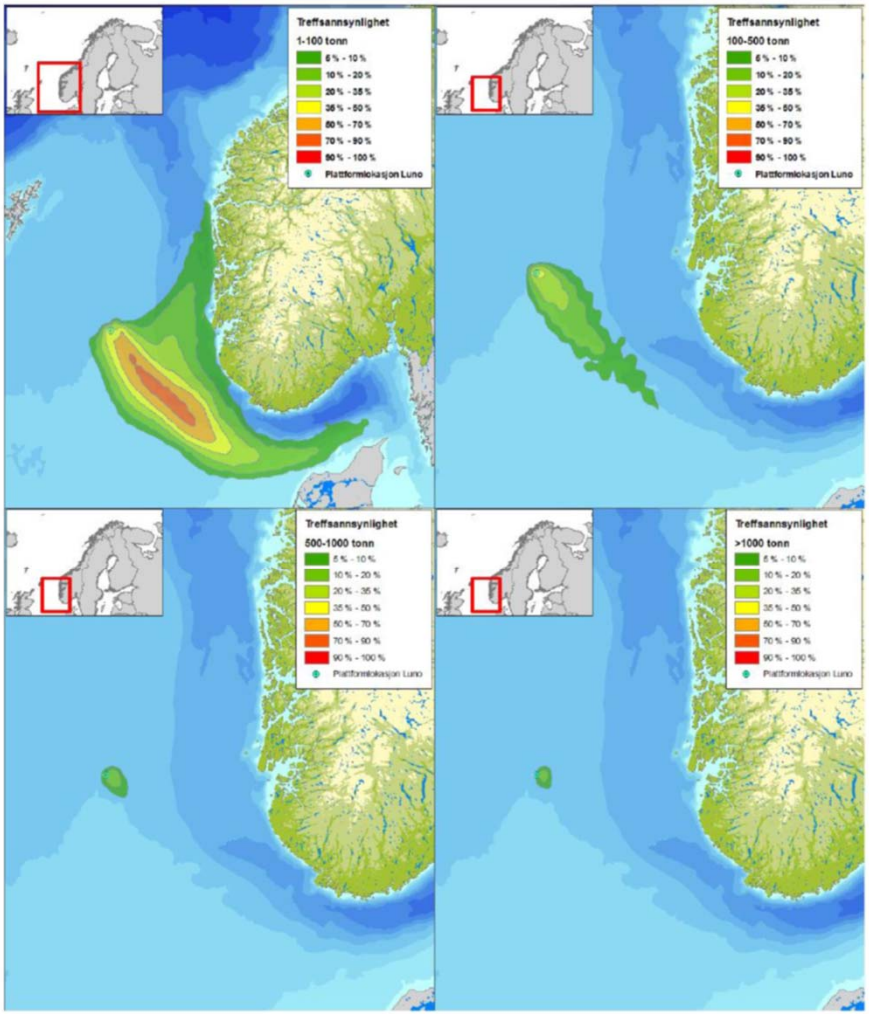




Figur 29. Sedimentering ved utslipp av vannbasert kaks ved havbunnen (sommersituasjon)

