eMaintenance solutions for the railway sector
an overview of ongoing research at JVTC

17th Nordic Seminar on Railway Technology

4 October 2012

Phillip Tretten

Outline

1. Div of Operation and Maintenance Engineering
2. Research Centers
   1. CMIS
   2. JVTC
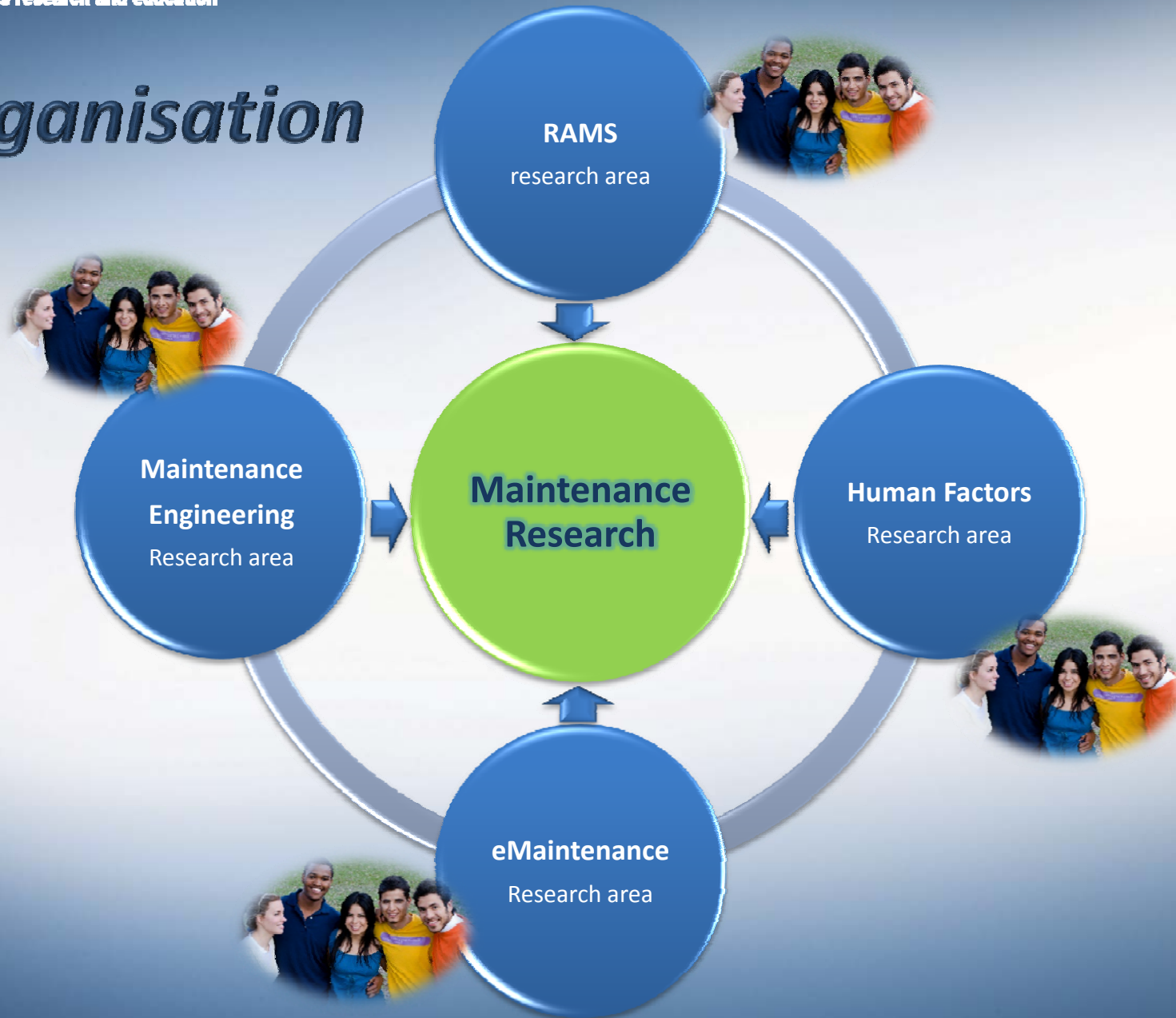3. Maintenance Research
4. eMaintenance
5. eMaintenace LAB

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LULEÅ
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OF TECHNOLOGY

Division of Operation & Maintenance Engineering

Personnel: 40+
(25+ PhD students)

Turnover + 4 000 000 €

Organisation

RAMS
research area

Maintenance Engineering
Research area

Maintenance Research

Human Factors
Research area

eMaintenance
Research area

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Research Centres

Center for Maintenance and Industrial services **CMIS**

Luleå Railway Research Center **JVT**

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Center for Maintenance and Industrial services

CMIS

- Goal: To develop within the area of maintenance; competence, applied research and conduct internationally competitive research

