

# SMART-monitering

## Overvågning af Vejdirektoratets store bygværker



Asger Knudsen, Rambøll

Bridge Management and Materials technology

# D2 – Store konstruktioner

**SensoByg**

Et innovationskonsortium for sensorbaseret overvågning i byggeriet



TEKNOLOGISK  
INSTITUT

## Monitering af broer med trådløse sensorer

*SensoByg – D2*



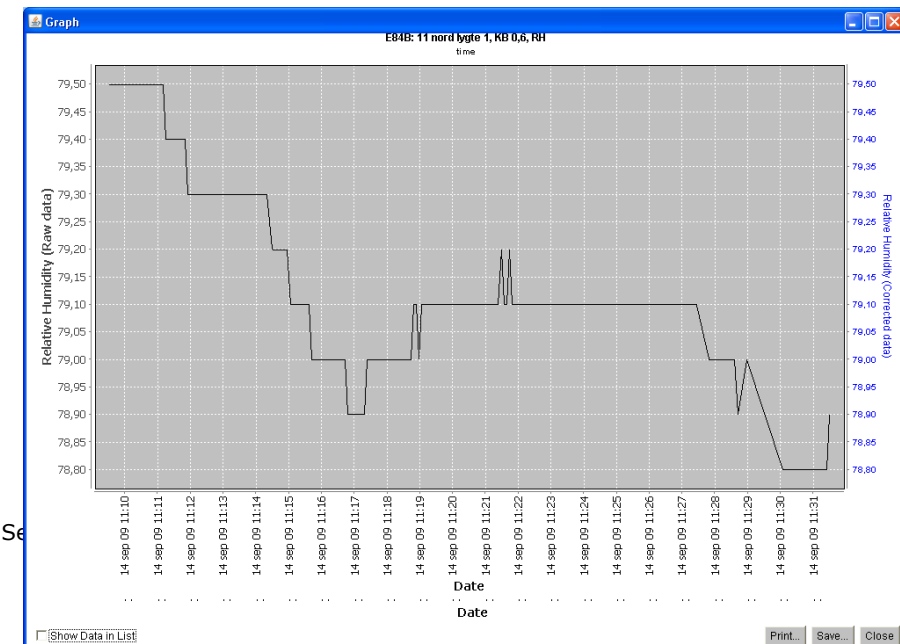
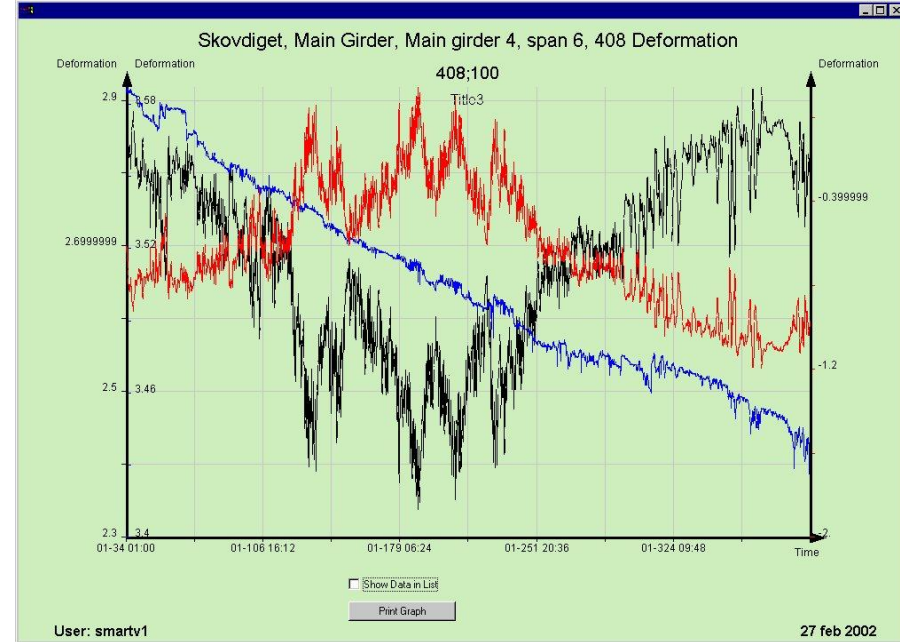
Rapport nr. : D2-1  
Udarbejdet af : Erik Stoltzner (Vejdirektoratet), Peter H. Møller (Rambøll), Jesper stærke Clausen (Rambøll), Asger Knudsen (Rambøll)  
Dato : November 2010

