

Hva vil Industri 4.0 bety for norsk produksjon?

Oslo 12. Mai 2016

Industri 4.0 for alle industribransjer

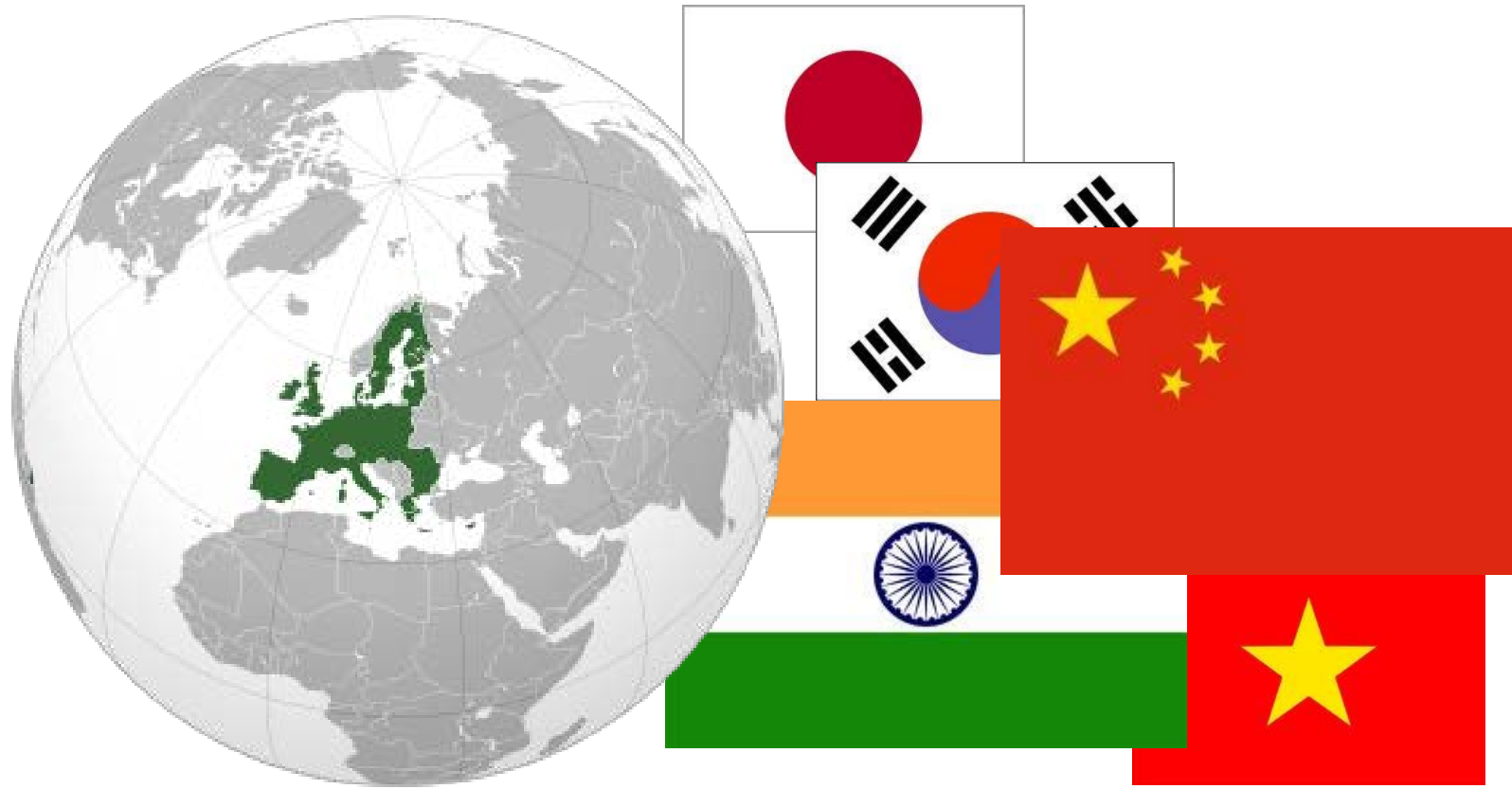
– også olje og gass

Odd Myklebust,

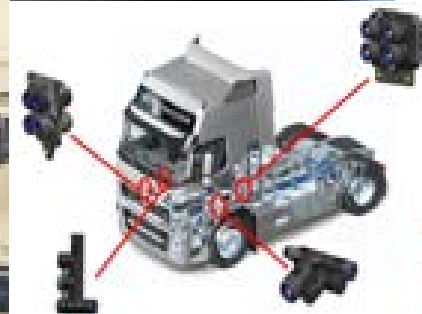
SINTEF/NTNU



Globalization, Norway not any longer a "different" country







An Industrial change in Norway....



??

Europa – many national approaches for *manufacturing strategies*.

	Program	Goal	Focus	Priorities
Europe		Manufacturing is a key enabler for Europe's grand societal challenges	Factory of the future	Advanced manufacturing processes Adaptive and smart manufacturing systems Digital , virtual and resource-efficient factories Collaborative and mobile enterprises Human-centred manufacturing Customer-focused manufacturing
Germany		Securing the future of German manufacturing industry	Cyber physical systems	Standardisation and reference architecture Managing complex systems A comprehensive broadband infrastructure for industry Safety and security Work organisation and design Training and continuing professional development Regulatory framework Resource efficiency
Dutch		A portent of a new era of manufacturing Netherlands	Network centric production	High quality, network-centric communication between players, human and system, in the entire value network Digitisation of information and communication among all value chain partners and in the production process on all levels Granular, flexible, and intelligent manufacturing technologies, adjustable on the fly to meet highly specific end-user demands
Sweden		Strengthening innovation for production in Sweden	Sustainable production	Environmentally sustainable production Flexible manufacturing processes Virtual production development and simulation Human-centred production system Product- and production-based services Integrated product and production development

Industri Futurum

- Hva betyr industri 4.0 for industriproduksjon i Norge?

