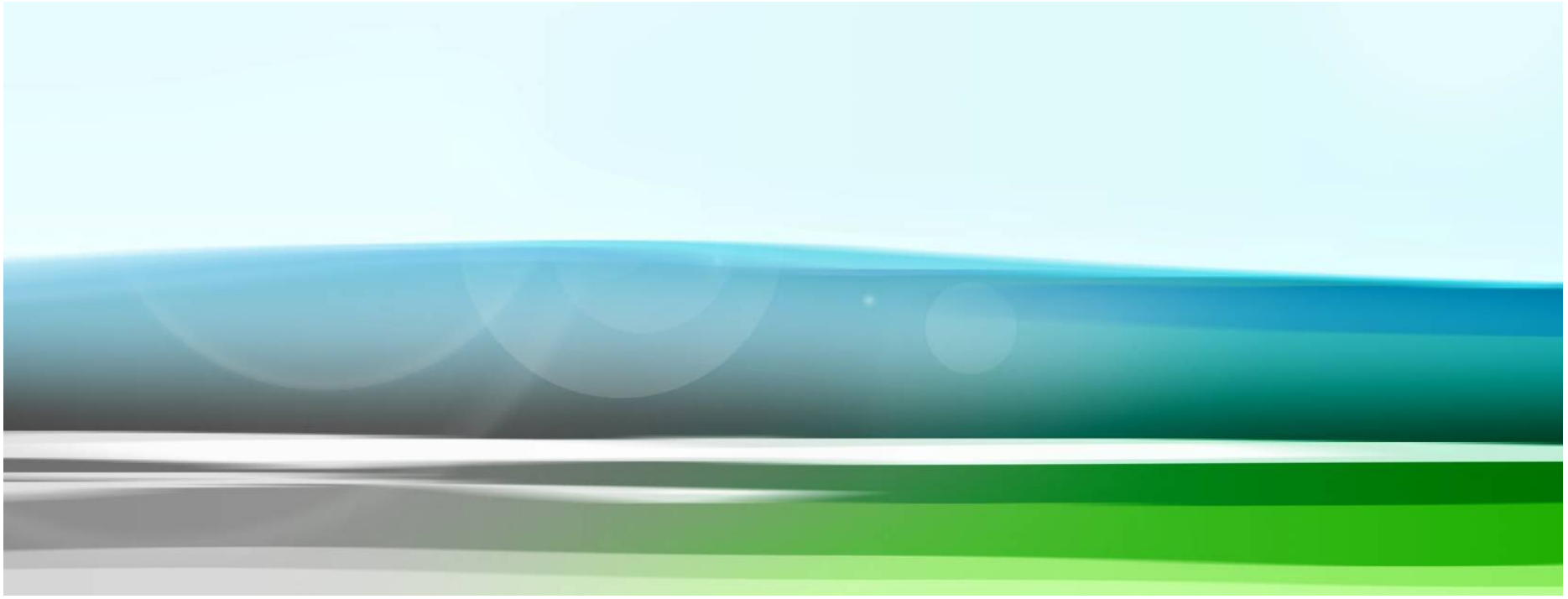


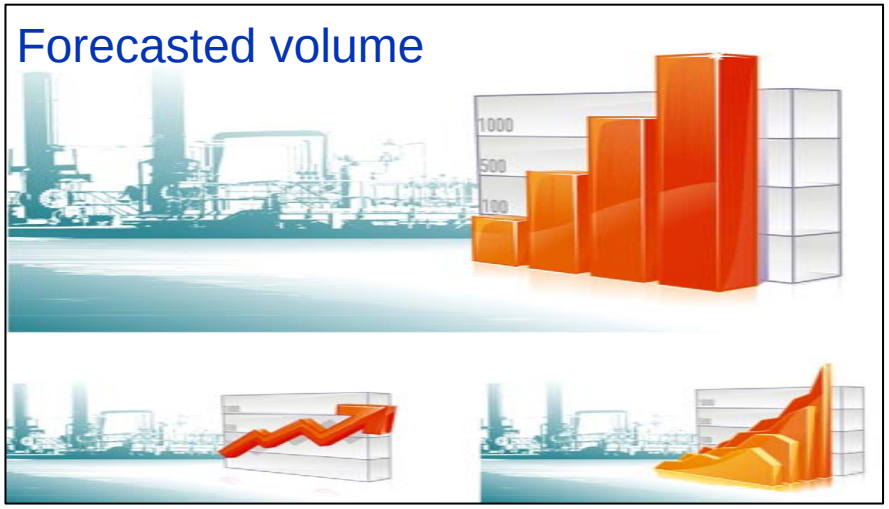
Production assurance - An approach to ensure cost optimal decisions

