



2nd IWA Leading-Edge Conference & Exhibition on  
**Strategic Asset Management**

**Failure Data Analysis - A Dutch Case Study**

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# Failure data analysis for Dutch water companies

- **2001** Workshop asset managers → Parameters (and values) for effective failure registration
- **2006** Inventory of what has been registered → What can be done with the data (statistical analysis)



# Parameters for registration 2001

Parameter	
<b>Failure</b>	Kind of failure
	Location
	Cause
<b>Failed object</b>	Type of component
	Component
	Protection measure
	Pipe material
	Diameter
	Year of installation
	Capacity
	Type of water meter



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# Aim

- Inventory current failure registration practices
- Demonstrate opportunities and limitations of:
  1. Registered data for statistical analysis
  2. Statistical methods for analysis of the failure databases



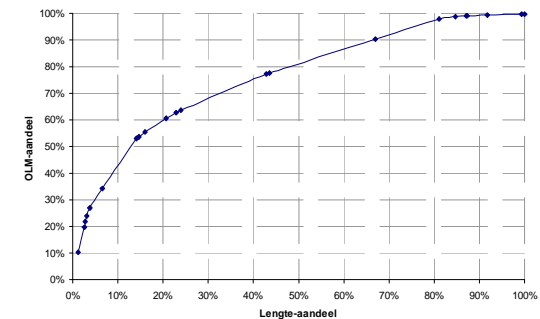
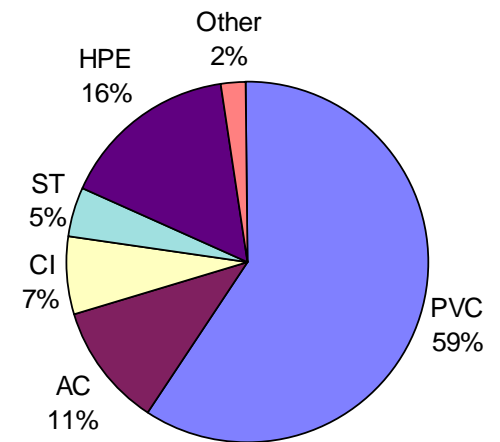
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# Approach

- Failure data inventory
- Network characteristics
- Statistical analysis

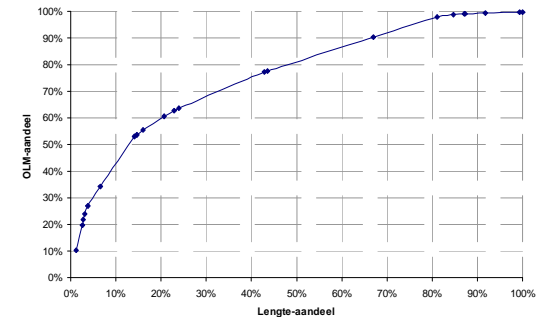
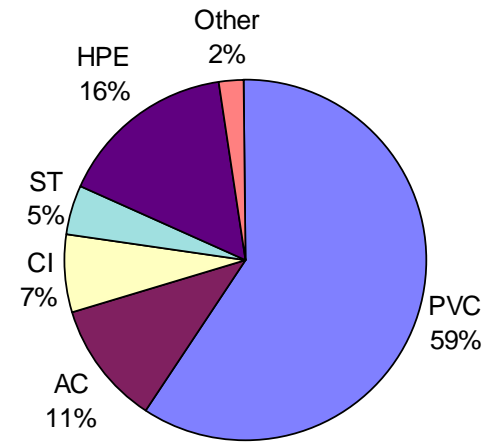
Failure database		
Registered	Failures	
Period	1998 t/m 2004	
Number of failures	Registered	659
	Used for analysis	340
Number of parameters	Registered	50
	In compliance with recommendations 2001	12
Values	Choice categories in combination with open fields	



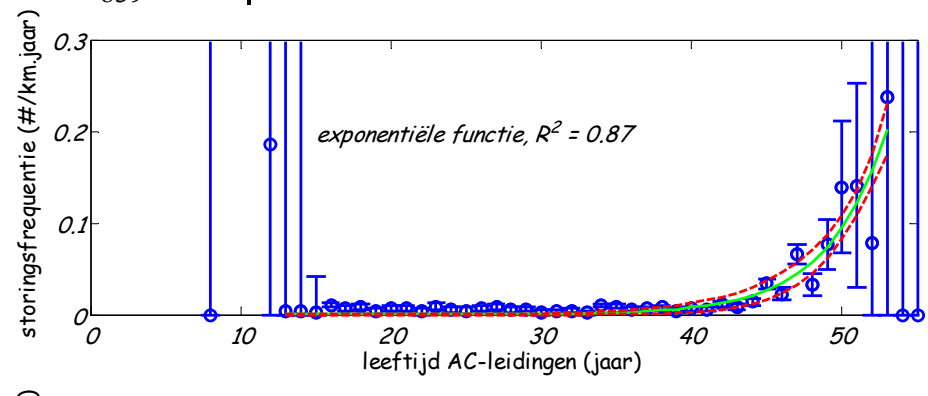
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# Approach

