Prof. PhD
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Technical systems
Operations and
Maintenance

eUnderhåll -
Utmaningar och
möjligheter

TRAFFIKVERKET
The Swedish Transport Administration
Trafikverket Scenario 2015 – Tasks 2020

• Needs for higher capacity on existing assets
• Lower costs
• Less time in track for maintenance
• Energy consumption must decrease
• Noise emissions must decrease
• Environmental impact must decrease (ECO Design)
• CO₂ must decreased with 20%, 1990 values, to 2020
Swedish deregulated Railway market

Ball No 2

1988-07-01
Banverket
- Järnvägsinspektionen
- Tågledning
- Banverket Produktion
- Client/contractor
- Infranord AB
- Trafikverket

1998-01-01
SJ
- Tågledning
- SJ AB
- Green Cargo AB
- Jenhusen AB
- EuroMaint AB
- TrafficCare AB
- Unigrid AB
- ASG
- AB TR
- Swebus
- Sweferry
- Nordwagon AB
- Nya trafikutövare

2001-07-01
SJ AB
- EuroMaint AB
- TrainTech AB
- Interfleet
- MTAB
- TGOL
- Connex

2004-01-01
2010-04-01
Transportstyrelsen
Carillion
Svensk Banproduktion
Balfour Beatty
Strukton
VRTrack
Infranord AB
Trafikverket

Idag > 20 trafikföretag
Solution – Systematic Approach for Development

Assess Current Performance
- Traffic failure and error costs (technical indicators)
- Maintenance costs (financial indicators)
- General performance (personnel, safety, quality based indicators)

Localize Problem Areas
- Analyze performance indicators
- View equipment data and trends
- Expose cost effects and OEE bottlenecks

Identify Root Causes
- Cross-organizational co-operation
- Acquire expertise, networking
- Eliminate root causes rather than consequences

Find Solutions
- Internal process-related expertise
- Development, upgrading
- Specialists, knowledge acquisition (R&D)

Realize Planned Actions
- Pick up the low hanging fruits
- Projected actions
- Reinvestments when appropriate

Monitor Progress

Plan- Do- Check- Act

Documentation
Ball No 4

Trafikverket R&D Tools

Federal/State/ Trafikverket

Universities R&D institutes

Big companies with own R&D

SME

Federal/State driven innovation process (i.e. CRC initiatives)

Technology driven innovation process (i.e. R&D results from universities)

Business driven innovation process (i.e. from business demands)

Market driven innovation process (i.e. from market initiatives)
R&D initiation during 1990-2010

- Federal/State/IM
- Universities R&D - institutes
- Big companies with own R&D
- SME

Cooperation organizations

R&D Needs

Cooperation
Intercommunication
Todays R&D initiation

- Universities
  - R&D institutes
- Procurement of R&D programs
- Industry R&D programs
- SME
- Federal/State/IM
- Big companies with own R&D
R&D implementation during 1990-2010

- Federal/State/IM
- Universities R&D institutes
- Updated standards, codes, norms, handbooks
- Big companies with own R&D
- SME

R&D results
Todays implementation

Federal/State/IM

Procurement

Universities
R&D - institutes

Procurement

Big companies with own R&D

R&D Results

SME

Agreements
Results and IP from R&D platforms

University Readiness level

Validation Readiness level

Universities and Institutes

Business and Stakeholders

Business driven innovation

System Test, Launch & Operations
System/Subsystem Development
Technology Demonstration
Technology Development
Research to Prove Feasibility
Basic Technology Research

TRL 9
TRL 8
TRL 7
TRL 6
TRL 5
TRL 4
TRL 3
TRL 2
TRL 1
Match making different stake holders

- Operation side – more than 20 operators with their own agenda and stakeholder demands
- Maintenance contractors with their sub-contractors with their own agenda and stakeholder demands
- Asset owner Trafikverket with our stakeholder (government) demands and KPI:s
  - Procurement with EU regulations
  - Tech. system integrity (Track, Signal, Telecom, Power)
  - Increased traffic volumes on existing assets
- Can we get ideas from others, aviation, process industry, power industry etc. ?
Condition Based Maintenance vs. Corrective Based Maintenance