# Online monitoring

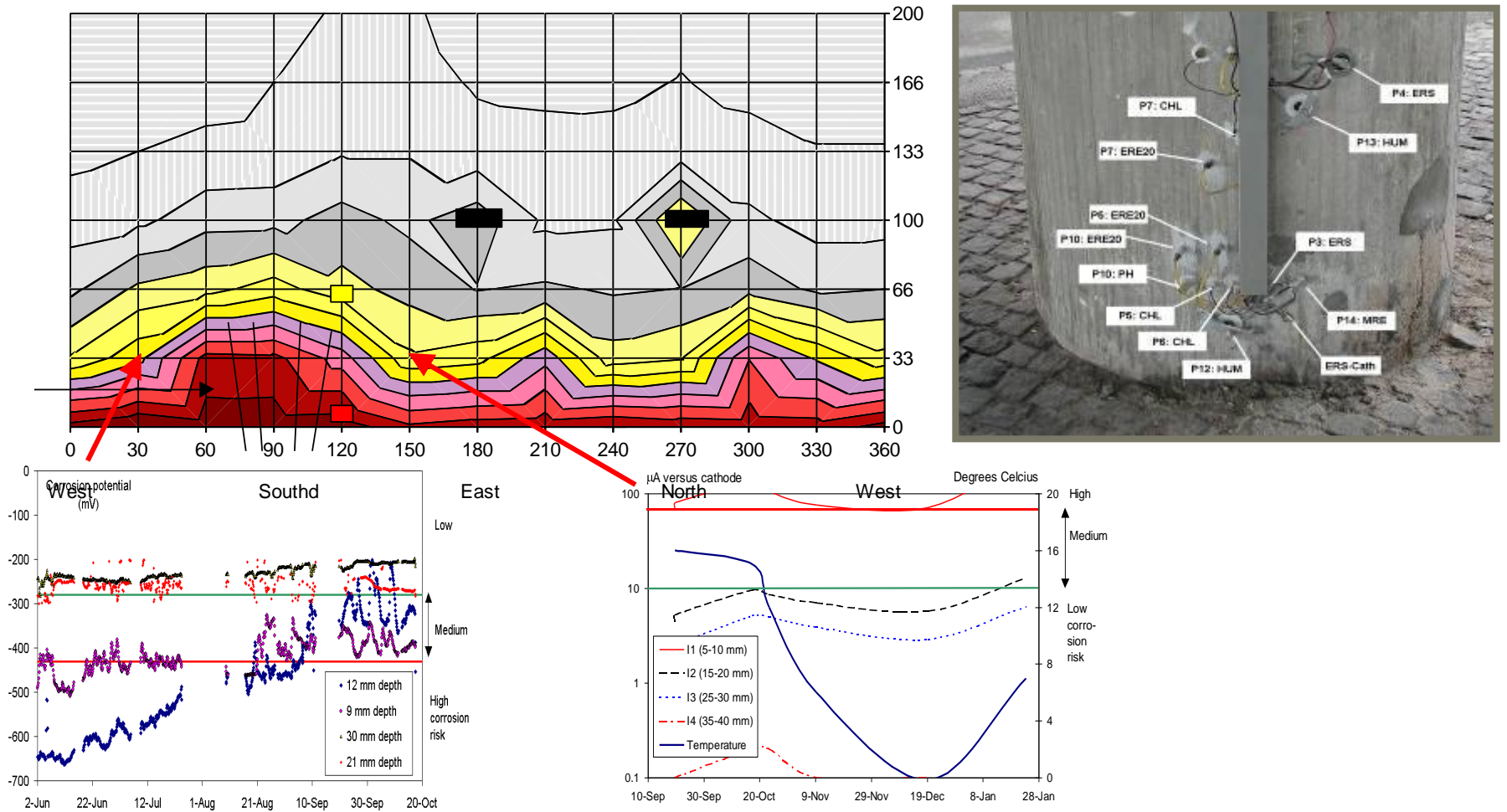
## Formål og fordele

The use of monitoring system with remote access has several advantages compared to the traditional approach:

- Better & simpler assessments
- Possible to monitor areas where access is difficult or impossible
- Easier inspections
- Traffic interference is reduced
- Early-warning of damages or safety risks
- The basis for making decisions and prioritization regarding maintenance and repair activities is improved
  - Fewer unexpected major costs
  - Postpone & tailor repairs (cost reductions)



# Monitering - Kombination med NDT

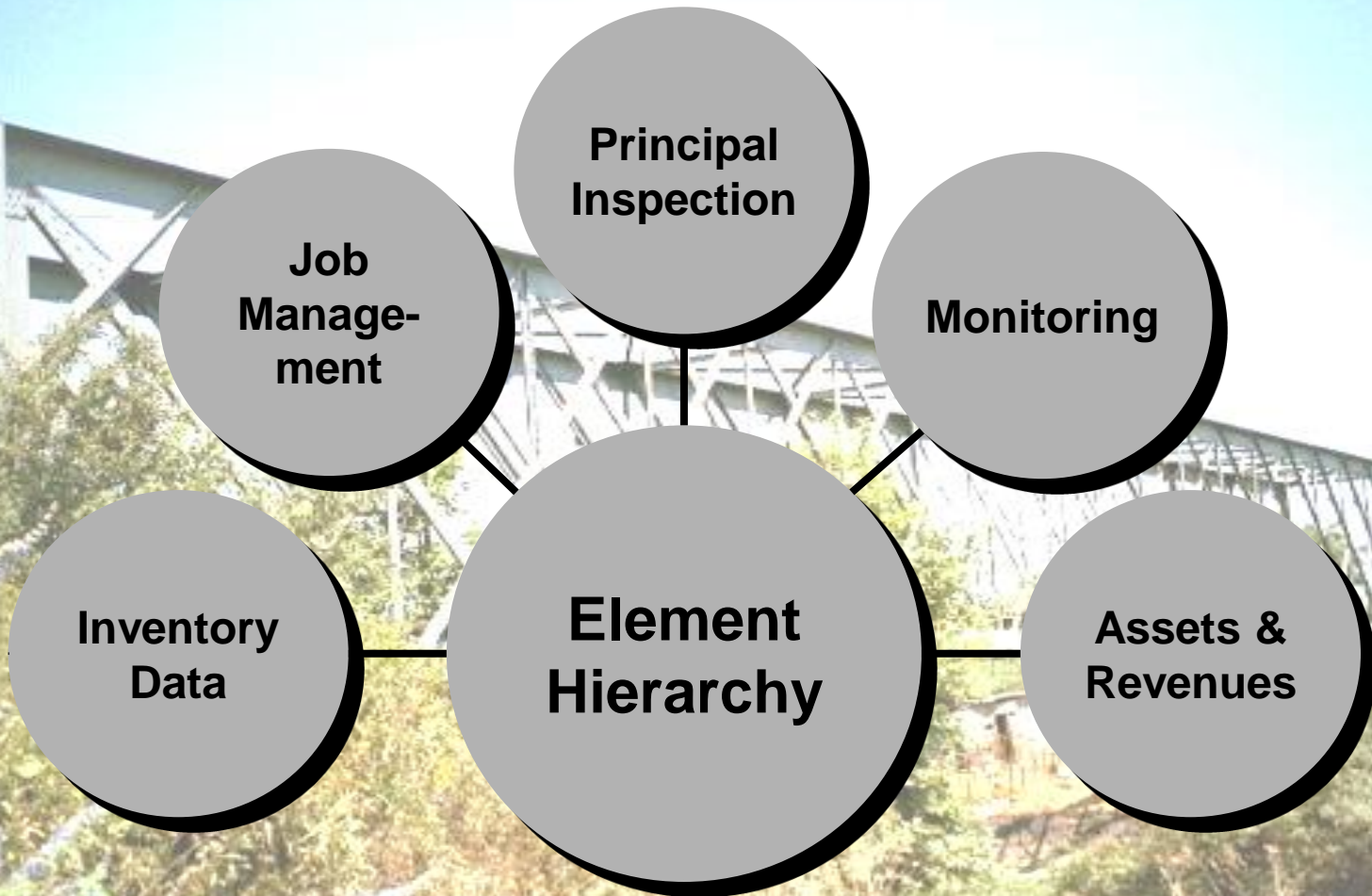


# SMART Bridge Management System

- Overview of Assets
- Overview of Documents
- Overview of Condition
- Activity Management
  - Planning
  - Budgeting
  - Priority Ranking
  - Follow-up on Execution and Economy
  
