Application of semantic technologies and ontologies to improve KPIs

Semantic Days 2008

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Issues addressed

- The oil industry's main challenges

- The industry's answer to these challenges
  - Integrated Operations (IO)

- Effects of IO on the industry's key performance indicators

- Things yet to be done and technologies required

- IBM's investments in IO solutions
  - Reference Semantic Model (RSM)
  - Integrated Information Framework (IIF)

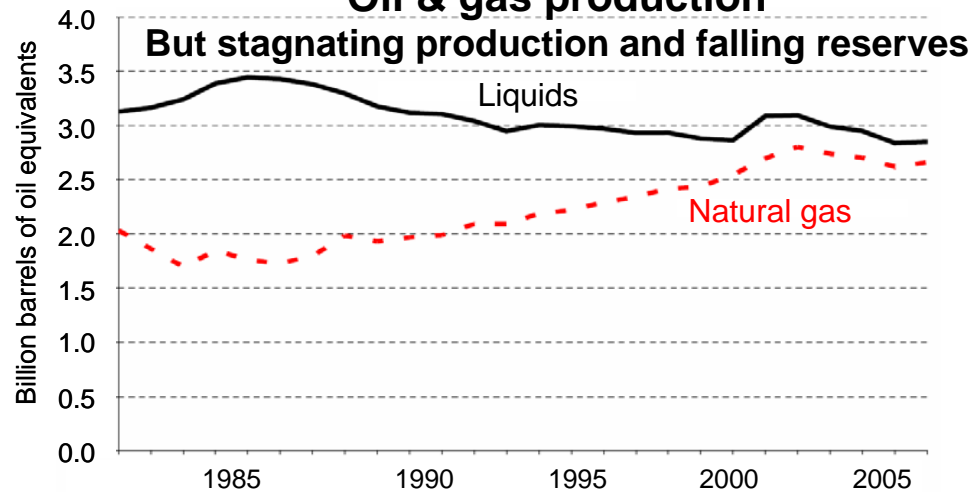- Some challenges solved by these solutions

The oil industry faces several challenges

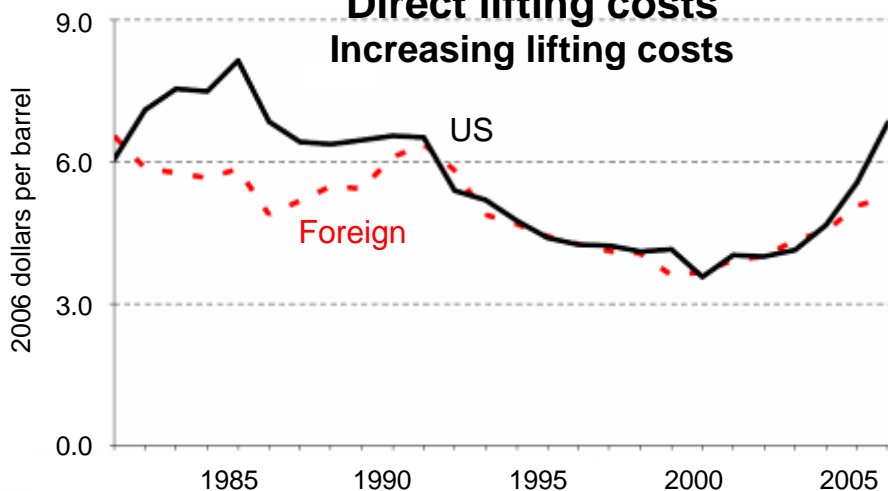### Return on net investments
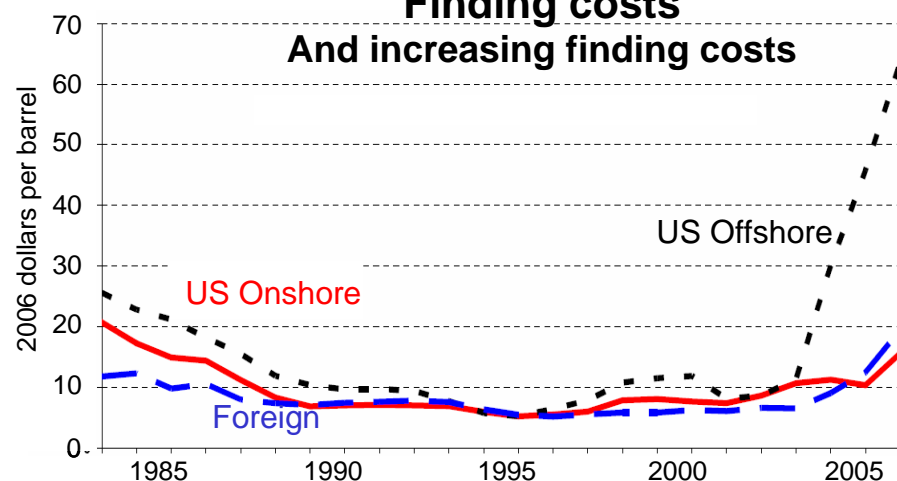**Sky-high oil prices and record profit**

