

↑ PG 4230 Field Development and operations

Prof: Milan Stanko → Production engineering

Tuesdays 8:15-11:00 Thursdays 14:15-1600

mixed theory and exercise sessions

→ made by me in class
→ done by students with my support

bring Laptop or
team-up with a
friend

60% written exam
40% exercises / project

5-6 sets

date 15.05.2017 KL.09:00

Consultation hours: after class

my office 230 2nd floor milan.stanko@ntnu.no

Main communication tool is Its learning. check it frequently
use the "discussion tools"

Student assistants:

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Vemund Flatebakken



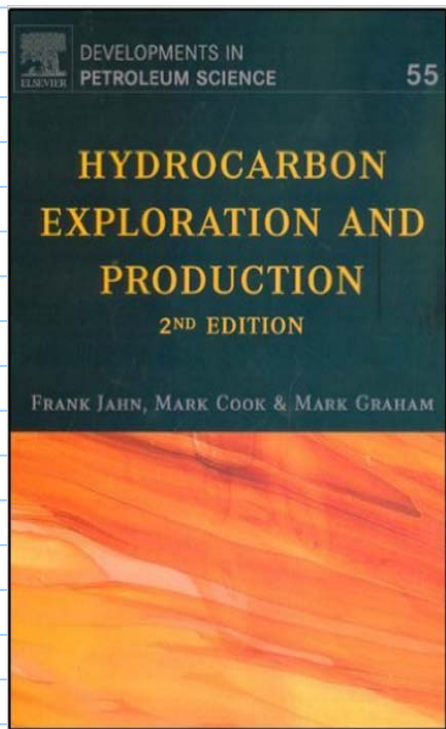
vemundf@stud.ntnu.no

- requirement for the exercises deliver all but 1
the compound exercise grade has to be 20/40
penalty for late delivery

Reference group:

<http://www.ipt.ntnu.no/~stanko/index.html>

Bibliography → support material



this course is focused on offshore Norway production

Field development and operations

flexibility
uncertainty
sensitivity analysis
scenarios
optimization

are tied to a physical system
to cope with its deficiencies

• exploit its advantages

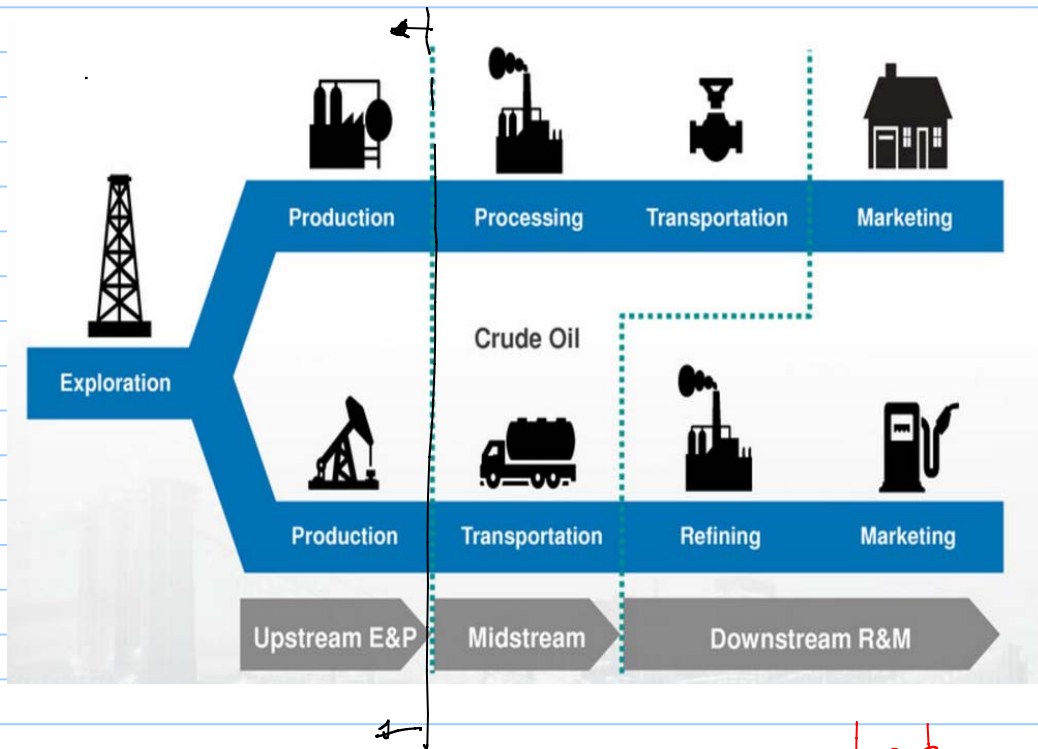
- {constrained}
- effectivization
- maintenance, troubleshooting