Ref: PDO Ivar Aasen. Det Norske

PRE-ENGINEERING - TASKS

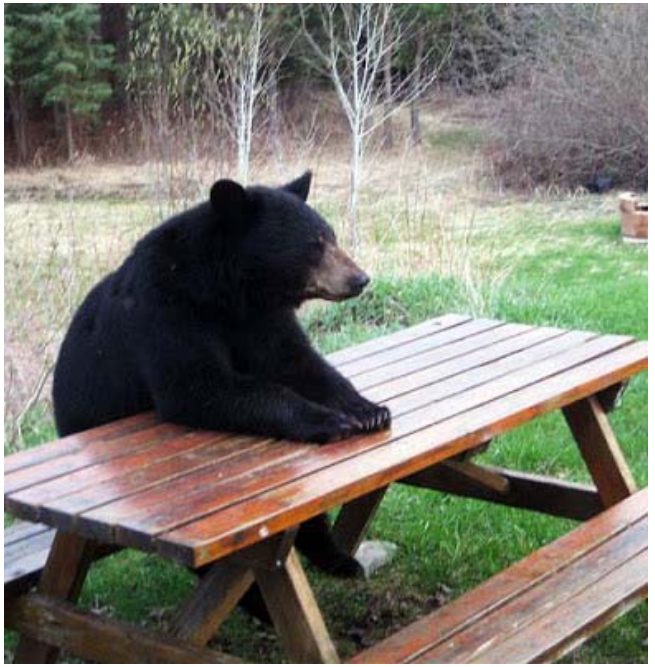


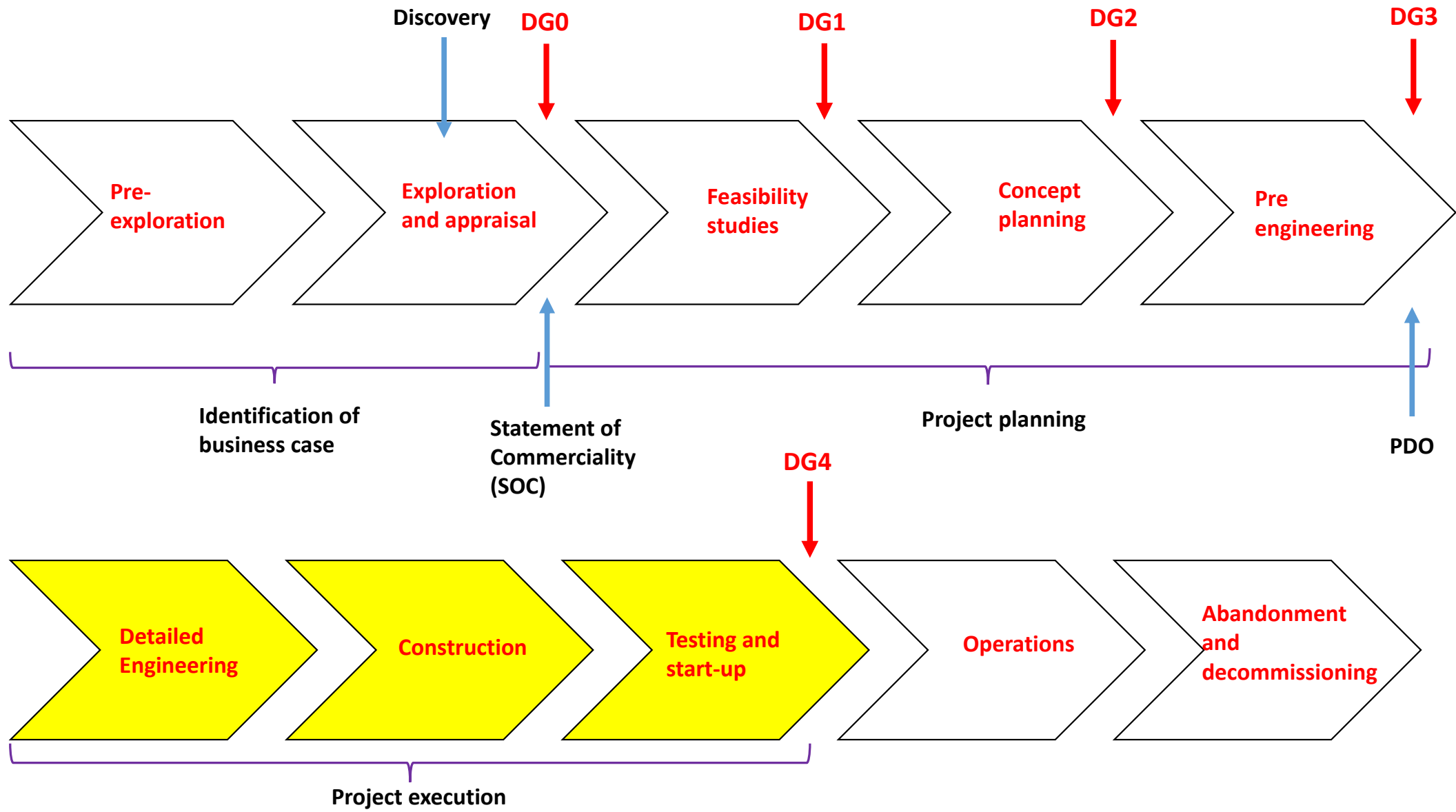
Figur 37. Sannsynligheten for treff av ulike mengdekategorier av olje i 10 × 10 km ruter gitt en sjøbunnsutblåsning fra Aasen/Grieg (helårsstatistikk). Influensområdet er basert på alle utslippsrater og varigheter og deres individuelle sannsynligheter. Merk at det markerte området ikke viser omfanget av et enkelt oljeutslipp, men er det området som berøres i mer enn 5 % av enkeltsimuleringene av oljens drift og spredning (Lundin 2011).

Ref: PDO Ivar Aasen. Det Norske

PRE-ENGINEERING - TASKS

- Wait for the government to study the proposal

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DETAILED ENGINEERING, CONSTRUCTION, TESTING AND STARTUP

OBJECTIVE: Detailed design, procurement of the construction materials, construction, installation and commissioning of the agreed facilities.