Atle Stokke
03 February 2010

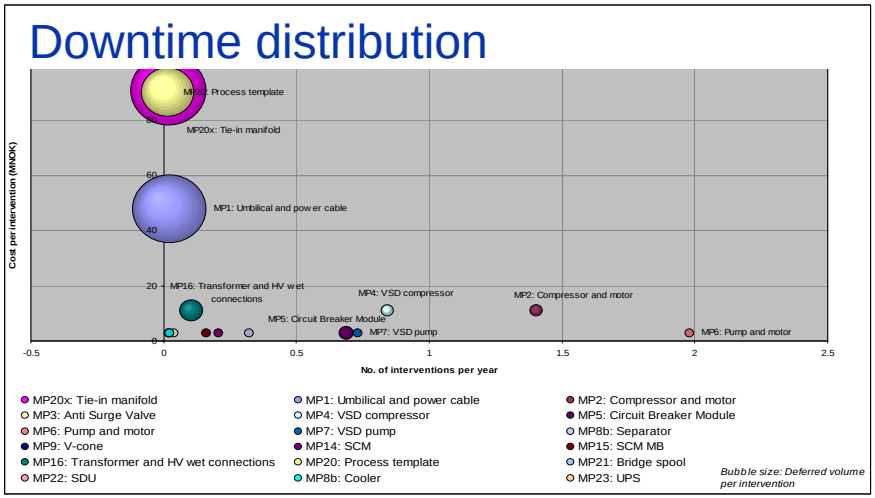
MANAGING RISK

What are the objectives of production assurance analyses?

Forecasted volume

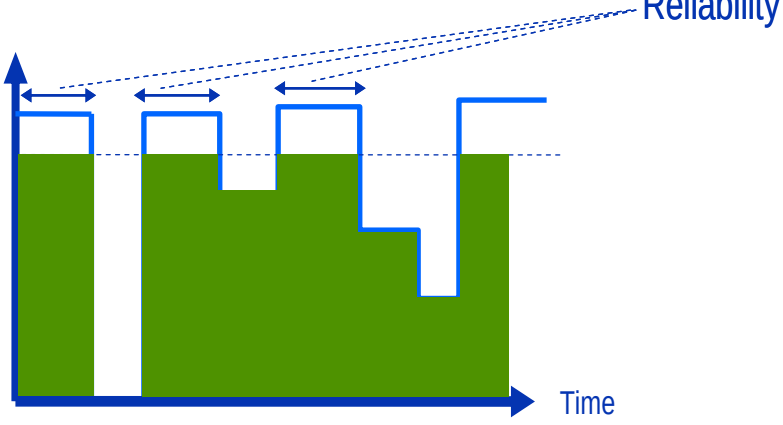


Downtime distribution



NPV

Availability – system/production



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MANAGING RISK

Production assurance and reliability management in the oil and gas industry

"The petroleum and natural gas industries involve large capital investment costs as well as operational expenditures.

The profitability of these industries is dependent upon the reliability, availability and maintainability of the systems and components that are used."

[ISO 20815 - Production assurance and reliability management]