Foreign

US

Percent

1980 · 1985 · 1990 · 1995 · 2000 · 2005
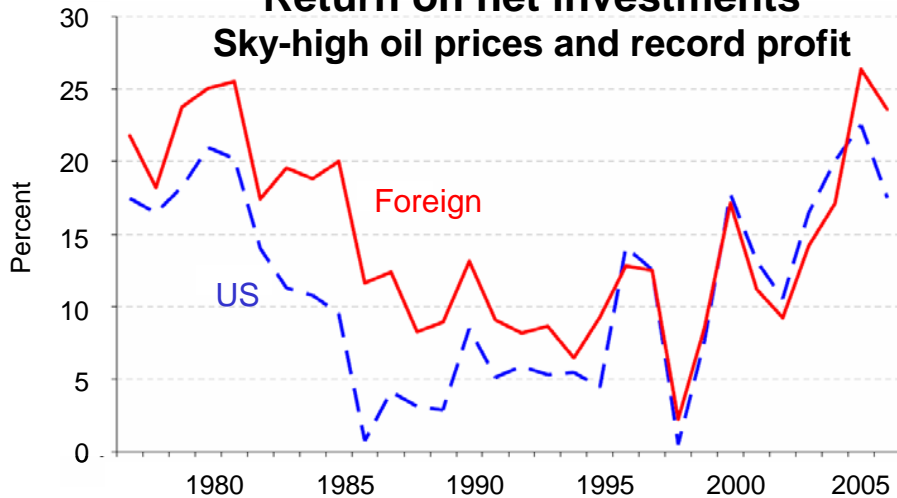
Oil & gas production
But stagnating production and falling reserves

Liquids

Natural gas

Billion barrels of oil equivalents

1985 · 1990 · 1995 · 2000 · 2005

Direct lifting costs
Increasing lifting costs

US

Foreign

2006 dollars per barrel

1985 · 1990 · 1995 · 2000 · 2005

Finding costs
And increasing finding costs

US Offshore

US Onshore

Foreign

2006 dollars per barrel

1985 · 1990 · 1995 · 2000 · 2005

Source: US DOE, 2007, Financial Analysis of the 16 largest US oil and gas companies

Integrated Operations is an important part of the industry's answer

Portfolio
- New projects
- Acquisitions and mergers
- Highgrading

Technology
- Classical E&P technologies
- Information & Communication technologies

Strategies

Organization
- Multidiscipline teams
- Central support centers
- Real-time processes

