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MANUAL 4

Tactical planning of urban water services at utility level

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Tactical planning of urban water services at utility level

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Introduction

Structuring common sense ideas into a transparent, accountable and forward-looking plan.

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1.1 Scope

The scope of this TRUST series of best practice manuals is the integrated planning of urban water services, focusing on **Infrastructure Asset Management (IAM)**. IAM aims at ensuring that infrastructures are managed in such a way that sustainability of the service is ensured by maximizing service performance at the minimum cost and with acceptable risk levels, in the long term. This manual is addressed to the utilities of urban water services whose main activity is based on network infrastructures. Urban water services include water supply, wastewater and storm water management.

This manual provides guidance on the tactical planning process that utilities need to carry out in order to ensure sustainable water services in the medium-term, assuring an alignment with the strategic plan.

This is the forth volume of a series of manuals developed in scope of the TRUST project (www.trust-i.net). Manual 1 introduces the TRUST global framework for managing urban water services. The other volumes include specific guidelines

for policy-making at a national or regional level (Manual 2) and for strategic planning at the utility level (Manual 3) as well as a *portofolio* of rehabilitation techniques using in water pipes and storage tanks and drainage systems (Manuals 5 and 6).

1.2 Document structure

The document has three chapters and an appendix, being the first chapter the present introductory chapter.

The manual aims at providing case-based learning process. **Chapter 2** presents the story of a new tactical planner, Lynn, at a city where the high water losses levels are a hot topic of the utility managers' agenda.

Chapter 3 explains the main principles and procedures of tactical planning of urban water services, which is a generalization of the rational adopted by Lynn in her specific city.

The appendix reproduces a template of a tactical plan, developed and adopted by many utilities in the framework of TRUST and other recent projects, AWARE-P, iGPI (www.iniciativaGPI.org) and iPERDAS (www.iPERDAS.org).

Lynn's story

Struggling among alternative priorities and tactics at my utility

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Who is Lynn?

"I am the new head of the water supply planning department at a mid-size urban water services utility. The utility has a strategic plan, as well as a master plan developed 6 years ago that defines the bulk drinking water and wastewater infrastructures of the utility. I am basically a tactical planner. There are not infrastructure asset management plans in this utility.

I used to work on water losses control at a neighbour city. I was invited for this job because the water losses here are very high and became a hot topic of the local political agenda."

How is Lynn's utility?

South Hampton Municipality is supplied by a groundwater source that supplies the City and two neighbour villages: Blue Village and Green Village.

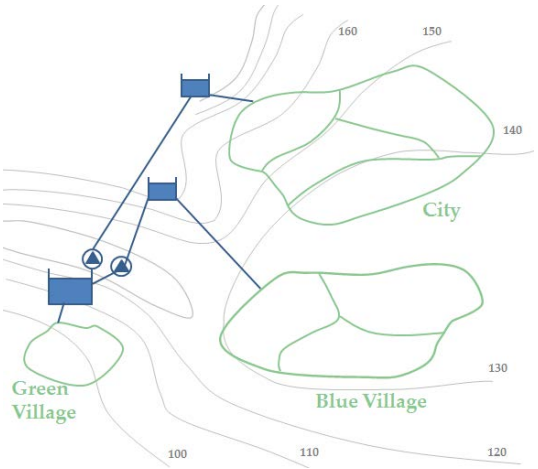


Figure 1 – Water supply system of South Hampton Municipality

The city water is pumped from the source at level 110 m to level 180 m and afterwards distributed by gravity from a service reservoir. A similar situation occurs in Blue Village, although with lower pumping needs: water is pumped from level 110 m to level 160 m. The City is predominantly urban, and is divided into 4 district metering areas (DMA). Blue Village is moderately urban. Green Village is the only area supplied directly by gravity. It is predominantly rural and, given its small size, is composed of a single DMA.

In the City, DMA A has an average operating pressure of 300 kPa, DMAs B and C of 400 kPa, and, finally, DMA D has a service pressure of 500 kPa (Figure 2).

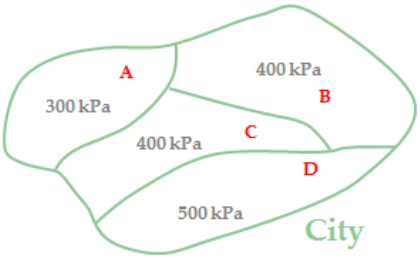


Figure 2 – City's district metering areas

These differences are due to topography and to the system layout. They are not related to differences in pressure supply needs, 300 kPa would be sufficient overall.

Non-revenue water is high, although non-billed authorized consumption is low, as well as apparent losses: the flowmeters have been recently installed and are well managed, and there is no evidence of significant unauthorised consumption. The network of the city is aged. Real losses seem to be by far the main cause of non-revenue water.

Blue Village is divided into three DMAs, which ensure a pressure of 300 kPa. A considerable portion of the pipe diameters are determined by the firefighting requirements. Consequently, the network is globally oversized, with available capacity and in many pipes flow velocities are below the minimum regulatory requirements. This is a common problem to the whole network managed by the utility, and the only noticeable problem at Blue Village, particularly in DMA E.

Figure 3 – Blue Village's district metering areas

Regarding Green Village, since its infrastructures were recently built (i.e., its average age is under 10 years old), a good overall performance is assured, and the strategic objectives set by utility are met. It is an area which, nowadays, presents no concerns to the utility.

The construction of an industrial complex was identified as the utilities' main concern in the strategic plan, as far the external context is concerned. The development involves the construction of a set of infrastructures to accommodate new projects in the south eastern area of the outskirts of the City, close to Blue Village, as shown in Figure 4.

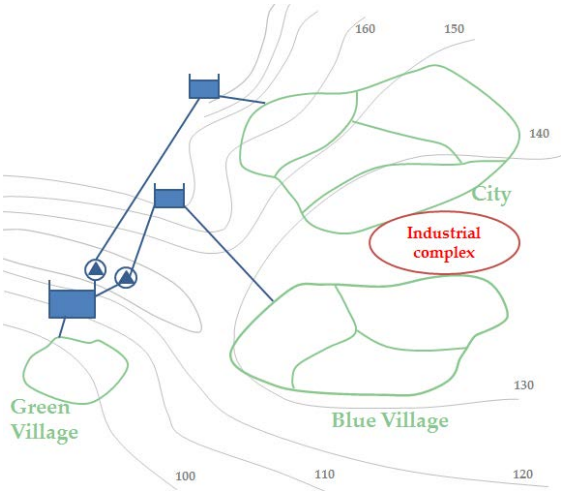


Figure 4 – Location of the new industrial complex

Construction is near completion. The solution thought of at the time of designing this network expansion was to supply the new industrial complex by connecting it to DMA D, in the City.

The diagnosis in the strategic plan identified water losses and energy costs as the mains reasons for a poorer performance nowadays.

What was Lynn struggling about when she started?

"When I assumed my current position I knew that I had to give priority to water losses management, but I also had been instructed to act according to the existing strategic plan. A new integrated approach to managing the urban water services was in place, aiming at a good alignment across decisional levels and between the main

utility management processes. This was new at South Hampton, but I am afraid that it was even newer for me, as in my previous job I had more independence to act.

In short, I had to adapt my way of thinking and acting to this new approach, which I conceptually endorse, but that I am struggling to fully understand how to apply in practice.

I had to propose alternative solution(s), which is not a challenge for me. When I analysed the situation, knowing that we could not afford solving the problems overnight, and having been instructed that I should give first priority of intervention to the DMA with higher water losses level, my solution is obvious: to install a pressure reducing valve (PRV) at the entry point of DMA E. Other PRV may follow at DMA B and C, which might be effective as well, in a second stage. Active leakage control should follow. My problem is that I have to justify why my alternative(s) is(are) globally good in the long term and how it(they) contribute(s) to the overall utility objectives. I have to adopt a clear and systematic decision making process that can be transparently communicated to stakeholders."

What was Lynn's key question at this stage?

"The question was how to choose the best tactics that align with the strategic plan and meet the medium term service sustainability. My experience tells me that the only sound solution in these cases is to implement a planning process that is **transparent** and **defendable**, yet **simple**! "

Adopted solution

"I know that for a planning process to be transparent, defendable and simple, it is essential to have:

- **Very clear tactical objectives**, aligned with the strategic strategies.
- **Clear metrics and targets** for specifying the tactic objectives in a concrete way and for monitoring the results.
- **A consensus among the stakeholders** about the objectives and the assessment system prior to start comparing tactics.

Dealing with urban water infrastructure systems, I know two major things about the approach I have to provide to our analysis:

Urban water infrastructure asset management approach:

- A system approach: instead of addressing independent individual assets, my elementary units of analysis need to be functional sectors of the system. In may case, DMAs are the best elementary units to be adopted.
- A long term analysis time window: considering that urban water systems have indefinite lives, instead of considering the life cycle of the individual assets, as different live stages take place in a network, at a given moment in time, I will use a 30 year time window in my analysis.

In a tactical level, I have to:

- analyse my system in a broad scale, considering the whole network, and
- deepen my analysis, considering the specific problems of each DMA."

The subsequent set of steps was followed, as explained below.

Step 1 –Tactical objectives definition

The board of directors and the main stakeholders had already decided to adopt the TRUST Sustainability Objectives and Criteria [Brattebø et al, 2013] as a good basis for work, in the Strategic Plan.

Some of the TRUST objectives have been recognised as very important in themselves, but not relevant for our case, or at least not in the core of the decision to be made. The table shows in bold the TRUST adopted criteria, at the strategic level. This could be our starting point at the tactical level.

