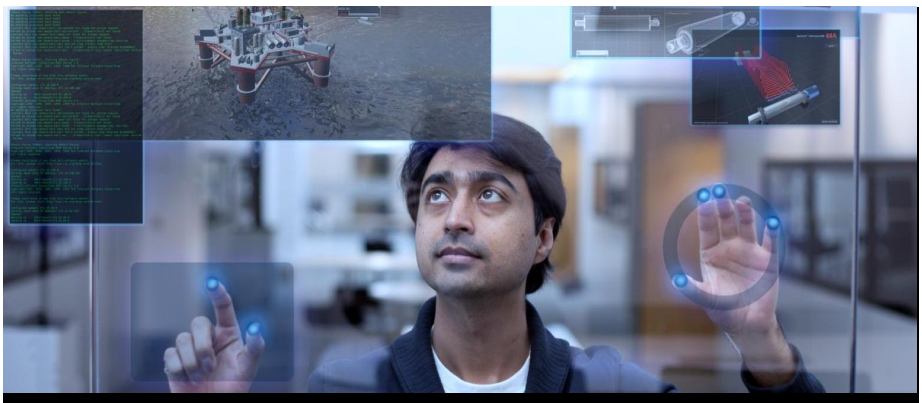

Tomas Lagerberg, ABB Corporate Research, Sweden

Technologies For Future Automation!?

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Power and productivity for a better world™

Easy to Stay Tuned?

- ”I think there is a world market for maybe five computers.”
  Thomas Watson, chairman of IBM, 1943
- ”There is no reason anyone would want a computer in their home.”
  Ken Olson, President, Chairman and Founder of Digital Equipment Corporation, 1977
- ”Internet is a buzz that maybe will just pass. I do not believe that people actually want to spend as much time, as is really required, to surf on the web.”
  Ines Uusman, IT-responsible minister, Sweden, 1996

Four Exciting Gadgets - One does not Belong…

Sources: www.svt.se, www.estimote.com, www.optoma.com

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Some Interesting Technologies

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ABB Corporate Research Global Lab…
… and Local Research Centers

Close to major markets, universities and ABB product units

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What is Key in Automation?

- Reliability - operation 24 hours a day 365 days a year
- Real time behaviour - "nothing" must dist…
- Predictability - the system sha…
- Tough environm…
- Safet… …gnest priority

…us entry and sabotage becomes

These basic requirements are taken for granted by our customers and are non-negotionable! The must be part of our life nerve!

…me time –
…, upgrade, modernize during a very long time period (5-20 years)

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Advanced Control & Optimization

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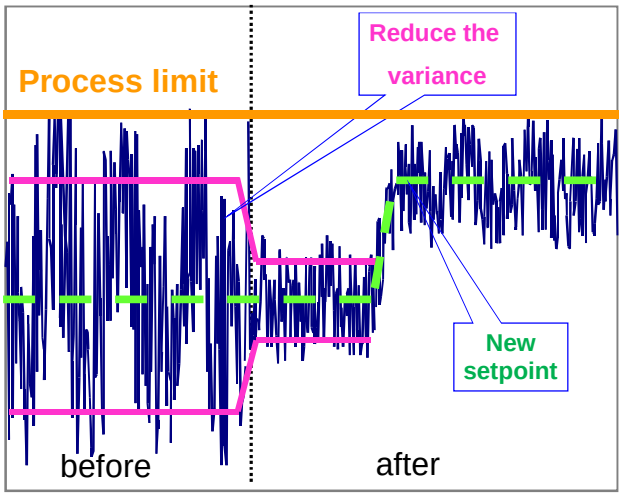
Process Modeling & Optimization



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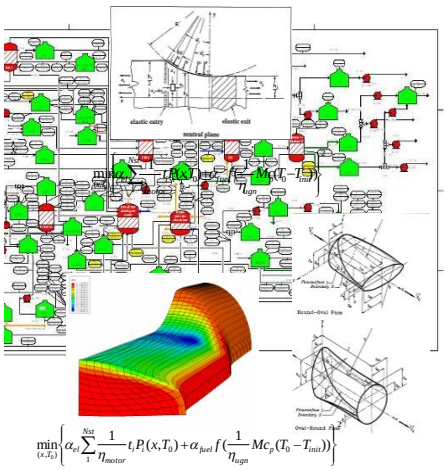
Build a Model of the Process

