# Semantic Web for Dummies

Stating that:

➢ The scope of unsolved data challenges is simply enormous

➢ The data volumes increase exponentially

➢ Semantic Web may lead to a "giant database in the sky"

➢ Web 1.0 – Pages and documents

➢ Web 2.0 – Social networking

➢ Web 3.0 – Semantic Web

➢ Web 4.0 – Operating system for applications and data system

➢ References to:

✓ ISO 11179 Metadata registries

✓ ISO 15926 Part 3 and Part 7
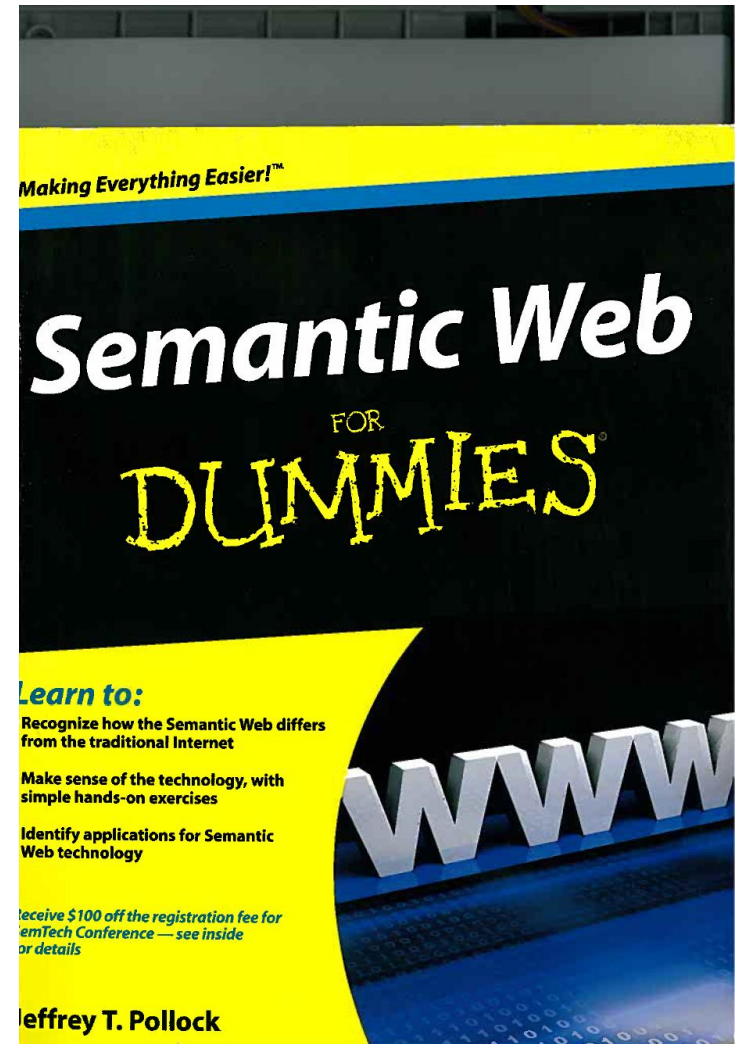
ISO 15926, Part 7: There are many industry-specific vocabularies that are adopting RDF and OWL. ISO 15926, Part 7 is one example focused on the exchange of data for different kinds of industrial plant operations — such as oil and gas drilling platforms.

Making Everything Easier!™

Semantic Web

FOR

DUMMIES®

Learn to:

Recognize how the Semantic Web differs from the traditional Internet

Make sense of the technology, with simple hands-on exercises

Identify applications for Semantic Web technology

Receive $100 off the registration fee for emTech Conference — see inside for details

Jeffrey T. Pollock

Integrated Operations and Data Interoperability

Dr. Thore Langeland
Manager IO, OLF
September 9, 2010

A small world
The oil spill disaster effects the Norwegian offshore industry

➢ What is happening in the Mexican Gulf, the oil disaster, is influencing opinion on Lofoten

➢ Norwegian opponents to opening the fragile ecosystems around the Lofoten Island with their critical spawning grounds for cod to oil drilling are arguing that Norway needs to delay any decision until the country fully considers the lessons from uncontrolled oil release off the coast of Louisiana

The Norwegian Oil Industry Association (OLF)

OLF The Norwegian Oil Industry Association

OLF The Norwegian Oil Industry Association is a professional body and employer's association for oil and supplier companies engaged in the field of exploration and production of oil and gas on the Norwegian Continental Shelf

OLF is a member of the Confederation of Norwegian Business and Industry, NHO

The main office is at Forus
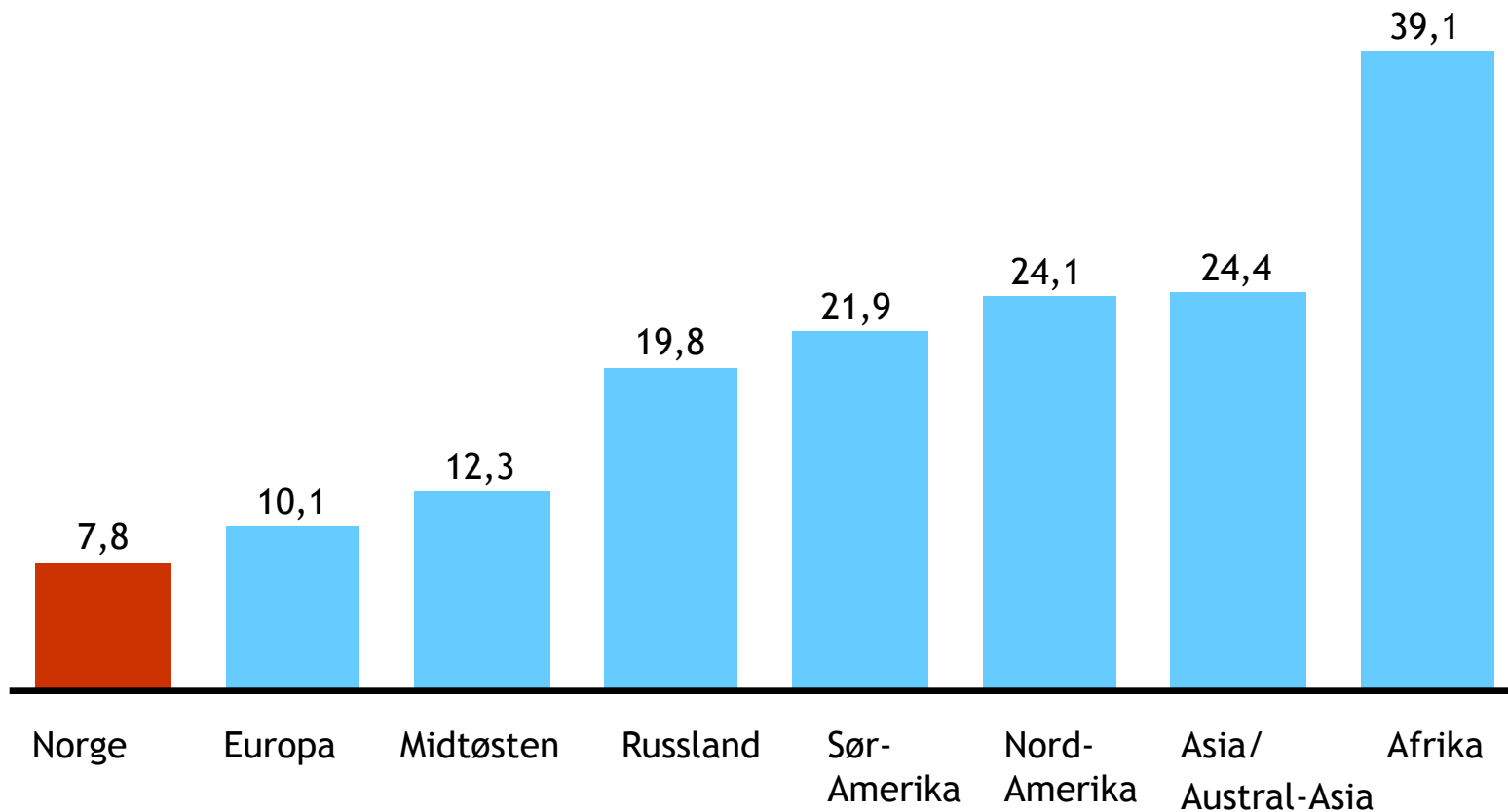OLF also has an office in Oslo

OLF's administration has 39 employees

Gro Brækken, Director General

Norway is the worlds cleanest oil and gas producer
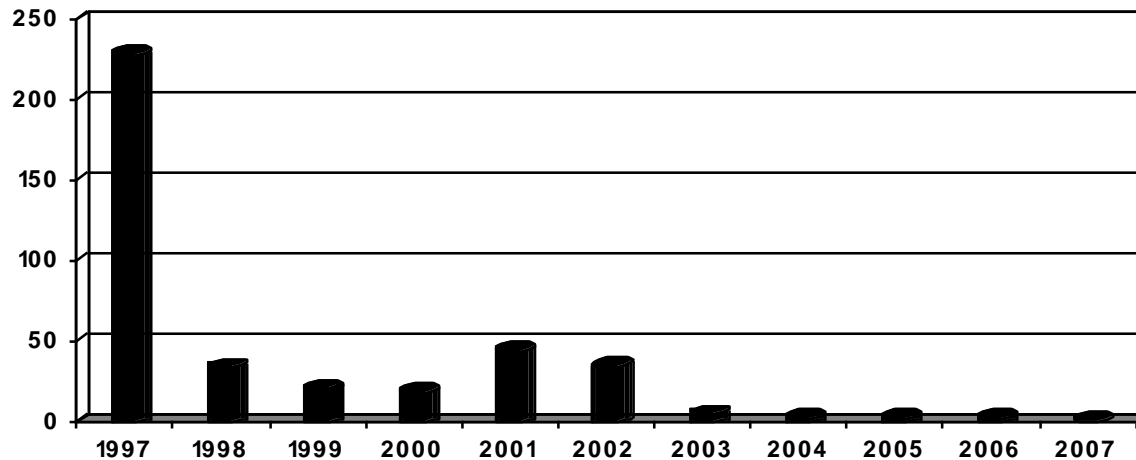
Kilo CO_2 per barrel o.e.

