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APPLICATION OF A DPA METHOD FOR ASSET MANAGEMENT IN SMALL WATER DISTRIBUTION SYSTEMS

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Asset Management – Asset Rehabilitation

Today's society and evolving infrastructure:

- Increasing length of infrastructure networks
- Ageing infrastructures
- Impossibility of permanent and continuous replacement

Need for improving the infrastructure asset management methods

Requires theoretical/practical effort ➔ find new models beyond the traditional economical ones.

INTRODUCTION

General objective: To create a decision support algorithm for assisting in establishing infrastructure investment plans of small water systems.

This presentation refers to an academic study that was carried out in collaboration with LNEC and a private water supply service provider.

The adopted method was a deterioration point assignment (DPA)

DPA methods ➔ Systems with lack of pertinent information.

CASE STUDY ➔ Marco de Canaveses distribution network

Objective of the study

- Identify core information to support A.M. strategy in small water utilities
- Develop an algorithm to make the most of the available information
- Mitigate the effect of the lack of some data
- Assess global rehabilitation needs, current asset values, intervention priorities and corresponding asset needs, based on a whole of asset life costs approach
- Develop a worksheet that supports data collection, implements the methodology proposed and can be used directly by decision-makers, or as a prototype for the development of a professional information system

Underlying assumptions or conditions

- Inexistence of reliable and well structured failure record
- Inexistence of reliable and well structured data on asset condition
- Inexistence of accounting information at the individual asset level
- Availability of qualitative information about construction quality
- Knowledge of the order of magnitude of asset age
- Availability of asset inventory (*i.e.* preliminary work to create an updated asset inventory must be carried out if an asset management strategy is going to be implemented)
- Availability of a Geographic Information System (GIS)
- Easy to use tool, not demanding in data collection and input
- Need to accommodate a potential further migration to a more sophisticated asset management system

DEVELOPED MODEL

- Simplicity ➔ MS® EXCEL worksheet
- Applicable to mains and service connections of water distribution networks, (however, the approach can be adapted to other type of assets), because:
  - Represent the most valuable and common type of assets
  - Challenging type of asset ➔ Buried and not easily inspected

Key references of the model

Inspired in the procedure recommended in the asset management workshops run by EPA (Parsons-GHP, 2006) and Deterioration Point Assignment model

Model description

Hierarchical structure adopted for the assets, four levels:

- Level 1: System
- Level 2: Main component of the system
- Level 3: Subcomponent
- Level 4: Type of individual assets

"Elementary Asset" →Detailed discussion with the utility managers

Higher Aggregation ➔ Less input data → Simplicity
Desegregation ➔ More information → Increases data exponentially

Decision → Keep GIS definition → one pipe GIS = one pipe AM application

REQUIRED DATA:

- Basic data:
  - Assessment year
  - Installation year
  - Pipe material
  - Material pressure class
  - Pipe diameter
  - Pipe length
  - Static pressure
- Installation and ease of intervention information:
  - N.º of service connections with diameter < 1"
  - N.º of service connections with diameter > 1"
  - Failure rate class
  - Installation quality class
  - Type of pavement class
  - Traffic load class
  - Replacement material
- Complementary qualitative information (if available and relevant):
  - Asset redundancy class
  - Social importance class, defined in terms of the relevance of the pipe for the service to specially relevant customers
  - Current condition class
  - Class of area in terms of constraints to interventions
  - Need of coordination with other infrastructure intervention

Driving Factors

- Pipe Diameter
- Installation Quality
- Service connection density
- Failure rates
- Traffic load
- Asset redundancy
- Social importance
- Current asset condition
- Type of pavement
- Ratio → static pressure/pressure class

Example for the Installation Quality

Instalation Quality	Global Relative Benefit
1	Excellent
2	Good
3	Average
4	Poor
5	Very Poor

DPA Models ➔ 1 to 5 grading scheme ➔ 3 = Average Situation/ Unavailable Data

Remaing Data Itens

- Diameter
- Service connection density
- Asset redundancy

Conversion methodology is as follows:

- The 20, 40, 60 and 80 percentiles of the set of values are assessed

- Every individual asset is graded as follows:
  - Values below the percentile 20, are graded 1
  - Values between percentiles 21 and 40 are graded 2
  - Values between percentiles 41 and 60 are graded 3
  - Values between percentiles 61 and 80 are graded 4
  - Values above the percentile 81 are graded 5