	STRATEGIC OBJECTIVE	CRITERIA
Social	S1) Access to urban water services	S11) Service coverage
	S2) Effectively satisfy the current users' needs and expectations	**S21) Quality of service** **S22) Safety and health**
	S3) Acceptance and awareness of UWCS	S31) Affordability S3X) Public acceptability to change
Environment	En1) Efficient use of water, energy and materials	**En11) Efficiency in the use of water** **En12) Efficiency in the use of energy** En13) Efficiency in the use of materials
	En2) Minimisation of other environmental impacts	En21) Environmental efficiency (resource exploitation and life cycle emissions to water, air and soil)

	STRATEGIC OBJECTIVE	CRITERIA
Economic	Ec1) Ensure economic sustainability of the UWCS	Ec11) Cost recovery and reinvestment in UWCS **Ec12) Economic efficiency** Ec13) Leverage (degree of indebtedness) Ec14) Willingness to pay (accounts receivable)
Governance	G1) Public participation	G11) Participation initiatives
	G2) Transparency and accountability	G21) Availability of information and public disclosure G22) Availability of mechanisms of accountability
	G3) Clearness, steadiness and measurability of the UWCS policies	G31) Clearness, steadiness, ambitiousness and measurability of policies
	G4) Alignment of city, corporate and water resources planning	G41) Degree of alignment of city, corporate and water resources planning
Assets	I1) Infrastructure reliability, adequacy and resilience	**I11) Adequacy of the rehabilitation rate** **I12) Reliability and failures** I13) Adequacy of infrastructural capacity I14) Adaptability to changes (e.g. climate change adaptation)
	I2) Human capital	I21) Adequacy of training, capacity building and knowledge transfer
	I3) Information and knowledge management	I31) Quality of the information and of the knowledge management system

As for Tactical Objectives, we opted for:

- Ensuring quality of service in terms of minimum pressure
- Ensuring water quality at the consumer's tap
- Efficiently use water resources
- Efficiently use energy
- Ensure economic efficiency
- Promote infrastructure's rehabilitation
- Enhance infrastructure reliability

Step 2 – Tactical assessment criteria definition and relative importance

The referred tactic objectives are clear enough to understand what are the key directions; however, they are quite vague to compare alternative tactics and to monitor the effects of implementing the selected tactics.

Therefore, we felt the need to define metrics and targets adequate to assess the objectives. As an intermediate stage to help in the process, we agreed on key assessment criteria for each objective.

The table shows in bold the adopted criteria. This task was carried out by the stakeholders' group for all the objectives.

TACTICAL OBJECTIVE	CRITERIA
S21) **Ensuring quality of service in terms of minimum pressure**	Minimum pressure in a contingency situation
S22) **Ensuring water quality at the consumer's tap**	Water travelling time
En11) **Efficiently use water resources**	Real losses control
En12) Efficiently use energy	Energy consumption
Ec12) **Ensure economic efficiency**	Total costs Energy costs
I11) Promote infrastructure's rehabilitation	Rehabilitation rate Infrastructure value
I12) **Enhance infrastructure reliability**	Failures

Step 3 – Metrics and reference value definition

When a consensus about the key assessment criteria was reached, a set of metrics was defined as well as the respective reference values. This process was carried out to all criteria, including the accurate definition of metrics and their source.

ASSESSMENT CRITERIA	METRIC	UNIT	REFERENCE VALUES
Minimum pressure in a contingency situation	1) Pmin: minimum pressure index in a contingency situation	(-)	index 1-3
Water travelling time	2) Wt: Water travelling time to the consumer's tap index	(-)	index 1-3
Real losses control	3) RealLoss: Real losses per connection	(l/conn./ day)	Good: ≤ 100 Fair: 100 - 150
Energy consumption	4) Energy: Provided energy surplus	(-)	index 1-3
Total costs	5) Cost: Cost index of implementing the alternative	(-)	index 1-3
Energy costs	6) EnergyC: Specific energy consumption	(kWh/m^3)	Good: ≤ 0.4 Fair: 0.4 – 0.6
Rehabilitation rate	7) Rehab: Rehabilitation rate	(%/year)	Good: ≥ 1% Fair: 0.8% - 1%
Infrastructure value	8) IVImin: Infrastructure Value Index (min)	(-)	Good: ≥ 0.45 Fair: 0.3-0.45
Failures	9) Failures in conduits	(nº/(100k m x year))	Good: ≤ 30 Fair: 30-60

As the relative importance that stakeholders give to the metrics is similar, most have the standard weight of 1. The exceptions are the metrics related to energy and water losses.

As these aspects were considered more relevant, a weight of 1.5 was allocated to these points of view. Furthermore, as two metrics are included for energy assessment, a weight of 0.75 was allocated to each of them.

After completing metrics definition, a judgement of the values of each metric was agreed among stakeholders.

The infrastructure value index (IVI) is a measure that reflects the degree of youth, maturity or aging of an infrastructure. It is given by the ratio between the current value of the infrastructure and the respective replacement value.

The IVI ideally should be between 0.45 and 0.55. The IVI_{min} penalizes aging infrastructure (IVI <0.45), and IVI_{max} identifies over-investment in infrastructure rehabilitation (IVI> 0.55).

The utility decided to penalize lower values of IVI, so opted to consider that IVI are good, if above 0.45. They also considered as poor, if below 0.3.

The P_{min}, minimum pressure index in a contingency situation, is a 0.0-3.0 index evaluated recurring to hydraulic simulation.

Considering a significant number of sectors provide water to residential buildings with four stories tall, a minimum pressure limit of 25 m was used.

To structure, document and simplify the decision process, I have decided to use the PLAN tool of the TRUST/AWARE-P system and software, as shown in the figure. This system converts any metric in a value ranging from 0-3, where 0 stands for the 'no function' and 3 means 'excellent'. Three grades of colours are used.

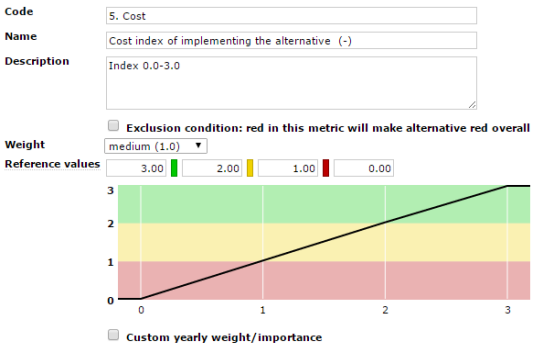


Figure 5

With the consensus among stakeholders about the full definition of objectives, assessment criteria and corresponding metrics and reference values, the assessment framework to be adopted from now onward in our utility has been consolidated.

Step 4 - Diagnosis

We started the diagnosis with a characterisation of the baseline situation, using our assessment system.

Based on the tactical evaluation system, DMA B and D were considered priority for intervention, in that order. The main reason for the choice of these two DMA was the high level of real losses in both, slightly higher in B.
However, DMA D turned out to be the first priority for the utility, given that, in the near future, we need to supply the industrial complex through DMA D!"

The TRUST/AWARE-P Plan tool was used to assess the current situation:

Figure 6 – Diagnosis of the current situation

This information, however, does not reflect the impact of the forecasted industrial complex, and we used our best tools to forecast the evolution of all the metrics at a *status quo* situation. We assumed that business would continue as usual, without changing the management policies, or investing in rehabilitation. Results were:

	Planning				
A.00 Statu Quo	**2014**	**2015**	**2016**	**2017**	**2018**
1. Pmin minimum pressure index in a contingency situation (-)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
2. Wt Water travel time to the consumer's tap index (-)	0.90 0.90	0.90 0.90	0.90 0.90	0.90 0.90	0.90 0.90
3. RealLoss Real water losses per connection (l/(conn.day))	225.00 0.50	230.00 0.47	232.00 0.45	234.00 0.44	236.00 0.43
4. Energy Provided energy surplus (-)	2.80 1.20	2.90 1.10	3.10 0.97	3.10 0.97	3.10 0.97
5. Cost Cost index of implementing the alternative (-)	3.00 3.00	3.00 3.00	3.00 3.00	3.00 3.00	3.00 3.00
6. EnergyC Specific energy consumption (kWh/m3)	0.55 1.25	0.67 0.82	0.68 0.80	0.68 0.80	0.69 0.77
7. Rehab Rehabilitation rate(%/year)	0.50 0.00	0.40 0.00	0.30 0.00	0.20 0.00	0.10 0.00
8) IVImin Infrastructure value index (-)	0.46 2.10	0.45 2.00	0.44 1.93	0.43 1.87	0.42 1.80
9. Failure Failures in conduits (nº/(100km x year))	53.00 1.23	53.00 1.23	54.00 1.20	55.00 1.17	56.00 1.13

Figure 7 – Screenshot of the TRUST/AWARE-P PLAN tool: metrics data input table

We used the Plan tool once again to represent this information in graphical form, to easily understand and communicate its essence:

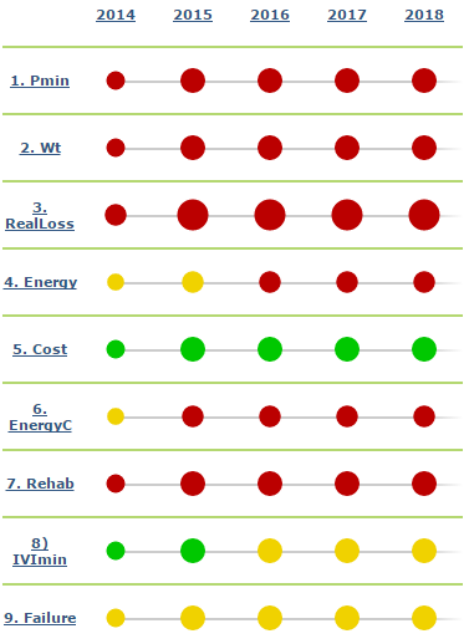


Figure 8 – Analysis of the status quo situation over time

Step 5 – Intervention alternatives

In general terms, the definition of intervention alternatives should follow the diagnosis.

In Lynn's case she had a solution in mind that looked obvious to her as soon as she scanned the situation. However…

"Well, in fact, now, I have a broader and more integrated view of the context, a better understanding of the strategic directions and a good diagnosis of my system and of my DMAs. The solution I initially had in mind continues to make sense for me, but I had better listen to other views and possible solutions."

Figure 9 – Sharing opinions to design possible alternatives of intervention

After a more detailed discussion, everybody agreed that two main alternatives should be compared at this stage: Lynn's first suggestion, and the alternative of supplying DMA D and the industrial complex to from Blue Village. This would achieve the same result as regards to service pressure, would save pumping energy, improve the overcapacity problem of the Blue Village network and, if the current connection of DMA with the rest of the system were kept for contingency situations, the current poor performance with this regard would improve.
None of these alternatives addresses the criteria "Rehabilitation rate" and "Infrastructure value of the infrastructure", to be sorted out by a phased replacement scheme to be included also in the analysis. However, this was left for the following step of the analysis in order to allow everybody to understand how this integrated approach may work in practice.