Norge	Europa	Midtøsten	Russland	Sør-Amerika	Nord-Amerika	Asia/Austral-Asia	Afrika
7,8	10,1	12,3	19,8	21,9	24,1	24,4	39,1

Total oil and gas produced, CO_2- og CH_4-gass inkluded
Source: OGP, OLF, Konkraft project

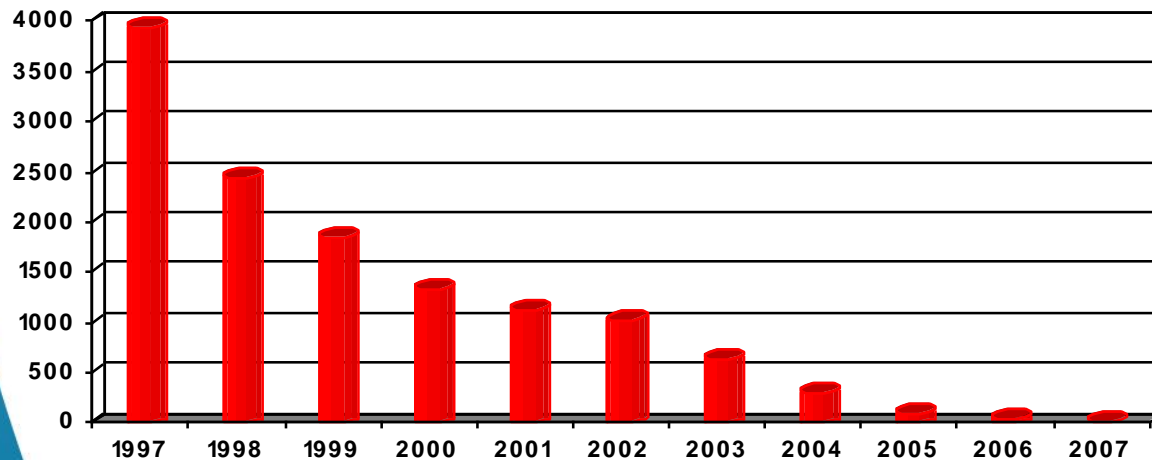# Norwegian offshore industry:
Dangerous environmental chemicals have been removed

■ Very dangerous   ■ Dangerous

1997: 228 tonn

2007: 1 tonn

1997: 3933 tonn

2007: 23 tonn

Integrated Operations

Generation 1 and 2

Integrated Operations reduce risks

> The Norwegian Snorre Field had an uncontrolled leakage of gas from a well in 2004

- ✓ Maintenance of a well
- ✓ A kick occurs and huge amount of gas leaks into the ground close to the sea bottom
- ✓ The gas is also filling up the water below floating platform
- ✓ Quite a few decisions were not according to regulations and good practices
- ✓ It serious event that could have been a new Piper Alpha accident

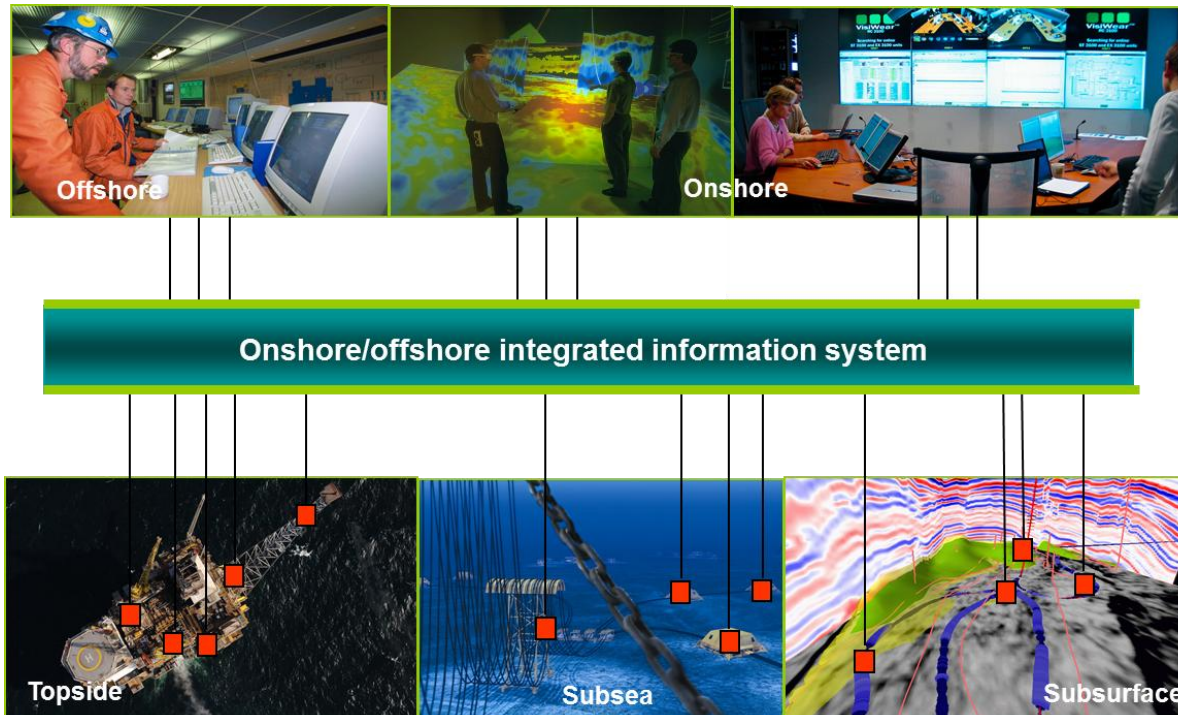"The Snorre event would not have happened if Integrated Operations had been implemented"

Terje Overvik
Executive Vice President, Statoil
(2006)

Integrated operations: Collaboration across all boundaries
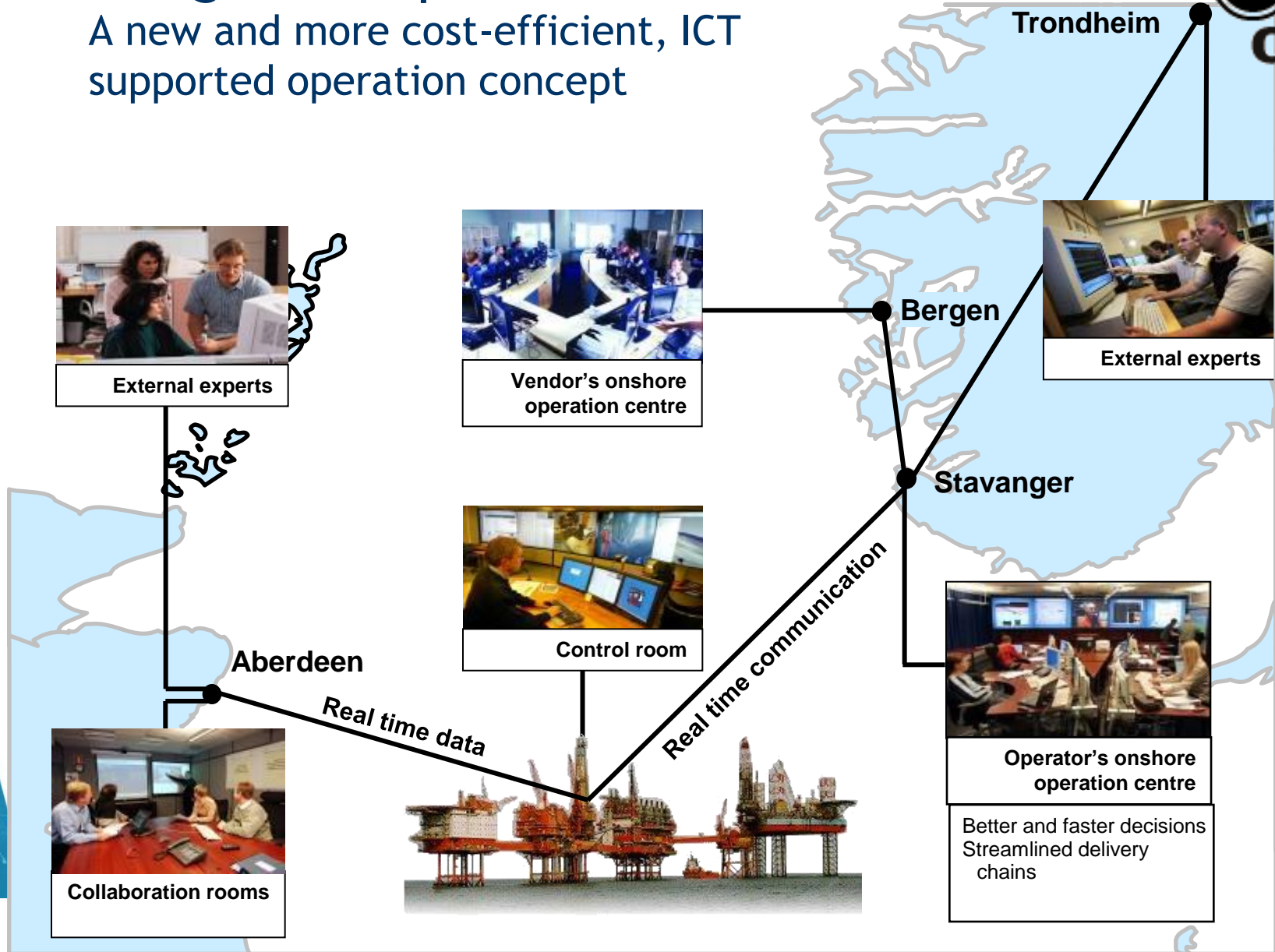## (OLF's IO Generation 1)

IO provides:

➢ Transparency
  ✓ Real time information shared offshore/onshore

➢ Improved work processes
  ✓ Onshore deciding
  ✓ Offshore executing

Integrated Operations
A new and more cost-efficient, ICT supported operation concept

