Decision Matrix for Rehabilitation Needs and Pipe Materials in Water and Gas Supply Systems (Sector C)

The development of the condition of pipeline networks is very strongly dependent on the pipeline materials that are used and their characteristic ageing. An important indicator for this is an increasing amount of damage that has a negative effect on sustainable network operations. The increasing cost pressure arising from liberalisation and privatisation on one hand, and tight public budgets on the other side in the western and eastern countries of Europe dictate the general conditions for the operation of supply and removal networks. The requirement for higher supply security and a reasonable risk of damages is confronted by limited budgets both for maintenance, inspection and repairs as well as for long-term renewal measures. In this situation, choosing the right pipeline materials is extremely important. In the process, the operator's attention should not be on short-term savings potential; rather, interest should be on permanent, economical solutions for improving the condition of the network. A low-cost investment can have unforeseeable consequences under circumstances.

This situation was the reason that CEOCOR setup a workgroup to investigate this area and to prepare a recommendation for the methodology for selecting pipe materials in general and for selecting pipelines for renewal in the existing pipeline networks.

Since September 2004, 4 sessions were held in Berlin, Innsbruck, Budapest, and Brussels. The participants came from utility companies in Belgrade, Brussels, Budapest, Essen, Innsbruck, Leipzig, and Paris as well as from private companies from Dresden, Hall, Klagenfurt, and Pont-a-Mousson.

The basis was the existing statistics from DVGW (German Association for the Gas and Water Sector), which has managed the inventory and condition of existing water supplies for many years.

