Net present value: KPI typically used to evaluate and decide on projects and to compare development alternatives

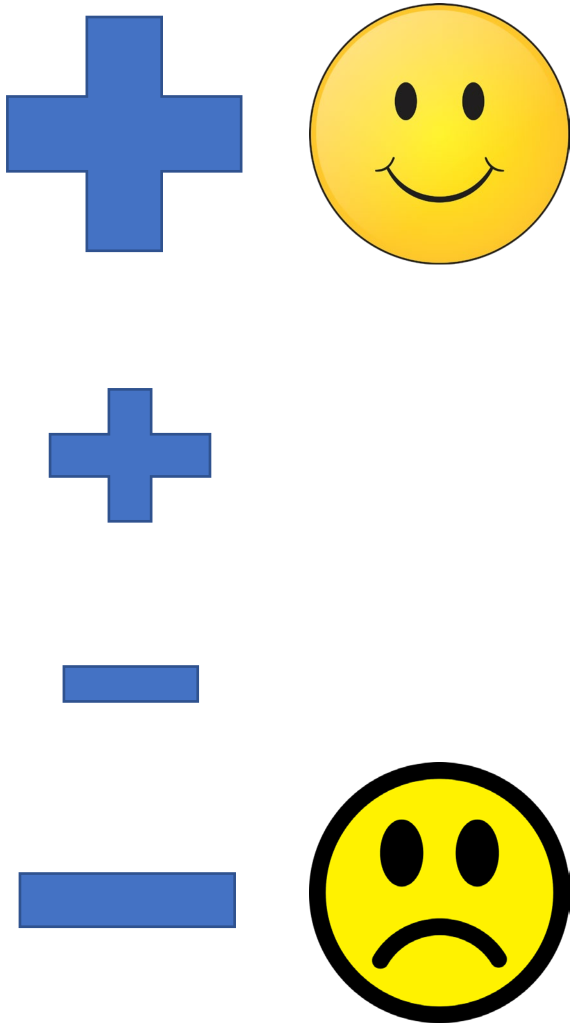
$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

Discounted cash flow (DCF) method

- Calculated on a yearly basis:
  - Typically end of year OR mid-year

Net present value: KPI typically used to evaluate and decide on projects and to compare development alternatives

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$



Discounted cash flow (DCF) method

- Calculated on a yearly basis:
  - Typically end of year OR mid-year

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

In currency of year «t»

Net present value

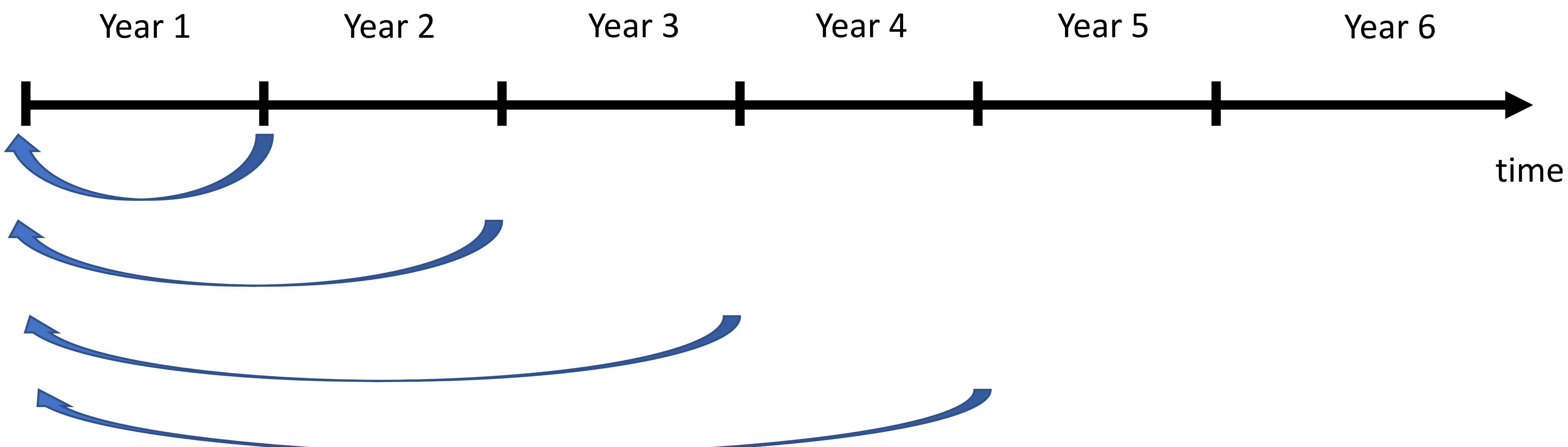
$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

To convert currency in year «t» to currency of year 0 (reference year)

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

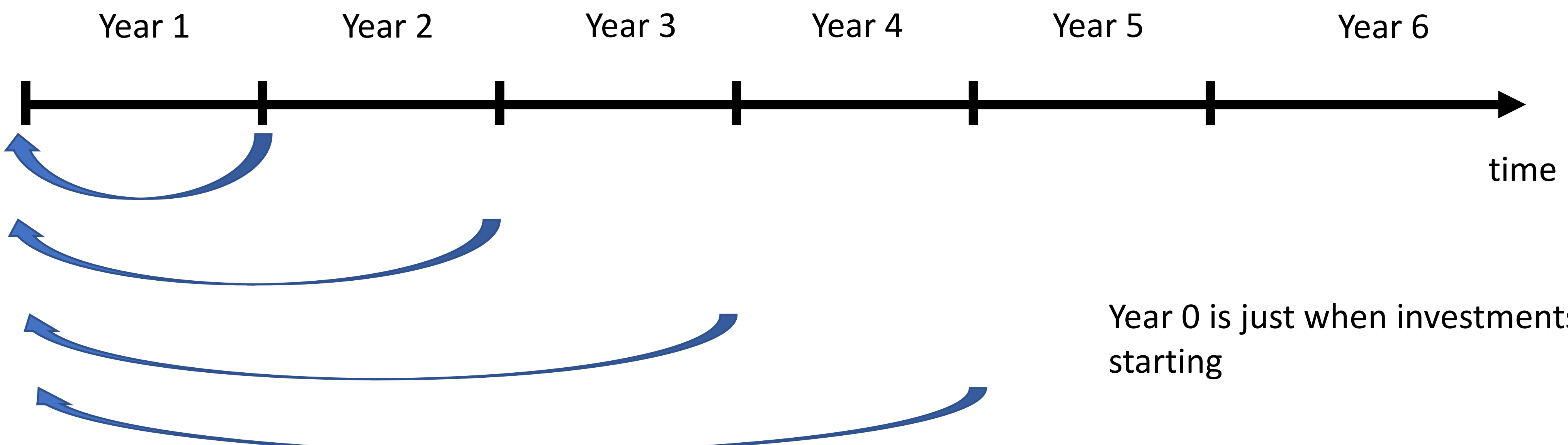
To convert currency in year «t» to year 0 (reference year)



Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

To convert currency in year «t» to year 0 (reference year)



Year 0 is just when investments are starting

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

- Typically: 7-12%, based on operator's past experience
- Should be better than investing the capital on other financial instruments

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$Revenue_t$:

- Sales of oil and gas (yearly production * price per volume)
- Tariffs to other companies for using your infrastructure (e.g. processing fluids for tie-backs)

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$Revenue_t$:

- Sales of oil and gas (yearly production * price per volume)
- Tariffs to other companies for using your infrastructure (e.g. processing fluids for tie-backs)

- Assuming 50 USD/bbl, a field with 150 kstbd, for a year this gives 7.5 E09 USD (20E06 USD per day)

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$Revenue_t$:

- Sales of oil and gas (yearly production * price per volume)
- Tariffs to other companies for using your infrastructure (e.g. processing fluids for tie-backs)

- Assuming 50 USD/bbl, a field with 150 kstbd, for a year this gives 7.5 E09 USD (20E06 USD per day)
- Assuming a gas price of 0.66 USD/m3 (Feb 2023), and a production of 20E06 Sm3/d, this gives for a year 4.8 E09 USD (13 E06 USD per day)

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$Revenue_t$:

- Sales of oil and gas (yearly production * price per volume)
- Tariffs to other companies for using your infrastructure (e.g. processing fluids for tie-backs)

→ (price per volume)

- Usually assumed constant
- If gas, it is usually negotiated as part of a delivery contract

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$Revenue_t$:

- Sales of oil and gas (yearly production * price per volume)
- Tariffs to other companies for using your infrastructure (e.g. processing fluids for tie-backs)

During early years (4-8) there is no revenue!! (field doesn’t exist)

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$$Expenses_t = DRILLEX_t + CAPEX_t + Depreciation_t + OPEX_t + TAX_t + ABEX_t$$

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$$Expenses_t = DRILLEX_t + CAPEX_t + Depreciation_t + OPEX_t + TAX_t + ABEX_t$$

The biggest expenses occur at the beginning, when there is a lot of construction and drilling

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$$Expenses_t = DRILLEX_t + CAPEX_t + Depreciation_t + OPEX_t + TAX_t + ABEX_t$$

Exploration costs

All exploration costs are, as a starting point, deductible and may be off-set against profits from production.