Trondheim

External experts

External experts

Vendor's onshore operation centre

Bergen

Stavanger

Aberdeen

Real time data

Real time communication

Control room

Collaboration rooms

Operator's onshore operation centre

Better and faster decisions
Streamlined delivery
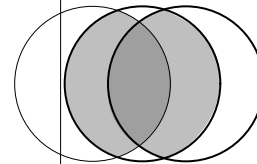 chains

Integrated Operations (IO)

Generation 1 and 2

IO is real time data onshore from offshore fields and new integrated work processes

IO has a potential of NOK 300 billions on the NCS
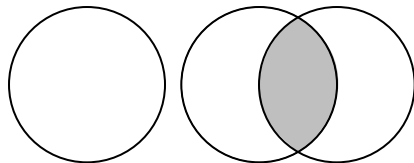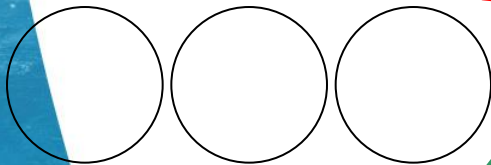
Potential

Integration across companies

Generation 2
- Integrated operation centers of operators and vendors
- Heavily automated processes
- 24/7 operation

Integration across onshore and offshore

Generation 1
- Integrated onshore and offshore centers
- Continuous onshore support

Limited integration

Traditional processes
- Self-sustainable fields
- Specialized onshore units
- Periodic onshore support

Time

2005   2010   2015
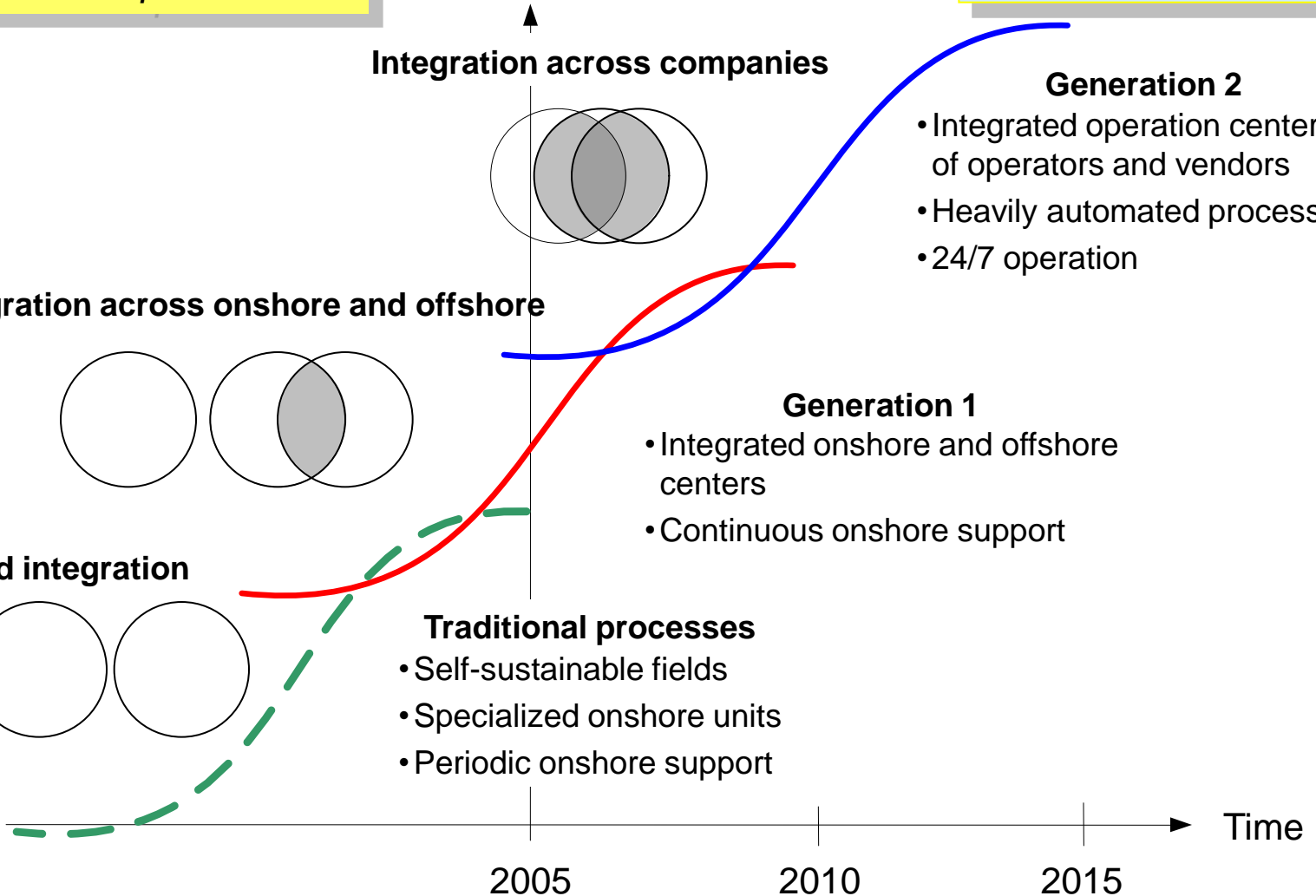
Integrated Work Processes
Traditional

- Daily operational decisions are made offshore with limited onshore support

- Personnel on- and offshore belong to several different organizational units

- Plans are made and changed fragmentally and at fixed times

- IT solutions are specialized and silo-focused

- Data necessary to optimize operations is time-consuming and difficult to gather

Self-sustainable fields & periodic communication

Self-sustainable field unit

Many onshore support units with different goals
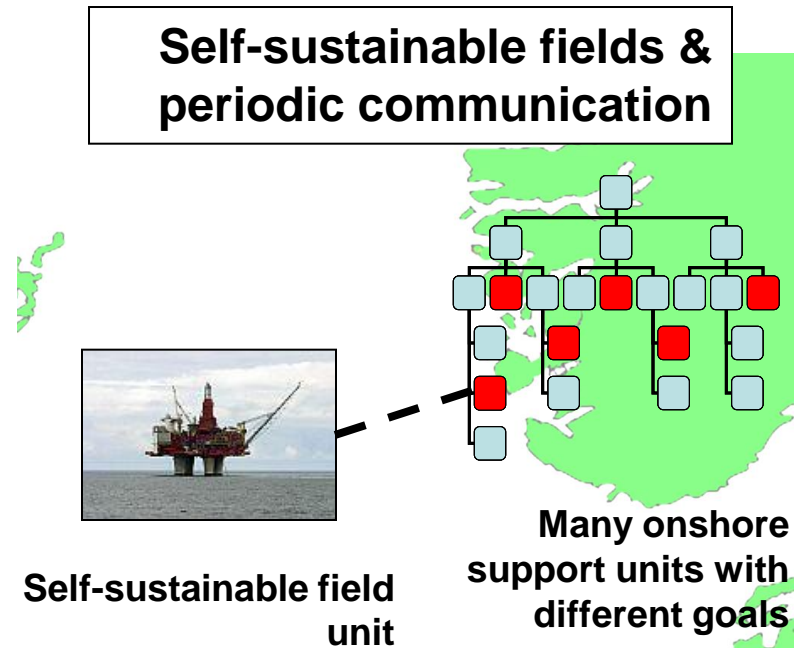
Integrated Work Processes
Generation 1

- Decisions are made jointly by teams onshore and offshore

- Personnel onshore monitor operations in real-time, identify operational and safety related problems, discuss actions with and support personnel offshore in the implementation phase

- For some areas like drilling onshore support is available 24/7, for other areas beyond normal work hours

- Off-the-shelf technologies like high quality audio and video systems are used extensively for real time co-operation

Integrated on- and offshore centers & real-time collaboration

Real-time collaboration rooms

Production

Drilling

Maintenance

Offshore gets continuous support from onshore

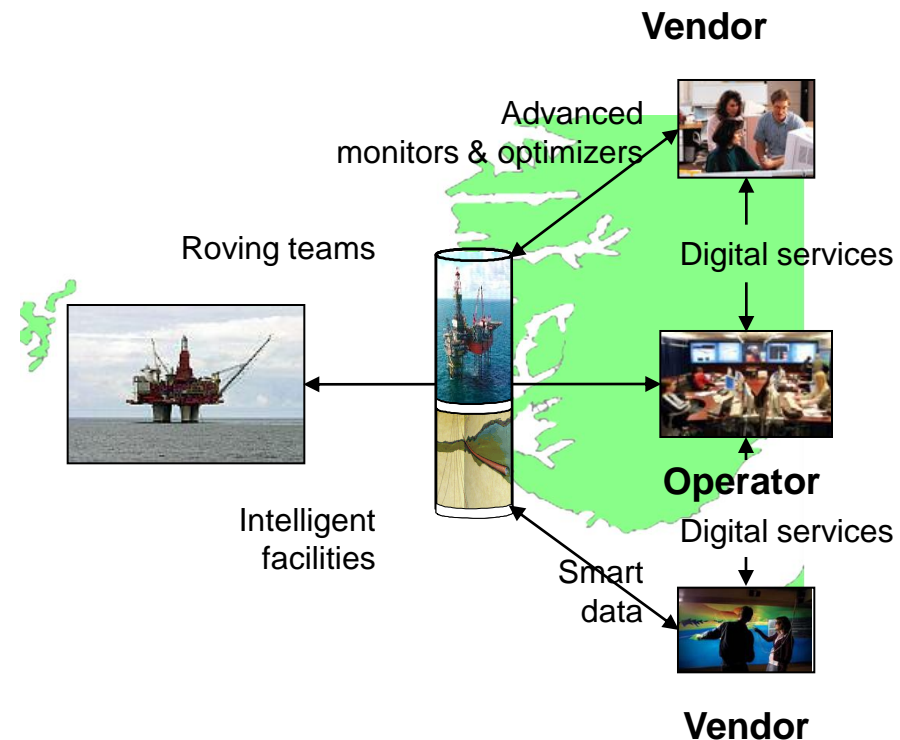**Integrated onshore centers are established**

olf

Integrated Work Processes
Generation 2

- Operation centers of operators and vendors are integrated
- Vendors are managing processes operators managed earlier
- Several tasks are automated
- The parties cooperate over "the net"
- The centers are operating 24/7
- Tasks are carried out according to "follow the sun" principles

Integrated operator and vendor centers and optimized delivery chains

Vendor

Advanced monitors & optimizers

Roving teams

Digital services

Intelligent facilities

Smart data

Digital services

Operator

Vendor

How to achieve IO G2?