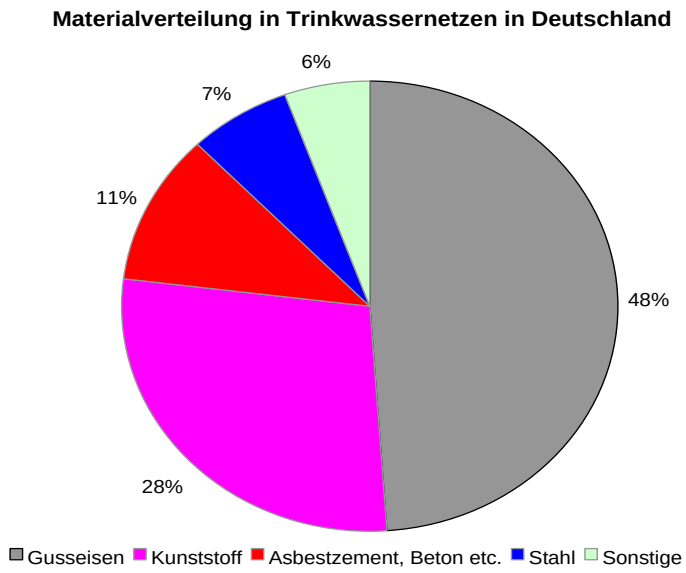

Figure 1: Material distribution in potable water distribution in Germany

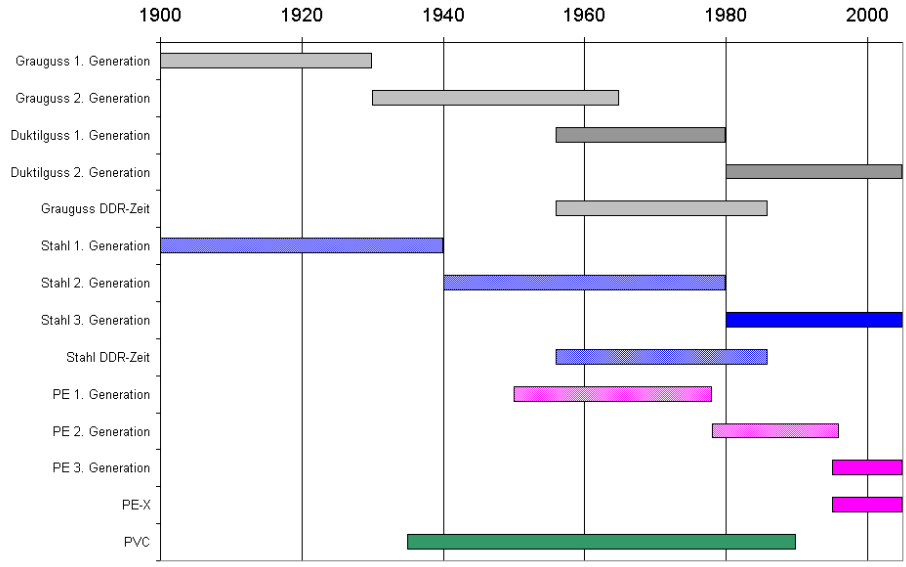

Figure 2: Installation periods of pipe materials in the potable water sector

	1997	1998	1999
Ductile iron	7	7	6
PE	11	12	12
PVC	5	5	5
Steel	31	29	33

Figure 3: Excerpt form the DVGW damage statistics for water [damages per 100 km and per year]

It was established that for all decisions for the rehabilitation of lines in utility companies, a high level of information is required about the inventory and the condition of the line networks.

The following data is required for the inventory:

material, nominal size, year of installation or installation period.

For the assessment of the condition, the following data is necessary:

material, nominal size, year of installation or installation period (in correlation to the inventory data), damaged part, type of damage, damage or repair date.

With the inventory and condition data, analyses were subsequently performed to establish the service life of the built-in pipe materials.