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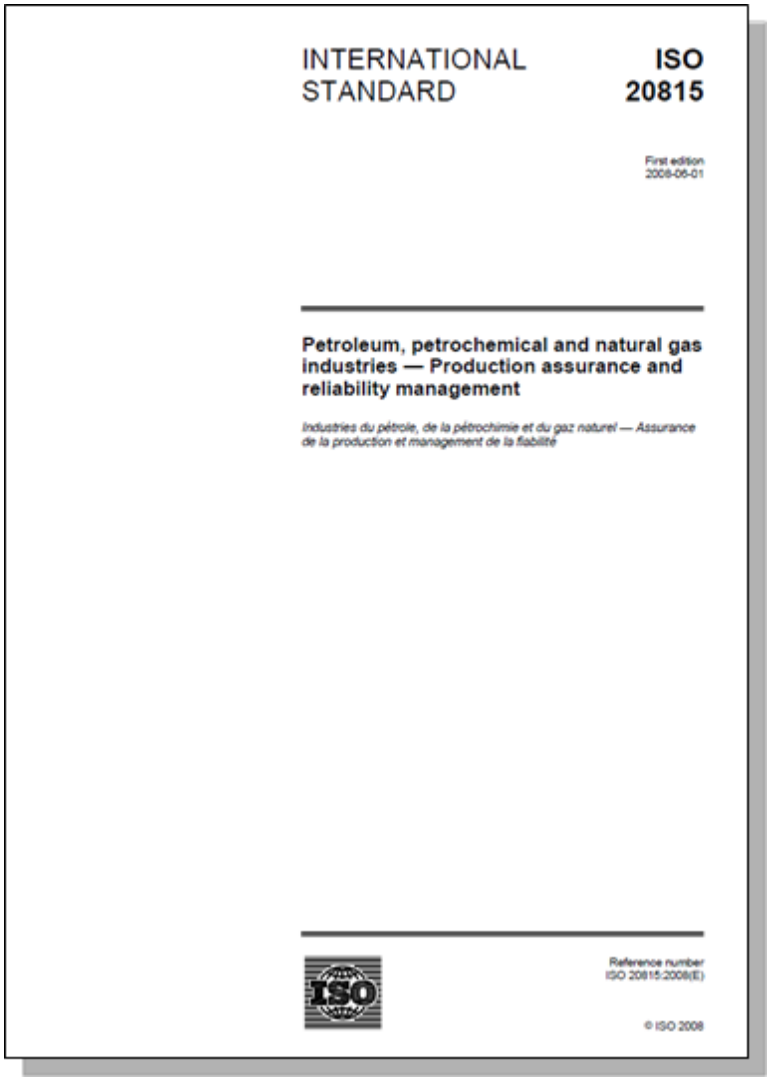
Let us consult the ISO standard

”*The objective associated with systematic production assurance is to contribute to the alignment of design and operational decisions with corporate and business objectives*”

“The standard recommends…[production assurance] processes and activities be initiated only if they can be considered to add value”

”The achievement of high performance is of limited importance unless the associated costs are considered”


INTERNATIONAL STANDARD

ISO 20815

First edition
2008-06-01

Petroleum, petrochemical and natural gas industries — Production assurance and reliability management

Industries du pétrole, de la pétrochimie et du gaz naturel — Assurance de la production et management de la fiabilité

Reference number
ISO 20815:2008(E)

© ISO 2008

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Content

- Terminology and project life cycle
- Case study
  - General introduction
  - Methodology and findings
- Conclusive remarks
- Questions and discussion

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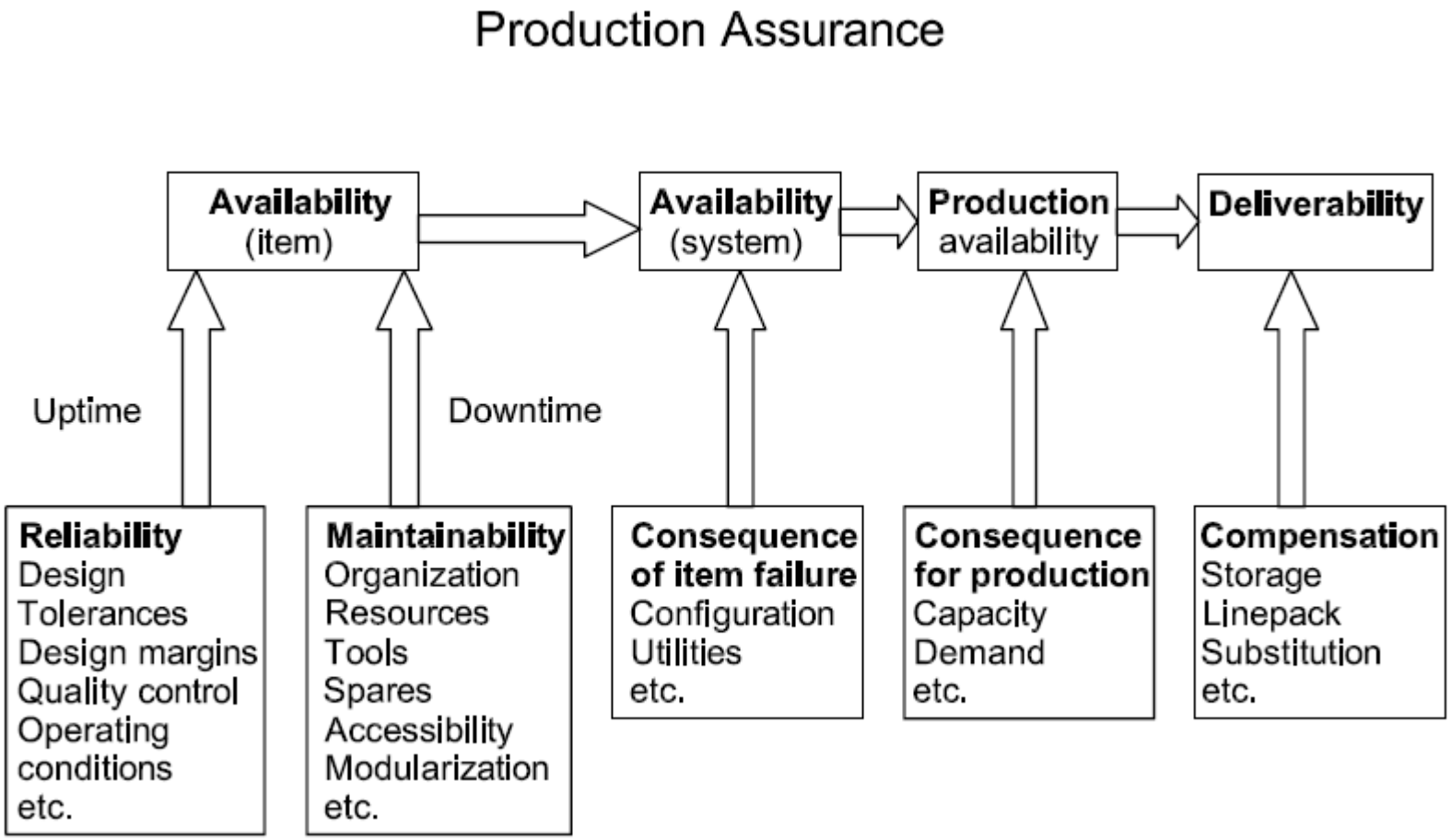
Production assurance terms



