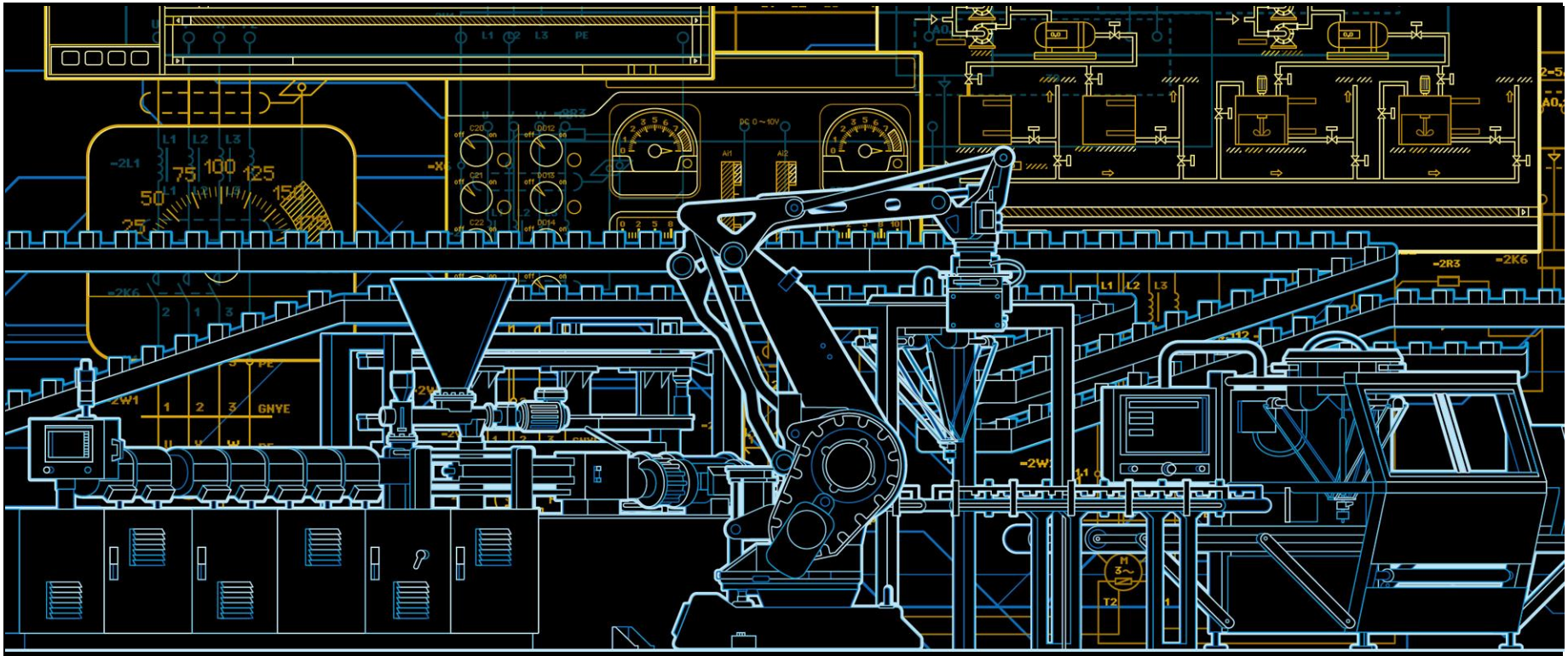


Linus Thrybom, ABB, Västerås, Sweden

Cyber Physical Systems
An Industrial View

Presentation at KTH – ACCESS-FORCES CPS Workshop, Stockholm, October 26, 2015

Outline

- ABB Overview
- Grand challenges for automation
- Future of automation?
- Examples
- Conclusions

What are We Doing at ABB?

We make sure that “two holes in the wall” are not just “two holes in the wall”,

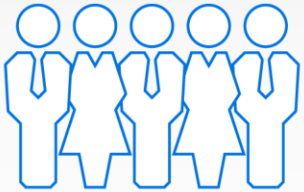
but rather a secure source of environmentally friendly electricity…

…and that the factories of the world can produce what they want in an efficient, safe and sustainable way!

Power and Productivity for a better World!

A Global Leader in Power and Automation
Leading Market Positions in Main Businesses

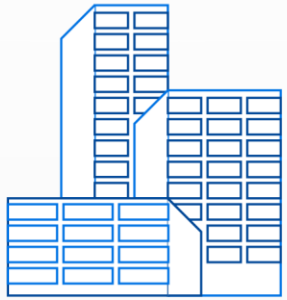
~145,000 employees



$42 billion
In revenue (2014)

Present in +100 countries

Formed in 1988



merger of Swiss (BBC, 1891) and Swedish (ASEA, 1883) engineering companies

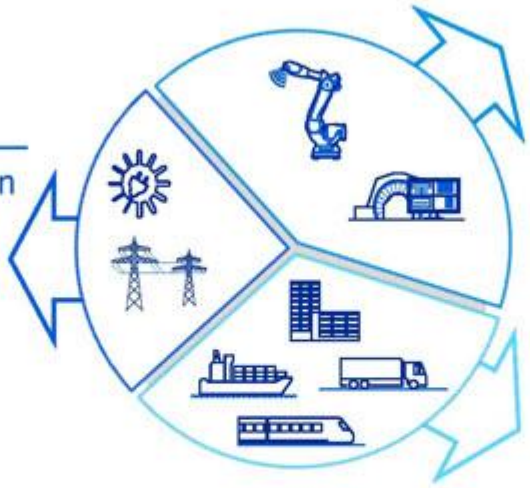
Well positioned in attractive markets

Power & automation demand drivers in three customer segments

Utilities

~$200 bn

- Renewables
- Grid automation
- Smart upgrades
- Emerging markets
- New consumption points