- Focus on: economics, the organization and new technologies for more effective and improved facilities, systems and products

Center for Maintenance and Industrial services CMIS

- Vattenfall – Hydroelectric power
- LKAB - Mining
- Saab Aerospace - Aircraft
- Boliden Mineral AB
- M-Real
- Hägglunds Drives
- Dynamate
- SKF - Condition Monitoring
- FMLOG
- Smurfit Kappa - Paper
- SSAB - Steel

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Center for Maintenance and Industrial services

CMIS

- InMaint - Integrated maintenance for improved production and products

- Condition Monitoring Diagnostics & Prognostics

- eMaintenance solutions for more effective decision support in maintenance

- eMaintenance infrastructure for better information logistics

Luleå Railway Research Center JVT

Goal:

Conduct research which leads to increased safety, capacity, availability and sustainability

for existing and new rail systems through improved operations and maintenance
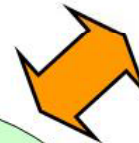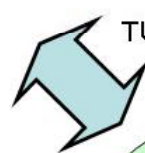
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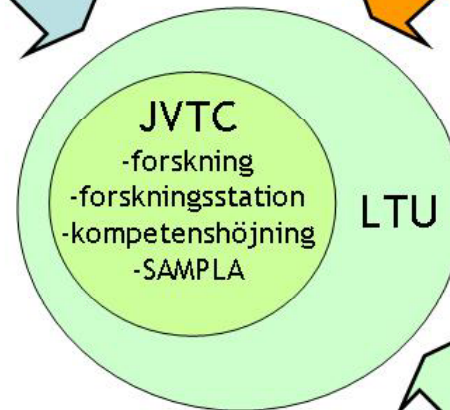
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Luleå Railway Research Center

Medlemmar

- Alstom Transport
- Duroc Rail AB
- Etteplan
- EuroMaint Rail
- Jernbaneverket
- LKAB
- Norut Narvik
- Trafikverket
- Tyréns
- Vectura
- Vossloh Nordic
- WSP
- ÅF Consulting

TURSAM

JVTC
-forskning
-forskningsstation
-kompetenshöjning
-SAMPLA

LTU

Intressenter:
Medlemmar
Satellitföretag
LTU
Samarbetspartners

Satellitföretag

Damill AB

Tyréns AB

Performance in Cold AB

Samarbete

- Eurnex
- EU-projekt
- Internationella föreningar
- Universitet

# Luleå Railway Research Center JVT

- 15 senior researchers (10 professors)

- 20 PhD students

- 5 satellite companies

- 3 R&D labs

- All of LTU's divisions

- 1.8 M € /year

- Sponsors – TrV, LKAB, VINNOVA, JBV, LTU, EU

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Luleå Railway Research Center JVT

- Measure wheel forces on the tracks
- Sensors take measurements 24/7
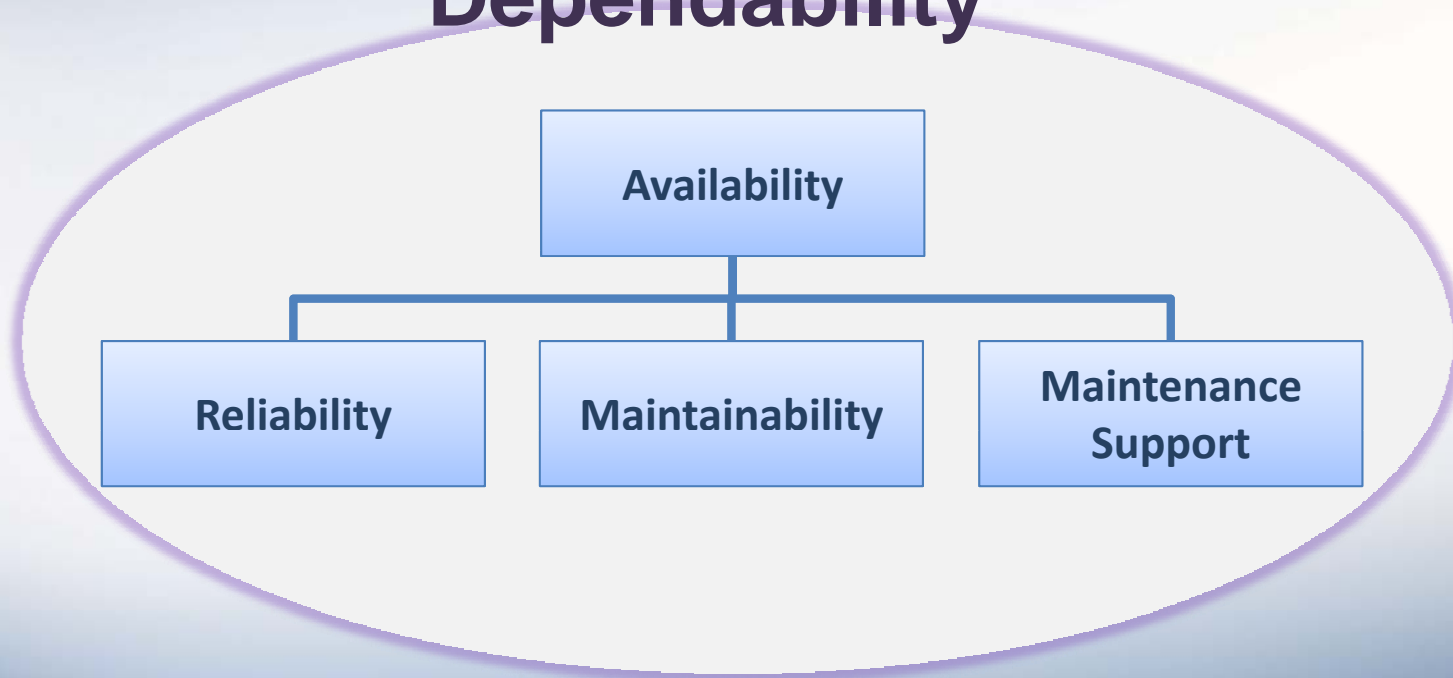- Measure and analyse data via Internet using eMaintenance LAB