OLF's Information Highway

> - The information highway
>   - ✓ Data capture
>   - ✓ Data transmission
>   - Fiber optics and WiMax
>   - ✓ Data integration
>   - Reference architecture for IO G2
>   - Harmonizing E&P terminology   (The oil & gas ontology)
>   - ✓ Data security
>   - A set of OLF guidelines with basic requirements for information security

> - Today's IT solutions have already major digestions problems, new technologies provide much more data – requiring new IT architectures

> - More and more of the communication will be between computers requiring languages based on reasoning understandable by computers

Fiber optics on the NCS

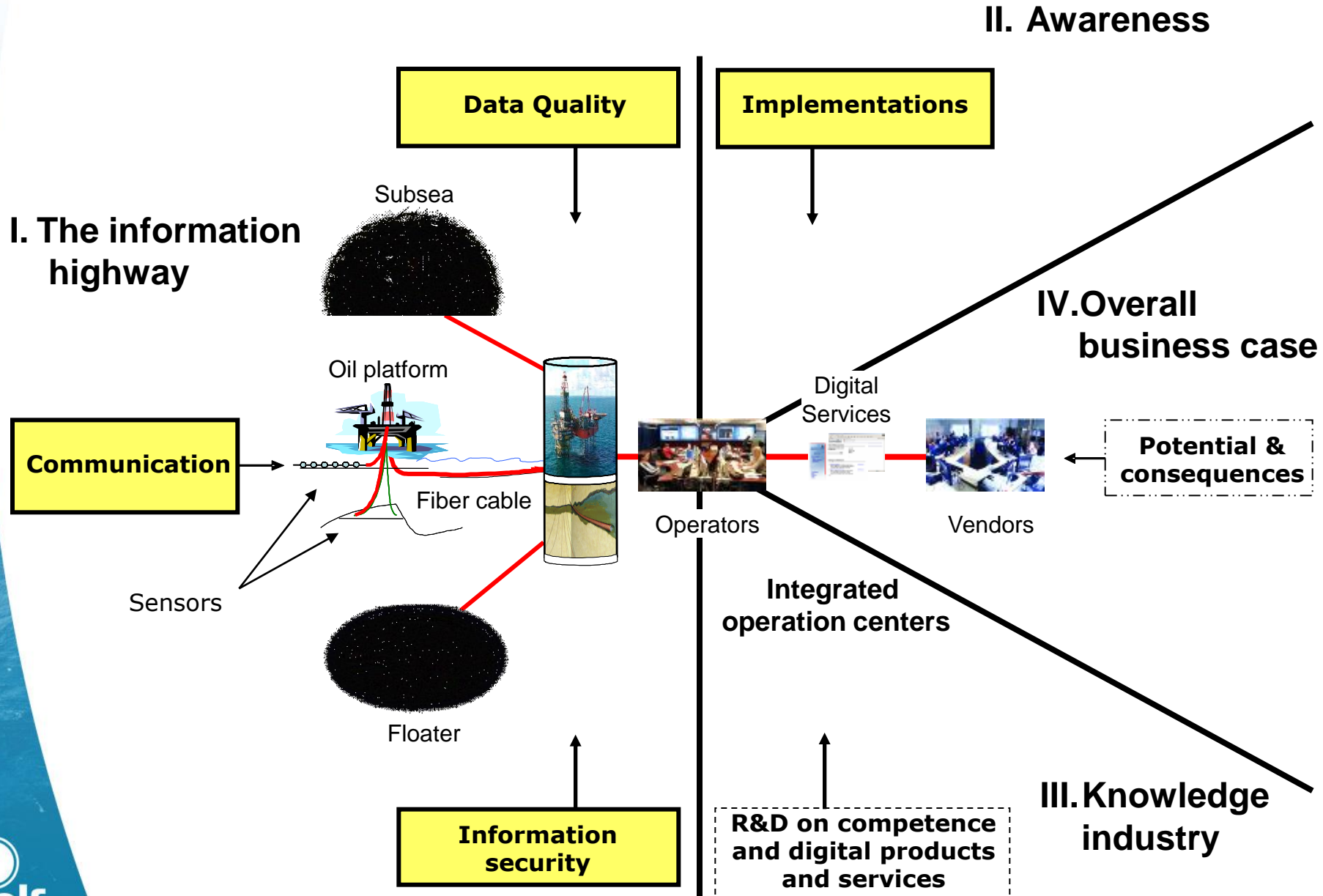**New technologies provide more data**
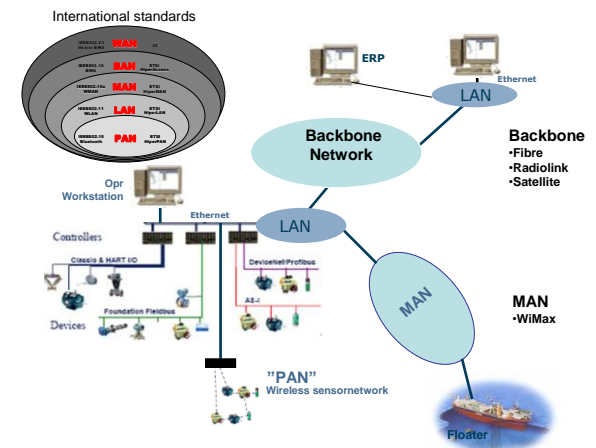
Machine-to machine communication

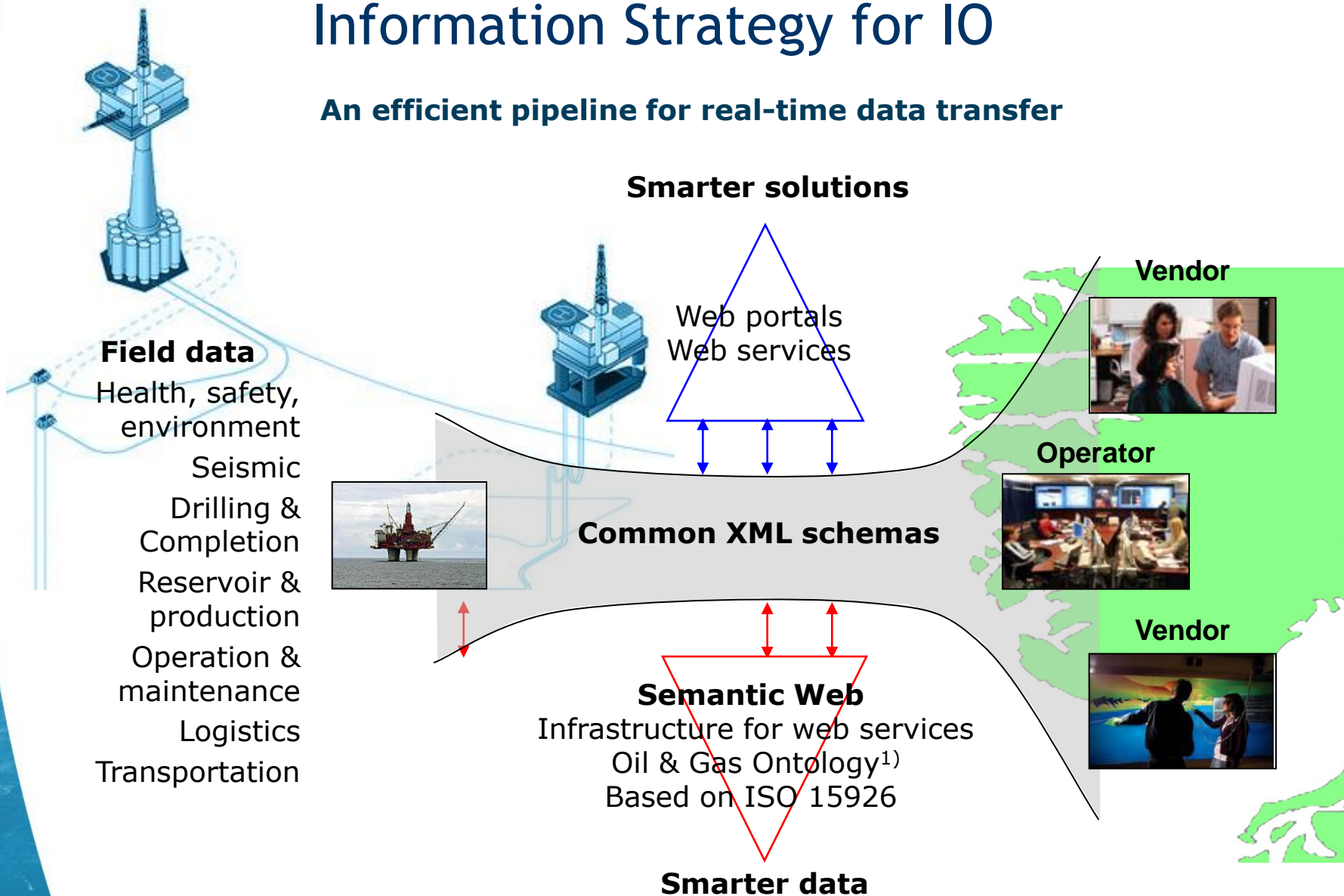An estimated 2 billion people will be on the web by 2011 ….

