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INTEGRATED ASSET MANAG

The main focus for a professional rehabilitation planning should be customer supply with high quality, safety and reliability. Hence, basic information from asset service like water loss management, cathodic corrosion protection or net analysis, data processing and the analysis and evaluation of the data are necessary. The presented RBS wave supply system management model realizes an efficient integrated asset management strategy for daily use.

Um eine professionelle Instandhaltungsplanung zu betreiben, sind Versorgungssicherheit, -qualität und -zuverlässigkeit die Hauptkriterien, die es zu betrachten gilt. Informationen aus dem täglichen Betrieb, wie Wasserverlustmanagement, Kathodischer Korrosionsschutz (KKS), Netzberechnung, die zugehörige Datenverarbeitung sowie die Auswertung und Bewertung der Daten bilden dazu die Grundlage. Mit dem hier vorgestellten RBS wave-Netzmanagement wird ein Modell beschrieben, wie diese Thematik in der Praxis optimiert umgesetzt werden kann.

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EMENT

According to national standards, water utilities have to guarantee the supply of water to their consumers in appropriate quality, quantity and pressure. Therefore, combining of information about net service, net condition and additional assets is the basis for developing a customized strategic asset management (SAM) and derivate an operative asset management (OAM).

Integrated Asset Management

Supply guarantee, supply quality and the reliability of supply are the milestones of a professional asset management. Periodic or condition based inspection, information from monitoring systems and the documentation of occurred failure and realised rehabilitation are the basis for developing a state-of-the-art strategy. The combination of the experience of the on-site operational staff and the „theoretical" available data is essential. A possible realisation of an integrated asset management for water supply systems is pictured in **Figure 1**. The five fields are explained in the following chapters.

Analysis-Management

Supply interruptions and collateral damage, especially those caused by pipe breaks, should be as low as possible. In some cases the buried water supply system is more than 100 years old but is still in use. Different external and internal loads have an influence on the ageing process. A direct inspection is in the majority impossible, therefore indirect methods are necessary for describing the actual condition for derivate a need for rehabilitation.

Hydraulic analysis

The actual hydraulic performance can be analysed by a hydraulic net-evaluation for several loading cases. A calculation of a defined hydraulic load case (night flow, fire fighting...) calibrated by on-site measurements will lead to significant statements to closed or semi-closed valves, sufficient supply pressure or hygienic problems according to raised hydraulic residence time.

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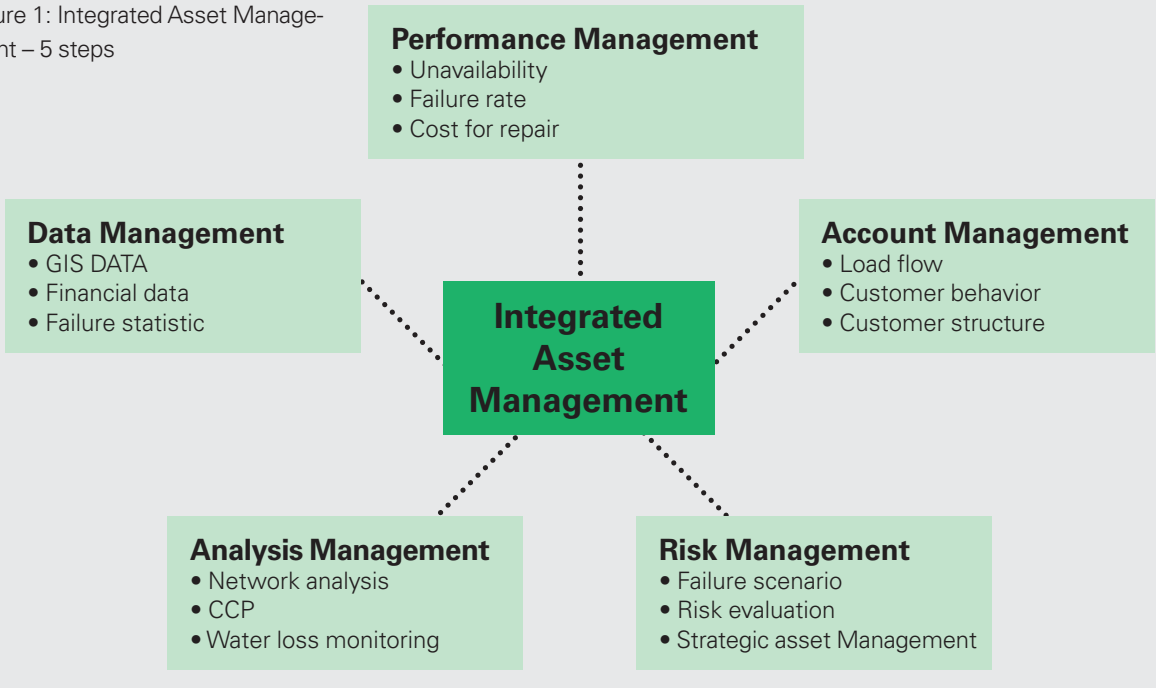
Water loss monitoring