- 100% web-based



# SMART Bridge Main Modules



**Inventory - Inventory Data**

1: District	2: Section	3: Location/Element	4: Object	5: Sub-object	6: Component
Victoria Falls Bridge	Superstructure Substructure Adjacent elements	Bridge surfacing Railing End span Zambia <b>Main span</b> End span Zimbabwe	Steel troughing Stringers, Cantilever upstrea Longitudinal girders Cross girders Bearing girder <b>Top chords</b> Horizontals (Level A) Horizontals (Level B) Arch chords Vertical posts Diagonals Struts Post bracing Wind bracing Joints Access facilities	Section 1, Zambia, Downs Section 2, Zambia, Downs Section 3, Zambia, Downs Section 4, Zambia, Downs Section 5, Zambia, Downs Section 6, Zambia, Downs Section 7, Zambia, Downs Section 8, Zambia, Downs Section 9, Zambia, Downs Section 10, Zambia, Dowr Section 10, Zimbabwe, Dc Section 9, Zimbabwe, Dov <b>Section 8, Zimbabwe, Dov</b> Section 7, Zimbabwe, Dov Section 6, Zimbabwe, Dov Section 5, Zimbabwe, Dov Section 4, Zimbabwe, Dov	

Buttons: Select from Map, Show Map, Data, Documents (0)

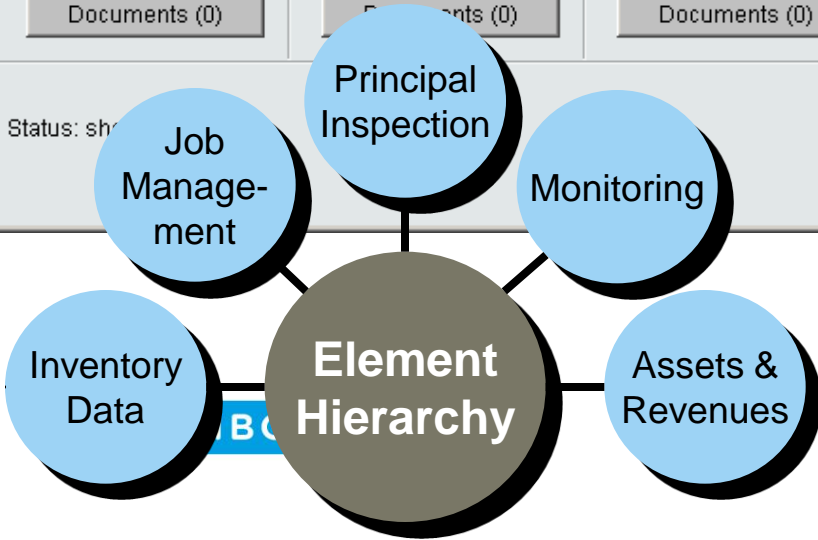
Smart - Microsoft Internet Explorer provided by RAMBOLL

**SMART - Bridges**

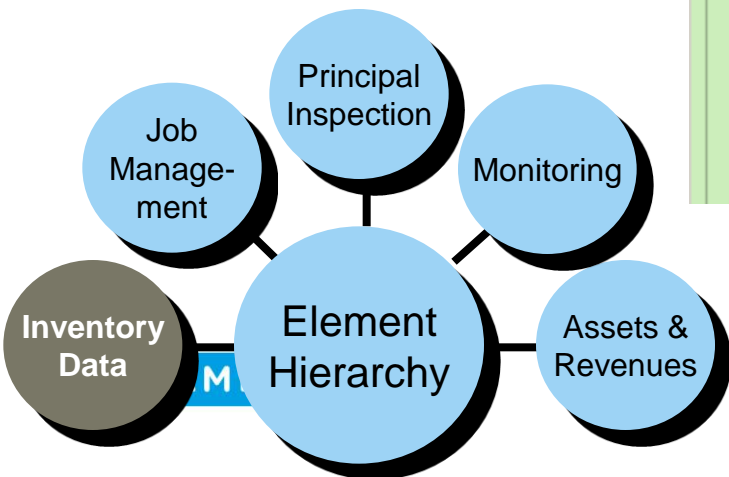
Inventory | Job Management | Condition | Reports/Overviews | Administration | Help | Close

Inventory Data...  
Assets and Revenues...  
Element Hierarchy>  
Prototypes...

Zambia Railways Limited - Victoria Falls Bridge



Properties can be registered on any element in the Hierarchy

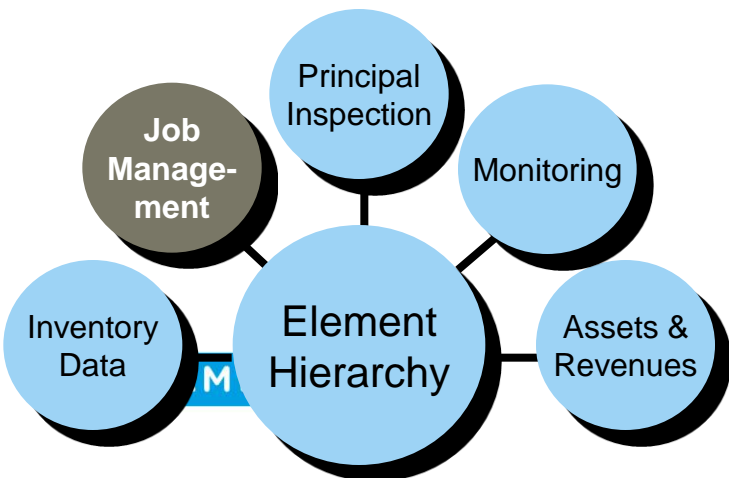
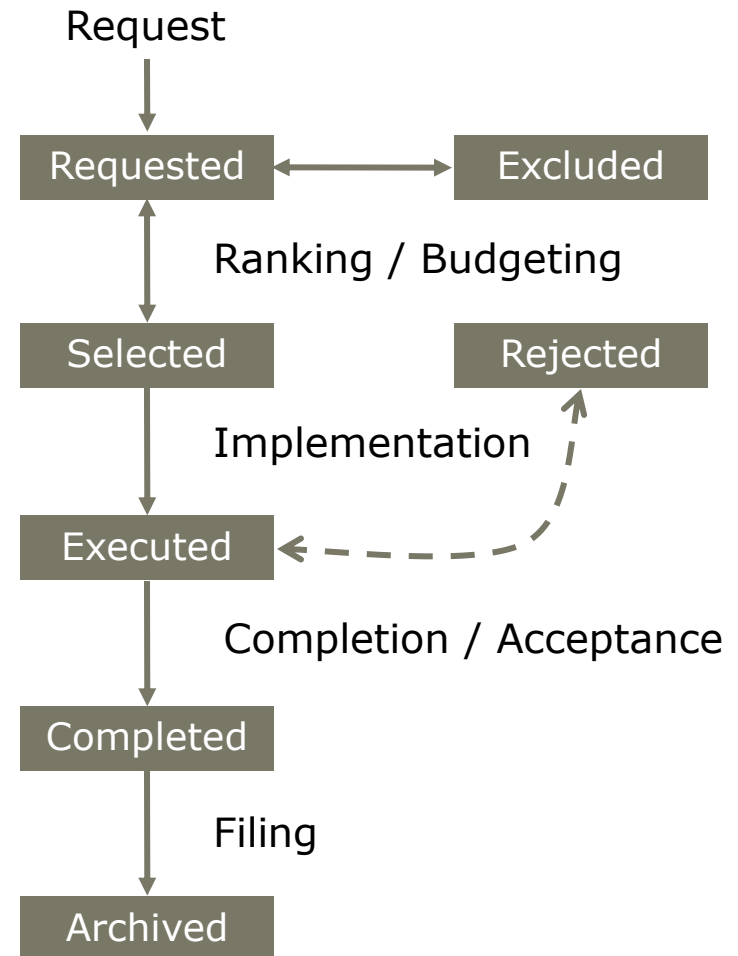