Moreover, companies may claim an annual cash refund of the tax value of direct and indirect exploration costs under ordinary petroleum tax and special tax (this amounts to 78% of such costs), with the exception of finance costs, with the amount of the refund limited to the tax value of the net tax losses. This is an alternative to carrying the losses forward.

Source: oil and gas taxation in Norway. Deloitte

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$$Expenses_t = DRILLEX_t + CAPEX_t + Depreciation_t + OPEX_t + TAX_t + ABEX_t$$

A deductible for taxes is **an expense that a taxpayer or business can subtract from adjusted gross income**, which reduces their income, thereby reducing the overall tax they need to pay.

https://www.investopedia.com › ... › Tax Deductions

Deductible Definition, Common Tax and Business Deductibles

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$$Expenses_t = DRILLEX_t + CAPEX_t + Depreciation_t + OPEX_t + TAX_t + ABEX_t$$

Examples:

- Well plugging
- Removal of flowlines, pipelines offshore structure
- Cleaning
- monitoring

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$$Expenses_t = DRILLEX_t + CAPEX_t + Depreciation_t + OPEX_t + TAX_t + ABEX_t$$

Are often neglected as they are deductible and they occur late in the life of the field (heavily discounted)

Abandonment costs

Abandonment costs are deductible when the costs are actually incurred. Accounting provisions made in order to meet future abandonment costs are not deductible.

Source: oil and gas taxation in Norway. Deloitte

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$$Expenses_t = DRILLEX_t + CAPEX_t + Depreciation_t + OPEX_t + TAX_t + ABEX_t$$

Capital allowances for investments made in productions facilities and pipelines and installations which are part of such production facilities and pipelines are calculated on a straight line basis over six years at a rate of 16.66% per year from the date the capital expenditure was incurred. The capital allowances are granted both when calculating the basis for ordinary petroleum tax and special tax.

Source: oil and gas taxation in Norway. Deloitte

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$$Expenses_t = DRILLEX_t + CAPEX_t + Depreciation_t + OPEX_t + TAX_t + ABEX_t$$

Examples:

- Drilling vessel renting (daily rate)
- Drilling materials (tubulars, cement, mud, completion, wellhead)
- Test during drilling (DST, logging, pressure tests, sampling)
- X-mas tree
- Drilling tools
- Salaries, insurance

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$$Expenses_t = DRILLEX_t + CAPEX_t + Depreciation_t + OPEX_t + TAX_t + ABEX_t$$

Examples:

- Drilling vessel renting (daily rate)
- Drilling materials (tubulars, cement, mud, completion, wellhead)
- Test during drilling (DST, logging, pressure tests, sampling)
- X-mas tree
- Drilling tools
- Salaries, insurance

- Cost per well:

30-180 E06 USD (offshore)
10-15 E06 (onshore)

Example

Source: Karish-Tanin PDO

Table 8-4: Drilling tangibles cost estimate

Item	Source	Cost (US$)
Wellhead	TechnipFMC quotation 7/4/17	362,500
Conductor	LR data based on planned 2017 well	320,000
20" Casing	Tenaris quotation 31/3/17	722.56/m
13-5/8" Casing	Tenaris quotation 31/3/17	342.76/m
9-5/8" Casing	Tenaris quotation 31/3/17	204.80/m
9-5/8" 13 Cr Casing	Tenaris quotation 31/3/17	956.00/m
Float equipment, etc. (full set)	LR data based on planned 2017 well	366,000
Total		**6,617,464.00**

Table 8-5: Completion tangibles cost estimate

Item	Source	Cost (US$)
Well test equipment	LR data based on planned 2017 well	1,015,000
SSTT	Expro quotation 10/4/17	750,000
OHGP	LR data based on planned 2017 well	925,000
Upper completion	LR data based on planned 2017 well	625,000
Xmas Tree	TechnipFMC quotation 7/4/17	4,738,682
FMC Installation costs	TechnipFMC quotation 7/4/17	1,300,000

Example

Source: Karish-Tanin PDO

Table 8-6: Total calculated drilling costs – 3 Karish Main development wells

Certainty level	Total days	Total Services Spread rate (US$ mln)	Total Rig rate (US$ mln)	Drilling tangibles (US$ mln)	Completion tangibles (US$ mln)	Total Drillex (US$ mln)
P90	379	95.22	94.75	24.82	35.07	248.86
P50	277	55.68	55.40	19.86	28.06	159.00
P10	241	36.33	36.15	14.89	21.04	108.41

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$$Expenses_t = DRILLEX_t + CAPEX_t + Depreciation_t + OPEX_t + TAX_t + ABEX_t$$

Examples:

- Engineering studies
- Processing facilities (separators, pumps, compressors, heat exchangers, control system, injection, oil, water and gas treatment
- Offshore structure (cost of platform or vessel, living quarters, power source, helideck)
- Subsea system (template, flowlines, pipelines, risers, umbilicals, metering)
- Export system
- Salaries, insurance

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$$Expenses_t = DRILLEX_t + CAPEX_t + Depreciation_t + OPEX_t + TAX_t + ABEX_t$$

Examples:

- Engineering studies
- Processing facilities (separators, pumps, compressors, heat exchangers, control system, injection, oil, water and gas treatment
- Offshore structure (cost of platform or vessel, living quarters, power source, helideck)
- Subsea system (template, flowlines, pipelines, risers, umbilicals, metering)
- Export system
- Salaries, insurance

There is usually a payment schedule for CAPEX over a few years for big items (FPSO, subsea equipment etc)

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$$Expenses_t = DRILLEX_t + CAPEX_t + Depreciation_t + OPEX_t + TAX_t + ABEX_t$$

Examples:

- Engineering studies
- Processing facilities (separators, pumps, compressors, heat exchangers, control system, injection, oil, water and gas treatment
- Offshore structure (cost of platform or vessel, living quarters, power source, helideck)
- Subsea system (template, flowlines, pipelines, risers, umbilicals, metering)
- Export system
- Salaries, insurance

- Total cost:

-O (1E09) USD

Examples:

-O(1E06) USD per km of subsea pipeline

-FPSO 200 – 3000 1E06 USD

Examples

Table 6-6 CAPEX Estimation Example (2007 Data)

1. Subsea Equipment Cost

Subsea Trees		Unit	Cost
Subsea Tree Assembly		**3**	**$4,518,302**
(each)	5-inch × 2-inch 10-ksi vertical tree assembly	1	included
	Retrievable choke assembly	1	included
	Tubing hanger 5-in. 10 ksi	1	included
	High-pressure tree cap	1	included
	5-in. tubing head spool assembly	1	included
	Insulation	1	included
Subsea Hardware			
Subsea Manifold			
	(EE trim)	1	$5,760,826
Suction Pile			
	Suction pile for manifold	1	$1,000,000
Production PLET		2	$3,468,368
Production Tree Jumpers		3	$975,174
Pigging Loop		1	$431,555
Production PLET Jumpers		2	$1,796,872
Flying Leads			$1,247,031
	Hydraulic flying lead SUTA to tree		
	Electrical flying lead SUTA to tree		
	Hydraulic flying lead SCM to manifold		
	Electrical flying lead SUTA to manifold		
Other Subsea Hardware			
Multiphase Flow Meter		1	$924,250

Source: Yong Bai, Qiang Bai, Subsea engineering Handbook.

Examples

Table 6-6 CAPEX Estimation Example (2007 Data)—cont'd

1. Subsea Equipment Cost

Subsea Trees		Unit	Cost
Umbilicals			
Umbilical			$11,606,659
	25,000ft Length		
Risers			
Riser			$6,987,752
	Prod. 8.625-in. × 0.906-in. × 65 SCR, 2 × 7500 ft		
Flowlines			
Flowline			$4,743,849
	Dual 10-in. SMLS API 5L X-65, flowline, 52,026 ft		
	Total Procurement Cost		**$54,264,324**
2. Testing Cost			
Subsea Hardware FAT,EFAT			$27,132,162
Tree SIT & Commissioning			$875,000
Manifold & PLET SIT			$565,499
Control System SIT			$237,786
	Total Testing Cost		**$28,810,447**
3. Installation Cost			
Tree	3 days × $1000k per day		$3,000,000
Manifold & Other hardware			$48,153
Jumpers	(1 day per jumper + downtime)		$32,102
ROV Vessel Support			$1,518,000
Other Installation Cost			$862,000
Pipe-lay	52,0260ft		$43,139,000

Source: Yong Bai, Qiang Bai, Subsea engineering Handbook.