- Describe the process mathematically
- Complex enough to describe the process behavior
- Simple enough to be suitable for real-time optimization
- Different approaches:
  - "Black box"
  - "White box"
  - "Grey box"



$$\min_{(x,T_0)}\left\{\alpha_{el}\sum_{1}^{Nst}\frac{1}{\eta_{motor}}t_i P_i(x,T_0)+\alpha_{fuel}f\left(\frac{1}{\eta_{ugn}}Mc_p(T_0-T_{init})\right)\right\}$$

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Optimize Using the Model – E.g.

Optimization of hot rolling including reheat furnace - minimize *total* energy cost

$$\min_{(x,T_0)}\left\{\alpha_{el}\sum_{1}^{Nst}\frac{1}{\eta_{motor}}t_i P_i(x,T_0)+\alpha_{fuel}f\left(\frac{1}{\eta_{ugn}}Mc_p(T_0-T_{init})\right)\right\}^2$$

- electricity cost
- roll force
- fuel cost
- temperature increase
- efficiency, motor
- efficiency, furnace

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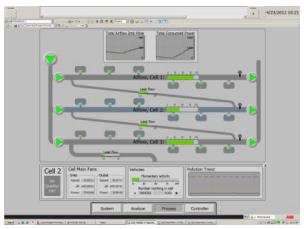
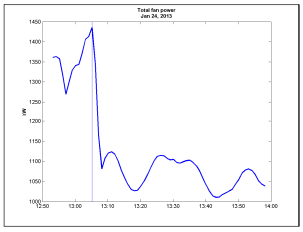
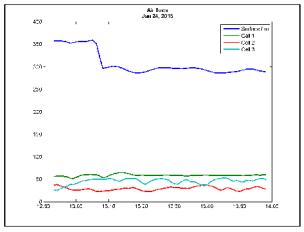
SmartAir – Optimized Control of Mine Ventilation