The two alternatives referred are:

Alternative of intervention 1 – Install a PRV in DMA D

- Year 1: install the PRV in DMA D and supply the industrial complex through DMA D

Alternative of intervention 2 – Supply DMA D through Blue Village keeping the actual connection for contingency

- Year 1: supply the industrial complex and DMA D through DMA E (in Blue Village)
- Year 1 - 5: Phase replacement of aged pipes in DMA D

The supporters of each of the alternatives had used their own criteria to defend their position.

The good news was that when we reached this point of the process we already had a sound assessment system that we could apply. Once again we used our best methods, tools and expertise, including the TRUST / AWARE-P PI tools.

We input the results for the Alternatives 1 and 2 in the PLAN project, where we had already defined the assessment system.

For Alternative 1, the inputs were the following:

A.01 Install a PRV in sector D	**2014**	**2015**	**2016**	**2017**	**2018**
1. Pmin minimum pressure index in a contingency situation (-)	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.00
2. Wt Water travel time to the consumer's tap index (-)	1.60 1.60	1.70 1.70	1.70 1.70	1.70 1.70	1.70 1.70
3. RealLoss Real water losses per connection (l/(conn.day))	225.00 0.50	90.00 2.20	90.00 2.20	91.00 2.18	91.00 2.18
4. Energy Provided energy surplus (-)	2.80 1.20	2.40 1.60	2.40 1.60	2.41 1.59	2.41 1.59
5. Cost Cost index of implementing the alternative (-)	3.00 3.00	1.90 1.90	3.00 3.00	3.00 3.00	3.00 3.00
6. EnergyC Specific energy consumption (kWh/m3)	0.55 1.25	0.66 0.85	0.66 0.85	0.66 0.85	0.67 0.82
7. Rehab Rehabilitation rate(%/year)	0.50 0.00	0.40 0.00	0.30 0.00	0.20 0.00	0.10 0.00
8) IVImin Infrastructure value index (-)	0.46 2.10	0.45 2.00	0.44 1.93	0.43 1.87	0.42 1.80
9. Failure Failures in conduits (nº/(100km x year))	53.00 1.23	44.00 1.53	44.00 1.53	45.00 1.50	45.00 1.50

For Alternative 2:

A.02 Supply sector D through Blue Village	2014	2015	2016	2017	2018
1. Pmin minimum pressure index in a contingency situation (-)	0.00 0.00	2.10 2.10	2.10 2.10	2.10 2.10	2.10 2.10
2. Wt Water travel time to the consumer's tap index (-)	1.60 1.60	1.80 1.80	1.80 1.80	1.80 1.80	1.80 1.80
3. RealLoss Real water losses per connection (l/(conn.day))	225.00 0.50	90.00 2.20	90.00 2.20	91.00 2.18	91.00 2.18
4. Energy Provided energy surplus (-)	2.80 1.20	1.50 2.56	1.50 2.56	1.51 2.54	1.51 2.54
5. Cost Cost index of implementing the alternative (-)	3.00 3.00	1.60 1.60	1.90 1.90	2.00 2.00	2.00 2.00
6. EnergyC Specific energy consumption (kWh/m3)	0.55 1.25	0.30 3.00	0.25 3.00	0.25 3.00	0.20 3.00
7. Rehab Rehabilitation rate(%/year)	0.50 0.00	0.80 1.00	1.00 2.00	1.50 2.50	1.50 2.50
8) IVImin Infrastructure value index (-)	0.46 2.10	0.46 2.10	0.45 2.00	0.45 2.00	0.45 2.00
9. Failure Failures in conduits (nº/(100km x year))	53.00 1.23	40.00 1.67	30.00 2.00	25.00 2.25	20.00 2.50

As we had already uploaded the current situation (Alternative 0, the baseline), we were able to compare the alternatives:

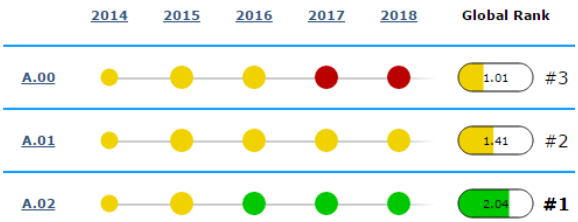
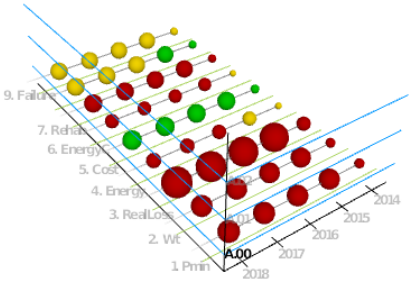
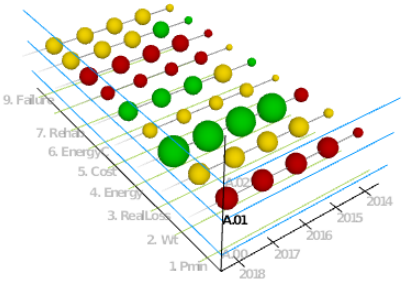


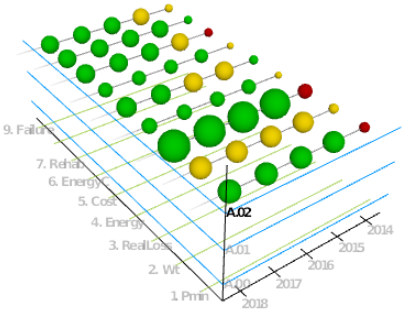
Figure 10 – 2D global overview of the results



Baseline



Alternative 1



Alternative 2

Figure 11 – Overview of the results: comparison amongst alternatives

Or, if seen all at the same time:

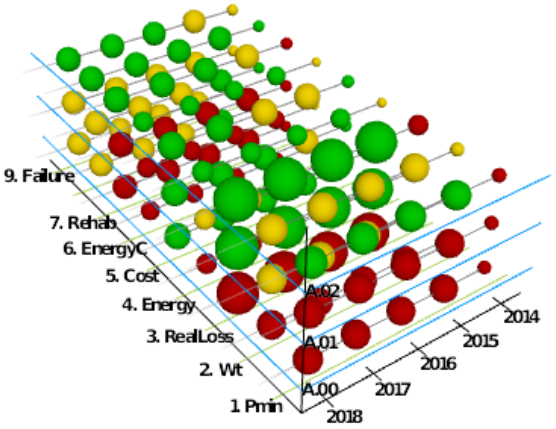


Figure 12 – 3D global overview of the results

The analysis of these results has clearly shown us that Alternative 2 was the most advantageous, but there were still some competing advantages and disavantages.

Alternative 2, for instance,:

- shows an improvement in terms of water losses and rehabilitation rates;

- but compared to the Alternative 1, it greatly increases costs without solving the water travelling time to the consumer's tap. However, considering that the actual connection to DMA D in the City area was kept for contingency, this problem may be addressed with the adequate operation tactics.

Lessons learned

If I were to summarise in three short sentences the lessons learnt during this process, I would say that:

- Alignment with the strategic plan is needed.
- Tactical decisions shall be supported on a sound assessment systems composed of objectives-assessment criteria-metrics-reference values.
- The decision process needs to be transparent and defendable, yet simple!

Guidelines for the development of a Tactical Infrastructure Asset Management Plan for urban water systems

3

3.1 Tactical planning in the IAM planning process

This chapter provides guidelines for the development of a tactical plan for infrastructure asset management of urban water services. This tactical plan is based on the methodological approach developed in the AWARE-P project (www.aware-p.org) and first presented in the *Technical Guides on Infrastructure Asset Management* published by ERSAR, LNEC and IST (Alegre and Covas, 2010; Almeida and Cardoso, 2010).

The cube shown in Figure 13 represents the AWARE-P approach. It advocates that IAM must be addressed at different planning decisional levels:

- a *strategic level*, driven by corporate and long term views and aimed at establishing and communicating strategic priorities to staff and citizens;

- a *tactical level*, where the intermediate managers in charge of the infrastructures need to identify the system sectors that are most in need for medium-term intervention and to select the best intervention solutions;

- and an *operational level*, where the short-term actions are planned and implemented.

It also draws attention to the need for standardized procedures to assess intervention alternatives in terms of performance, risk and cost, over the analysis period.

The other relevant message is that IAM requires three main pillars of competence: business management, engineering and information.

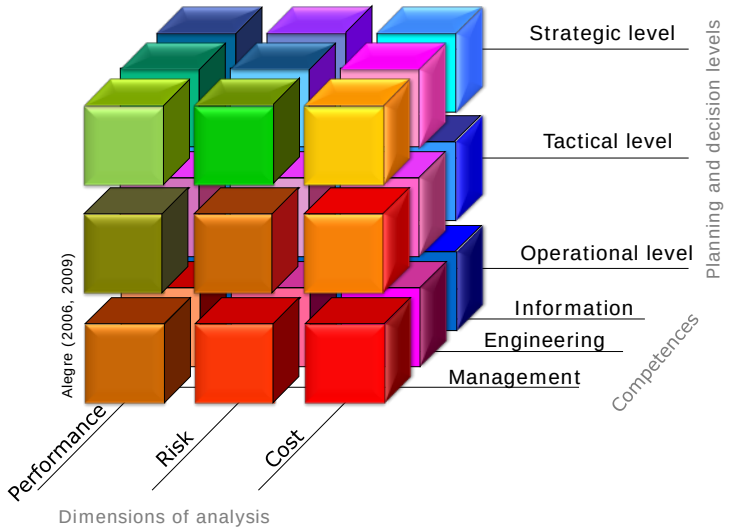


Figure 13 – The AWARE-P approach

At each level of management and planning – strategic, tactical and operational – a structured loop (Figure 14) is proposed that comprises the following stages:

1. definition of objectives and targets;
2. diagnosis;
3. plan production, including the identification, comparison and selection of alternative solutions;
4. plan implementation;
5. and monitoring and review.