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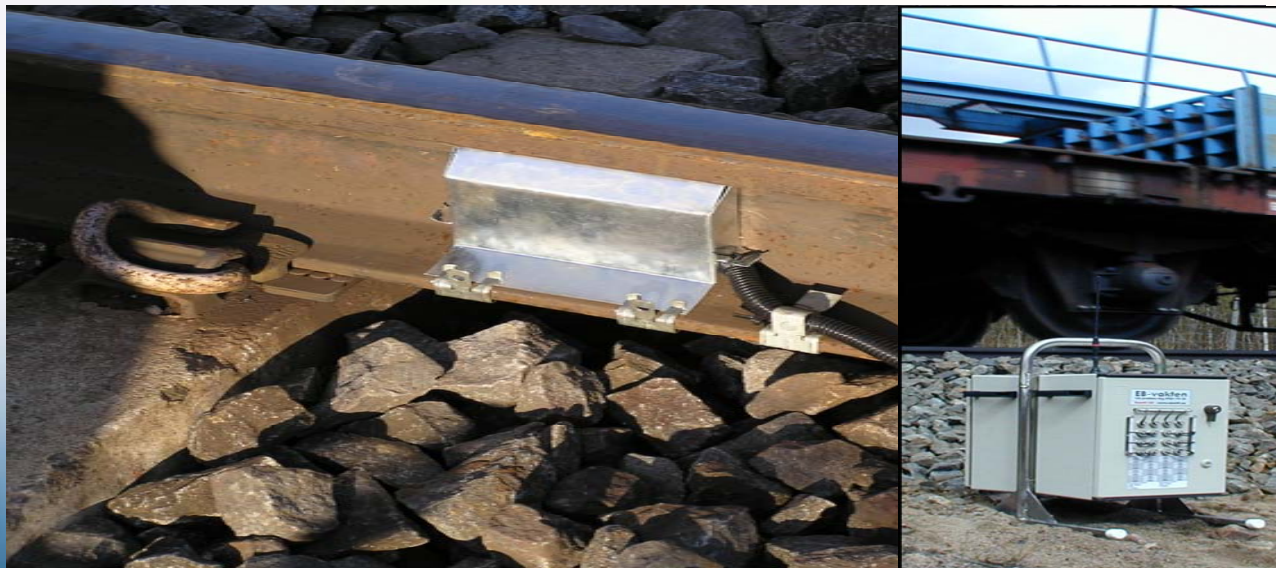
Maintenance Research

The concept of dependability

Dependability

Availability

Reliability

Maintainability

Maintenance Support

Maintenance - Lifecycle Perspective

Concept | Development | Production | Utilization | Support | Retirement

Concept | Development | Production | Utilization | Support | Retirement

Concept | Development | Production | Utilization | Support | Retirement

Concept | Development | Production | Utilization | Support | Retirement

(ISO/IEC, 2002; IEC 2001)

eMaintenance at a Glance

eMaintenance

Facts
(Data)

Relationships
(Information)