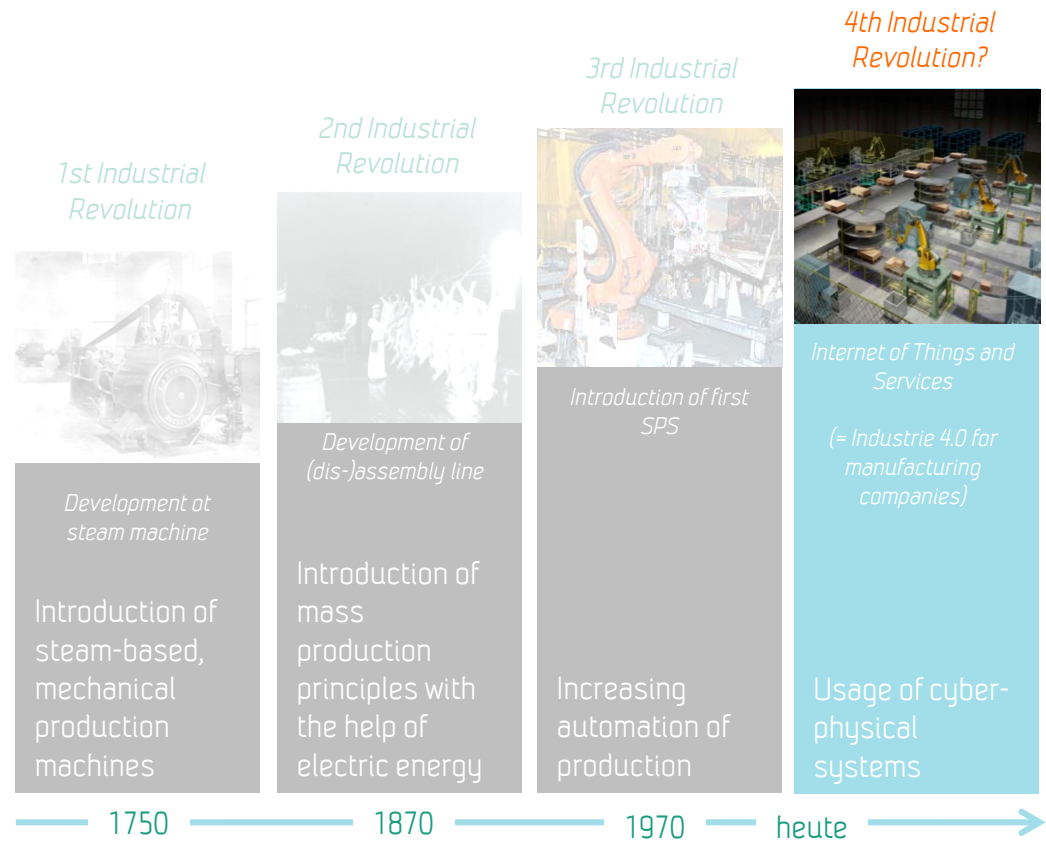
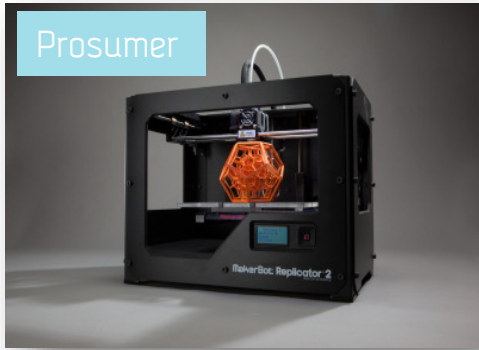
- *Industri Futurum er Norsk Industries initiativ til å få etablert «den norske Industri 4.0»*

"The Future is Digitalization"

- Advanced manufacturing, disruptive technologies
- Digitalization (extended automation possibilities)
 - BIG DATA
 - INTERNET OF THINGS
 - CPS Cyber Physical Systems
- Flexibility, (even more) custom orientation
- Knowledge oriented workers/operators
- Product – services

- Sustainability, going green, live-cycle perspectives

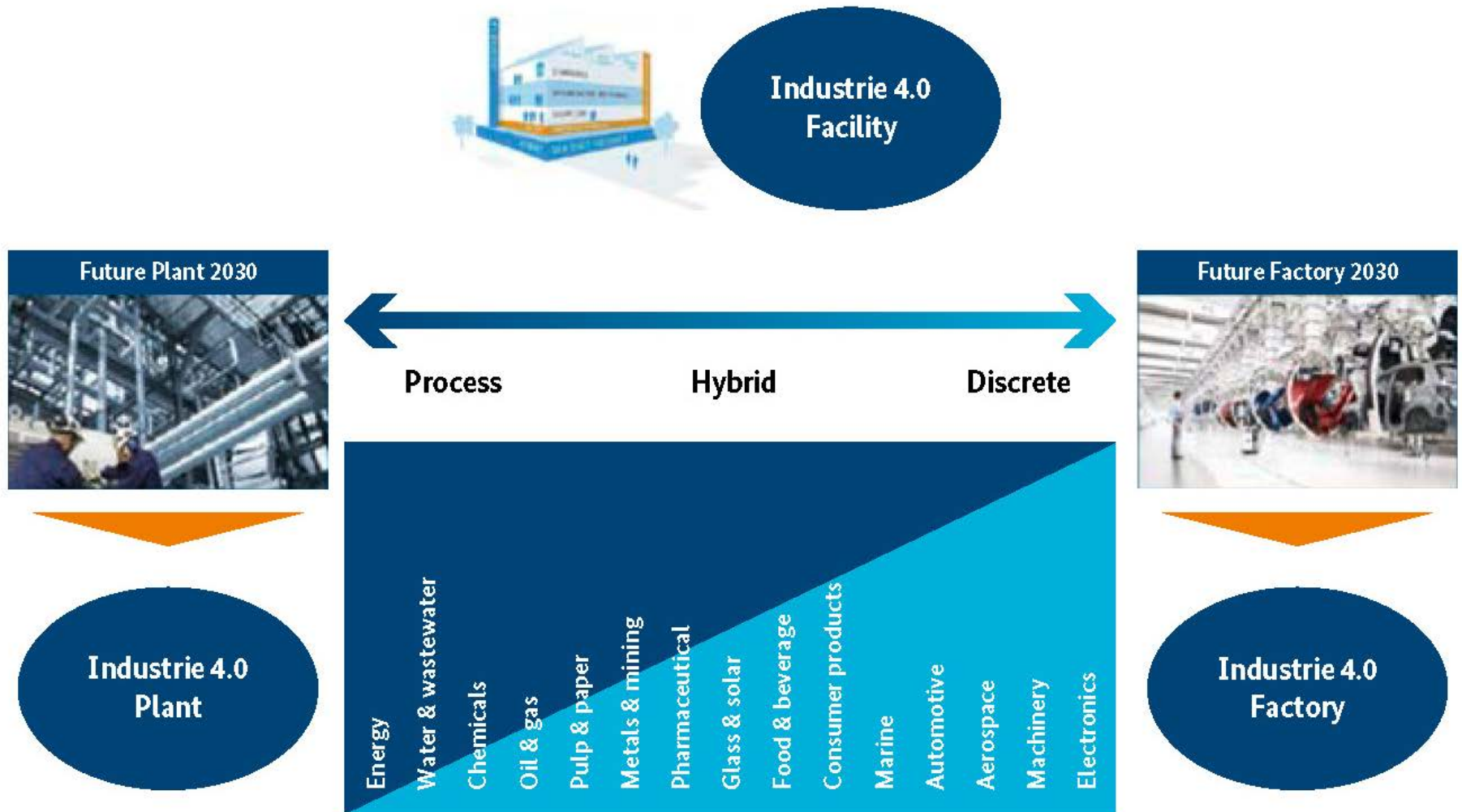
Industrial revolutions and Industrie 4.0



Industrial revolutions are a mirror of demands, developments and crisis in society.
The 4th industrial revolution is based on **digitalization and connectivity**.