Most utilities already have several elements of this process in place. What is often missing is a review mechanism – a way to measure compliance with set goals – as well as an effective alignment between the different management levels.

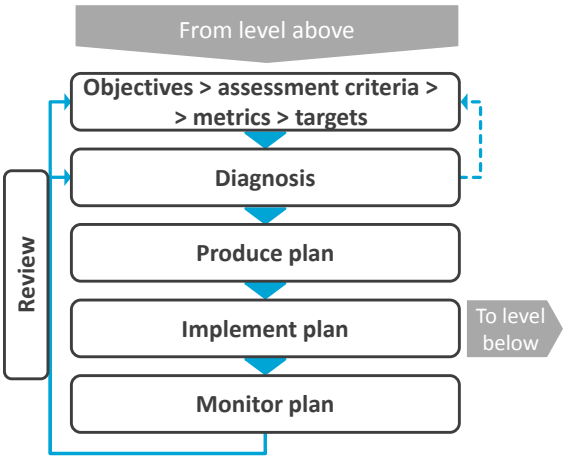


Figure 14 – The planning process (at each planning level)

Setting up the assessment system (objectives, assessment criteria, metrics, reference values and targets) is a crucial stage in order to set up clear directions of action, as well as accountability of results through timely review.

The four sequential concepts in the proposed assessment system, similar to the one developed in the strategic level, are the following (for further details, see Volume 3):

- *Objectives* are the goals that the organization aims to achieve. The AWARE-P approach demands that objectives are clear and concise, as well as ambitious, feasible and compatible. In the tactical level, tactical objectives should be aligned with strategic objectives. For each objective, it is recommended that key assessment criteria be specified.
- *Criteria* are points of view that allow for the assessment of the objectives. For each criterion, performance, risk and cost metrics must be selected in order for clear targets to be set, and for further monitoring of the results.
- *Metrics* are the specific parameters or functions used to quantitatively or qualitatively assess criteria; metrics can be indicators, indices or levels. Metrics must be should be framed by reference values, which allow for a judgment to be made (e.g., good, acceptable or bad)
- *Targets* are the actual proposed values to be achieved for each metric within a given time frame (medium term, in the tactical level).

For instance: for a strategic objective of *social sustainability*, one possible criterion could be *quality of service*, measured through a *service complaints (number of complaints/day)* metric. At a tactical level, this objective could be stated as *Effectively satisfying the current users' needs and expectations*, one possible criterion could be *quality of service from the users' point of view*, measured through a *service complaints per connection (number of complaints/conn./day)* metric.

Assessment metrics are a key element of the whole process: they are used to establish targets, to set up a diagnosis, to prioritize system sectors, to compare and select alternative courses of action, and to monitor and review the process. They should be relevant, reliable, simple, and effectively measure success.

Objectives and targets are also a powerful means of communication within the organisation and with other stakeholders, allowing a transparent and replicable assessment.

As illustrated in Figure 15, the process cascades through the decisional levels within the organization's management structure. The global approach is based on **plan-do-check-act** (**PDCA**) principles aiming at the continuous improvement of the IAM process. The tactical planning is part of this overall structure.

The key notions in this process are *alignment*, *feedback*, *involvement* and *empowerment* (for further details, see Volume 3)

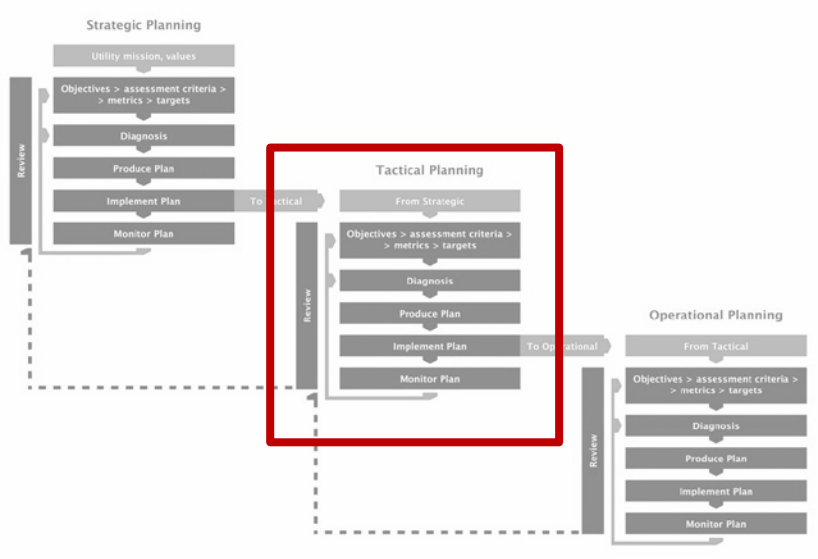


Figure 15 – Interlinks, alignment and feedback mechanisms between tactical and other planning levels

The aim of tactical IAM planning is to define the tactics that will support the decision-making process in the medium-term and involve the wider scope of the entire organization. This is achieved through the identification of key internal and external factors that influence its performance..

IAM tactical planning takes shape in medium-term tactics that materialize the strategies identified at the strategic level, specifically chosen for the system sector(s) considered priority.

Divide and rule - or, in the context of IAM, split to better manage - is the motto to adopt the level of tactical planning. In fact, the division of the system managed by the utility in functional units facilitates the analysis process.

The main purpose of the division of the entire area of intervention into independent groups, or system sectors, is to establish priorities for action at the tactical plan.

The system sectors correspond, in principle, to the functional subdivisions of the urban water system.

Additionally to this division into system sectors, for some types of problems I might have to consider other units of analysis, based on:

- other physical criteria,
- information management, and
- human or technological resources management.

The selected criteria naturally depend on the objectives the utility wishes to achieve, the nature of the main problems to be addressed and the information availability.

Where problems of hydraulic nature exist, which is a very common situation, the system sectors should be established based on physical criteria (e.g., distribution subsystems, DMAs, basins or drainage sub-basins). The level of disaggregation used in this case should take into account the total number of corresponding system sectors and the availability of information to calculate the metrics chosen in each of these units. The latter aspect is particularly important in that it is necessary to preserve alignment with strategic planning.

In short, the system sectors definition dependents on the system layout, the way information is organized on GIS or other information systems.

In my case I will only use the system as a whole and the DMAs.

The selection of IAM tactics is a structuring process in planning at this level. The tactics are the actions that allow achieving the tactical objectives, and may include:

- Structural intervention, referring to physical interventions, rehabilitation and system expansion;
- Operation and maintenance tactics;
- Other non-infrastructural tactics, including aspects related to management and information.

As in IAM strategic planning, the tactical planning process is specific to each utility, and covers the strategic guidelines for all organization performance domains. It should be developed by a multidisciplinary team and be taken by the whole utility.

3.2 The PDCA cycle in tactical planning

The PDCA (*Plan-Do-Check-Act*) cycle, aims to support the improvement process of organizations, assuring that this process is developed in a coherent, structured and systematic way.

At a tactical level, the initial stage (plan) consists of splitting the area of influence of the utility into system sectors, the definition of the tactical objectives and targets (in alignment with the strategic plan), the diagnosis (e.g., using the assessment system), the definition of priority system sectors and the establishment of tactics. Afterwards (at the 'do' stage), the tactical plan is implemented according to the established tactics. In the third stage (the level of implementation) the results of the tactics are assessed. Finally, the tactical plan is reviewed based on the assessment of the previous stage. This last stage is the starting point for the application of a new PDCA cycle.

For a more detailed overview on the PDCA cycle, see Volume 3.

The decision-making process

Decision making is the moment of choosing between various alternatives and determining the course of action, in order to solve a real or potential problem.

The decision-making process is, in essence, the process of finding the best compromise between the allocation of resources, which become unavailable for other actions, and to achieve results that are aligned with the vision and strategy of the decision maker.

There are several models to the decision-making process in the organizations. However, it is possible to consider that, in general, decision-making involves three main phases which are: (i) identification of the problem; (Ii) development of alternatives; and (iii) evaluating and selecting alternatives.

The decision-making process is illustrated as follows:

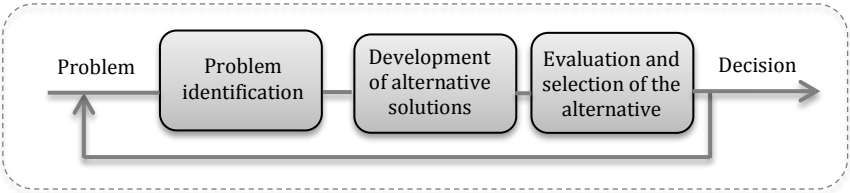


Figure 16 – Decision-making process

3.3 Content of a tactical plan

The tactical planning is materialized in the form of a plan that converts the strategic objectives into sectorial objectives, setting priorities for action, as well as defining the timing and resources needed to achieve the intended goals.

The **tactical plan** is a key management tool for establishing the connection and ensuring the consistency between the routine activities, at the operational level, and the overall organizational strategies.

The tactical plan should serve as a communication tool within the organization.

The proposed tactical plan model is organized in a main document – Tactical Plan – which is supported by a separate document for each system sector – Detailed Analysis

Document – intended for the detailed presentation of the tactics selection process.

An IAM Tactical Plan should include the following elements:

- alignment with the strategic plan
- planning and analysis time horizons;
- tactical objectives, criteria, metrics, reference values and goals;
- identification of scenarios;
- tactical level diagnosis:
  - identification and evaluation of existing information,
  - delimitation of the system sectors,
  - evaluation of the reference situation for the global system and for each system sector,
  - ranking of the system sectors per intervention priority;
  - identification of eventual priority changes;
- overall adopted tactics and associated resources;
- procedures for the plan's monitoring, evaluation and revision.

For each of the selected system sectors (ranked per intervention priority), a specific **Detailed Analysis Document** is proposed, which should include the following content:

- identification of tactical metrics and goals that specifically apply to the system sector in question;
- detailed diagnosis;
- identification and analysis of alternatives tactics;
- resources associated with the chosen tactics.

3.4 Key elements of a tactical plan

The following are relevant elements to consider when developing an IAM tactical plan.