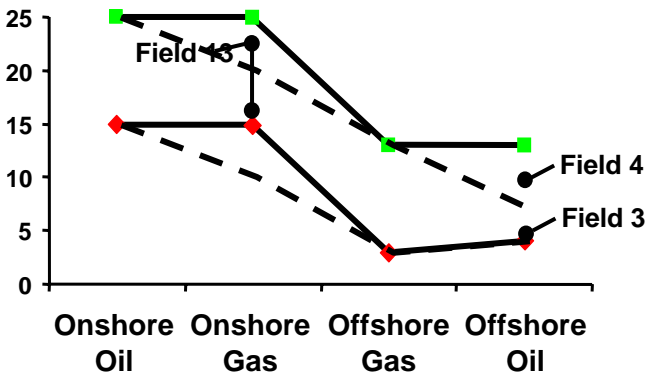**Integrated Operations (IO)**
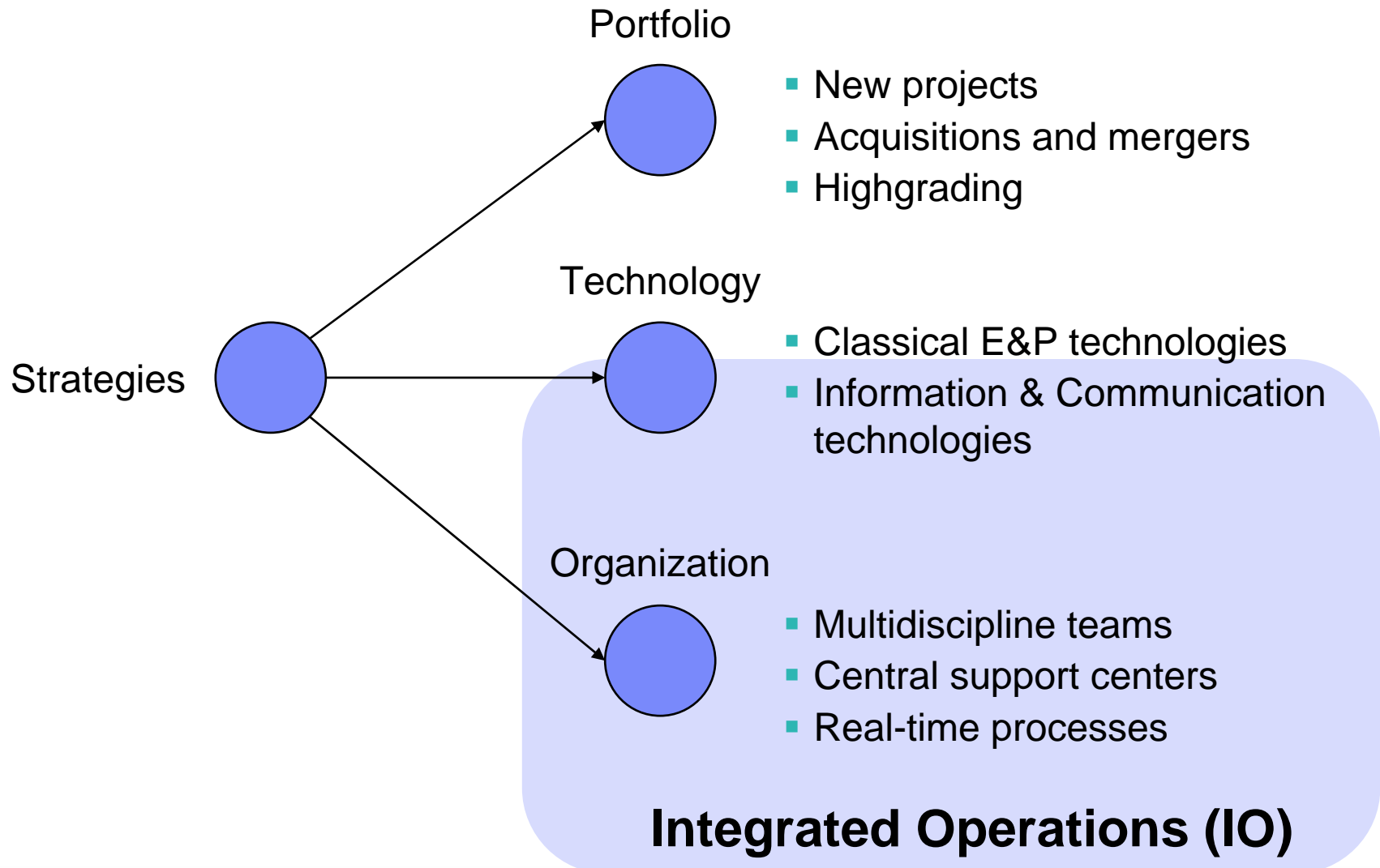
The effects of IO on the industry's performance already are significant
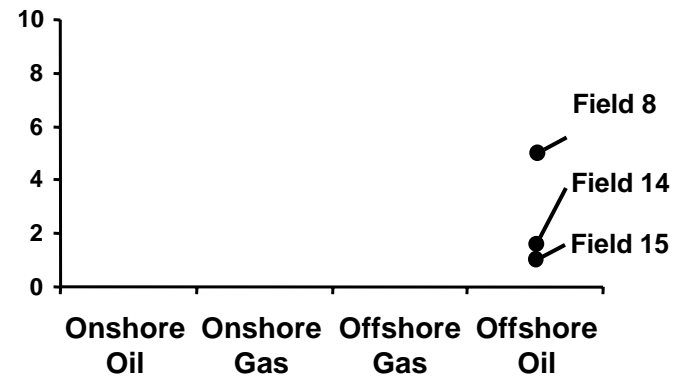