Run and fail – Immediate corrective maintenance

- Operation (Up-time)
- Wait time
- Repair time
- Oper.
- Down Time

Plan and control – Condition-based maintenance

- Operation
- Repair time
- Operation
- Down time

Early warning

Planning and repair
Need for solutions

• **Correct** information to correct personal for correct decisions at correct stakeholder
• **Real time** – updated information
• **Transparency** maintenance information inside and outside own organization
• **Predict** maintenance actions
• **Support** different levels the organization
• **Support** logistic decisions
• **Support** KPI
Possibilities if we have information

Degradation curve: Improve knowledge on track system prediction models

New knowledge to support new designs, improved prediction models

Improved triggers, limits and methods

Reduced wear and degradation

Less maintenance, improved capacity, lower cost, smarter machines, better planning, execution and work flows
Posibilities with increase operational availability

In order to reduce size of planned unavailability (possessions and slots), study possibilities to:
- reduce preparation and withdrawal time
- increase speed of activity
- only plan maintenance when necessary or useful
- combine activities
- less inspection train paths (fault or condition detection in asset itself)

Spin-off of developing solutions will be:
- insight in performance of machines and components, and suggestion for their design
Possibilities with Design for Maintenance

Information supports real and true condition data from manufacturing, logistic supports, operation and maintenance etc.
Some examples on-going activities in Sweden

- SKF UTC – MTAB, Bombardier, Trafikverket – Instrumented IORE locomotives
- eMaintenance365 AB – CBM projects with SJ & MTAB
- ARROWHEAD – EU project, cooperative automation in infrastructure and energy
- Alstom – CBM projects with SL in Stockholm
- Damill AB – CBM project with Trafikverket, InfaNord
- ePilot – CBM project on JVTC platform
One example: Shift2Rail

Data Collection
- Contactor Raw Data

Signal Processing
- Transformed Data

Feature Extraction
- Condition Indicators

Fault Classification
- Prognostic Modelling

Data Collection
- Sensors

Sensors
- Work Order

Data from
Train & Infra

Data from
Train & Infra

Signal Processing
- CMMS ERP SCADA

Managerial data
- Historical data

Required functions
- Contractual Condition Evaluation

Decision support system
- Remaining useful life
  Reliability prediction
  Risk assessment

Fault Detection and Evaluation

Track/Train Maintenance Contractors

SCADA Supervisory Control And Data Acquisition
ERP Enterprise Resource Planning
CMMS Computer Maintenance Management Software
It starts to look like ICT can help us

Let us do the right thing, the right way at the right time with the right approach and tools

TRV alone do not have to grasp and solve it all our themselves.

The sum of everyone’s knowledge, can solve the big picture and the tasks.
Think 3D

• **D**ream
  We tell our dreams to universities and R&D institutes, stories that we had seen in our dreams

• **D**ecide
  We then decide if the results of a dream make sense for the market, for the owners and for the future business development

• **D**eliver
  We market our dreams using the results, in combination with traditional engineering skills and engineering performance
Trafikverket Scenario 2015 – Tasks 2020
Refinement of your common ICT

Adopt, adapt, improve available systems information
Information scope in harmony with business development
High functionality of complex systems – technology integrity
Onboard monitoring. Impact from infra.

Maintenance contractors
Train operation

Wayside monitoring. Impact from traffic

Trafikverket
Infra. Managers

Maintenance contractors
Infrastructure
Some examples where IT works
Business model

Trafikverket specify a standard data protocol and data quality for a geographical area to be studied.

Trafikverket only pay for correct data quality.

In this example Trafikverket do not own the actual equipment.
Existing systems today


Second procurement are now running. Contractor is ARS Traffic & Transport Technology.

Way side cameras for data harvesting of traffic capacity on roads

Used for monitoring traffic flows and give information of current traffic situation
Test platform for introducing the concepts on Railways

**ePilot – The movie**

**ePilot – Project**
3D Results used in room and in space

- Contractors, entrepreneurs, consultants and academia
- Attitude – Neutral office room and test platform
- Today's results – On track verification
- Tomorrows results – Decide what to do
- Future results – Dreams come true
- European results – European “leaf let”
- UIC results – International “leaf let”
Rogers Model + Partnering = ePilot

Knowledge

Modification and improvements

Awareness and insight

Determine and evaluate

Acceptans

In operation

Adopt and modify

Decide

START

STOP
Thank you! Questions?