

# **Overview of the evaluation of assets and deterioration issues**

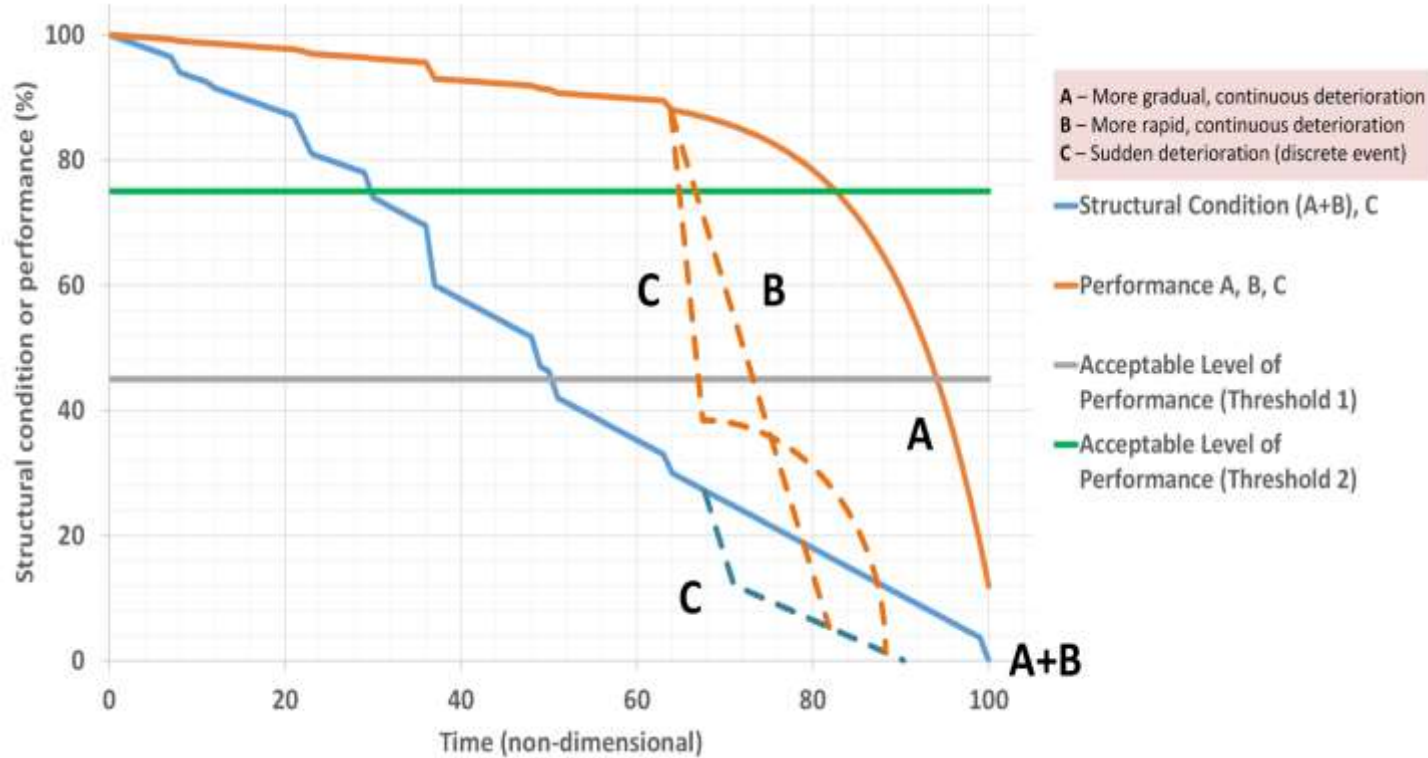
## **Introduction to JRA2 Co-UD Labs**

**Simon Tait – University of Sheffield**

## JRA2 – ASSET EVALUATION, DETERIORATION AND PERFORMANCE

- Asset Inspection – evaluation of defect identification and condition classification methods – commonality?
- Deterioration estimation and understanding mechanisms of deterioration
- System performance and how it is impacted by asset deterioration