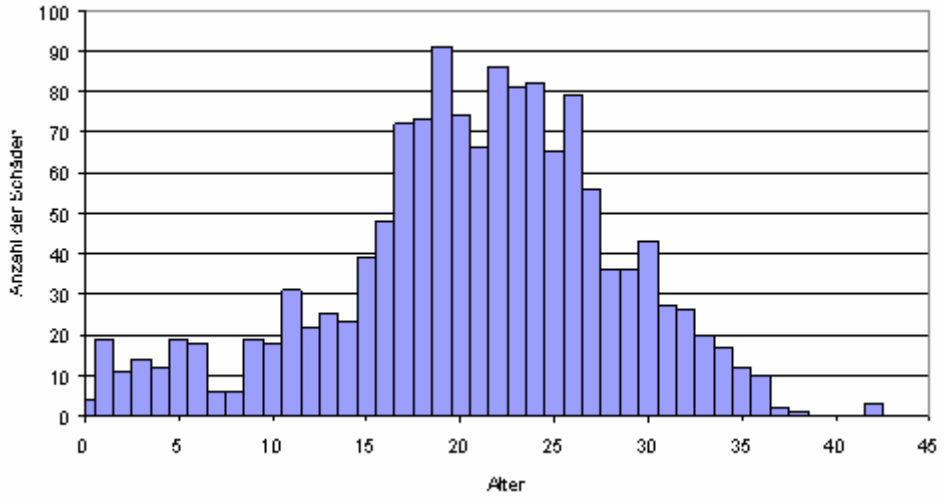

Figure 4: Amount of damage to a pipeline group according to age classes

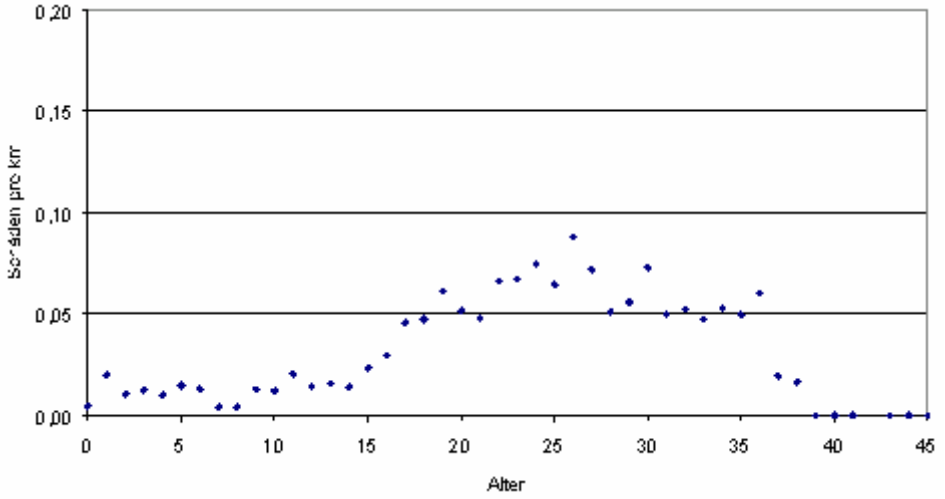

Figure 5: Associated damage rate of a pipeline group according to age classes

This comparison shows that a statement about the amount of damage to a material group can only be conditionally used as a parameter. Establishing the specific damage rate (damage per km) is the important and comparative parameter.
Furthermore, the age of the lines was given as a reference parameter, independent of when the line was installed.

With these parameters, the service life of the individual material groups was established, which is used as the basis for the survival time period.
A rehabilitation strategy was developed in a pilot project for a supply network with a 111 km length of pipeline and 241 house connections.

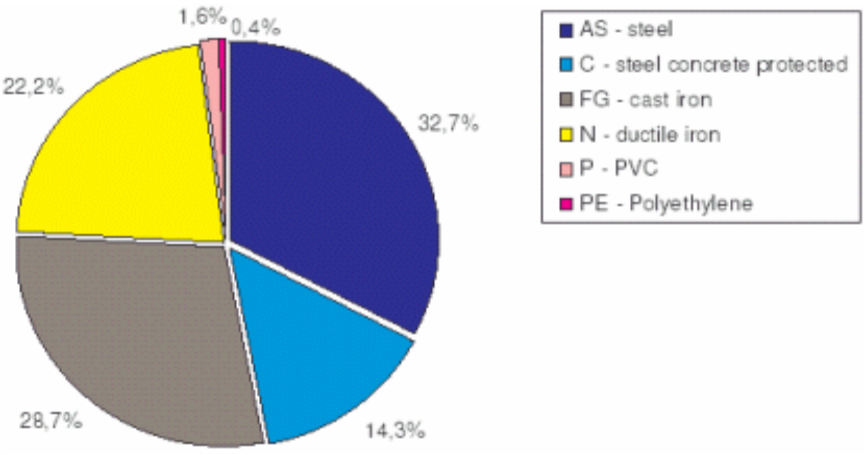

Figure 6: Material proportions of the pipelines in the pilot project

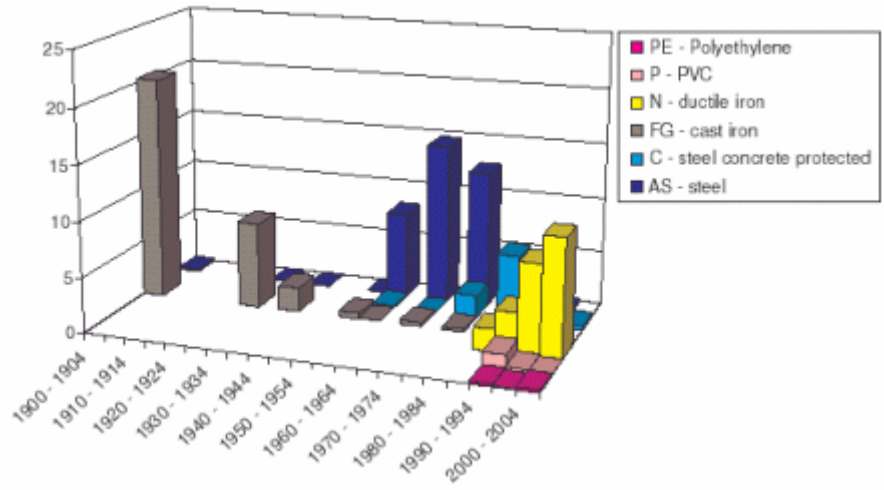

Figure 7: Material distribution of the pipelines in the pilot project

	No. of interventions	Gross rate	Net rate	Ratio	Average age
FG	50	0.30	0.79	2.6	93.2
N	6	0.05	0.42	8.9	8.3
AS	19	0.10	0.31	3.0	37.4
C	4	0.05	0.39	7.9	18.7
PE	*1*	*0.56*	*7.62*	*13.6*	7.4
P	3	0.36	0.70	2.0	12.7
total	83	0.16	0.57	3.68	43.8