[ISO 20815 - Production assurance and reliability management]

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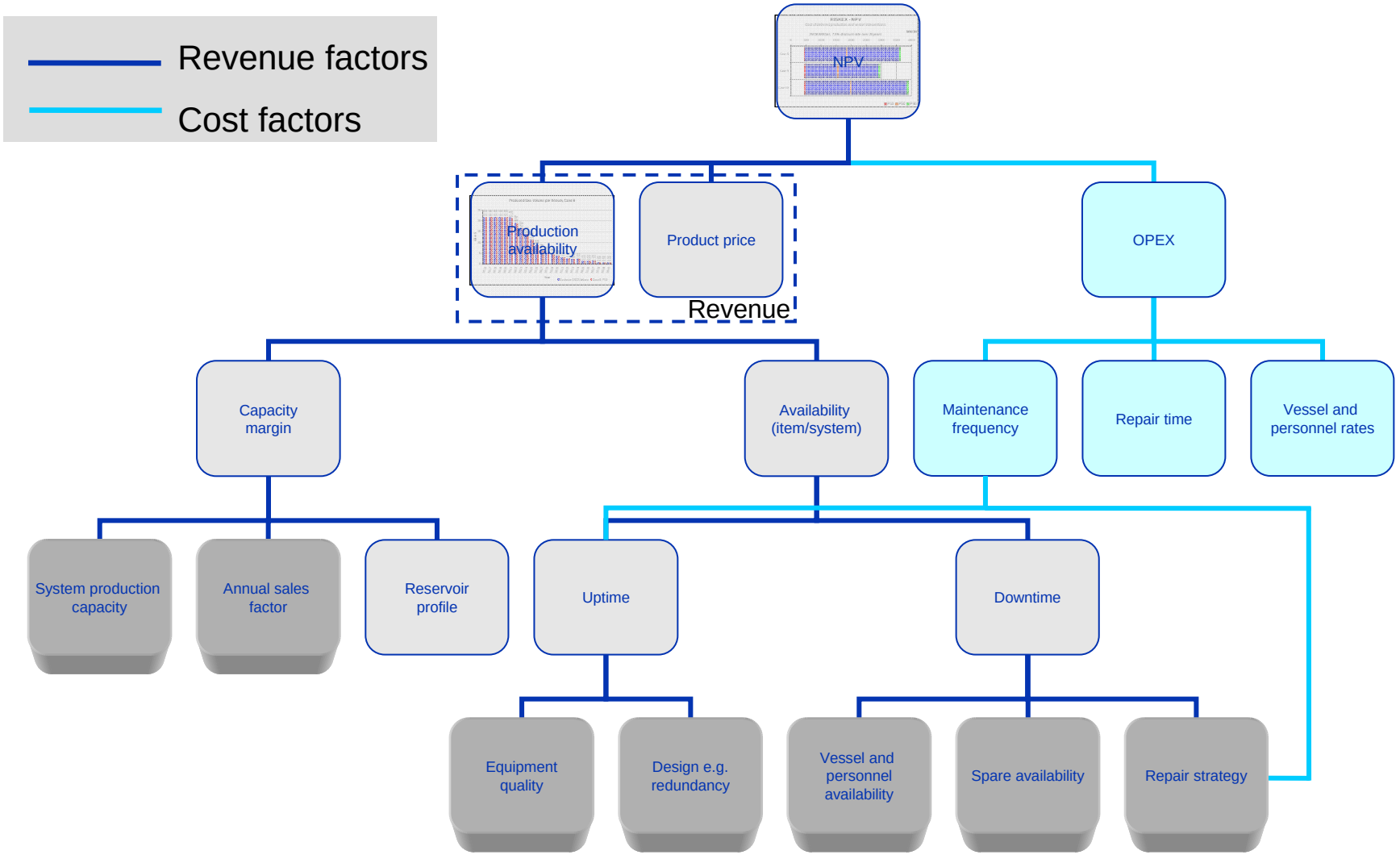
Decision criteria