Individual contracts

- Detailed engineering
- Bids, contracts
- Construction, fabrication
- Installation
- Commissioning (Cold or Hot)

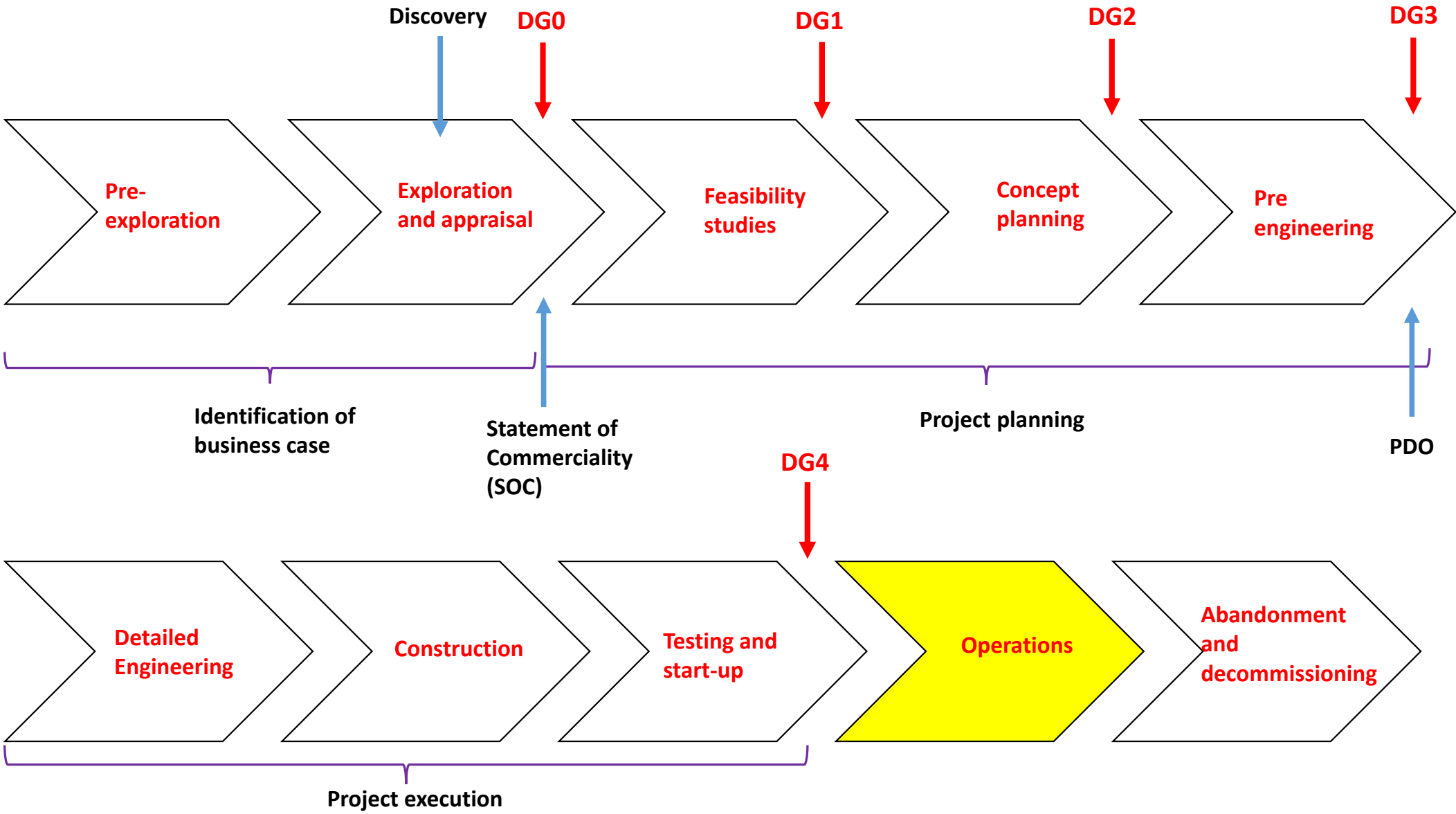
EPCM (Engineering, procurement, construction, and management contract) with one main contractor.