Patterns
(Knowledge)
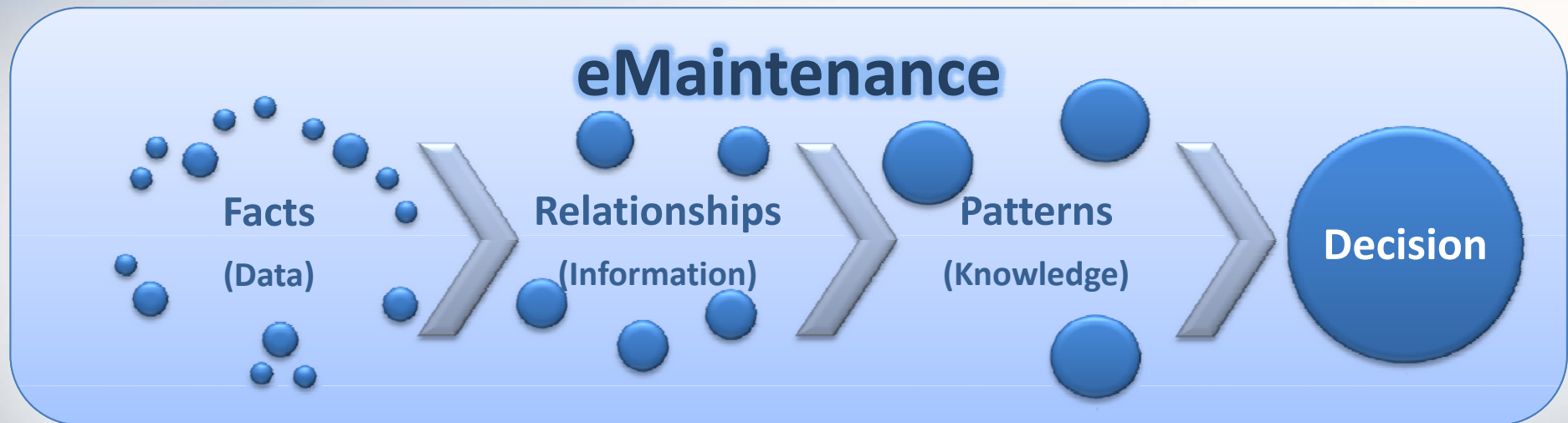
Decision

- Decision support to the maintenace decision process
  - During a system's whole lifecycle

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Examples of Research Activities

- Tools for industrial process simulation
- Tools for Prognostics Health Management
- Tools for LCC calculation
- Tool for RAMS calculation
- Tools for risk management
- Smart sensors, e.g. embedded, for decent... ...sing and data analysis
- Model based visualisation tools, for... ...ration and maintenance processes
- Data mining tools, e.g. F...
- Tools for model ba... ...agnostics
- Tools for mo... ...tion Management
- Tools for mode... ...rmation logistics
- Content manage...ent tools
- Software development tool
  - Conceptualisation, design, development, test, and deployment
- ...

Fusion & Integration !

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eMaintenance – A New Mind Set

**eMaintenance is maintenance
managed and performed
via
computing!**

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eMaintenance - Why

- Maintenance De...
  - When ...
  - ...

Real-time integration between system lifecycle phases & processes!

Business, Operation, Maintenance, Retirement ...

eMaintenance – Field Device

Display

Transparent display which present all the information useful for the technician.

Equipped with a light enhancing function that gives the technician the possibility to see better in poor light conditions.

Headphones

Equipped with Blue Tooth for easy data transfer between the aircraft and the technician. The headset is connected to the display where the information is presented.

Equipped with GPS that makes it possible to constantly see the location of the technician.

Camera

Recordable and real time video provides the possibility for others to see the same thing as the technician.

Warning system

A system with the help from the GPS and other systems warns the technician if he/she is about to do something that endangers the aircraft or him/her.

Microphone

Provides easy communication with the pilot and the other technicians.

"
et" or the "digital paper", a bendable screen with many features. Hold it in hand, strap it around an arm or place nto the aircraft. Fold it and store in a pocket.

of functions:
r with a pen, touch, voice or movements
ording
information transmission
e aircraft, pilot, staff and other technicians
:anning
:king
identification

ructing in wrong hands
sparent
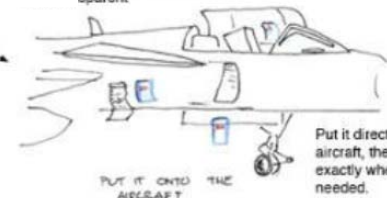
Put it direct onto the aircraft, the floor or exactly where it is needed.

PUT IT ONTO THE AIRCRAFT

ARMSTRAP

sy to maneuver.

LG.PHILIPS LCD

eMaintenance – Back Office

CONCEPT "WORKSTATION"

A small "base" where all information needed is available out on the line, either stationary or mobile. The concept is combined with a handheld device for the most necessary information. It enhances the possibility to store all equipment at the same place.