Cover

If the IAM planning includes formal plans for each decision level (strategic, tactical and operational), the cover of these documents should clearly identify (Figure 17):

- the utility;
- the urban water system or service;
- the type of document;
- the planning horizon;
- the date of publication.

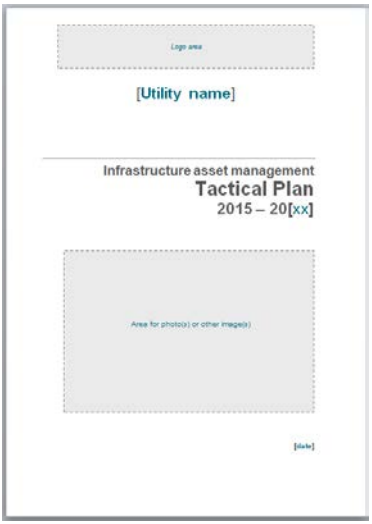


Figure 17 - Example for a Tactical Plan cover

Executive summary

The executive summary introduces the system for which the IAM plan is being drawn and the utility service provided. The reader should be given information on the tactical planning objectives and their relation to the overall IAM plan.

Executive Summary

AquaSan utility is responsible for supplying drinking water and managing wastewater and stormwater of the of Lusitania region. It is mostly a publicly management system, with a PPP for the wastewater treatment.

The 2015 – 2020 Tactical Plan outlines the utility's tactical objectives, targets and tactics, ensuring **alignment** with the strategic plan.

The plan has three tactical objectives that address the key responsibilities to the community and the environment: (i) Ensure water quality at the consumers' tap in normal and contingency situations; (ii) Promote the efficient use of water; (iii) Reduce rain water inflow and infiltration into the wastewater system (iv) Ensure infrastructural performance.

The priority system sectors are Green Acres and Downtown Alley. The scenario analysis was performed. The main causes of less adequate performance are the inadequate system operation, the deficient knowledge of the systems' characteristics and the poor condition of the aging infrastructure. Eight **tactics** were identified as the alternative solutions that mostly contribute to the tactical objectives. Two of them are non-infrastructural, applying broadly to the overall system. Four tactics relate to infrastructural interventions and the remaining two concern maintenance interventions, mostly in Green Acres.

These tactics will be implemented and materialized in the operational level.

The utility will publicly report annual progress of the implementation of this Plan.

Figure 18 – Example of contents of an Executive Summary

Alignment with the Strategic Plan

As previously mentioned, the purpose of tactical planning is the materialization of the IAM strategies of the organization, defining the sectorial and temporal process of implementation to achieve the desired results. The inclusion of the organization's strategic objectives, in the Tactical Plan, illustrates this alignment.

STRATEGIC OBJECTIVES	ASSESSMENT CRITERIA
Public health	Adequate water quantity Structural integrity
Service sustainability	Economic sustainability Infrastructure sustainability
Environmental sustainability	Environmental resources efficient use Pollution prevention and control

Figure 19 – Example of strategic objectives and assessment criteria

Planning and analysis time horizons

In tactical planning, the following time horizons must be considered:

- **Tactical planning horizon** is the estimated time horizon for the implementation of the measures that materialize the tactical plan. This period corresponds to the actual scope of the tactical plan (typically 3-5 years).
- **Tactical analysis horizon** is the necessary time to quantify the expected impact of IAM tactics, especially considering strategic and tactical objectives. It should be long enough to reflect possible effects on performance, risk and cost aspects of the considered tactics. This period includes the tactical planning horizon, and is typically quite long (it may equal the strategic planning horizon, for example).

Examples of the two periods are presented as follows:

The impact of a tactic implemented over 3 years (**tactical planning horizon**), with conduit replacement and operation changes may be analyzed after 20 years (**tactical analysis horizon**).

Figure 20 – Example of tactical time horizons

Objectives, criteria, metrics, reference values and targets

The tactical objectives must be aligned with the strategic objectives, thus materializing the organization's strategies.

> **Tactical objective**
>
> In order to address this need of alignment, a possible solution is the definition of tactical objectives directly associated to each of the evaluation criteria established at the strategic level.
> Tactical objectives should be pragmatic, measurable, feasible and mutually compatible.

This simplification of the relationship between IAM planning levels can be enhanced by the adoption, at the tactical level, of the metrics already selected at the strategic level, complemented by others that may be relevant to the case.

As a working basis for selecting tactical objectives, the following documents are suggested:

- Technical Guides on Infrastructure Asset Management published by ERSAR, LNEC and IST (Alegre and Covas, 2010; Almeida and Cardoso, 2010);
- Quality Assessment Guide of Water and Waste Services Provided to users - 2nd Generation Assessment System (ERSAR and LNEC, 2010);
- ISO 24510 (ISO, 2007a), ISO 24511 (ISO, 2007b) and ISO 24512 (ISO, 2007c).

The process of defining tactical objectives and corresponding evaluation criteria, metrics and reference values are exemplified as follows.

STRATEGIC ASSESSMENT CRITERIA	**TACTICAL** OBJECTIVES
Adequate water quantity	Ensure adequate water quantity at the consumer's tap in normal and contingency situations
Infrastructure integrity and sustainability	Ensure infrastructure's integrity and sustainability
Environmental resources efficient use	Promote an efficient use of water

Figure 21 – Example of tactical objectives

The application of the assessment criteria is done by defining metrics that should:

- be as objective and accurate as possible;
- be complementary to each other;
- and not duplicate information.

The AWARE-P methodology (www.aware-p.org) recommends considering the performance, risk and cost dimensions in this assessment.

The next image presents an example of several assessment criteria for different objectives.

OBJECTIVES	CRITERIA
Ensure adequate water quantity at the consumer's tap in normal and contingency situations	Water quantity adequacy in the consumer's tap in a normal situation
	Water quantity adequacy at the consumer's tap in contingency situations
Ensure infrastructure's integrity and sustainability	Infrastructural integrity
	Infrastructural sustainability
Promote an efficient use of water	Adequacy of the system's real water losses

Figure 22 – Example of assessment criteria for different tactic objectives

Applying assessment criteria is carried out by defining metrics that should be complementary, mutually exclusive and as objective and accurate as possible. Metrics and targets are an essential basis for establishing the diagnosis, prioritizing intervention solutions and monitoring the results.

As a working basis for selecting performance metrics, the following indicator libraries are suggested:

- AWARE-P PI (available in www.baseform.org);
- TRUST PI;
- IWA (Matos et al., 2003 and Alegre et al., 2006);
- Key Performance Indicators for Government and Non Profit Agencies: Implementing Winning KPIS by David Parmenter.

The number of metrics should be as limited as possible. The indicator library corresponding to each metric should be referred in the tables included in the Strategic Plan. In the case

of metrics defined by the utility, their specification should be presented.

Once the evaluation metrics are defined, the reference values and desired targets at the planning horizon (t_N) should be established.

One or more intermediate points should be set in time for the evaluation of system performance, along with the establishment of intermediate targets (*t#*).

Targets should be set up after the diagnosis of the system, ensuring the establishment of realistic and achievable goals.

Figure 23 presents an example of metrics for each assessment criteria.

Criterion	Metric	Library	Reference values	Targets	
				t#[20##]	tN[20##]
Water quantity adequacy in the consumer's tap in a normal situation	Supply continuity (%)	[text]	Poor: [range] Fair: [range] Good: [range]	[value]	
	Adequacy of service minumum pressure (%)	[text]	Poor: [range] Fair: [range] Good: [range]	[value]	
Water quantity adequacy at the consumer's tap in contingency situations	Adequacy of fire figthing minumum pressure (%)	[text]	Poor: [range] Fair: [range] Good: [range]	[value]	

Figure 23 – Example of metrics, reference values and targets at a tactical level

Identification of scenarios

Under the AWARE-P methodology, the term "scenario" stands for the set of factors not controlled by the utility that have the potential to influence performance during the period of analysis. These were already defined at the strategic level (see Volume 3).

At the tactical level, only the scenarios that will effectively influence the decision-making process at the tactical level should be identified and analyzed.

If there is more than one scenario under consideration, analysis and comparison of policy alternatives must be made for each scenario; the alternative that represents the best compromise in all the scenarios considered is to be chosen.

Tactical level diagnosis

The tactical level diagnosis provides the basis for the evaluation of the benefit or difficulty associated with the intervention alternatives. The tactical diagnosis includes the evaluation of a baseline reference situation and forecasts the future behavior in the status quo alternative. The latter means, in the AWARE-P methodology, that "structural interventions are not carried out and the operating practices and infrastructure maintenance are maintained" (Alegre and Covas, 2010).

The tactical diagnosis requires the evaluation of the urban water system based on a reference situation, a baseline. This situation corresponds to the evaluation starting point. It is important to clearly establish the moment in time associated with the reference situation. The reference situation might refer to the current situation (most frequent option), to a recent past situation or to a situation in the near future (e.g., the beginning of the following financial year).

At the tactical level, the diagnosis is developed in two phases.

- **Global diagnosis**: Initially, an overall assessment of urban water system is made. This assessment identifies needs of the global system and the respective global tactics (e.g., the implementation of GIS)
- **Sectorial diagnosis**: The second phase of diagnosis allows prioritizing system sectors and requires a deeper understanding of the assessment of each system sector.

Using the tactical assessment system ensures that a similar approach is used in both phases, and also ensures the alignment with the strategic planning.

The diagnosis of an urban water system comprises the following steps:

- Identification and evaluation of existing information –information should be sufficient to characterize the system (supporting performance, cost and risk assessment), to predict the evolution in the medium and long term and to support the definition of the tactics to implement. If not, information gaps should be identified and a monitoring procedure should be implemented (which is a tactic itself)
- Delimitation of the system sectors – system division into independent functional units facilitates the analysis of the operating conditions. The establishment of groups of assets with common characteristics can be based on physical criteria, information management, and management of human and technical resources.
- Evaluation of the reference situation - statu quo scenario for the global system (global diagnosis) and for each system sector (sectorial diagnosis), for the actual time step. Comparing the metrics' observed values with established targets allows evaluating the baseline scenario. It should also include the identification of the causes associated with the identified problems.
- Prediction of the statu quo scenario in future time steps - the prediction of future behavior should consider the natural degradation of the assets and the medium term changes in clients' demand.
- Ranking of the system sectors per intervention priority –the identification of the system sectors that need priority intervention should be based on the assessment carried out in the two previous steps.
- Identification of eventual priority changes - the previous ranking can be adjusted due to alternative scenarios or to external (or even

internal) events that have not yet been taken into account (eventually, events specific to a particular system sector) and that may affect the decision process. Given the difficulty in predicting values for the metrics in future scenarios, the utility may opt to evaluate only whether the ranking of priorities will change.