Increased Reservoir Recovery (% OOIP) Increased Production Rates (%)
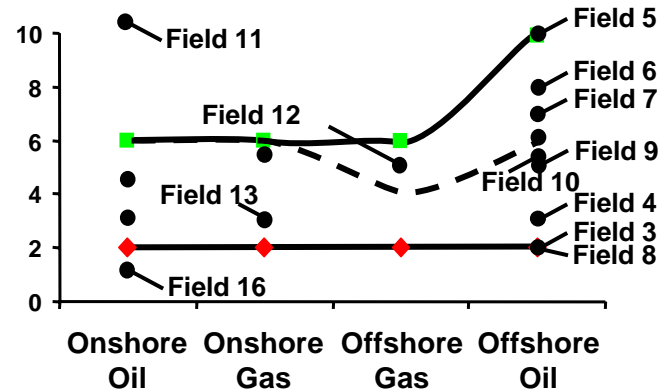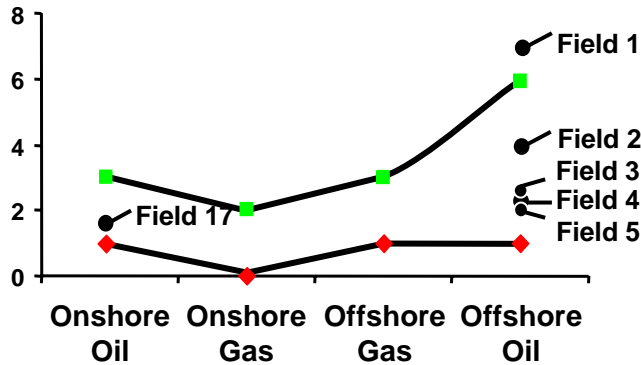
Lower Operating Costs (%)
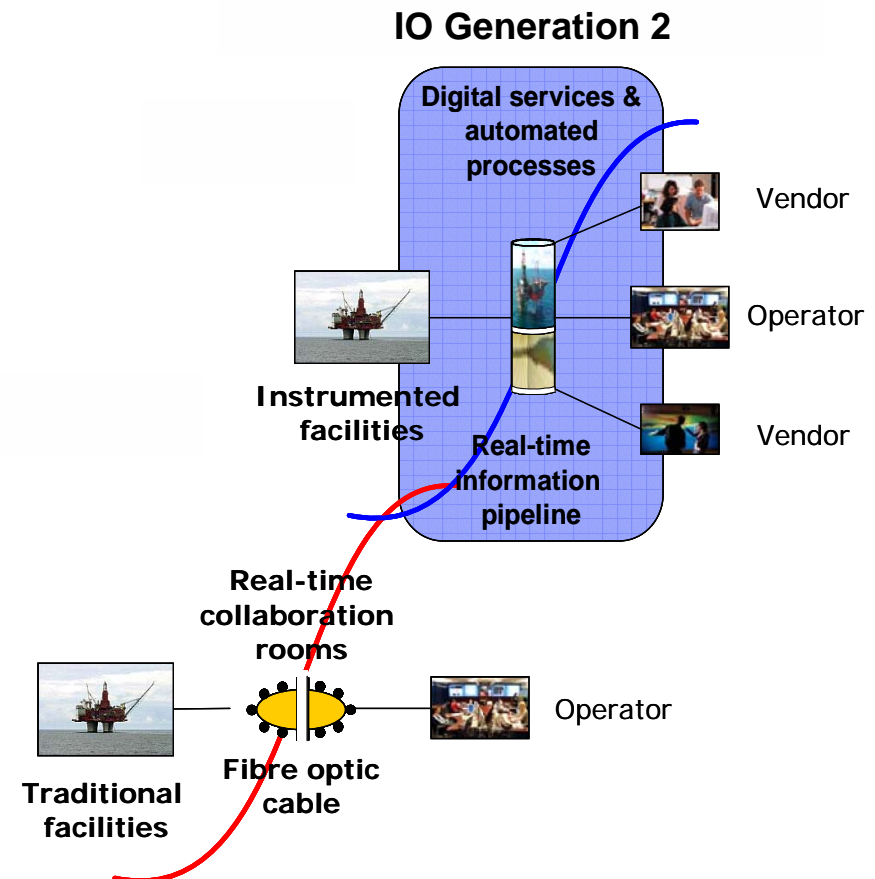