Industry

~$250 bn

- Productivity
- Energy efficiency
- Automation penetration
- Power quality and reliability
- Emerging markets
- US re-industrialization

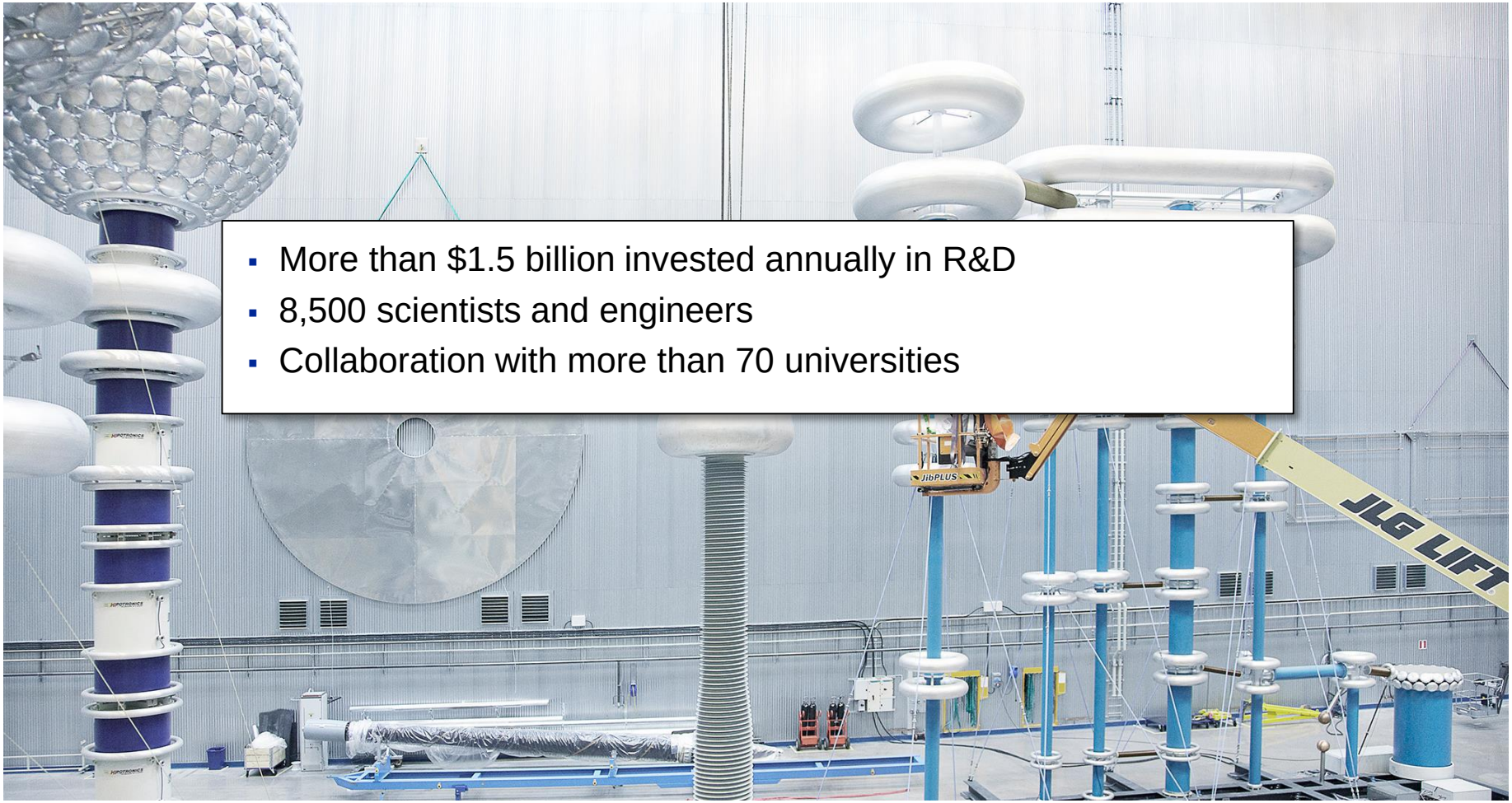
Transport & Infrastructure

~$150 bn

- Urbanization
- Energy efficiency
- Electric transport
- Power quality and reliability