To obtain detailed information on the implementation of the tactical diagnosis, the following documents are suggested: Technical Guides on Infrastructure Asset Management published by ERSAR, LNEC and IST (Alegre and Covas, 2010; Almeida and Cardoso, 2010).
The AWARE-P software (www.baseform.org) is a very useful tool for the tactical diagnosis, as it assists the implementation of the assessment system. It provides a joint vision of the evaluation results for the different system sectors, allowing establishing the intervention order of priority.

Several examples of the referred concepts are presented below.

- Organization's strategies
- Data necessary to calculate the metrics (performance, cost and risk) at a system's level
- Register information (physical characteristics of the assets)
- Qualitative operational information on the assets' condition
- Information concerning the system's operation modes
- Information on demands
- Accounting data

Figure 24 – Example of information required for the diagnosis

Description:
The Lusitania water system covers an intervention area of about 319 km² with a 1194 km network, which includes water supply and distribution.

System sectors:
The system is divided into 14 DMA, corresponding to 14 system sectors.

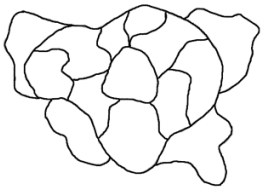


Figure 25 – Example of an area's system sectors

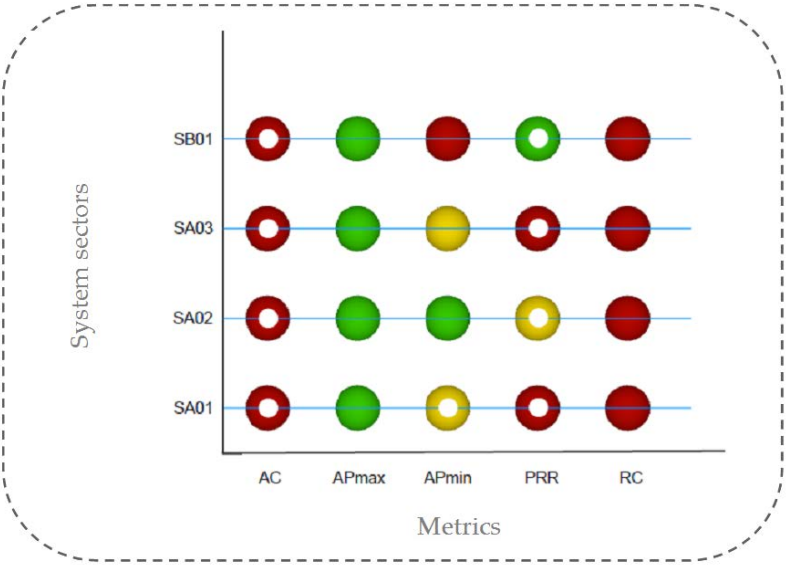


Figure 26 – Example of an overall assessment of baseline situation [Source: AWARE-P software (www.baseform.org)]

Figure 27 –Example of system sectors priority rank
[Source: AWARE-P software (www.baseform.org)]

Infrastructure asset management tactics

The Tactical Plan should present the complete set of infrastructural and non-infrastructural tactics outlined for each of the system sector, considering the planning horizon. This demonstration should be synthetic, to facilitate a global perception of the interventions set for the system managed by the utility. The detailed presentation of the tactics is made in the Detailed Analysis Documents.

As already mentioned, there is an alignment between strategies and tactics, as the latter are the implementation of the first. It is therefore important that the Tactical Plan document specifies the existing relation, by identifying the tactics associated with each strategy.

At this stage it should be verified whether all strategies are covered by tactics and whether tactics that apply to the global system were identified. Global tactics may be aimed at, e.g., minimizing internal context weaknesses or filling information

gaps, required for diagnosis or for improving infrastructural knowledge.

It should also be checked whether all the tactics identified in the Detailed Analysis Documents are properly reported in the Tactical Plan.

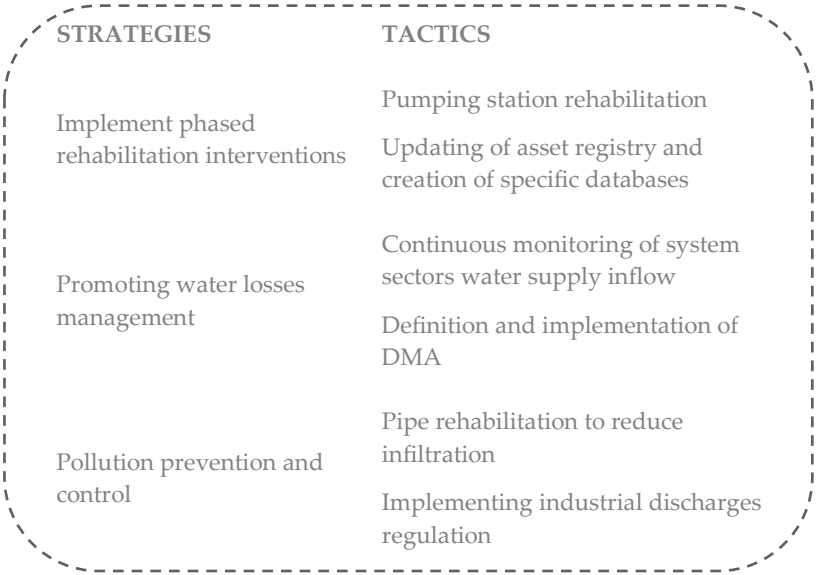


Figure 28 – Example of aligned strategies and tactics

Resourcing

The tactical plan should include information of human, technological and financial resources necessary for its implementation. These can be outline with varying degrees of detail, depending on the information available.
A schedule for the need for each resource should be provided. This information is obtained during the selection of tactics and should be provided in a summary form.

Monitoring and revision of the tactical plan

Monitoring involves the collection of necessary data, the systematic calculation of metrics for all tactical objectives, and the comparison between those and the respective targets.

As the benefit of some tactics is only reflected in the metrics' values after its completion, it is important that monitoring also includes assessing the degree of implementation of each tactic.

Tactical plan monitoring includes two parts:

- assessment of the selected metrics
- assessment of the degree of implementation of each tactic - which should be done annually

The monitoring process should deliver an annual document synthesizing the obtained results.

This document contributes to the IAM Strategic Plan monitoring, if any common metrics exist (which is the recommended situation).

The tactical plan revision consists of analyzing the monitored results to identify the causes of gaps and improvement measures to bridge those gaps. This revision should happen annually.

The revised Tactical Plan date corresponds to the date of the revision and the final date corresponds to the time horizon for the tactical planning (3-5 years).

The revision of the tactical plan should consider the review of :

- tactical objectives, criteria and metrics
- respective targets
- the proposed tactics.

It is important to ensure alignment between the different levels of IAM planning. Thus, whenever changes are made at the tactical level, the strategic objectives and goals must be checked for consistency.

The document containing the IAM tactical plan should include in an appendix a table of the changes made during the monitoring and revision processes (including the person responsible and the type of change). This record allows the proper documentation of the evolution of the tactical planning during the revision process.

References

The tactical plan should cite all technical and scientific documentation used for its development and, in particular, other plans developed by the utility that have been used.

3.5 Key elements of a Detailed Analysis Document

As previously mentioned, the Tactical Plan is supported by a separate document for each system sector – the **Detailed Analysis Document** – which intends to detail the tactics selection process. The following are relevant elements to consider when developing an IAM tactical Analysis Document.

Cover

If the utility opts to produce individual **Detailed Analysis Documents** for each system sector, the cover of these documents should clearly identify (Figure 17):

- the utility;
- the urban water system or service;
- the type of document;
- the system sector and the respective urban water service
- the integration in the tactical plan and the planning horizon;
- the date of publication.

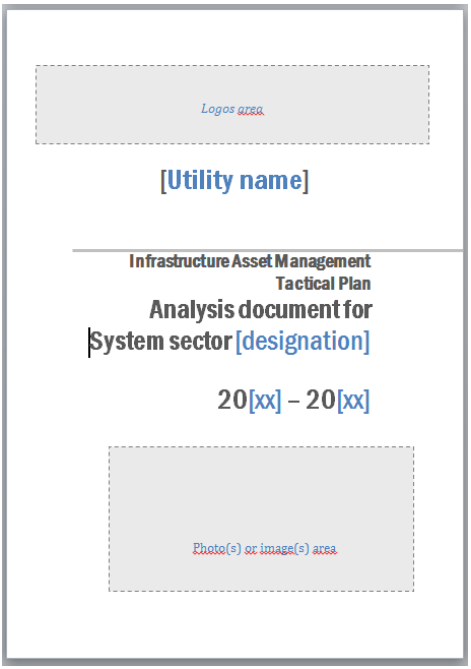


Figure 29 - Example for a Detailed Analysis Document cover

Executive summary

The executive summary introduces the system sector for which the Detailed Analysis Document is being drawn. The reader should be given information on the tactical planning objectives.

Adjustments made to the metrics and targets in the system sector in question should also be mentioned. A brief presentation of the selected tactics should be made.

Executive Summary

AquaSan utility is responsible for supplying drinking water and managing wastewater and stormwater of the of Lusitania region.

This Detailed Analysis Document refers to the Green Acres system sector and is integrated in the 2015 – 2020 Tactical Plan. The identification of this system sector derives from specific water supply contingencies.

The tactical objectives are: (i) Ensure water quality in the end-user's tap in normal and contingency situations; (ii) Promote the efficient use of water; (iii) (iii) Ensure infrastructural performance.

The targets related to the metric "Water supply in contingency situations" were adapted.

Three tactics were identified. One is non-infrastructural, another is an infrastructural intervention and the remaining one concerns a maintenance procedure.

