TPG 4230 – Field development and operations

Prof. Milan Stanko — Associate professor Production engineering → well construction and production systems

Teaching hours: Mondays 14:15 – 17:00 } P11
Tuesday 10:15 – 12:00 }

2 student assistants: • exercise sessions held by student assistants every week

Martin Martinussen 1 pending

martinhm@stud.ntnu.no

Consultation → after class
↳ send me an email milan.stanko@ntnu.no

Evaluation: 40% home exercises → 5 sets with 3-4 problems each.
In groups of ~ 3
to get approval to take the exam
- deliver all but one
- compound grade at least 20/40
- penalty for late delivery

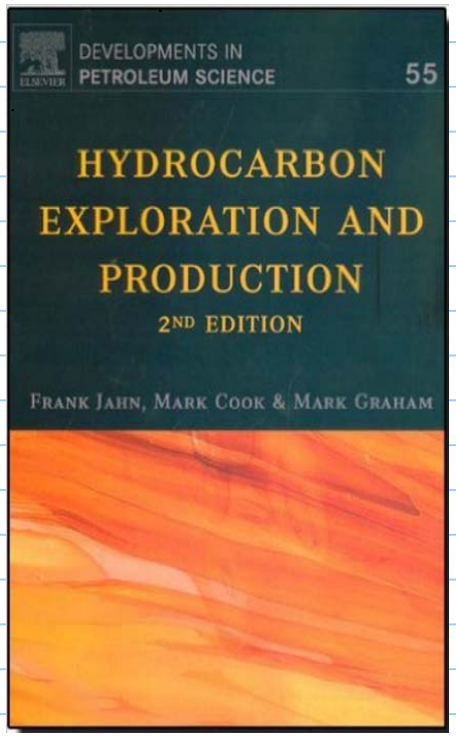
60% exam. Digital exam 24.05.2018 JC23 Realfag.

Main tools are:
- Excel → VBA Visual Basic for applications
  be careful mac users! → check your version
  ↳ has VBA functionality
  ↳ install a virtual machine with windows
  ↳ computers in the computer lab
- IPM → integrated petroleum management { Prosper, Gap
  make models of production system
  calculate rates, p, T,
- Hysys → process modeling → farm.ntnu.no

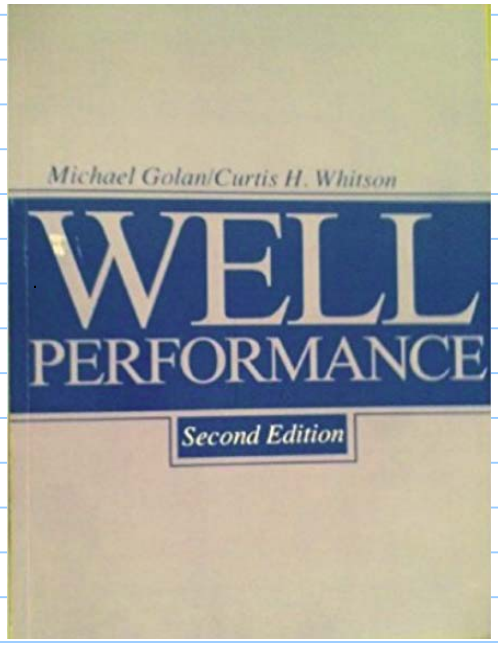
Reference group:
- Petra Bachhuber
- Fabian Barganski
- Abdul Saboor Khan

Some mondays we might get some guest lectures (14:15–15:00)
to assist at least to 50% of them to take the exam.

Reference material:



Well performance by Michael Golan



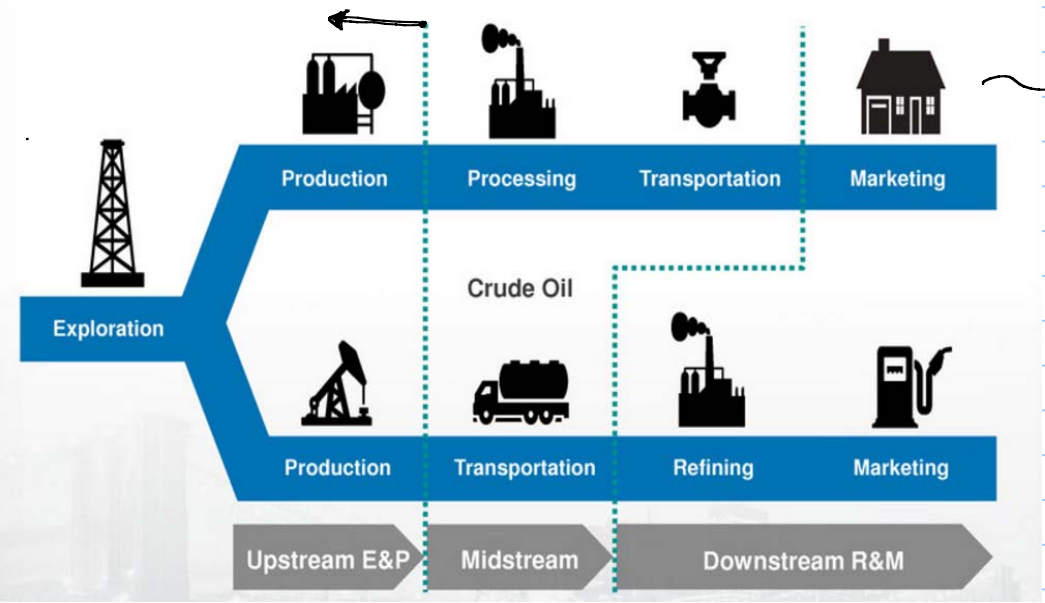
Compendium by Milan.

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	Appreciation	NO	-	-
Additional skills gained by home and class exercises			Group work. Develop written and oral engineering communication skills.	

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

Introduction to subsea boosting	TPG4200	~ Prof Sangesland / Gjersvik
Introduction to subsea systems	TPG4200	~ Prof Sangesland / Gjersvik
Risk analysis, decision making, uncertainty	TPG4151	~ Prof Bratvold
Life cycle of an oil and gas field. Fundamentals	TPG4105	~ Prof Stovas

where is TPG4230 located? ~ E and P ~ exploration and production
↳ upstream



Field development and operations

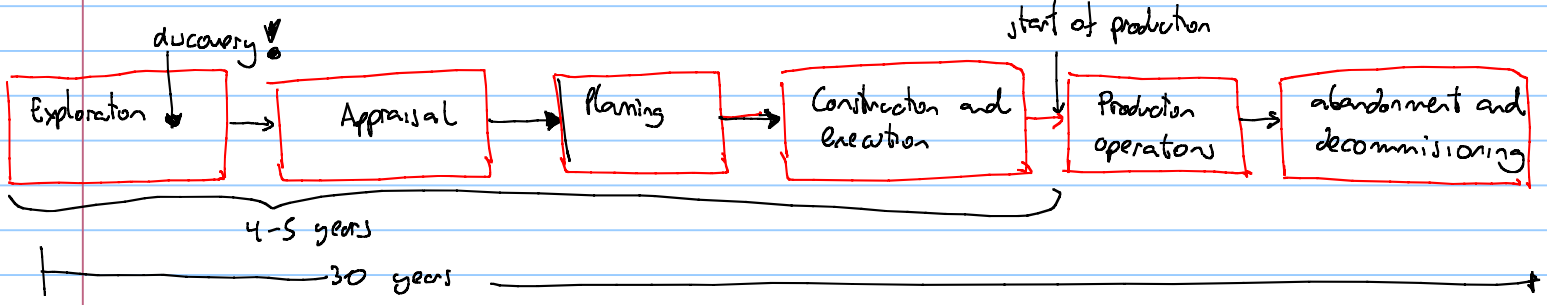
(1)

- high uncertainty
- empty start point { high flexibility, a lot of decisions to take.
- offshore production
- evaluation of several options
- find best suitable solution