Topic	Level	Exercise	(Engineering skills)	Computational Tools
Life cycle of a hydrocarbon field	Appreciation	NO	-	-
Field development workflow - Probabilistic reserve estimation - Cost estimation and NPV calculations	Appreciation/ configuration/ (design)	YES	Gant chart, NPV calculations, Spider plot, decision trees, Monte Carlo simulation, basic probability	Excel VBA
Offshore (and some onshore) field architectures and layout of production systems - Production manifold - Pigging facilities	Configuration	YES	Engineering diagrams and drawings. Analysis	-
Dynamics of marine structures - Wave statistics	Configuration/ design	YES	Analysis. Modeling. Fast Fourier Transform for signal analysis.	Excel VBA
Reservoir depletion and field performance - Production potential - Production scheduling - Flow equilibrium in production systems, choking and boosting - Flow performance of surface and downhole production networks	Design	YES	Modeling. Programming. Problem solving	Excel VBA, Gap, Prosper (or Pipesim)
Flow assurance - Modeling of gas and condensate transport in pipeline and hydrate formation - Simplified modeling of oil and water emulsions	Appreciation, Design	YES	Modeling. Programming. Analysis. Problem solving.	Hysys, Excel VBA
ESP fundamentals, design and plan for the field life	Design	YES	Modeling. Problem solving.	Excel VBA
Early subsea boosting design	Design	YES	Modeling. Problem solving.	Excel VBA
Data management and (allocation)	Appreciation/ design	YES	Data analysis, filtering, QC, averaging, aggregating.	Excel VBA
Production optimization.	Design	YES	Analysis, modeling, critical thinking. Problem solving.	Excel VBA
Integrated asset modeling I Am	Appreciation	NO	-	-
Additional skills gained by home and class exercises			(Group work) Develop written and oral engineering communication skills.	

Material balance	TPG4145	Whitson
Reservoir simulation fundamentals, flow tables	TPG4160	Kleppe
Well inflow	TPG4245	Ashwin
Fluid phase behavior	TPG4145	.
Black oil model	TPG4145	.
Single and multi phase fluid flow in pipes (computation of pressure and temperature losses)	TPG4135 TPG4245	Larsen
Processing fundamentals, separation,	TPG4135	
Compression fundamentals	TPG4135	
Pumping fundamentals	TPG4135	

Introduction to subsea boosting	TPG4200	sangesland
Introduction to subsea systems	TPG4200	
Risk analysis, decision making, uncertainty	TPG4151	Bratbold
Life cycle of an oil and gas field. Fundamentals	TPG4105	Stork