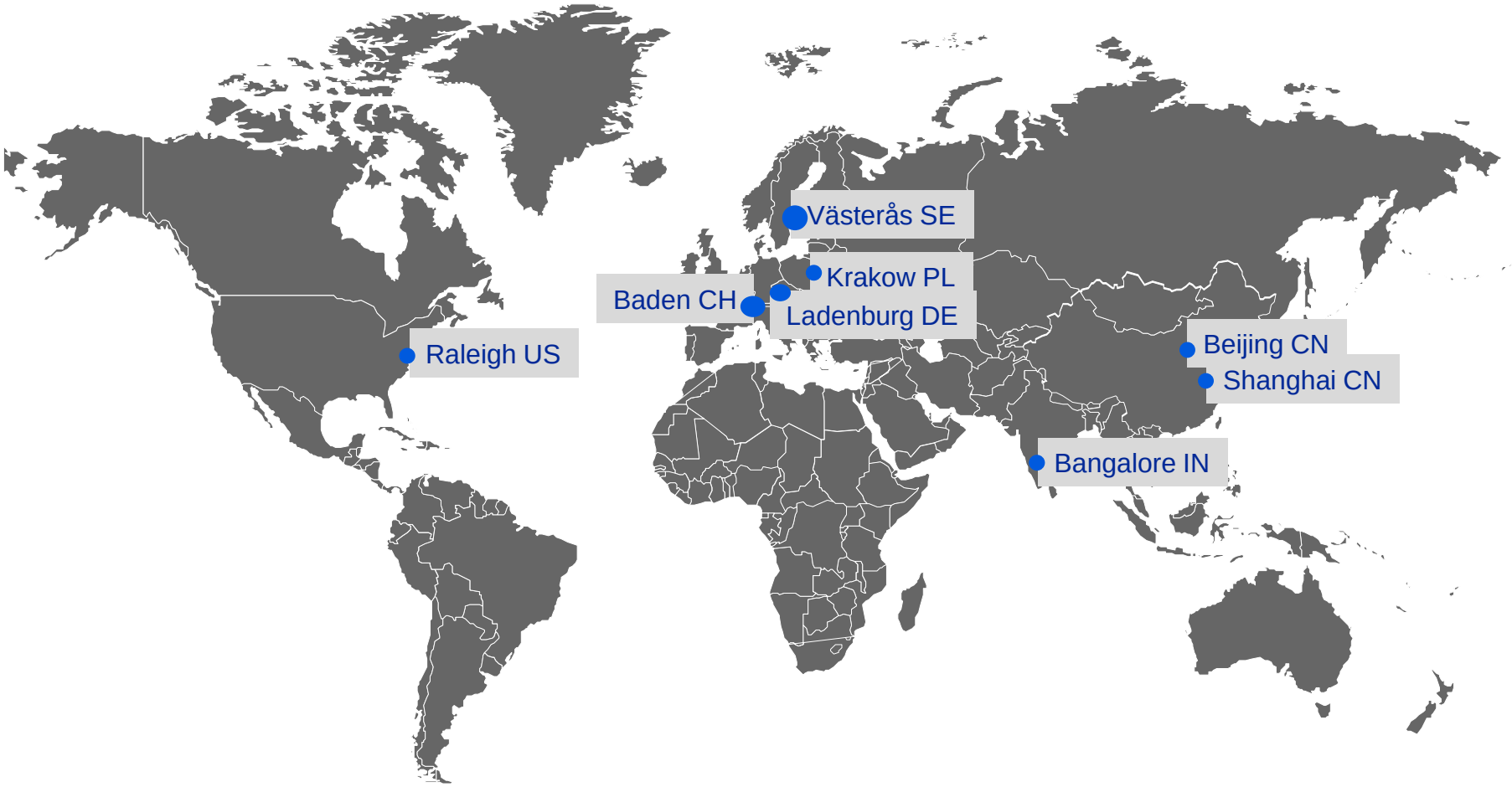
Significant market opportunities – today: ~ $600 bn, 2020: ~ $750 bn

Innovation is Key to ABB's Competitive Advantage
Leadership Built on Consistent R&D Investment



- More than $1.5 billion invested annually in R&D
- 8,500 scientists and engineers
- Collaboration with more than 70 universities

Corporate Research Centers



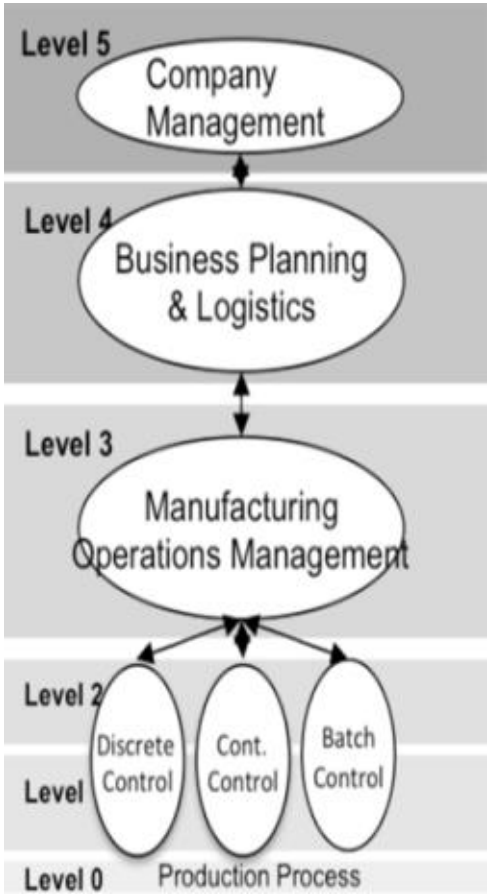
Close to major customers, universities and ABB‘s business responsible units

Grand Challenges for Automation

Grand challenge for automation # 1
The sustainable 100 % available plant

- **predictive maintenance** which would allow all maintenance to fall within periods of scheduled process stops
- planned stop periods should be reduced by 50% through use of **intelligent diagnostic** embedded in all devices
- productivity would thereby increase substantially across all manufacturing and process plants by the elimination of unplanned stops
- holistic **optimization of total process** to remove bottlenecks and further increase productivity
- **energy efficient equipment** performing optimally at each operating point through integration of intelligent embedded component
- 100% **secure wireless communication and remote diagnostics** fully utilized in plant operation
- **flexibility** in production down to batch quantities of a single unit
- **ease-of-use** in operation based on intuitively understandable information displayed ergonomically