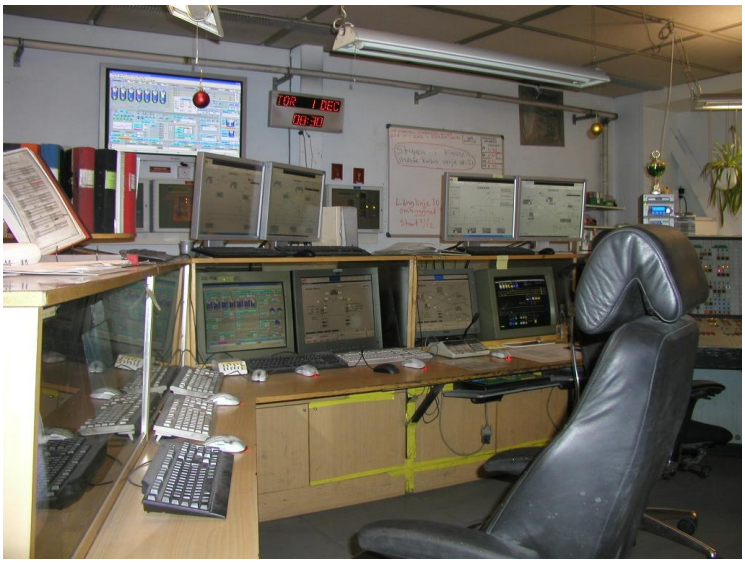




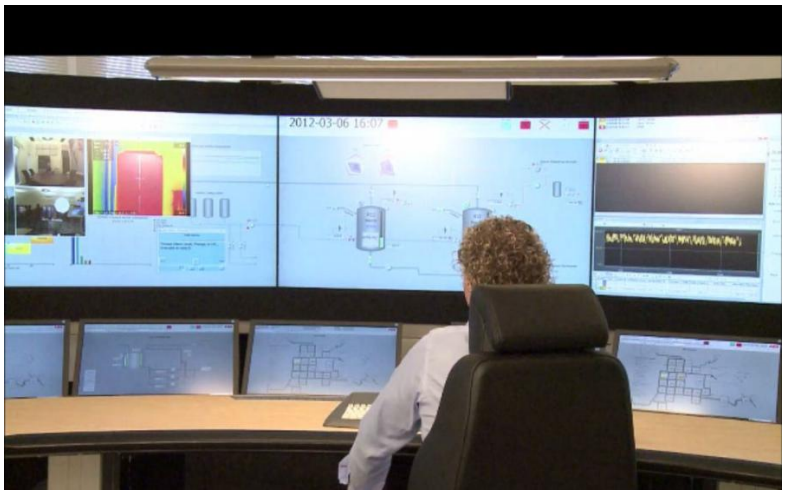
- Unique on-line method for fast process identification
- Optimized control - based on measured air flows, air quality, and fan power
- Significantly improved equipment life time
- Verified energy savings of 30-50%!!

Visualisation, User Interaction & Operator Environment

A Control Room reality check



How it Could / Should Look Like

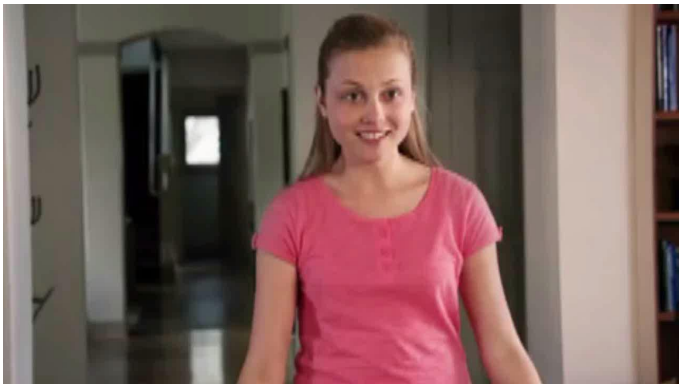


Human Computer Interaction
CLI -> GUI -> NUI

- Command Line Interface (CLI) -> Graphical User Interface (GUI) - > Natural User Interface (NUI)
  - Direct & natural communication between human and computer:
    - (Multi)touch
    - Gestures and movements
    - Voice
    - Eye-tracking
    - Recognition and perception
    - Tactile feedback (”force feedback”)
    - …
  - Builds upon existing skills

New Ways of Interacting with Computers…

New Ways of Interacting with Computers – Microsoft Kinect



Source: www.xbox.com

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Microsoft - Project Natal -> Kinect

Source: www.xbox.com

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New Ways of Interacting with Computers - Brain Ball

Source: Interactive Institute, Interactive Productline

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3D Visualization – In Gaming

Sources: www.ea.com, us.blizzard.com, www.steampowered.com

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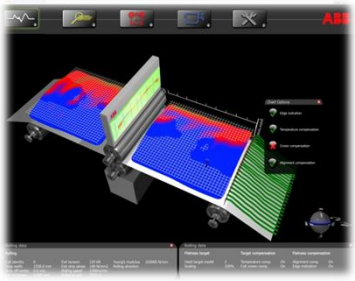
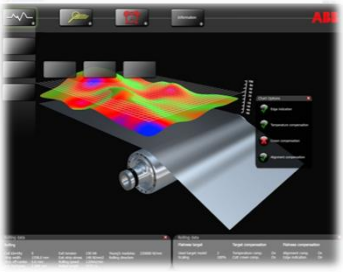
3D Visualization – In Industry
Applied Where it Makes Sense





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3D Visualization – In Industry
Applied Where it Makes Sense