where are we? P11



E and P

exploration and production

understanding
the subsurface

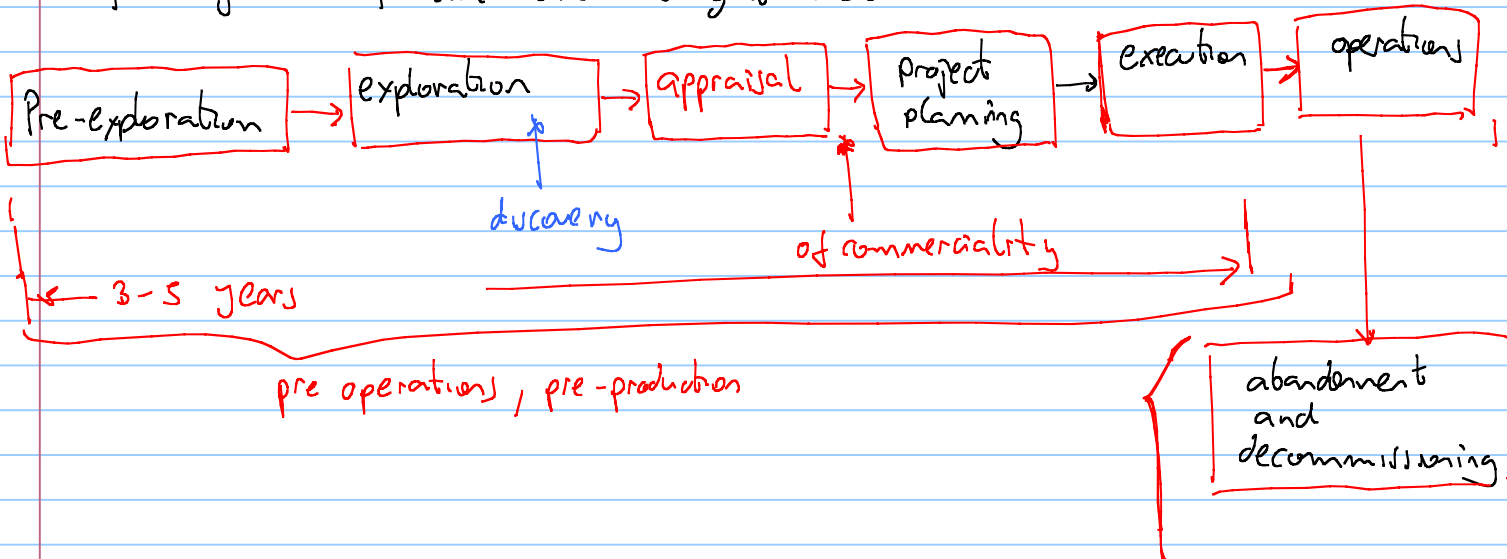
optimization of
the development
development phase
operation phase

commercialize the
resource

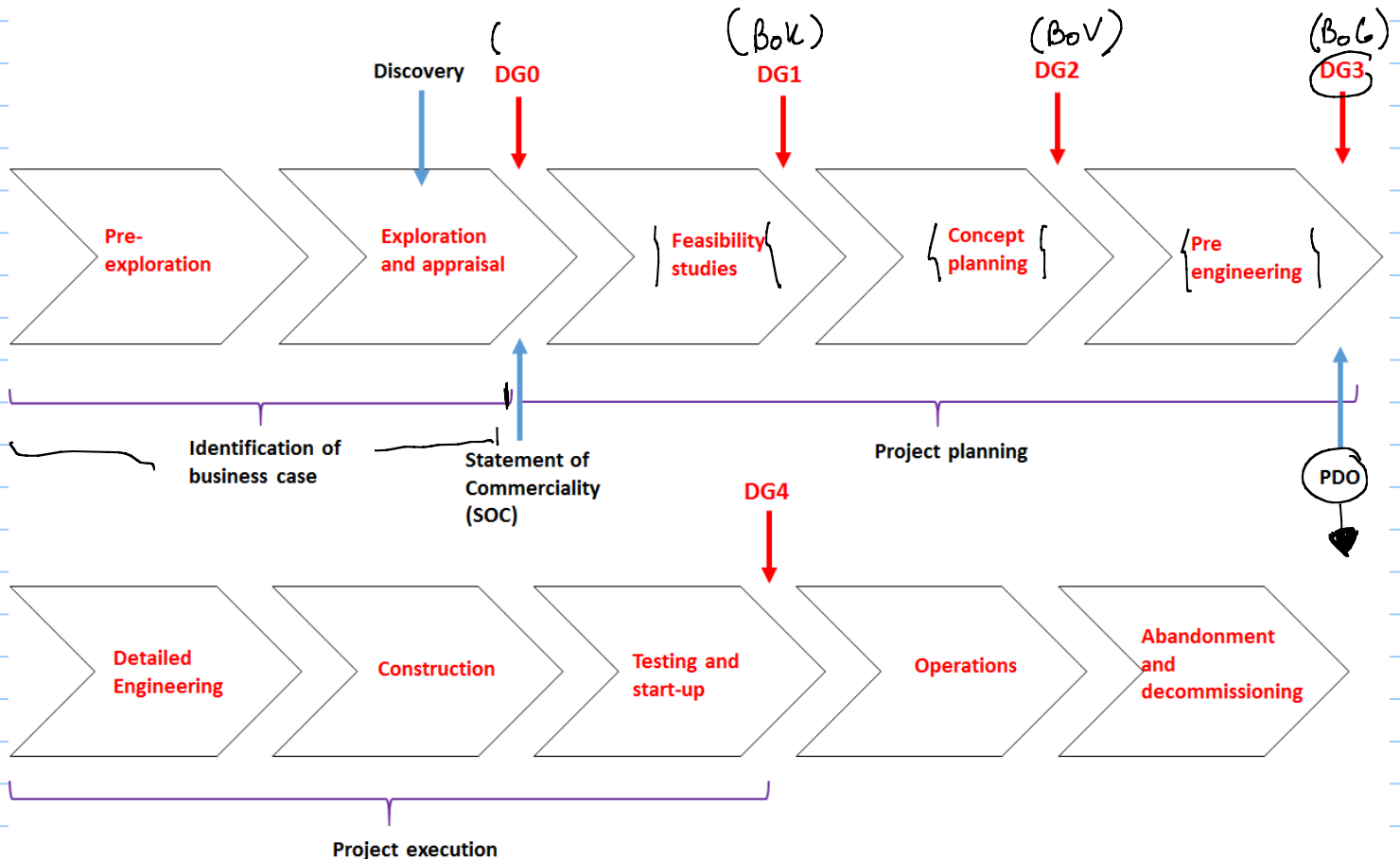
when?