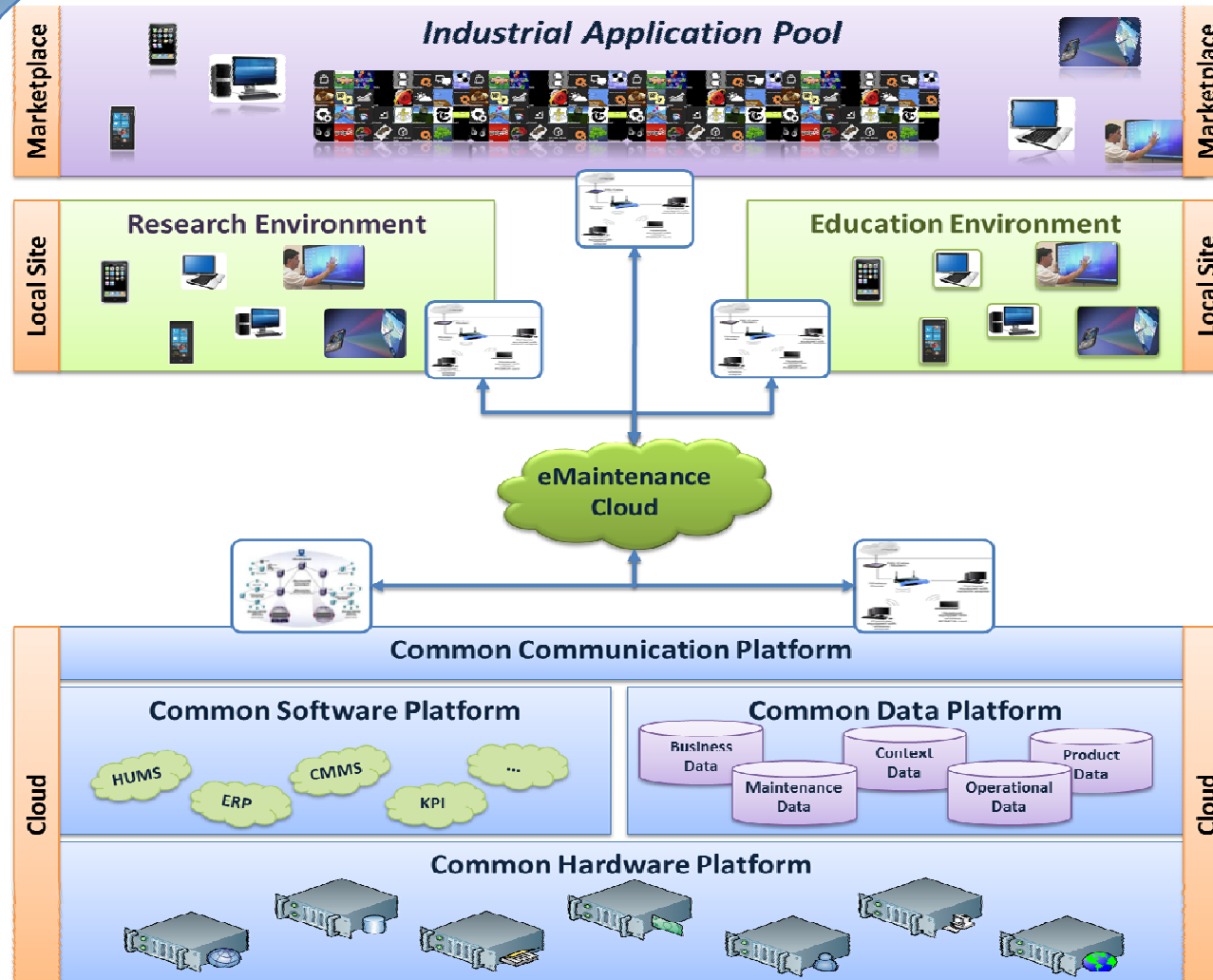Large multi-touch workstation.
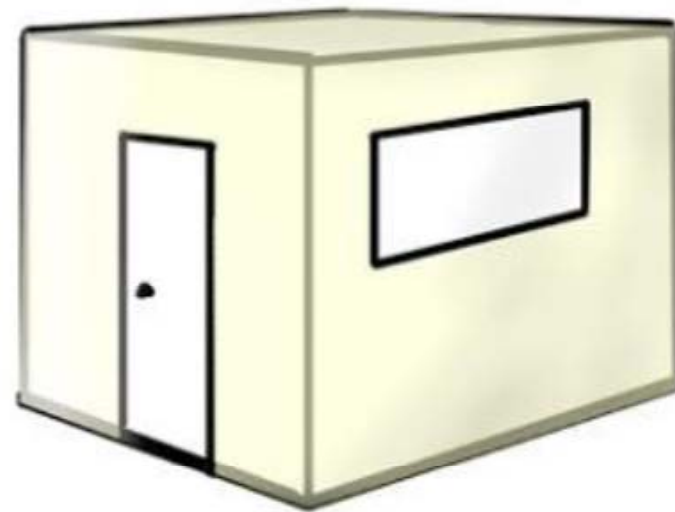