# ASSET DETERIORATION AND PERFORMANCE – SOME THOUGHTS



- In the EU sewer networks are 2.5 MKm: a replacement value of 2.5 trillion €.
- Chinese building 25-30,000 km every 12 months [100]
- Performance – UK: 1:10 year return period for property flooding – gradual/sudden
- How to link performance and asset condition?
- Manage these assets – need to look into the future – rates of deterioration

# ASSET EVALUATION – ARE WE DOING THIS WELL?



[www.pellows.co.uk](http://www.pellows.co.uk)

- First introduced in the 70/80's.
- Tethered platform under human control
- In UK a “good” CCTV team can inspect 2000m/day
- Originally manual interpretation against defect classification – now being automated



Japanese video much higher quality

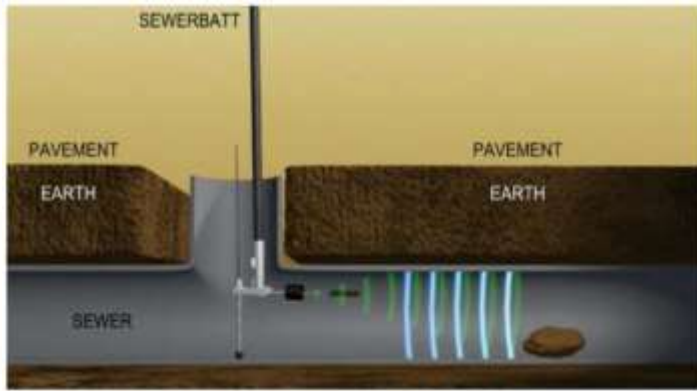


European video much more variable quality

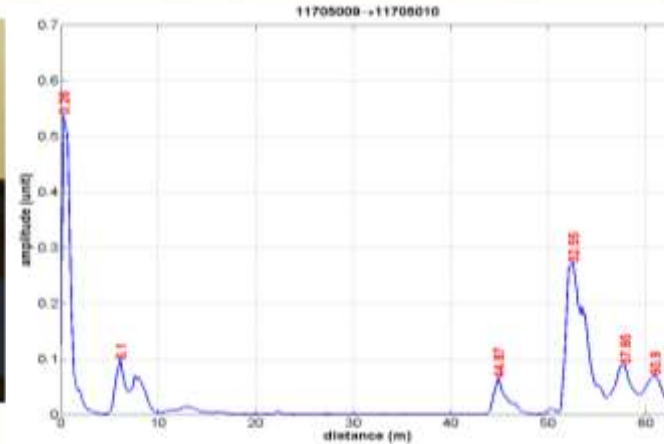
**Dirksen, J and al. (2011)** *The consistency of visual sewer inspection data*. Structure and Infrastructure Engineering Vol. 9, No. 3, March 2013, 214–228.

# ASSET EVALUATION: EMERGING TECHNOLOGIES

## Acoustic Reflectometry



[www.acousticsensing.co.uk](http://www.acousticsensing.co.uk)



Automated analysis of acoustic signals – more limited defect information

Still need to “enter” sewer – traffic disruption but much quicker than CCTV

### Costs

CCTV (on-road), CCTV (off-road) \$1.68/ft, \$2.03/ft

AR (on- and off-road) \$0.14/ft

## Pervasive Sensing

### Autonomous Robotics Platforms



[www.pipebots.ac.uk](http://www.pipebots.ac.uk)