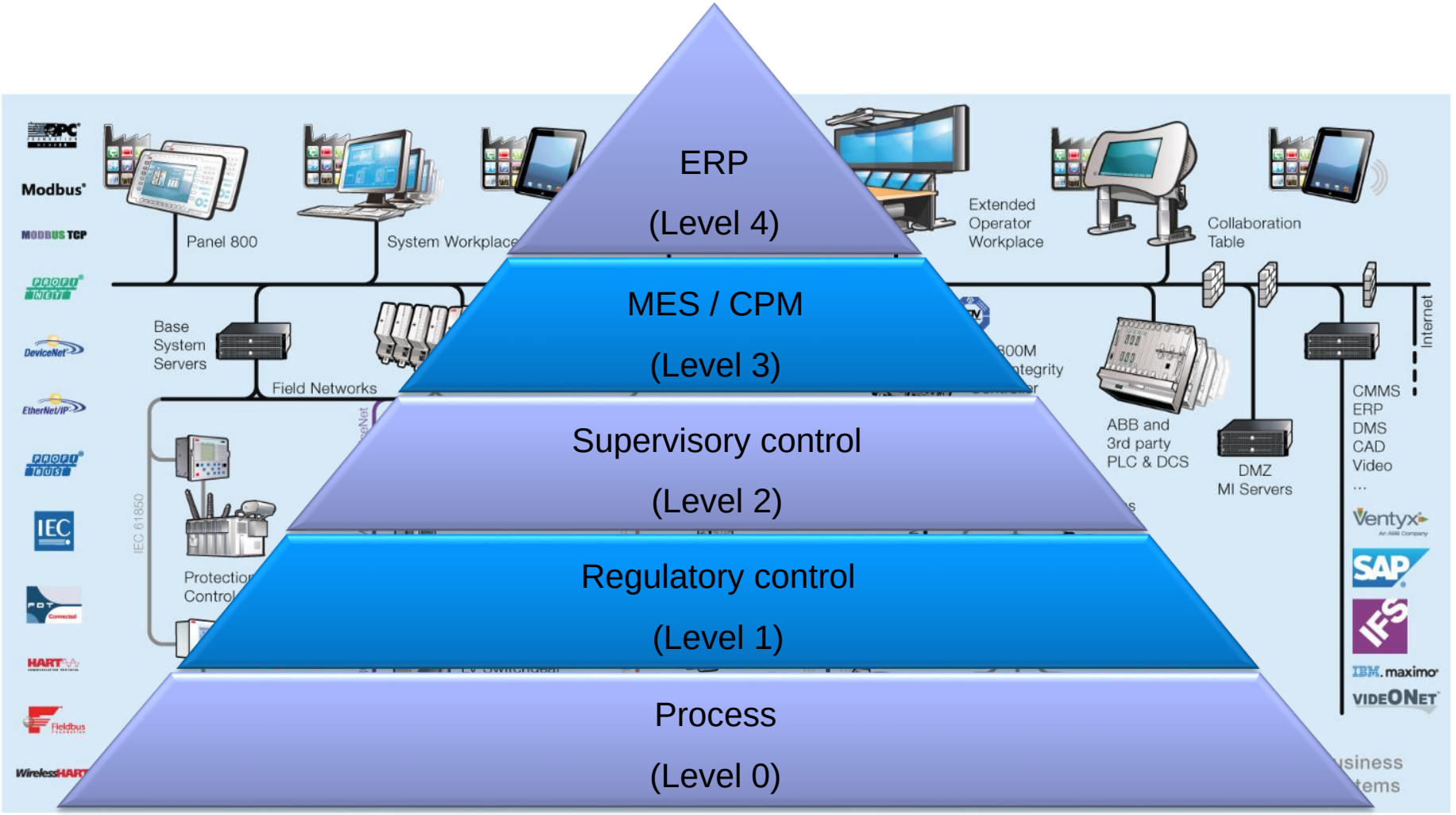
Grand challenge for automation # 2
Engineer system 10x today's complexity with 10% today's effort



- **tools** handling several levels of complexity in an intuitive fashion must be developed
- **simulation and verification tools** for establishing the feasibility and security of a solution must be found
- software and hardware of **several generations** must be possible to **easily integrate** with the help of tools
- software and hardware of **different applications** must be **easy to integrate** via a common platform ex. CAD information and Instrument diagram with control systems
- **ease-of-use** must be emphasized in all aspects of the system engineering process decoupling the complexity into manageable components
- work process to support effective cooperation with **networked expertise** physically located in different geographies
- solutions to be able to manage plant information over the **entire lifecycle of all assets**

What can we expect from the future?