Location	Technical Data	Passage Data
<b>Geometry</b>		
Length [m]	<input type="text" value="24.0"/>	
Carriageway Width [m]	<input type="text" value="6.2"/>	
Area [m2]	<input type="text" value="148.8"/>	
Max Span width [m]	<input type="text" value="24.0"/>	
<b>Design</b>		
Over/Underpass	<input type="text" value="0"/>	
Type of crossing passage	<input type="text" value="Creek"/>	
Structural Design	<input type="text" value="Simple Span"/>	
Superstructure cross section	<input type="text" value="Truss"/>	
Number of Spans	<input type="text" value="1"/>	
Primary material	<input type="text" value="Steel profiles"/>	<b>(Steel)</b>



# Work order life cycle

All parties involved perform their activities in the same database through the web, governed by individual user rights.



**Principal Inspection**

1:Region South Island  
 2:Category Bridges  
 3:Location Copper Creek Bridge

Carry Out Date 2002-06-20 Job Supplier FNJ-Consult Weather Cloudy  
 Initials fnj Temperature 0

General remarks

Modify Save Cancel

Select Inspection Actual

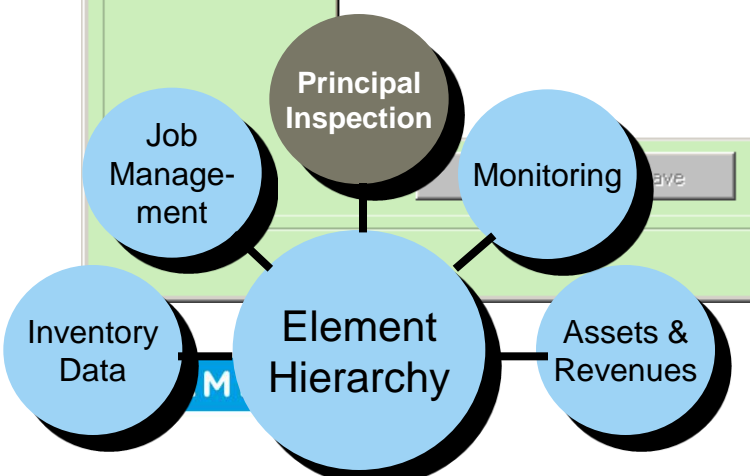
3:Location	4:Component	5:Subcomponent	CR	Type	S	Job Name	Quantity	Cycle	Week	Price
Copper Creek Bridge			3	Rep	▲	Gunite without reinforcement	67.0 m2	None	2002:45	297023
	Abutments		3							
	Bridge in General		3							
				Insp	▲	Ordinary Inspection		2 Week	2001:30	311
				Insp	■	Principal Inspection	1.0 Sum	4 Year	2002:35	1867
	Parapets/railing		2							
		Railing on approaches	2							
		Railing on bridge	0							
	Slopes		2							
	Substructure									
	Superstructure									

In the Principal Inspection Module, condition ratings are registered together with damage description, rehabilitation needs, and photos