Source: Plattform Industrie 4.0, Druckhelden, Leoni

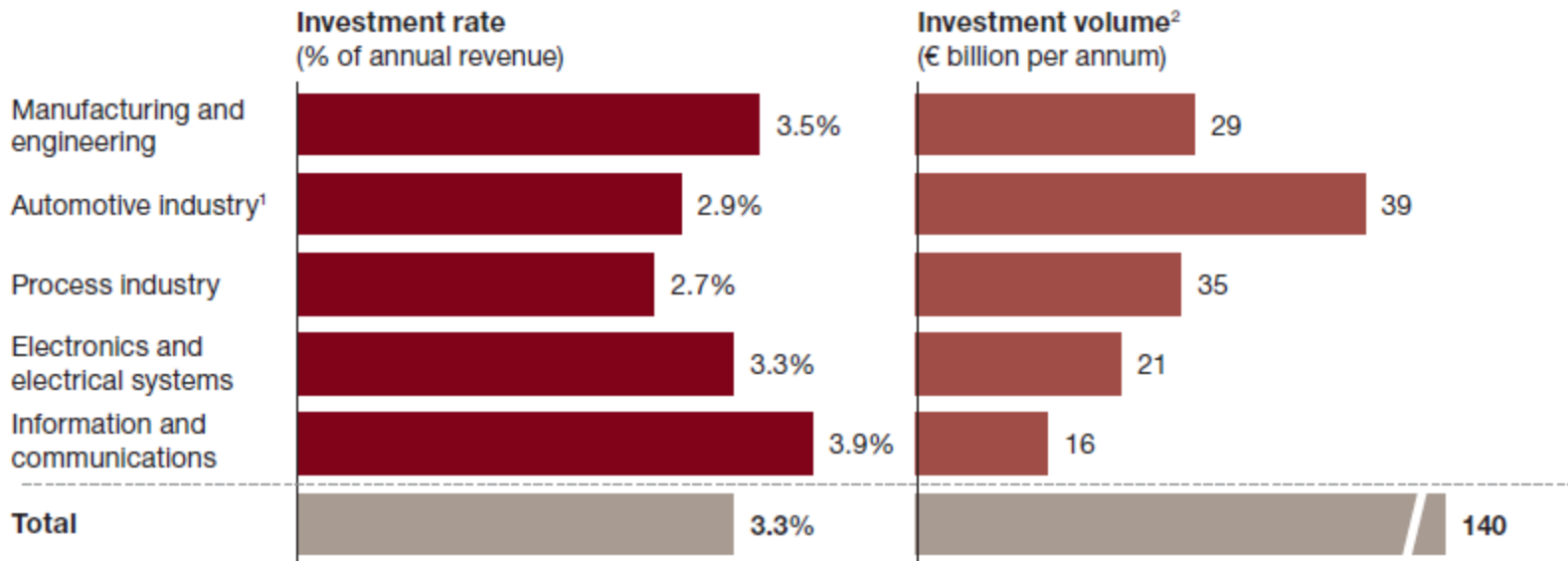
Industry 4.0 concerns all kinds of Manufacturing:



Source: Siemens AG

The European industry will invest €140 billion annually in Industry 4.0 solutions until 2020

Annual investments in Industry 4.0 solutions through until 2020



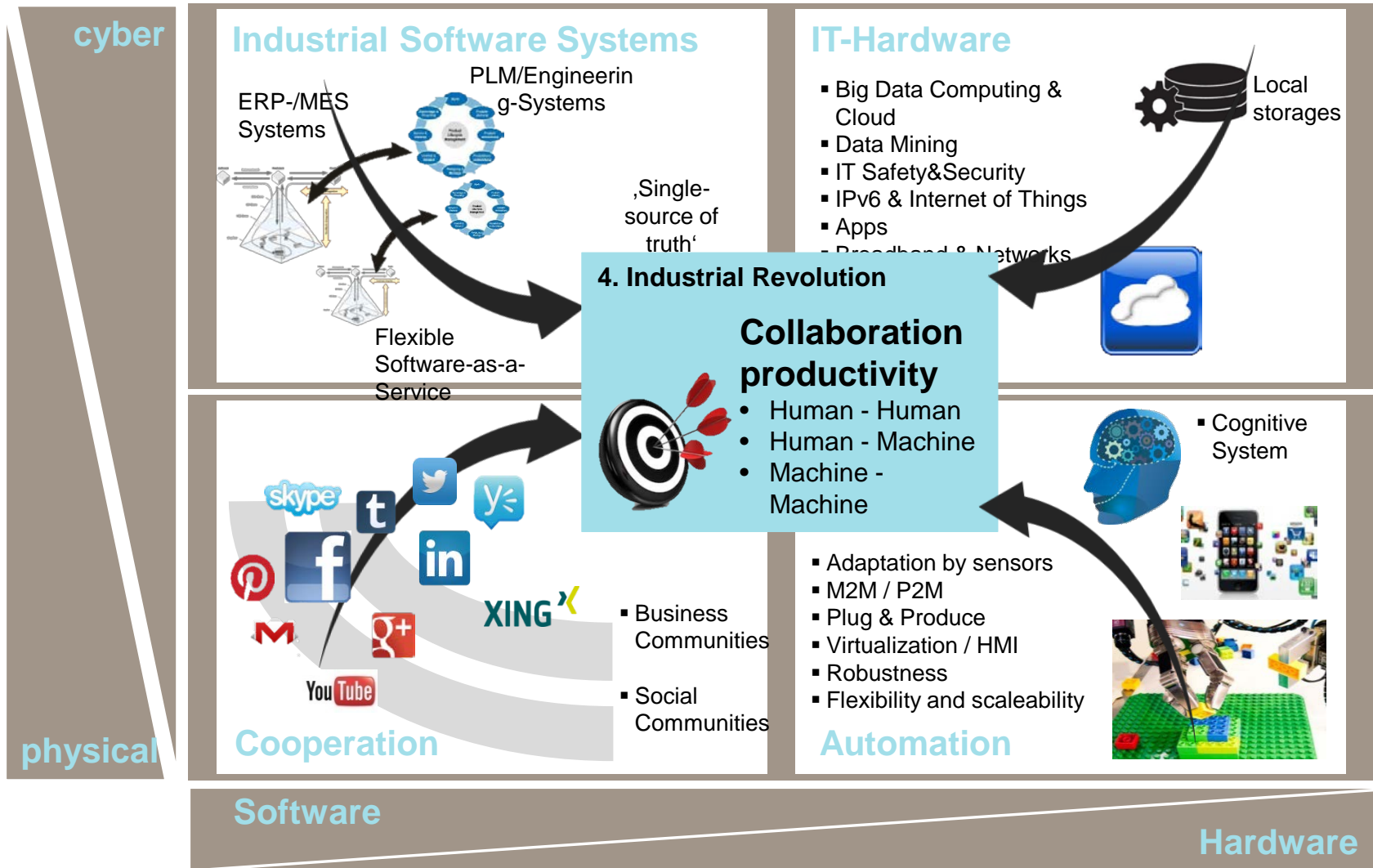
¹ Projection for the entire automotive industry (economic sector 29: production of motor vehicles and motor vehicle parts).