30 years

life cycle of an oil and gas field



DG - decision gate



• Identification of business case:

Demonstrate economic potential of the discovery and quantify and reduce uncertainty about recoverable reserves.

Steps: 1st pre exploration activities and scouting

- ↳ collect information on areas of interest where there might be potential for hydrocarbon accumulation
 - technical, political aspect, geographical, social, geological, environmental

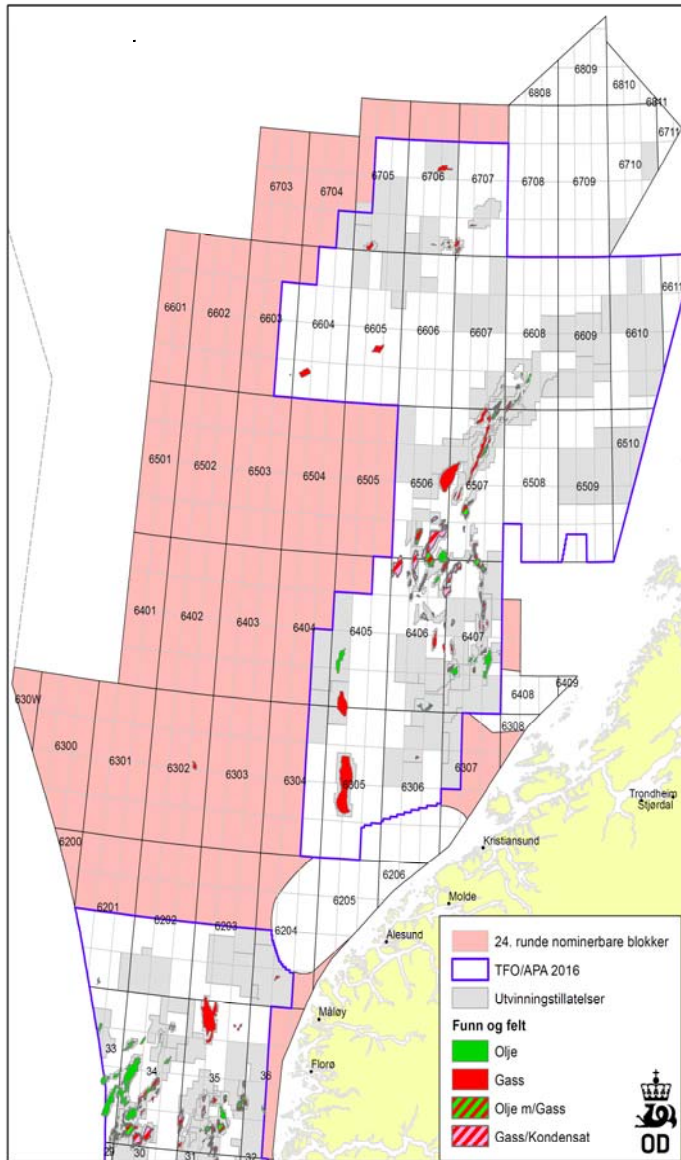
↳ chance of finding reserves and how big