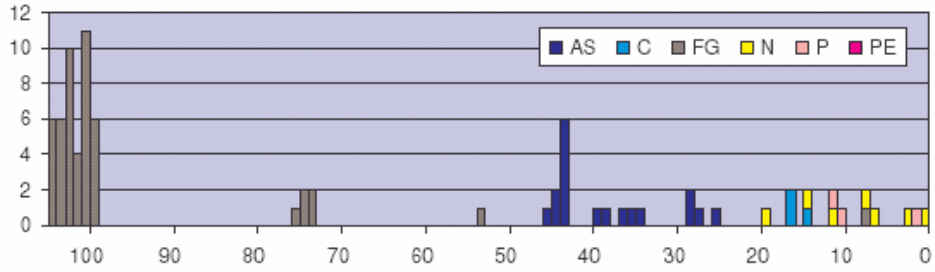

Figure 8: Average rate of damage and average pipeline age in the pilot project

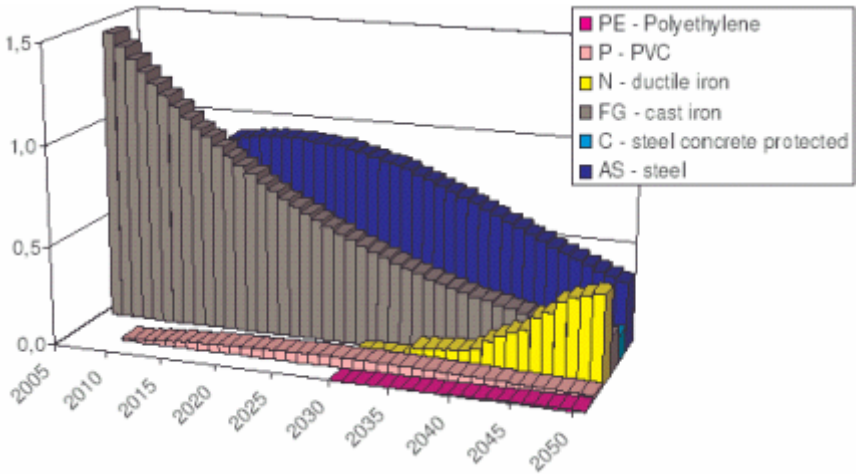

Figure 9: Established pipeline lengths for the rehabilitation in the pilot project

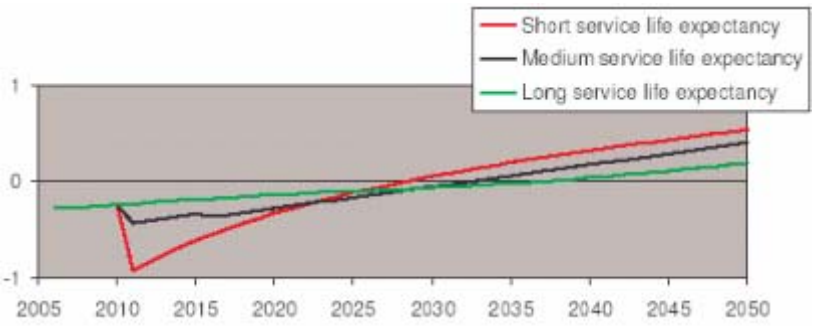

Figure 10: Established cost-benefit calculation for the pilot project in accordance with the established strategy.

The benefits of the investment for the renewal appear approximately in the year 2030.

Evaluation criteria for the rehabilitation decision for supply lines.