Lower Capex (%)

But several things yet are to be done, as illustrated by the example below

- Automatic detection of events
  - Well, process, critical equipment
- Automatic evaluation of the effect of events on KPIs
  - Production targets, costs or HSE
  - From corporate to equipment level
- Automatic generation of advices on how to manage events
- Automatic processing of events
- Automatic follow-up of events, e.g. actions required to handle events

300 bill. NOK on the NCS
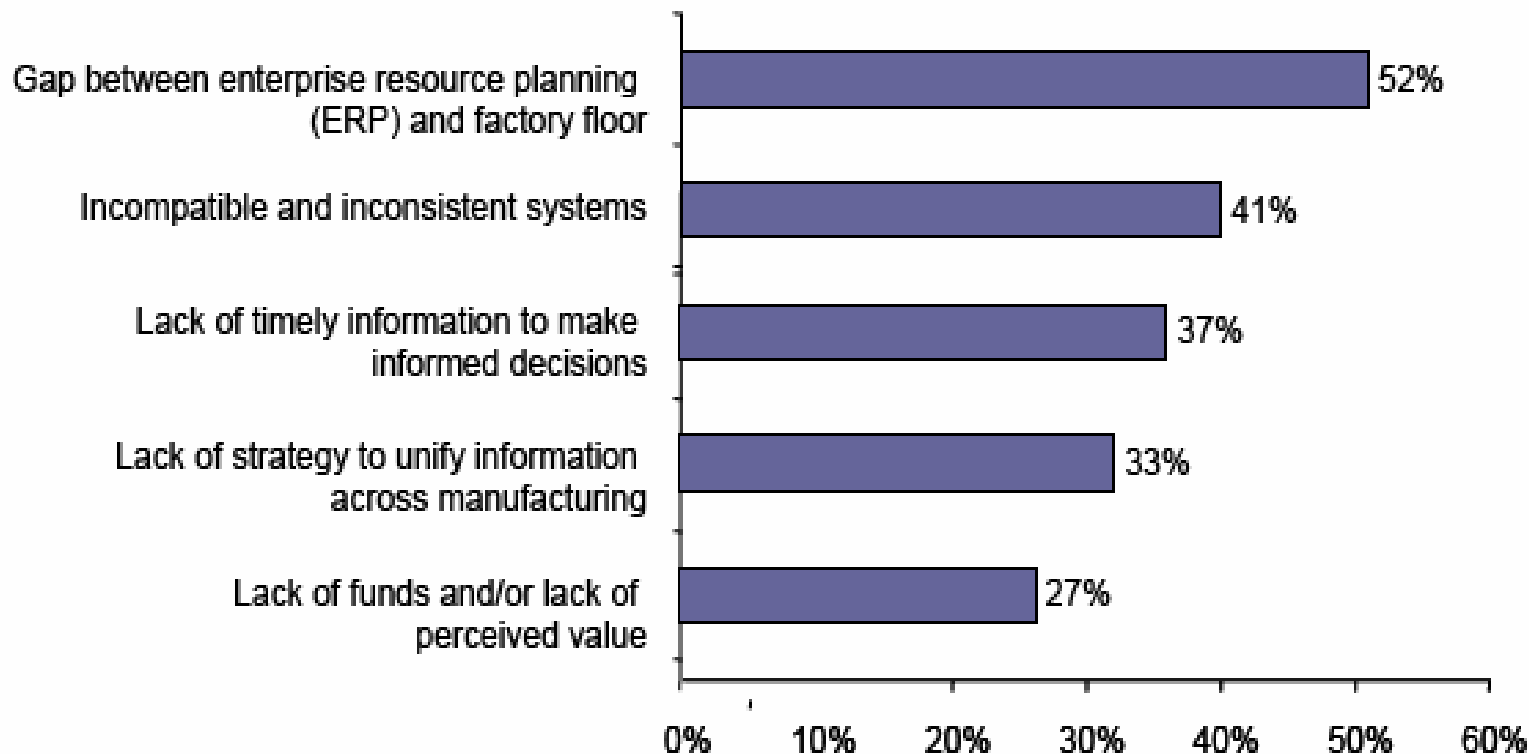
Source: OLF, 2008

IO Generation 2

Digital services & automated processes

Vendor

Operator

Vendor

Instrumented facilities

Real-time information pipeline

Real-time collaboration rooms

Traditional facilities

Fibre optic cable

Operator

This is confirmed by international studies

Figure 2. Internal Challenges (all performance categories)

Internal Challenge	Percentage
Gap between enterprise resource planning (ERP) and factory floor	52%
Incompatible and inconsistent systems	41%
Lack of timely information to make informed decisions	37%
Lack of strategy to unify information across manufacturing	33%
Lack of funds and/or lack of perceived value	27%

Source: Aberdeen Group, May 2006

New and highly scalable technologies are required

Process control systems

Sensors
Downhole & onboard facilities

Web services
Open IT standards

Vendor

Operator

Vendor

Real-time integration solution

Semantic models
Open industry standards

Decision support tools
Real-time monitoring, simulation, optimization & automation of operations

Broadband communication networks
Fiber optic cables & wireless networks

IBM invests significantly in new, open solutions for the oil industry

- A common reference semantic model (RSM) based on open industry standards

  – In cooperation with the industry's main standardization associations

- A solution – Information Integration Framework (IIF) - for integration of real-time information

  – Applied by StatoilHydro's Tail IO project and partners ABB, Aker Solutions and SKF