The monitoring of a water supply system can be realised by highly accurate flow meters which are positioned at hydraulically relevant positions (pipes) over the distribution system to meter conspicuous changes in the flow velocity **(Fig. 2)**. If one conspicuous change is stable for more than two or three days (nights), the change is caused by a leakage and not by customers' water consumption. The changed flow velocity is metered by the installed measuring instruments regarding to their hydraulic position (closeness) to the leakage. With the strategic position of the sensors in the network, virtual district metered areas (DMAs) are

Figure 1: Integrated Asset Management – 5 steps



Source: [1]

introduced between the sensors **(Fig. 3)**. Analysis of the influenced meter spread over the distribution system results in a first rough estimation of the localisation of the leak [2]. Hence the leakage can be quantified and localised by the operational staff.(Fig. 3)

Cathodic corrosion protection

For metallic materials of water or gas pipes, a condition based analysis of the pipeline is possible by using a cathodic corrosion protection (ccp). Periodically measured ccp-values reflect the condition of the coating and also the effectiveness of the ccp in all major defective zones [3]. Additional statements to critical external stray current or a. c. voltage is possible.

Experience of the last ten years with ccp-remote monitoring system show a significant upgrade in the quality of describing the technical condition of a pipeline. Seasonable fluctuation at measuring points can cause potentials to fall below reference values during some periods [1].

A remote monitoring system provides at least one measuring value a day. In this respect, a condition based evaluation is possible when we compare the current value of a sensor to its past value (reference value) or when we correlate a sensor's value to the value of sensors that belong to other measuring points.

Data-Management

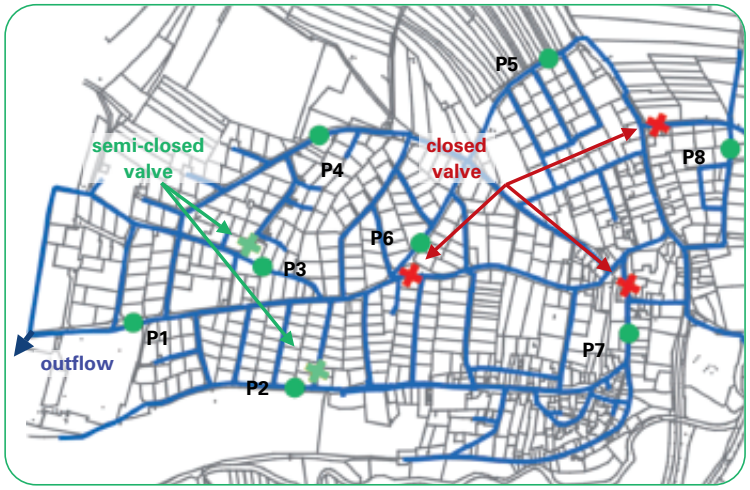
The basis for an integrated asset management is the combination of available data from the analysis management and the experience of the operational staff. It is important to link those results provided by monitoring systems for water loss and cathodic corrosion protection as well as results of hydraulic analysis and financial data to their geographic position. Leading software systems for this purpose are geographical information systems (GIS).