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Failure database	
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Period	1998 t/m 2004
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# Registration in practise



Waterleidingbedrijf

Schadeadres: Barentsplein 2 van Diemenstraat

Schade datum: 5 juli 2004

Gemaakt door: dm v d Broek

Waar is beschadigd object: 42 V d g

Schade aard/soort/omvang: 42 V d g

Is er gevolgschade: Ja

Schadeveroorzaker: WVS

Adresplaats: Stad. Westerpark

Cyclusnummer: WVS

Aanspreek: WVS

Maakt onderdeel van het werk: WVS

Gebruik: WVS

Tekening (VLI) op werk aanwezig: WVS

Ligging in overeenstemming met tekening(en)? WVS

Werk en procedure in overeenstemming met tekening(en)? WVS

Is de ligging van de loodpijpen tekening wijzen, zo niet toelichten: WVS

Schadeveroorzaker bekend met doordat de schade is ontstaan? WVS

Eventuele opmerkingen: WVS

Is schade geneukt bij plaats: WVS

Schaderapport opgemaakt door (naam): P. Jansen

Multimediale afbeelding: WVS

ADMINISTRatieve GEGEVENS

Completter: 114632

Verzakt door: SCS

Overzet door: SCS

da: 5/7/04

Schaderapport sector Infra & Project

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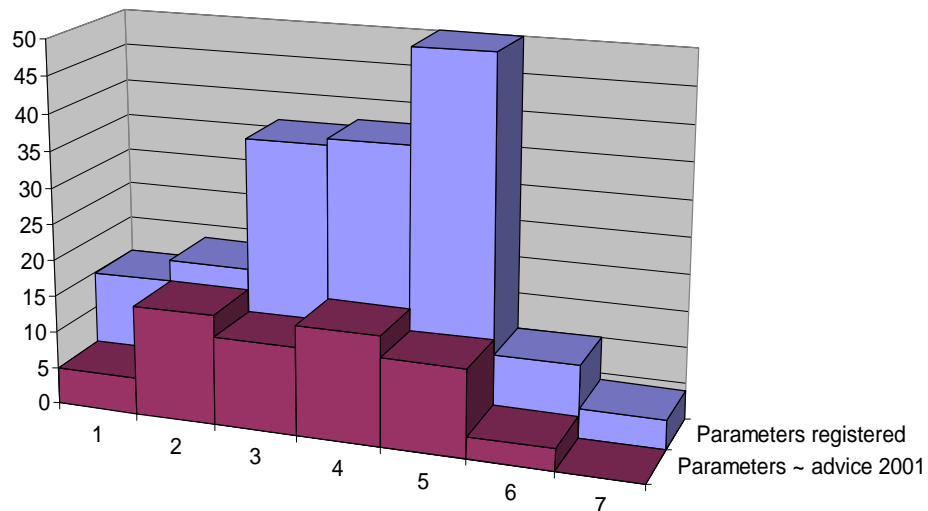
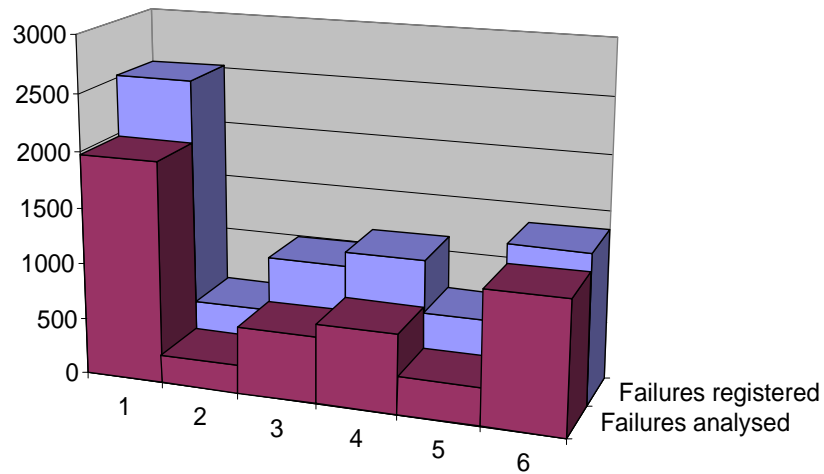
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# Inventory of failure databases