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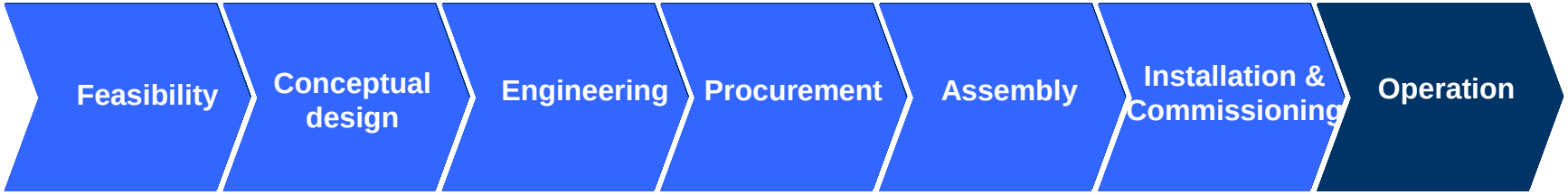
Production assurance in the project life cycles



- Protection from environment
- Reliability testing
- Self-diagnosis
- Buffer and standby storage
- Bypass
- Spare parts
- **Maintenance strategy**
- Maintenance support
- Utilization of design margins

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MANAGING RISK DNV

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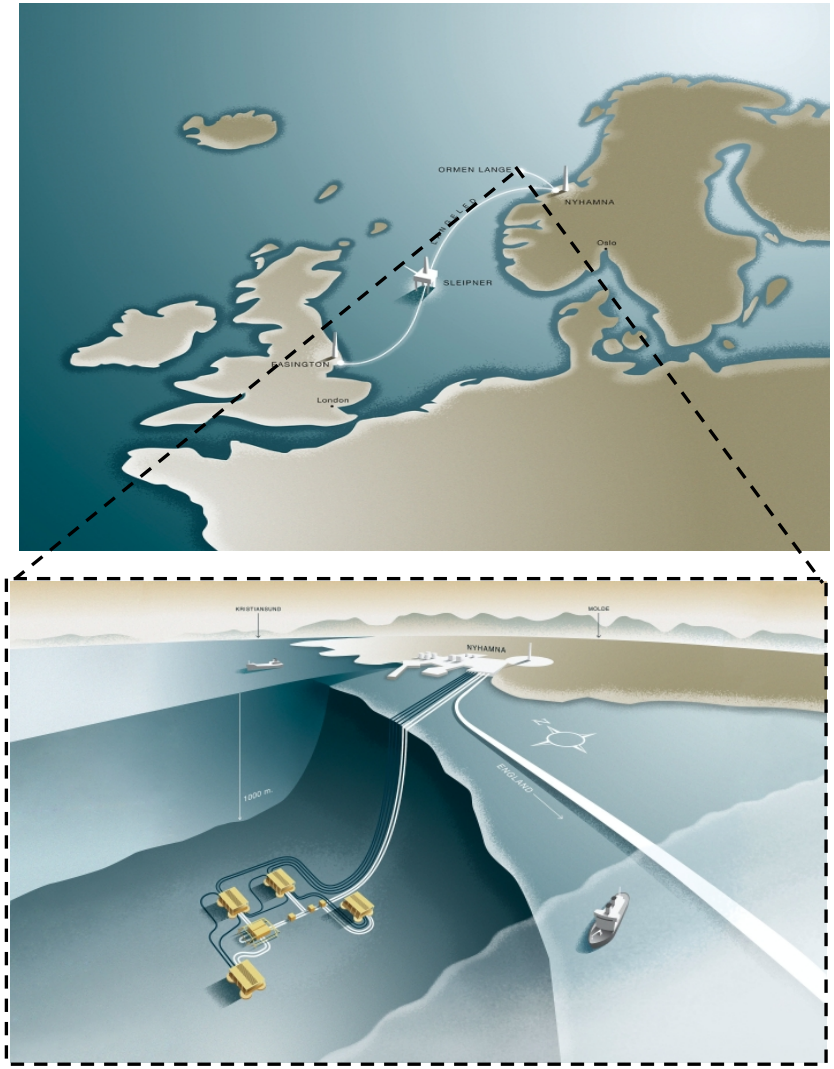
Ormen Lange in numbers