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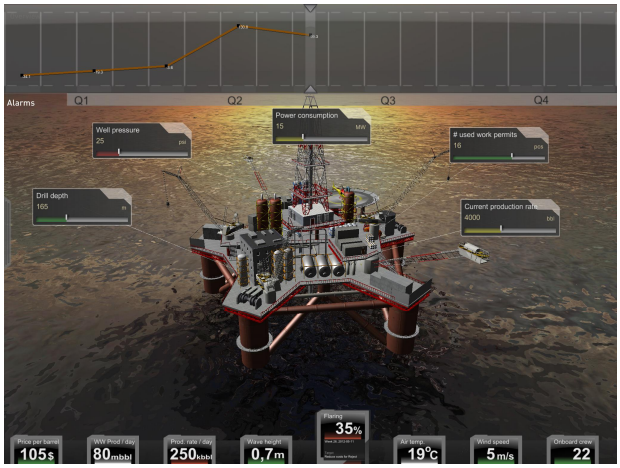
Updated graphics



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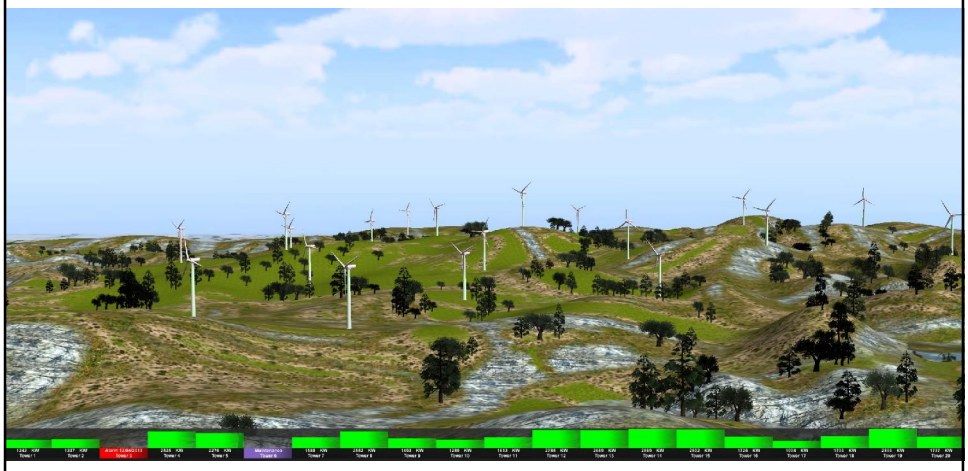
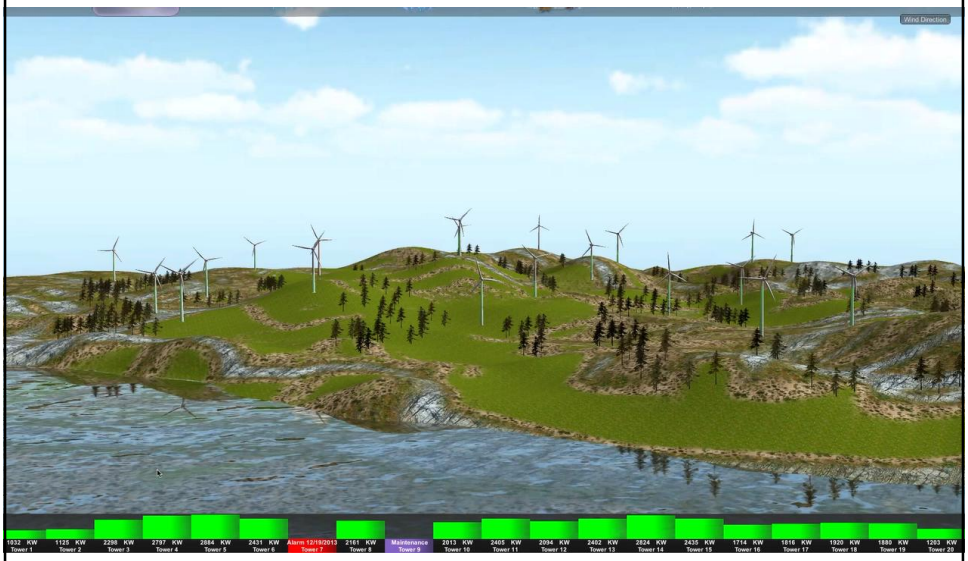
3D Visualization of Windfarms