Public commission for supply:	Number of faults
	Supply quality
Economical operations management:	Operating costs
	Costs for maintenance and repair

A decision matrix was developed from these evaluation criteria, which is an aid for the decision-making process.

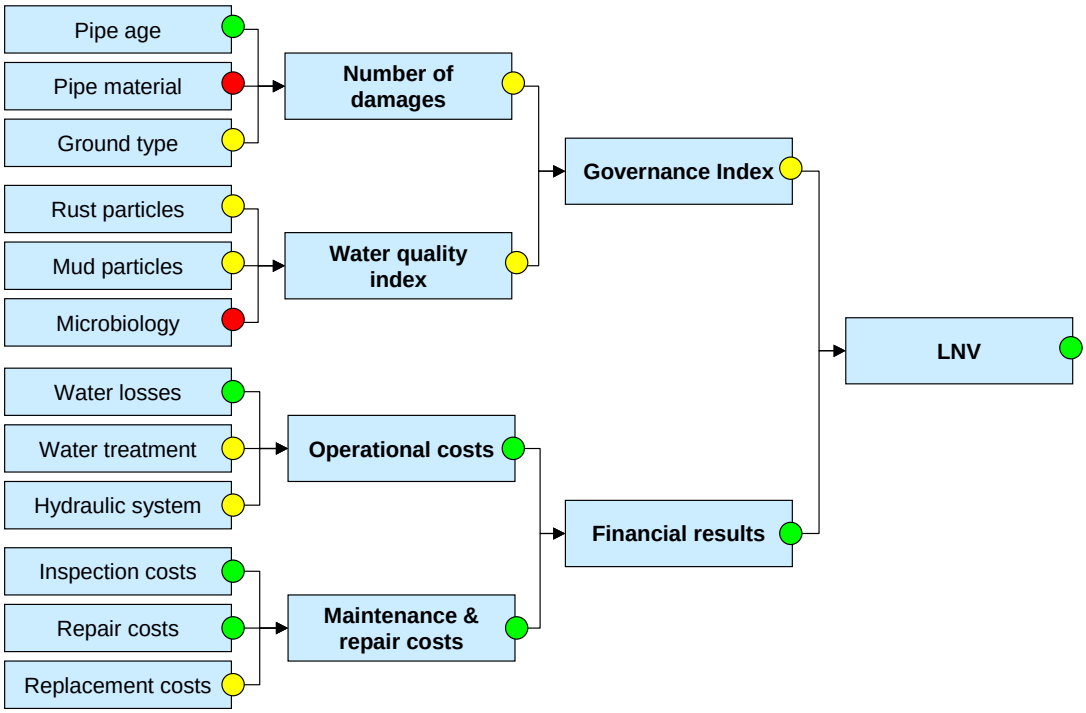

Figure 11: Strategic decision matrix for establishing the investments on the basis of characteristic values

To establish the decision for the renewal of lines, a table with characteristic values was developed that the user can use to interpret local problems. In addition, a position catalogue was developed which permits 40 criteria so far, which are compiled into groups. These groups are taken into consideration in the decision matrix.

The analysis of the individual criteria is assessed with points and multiplied by factors. Consequently, the result shows the weighting of the individual groups and permits individual decisions based on the local conditions.

Influences on the pipeline materials:

1. Type of the underground
2. Aggressiviness of the underground
3. Coating of the pipe inside and outside
4. Pressure level of the medium
5. Resistence against damages
6. Maintanance procedures
7. Cost for the pipes and store management
8. Service life time of the material
9. Necessary quality of construction
10. Available fittings and accessoires
11. Available repair materials
12. Existing pipe materials in the network
13. Influence of the pipe material on the water quality
14. Total costs of the constructed pipe
15. Costs of the pipe material

Figure 12: Table of the influences on the pipeline materials

The workgroup is aiming to submit the result of its work during the course of 2006, or by the beginning of 2007 at the latest. Further efforts will be taken to involve other colleagues in these activities, above all from Southeast Europe.

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