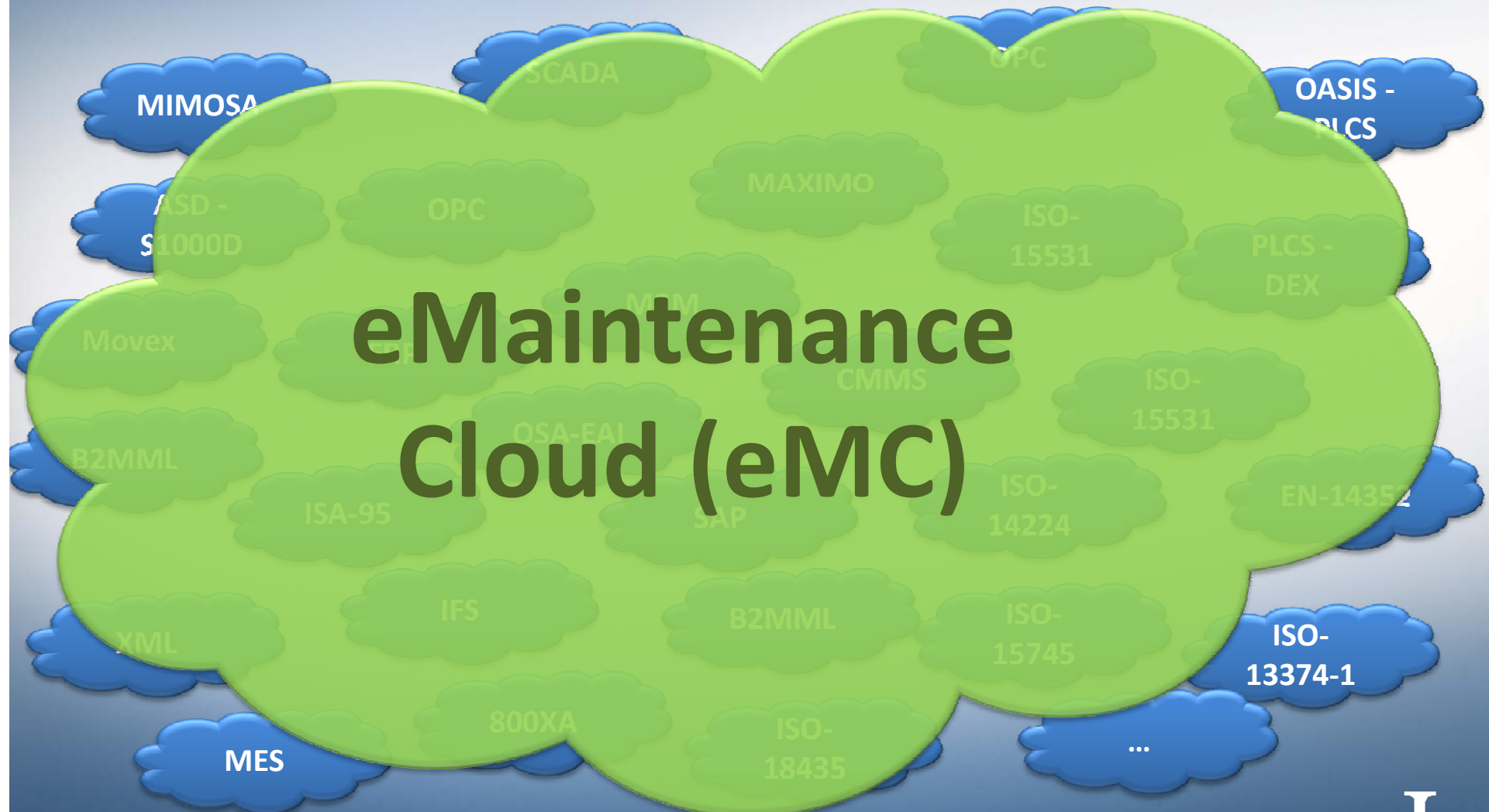
eMaintenance – Conceptual Model