- Located 120 km north-west of Kristiansund
- Water depths 800-1100 m
- Estimated reserves 397 billion Sm^3
- Production started by the end of 2007
- Can potentially supply 20% of the British gas market for 30-40 years
- Export through Langeled, 1200 km
- **Need for additional compression support from approximately 2016**



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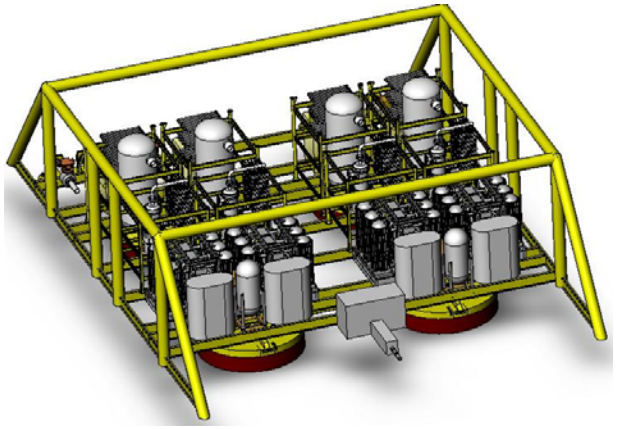
Main compression alternatives

Floater with compression	Subsea compression
▪ High CAPEX ▪ High manpower cost ▪ Low intervention costs ▪ Safety risk	▪ Halved CAPEX ▪ Low manpower cost ▪ Uncertain life cycle performance ▪ Limited safety risk



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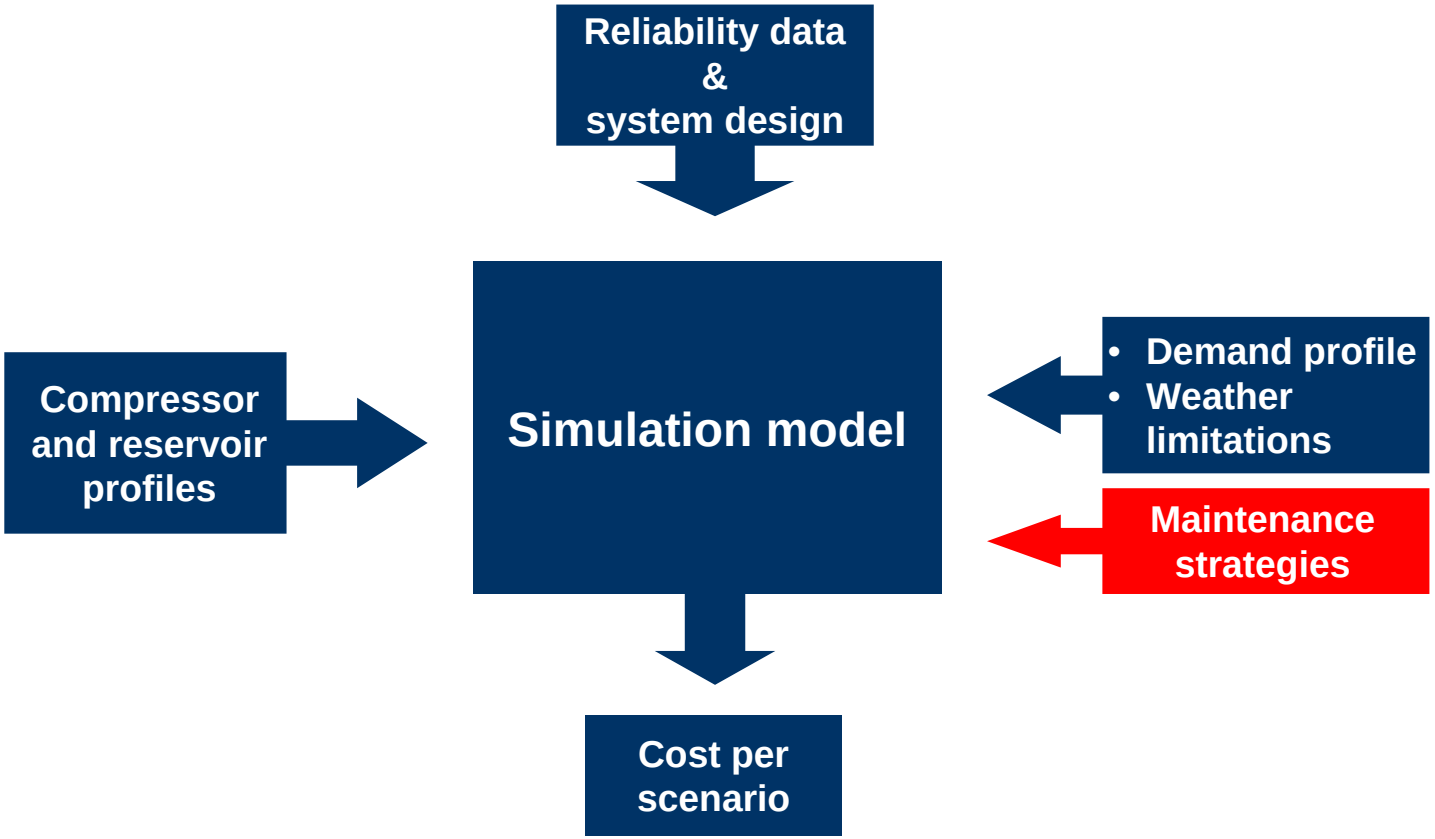
An Integrated Approach