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$$Expenses_t = DRILLEX_t + CAPEX_t + Depreciation_t + OPEX_t + TAX_t + ABEX_t$$

Examples:

- Salaries
- Insurance
- Maintenance
- Equipment
- Well intervention
- Power consumption
- Production chemicals (MEG, inhibitors)
- Pigging
- Transportation and export

- Heavily depends on the size and type of facility
- It often dictates when to abandon (CF becomes negative)

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$$Expenses_t = DRILLEX_t + CAPEX_t + Depreciation_t + OPEX_t + TAX_t + ABEX_t$$

Examples:

- Salaries
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- Equipment
- Well intervention
- Power consumption
- Production chemicals (MEG, inhibitors)
- Pigging
- Transportation and export

- Heavily depends on the size and type of facility
- It often dictates when to abandon (CF becomes negative)

$$\text{Annual OPEX} = [A(\%) \times \text{cumulative CAPEX}(\$)] + \left[B\left(\frac{\$}{\text{bbl}}\right) \times \text{production}\left(\frac{\text{bbl}}{\text{year}}\right)\right]$$

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$$Expenses_t = DRILLEX_t + CAPEX_t + Depreciation_t + OPEX_t + TAX_t + ABEX_t$$

Should be adjusted by inflation

$DRILLEX_t$

$CAPEX_t$

$OPEX_t$

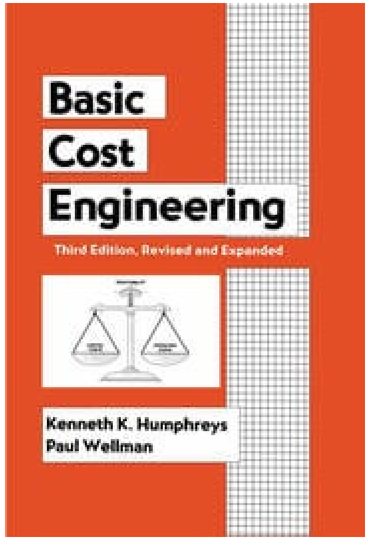
Function of number of wells, maximum production rates of oil, gas and water, development concept, type of fluids etc.

Cost estimation – expected accuracy

- For DG1, +-40%
- For DG2, +-30%
- For DG3, +-20%

Costing

- It is a profession and a discipline
- Internal company databases (based on previous projects)
- Provided by contractors and suppliers
- Commercial software
- Depending on the desired accuracy, can take significant time



$$C_2 = C_1 \left(\frac{S_2}{S_1} \right)^n$$

C_1 = cost of equipment of capacity S_1
C_2 = cost of equipment of capacity S_2

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$$Expenses_t = DRILLEX_t + CAPEX_t + Depreciation_t + OPEX_t + TAX_t + ABEX_t$$

- Petroleum tax
- CO_2 tax (in 2022 NOK 1.65 NOK/Sm3 gas)

The Norwegian petroleum tax system is based on the taxation of the entity rather than taxation of specific petroleum assets.

Neutral tax system

The petroleum taxation system is intended to be neutral, so that an investment project that is profitable for an investor before tax is also profitable after tax. This ensures substantial revenues for the Norwegian society and at the same time encourages companies to carry out all profitable projects.

To ensure a neutral tax system, only the company's net profit is taxable, and losses may be carried forward in the company tax. Special tax value of losses is reimbursed at the tax settlement, the year after it accrued. Neutral properties in the tax system are also important when defining investment based tax deductions.

Sources:
oil and gas taxation in Norway. Deloitte
https://www.norskpetroleum.no/en/economy/petroleum-tax

Ordinary corporate tax	Special tax
Operating income (norm prices for oil)	Operating income (norm prices for oil)
- Operating expenses	- Operating expenses
- Linear depreciation for investments (6 years)	- Depreciation for investments (100 %)
- Exploration expenses, R&D and decom.	- Exploration expenses, R&D and decom.
- Environmental taxes and area fees	- Environmental taxes and area fees
- Net financial costs	- Calculated ordinary tax
- (Loss carry forward)	
= Corporation tax base (22 %)	**= Special tax base (71,8 %)**

The Petroleum Price Council is responsible for setting norm prices, which it does after collecting information from the companies and holding meetings with them. The norm price system applies to various types and qualities of petroleum. For gas, the actual sales prices are used.

Source: https://www.norskpetroleum.no/en/economy/petroleum-tax

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$$Expenses_t = DRILLEX_t + CAPEX_t + Depreciation_t + OPEX_t + TAX_t + ABEX_t$$

- CO2 tax (in 2022 NOK 1.65 NOK/Sm3 gas)

Net present value

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$$Expenses_t = DRILLEX_t + CAPEX_t + Depreciation_t + OPEX_t + TAX_t + ABEX_t$$

- CO_2 tax (in 2022 NOK 1.65 NOK/Sm3 gas)

Example:

- Considering gas turbine efficiency 1 MWh/257 Sm3 gas (TPG4245 – 2022).
- For a field with 30 MW, in a year this represents 262 800 MWh, which represents 67 E06 Sm3 of gas.
- This will be taxed with ca 111 E06 USD.

Net present value - Royalties

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+i)^t} = \sum_{t=1}^{n} \frac{Revenue_t - Expenses_t}{(1+i)^t}$$

$$Expenses_t = DRILLEX_t + CAPEX_t + Depreciation_t + OPEX_t + TAX_t + ABEX_t$$

- Used in some countries
- % from the production, not the profit!!

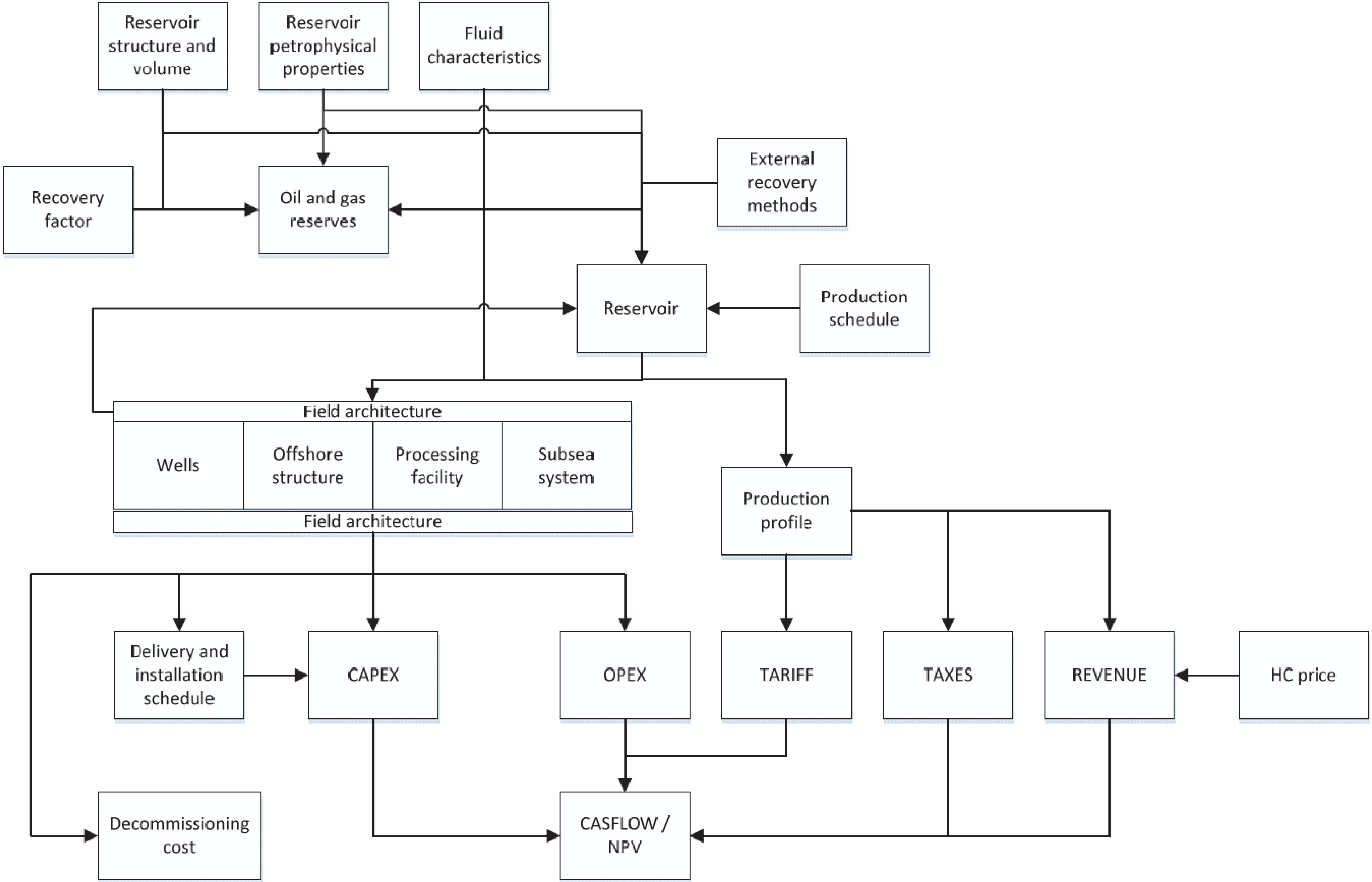
Net present value calculation- Who does what:

- Production profiles of oil, gas and condensate: petroleum engineers
- CAPEX: cost engineers (or suppliers) with input from facilities engineers, marine engineers
- DRILLEX: cost engineers (or suppliers) with input from drilling engineers
- Gas and oil prices: Market analyst
- Tax, Inflation, Exchange rate, discount rate: Finance department

Net present value calculation- Who does what:

- Production profiles of oil, gas and condensate: petroleum engineers
- CAPEX: cost engineers (or suppliers) with input from facilities engineers, marine engineers
- DRILLEX: cost engineers (or suppliers) with input from drilling engineers
- Gas and oil prices: Market analyst
- Tax, Inflation, Exchange rate, discount rate: Finance department

- Highly affected by the development strategy
- All are interconnected!!
- Take time to generate. If there are changes, it takes time to get new values


Reservoir structure and volume
Reservoir petrophysical properties
Fluid characteristics
Recovery factor
Oil and gas reserves
External recovery methods
Reservoir
Production schedule
Field architecture
Wells
Offshore structure
Processing facility
Subsea system
Field architecture
Production profile
Delivery and installation schedule
CAPEX
OPEX
TARIFF
TAXES
REVENUE
HC price
Decommissioning cost
CASFLOW / NPV

Example:

Higher production rates→

bigger separators and compressors→

more weight→

bigger offshore structure

NPV estimation

Source: Hebron field PDO

Table 13.4-1: Hebron Platform Development Capital and Operating Estimates

Year	Capital Costs ($M CAD))						Operating Costs ($MCAD)
	Pre-Production				Drilling	Total	
	Proj. Admin.	Topsides	GBS	OLS			
2010	68	12	13	0		93	1
2011	174	394	240	0		807	9
2012	244	704	291	12		1252	11
2013	216	698	391	36		1340	14
2014	290	643	444	107		1484	20
2015	327	409	234	69		1039	36
2016	256		175	0	82	513	65
2017					222	222	157
2018					236	236	147
2019					242	242	148
2020					242	242	174
2021					242	242	159
2022					218	218	159
2023					189	189	159
2024					215	215	179
2025							159
2026							161
2027							164
2028							187
2029							176
2030							196
2031							194
2032							210
2033							190
2034							188
2035							186
2036							202
2037							182
2038							181
2039							179
2040							197
2041							180
2042							180
2043							180
2044							187
2045							176
2046							592
TOTAL	$ 1,575	$ 2,861	$ 1,788	$ 224	$ 1,887	$ 8,334	$ 5,883

CF versus time

Source: Frank Jahn, Mark Cook, Mark Graham. Hydrocarbon Exploration and Production

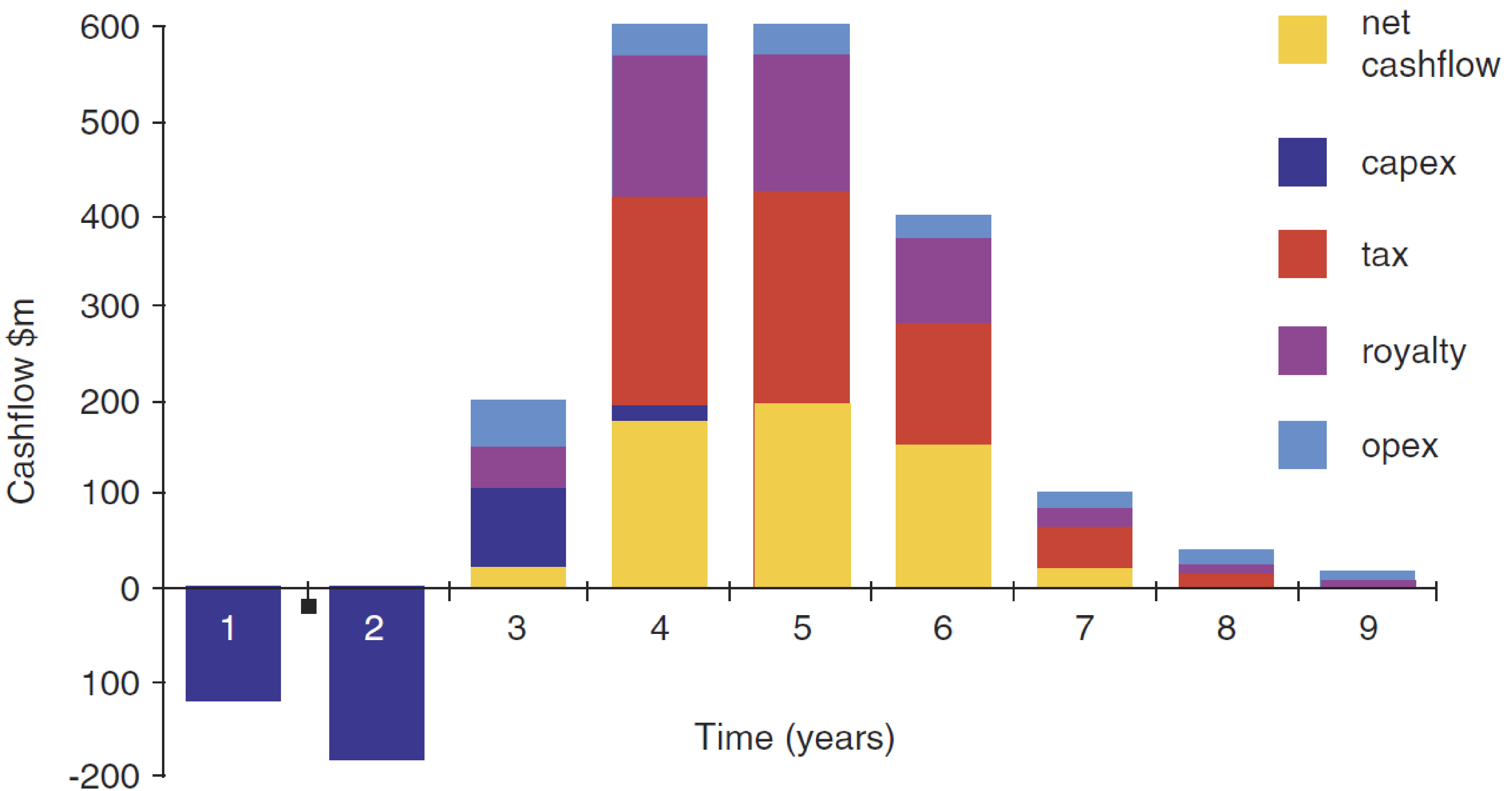
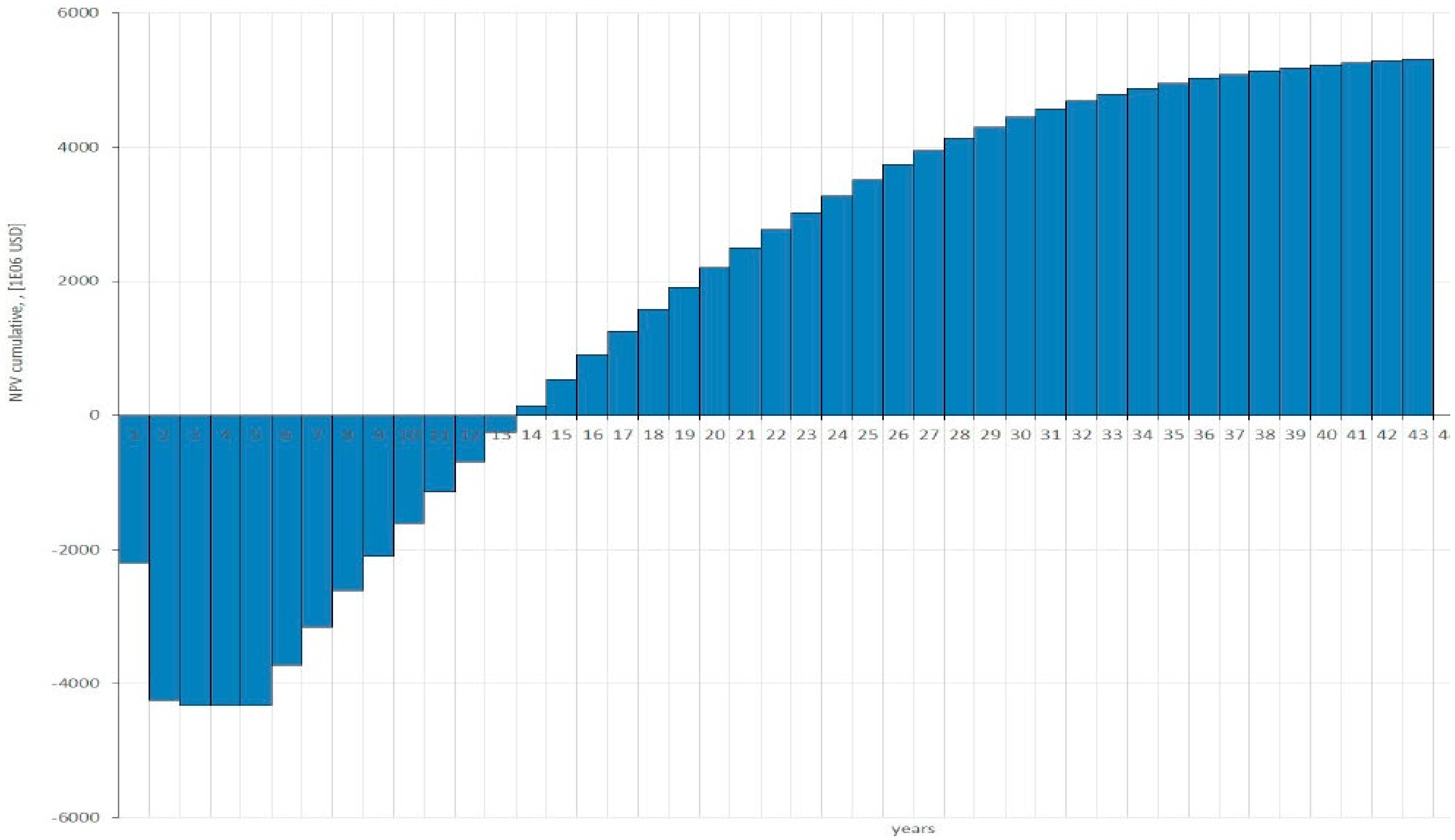