Accounting-Management

For water supply utilities water loss is a main benchmark that reflects the quality of a grid. The data basis which is used for the calculation of a water loss balance inflow and outflow has to be highly accurate. As a result, it is possible to quantify water loss. Knowing these values, several methods for changing the actual situation can be taken into consideration. These methods can be very expensive and should be discussed in detail before they are possibly realized. In this regard, it is important to know if the measured date from the flow meters and the data about the customers use are accurate or not. The German standard provides further essential information [4].

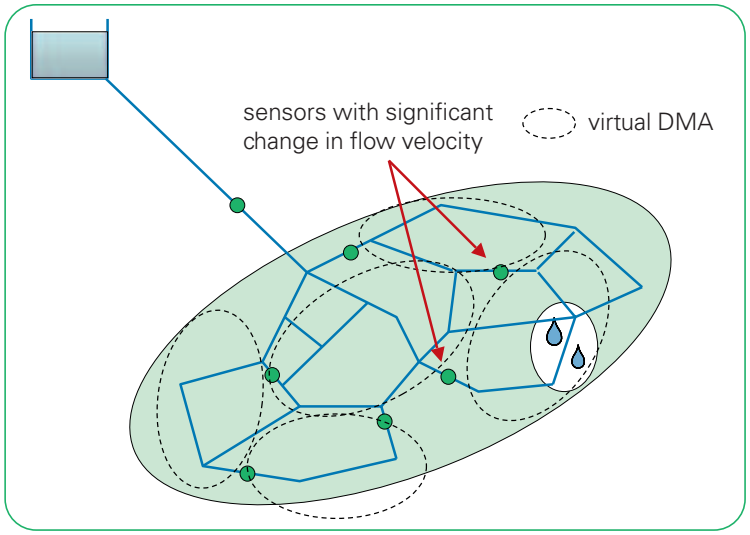
Performance Management

In order to develop a foresighted strategy for a water supply utility, it is necessary to discuss the actual condition of the distribution system. Furthermore, utilities need to define performance indicators. These performance indicators can be calculated using the information of analysis-, data- and



Source: RBS wave GmbH

Figure 2: Result of a hydraulic analysis



Source: [2]

Figure 3: Leakage in a virtual DMA

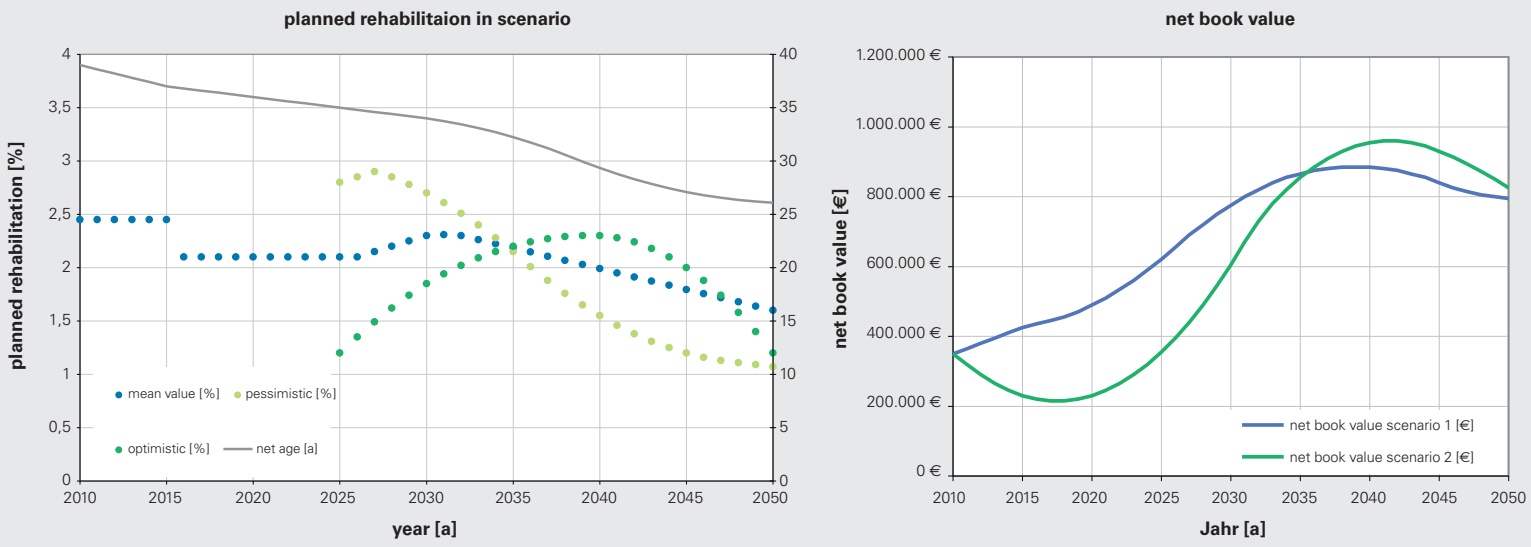
accounting management. For water supply utilities, the German standard DVGW has defined performance indicators for the annual failure rate [5] or a specific water loss rate [4].