Condition Rating(CR) 3: Damage. Repair soon

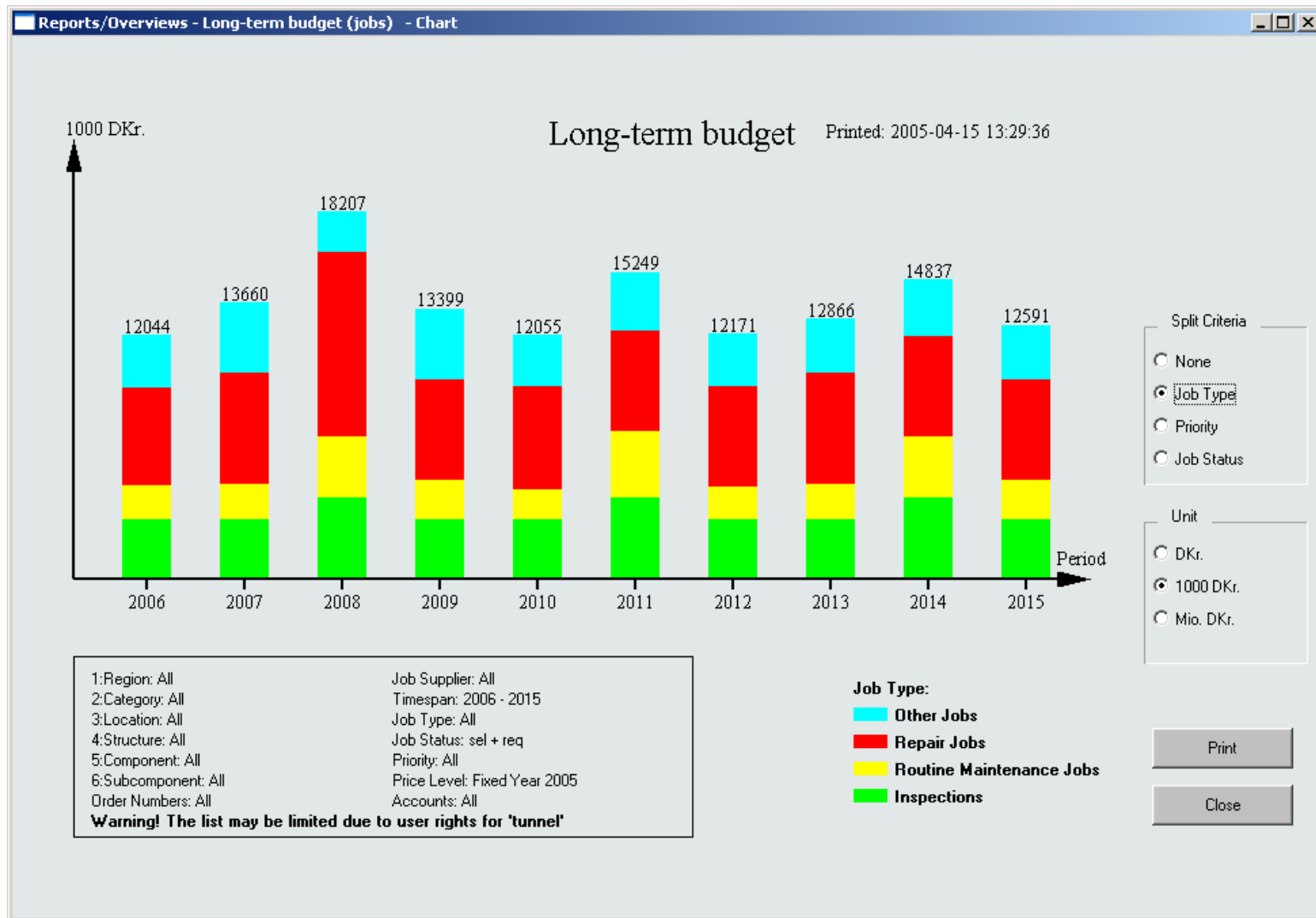
Damage Description An interim bracing has been applied to prevent inclination of abutments. See ph