Reported databases			
Water company	Length network [* 1000 km]	Registered	Period
1	8,7	Failures	2003 - 2006
2	4,4	Failures	2004 - 2005
3	3,5	Failures	2004 - 2006
4	9,1	Failures	2003 - 2005
5	6,3	Failures	1998 - 2004
6	4,2	Failures	2003 - 2005
7	15,5	Complaints	2005



# Statistical analysis

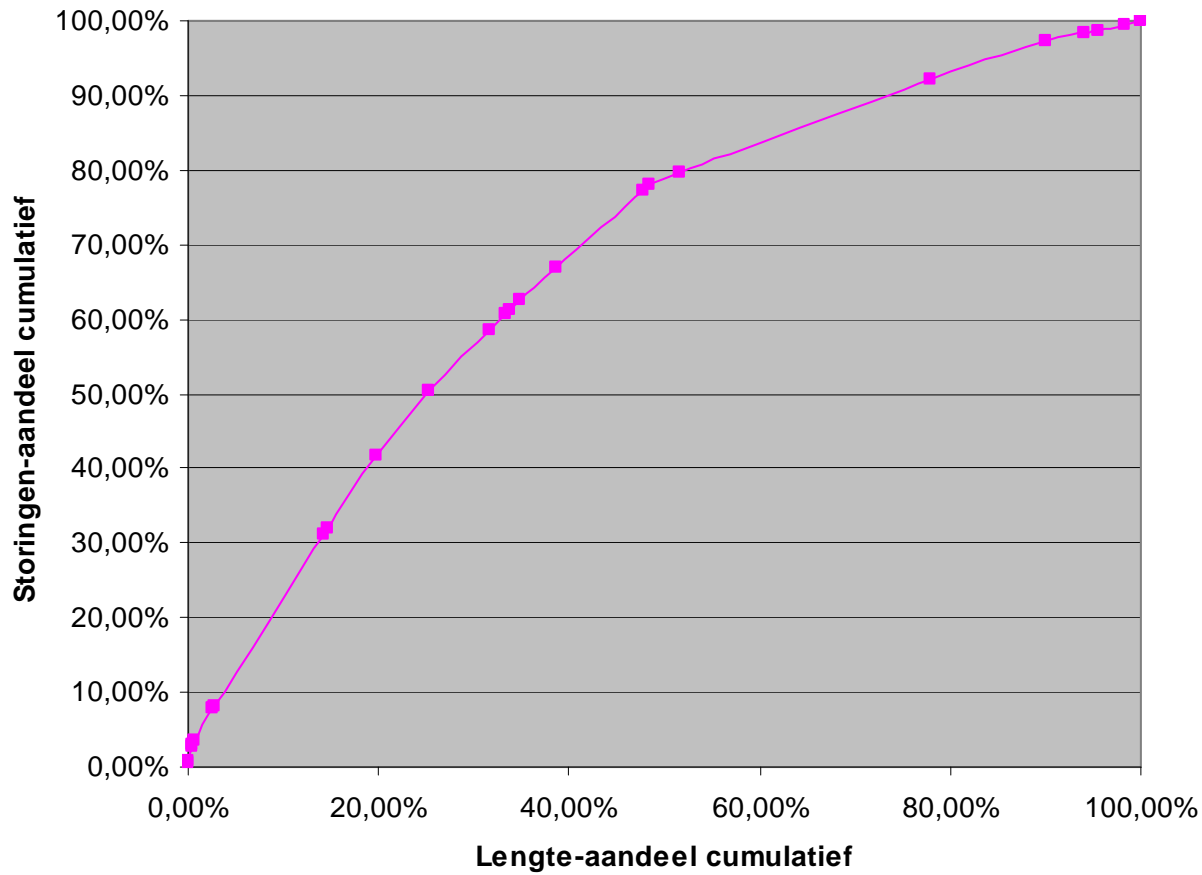
Based on failure data and network characteristics