The strategic asset management needs to combine all technical and economical performance indicators in order to decide on an optimal utility specific approach.

Risk-Management

The ongoing deterioration of the net, the change of the net condition caused by several influencing factors has to be merged and evaluated in a risk management. The utility specific performance indicators and possible acceptable condition has to be taken into consideration. The comparison with standard performance indicators like the failure rate listed in [6] may help to get a feeling of the own position compared to the position of others. Nevertheless an aging function should reflect the own situation. Thus it is evident that it needs to be calibrated.

In order to calculate a water supply system's future need for rehabilitation, it is necessary to comprise today the ongoing deterioration of materials by a raising failure pro-



Source: RBS wave GmbH

Figure 4: Planned scenario with related net book value

bability. This approach is well-grounded in several corresponding studies for the sectors water [5], gas [6] or electricity [7]. To describe this deterioration process, some well-known theoretical probability distribution functions can be fitted to the recorded failure data by statistical analysis. Hence, a failure or risk probability for each defined pipe group depending on the ongoing age can be calculated.

Implementation of the Integrated Asset Management Approach

A strategic asset management concept is based on ageing functions that are well fitted to water utility's own failure logs. An appropriate strategy can be found for different scenarios, when equipment belong to pipe groups and when it is known how many segments are going to fail with increasing age **(Fig. 4)**. The strategy should regard economical aspects (e. g. grid's changing value), technical aspects (e. g. changing equipment's mean age) or risk aspects like grid's availability and failure rate. [8] provides several fitting methods for aging functions.

Operational Asset Management

The operational asset management's mission is to define medium-term rehabilitation requirements based on long-term ones. Furthermore, it defines maintenance tasks [5, 6, 7]. Pipes belong to groups with a certain demand of rehabilitation. The demand of rehabilitation should then be allocated to pipe segments. The corresponding guideline provides a list of criteria [5] and also a related evaluation method in order to prioritize pipe segments. For mid-term rehabilitation and maintenance planning, further internal and external criteria have to be considered. These criteria require company specific and local knowledge.

The failure rate of each segment or line of the urban water supply system is an important rehabilitation criterion that determines where maintenance should take place. Further rehabilitation criteria result from analysis management. It is self-evident that the performance management need to rate those rehabilitation criteria according to their relevance.

At this point, recorded failures, results from network calculations, results from inspections and results from cathodic corrosion protection are brought together in order to segregate segments that need urgently be replaced.

In addition to the mentioned criteria above, we should also incorporate external factors. The Swiss guideline [9] for example expresses these factors by a pipeline index, by an environment index and by a supplementary index. These indices take into account if construction areas can be handled jointly or not. Moreover, they can include comparison of cost like for example between corrective and predictive maintenance strategies.

The result of the criteria evaluation gives us the opportunity to define a list of priorities. This list enumerates pipeline segments according to their importance and urgency. When these pipeline segments are finally visualized by GIS **(Fig. 5)**, it should be possible to plan constructing areas efficiently. Figure 5 summarised the rehabilitation priorities connected with result from hydraulic analysis for zones with high pressure and pipe incrustation.