We Face a Tremendous Transition
Automation Network and Hierarchy



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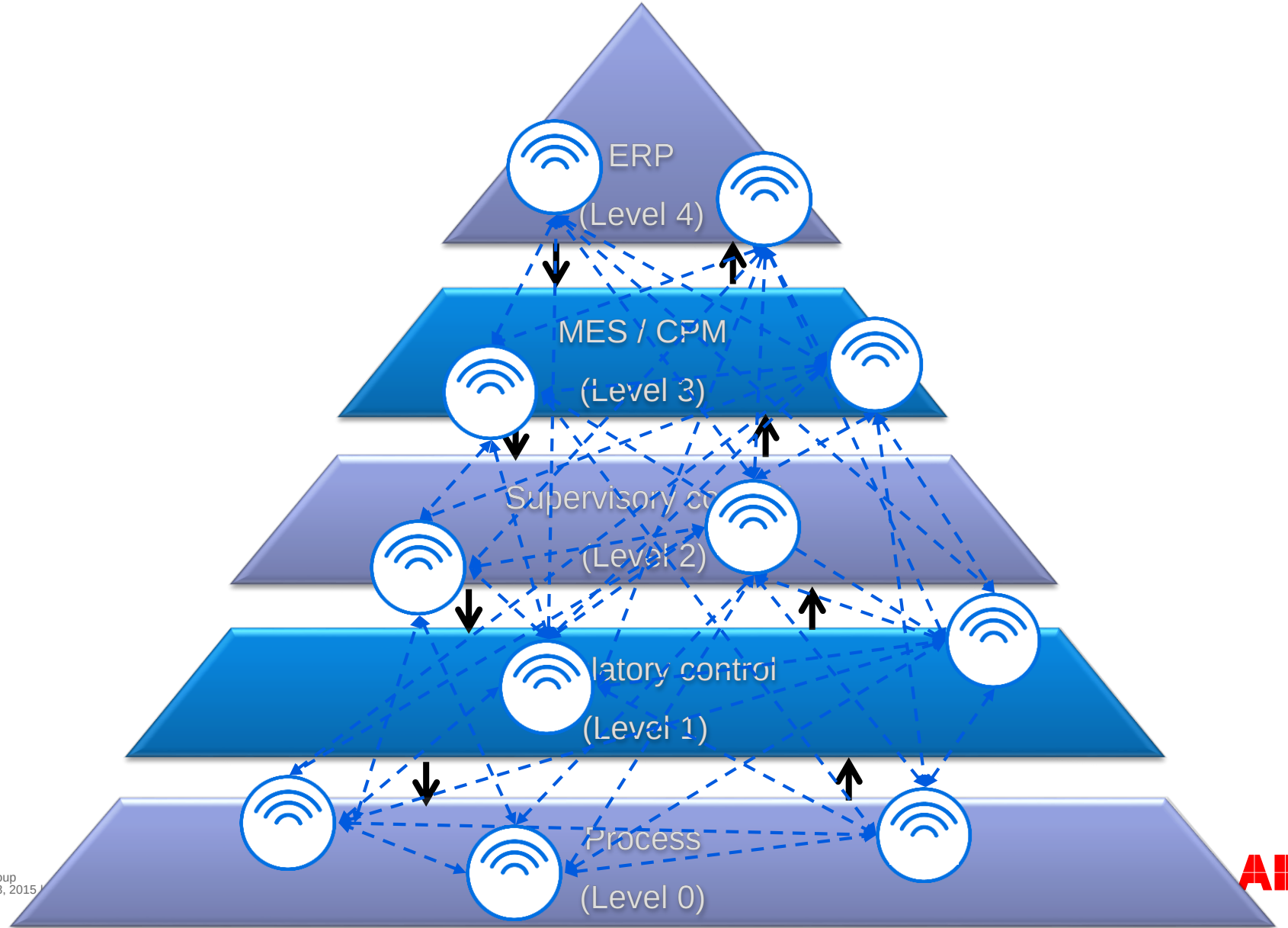


End of Isolated Solutions
Balancing Between Control Systems

Energy availability and pricing

(smart grids)

Grid control

Industrial demand-side management

Production Management

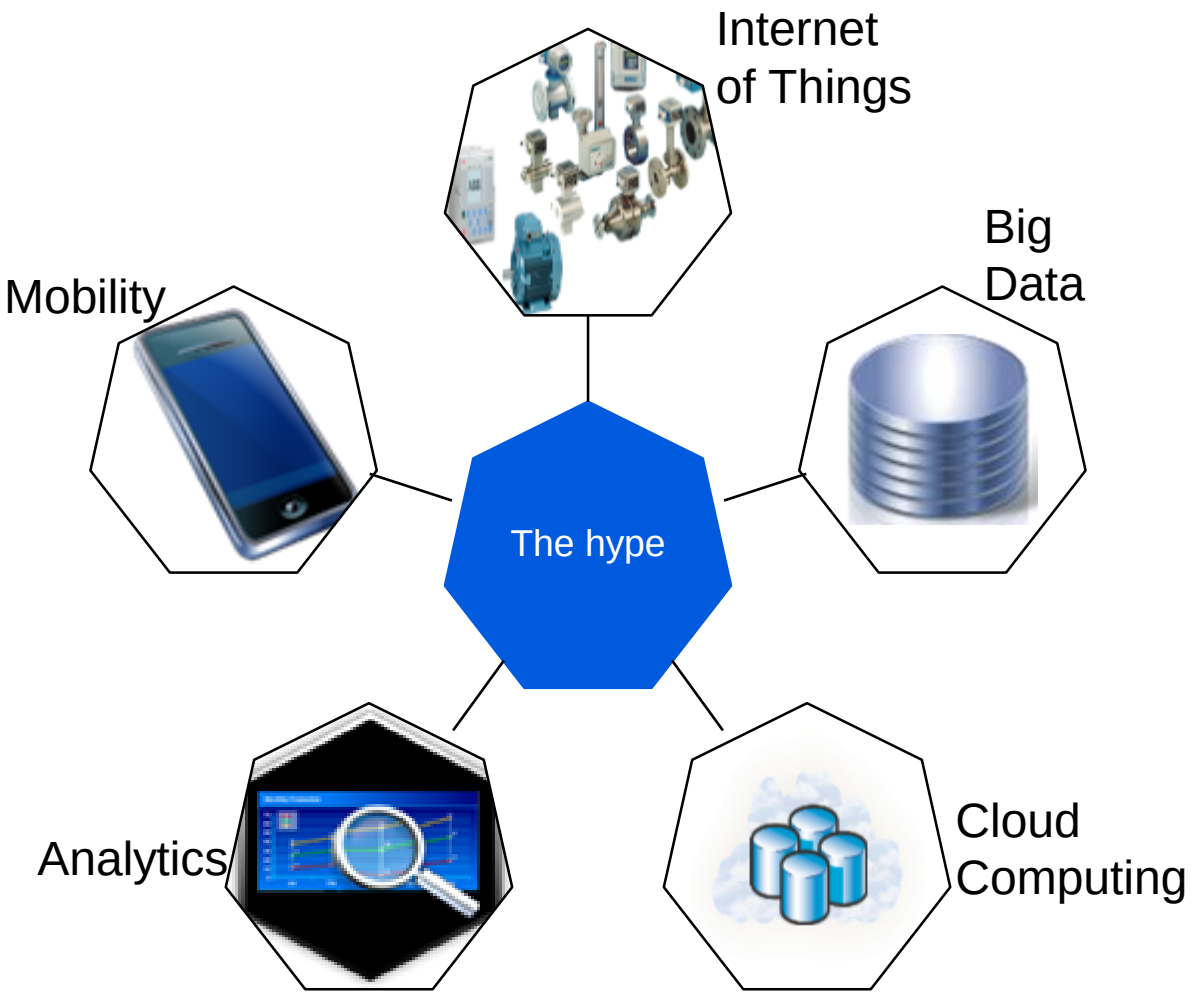
(P&S, APC, Analytics, …)