² Projection on the basis of total revenues per industry sector in the EU-28.

In five years, more than 80% of companies will have ***digitized their value chain***

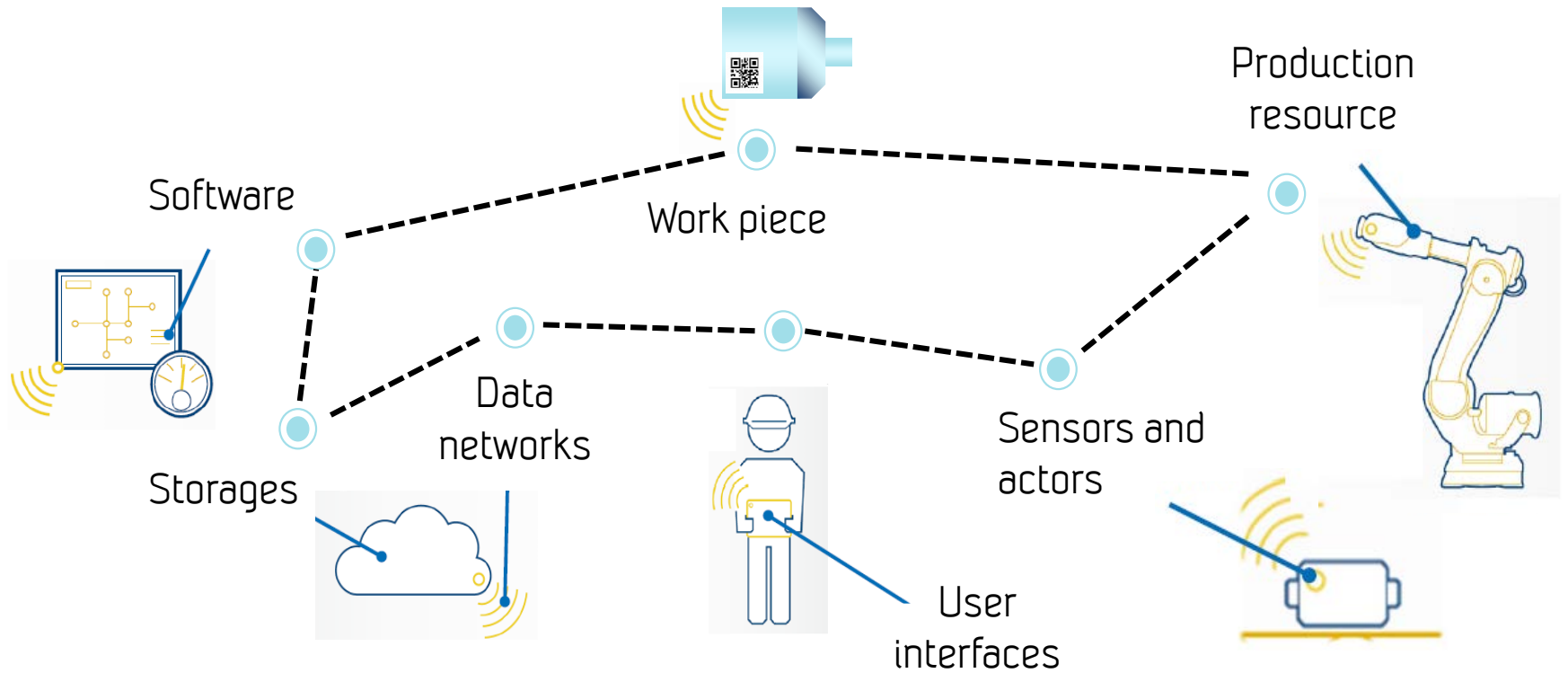
Source: PWC

What are enabler behind Industrie 4.0?



What is a CPPS?