Conclusion

As seen from the practise, public utilities provide lots of information; but this information isn't evaluated on a stretch. It should be the aim of an asset manager to associate this information in a database (like a GIS) and evaluated them by asset management software (e. g. PiReM). As a result he has a solid fundament for further decisions.

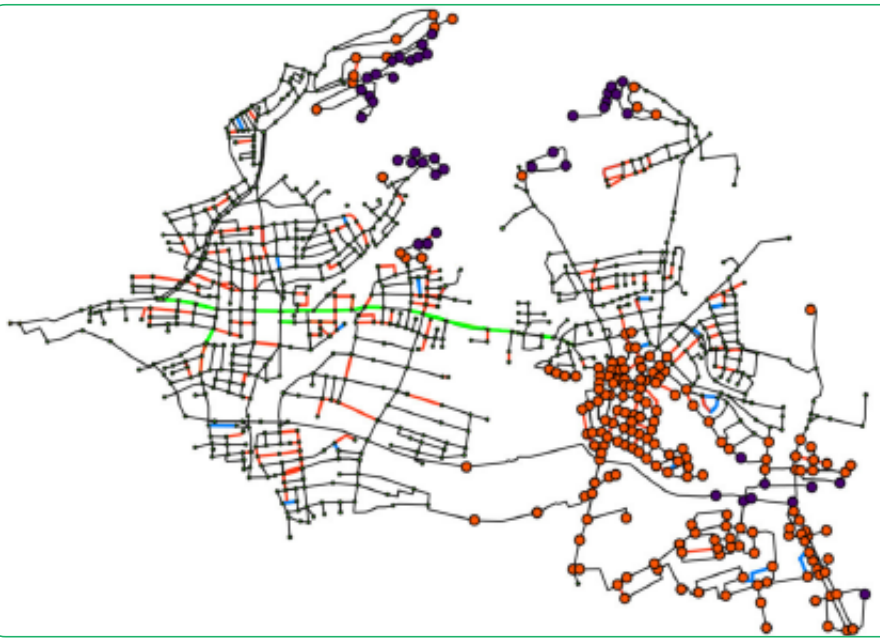


Figure 5: Summary of aspects for a rehabilitation-strategy of a water supply district

Source: [10]

The RBS wave water supply management presented in this paper understands the strategic and operative asset management as a cluster of five important management departments.

Through a clever combination of those management compartments a water supply utility can efficiently utilize company's know how from daily operation and strategic planning in order to compete successfully during the daily economic competition.

Literature:

[1] Gangl, G., Deiss, R. (2010), Netzmanagement in der Praxis, 3R international (49) Heft 3/2010

[2] Kober, E; Gangl, G. (2009) New Monitoring Methodology for Water Distribution Systems, IWA Conference Water Loss 2009, Cape Town

[3] DIN EN 12954 (2001) Cathodic protection of buried or immersed metallic structures. General principles and application for pipelines

[4] DVGW W 392 (2003) Pipe network inspection and water loss – measures, procedures and evaluation, www.dvgw.de

[5] DVGW W 401 (1997) assistance fort he rehabilitation of water distribution systems, www.dvgw.de

[6] DVGW G 401 (2009) Erfassung und Auswertung von Daten zum Aufbau von Instandhaltungsstrategien für Gasverteilungsnetze, www.dvgw.de

[7] FGH (2006) Asset-Management von Verteilungsnetzen – Komponentenverhalten und Analyse des Kostenrisikos, www.fgh-ma.de

[8] Gangl G. (2008) Rehabilitationsplanung von Trinkwassernetzen, Schriftenreihe zur Wasserwirtschaft, Band 53, Graz University of Technology, ISBN 978-3-85125-007-7

[9] SVGW G 1001d (2004) Sicherheitsbeurteilung von Erdgasleitungen mit Betriebsdruck 1 bis 5 bar, www.svgw.ch

[10] Gangl, G. (2010) Operatives Asset Management am Beispiel der Wasserversorgung Stuttgart, Vortragsreihe der Fakultät für Bauingenieurwissenschaften der TU Graz, Graz 25.03.2010

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