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Objective of analysis

Choose the cost optimal maintenance strategy

Vessel contracting strategy

- Contract a vessel on the spot market on demand
- Contract/purchase a vessel dedicated to Ormen Lange
- Share vessel with nearby fields

Repair strategy

- Repair redundant components on first failure
- Repair redundant components when loss of function
- Combination of the two strategies above depending upon type of component

Scenarios: Combinations of the above strategies

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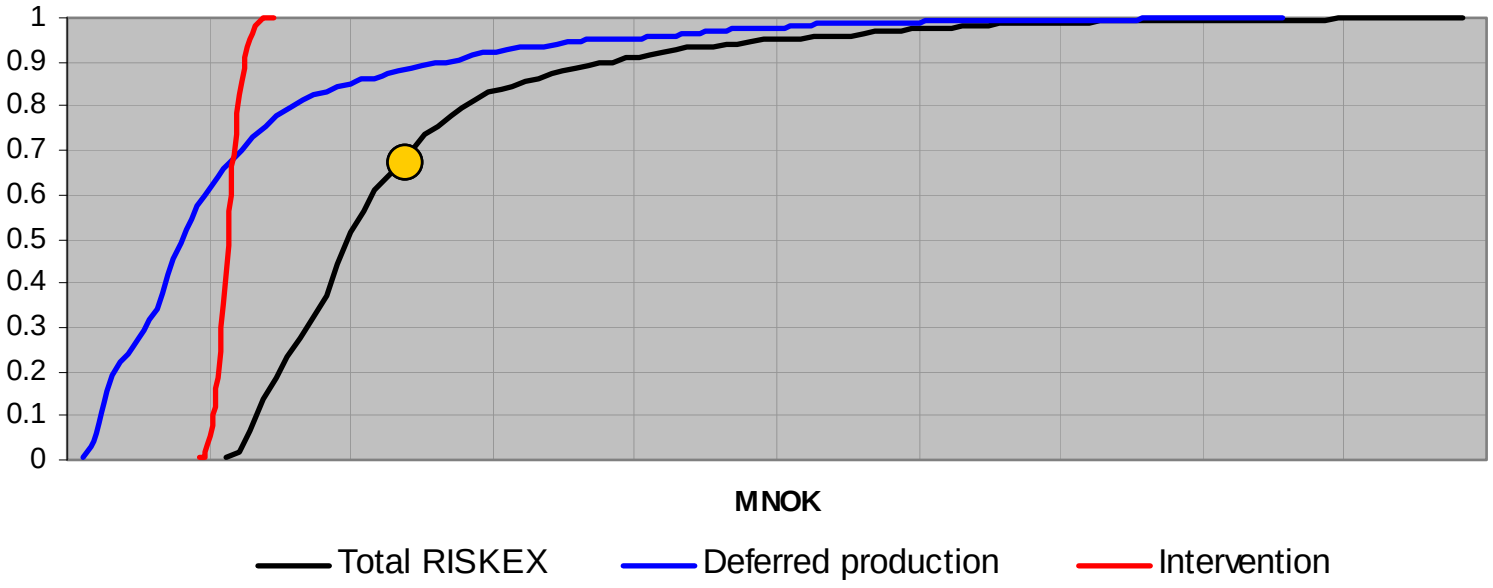
RiskEx – The decision variable