Figure 30 – Example of contents of an Executive Summary

Metrics and targets applied to the system sector

Applying the same tactical assessment system to the different system sectors ensures homogeneity in this sectorial approach. However, provided that alignment with the IAM strategies is guaranteed, adjustments in the metrics and targets may be done for each system sector.

This procedure should be limited to specific cases, whenever tactical planning involves questions that are particularly important to a certain system sector.

As an example, consider a system sector that includes a bathing area – in this case, imposing a stricter target for the quality of the discharged wastewater is justifiable.

These possible adjustments to the metrics and targets must be restricted. The Detailed Analysis Documents should clearly present the adjustments made and the underlying reasons for the changes made. It is important to ensure that such adjustments do not compromise the tactical objectives established for the overall system. It is thus essential to verify this compliance after the implementation of the detailed diagnosis in each system sector.

Sectorial diagnosis in the system sector

When performed at the system sector's level, diagnosis should allow evaluating the results in the statu quo alternative:

- the identification of the type of problems;
- the identification of the main causes of such problems;
- the exact location of problems within the system sector.

The depth of the sectorial diagnosis naturally depends on the quantity and quality of information available for each sector. At this point information gaps should be identified, indicating a procedure to assure the improvement of this aspect.

Water Supply

Inadequate water pressure in Liberty Street and Victoria Street, due to lower elevation in these streets.

High failure rates in Greenfield area, due to the fact that most network is old and consist of asbestos pipes.

Water quality problems in the network's downstream ends, due to high travel times.

Wastewater drainage

Frequent overflows in the waterfront streets, due to lower elevation and the vicinity of Riverside stream.

Pipes in inadequate condition in Old Town due to their age and inappropriate maintenance

Figure 31 – Example of problem identification in the detailed diagnosis

Identification and analysis of alternatives

Under the AWARE-P methodology (www.aware-p.org), the "alternative" term designates the set of options considered in the decision process for the resolution of the problems identified in the diagnostic phase. Intervention alternatives can:

- be exclusively infrastructural (i.e., rehabilitation or expansion works);
- relate to changes to the operation and maintenance procedures (i.e. non-infrastructural); or
- combine infrastructural and non-infrastructural interventions.

ALTERNATIVE 1 - *Statu quo*
Keeping a reactive maintenance policy, where repair is only performed after system failure.

ALTERNATIVE 2 – *Like-for-like*
Listing of priority conduits (for instance, asbestos pipes) to be replaced by similar pipes (in HDPE), with the same cross section

ALTERNATIVE 3 – *Gradual rehabilitation toward optimum design*
Considering the systems optimum design, apply Alternative 1 replacing priority conduits with more adequate diameters

Figure 32 – Example of intervention alternatives

For each of the identified alternatives it is necessary to evaluate the technical and economic feasibility, considering the period of analysis and the scenarios defined in the tactical plan. Choosing the best solution is based on the integrated

analysis of the relationship between cost, performance and risk for each alternative.

It is important to present summarized results of this analysis to facilitate their interpretation and overall perception by the decision maker. The AWARE-P software (www.baseform.org) can be used to evaluate and compare the alternatives under consideration. The available tools can be used to calculate indicators, indices, metrics, cost and risk.

The intervention priorities for each system sector can be established based on:

- the results of the cost-performance-risk assessment for each alternative;
- factors that have not yet been included in the overall technical evaluation (e.g. interventions in other infrastructures).

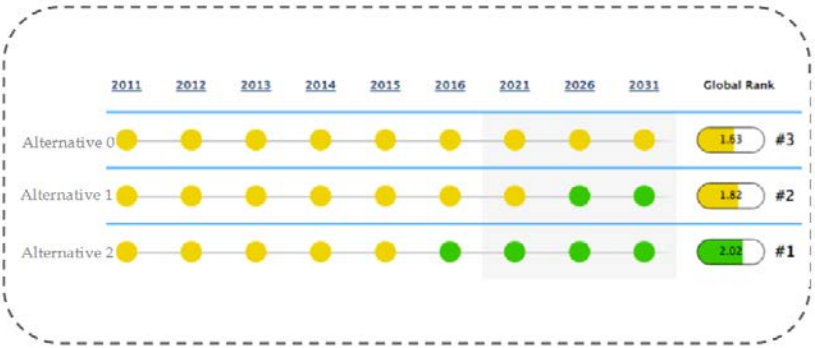


Figure 33 – Example of intervention alternatives priority rank [Source: AWARE-P software (www.baseform.org)]

To obtain detailed information on the identification, analysis and prioritization of alternatives, the following documents are suggested: Technical Guides on Infrastructure Asset Management published by ERSAR, LNEC and IST (Alegre and Covas, 2010; Almeida and Cardoso, 2010).

Tactics development

As previously mentioned, an alternative may include rehabilitation or expansion works, changes of operation and maintenance procedures, or a combination of both. Tactics result directly from the selected alternative and refer exclusively to a particular type of intervention: infrastructural or non-infrastructural.

The Detailed Analysis Document must comprise the full set of selected tactics for the system sector in question. This presentation must be made according to the nature of tactics: infrastructural (Tif), operation and maintenance (Tom) and other non-infrastructural tactics (Tni). With this organization, one seeks to provide, in a summarized form, relevant information on the characteristics of the tactics, the investment to be made and the schedule for their implementation, among others. The Detailed Analysis Documents should consider the same type of presentation for tactics, providing the necessary compilation required for the Tactical Plan.

References

The tactical plan should cite all technical and scientific documentation used for its development and, in particular, other plans developed by the utility that have been used.

References

4

ALEGRE, H.; COVAS, D. (2010). *Gestão Patrimonial de Infra-estruturas de Abastecimento de Água. Uma Abordagem Centrada na Reabilitação*, Guia Técnico nº. 16, Série Guias Técnicos, ERSAR/LNEC/IST, Lisboa, 472 pp. (ISBN: 978-989-8360-04-5).

ALEGRE, H.; BAPTISTA, J.M.; CABRERA JR, E.; CUBILLO, F.; DUARTE, P.; HIMER, W.; MERKEL, W.; PARENA, R. (2006). *Performance Indicators for Water Supply Services*. Second Edition. IWA Publishing. ISBN: 9781843390510.

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BRATTEBØ, H.; ALEGRE, H.; CABRERA, E.; MARQUES, R., C.; HEIN, A.; CRUZ, C. O. (2013). A Master Framework for UWCS Sustainability. TRUST - Transitions to the Urban Water Services of Tomorrow (www.trust-i.net).

ERSAR e LNEC (2010). *Guia de Avaliação da Qualidade dos Serviços de Águas e Resíduos Prestados aos Utilizadores. 2.ª Geração do Sistema de Avaliação*. Versão 2.0, ERSAR/LNEC.

ISO 9001:2008 *Quality Management Systems*

ISO 24510:2007(E). *Activities Relating to Drinking Water and Wastewater Services - Guidelines for the Assessment and for the Improvement of the Service to Users*.

ISO 24511:2007(E) *Activities Relating to Drinking Water and Wastewater Services - Guidelines for the Management of Wastewater Utilities and for the Assessment of Wastewater Services*.

ISO 24512:2007(E).*Activities Relating to Drinking Water and Wastewater Services - Guidelines for the Management of Drinking Water Utilities and for the Assessment of Drinking Water Services*.

ISO 55000:2014 Asset management -- Overview, principles and terminology

ISO 55001:2014 Asset management -- Management systems -- Requirements

ISO 14001:2004 Environmental management systems -- Requirements with guidance for use

MATOS, R.; CARDOSO, A.; DUARTE, P.; MOLINARI, A.; SHULZ, A. (2003). *Performance Indicators for Wastewater Services*. IWA Publishing (ISBN: 9781900222907).

APPENDIX: Template for a Tactical IAM Plan

5

There is not a unique adequate structure for a tactical plan that responds to these guidelines. For ease of application, a template for the development of IAM tactical plans is presented. The original MS Word file can be downloaded from TRUST/AWAR-P_Tactical Plan Template.

Logos area

[Utility name]

Infrastructure Asset Management

Tactical Plan

20[xx] – 20[xx]

Photo(s) or image(s) area

[date]

Infrastructure Asset Management Tactical Plan

20[xx] – 20[xx]

Version: 2015/[xx]/[xx]

Document reference: [File name]	Utility logo	Utility contacts

Revision #	Date	Author	Approved by:
0	20[xx]/[xx]/[xx]		
1			

The template adopted in this plan resulted from research that received funding from European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement no. 265122.

The publication reflects only the author's views and the European Union is not liable for any use that may be made of the information contained therein.

Original template:

TRUST/AWARE-P_Tactical PlanTemplate

CONTACT:

info@trust-i.net / media@trust-i.net

www.trust-i.net

Integrated planning

This IAM tactical plan is related with the other following planning instruments:

- [TEXT TEXT TEXT TEXT TEXT
- TEXT TEXT TEXT TEXT TEXT
- TEXT TEXT TEXT TEXT TEXT
- TEXT TEXT TEXT TEXT TEXT
- TEXT TEXT TEXT TEXT TEXT]

The following figure synthetises, in graphical form, the dependencies between this plan and other inter-related planning instruments.

Area for the scheme with the global planning structure

List of symbols

List of acronyms

Table of contents

Table of figures

Table of tables

1. Executive summary

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

1.1. Content

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]
This plan is also accompanied by the following supporting documentation:

• Detailed Analysis Document for the [TEXT TEXT] system sector(s).

1.2. Plan scope and horizon

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

Table 1.1 – Temporal horizons for the IAM Tactical Plan

Horizon	Characterization
Planning horizon	Duration: [x] years
	Application: from 20[xx]/[xx]/[xx] to 20[xx]/[xx]/[xx] (ano/mês/dia)
Analysis horizons (considered range)	Infrastructural tactics: from [x] years to [x] years
	Operations and maintenance tactics: from [x] years to [x] years
	Other non-infrastructural tactics: from [x] years to [x] years

1.3. Strategic assessment system and defined strategies

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT].

This information comes from the utility's Strategic Plan.