Cyber-Physical Production System

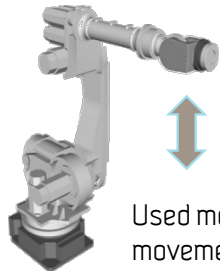


Source: Fraunhofer IPT, ABB

Cyber-Physical Production Systems

Escaping from the productivity trap of takt production systems

State-of-the-art: Permanent clocked & synchronized production systems



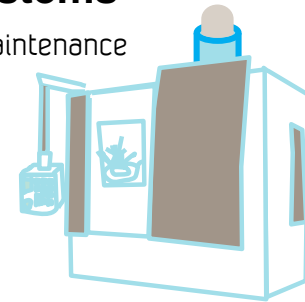
Used movement < potential movement

Synchronized production



Unused takt time

Reactive maintenance

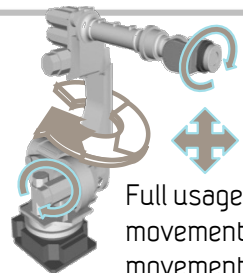


Unused machine capabilities

Unused takt times

Errors and stops

Tomorrow: Industrie 4.0 in production control

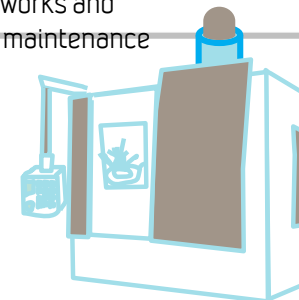


Full usage of flexibility
Used movement = potential movement

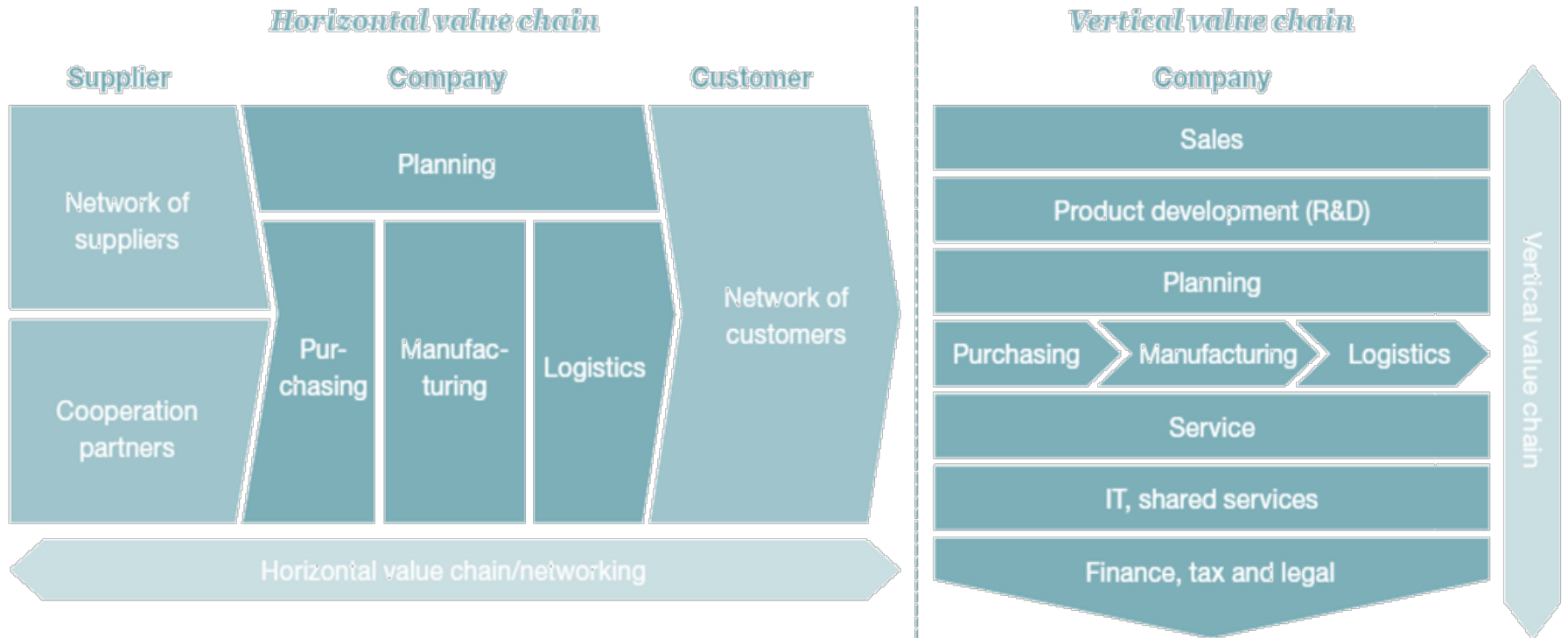
Autonomous network leads to fully used capacities



Sensor networks and preventive maintenance



Horizontal and vertical value chain



INDUSTRI 4.0 BMW, Flexibility in Automation



- High Automation level, customized manufacturing system with six car models at the same line.
- 800 til 1000 robots from 10 kg to 750 kg lift capacity.
- Integrated Production Control, Big data, CPS, sensor systems
- Industrial Internet, online manufacturing monitoring and Control OtD according to customizing.

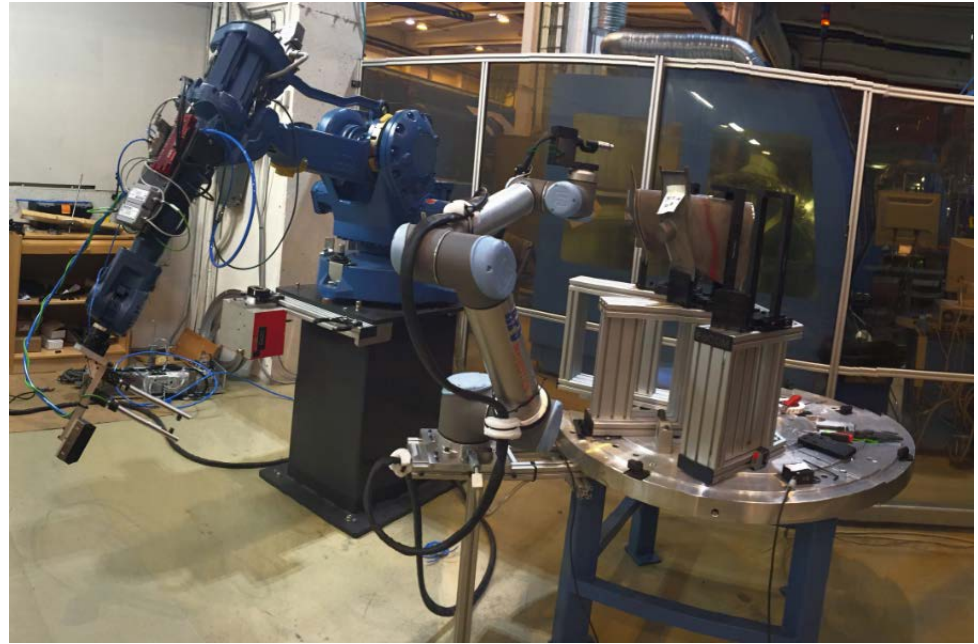
Collaboration Robots ("Cobots"), for complex lines

Company example Airbus



Technical approaches for Zero Defect Manufacturing, GKN Aerospace Kongsberg

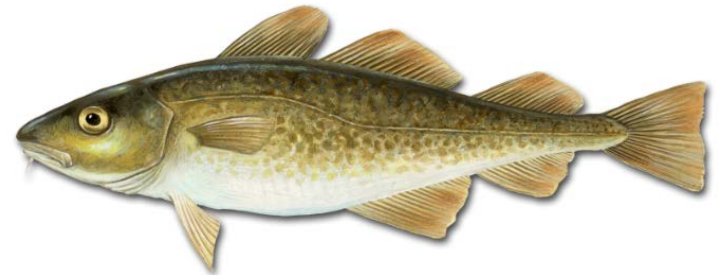
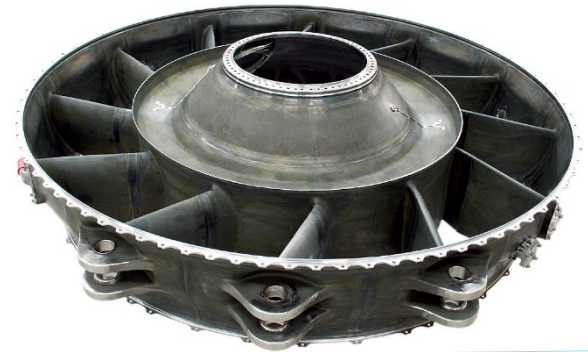
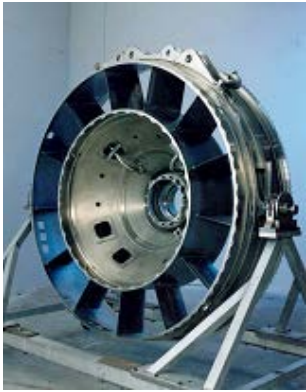
- Censoring and cognitive signal analysis
- Real-time corrections and adaptive control (self optimizing)
- AI Techniques (Neural Networks and Fuzzy logic) for machine system self adaption
- Data communication, integration and storage
- Demonstration, requirement, development, implementation
- Methodology for ZDM development and implementation