Model Calculated Indices

- **Difficulty of Intervention Index ➔** provides information on the relative difficulty associated to the rehabilitation of each elementary asset
- **Demand for Intervention Index ➔** takes into account the quality and the condition of the current asset, and therefore its need for intervention based on its conditions, regardless of serviceability
- **Importance of the Asset for the Service Index ➔** aims at assessing in a simplified way, the contribution of the asset for the global service provided by the infrastructure

Driving Factors weights ➔ Calculated Indices

Driving Factors	Indices		
	Difficulty of Intervention	Demand for Intervention	Importance of the Asset
Static pressure/pressure class		10%	
Pipe diameter	10%		50%
Installation quality	5%	10%	
Number of service connections >1"	25%		5%
Social importance		15%	25%
Type of pavement	30%		
Traffic load	30%		
Failure rates		35%	
Current asset condition		30%	
Asset redundancy			25%

Note: In the model worksheet, weights can be customised

Preliminary Rehabilitation plan

Assumptions:

- Asset replaced when reaches its expected corrected useful life
- Interventions correspond to the replacement costs
- Average replacement costs are adopted
- Techniques that expand useful life but don't reset the clock to zero are not considered
  - Simplifying assumption ➔ Acceptable on pipes ➔ Relining not relevant

Asset	2008	2009	2010	2011	2012	2013	...
A0255	13135						...
A0280		1089					...
A0300				2841		11482	...
A0355					3888		...
B0205				12158			...

Average Asset Age

Weighted average of individual elementary assets age ➔ Pipe length as weight

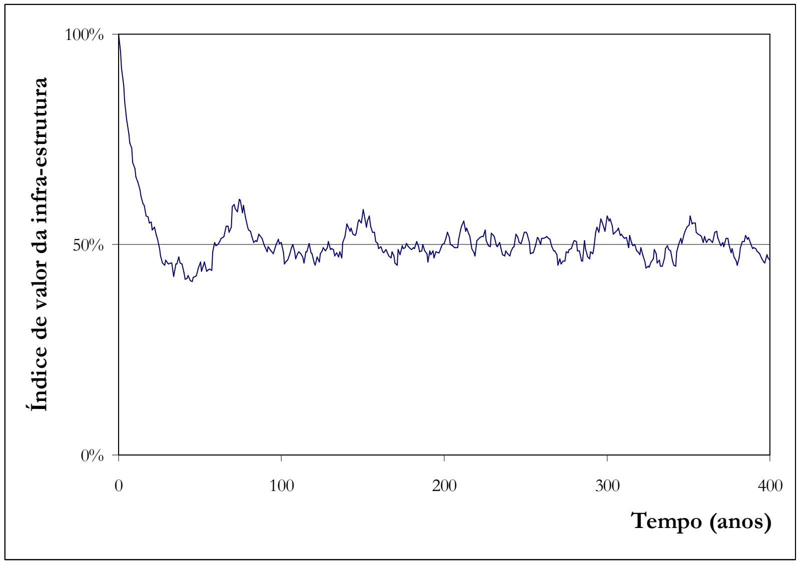
Index ➔ more information if unit replacement costs are the same for every asset

Infrastructure Value Index (IVI)

IVI (%) = current infrastructure value / infrastructure replacement cost

Detailed formulation in the paper

IVI % (Alegre, 2007) tends to 50 % in mature infrastructures



High IVI values > 50%

- *Young infrastructures, not yet stabilized*
- *Older infrastructures, in a development stage*
- *Over-investment in rehabilitation*

Low IVI values < 50%

- *Older infrastructures*
- *Under-investment in rehabilitation*

IVI ➔ Particularly interesting on the following situations

- Support planning strategies on Asset Management framework
- Overall condition of an infra-structure at beginning/end of concession period
- Regulatory or contractual goals and limits in managing infrastructures
- Support regulatory guidelines and national or regional policies

Concluding remarks

- The model produces several indices that may support decision making
- The model also produces a preliminary investment plan
- Feasibility of using coherent information structures to support infrastructure AM in small utilities is demonstrated