Cost of deferred production
+ Cost of unplanned interventions
= Risk expenditures (RiskEx)

$$\text{PV RISKEX} = \sum_{i=1}^{T} \frac{(V_{\text{unrisked}_i} - V_{\text{risked}_i}) \cdot P + C_i}{(1+r)^i}$$



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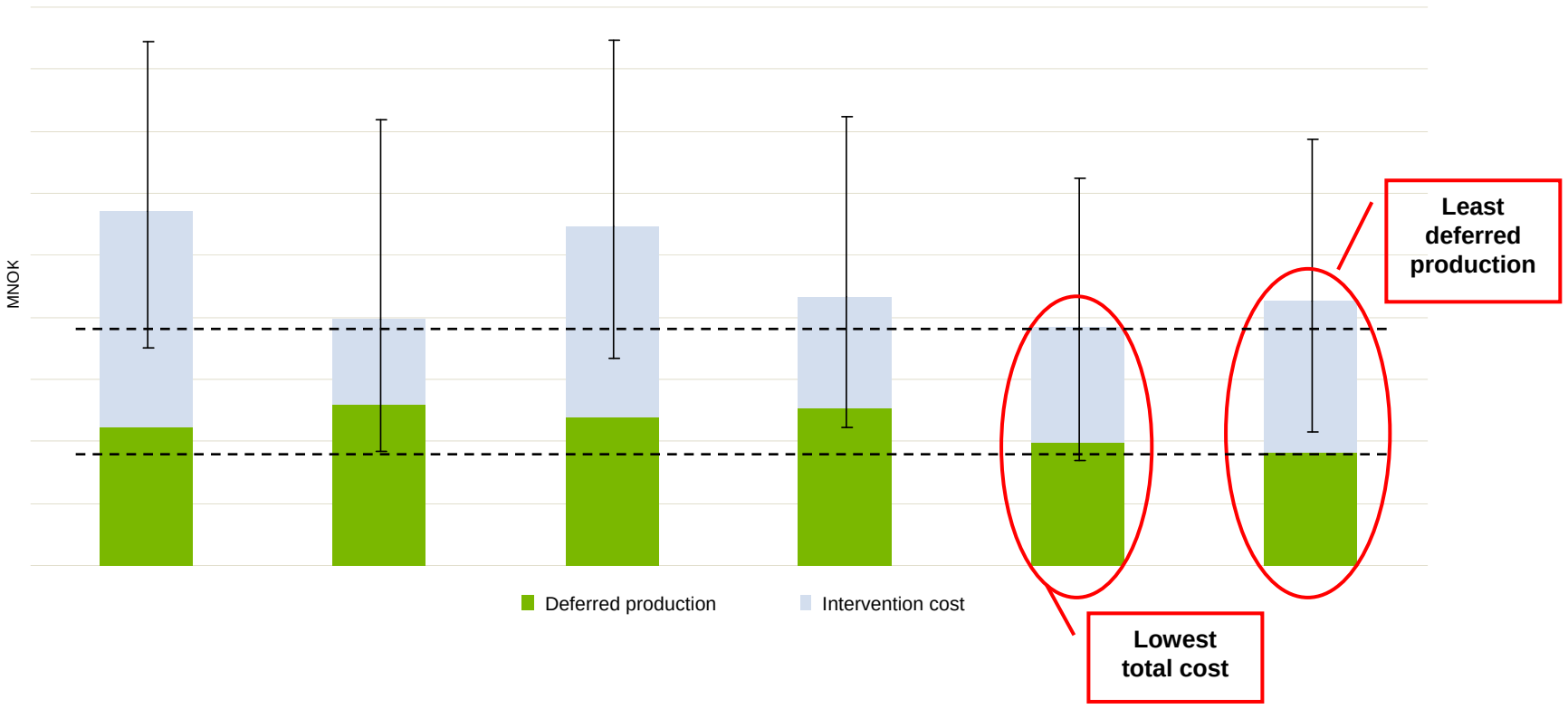
The cost optimal solution



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Conclusive remarks

- Case specific conclusions
  - Approximately 25% cost difference between highest and lowest cost
  - An integrated approach crucial to obtain relevant decision support
- General remarks
  - Production assurance activities should always be aligned with business objectives
  - A strategy giving the highest availability is not always optimal with regard to project economy

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