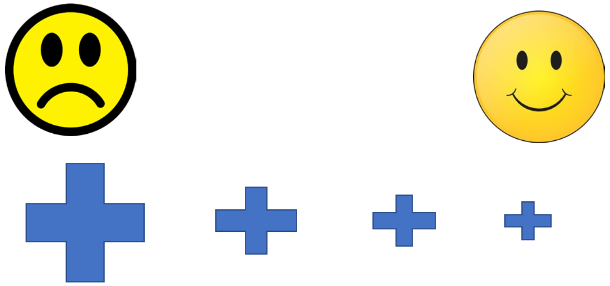
Figure 14.5 Components of a project cashflow.

NPV versus time



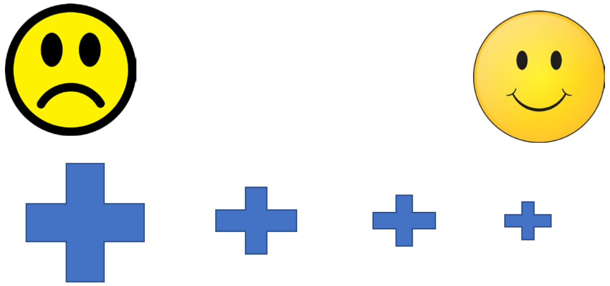
Other KPIs used

- Break-even price → oil price that give NPV = 0

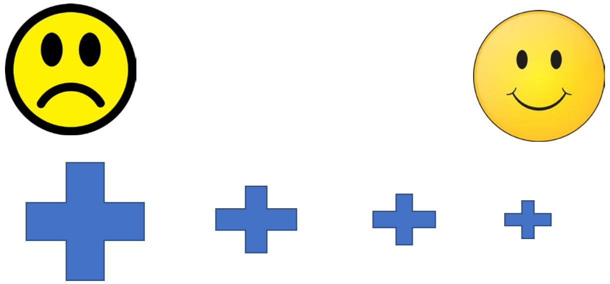


Other KPIs used

- Break-even price → oil price that give NPV = 0

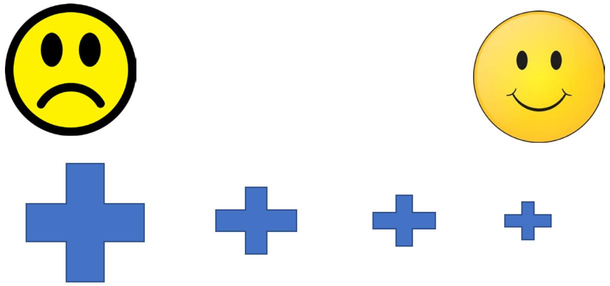


- NPV break-even→ time when NPV = 0

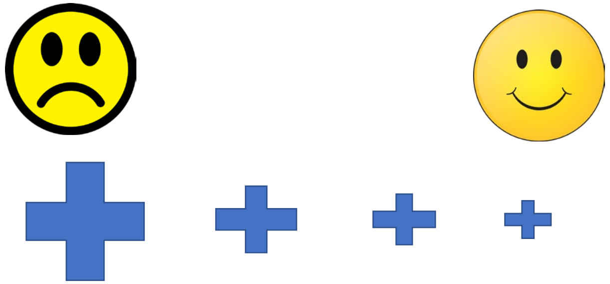


Other KPIs used

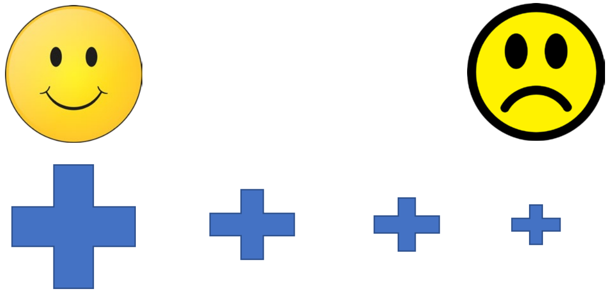
- Break-even price → oil price that give NPV = 0



- NPV break-even→ time when NPV = 0

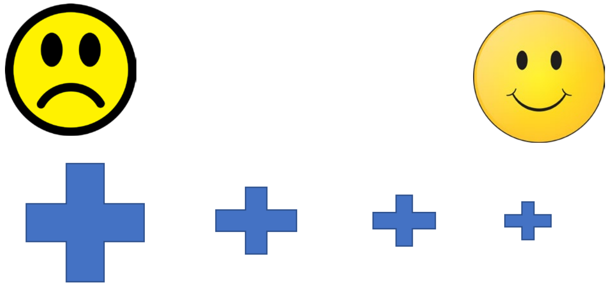


- Internal rate of return (IRR) → discount rate for which NPV = 0

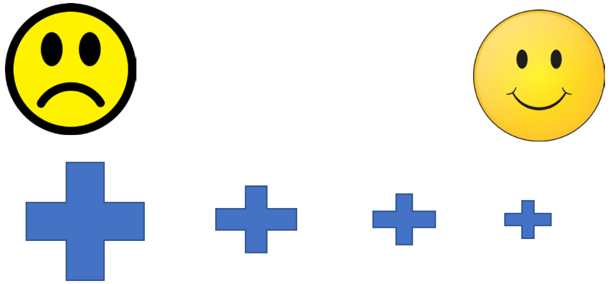


Other KPIs used

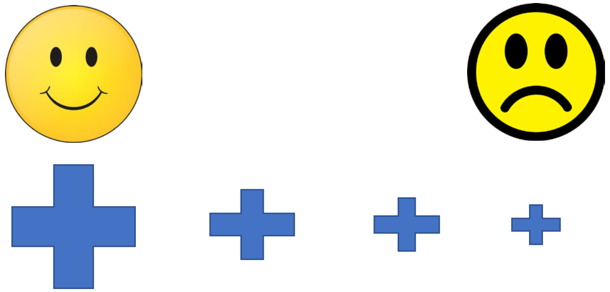
- Break-even price → oil price that give NPV = 0