Table 1.2– Strategic assessment system

Objectives	Criteria	Metrics	Library (code)	Reference values		
				Class 1	Class 2	Class 3
Objective 1	Criterion 1.1	Metric # designation (units)	[text]	[range]	[range]	[range]
		Metric # designation (units)	[text]	[range]	[range]	[range]
		Metric # designation (units)	[text]	[range]	[range]	[range]
	Criterion 1.#	Metric # (units)	[text]	[range]	[range]	[range]
		Metric # (units)	[text]	[range]	[range]	[range]
[…]	[…]	[…]	[…]	[…]	[…]	[…]

Table 1.3– Strategies defined in the Strategic Plan

[Strategy designation]
Strategy description: [TEXT]
[Strategy designation]
Strategy description: [TEXT]

2. Tactical assessment system

2.1. Tactical objectives

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

Table 2.4– Tactical objectives

Objective 1: [Designation]
Objective description: [TEXT]
Objective 2: [Designation]
Objective description: [TEXT]

2.2. Assessment criteria

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

Table 2.5–Assessment criteria

Tactical objectives	Assessment criteria
Objective 1 [**Designation**]	Criterion 1.1 [Criterion description]
	Criterion 1.2 [Criterion description]
Objective 2 [**Designation**]	Criterion 2.1 [Criterion description]
	Criterion 2.2 [Criterion description]
	Criterion 2.3 [Criterion description]

2.3. Assessment metrics, reference values and targets

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

Table 2.6– Tactical assessment system

Objectives	Criteria	Metrics	Library (code)	Reference values		
				Class 1	Class 2	Class 3
Objective 1	Criterion 1.1	Metric # designation (units)	[text]	[range]	[range]	[range]
		Metric # designation (units)	[text]	[range]	[range]	[range]
		Metric # designation (units)	[text]	[range]	[range]	[range]
	Criterion 1.#	Metric # (units)	[text]	[range]	[range]	[range]
		Metric # (units)	[text]	[range]	[range]	[range]
[...]	[...]	[...]	[...]	[...]	[...]	[...]

3. Scenario identification

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

Table 3.7 - Identified scenarios

Scenario 1 - [baseline asssement]
scenario description [TEXT] [TEXT]
Scenario # [TEXT]
scenario description: [TEXT]
[...]
[...]

4. Diagnosis

4.1. Global diagnosis

4.1.1. Available information

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

4.1.2. Global system assessment

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

Table 4.8 – Base line assessment of [global system designation] in 20[xx]

	Metric result	**Assessment *Plan* AWARE-P**	**Comments**
Criterion 1.1			
Metric (units)	[value]	[chose an icon]	[text]
[…]	[…]	[🟢🟡🔴]	[text]
Criterion 1.#			
[…]	[…]	[🟢🟡🔴]	[text]
Criterion 2.1			
Metric (units)	[value]	[chose an icon]	[text]
[…]	[…]	[🟢🟡🔴]	[text]
Criterion #.#			
[…]	[…]	[🟢🟡🔴]	[text]

Table 4.9 – Targets for [global system designation]

Objectives	Criteria	Metrics	Metric result	Target	
			t0	t…	tN
Objective 1	Criterion 1.1	Métric # (units)	[value]	[value]	[value]
		Métric # (units)	[value]	[value]	[value]
		Métric # (units)	[value]	[value]	[value]
	Criterion 1.#	Métric # (units)	[value]	[value]	[value]
		Metric # (units)	[value]	[value]	[value]
[…]	[…]	[…]	[…]	[…]	[…]

4.2. Sectorial diagnosis

4.2.1. System sectors definition

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

Table 4.10 – System sectors of the [system designation]

System sector1: [designation]
Brief description: [text]
System sector #: [designation]
Brief description: [text]
[...]
[...]

4.2.2. Sectorial system assessment

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

Table 4.11 – Baseline assessment for the system sector [system sector designation] in (20[xx])

System sector 1	**Metric result**	***Plan* AWARE-P results**	**Assessment**
Criterion 1.1			
Metric (units)	[value]	[chose an icon]	[text]
[...]	[...]	[🟢🟡🔴]	[text]
Criterion 1.#			
[...]	[...]	[🟢🟡🔴]	[text]
Criterion 2.1			
Metric (units)	[value]	[chose an icon]	[text]
[...]	[...]	[🟢🟡🔴]	[text]
Criterion #.#			
[...]	[...]	[🟢🟡🔴]	[text]

(Note: repeat for each system sector)

4.2.3. Ranking of the system sectors per intervention priority

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

Table 4.12 – Ranking for a baseline assessment of the statu quo scenario in (20[xx])

	Criterion 1.1 Metric (units)	**Criterion 1.#** Metric (units)	**Criterion #.#** Metric (units)	**Global value for the system sector**	**Statu quo Ranking**
System sector 1: [designation]	[value]	[value]	[value]	[value]	[value]
System sector #: [designation]	[value]	[value]	[value]	[value]	[value]
[…]	[…]	[…]	[…]	[…]	[…]

Table 4.13 –Statu quo ranking in future time steps, priority changes and corrected ranking (if applicable)

System sector	**Statu quo Ranking for future time steps**	Priority change due to scenario	Scenario identification	Priority change due to internal context changes	Internal context change identification	Priority change due to external context changes in the sector	External context change identification	Overall priority change	**Corrected ranking**
Sector 1 [designation]	**[value]**	[✓/×]	[text]	[✓/×]	[text]	[✓/×]	[text]	**[↗/→/↘]**	**[value]**
Sector 2 [designation]	**[value]**	[✓/×]	[text]	[✓/×]	[text]	[✓/×]	[text]	**[↗/→/↘]**	**[value]**
[…]	**[…]**	[…]	[…]	[…]	[…]	[…]	[…]	**[…]**	**[…]**

5. Infrastructure asset management tactics

5.1. Non-Infrastructural tactics

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

Table 5.14 – Non-Infrastructural tactics

Tactic identification	Scope[global/ system sector #]	Description	Investment	Associated tactical objective	Priority	Intervention period [beginning / end]
Tni01	[text]	[text]	[value]	[text]	[value]	[20XX/XX]
Tni0#	[text]	[text]	[value]	[text]	[value]	20XX/XX]
[...]	[...]	[...]	[...]	[...]	[...]	[...]

Table 5.15 – Relevance of the Non-Infrastructural tactics to other management processes

Tactic identification	Description	Information management	Processes and activities management	Financial resources management	Human resources management	Technological resources management	Environmental management	Risk management
Tni01	[tactic desigation]	[✓/×]	[✓/×]	[✓/×]	[✓/×]	[✓/×]	[✓/×]	[✓/×]
Tni0#	[tactic desigation]	[✓/×]	[✓/×]	[✓/×]	[✓/×]	[✓/×]	[✓/×]	[✓/×]
[...]	[...]	[...]	[...]	[...]	[...]	[...]	[...]	[...]

5.2. Operation and maintenance tactics

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

Table 5.16 – Operations and maintenance tactics

Tactic identification	Scope[global/ system sector #]	Descriptiom	Investment	Associated tactical objective	Priority	Intervention period [beginning / end]
Tom01	[text]	[text]	[value]	[text]	[value]	[20XX/XX]
Tom0#	[text]	[text]	[value]	[text]	[value]	20XX/XX]
[…]	[…]	[…]	[…]	[…]	[…]	[…]

5.3. Infrastructural tactics

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

Table 5.17 –Infrastructural tactics

Tactic identification	Scope[global/ system sector #]	Descriptiom	Investment	Associated tactical objective	Priority	Intervention period [beginning / end]
Tif01	[text]	[text]	[value]	[text]	[value]	[20XX/XX]
Tif0#	[text]	[text]	[value]	[text]	[value]	[20XX/XX]
[…]	[…]	[…]	[…]	[…]	[…]	[…]

5.4. Alignment between Strategies and Tactics

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

Table 5.18 – Alignment between Strategies and Tactics

Strategies	**Tactics**
Strategy ## [desigation]	Tni##: [tactic desigation]
	[…]
	Tom##: [tactic desigation]
	[…]
	Tif##: [tactic desigation]
	[…]
Strategy ## [desigation]	Tni##: [tactic desigation]
	[…]
	Tom##: [tactic desigation]
	[…]
	Tif##: [tactic desigation]
	[…]
[…]	[…]

6. Resources needed for the IAM Plan implementation

6.1. Human resources

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

Table 6.19 – Human resources needed for the IAM Plan implementation

Tactic	Resources	[t1]	[t2]	...	[tN]
[tactic desigation]	[text]	[value]	[value]		[value]
[tactic desigation]	[text]	[value]	[value]		[value]
[...]	[...]	[...]	[...]		[...]

6.2. Technological resources

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

Table 6.20 –Technological resources needed for the IAM Plan implementation

Tactic	Resources	[t1]	[t2]	...	[tN]
[tactic desigation]	[text]	[value]	[value]		[value]
[tactic desigation]	[text]	[value]	[value]		[value]
[...]	[...]	[...]	[...]		[...]

6.3. Financial resources

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

Table 6.21 – Financial resources needed for the IAM Plan implementation

Tactic	**Resources**	**[t1]**	**[t2]**	**…**	**[tN]**
[tactic desigation]	[text]	[value]	[value]		[value]
[tactic desigation]	[text]	[value]	[value]		[value]
[…]	[…]	[…]	[…]		[…]

7. Monitoring and revision of the IAM Tactical Plan

7.1. Monitoring procedure

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

7.2. Revision procedure

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

7.3. Non-conformity procedure

[TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT TEXT]

8. References

9. Apendices

A.1 Document version control

Table A.1.1 – Document control

Version #	Date	Main changes	Person in charge
1			
2			

A.2 Basis for the diagnosis of the current situation

Table A.2.1 – External global context

Table A.2.2 – External specific context

Table A.2.3 – Internal context

A.3 Basis for monitoring and revision of the IAM Tactical Plan

Table A.3.1 – Assessment of the current performance

Metrics	Targets (t)	Results (t)	Comment
Metric ## (units)	[value]	[value]	[text]
Metric ## (units)	[value]	[value]	[text]

Table A.3.2 – Tactical Plan revisions

Revision #	Date	Main changes	Person in charge	Approved by:
0				
1				
…				

D53.1c / MANUAL 4
Tactical planning of urban water services at utility level

The research leading to these results has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 265122.