…and a trillion connected objects – cars, appliances, cameras, roadways, pipelines – comprising the "Internet of Things"

Areas addressed by OLF

II. Awareness

| Data Quality | Implementations |

I. The information highway

Subsea

Oil platform

Communication

Fiber cable

Sensors

Floater

Operators

Digital Services

IV. Overall business case

Vendors

Potential & consequences

Integrated operation centers

III. Knowledge industry

Information security

R&D on competence and digital products and services

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Information Strategy for IO

An efficient pipeline for real-time data transfer

Smarter solutions

Field data

Health, safety, environment

Seismic

Drilling & Completion

Reservoir & production

Operation & maintenance

Logistics

Transportation

Web portals
Web services

Common XML schemas

Vendor

Operator

Vendor

Semantic Web
Infrastructure for web services
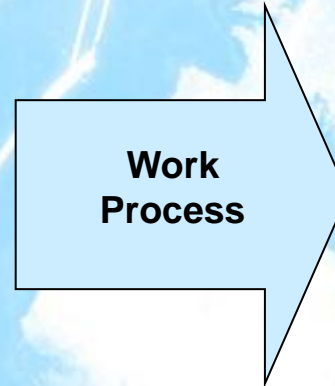Oil & Gas Ontology[1]
Based on ISO 15926

Smarter data

[1]**Ontology** = A hierarchical data structure containing concepts, relationships, properties and rules for a specific domain
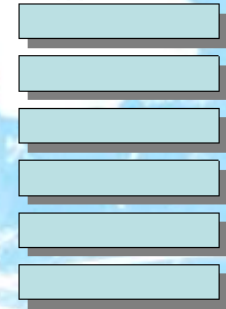
Information sharing

Company C
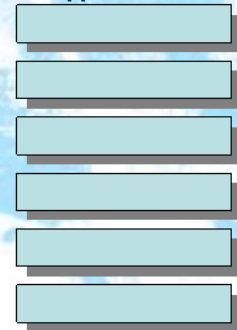End-users
applications

Company A
End-users
applications

SOURCE → **Repository**

Work Process

Well defined data according to ISO 15926

Company B
End-users
applications
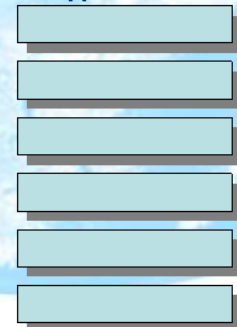
OLF has focus on data

Availability and quality of **data**
is the basis for:
- ✓ work processes
- ✓ operational decisions

IT - OLF has focus on transformation and routing
(Information Service Bus (ISB) and iRing)

Data

Domain - OLF has focus on terminology (ISO 15926)
(3 levels of data integration
- Dictionary
- Taxonomy
- Ontology)

OLF's IO Generation 1 & 2 and Semantics

IO Generation 2
Integrated operation centers of
operators and vendors
Heavily instrumented facilities
Heavy automation and multi-domain
optimization of processes

Generation 2
Complete ontologies
supporting automated
reasoning or inference of
data using logical rules
Taxonomies for multiple
domains

Automatic optimization

Intelligent facilities

Oil & gas ontology

IO Generation 1
Integrated onshore and
offshore centers
Intra-domain optimization of
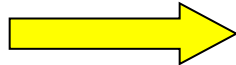work processes

Real-time collaboration rooms

Generation 1
Terminologies for single domains
The basis for XML schemas for
automatic transferal of data between
applications in same domain

Traditional facilities

Construction of the oil and gas ontology

XML Schema

XML Schemas:

HSE:
- ✓ Yearly environmental report

Drilling
- ➢ WITSML
  - ✓ Daily drilling report

Development/Operation
- ➢ DataSheetML
  - ✓ Instrumentation, electrical, subsea equipment, static equipment, rotating equipment, piping &

The oil and gas ontology

All meta data in the XML schemas should be

No.	N1	N2	N3		Nn
1					
2		HSE		Drilling	
3					
m					

HSE Drilling Development Production Operation Logistics

...roduction report, monthly production report
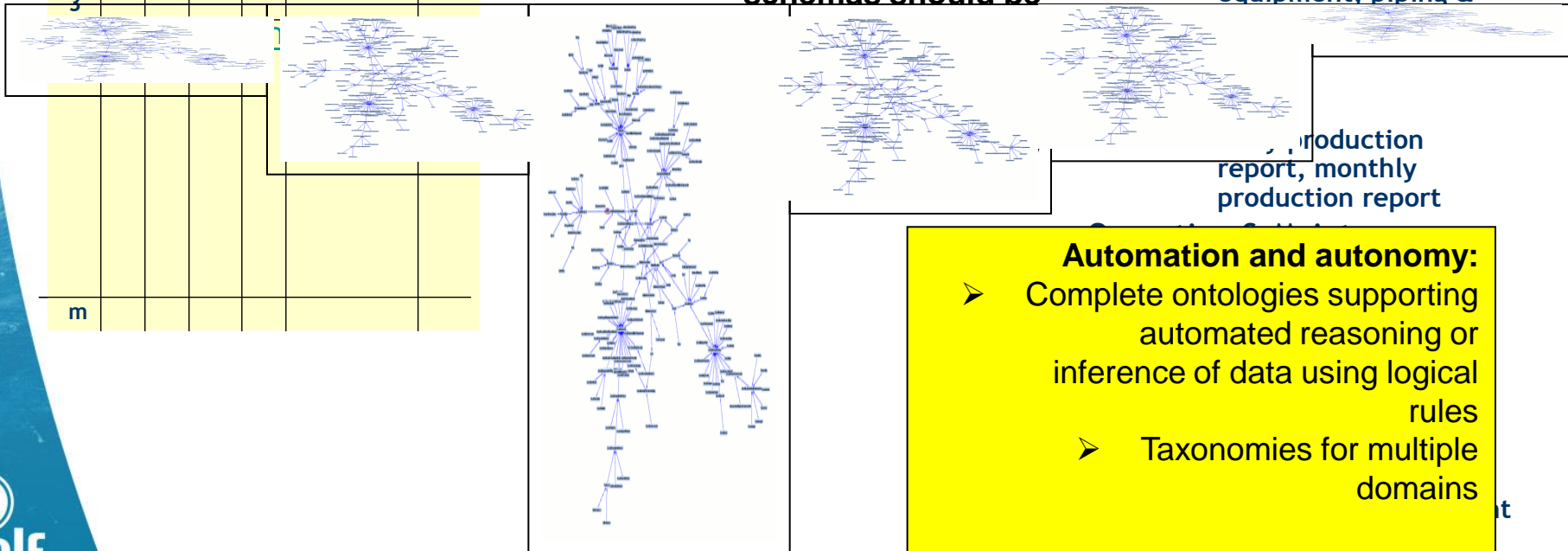
Automation and autonomy:
- ➢ Complete ontologies supporting automated reasoning or inference of data using logical rules
- ➢ Taxonomies for multiple domains

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Information quality

- Information quality
  - A common dictionary

    (HSE, drilling, development, production, logistics, operation and maintenance)

- Deployments
  - Daily Drilling Report
  - Daily Production Report
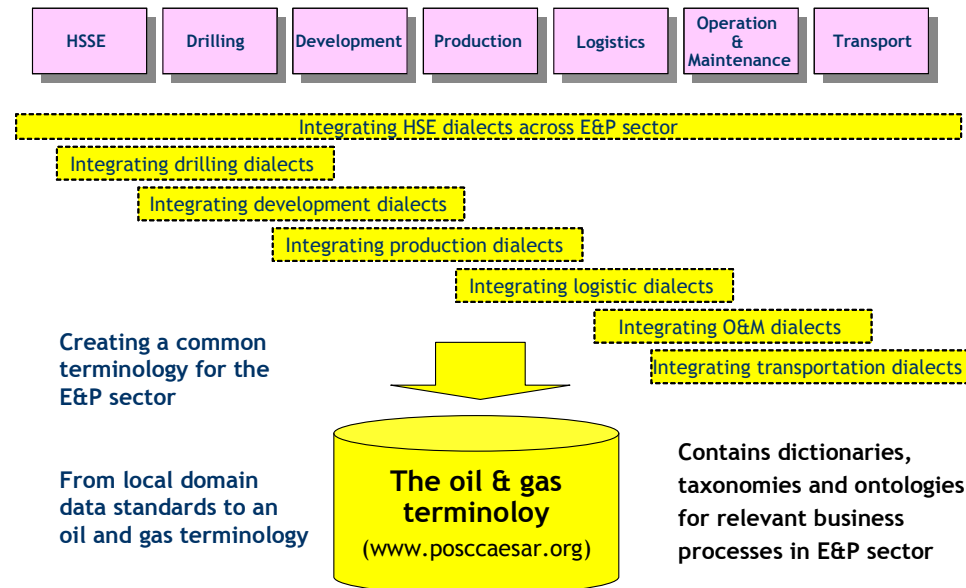 - Monthly Production Report
  - Yearly Environmental Report
  - RFID deployment
    - Personnel
    - Container
    - Drill string
    - Equipment
  - EqHub – a common database for standard equipment

Harmonizing the E&P terminology

Integrating the terminology from the different business domains in E&P

| HSSE | Drilling | Development | Production | Logistics | Operation & Maintenance | Transport |

Integrating HSE dialects across E&P sector

Integrating drilling dialects

Integrating development dialects

Integrating production dialects

Integrating logistic dialects

Integrating O&M dialects

Integrating transportation dialects

Creating a common terminology for the E&P sector

From local domain data standards to an oil and gas terminology

The oil & gas terminoloy
(www.posccaesar.org)

Contains dictionaries, taxonomies and ontologies for relevant business processes in E&P sector