Integration of scheduling and control

Process variations, e.g. quality, yield, disturbances (DCS)

Process control

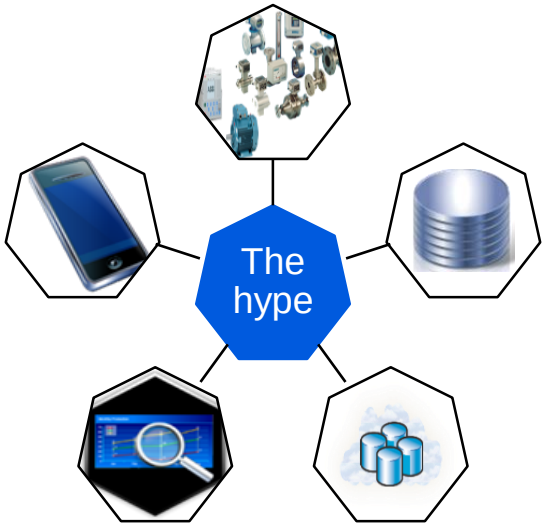
Market Trends
The Five Major Trends that Manufacturers must follow



Market Trends
The Five Major Trends that Manufacturers must follow

What the customer really needs

- Safety
- Lower cost and simplified operations
- Production efficiency
- Better asset utilitization / ROA
- More effective decisions



Today
An industry perspective on big data

- Facebook
  - 1 Billion transactions / day[1]
- A typical chemical oil & gas company
  - 2.6 Billion transactions / day per plant

- ABB Historian recording capability
  - 520 Billion values / day

“Big Data? Been there, done that.“
Mike Williams – Dow Chemical[2] (Retired)

Sources: 1) McKinsey & Co. 2) Dow Chemical has approximately 350 plants

Examples
Monitoring

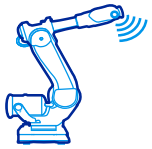
Application Example: Robotics
Remote Service Center

People

Clients can access actionable information from smartphones and tablets

The information is available at any place, any time

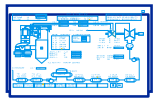
Things



Intelligent and connected robots

Sending data to cloud servers for back-up, reporting, diagnostics, and benchmarking