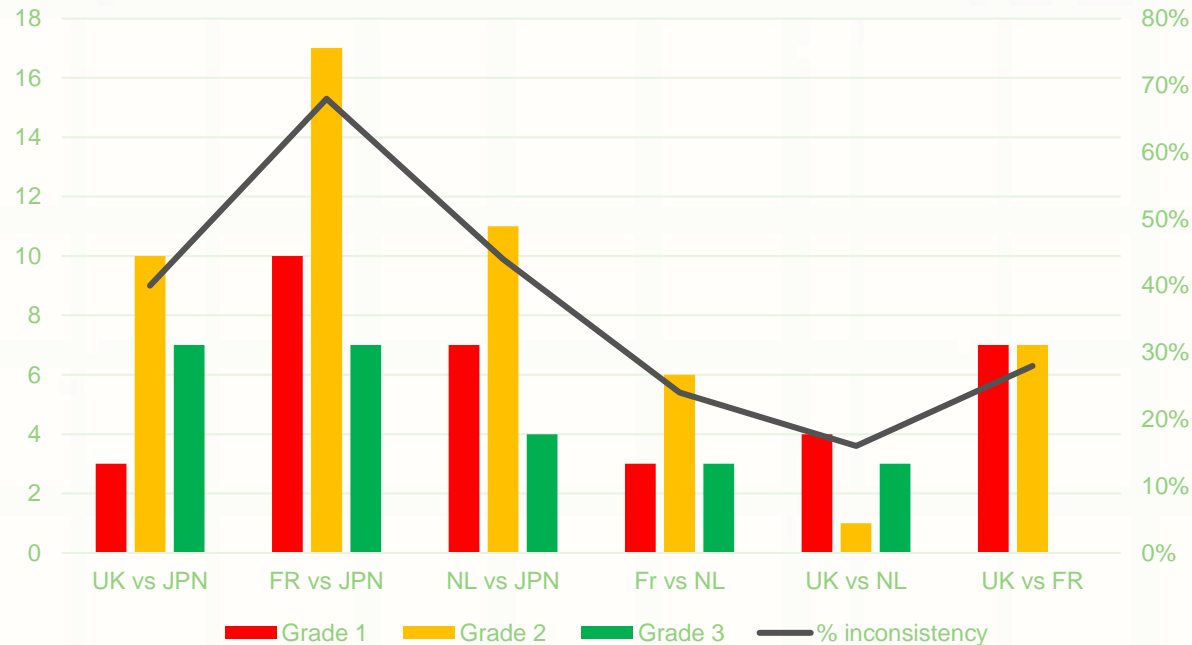
No need for manual entry to sewer

Automated – navigation, multi mode sensing and communications

Highly cost effective – collaborative working

# COMPARISON OF PIPE CONDITION CLASSES

Comparison of condition classification given by different classification standards