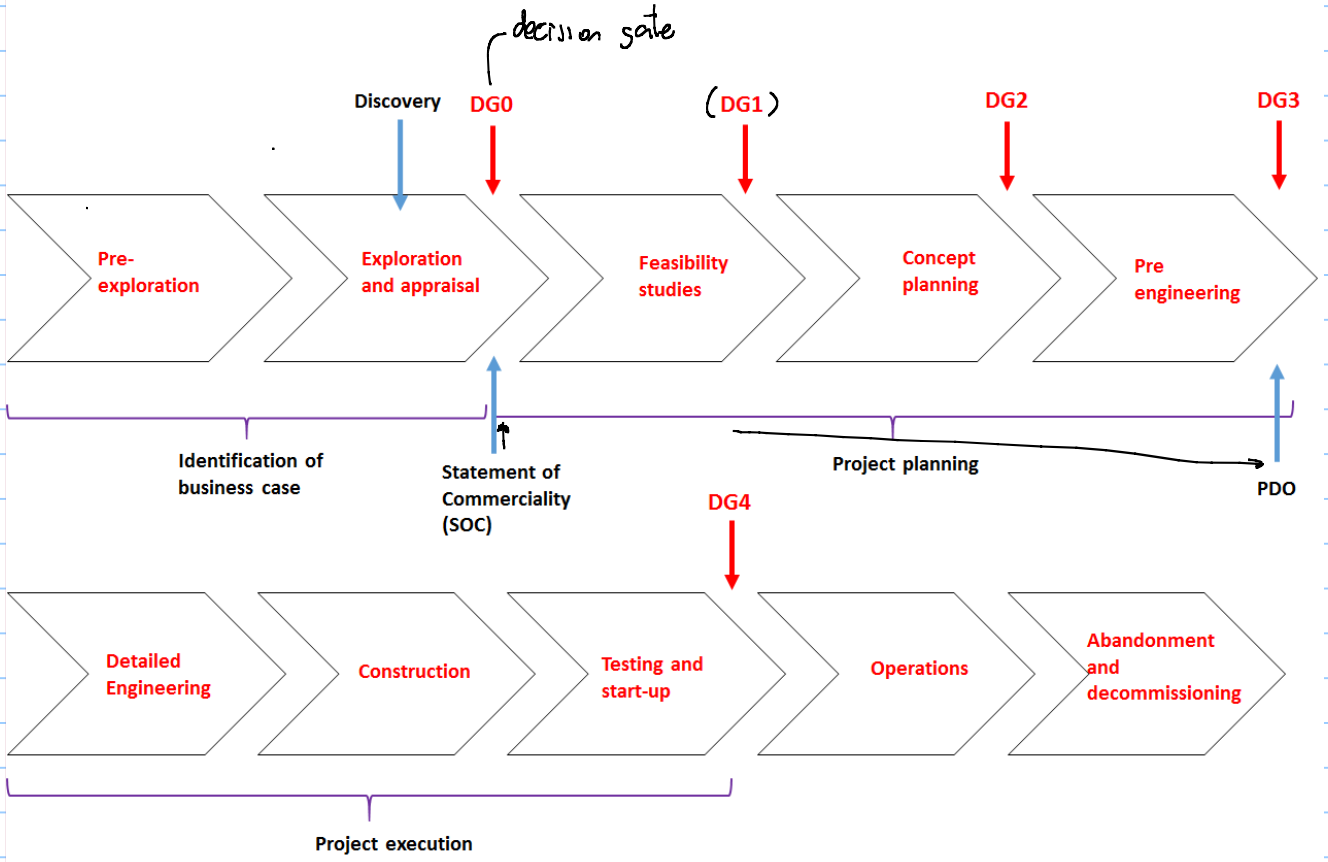
{ increase value to shareholders in a sustainable and environmentally friendly manner

- existing system
- cope with its deficiencies, take advantage of its characteristics
- optimize production { troubleshooting, maintenance, modifications.

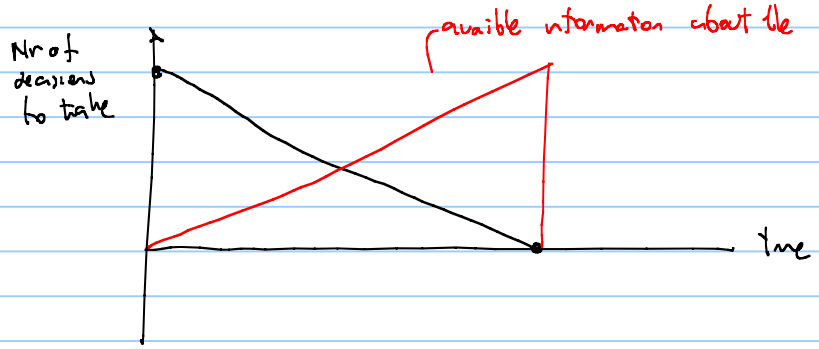
life cycle of a hydrocarbon field:



Field development process

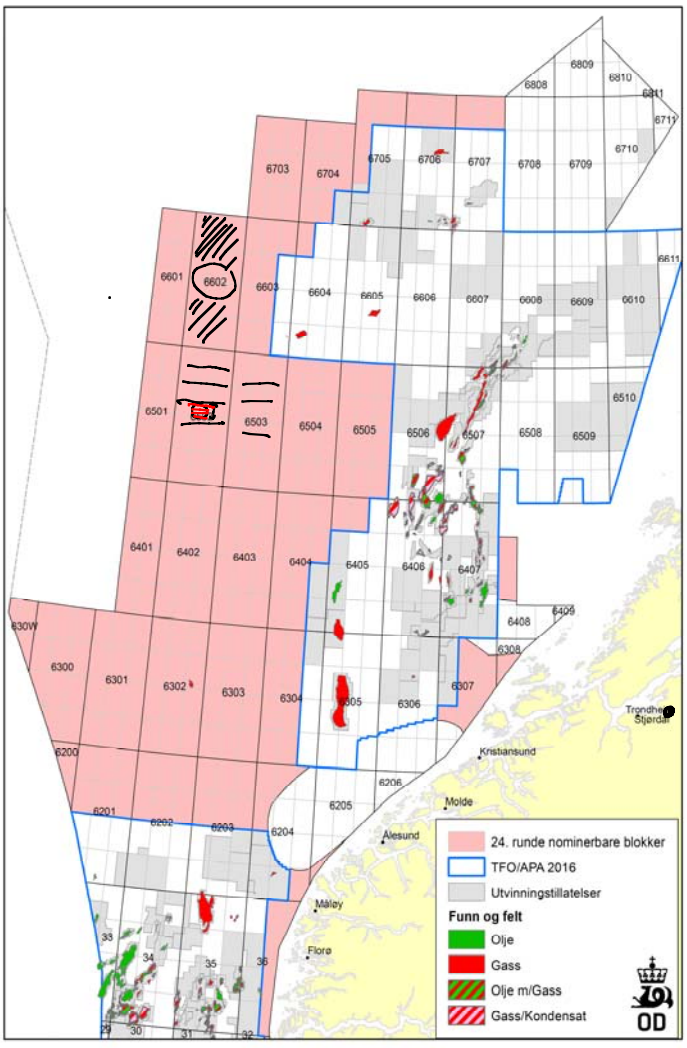


Project management process (strategy) (stage-gate process)



Business Case identification:

- pre exploration
  - scouting: collecting information about areas of interest.
    - politics
      - government
      - personnel security
    - technical
      - geology
      - geographical
      - social
      - environmental issues
      - taxation
      - previous experience
  - get pre-exploration access { seismic and drilling shallow wells
    - not done by oil company ~ scouting companies
  - identify prospects
  - get a production license → exclusive!
    - licensing rounds. APA { Awards in predefined areas

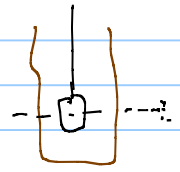


Year 1: 34000 NOK/Km²

Year 2: 68000 NOK/Km²

Year 3: 137 000 NOK/Km²

- exploration:
  - perform geological studies
  - geophysical surveys, seismic
  - exploration drilling
    - core sampling
    - wall sampling
    - cuttings
    - fluid samples
    - wireline logging
    - productivity test



- DISCOVERY!

- Assessment of the discovery
  - Probabilistic reserve estimation
  - Perform a simplified economic valuation of resources
  - Appraisal { drill more exploration wells { extent of reservoir, fault communication, aquifer type and behavior, WOC (water oil contact), GOC (gas oil contact)
    seismic }

DG0 { issue a SOC Statement of commerciality
- perform more appraisal.
- sit and wait
- sell the discovery
- Relinquish to government. }

if the field is declared SOC

- project planning phase main purpose: - is to identify and screen several options to develop the field
  - select an define a development concept { feasibility, economical evaluation }
  - document the final solution for delivery to the authorities.

- feasibility studies: - identify development options (top level)
  - objectives of the development in line with corporate strategy
  - project timeline
  - identify possible stoppers / show blockers
  - Rough cost valuation of field

Concept planning

- compare alternatives for development, screen out less attractive / non viable options
- PEP project for execution plan { describes project / management }
- defining the commercial aspects, legislation, taxation, agreements with partners / markets
- ! Create static and dynamic reservoir model → production scheduling, production strategy
- HSE
- flow assurance issues (management strategy) { wax, hydrates, emulsion, erosion, corrosion, scale, slugging }

- Planning drilling campaign (location completion)
- Pre-design of facilities

Pre-engineering

- mature and expand the final development option
  - Select the final technical solution
  - Define technical requirements for each package FEED Front end engineering design
  - establish the base for awarding contracts
  - plan ad prepare execution phase
  - perform an environmental assessment)
  - prepare POD plan for development and operations
    PUD
    DP