EqHub - pre-qualified information delivered once and for all
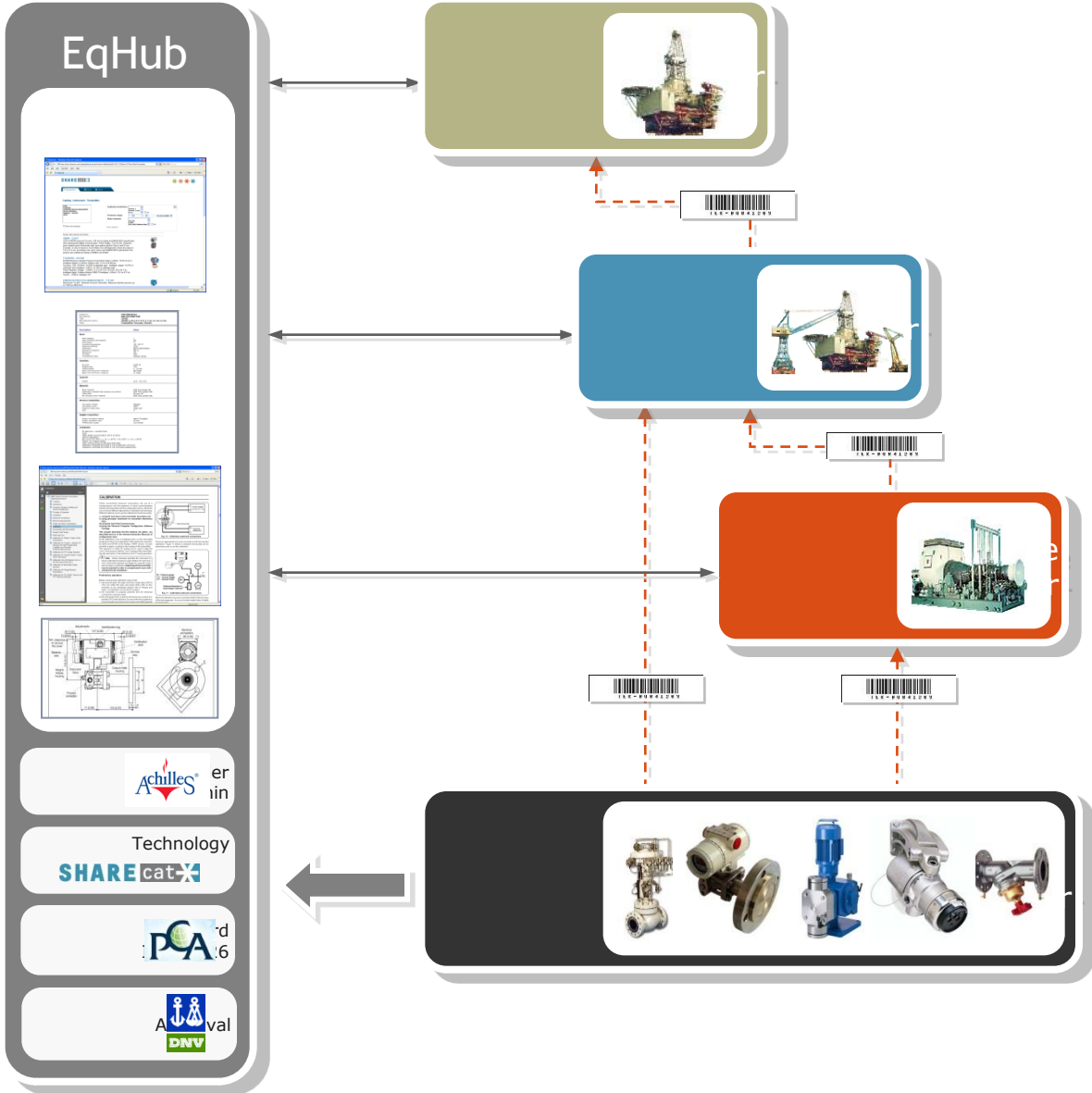
Deployment RFID in oil and gas

Deployment of RFID in oil and gas
– an OLF Guideline for:
- ✓ Personnel
- ✓ Containers
- ✓ Drill strings
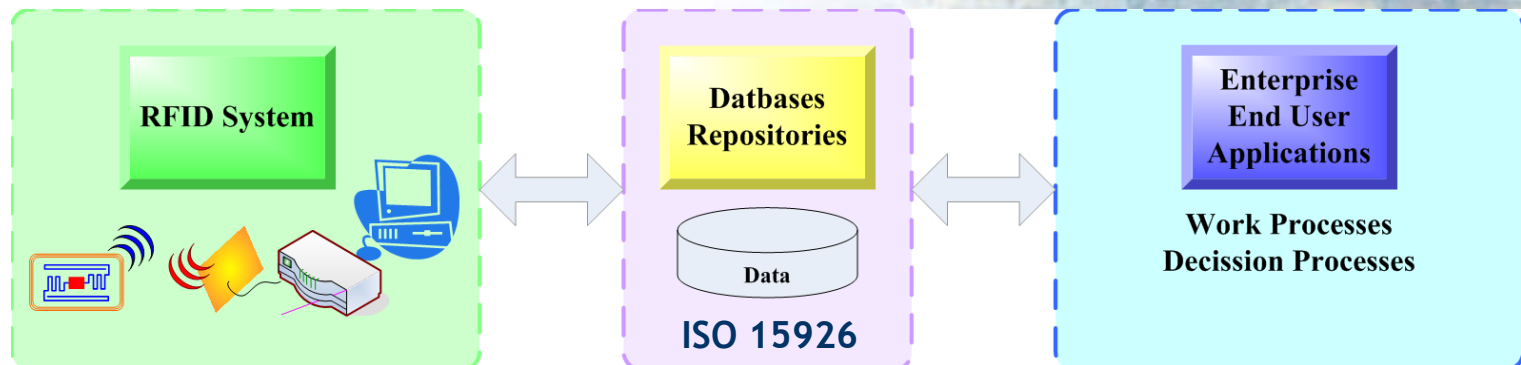- ✓ Mobile equipment
- ✓ Fixed equipment

The guideline is based on ISO standards

http://www.olf.no/rapporter/category229.html

RFID System

⟷

Datbases Repositories

Data

ISO 15926

⟷

Enterprise End User Applications

**Work Processes Decission Processes**

Vertical integrations: ERP - O&M - Process control

International Society for Automation (ISA) has introduced the vertical integration for enterprise, manufacturing and process control given in the figure on the right.

➢ **Operations**
   Use of automated information systems can improve operations and its control. This will reduce costs and improve productivity.

➢ **Maintenance**
   Use of automated and condition monitoring information systems enables fault diagnosis and predictive maintenance. Predictive maintenance reduce maintenance cost and improve regularity.
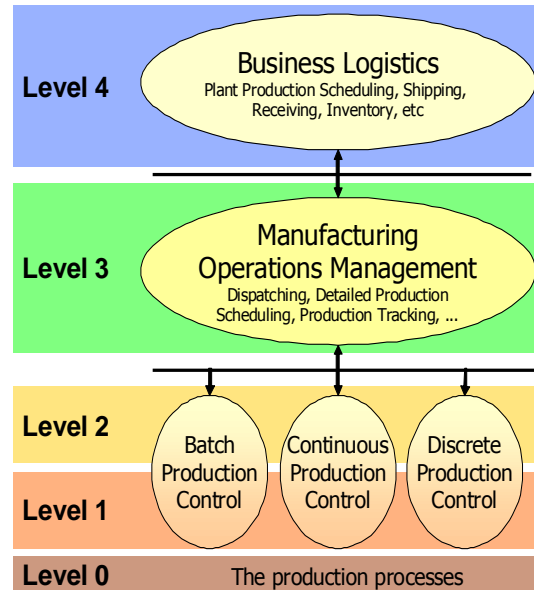
Relevant standards from Open O&M
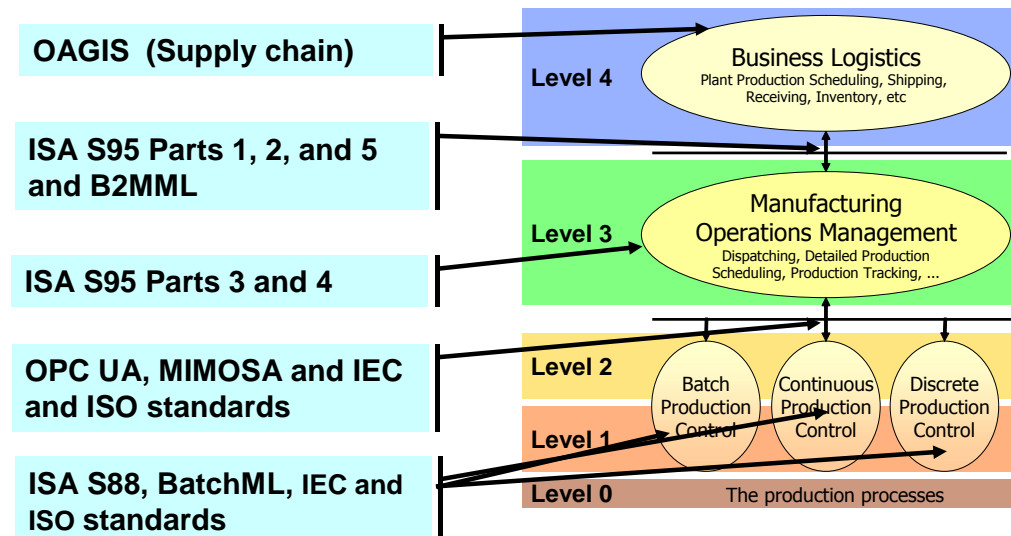
IBM's RSM on the way to ISO

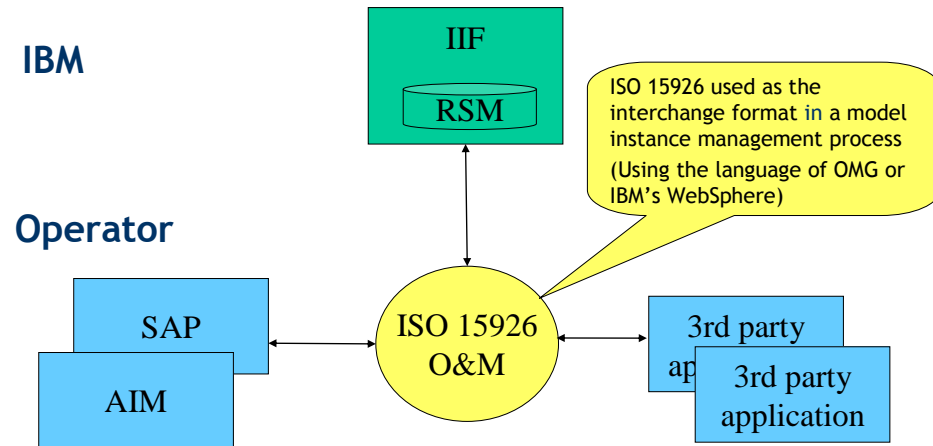➤ To make IBM's Information Integrating Framework compatible with international standards a process has been initiated through IOHN to map RSM into ISO 15926 and to standardize that part as an ISO standard