## Comparative Study

>50 CCTV records from UK, NL and JPN

All coded with UK, NK and JPN defect classification and pipe condition class

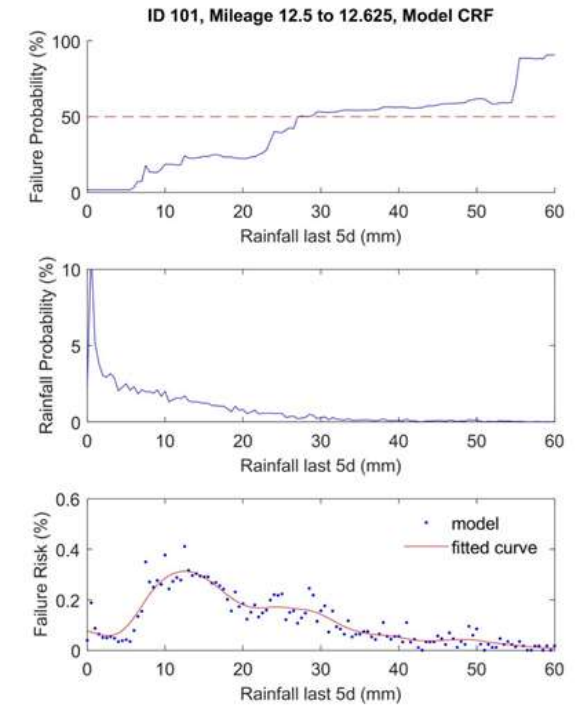
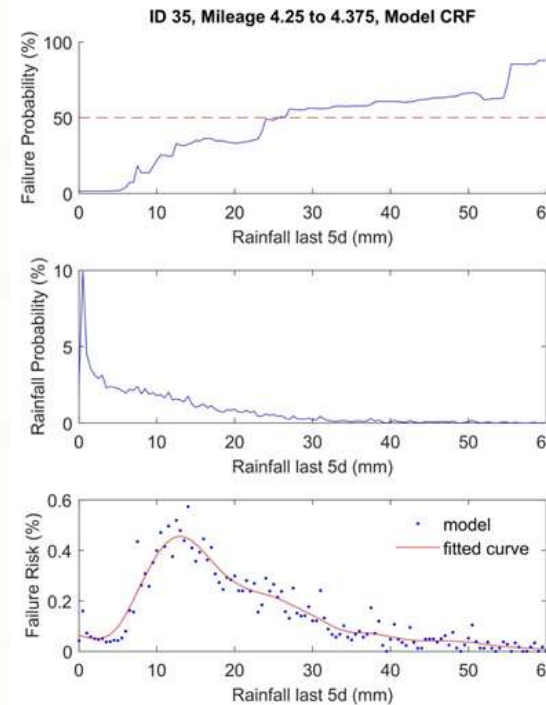
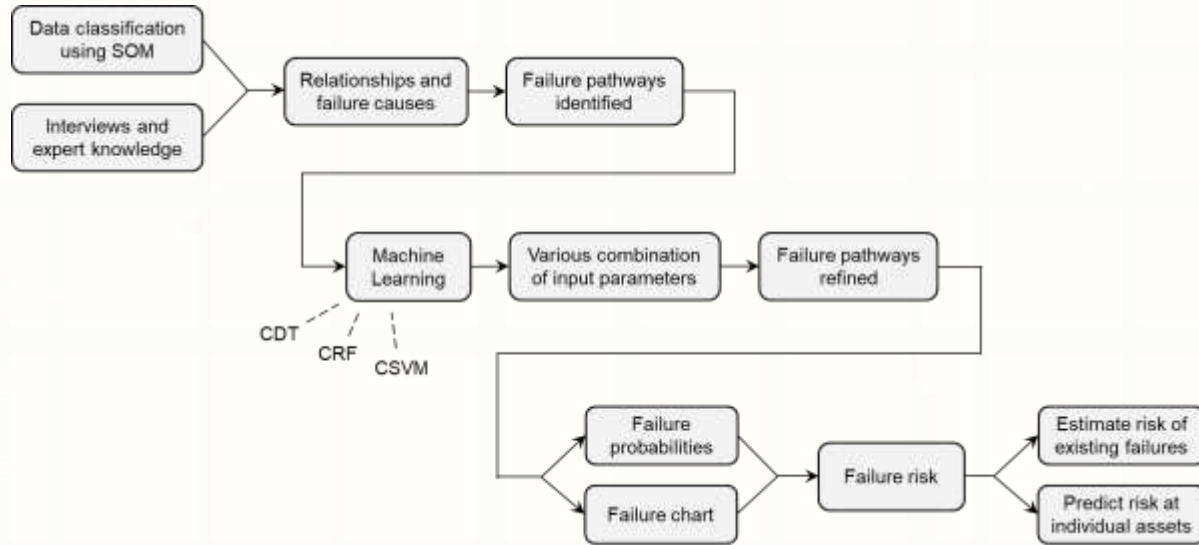
Minor classification classes amalgamated to match JPN with UK/NL

The UK standard is not as robust as the Japanese standard, cross-comparison highlights weakness in the defect scoring system and in the number of defects.