https://www.youtube.com/watch?v=TzLAfzhqVHc

https://www.youtube.com/watch?v=TiWOgTq0YD4

DETAILED ENGINEERING, CONSTRUCTION, TESTING AND STARTUP

- Constructing wells.
- Perform hand over to asset, operations
- Prepare for start-up, operation and maintenance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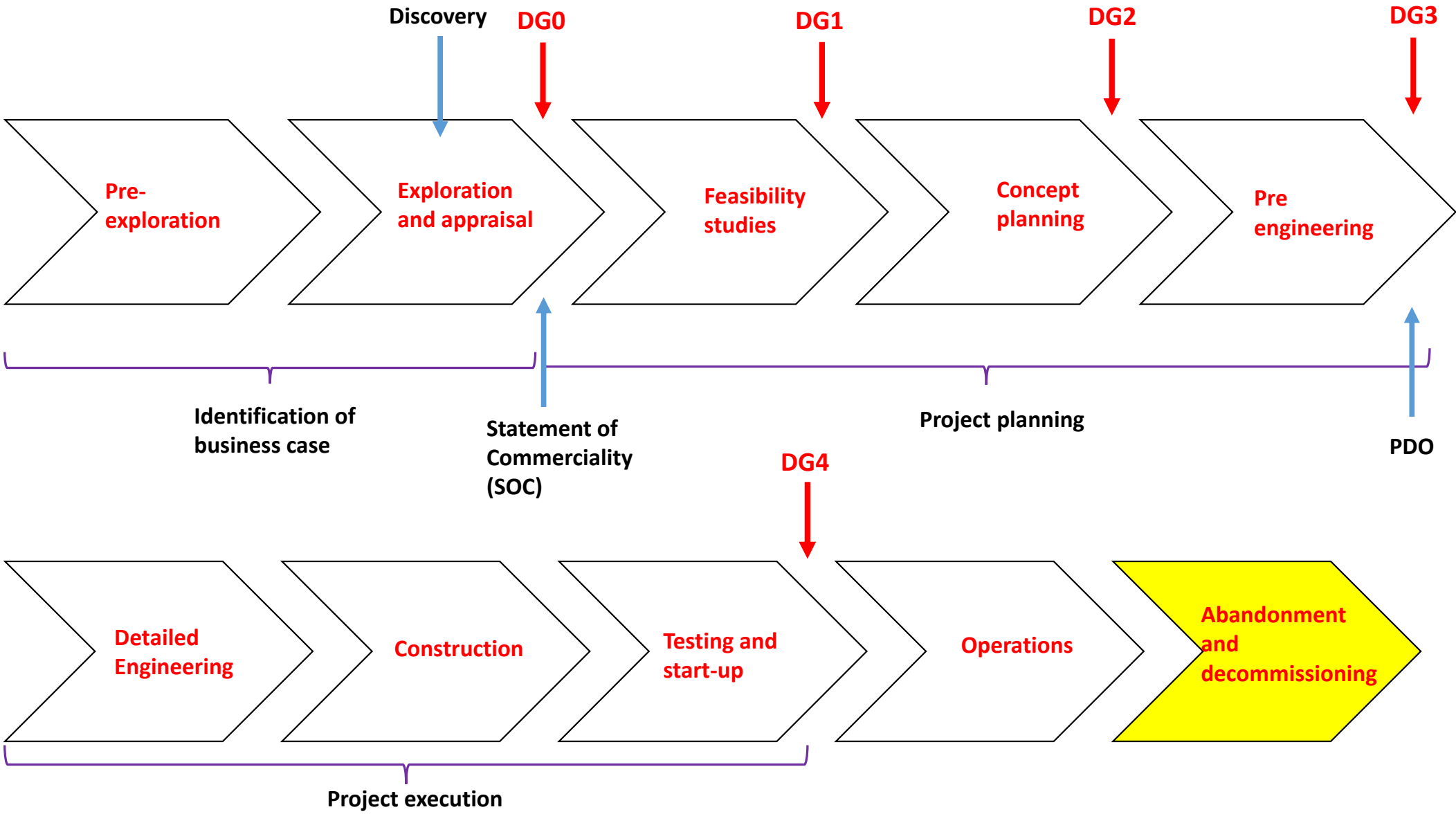
OPERATIONS

- Production startup, Build-up phase, Plateau phase, Decline phase, Tail production, Field shut-down.
- Maintenance.
- Planning Improved Oil recovery methods.
- Allocation and metering.
- De-bottlenecking.
- Troubleshooting.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DECOMISSIONING AND ABANDONMENT

- Engineering “down and clean”: flushing and cleaning tanks, processing equipment, piping.
- Coordinate with relevant environmental and governmental authorities.
- Well plugging and abandonment (P&A)
- Cut and remove well conductor and casing.
- Remove topside equipment.

DECOMISSIONING AND ABANDONMENT

- Removal of the offshore structure: Lifting operations and transport
- Remove or bury subsea pipelines
- Mark and register leftover installations on marine maps
- Monitoring
- Recovery of material: Scrap (steel) and recycling equipment (Gas turbines, separators, heat exchangers, pumps, processing equipment)
- Disposal of residues

DECOMISSIONING AND ABANDONMENT

https://www.youtube.com/watch?v=SLO9uD5Ub_Y

DECOMISSIONING AND ABANDONMENT

https://www.youtube.com/watch?v=1GA3EIu81rw