(press release on OLF web site)

➤ Together with OLF and PCA, IBM is also proactive working with other relevant standardization to get acceptance for the proposed IT architecture to be solution for the E&P sector

IBM

IIF

RSM

ISO 15926 used as the interchange format in a model instance management process (Using the language of OMG or IBM's WebSphere)

Operator

SAP

AIM

ISO 15926 O&M

3rd party application

3rd party application

Collaborating standardization organizations
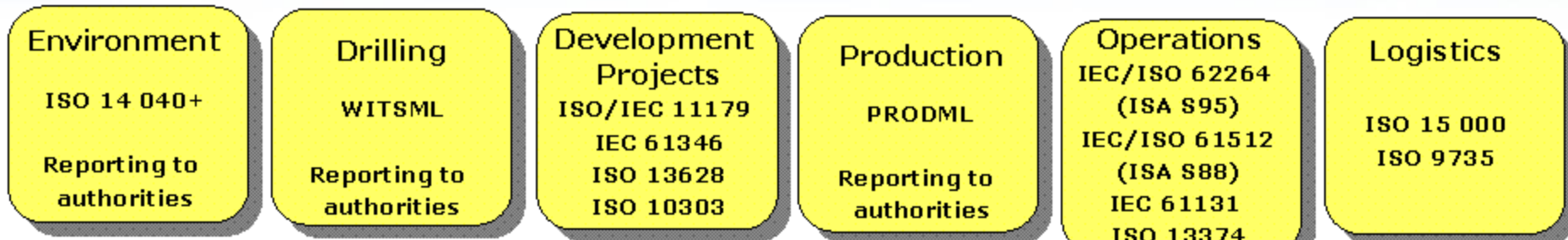
ISO International Organization for Standardization

energistics

W3C Semantic Web

PCA POSC Caesar Association FIATECH

PCA POSC Caesar Association

MIMOSA

The Open O&M

OLF and EPIM

OLF has initiated and completed terminology and format (XML) work of:

- ➢ Daily drilling report
- ➢ Daily production report
- ➢ Monthly production report
- ➢ Yearly environmental report

OLF has initiated work on:
- ➢ EqHub
- ➢ Terminology work in O&M
- ➢ Reference IT architecture

http://www.olf.no/rapporter/category229.html

EPIM has the management of these reports:

Monthly Production Report (MPR)

Daily Production Report (DPR)

Daily Drilling Report (DDR) version 1.1 -Terminology

Daily Drilling Data
TVD, MD, kick data, geology, gas readings ....

Smarter solutions

Licence Web
Web services
WITSML
DDRML

Common XML schemas

Semantic Web
ISO 15926
PCA RDL

Smarter data

Authorities

Operator

Partners

http://www.epim.no/visartikkel.asp?id=1251
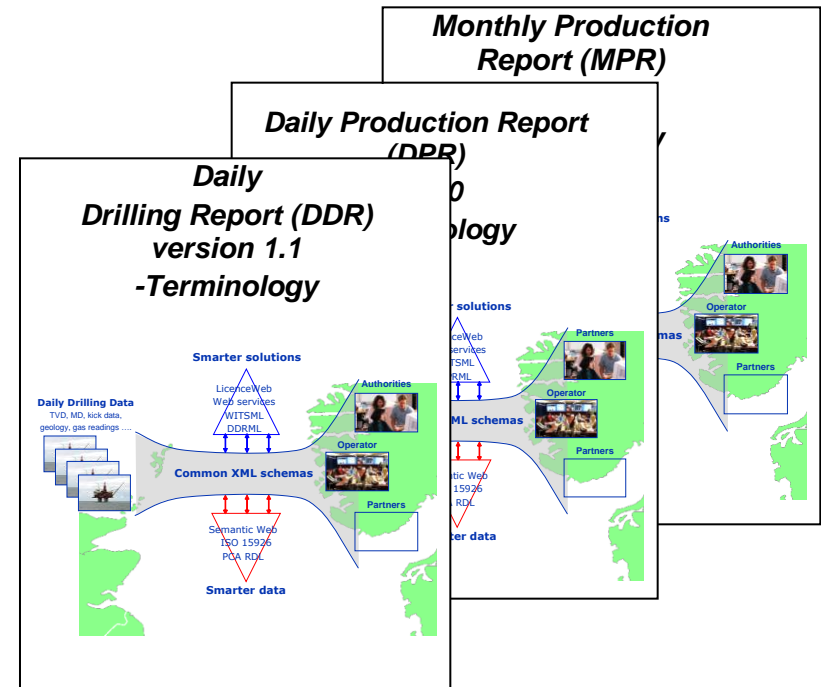
Information and IT architecture

➢ The reference IT architecture developed by OLF is an open infrastructure for loosely-coupled integrated applications based on service orientated principles

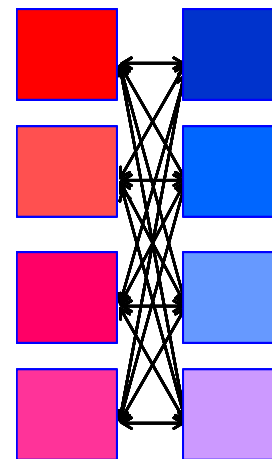➢ This approach avoids the exponentially growing complexity of integrating applications by using the oil & gas ontology as a reference for mapping.

| Drilling and Completion | Reservoir and Production Management | Operations and Maintenance | Enterprise' |

NEW UPSTREAM APPLICATIONS

Enterprise Service Bus
Services integration
Communication and Information Security

Oil & Gas Ontology

DCS, PLC & Historians | Rotating Equipment Monitoring | Facility Monitoring and MES | Engineering Systems | Maintenance & Asset Management | Equipment and Process Documentation

EXISTING APPLICATIONS & INFORMATION REPOSITORIES

PROCESS CONTROL DOMAIN

ENTERPRISE DOMAIN

Software integration

Interoperability

ISO 15926 Oil and Gas Ontology

Sharing today

Sharing tomorrow

IO in the High North (IOHN)

High North: typical operational concept

- Heavily instrumented facilities
- Lean local organization
- Extensive remote support organization

⇒ **Robust and secure digital infrastructure required**

⇒ **Novel collaborative work processes required**

Heavily instru-mented facility

Lean local organization

External expert center

Remote asset organization

Multi-asset support center
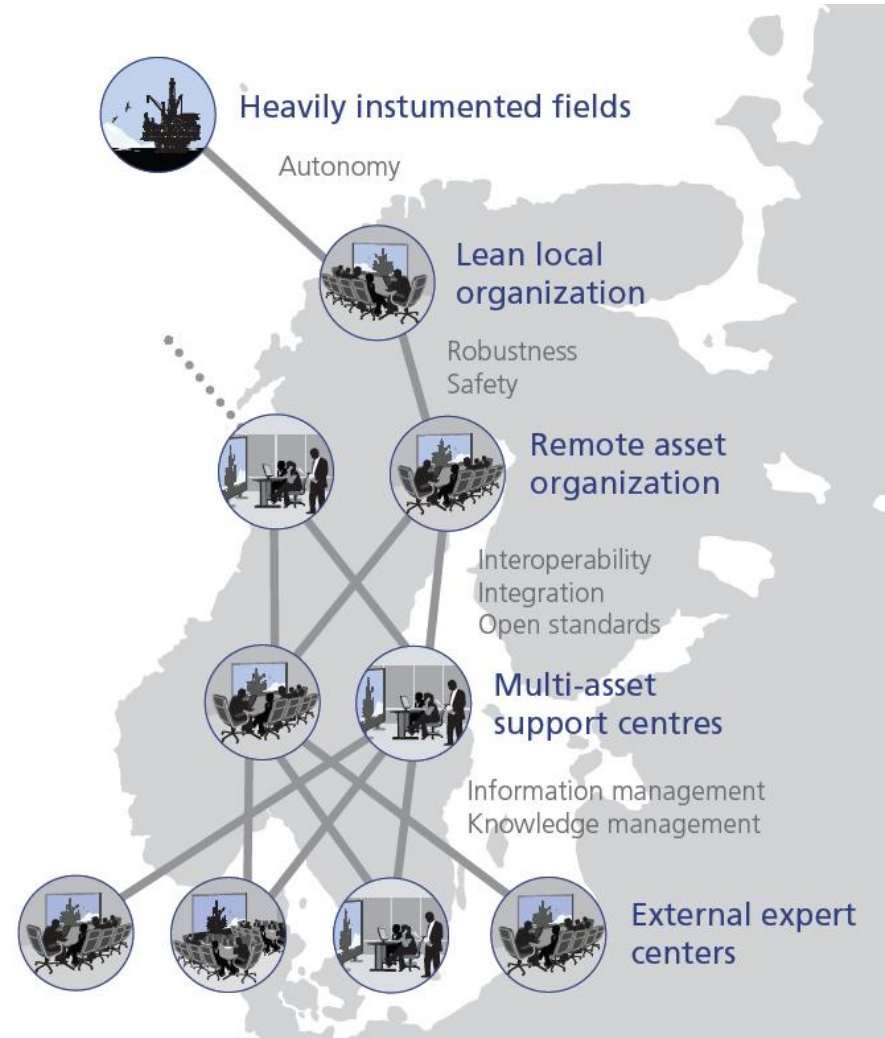
Main Objective for IO in the High North

Main objective: Demonstrate a reliable digital platform for Integrated Operation Generation 2 (IO G2)

Requirements: Come from use cases within

- Drilling & Completion
- Production & Reservoir management
- Operation & Maintenance