3D Visualization of Windfarms



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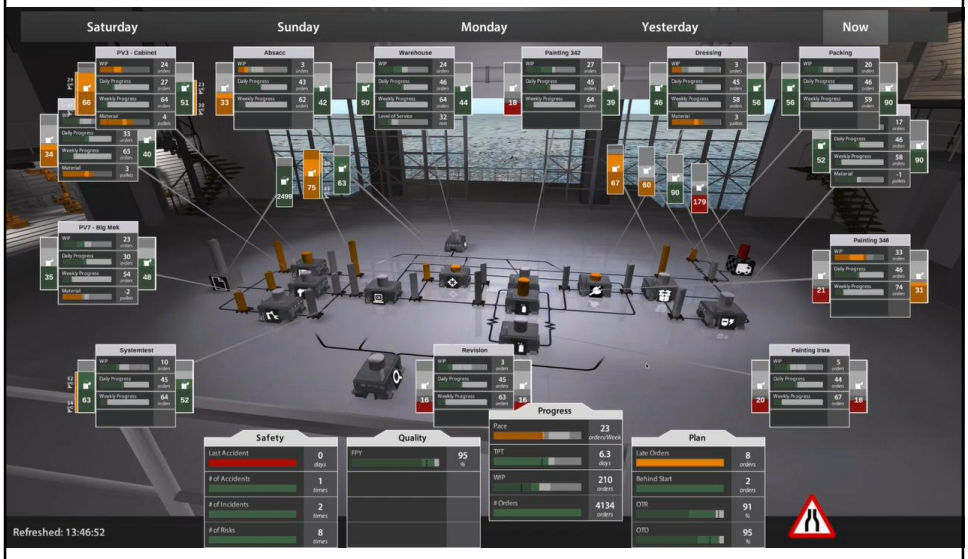
Virtual Genba – Robotics Production



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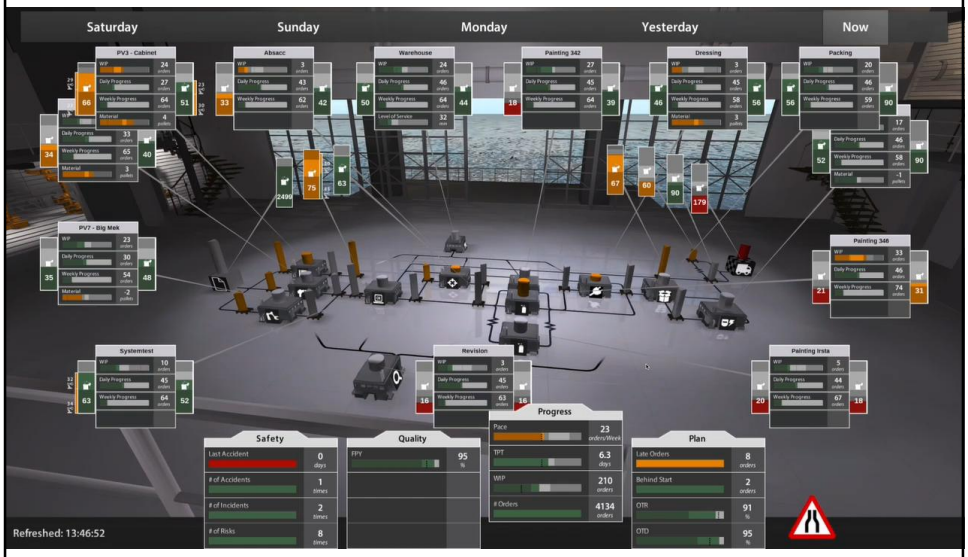
Virtual Genba – Robotics Production



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New Interaction Concepts For Industry
Shown at Automation & Power World 2012

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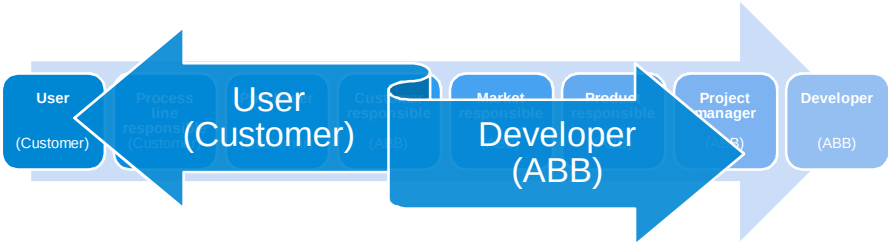
Good User Interaction
Involve the Users in the Product Development!