- NPV break-even→ time when NPV = 0

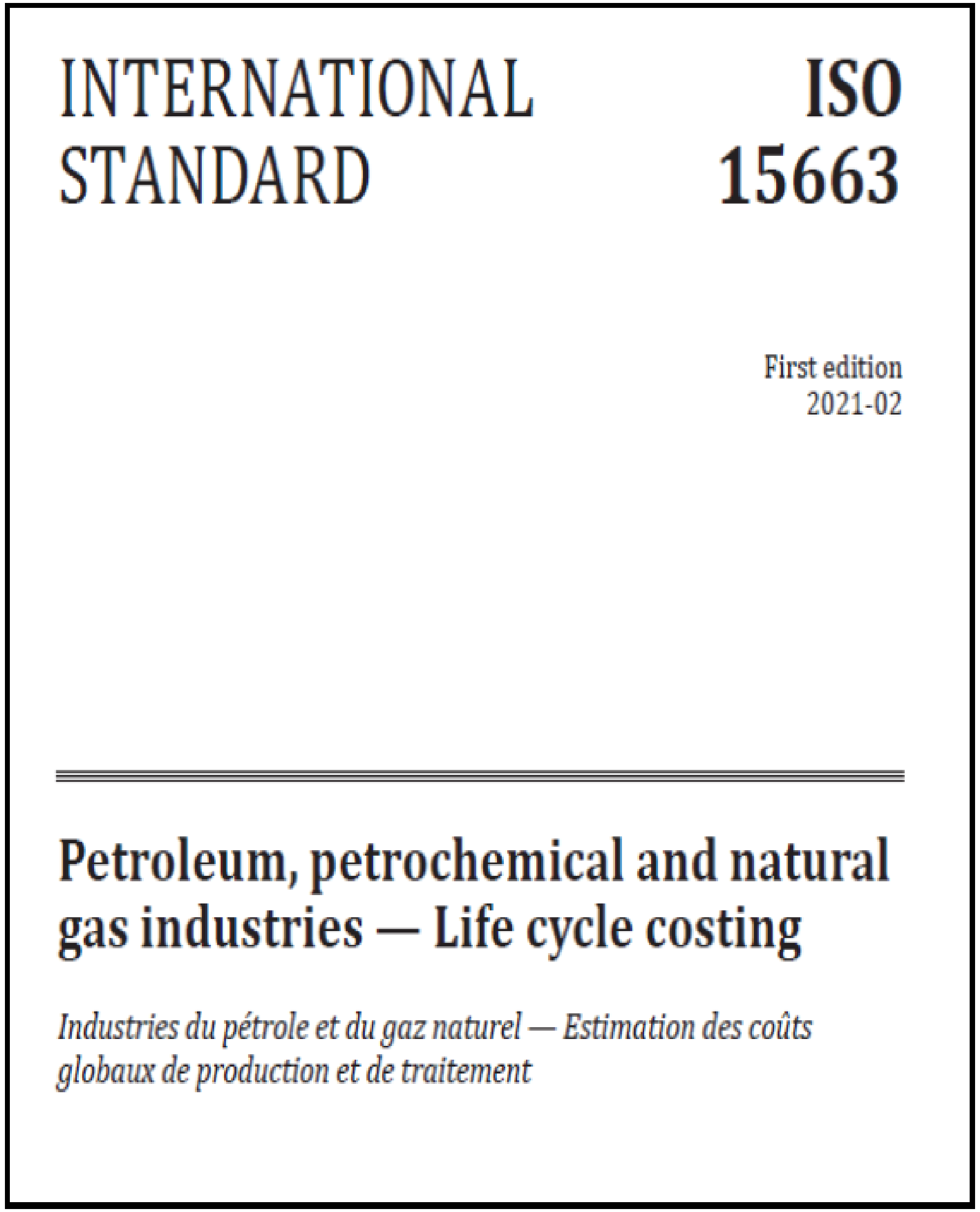


- Internal rate of return (IRR) → discount rate for which NPV = 0



- OTHERS…

Standards



INTERNATIONAL STANDARD

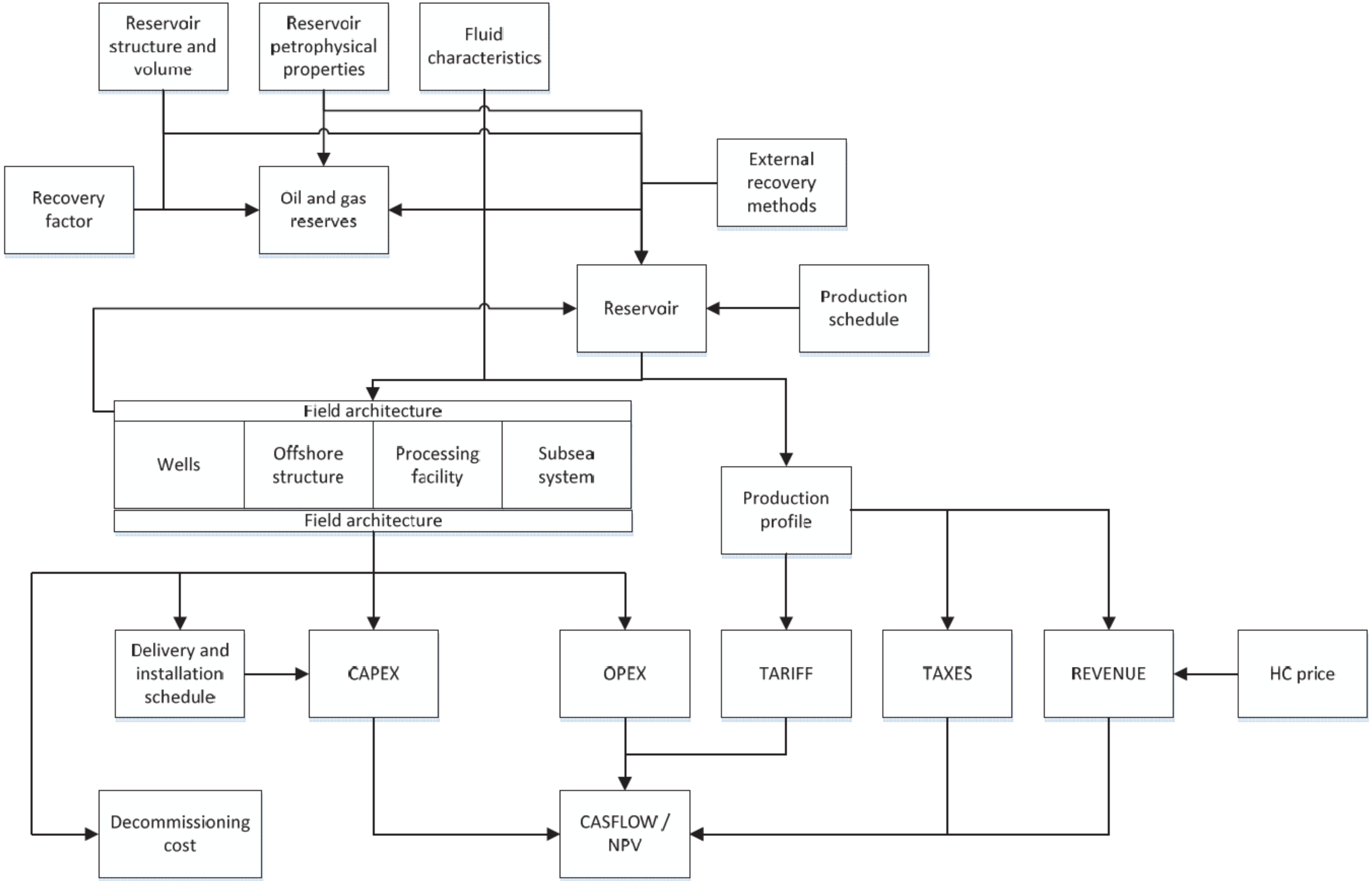
ISO 15663

First edition
2021-02

Petroleum, petrochemical and natural gas industries — Life cycle costing

Industries du pétrole et du gaz naturel — Estimation des coûts globaux de production et de traitement

Handling uncertainty



Handling uncertainty – from the standard

Industry practices:

- **Typical sensitivity analysis is performed changing inputs for CAPEX (e.g. +-15% and +-30%), product price (e.g. +-10% and +-20%), production start delay (e.g. 1 year). Results are calculated for NPV and IRR**
- **For production impact, worst and best production cases are performed**
- **Probabilistic approach with quantitative analysis very complex to be performed and very seldom used (for giant project only in case).**
  - **The results is a probabilistic curve for NPV and IRR using risked CAPEX and schedule, production, prices and discount rate as input**
  - **Deterministic NPV with P< P50 indicates good probability to achieve the deterministic result**
- **Sensitivity for CO2 tax scenarios is also performed**

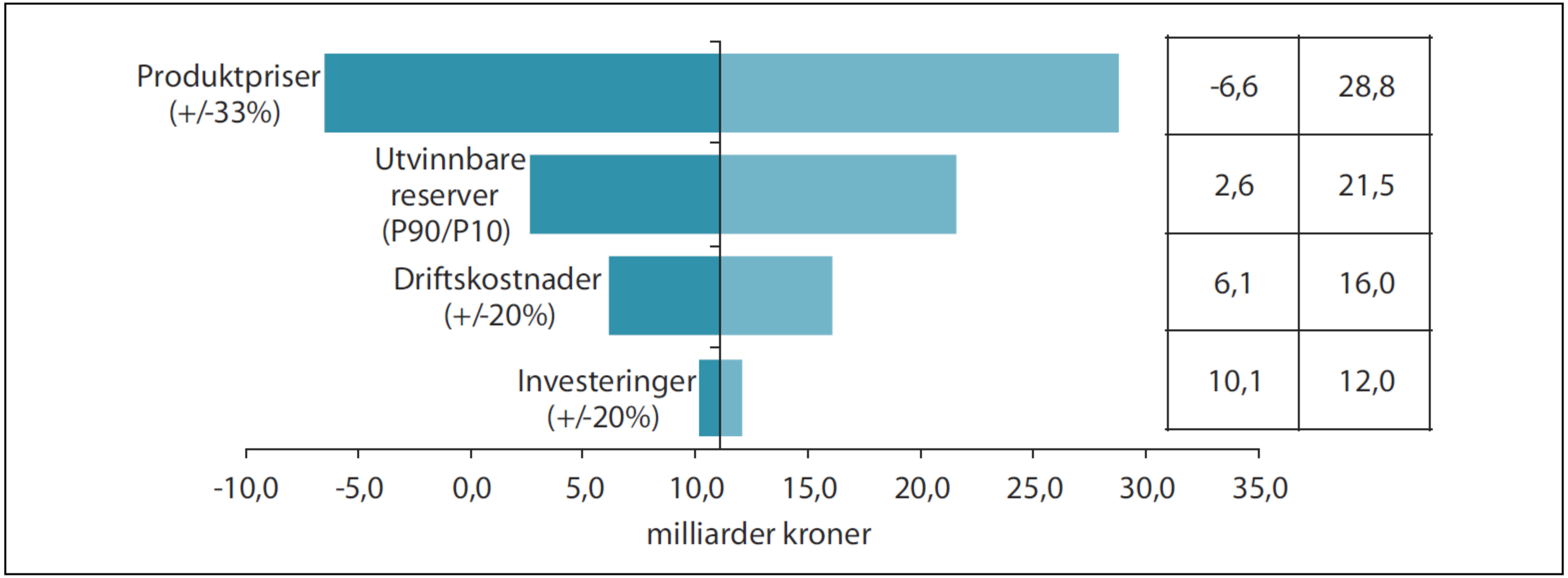
Source: ISO 15663:2021 course, 9 June 2021

Sensitivity analysis

Varying one at a time: «Ceteris paribus» principle

Sensitivity analysis

Tornado chart



Figur 2.3 Sensitivitetsanalyser

Source: Proposisjon til Stortinget: Utbygging og drift av Aasta Hansteen-feltet

Sensitivity analysis

Spider plots

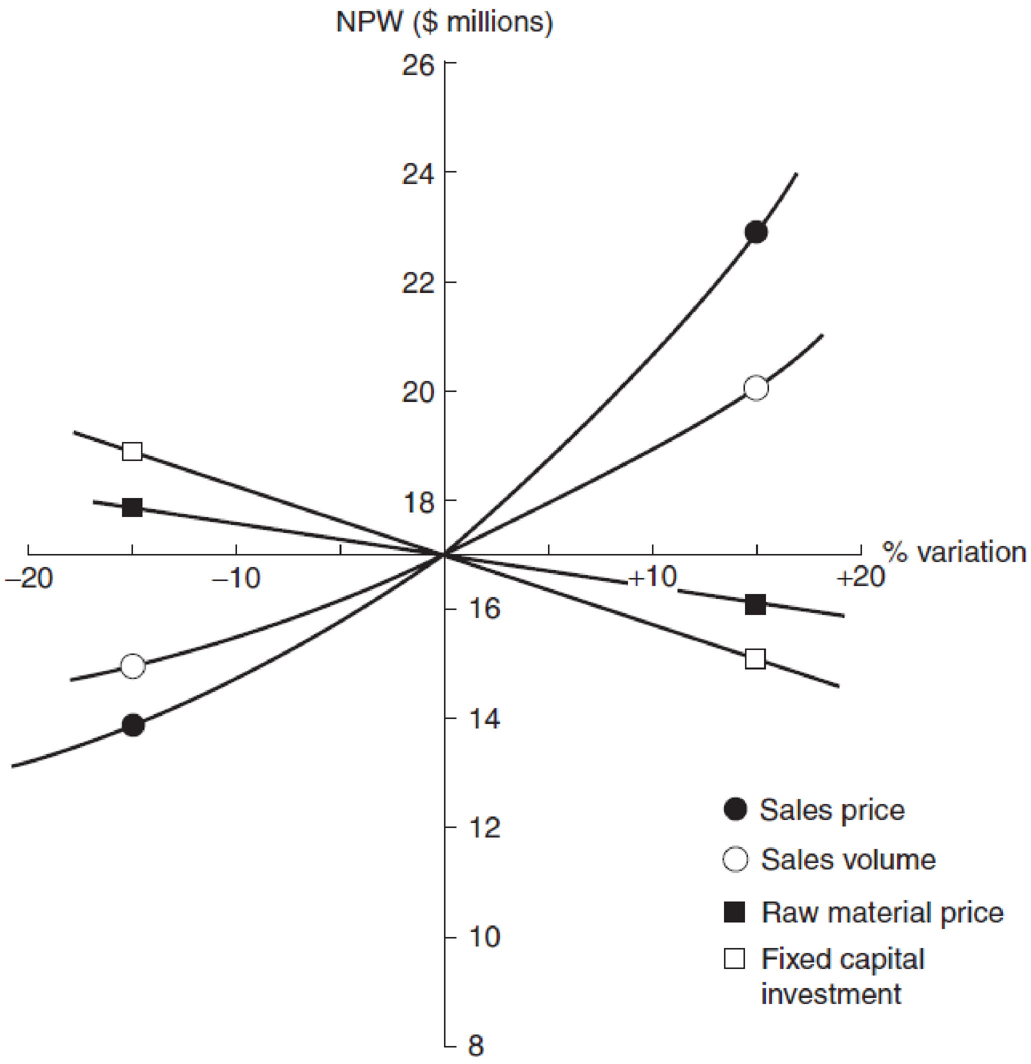


FIG. 9-14 Strauss plot.

Sensitivity analysis - defficiencies

- There could be uncertainties that occur simultaneously
- Probability of occurrence?

Field development goal

Find field design to maximize NPV

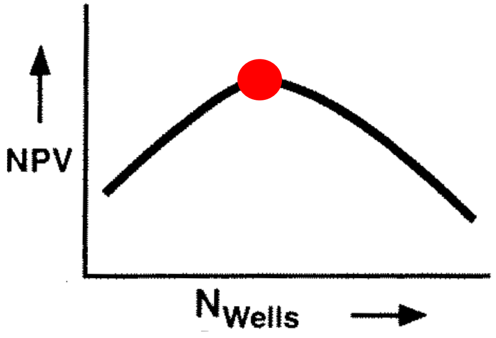
Field development goal

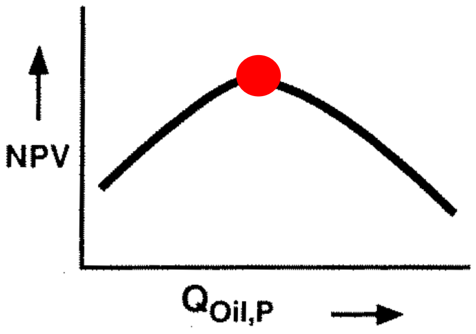
Find field design to maximize NPV

There is an optimal production scheduling and drilling schedule that maximize NPV