A Service-Oriented Approach

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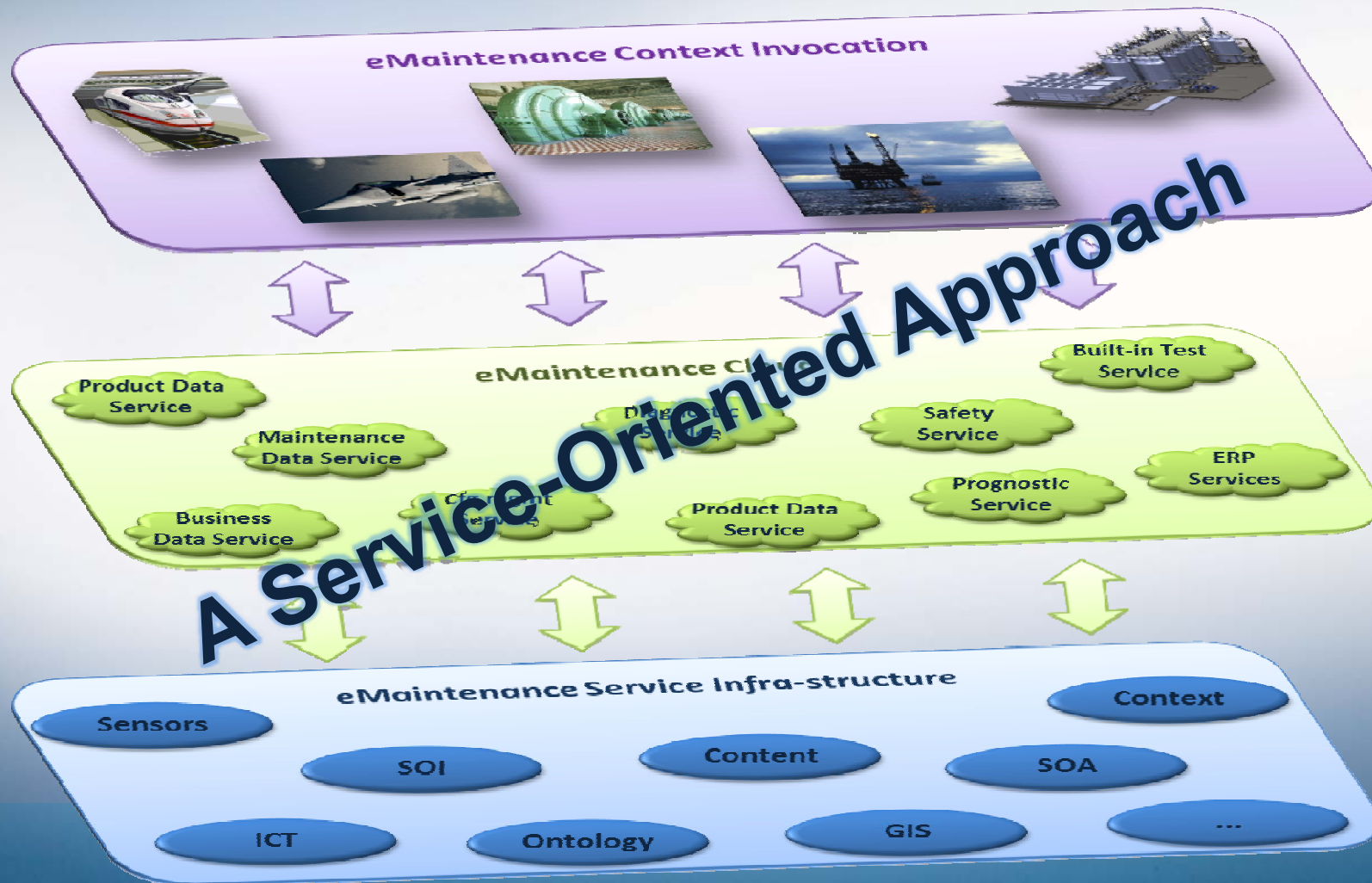
The hands-on experience
eMaintenance LAB