  – Made available to NTNU's IO Centre

Process domain
- Real-time information from many, highly different assets

Corporate domain
- Common asset models
- Common processes and applications
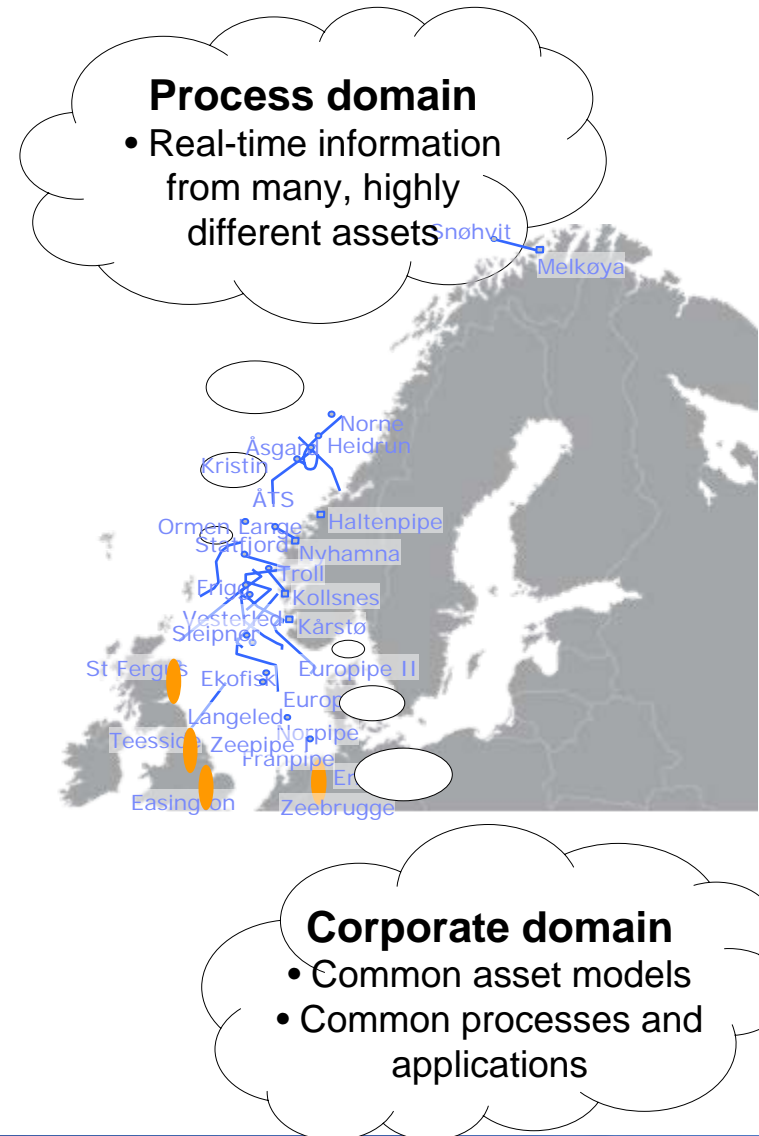
The reference model consists of several international standards

- MIMOSA
- OAGi
- WBF
- Energistics
- ISA 88
- ISA 95
- POSC Caesar
- OPC
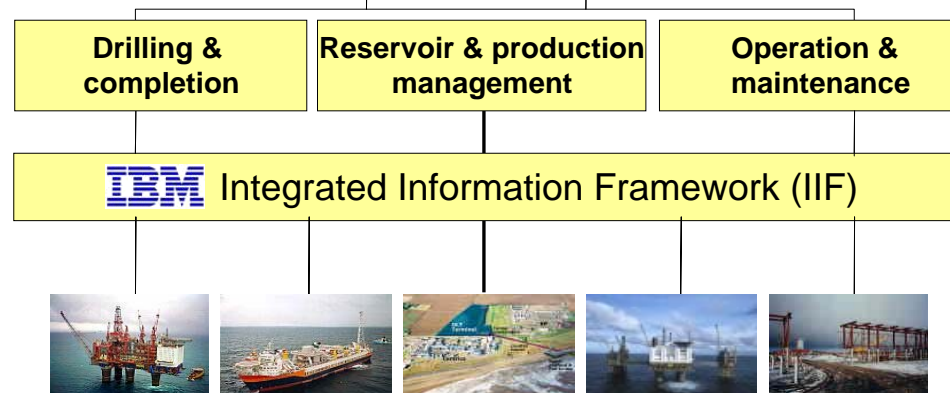- OSIsoft
- DNV
- DOW
- SISCO
- IBM
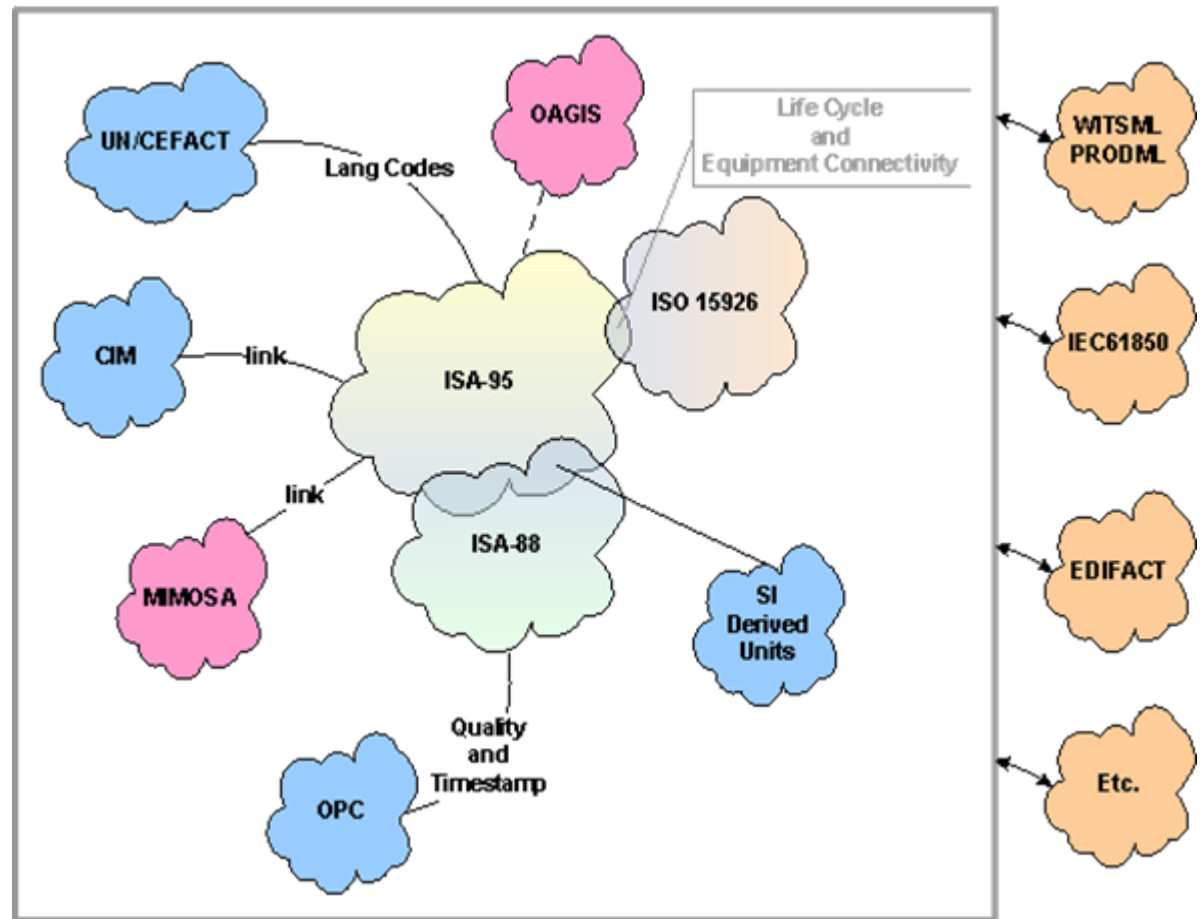
The IIF is a service-oriented solution based on open IT standards

