A system-centric approach to infrastructure asset management planning

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ANAREP» Urban water systems

- High levels of deferred maintenance and rehabilitation and overwhelming investment needs in urban water services infrastructure demand wise spending and innovative, efficient planning.
- Rather than component-centric AM approaches, the complexity of the problem must be addressed by system-centric methods that ensure the best possible compromise between performance, risk and financial effort.

ANAREP» Infrastructure asset management

-the "art of balancing performance, cost and risk in the long term".
 - Brown and Humphrey (2005)

• Systems, not collections of assets

• Long-term evaluation: as a whole, these infrastructures have an indefinite life

ANAREP» IAM at each planning level

A PDCA loop



ANAREP» Through decisional levels...



AAREP» objectives -> metrics -> targets



• Time frames: planning horizon, analysis horizon

AAREP» The planning process: problemdriven



<u>C 001</u>	<u>C_002</u>	<u>C 003</u>	<u>P.01</u>	<u>P 02</u>	<u>P 03</u>	<u>P_04</u>	<u>R 1</u>

for the current system...



	<u>C 001</u>	<u>C 002</u>	<u>C 003</u>	<u>P 01</u>	<u>P 02</u>	<u>P 03</u>	<u>P_04</u>	<u>R 1</u>
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for each planning alternative...

















ANAREP» The AWARE-P software

- An organized assessment environment where planning solutions or competing projects are measured up and compared.
- A portfolio of performance, risk and cost metrics and analysis tools for diagnosis and sensitivity gain.

P.02

P.01

C.003

C.002

ANAREP» The AWARE-P software

- Integrates all the necessary data
- Oriented to system response
- Capable of system-level metrics and component-level metrics (within the system)

AVAREP» Current toolset

- NETWORK model-enabled network analysis envmt.
- PLAN the central planning framework
- PI Performance Indicators
- PX Performance Indices
- FAIL Poisson and LEYP, pipe failure prediction
- CIMP component importance (impact of its failure on nodal consumption).
- UNMET reduced service estimation.
- IVI Infrastructure Value Index

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AMAREP»	Folder: Alternative 0 Statu quo						
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Data	<u>Name</u>	Туре	Modified	Size			
Network	Alternative 0	Epanet INP File	2012/04/04	83 kB			
Plan	Alternative 0 Comp Imp	Component Importance Table	2012/04/04	0 rows			
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PERFORMANCE	Alternative 0 emergency Pmin	Performance Index Table	2012/04/04	14251 rows			
Indicators	Alternative 0 Failure analysis	Failure Analysis Table	2012/04/04	11481 rows			
Indices	Alternative 0 IVI	Cost Table	2012/04/04	459 rows			
RISK	Alternative 0 PI	Performance Indicator Table	2012/04/04	45 rows			
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Component Importance	Alternative 0 Risk	Risk Assessment Table	2012/04/04	457 rows			
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COST							
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Aware / Performance Indicator: Alt3 new run

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<u>m</u> SINGLE USER \otimes Performance Indicator: Alt3 new run Indicators Timesteps 70 PIs Summary Find and select PIs for your cart File name Alt3 new run SEARCH Objectives / Criteria + Folder Alternative 2 Name Owner single user Fi11 - Other costs Size 0 rows Fi25 - Unit investment Water supply PI library -PI library IWA Fi26 - Investments for new assets and reinforcement of existing assets OPEN IN DATA MANAGER Fi27 - Investments for asset replacement and renovation Fi28 - Average water charges for direct consumption PI Cart Fi29 - Average water charges for exported water Fi30 - Total cost coverage ratio Fi26 Investments for new assets and reinforcement of existing assets Fi31 - Operating cost coverage ratio **Op16** Mains rehabilitation Fi4 - Unit total costs QS13 Water interruptions Fi40 - Debt equity ratio Fi46 - Non-revenue water by volume Input variables required Fi5 - Unit running costs C8 Mains length Fi7 - Internal manpower costs D20 Mains rehabilitation Op12 - Emergency power system inspections D35 Water interruptions Op16 - Mains rehabilitation F1 Population supplied Op17 - Mains renovation G32 Investment in tangible assets Op18 - Mains replacement G33 Investments for new assets and Op19 - Replaced valves reinforcement of existing assets Op20 - Service connection rehabilitation H1 Assessment period Op23 - Water losses per connection Op24 - Water losses per mains length On27 - Real losses ner connection

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Aware / Failure analysis: Alternative 2 Failure analysis

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Failure analysis: Alternative 2 Failure analysis

Summary		O Pois	O Poisson 💿 LEYP								
File name Alternative 2 Failure		Year 20	ear 2031 UPDATE								
Folder	Alternative 2	Materi	al α	δ	β ₀	β_{diam}	β _{ILen}	Fails. per year	Fails./km per year		
Owner	single user	FF	0.0000	0.0000	101.1552	-0.6617	-63,7024	0.00	0.00		
Size	11482 rows		0.1284	0.1272	0.6123	0.1260	0.0543				
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Work Order	Failures database A2 t5	-	0.9999	0.5322	0.0039	0.3909	0.0302				
Failures		FD	6.9695	0.5402	-5.1167	-0.0007	0.3525	1.23	0.12		
OPEN IN DATA MANAGER			0.0180	0.1375	0.0000	0.7223	0.0145				
		PEA	5.8924	0.5759	-5.3204	-0.0043	0.5626	37.73	0.29		
Model info			0.0000	0.0000	0.0000	0.0000	0.0000				
		FC	1.7160	0.7499	-4.2285	-0.0023	0.3578	187.72	1.70		
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		PVC	1.7441	0.7040	-5.3085	-0.0020	0.5652	59.23	0.52		
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Pipe ID	Failure Rate	Failure Probability
815102	2.7346	91.0%
14180	3.3388	89.8%
11295	1.9259	83.8%
1123090	1.8222	81.8%
10711	1.8130	79.2%
11370	1.6338	77.2%
10922	1.5801	76.2%



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000 Aware / Model: Alternative 2 C Q. Google m + >> http://127.0.0.1:8080/?loadEpanetFile=283 SINGLE USER \otimes Model: Alternative 2 Chart & Scale Visualization Model Summary 🕂 🕂 🕄 — Layers ₩ OpenStreetMap ‡ 🔘 🗹 Junctions (567) 👿 🗹 Reservoirs (2) 🗹 Tanks (0) 🛏 🗹 Links (602) O Vertical Pumps (0) Valves (143) Specify below the <u>EPSG code</u> to define source file projection on the map Rua Dr. Roa Antó Rua Alexandre Hercu φ Rua da Ribeira EPSG 3763 OK TUB Antonio Sa FARMÁCIA CLABEL Simulation Ceuta DNEL Last simulation: 2012/05/24 13:55:30 Duration 24:00:00 P Pattern time step 15 minutes ÷ Hydraulic time step 15 minutes ÷ Quality time step 15 minutes ÷ abro Praceta

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Buildings © 2008 3D Cities SA © 2012 Cnes/Spot Image Image © 2012 GeoEye

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ANAREP» Technology, at a glance

- Web-based
- Modular, made to grow
- Client-server

 cloud / corporate / local
- Multi–user
- Multi-platform

 PC, Mac, iPad, linux
 Laptop, tablet
- Compatible with existing SI

ANAREP» For more info...

• The AWARE-P project:

www.aware-p.org

• The software:

www.baseform.org