- Descriptive models
- Linear regression
- Probability models



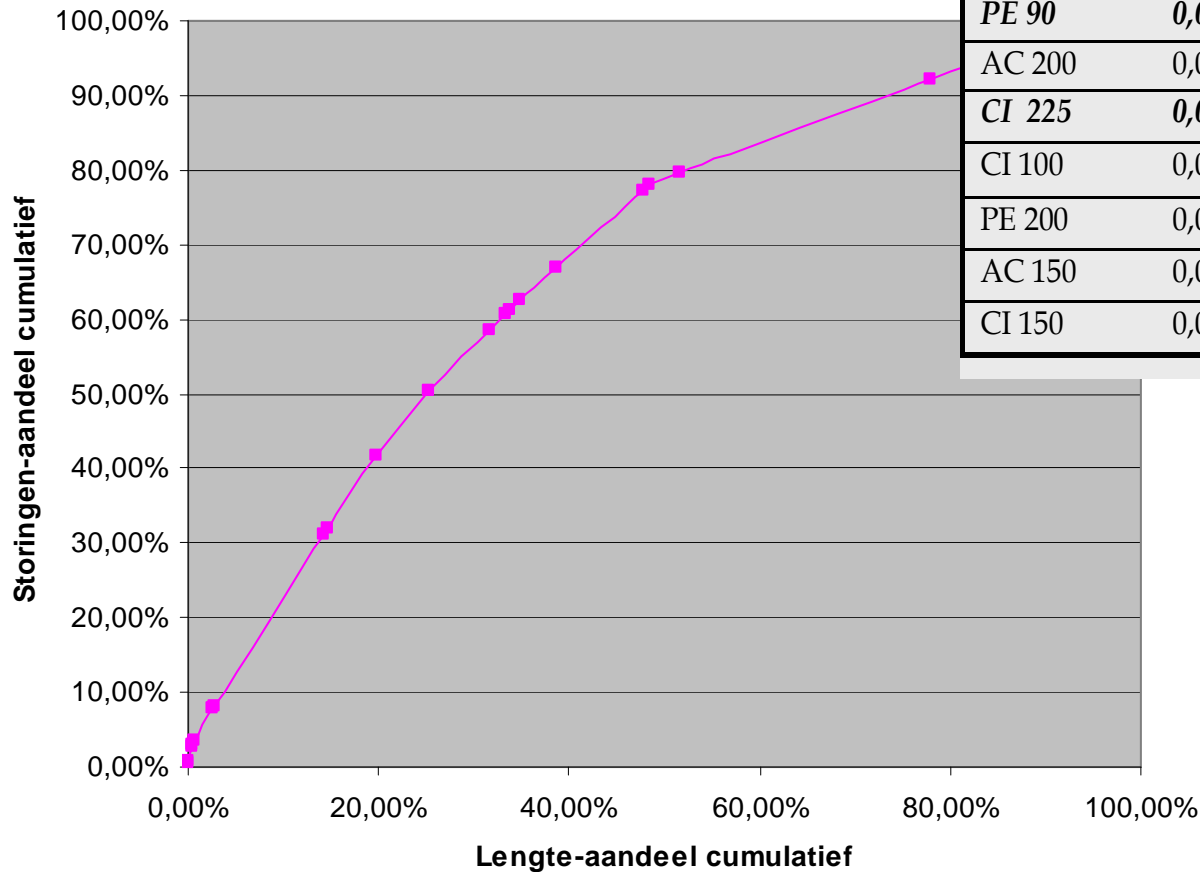
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# Results



# Results

Material Diameter	Failure frequency [failures/km/yr]	Number of failures	Length [m]
CI 80	0,172	4	11.628
<i>PVC 250</i>	<i>0,086</i>	<i>1</i>	<i>5.814</i>
<i>PE 90</i>	<i>0,076</i>	<i>1</i>	<i>6.612</i>
AC 200	0,071	10	70.037
<i>CI 225</i>	<i>0,067</i>	<i>1</i>	<i>7.468</i>
CI 100	0,062	53	428.869
PE 200	0,061	2	63.776
AC 150	0,06	23	190.214
CI 150	0,049	20	205.016







# Conclusions & Recommendations

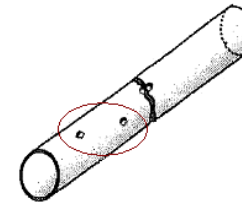
## ■ Registration

- Define goal
- Parameters and values: Keep it simple!
- Training and feedback
- Month / quarterly registration of incidents

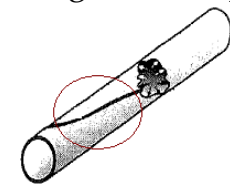
## ■ Analysis

- Define goal
- Analysis per region, before combining the data

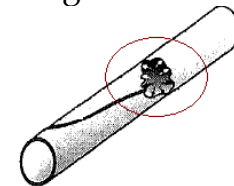
Pinhole



Longitudinal split



Fragmental burst



Circular break



# Cultivate your databases and use them!

**...because knowledge becomes valuable if you put it  
into practice**



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