Services

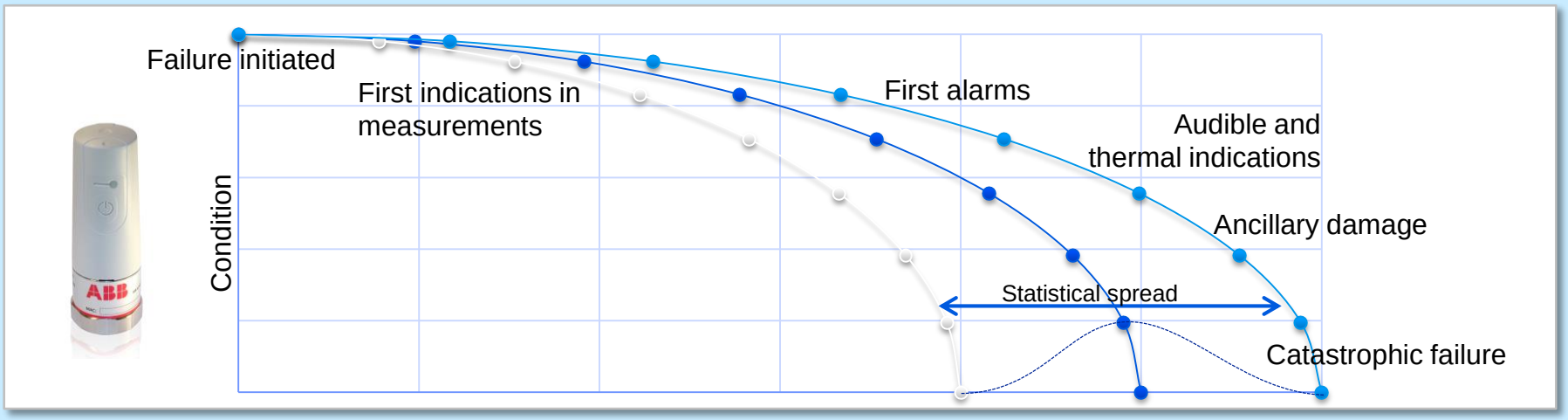


Central service unit remotely monitoring robots to support clients 24/7

Provides analytics to optimize robot usage and predict maintenance needs

A Cyber Physical System in action

Application Example: Fleet Management
Predictive Maintenance Potential



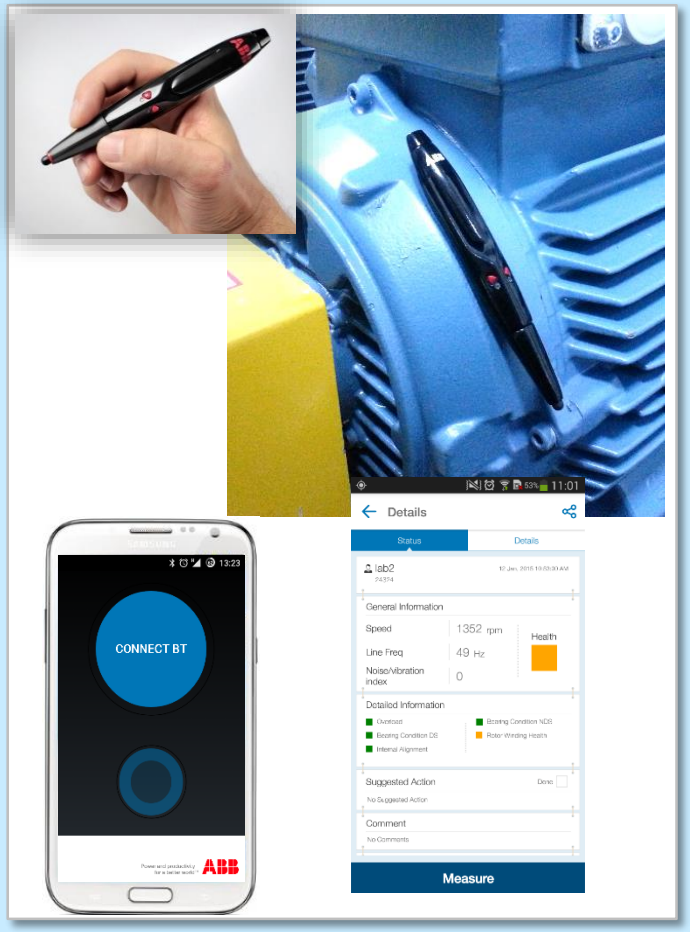
Good statistical knowledge important for accurate predictive maintenance

Time to react increased with improved predictive methods

Failure patterns observed in the fleet can be identified early in measurements

Integrating and analyzing monitoring data from a variety of installations of the same device type throughout the industry is essential

Application Example
Integration of Mobile Measurement



Challenge:

Cost: fixed installation of diagnostic sensors too costly, they may be too expensive, or too rarely used to justify the investment

Age: Installed equipment was installed at a time when these sensors were not available (30-50 years ago)

ABB solution:

Use low-cost low power sensors in form of a Bluetooth-connected pen

- Accelerometer for vibrations
- Compass for magnetic field

Quick health indication sufficient to initiate further actions:

- Store device fingerprint and detect trends
- More precise measurements
- Service technician intervention