2nd Getting pre-exploration access → the exploration license

non-exclusive right to an area { seismic } in MCS
 { shallow wells }
 ↳ Sometimes this is done by specialized companies.

3: Identity a prospect

4: Applying for a exclusive production license. In NCS
 is max 10 years * •licensing rounds (frontier areas)
 • APA (Awards in predefined areas)



1st year

34000 NOU/km²

2nd

68 000 NOU/km²

3rd

134 000 NOU/km²

• Exploration

perform geological studies, geophysical survey,
 seismic, exploration drilling.

well cores
 well cores
 cuttings
 fluid samples
 productivity test
 logging
 DST
 Drill stem
 test

• Discovery!

- Assess the discovery further. Uncertainty, manage risk.
 - • Probabilistic reserve estimation. Identify and assess additional prospects and segments
 - Perform simplified economical evaluation
 - • Field appraisal to reduce uncertainty: more exploration wells and seismic. fault communication
extent of reservoir
aquifer
woc water oil contact
goc gas oil contact
etc
- Reach D60
 - Issue a SOC (Statement of commerciality) and ROC
continue to next phase
 - Do more appraisal.
 - Sell the discovery
 - Do nothing wait
 - Relinquish to the government

Project planning phase:

- feasibility studies find one or concepts (general) that are technically, commercially and organizationally viable
- objectives of the developments
- establish feasible development scenarios
- demonstrate technical and economical feasibility

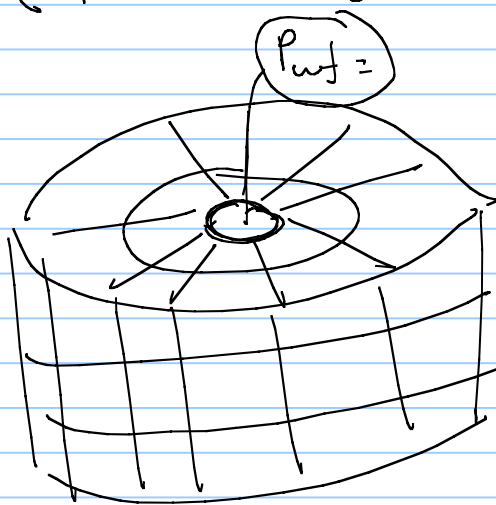
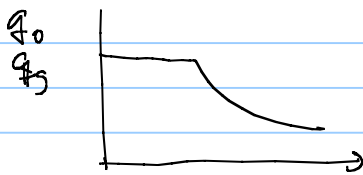
- identify potential stoppers
- Identify the need for new technology
- Cost estimation including system.

Concept planning

Identify alternative concepts, select a "viable" concept and document it preparing for OG2

- Define the commercial aspects: legislation, agreements, licensing, financing, marketing and supply, taxes

- Reservoir behavior (depletion strategy) → production profiles



reservoir model

- static modeling
- dynamic modeling

- Reservoir simulator
- material balances + IPR equation
- Decline curve analysis

- Flow assurance
 - hydrates
 - wax
 - scale
 - slugging

- Drilling and well planning
- facilities
- operation, start-up, operations, maintenance
- Concept selection

- Cost and manpower estimates

Pre engineering

mature, define document the selected concept -

- Selection of the final technical solution. Define all remaining technical alternatives
- execute FEED (front end engineering design)

technical requirements (arranged in packages) based on the final solution. After solution

- plan and prepare the execution phase.
- prepare submission of PDO plan for development and operations

Consequence and impact report.

PID. Plan for installation and operation of facilities for transport and utilization of petroleum

for next class read page 9-17.