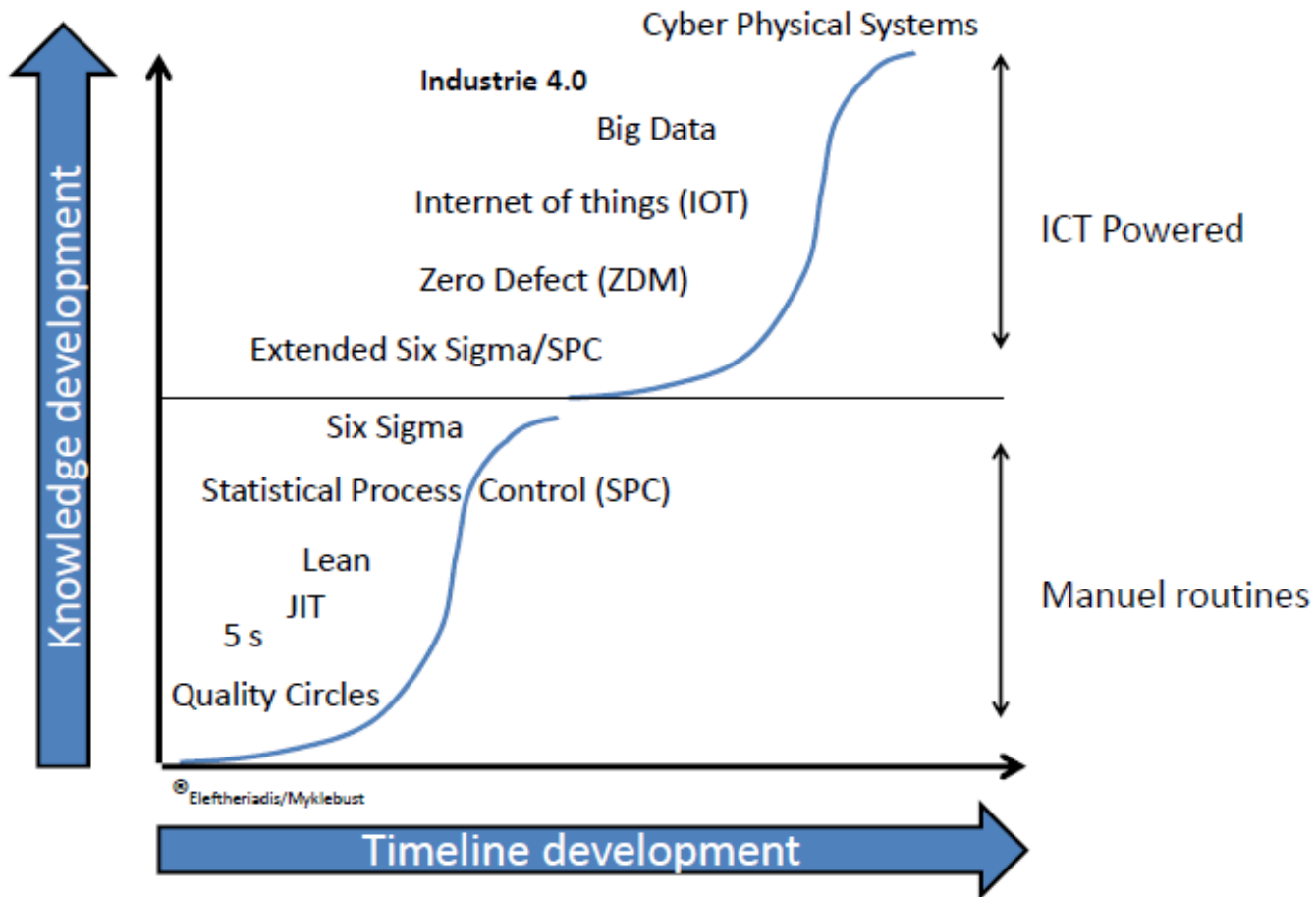
"GKN: Årets Smarteste Bedrift 2016"

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Difference shapes, sizes and structures



ICT Powered Quality systems





Challenges of Industrie 4.0

- Many interpretations and definitions: no common understanding, what 'Industrie 4.0' is
- A lot of software and hardware providers that state 'Industrie 4.0' solutions to their customers
- No general procedure how to make a company to an 'Industrie 4.0'-company
- Missing standards and reference architectures

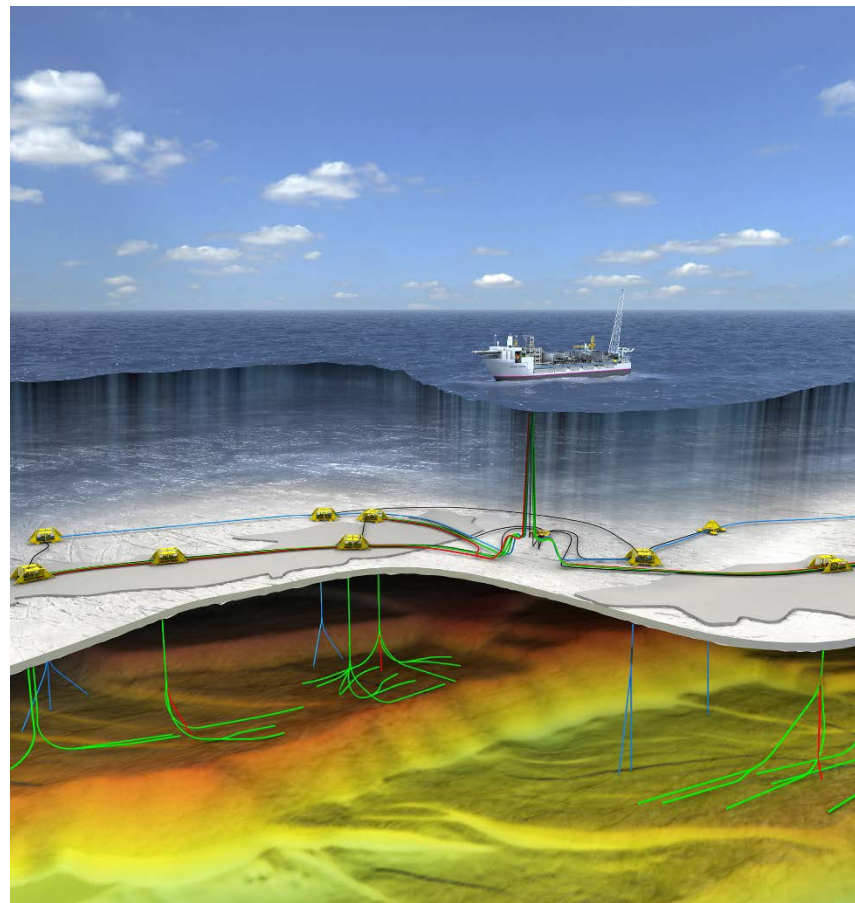


A lot of examples, use-cases and ideas for Industrie 4.0 already exist.