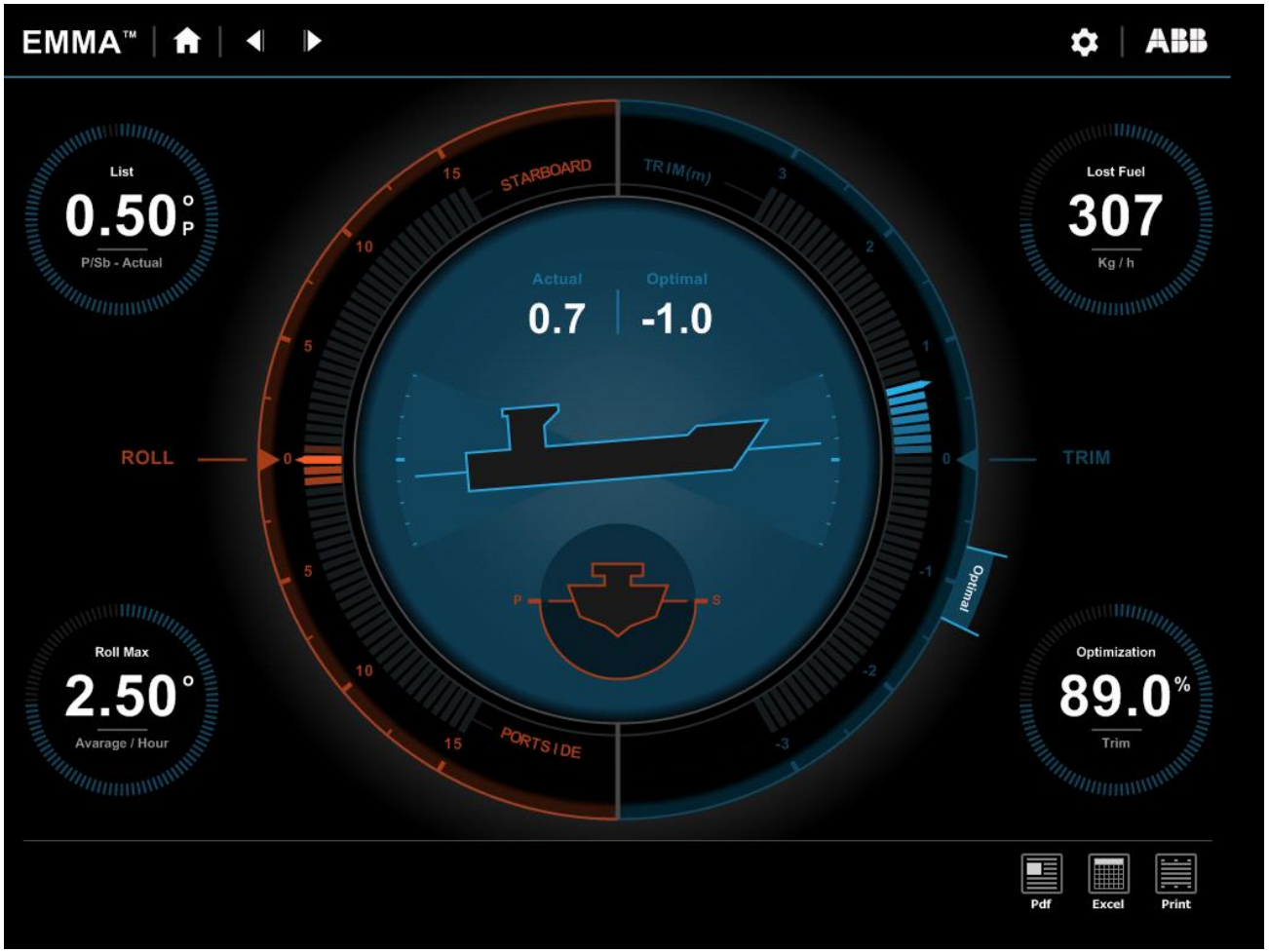
Examples
Sustainability & Optimization

Energy Efficiency through Automation
Software solutions often involving optimization

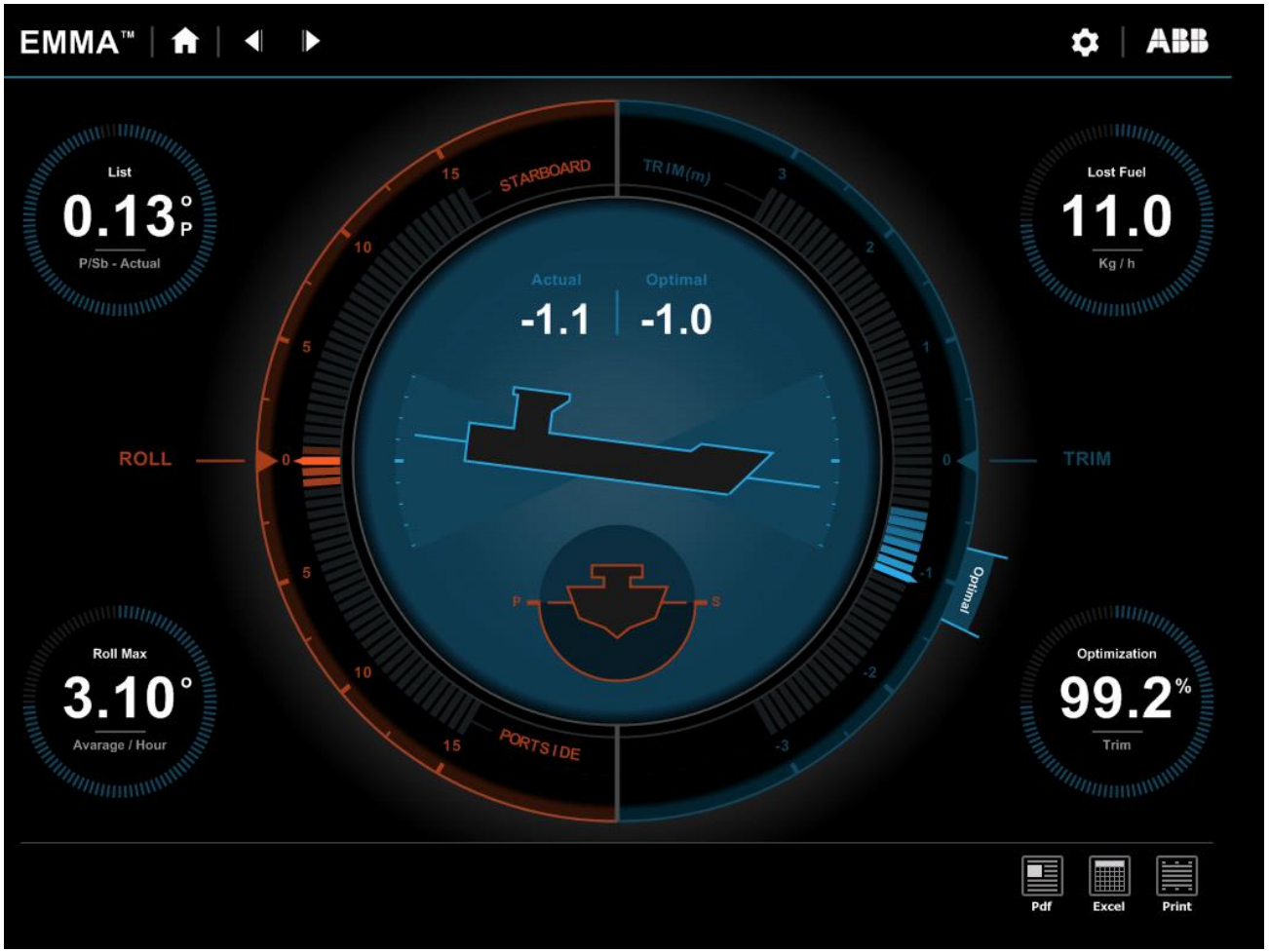
With and without trim optimization

4 MW less propulsion power.
Savings of $1 million per year.

Advisory
Trim – not in an optimal state



Advisory
Trim – close to perfect



Conclusions
Interesting Journey ahead for Academia & Industry

- Cyber Physical Systems
  - Intelligent devices equipped with sensors are providing large amounts of data that is today used in the automation system
  - Today's essential requirements remain valid (safety, reliability), cyber security and data privacy become even more important
- People
  - People will not be obsolete. They are still the decision makers.
- Services
  - Business model is key. Monitoring and analytics natural first step, but operations will follow.
- More complex systems need to become simpler to manage
  - Smartphone a good example of this…

Conclusions
Interesting Journey ahead for Academia & Industry

Academia: What is theoretically possible?

Industry: What is commercially realistic?

Acknowledgements

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