Save Cancel

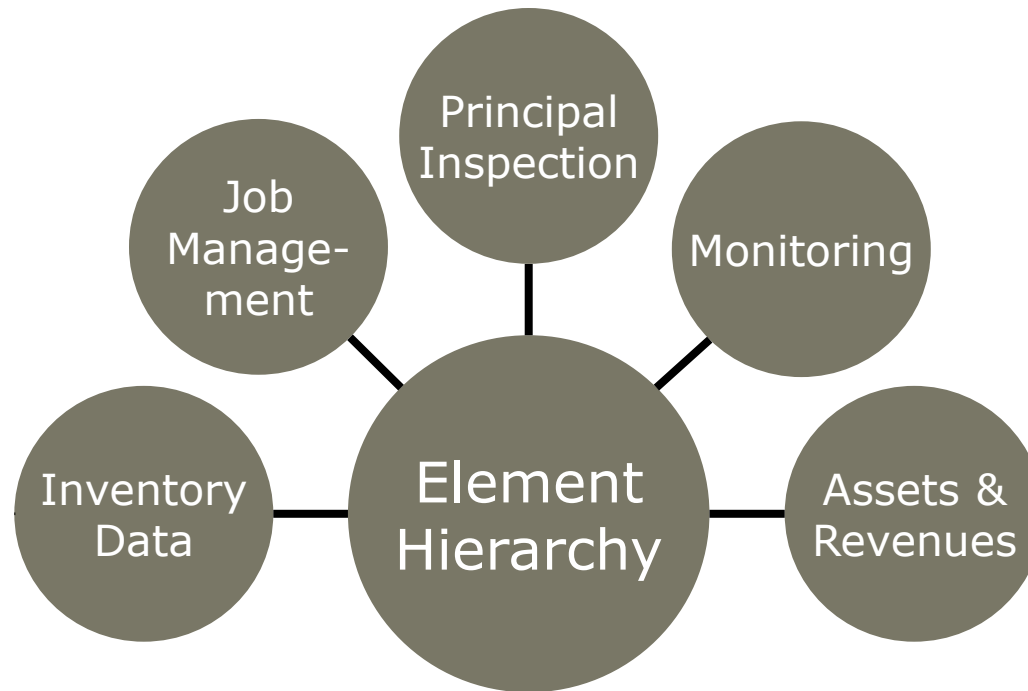


Archive Documents (0) Close

# 10 years' budget



# Reports and Overviews Examples



Bridge List

Principal Inspection Report

Condition Rating Statistics

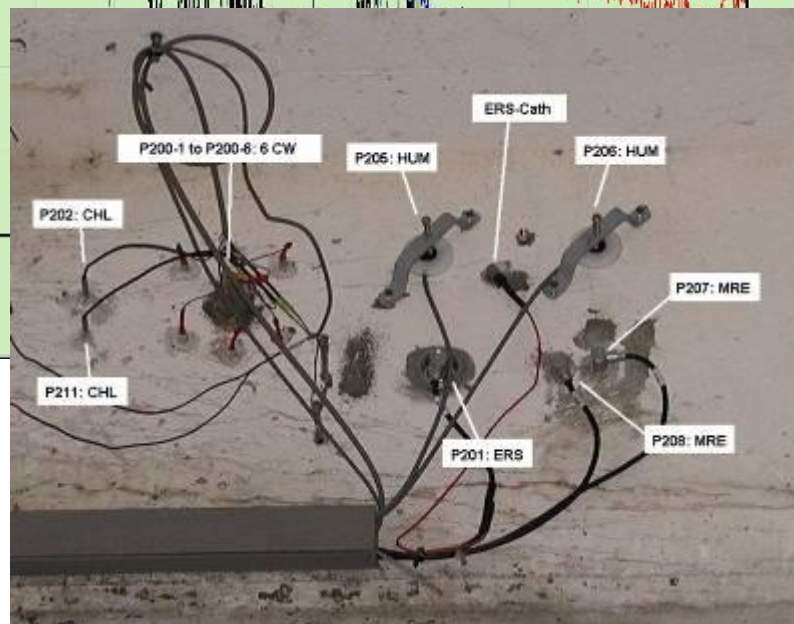
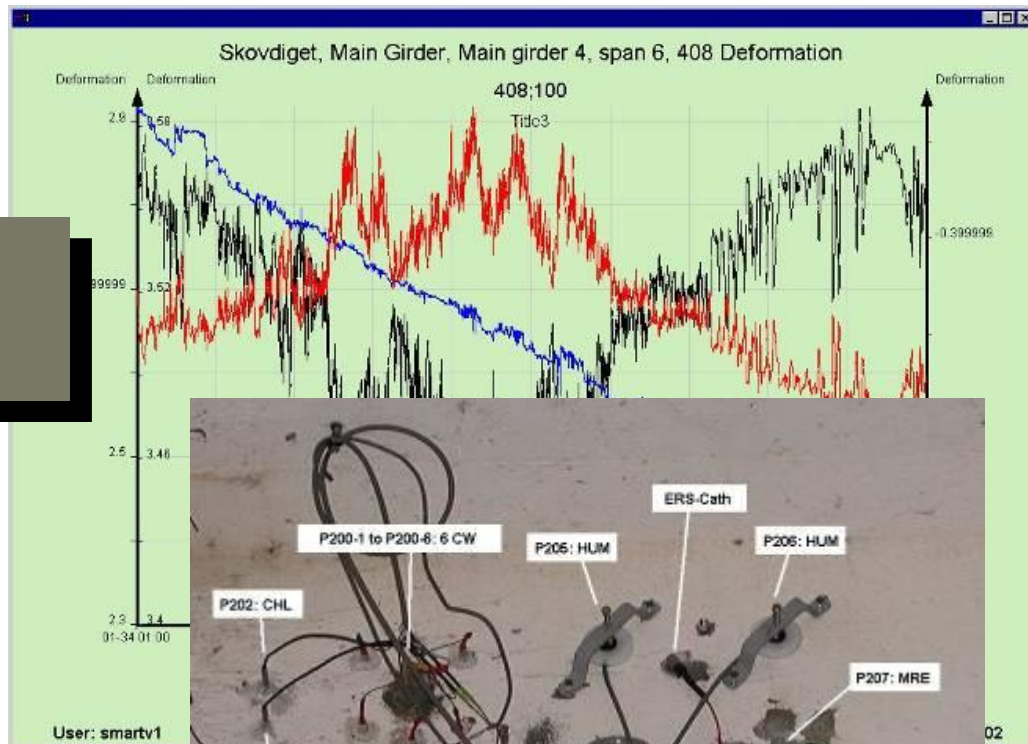
Budgets