- The **large** distance between users and developers often results in products that are difficult to use
- By connecting users and developers we create conditions for products that are easy, effective and fun to use!

The user, only the user, can judge when something is easy to use!

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Same User Interface for All Users?

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Same User Interface for All Users?

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ABB – User Centric Design

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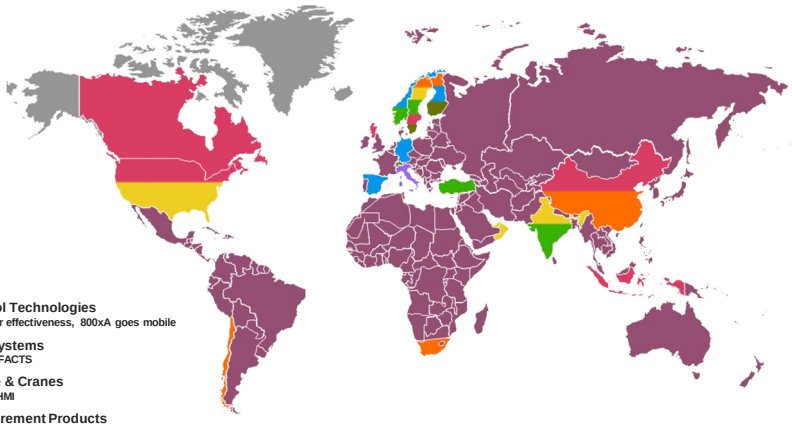
Global User Studies



- **Control Technologies**
  Operator effectiveness, 800xA goes mobile
- **Grid Systems**
  HMI for FACTS
- **Marine & Cranes**
  Marine HMI
- **Measurement Products**
  Harmonized HMI for FM
- **Mining**
  Mining 2.0 I&I, Efficient mine
- **Network Management**
  CosyViz/SENSE
- **Robotics**
  ASIMOV

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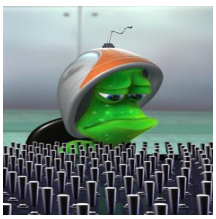
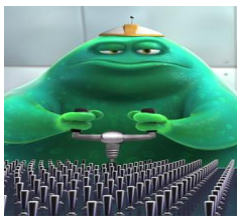
User Analysis
Let's take a closer look at some operators

This operators work together in a shift team!

Eric	**Kumar**	**Tom**
The young operator	The experienced operator	The senior operator
"There is a lot of waiting. We do not really have much to do!"	*"The everyday challenges motivate me!"*	*"I have full control over all situations throughout the whole process!"*
		

Tomorrow's users –
"Digital Natives"

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Let's Take a Closer Look at Eric, a Young Operator
Eric = Efficient?

- Bored
- No self-confidence
- Totally dependent upon the more experienced operators
- Does not have the same background as Tom and Kumar
- He feels like he is at the wrong place!

Can influences from gaming make Eric more efficient? Motivated?

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Let's Take a Closer Look at Eric
eSports – Computer Gaming

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Let's Take a Closer Look at Eric
Eric as Gamer = Efficient!

- Eric is extremely self-confident as computer gamer
- Eric has more than 200 APM when playing
- Eric gets at least 5 adrenalin kicks per minute during gameplay
- Eric feels lots of self-realization and being part of a community when playing

Gamification!?

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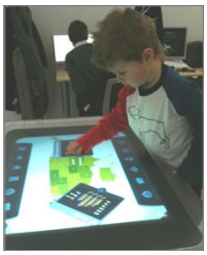
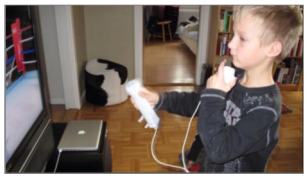
Future workforce…



Operator?

Maintenance engineer?