Local & global operation centers

- Corporate processes and 3rd party services and applications (standardized)
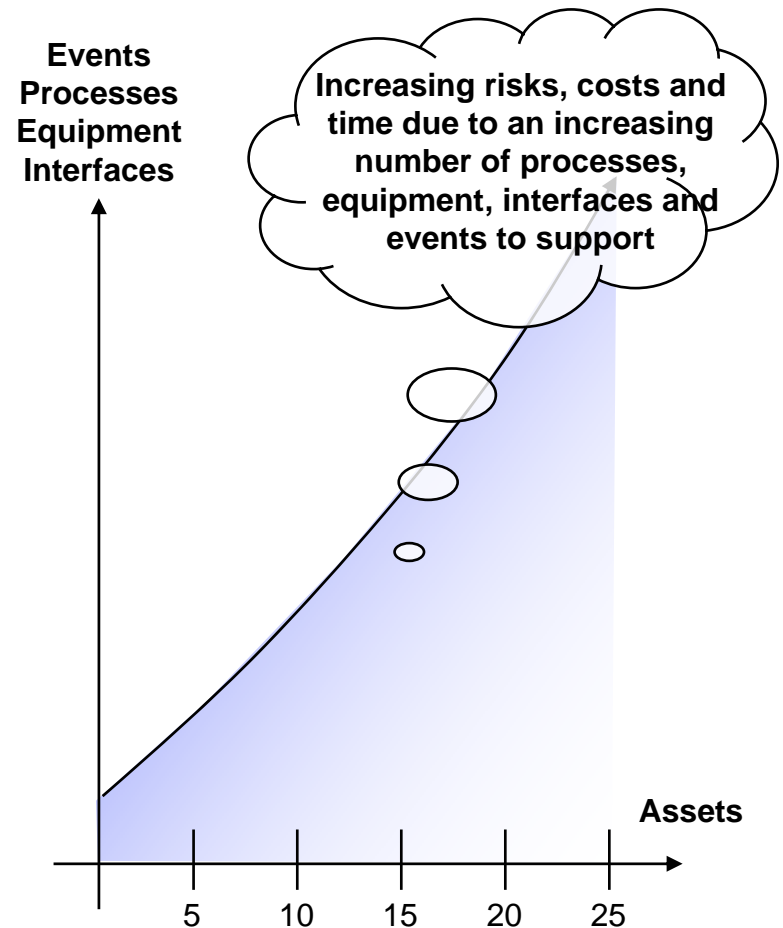
| Drilling & completion | Reservoir & production management | Operation & maintenance |

IBM Integrated Information Framework (IIF)