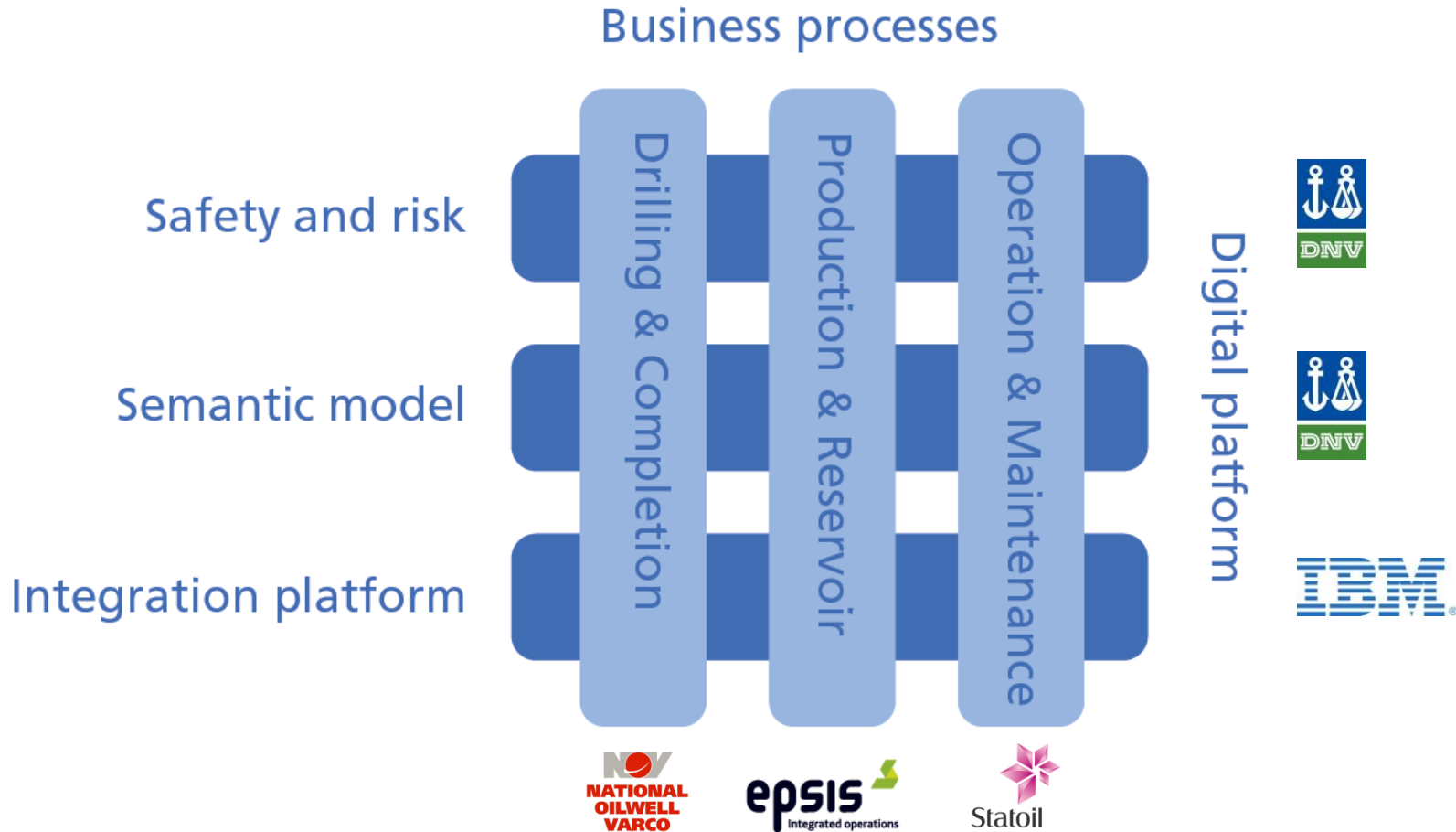**Key element:** Handling of real-time data across applications, disciplines, locations and organizations

Heavily instumented fields

Autonomy

Lean local organization

Robustness
Safety

Remote asset organization

Interoperability
Integration
Open standards

Multi-asset support centres

Information management
Knowledge management

External expert centers

Project set up and activity leads

Target architecture

Users

Applications

IBM's IIF

Classification

Classes & Relations

PCA's RDS (ISO 15926)

Information Service Bus (ISBM) OpenO&M, PCA, iRING

Registration

Assets & Systems (Individuals)

MIMOSA's Registry

Providers

Data Historian

EqHub

EPIM's Equipment Catalogue

Maintenance
Operations
Production
Development
Drilling
Environment
Safety

RFID Global unique identification Number (IOT)
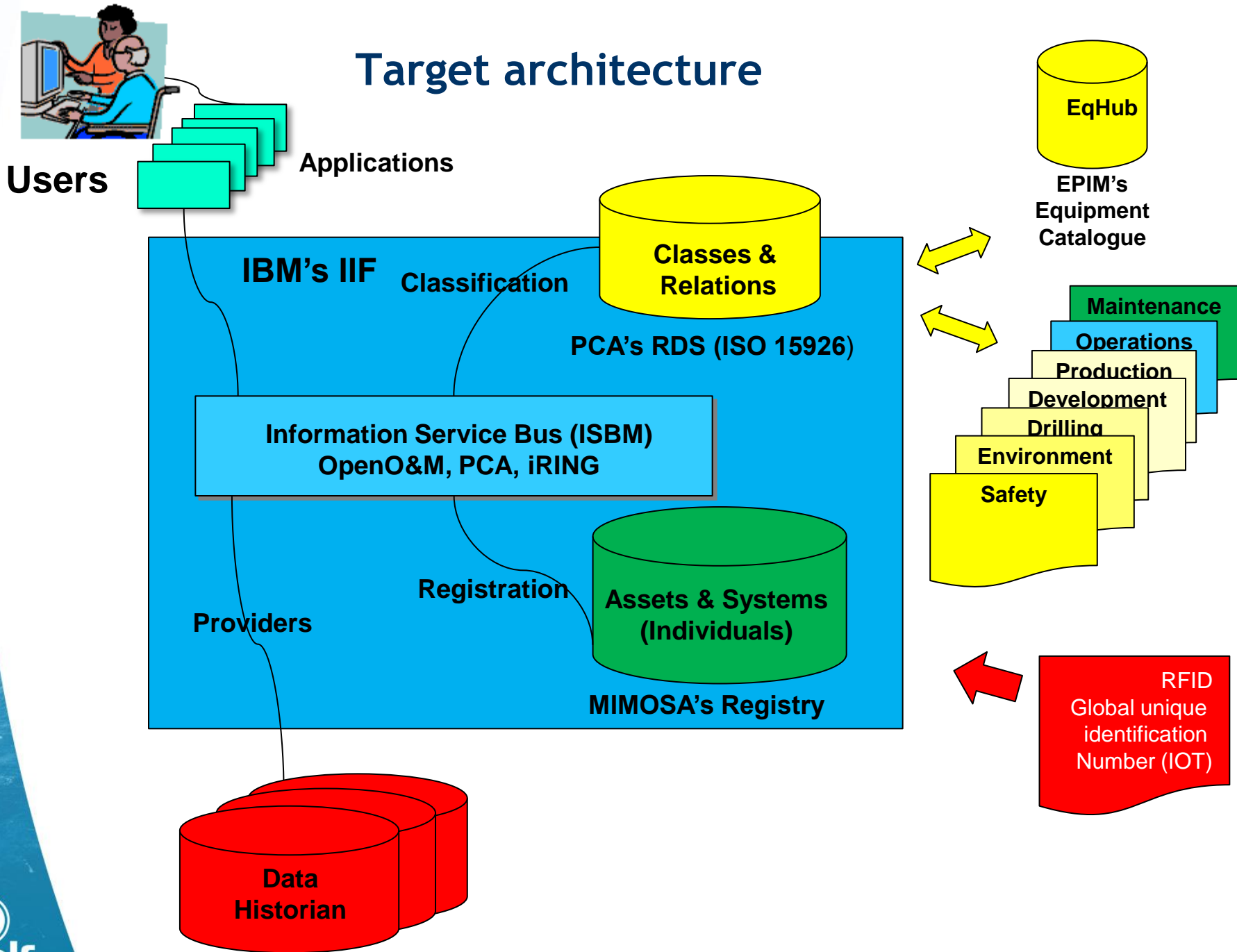
Target architecture - multiple ISBM

Applications

Users

Consumers

ISO 15926 RDF Template instances

Classes & Relations

PCA's RDS (ISO 15926)

Users

ISBM 1

ISBM 2

ISBM 3

IBM's IIF ESB

iRing ESB

IBM's IIF or other ESB

Providers

Providers

ISO 15926 RDF Template instances

Data Historian

Assets & Systems (Individuals)

Instance Model Exchange when integrating same assets

Assets & Systems (Individuals)

Data Historian

IBM's IIF RSM with ISO15926, ISA95/88 and Mimosa class instances

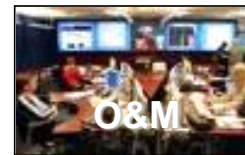**MIMOSA's Registry**

Integrated Information Framework (IIF)
Purpose

Provide a basis for standardization of processes and applications across facilities

- Standardized processes

- 3rd party applications

D&C   **R&P**   **O&M**

- Operation & expert centers

Enterprise

IBM Integrated Information Framework (IIF)

- Standardized access to information

Plant

- Facility specific processes

- Many different well management, DCS, asset management, IMS and other systems

Summing up

Integrated Operations

➢ IO is access to offshore information in real time onshore

➢ IO is integrated work processes across drilling, production, operation and maintenance in real time

➢ IO is safer, cleaner, faster and better decisions

➢ IO has a potential of at least $ 50 billions on the NCS

➢ IO is a quiet revolution an has changed offshore operations already and more will come with IO G2

How to get started with the oil and gas terminology and ontology?

Initiator	Standardization	Operation
Daily Drilling Report	Reference Data	January 1, 2009
Daily Production Report	System	January 1, 2009
Monthly Production Report	RDS	January 1, 2009
Yearly Environmental Report	RDS (includes	-
IOHN - Drilling	PRODML)	-
- Production	RDS	-
- Operation & Maintenance	RDS - in progress	-
- IT Architecture (ESB)	RDS - in progress	-
RFID	RDS - in progress	-
NorHub (equipment information)	-	July 1, 2010
	RDS	
	RDS – in progress	

Thank you for your attention!

Compete and collaborate - co-epitition - is the way to stay alive in the global economy.