Action	Advantages	Disadvantages
Higher HC rates during early times	Gives higher revenue	Gives higher cost (CAPEX, OPEX)
Drill more wells	Allows for higher rates, extends field life	Gives higher cost (DRILLEX, CAPEX, OPEX)

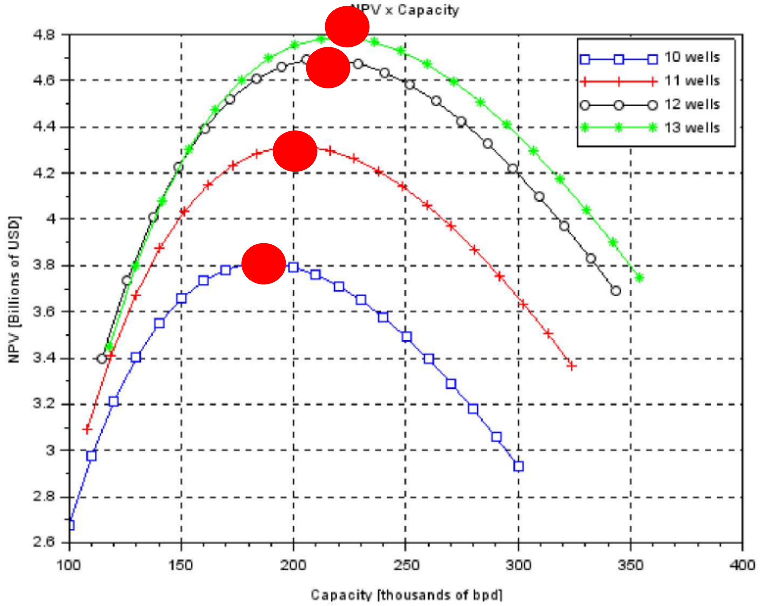
Variation of NPV with plateau rate and number of wells:





Choosing between rocks, hard places and a lot more: the economic interface

Helge Hove Haldorsen

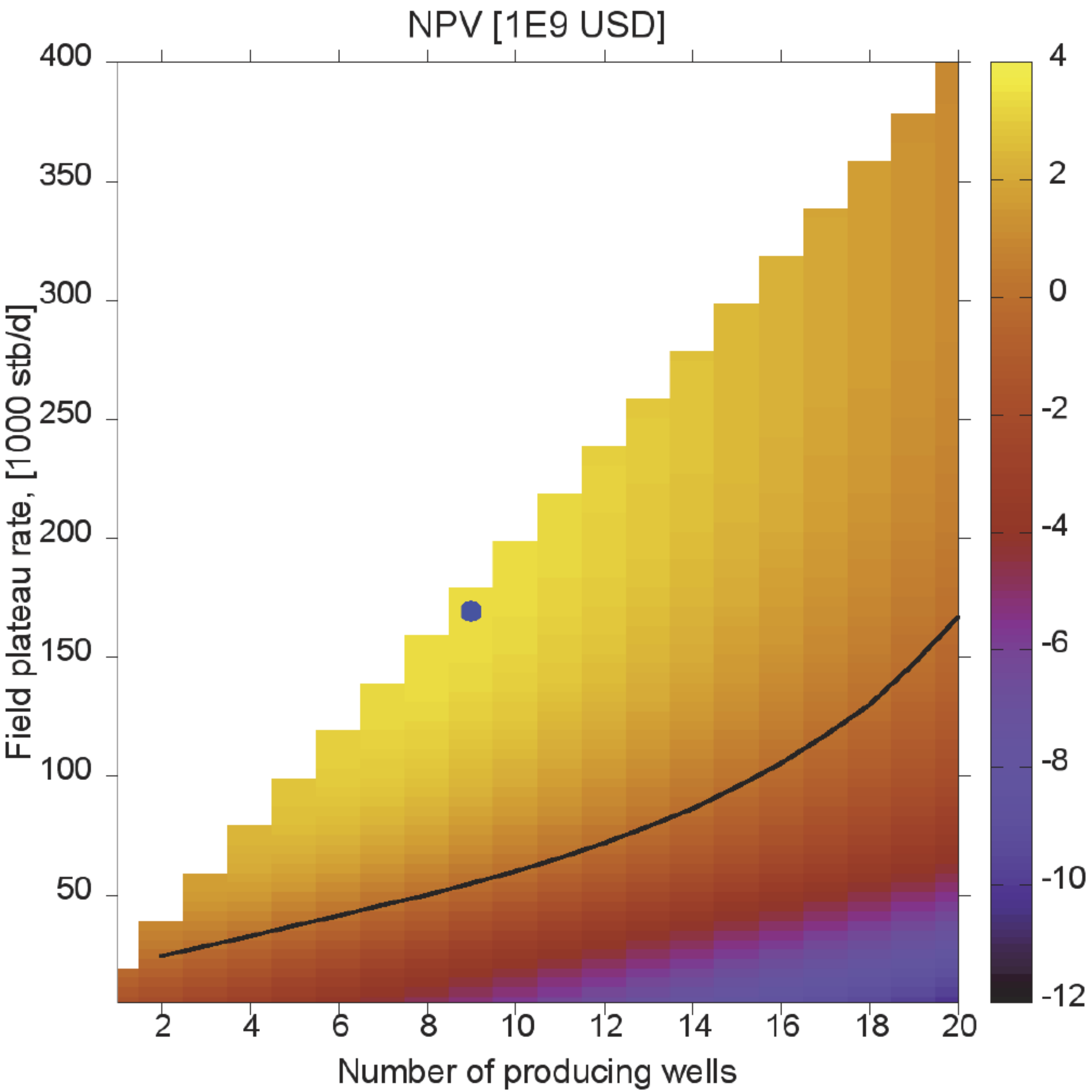


OTC-28898-MS

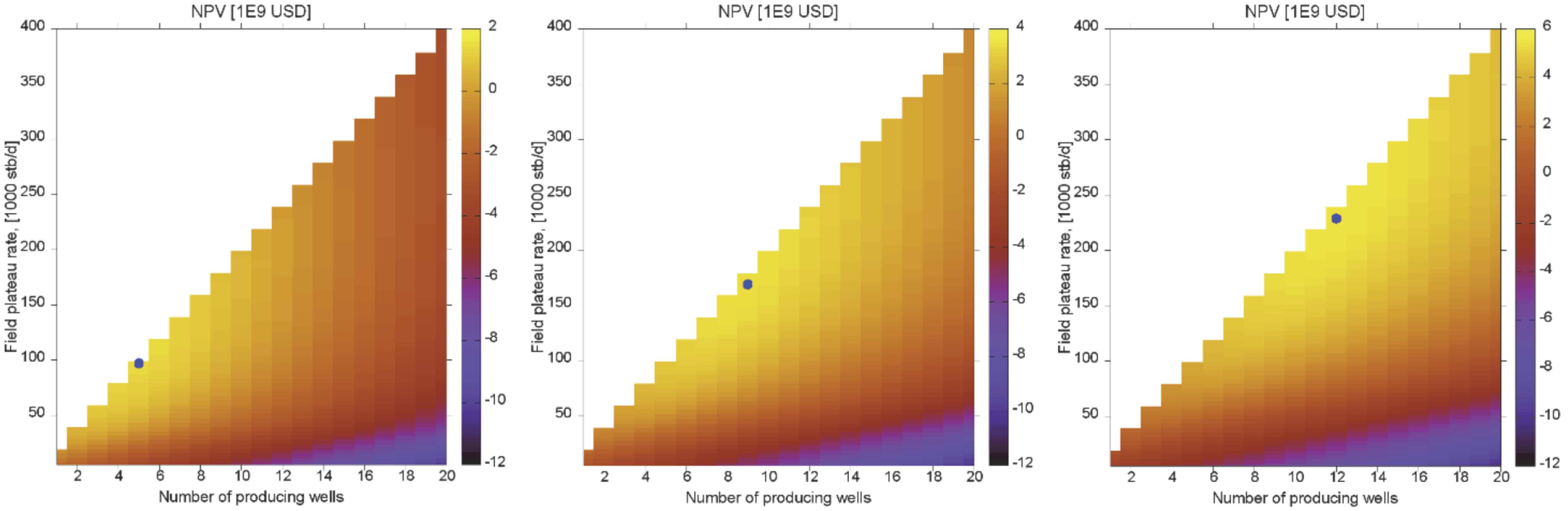
A Cost Reduction Methodology for Offshore Projects

G. C. Nunes, Rio Petroleo Consulting Group; A. H. da Silva and L. G. Esch, Universidade do Estado do Rio de Janeiro

Example from Milan's Compendium section 5.2.3.



Effect of uncertainties



a) N= 0.6·base

b) N= base

c) N= 1.4·base