Simplifying the UK mapping system would obtain an equivalent level of robustness to the Japanese standard

# DETERIORATION RATE ESTIMATION – DATA DRIVEN APPROACHES

Failure Pathways, Data: asset condition class 1-5, asset characteristics, rainfall volumes

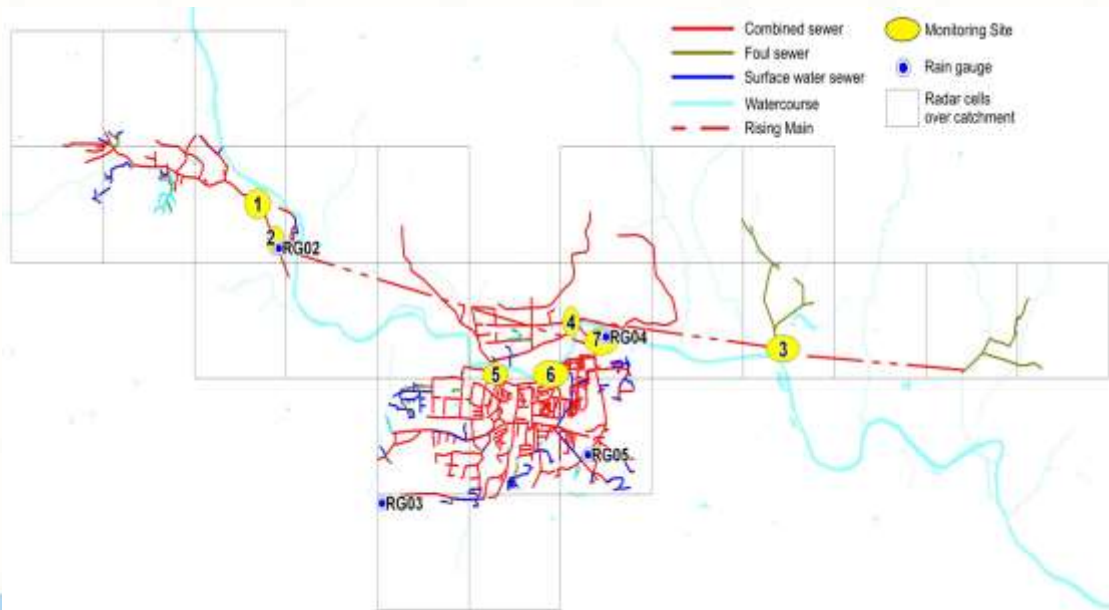


Identify individual assets at risk of failure – asset data intensive

# IMPACT AND CHANGE IN SYSTEM PERFORMANCE WITH TIME

## Acceptable levels of performance

- Impact of individual asset condition on system performance
- Change in asset condition: deterioration rate at cohort level – not individual asset level



		End Condition				
		1	2	3	4	5
1	Observed	79.1%	18.45%	1.66%	0.39%	0.39%
	Expected	81.2%	15.96%	1.78%	0.48%	0.36%
2	Observed	0	94.96%	4.14%	0.63%	0.26%
	Expected	0	95.25%	3.72%	0.70%	0.32%
3	Observed	0	0	94.56%	4.27%	1.17%
	Expected	0	0	94.01%	4.44%	1.56%
4	Observed	0	0	0	91.34%	8.66%
	Expected	0	0	0	91.52%	8.48%
5	Observed	0	0	0	0	100.00
	Expected	0	0	0	0	100.00

Service condition change - 300mm pipes – 5 year period



## JRA2 – ASSET EVALUATION, DETERIORATION AND PERFORMANCE

- Asset Inspection – evaluation of defect identification and condition classification
- Deterioration estimation and understanding deterioration mechanisms
- System performance and how it is impacted by asset deterioration
  
- Inspection – image based inspection of pumping station wet wells
- Data driven tools to aid rehabilitation and inspection strategies
- Deterioration failure mechanisms of individual asset types