- Common access to information

- Service-oriented
- Incorporating reference model

- Plant specific procedures & applications
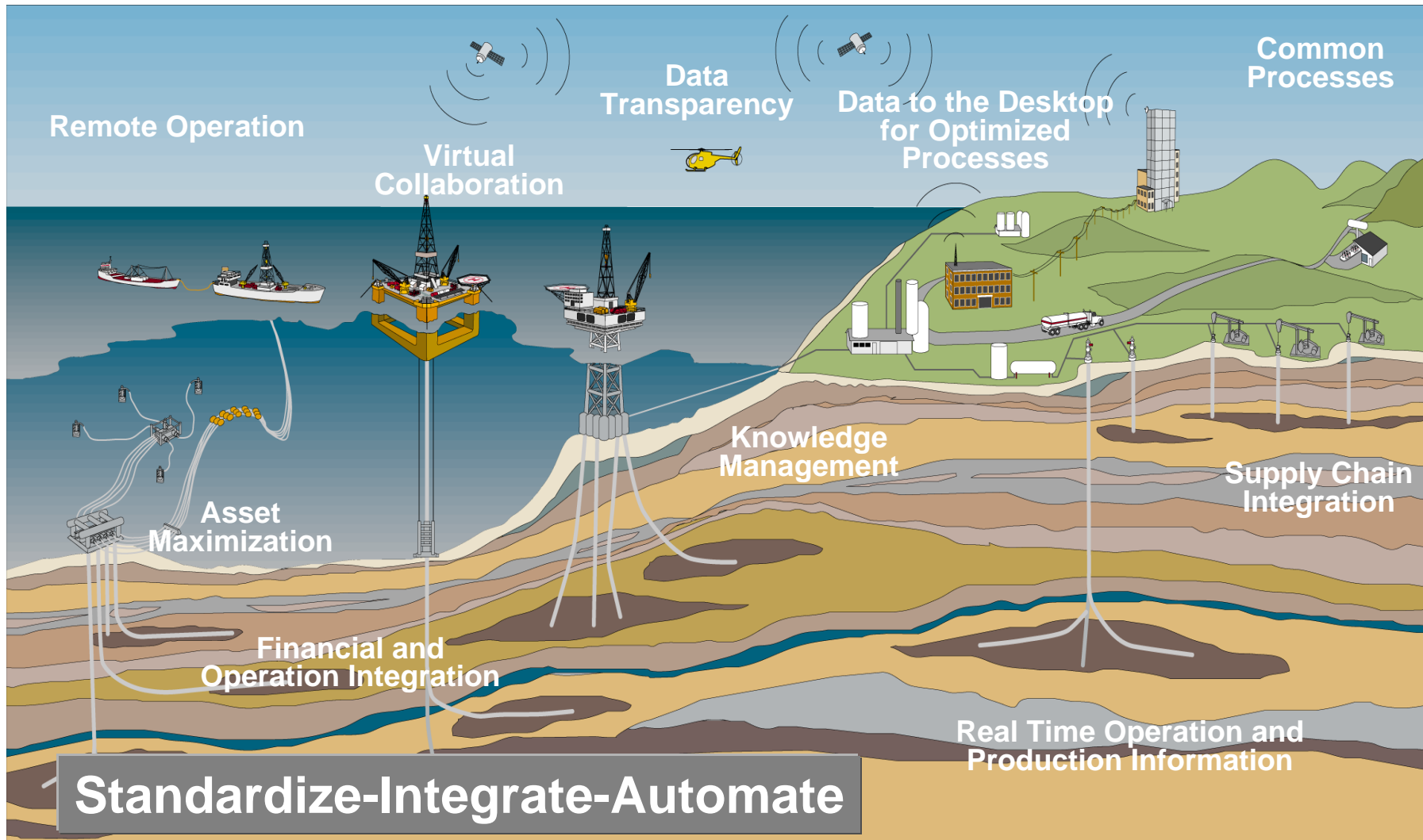
Many unique facilities in many countries

* The Norwegian Research Council is supporting several of the Tail IO projects

The IIF solution solves many of the scalability issues that the industry is facing

- **Automates updating of asset models**
  - When systems of authority are updated

- **Standardizes access to data across all assets**
  - Supports existing applications
  - Protects existing investments

- **Facilitates development and deployment of common processes and applications across assets**
  - No changes to assets required

Events Processes Equipment Interfaces

Increasing risks, costs and time due to an increasing number of processes, equipment, interfaces and events to support

Assets

5   10   15   20   25

The IIF solution facilitiates implementation of new, truly innovative processes

The effects of the new technologies on the industry's KPIs will be significant

- Fast and efficient rollout of new and more efficient real-time processes across assets
  - Accelerated production, improved regularity and reduced operating costs

- Realization of economies of scale across assets and domains in the business, IT and information management areas
  - Reduced investment, implementation and operating costs

Summary

- Ontologies and real-time integration technologies will affect the KPIs of the oil industry significantly
    - Standardize, integrate and automate processes
    - Solve scalability issues
    - Facilitiate fast and efficient rollout of new real-time processes and solutions across assets

- IBM will continue development of the RSM and the IIF solution in cooperation with Norwegian and international oil & gas companies, R&D institutions and vendors