Industri 4.0– også olje og gass

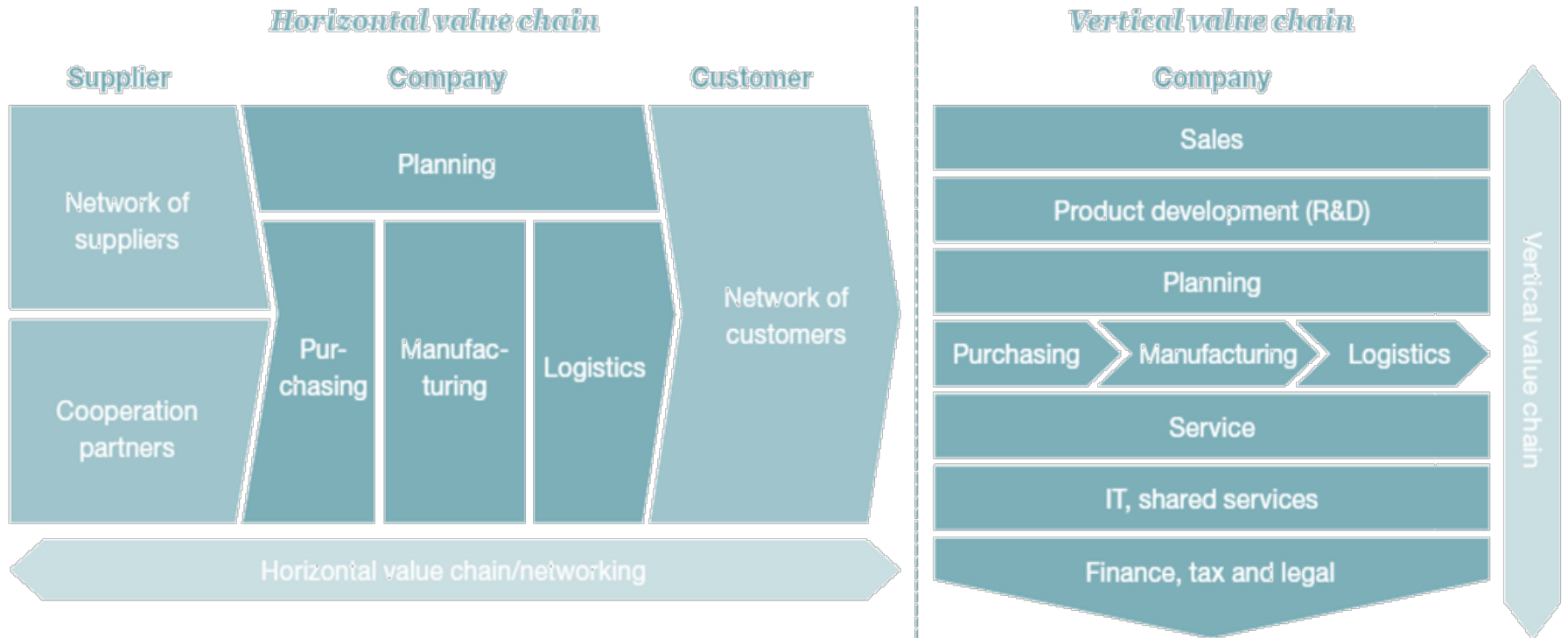


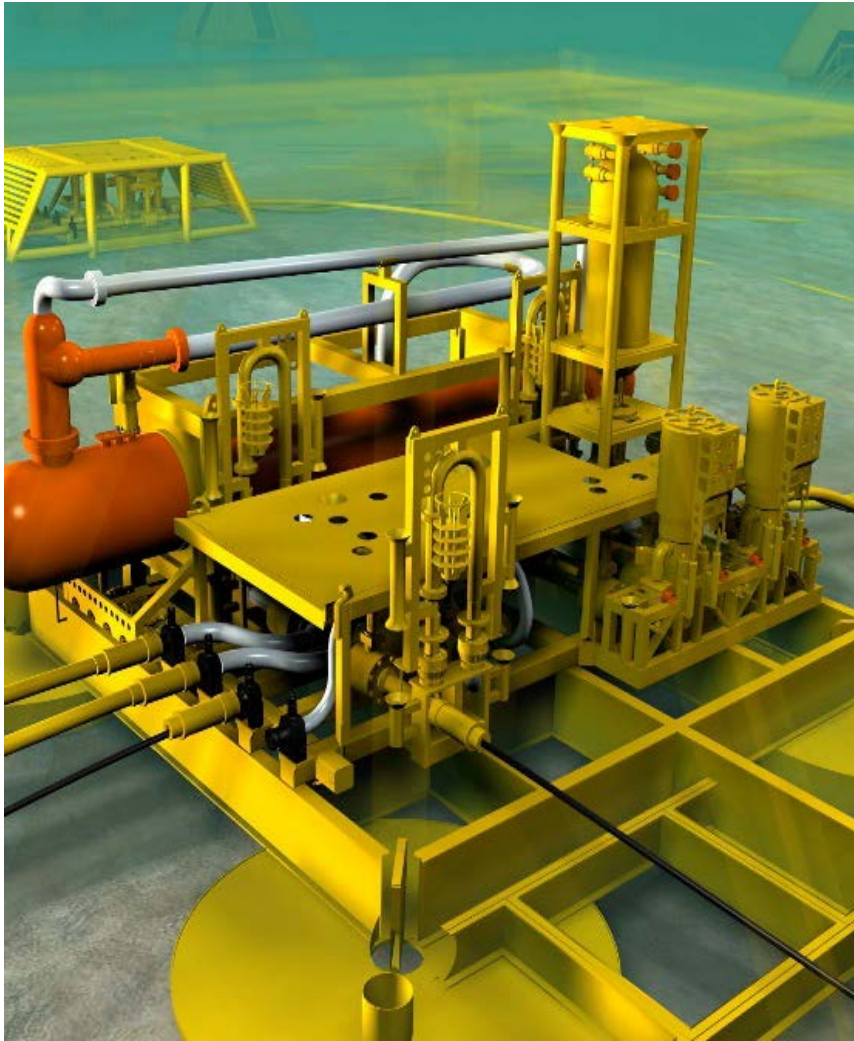
- Industri 4.0 metodikk på produkt/anlegg og produksjon av utstyr, inkludert underleverandører