Plant manager?



Robot programmer?

Production planners?

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Mobile Devices
Very Powerful Computers!

- Processing power
- Graphics
- Sensors
- Communication
- Data speed
- Storage
- Portability
- Distribution
- …

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”The Memory Revolution”

Bring all your information anywhere. Today available with up to 256 GB, i.e. appr. 96.000 diskettes!!

Source: www.kingston.com

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”The Memory Revolution”

1984

2015

2 TByte, 85 USD!!
(corresponding to
1.390.000 diskettes!)

Sources: www.lacie.com, www.gizmodo.com

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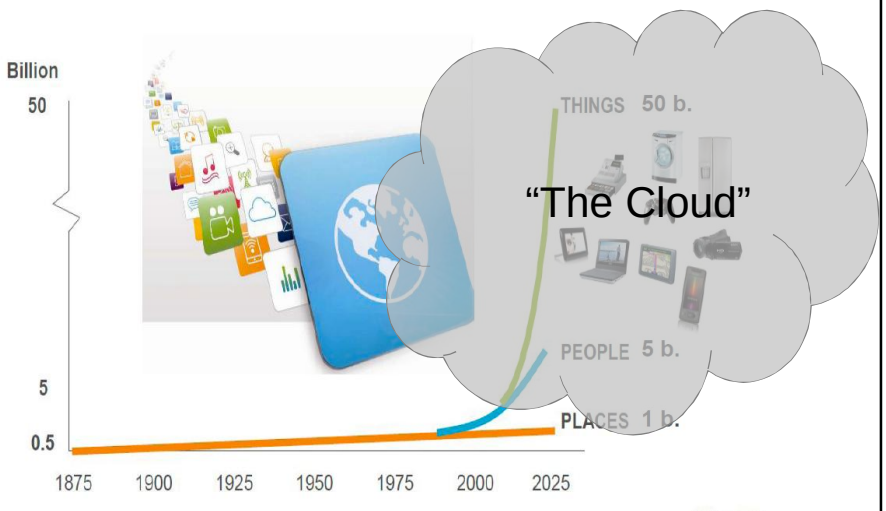
Internet of Things (IoT) – Big Data Analytics



Source: Ericsson

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Things?

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Things?

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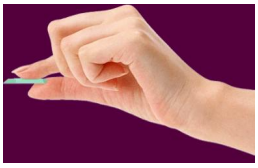
Things? – Estimote Beacon

- 32bit ARM computer with 256 kB Flash
- Temperature sensor (-20 to +50 deg C)
- Accelerometer
- Bluetooth Low Energy
  - 70 meter range
  - Proximity info
- 2-4 years battery life
- iBeacon compatible

- Pack of 3 – 99 USD

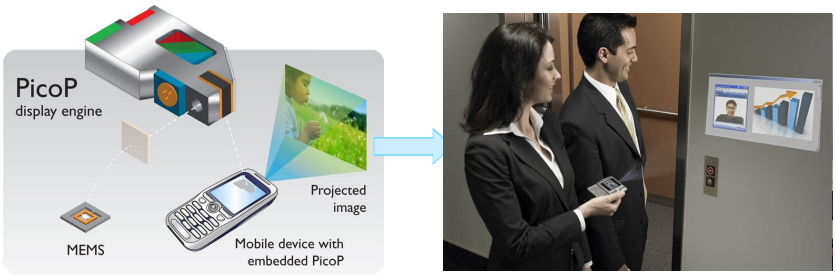
Things? – Estimote Sticker



- 32bit ARM computer with 256 kB Flash
- Temperature sensor (-20 - +50 degrees C)
- Accelerometer
- Bluetooth Low Energy
  - 70 meters
  - Range & Proximity
- 1 year battery life
- iBeacon compatible

- Pack of 10 – 99 USD

Make Presentations - Tomorrow



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Pico Projectors

Sources: www.optoma.com, www.nikon.com, www.samsung.com, www.brookstone.com

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Augmented Reality

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Google – Project Glass

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Microsoft HoloLens

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Microsoft HoloLens

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What Else is ”Hot”?