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Service Level Agreement (SLA)
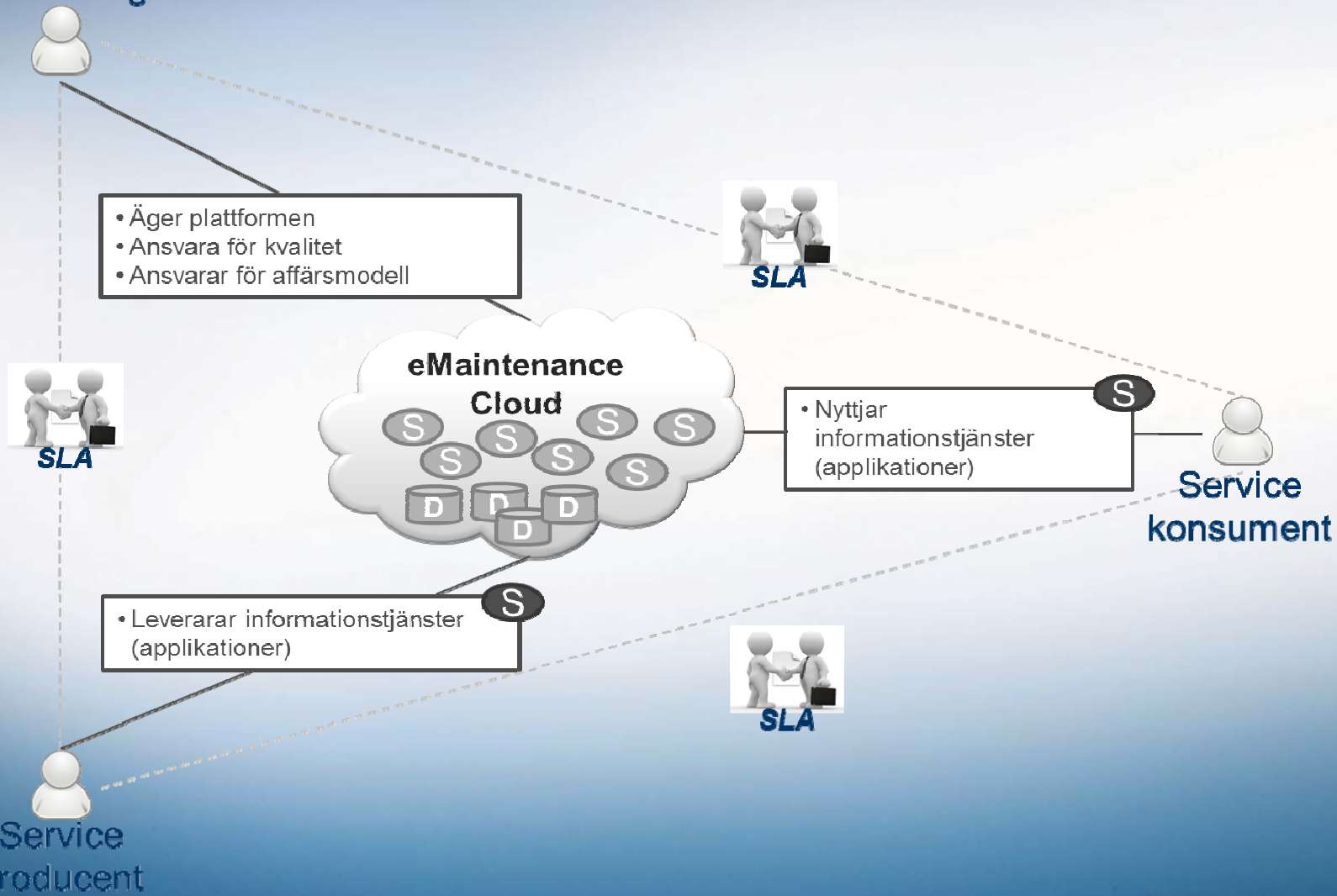
Trends & Challenges in eMaintenance

- **Business trends**
  - Asset management
  - Performance Based Logistics (BPL)
  - Contracted Logistic Support (CLS)
  - Sustainability
  - Key Performance Indicators (KPI)
  - Lifecycle management

- **Methodology trends**
  - RAMS analysis
  - Risk management
  - Predict-and-Prevent instead of Fail-and-Fix
  - Prognostic Health Management (PHM)
  - Data mining
  - Data analysis
  - LCC & Risk calculation

- **Technology trends**
  - "Asset monitors"
  - Cloud computing
  - Decentralised data processing
  - Embedded systems
  - Real-time & on-line data processing
  - Data integration
  - Ontologies
  - Model development
  - Data acquisition
  - Context sensing
  - Content management
  - Service-orientation
  - Event-driven

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Topics

- **eMaintenance**
  Decision support

- **eMaintenance**
  Concepts and frameworks

- **eMaintenance**
  Data and service fusion

- **eMaintenance**
  Data quality

- **eMaintenance**
  Diagnosis and prognosis

- **eMaintenance**
  Information logistics

- **eMaintenance**
  Solutions for Performance Based Logistic (PBL)

- **eMaintenance**
  Solutions for Integrated Logistics Support (ILS)

- **eMaintenance**
  Data warehousing and data mining

- **eMaintenance**
  Embedded system technologies

- **eMaintenance**
  Solutions for estimation of Remaining Useful Life (RUL)

- **eMaintenance**
  Enterprise Resource Planning (ERP)

- **eMaintenance**
  Support to Operation Performance Monitoring (OPM)

- **eMaintenance**
  Support to Life Cycle Management (LCM)

- **eMaintenance**
  Integration with Prognostic Health Management (PHM)

- **eMaintenance**
  Maintenance optimazition

Important Dates/Deadlines

Submission of abstract
20 June 2012

Notification of Abstract Acceptance
1 July 2012

Paper Submission
1 September

Notification of Paper Acceptance
15 October

Camera Ready Manuscript
15 November

Early Birds Registration
15 October - 1 November

Organised by:
Division of Operation and Maintenance Engineering,
Process IT Innovations

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L The northernmost University of Technology in Scandinavia
Worldeclass research and education

Invitation

The 2nd international workshop
and congress on eMaintenance

eMaintenance

**Trends in technologies & methodologies
challenges, possibilities, and applications**

2012 Dec 12-14
Luleå
Sweden

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Thank you for your attention!