Industrie 4.0 metodikk i drift og vedlikehold

Horizontal and vertical value chain

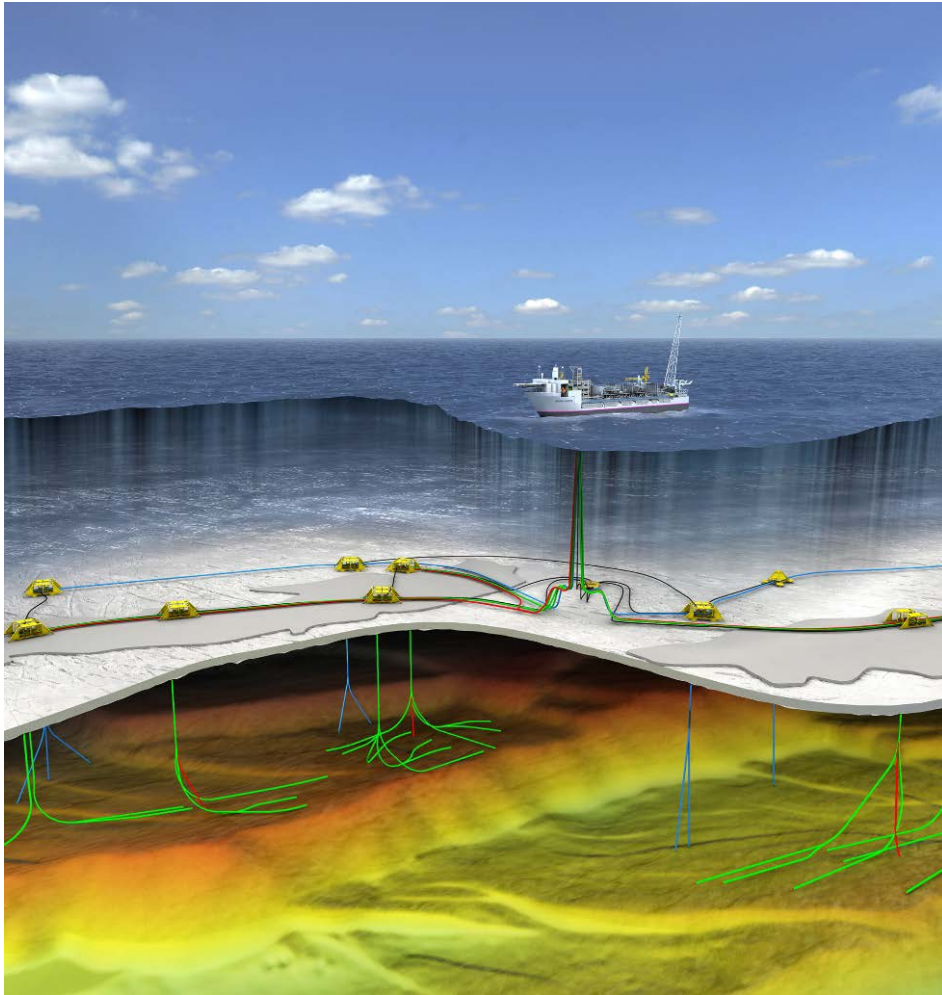




Industrie 4.0 produksjon og bygging av utstyr

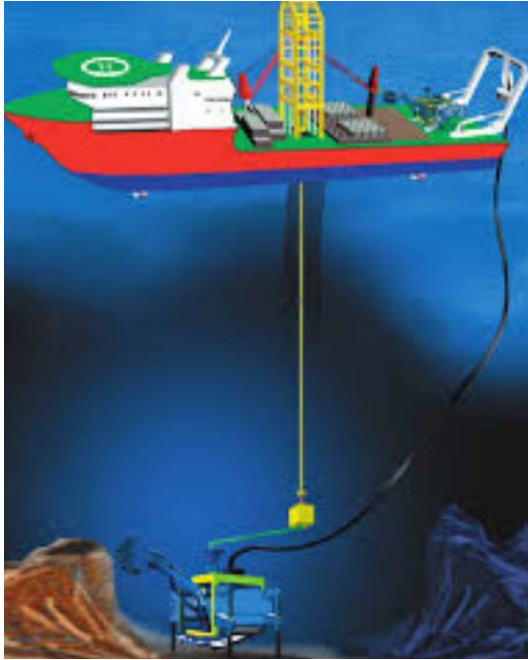
- Industrialiser hele prosessen (ikke prosjekt orientering), en-stykk, småserie Industrie 4,0 produksjon
- Standardiser og modul og parameteriserte løsninger så mye som mulig, bruk ISO standardisering mest mulig
- Lean, 6 sigma, kontinuerlig forbedring
- Automatiseringspotensial, adaptivitet, styring, sensorløsning kommunikasjon IKT, digitalisering
- Det finnes nok mye av dette alt i dag, men løsningene må optimaliseres m.h.p kostnadsreduksjon uten kvalitets reduksjon
- Lønnsomme anlegg til 40 – 50 \$ pr. fat?

Industrie 4.0 metodikk i drift og vedlikehold

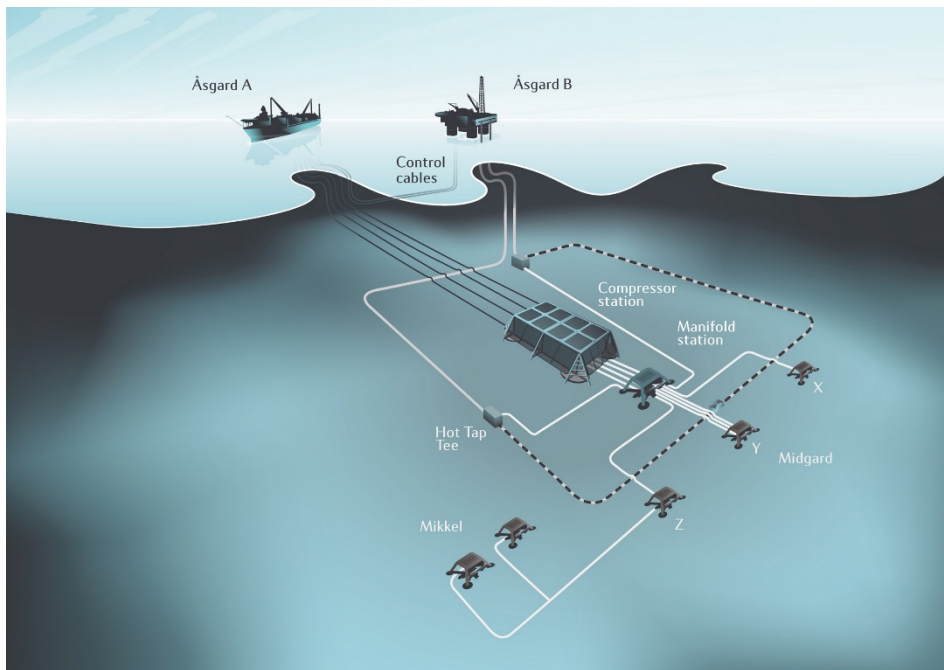


- Autonome anlegg
- Fjernstyrte og selvjusterende vedlikeholds prosesser
- Reelt tilstandsbasert vedlikehold utvikler seg til riktig prediktivt vedlikehold
- Tilbakemelding til design – utvikling b nye systemer
- Det er nok også her mye å bygge på av dagens løsninger
- Lønnsomme anlegg til 40 – 50 \$ pr. fat?, ta ut for fullt det økonomiske potensialet i digitalisering
- Internasjonale Subsea leveranser

Fremtids muligheter inne Subsea: Mining og Farming + Oil & Gas



New Norwegian Program? ARENA 2026, The subsea field of tomorrow



- The cooperative research environment "ARENA2036" develops competitive production models for the next generation of Subsea plants. Whereas today's subsea plants are manufactured in engineering and manual manufacturing mode, tomorrow's manufacturing systems fully-flexible and highly-integrated.
- *Bør kunne bli et Stort Norsk subseaprogram som gjennomfører et slikt løft på same måte som Tyskland gjør dette med sitt "hovedprodukt", bilen.*

SINTEF