Source: www.apple.com

Apple vs. Microsoft Stock Value

”iPhone-killer”!?

”iPhone-killer”!?

Source: www.ronen-kadushin.com

3D Printers – Desktop Production

- Today plastics
- Today single material, single color
- Today slow
- Today expensive

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3D Printers – “Digital Fabs”
Robot Spare Part!

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Service Robots for Industry…

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Service Robots for Industry…

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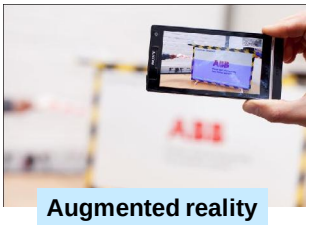
Pure Science Fiction?



Augmented reality

3D modeling in real time

Quadcopters

Telepresence

Social Media - Some Facts 2013

2004

1.230.000.000 users
>50% of North American population
200.000.000 new users
4.750.000.000 sharings/day
4.500.000.000 likes/day

9.600.000.000.000 SMS
260.000 per second

2005

6.000.000.000 hours/month
100 new hours/minute
Gangnam Style has 2.234.161.849 viewings

2010

152.000.000 monthly users
55.000.000 photos/day
9.500 comments & likes/second

66.000.000.000.000 email
51% opened on mobile dev's
68,8% spam

2006

500.000.000 tweets/day
250.000.000 monthly users

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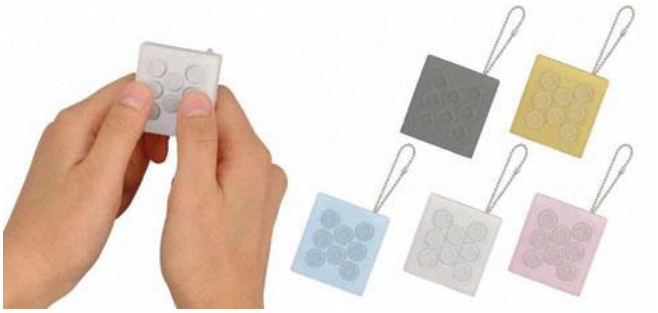
Puchi Puchi!!??



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Four Exciting Gadgets - One does not Belong…

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Future Automation Systems?

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Future Automation Systems!?

- Wireless sensors everywhere – self configuring
- Smart devices – where should the intelligence be?
- Everything connected to and accessible via "the net" - safe and secure"
- A unified object model (Aspect Objects) to manage and access all information anytime, anywhere
- Cloud based for minimized IT maintenance
- Pay by use, with arbitrary granularity – HW & SW
- "AppStore" to find new efficient tools and functions
- Designed for collaboration via e.g. social media and integration
- Remote control, support, access, diagnostics. Mobility
- New ways to interact and visualize – designed for the users
- Models and simulators for commissioning, training, optimization, planning, diagnostics etc.
- Optimized maintenance e.g. condition monitoring, 3D printing for spare parts, service robots
- Easy to use decision support via advanced big data analytics

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Quick Summary!

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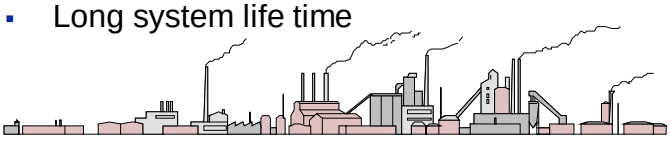
Quick Summary – Industrial Requirements

- Reliability
- Real time behavior
- Predictability
- Tough environment
- Safety
- Security
- Long system life time



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Quick Summary – The User in Focus

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QuickSummary – Lots of New Technologies

Cloud
Big data
3D-printers
Gamification
Industrie 4.0
Optimization
Sensors
Internet of Things
Multi-core
Mobile devices
Augmented reality
Modeling & simulation
Collaboration
Remote control
Cyber Physical Systems
Power electronics
Service robots
NUI
Social media
Virtualization
New materials

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Quick Summary!
Technology is a Global Language

Source: sr.se

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Quick Summary!
Technology is a Global Language

Source: sr.se

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for a better world™