Job Overview

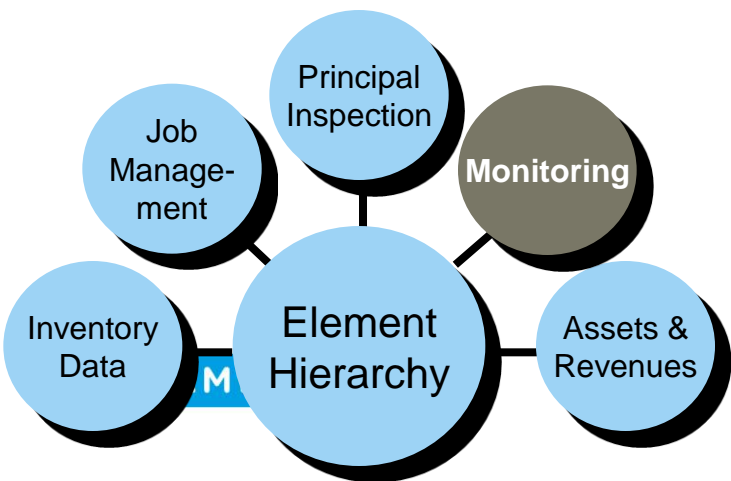
# SMARTmonitoring module

## En integreret del af den almindelige forvaltning

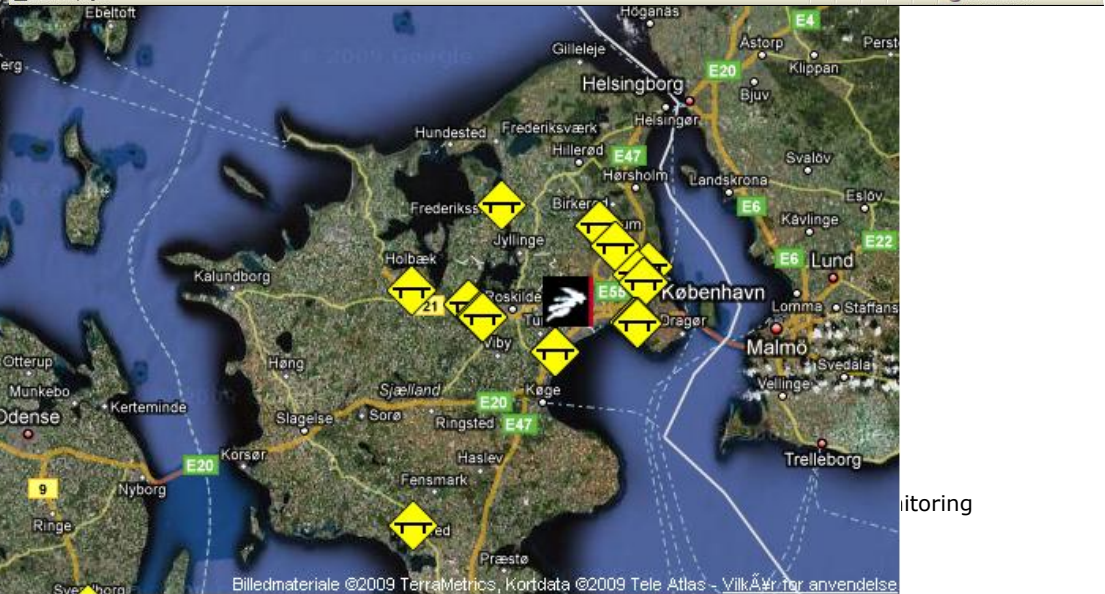
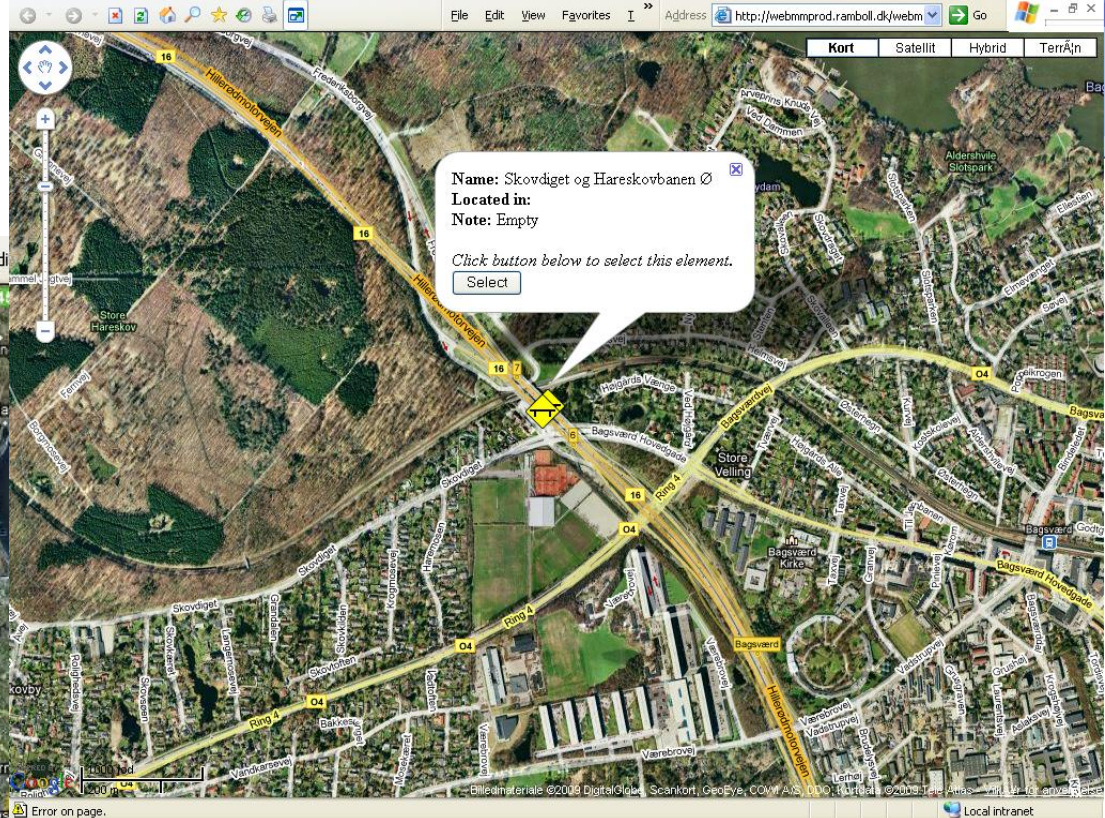
Monitoring data can be presented and analysed



SensoByg, Seminar 10. november 2010, SMART and SMARTmonitoring

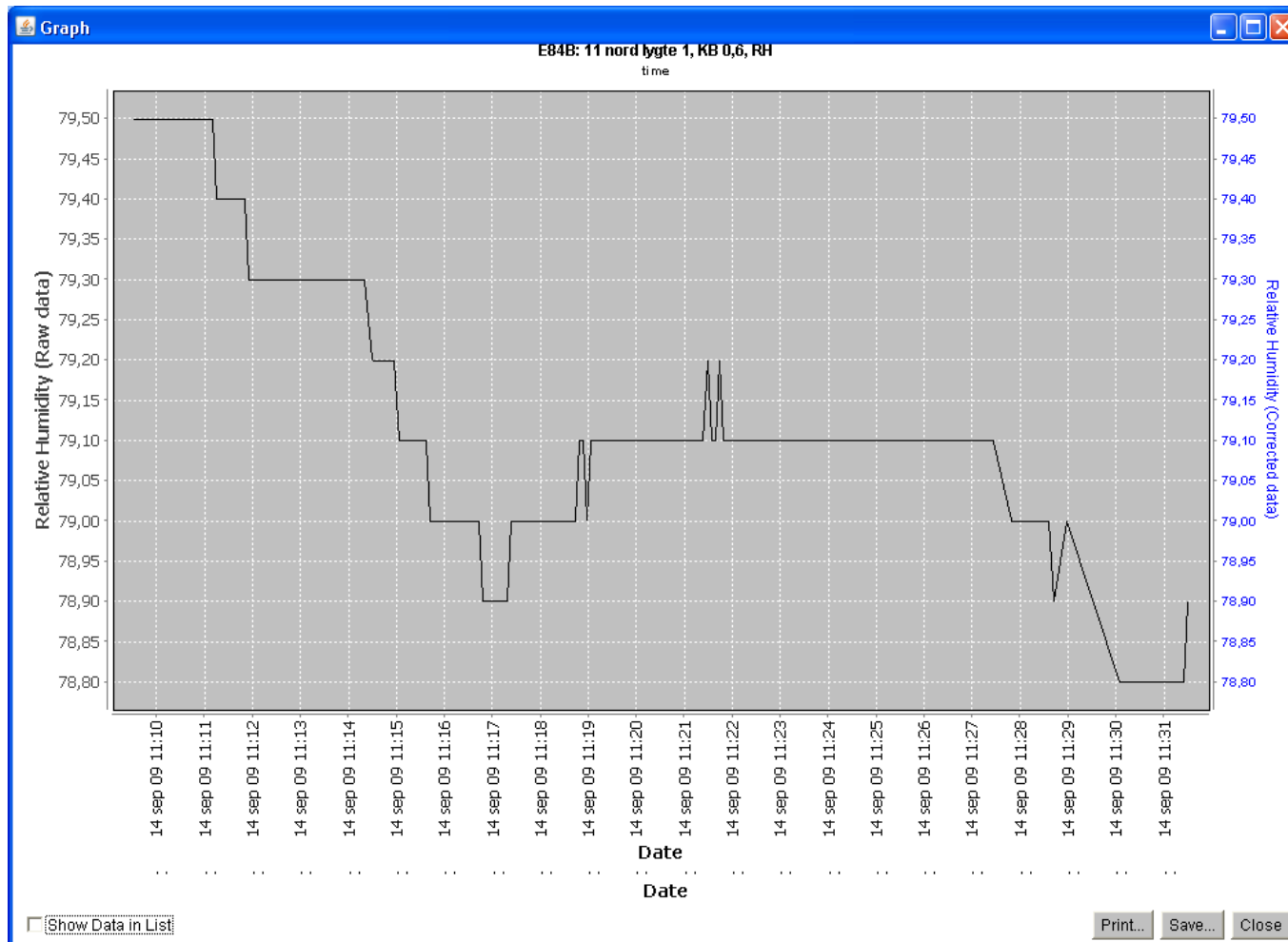


# SMARTmonitoring Google map navigation



# SMARTmonitoring

## View of data

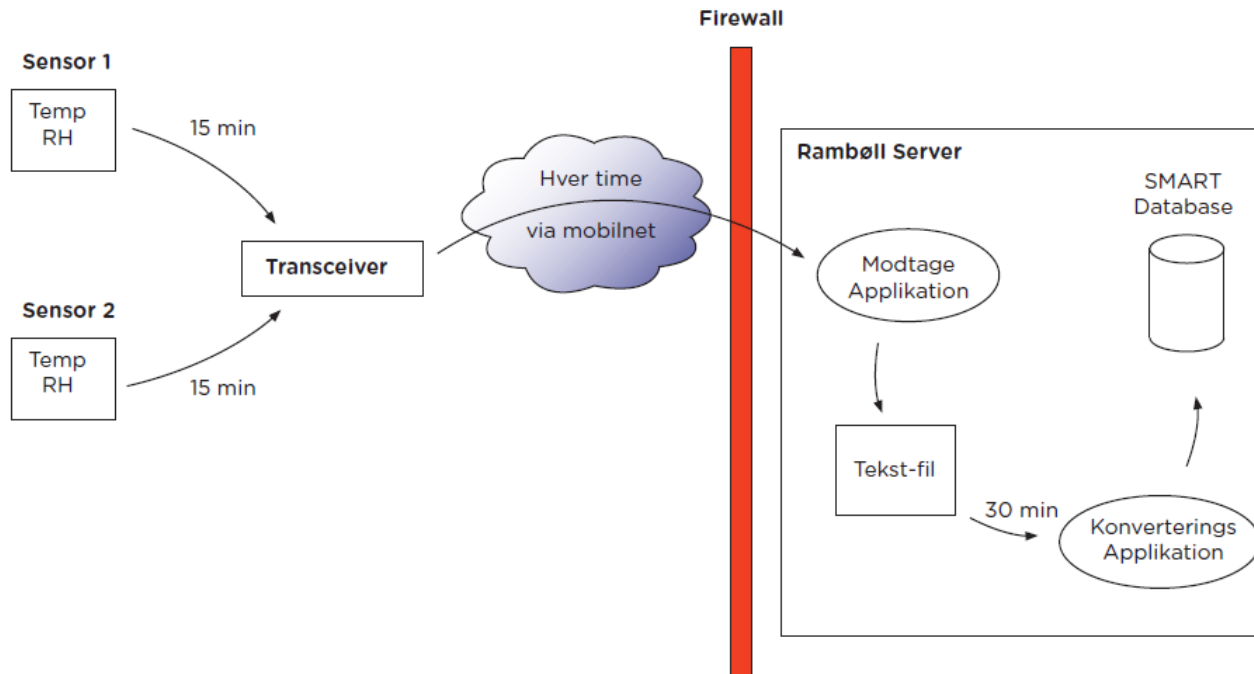


# SMARTmonitoring

## Automatic data transmission via GSM



### SMART MONITOR

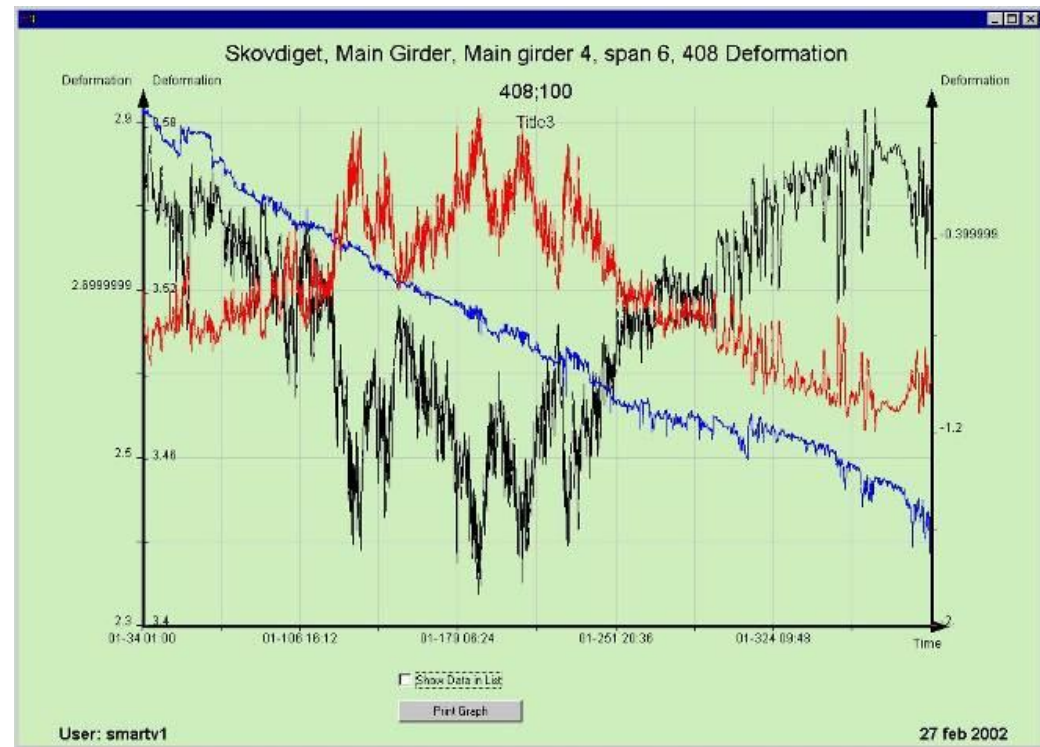




# SMARTmonitoring module

Live demo ....

[http://webmmprod.ramboll.dk/SMART\\_Monitor\\_VD/smart.htm](http://webmmprod.ramboll.dk/SMART_Monitor_VD/smart.htm)



# Tak for opmærksomheden

Asger Knudsen

Mail: [akn@ramboll.dk](mailto:akn@ramboll.dk)

Phone: +45 5161 6134

Bridge Management and Materials Technology

