Experiences and Success with a Risk- and Best-Net-oriented Rehabilitation Strategy

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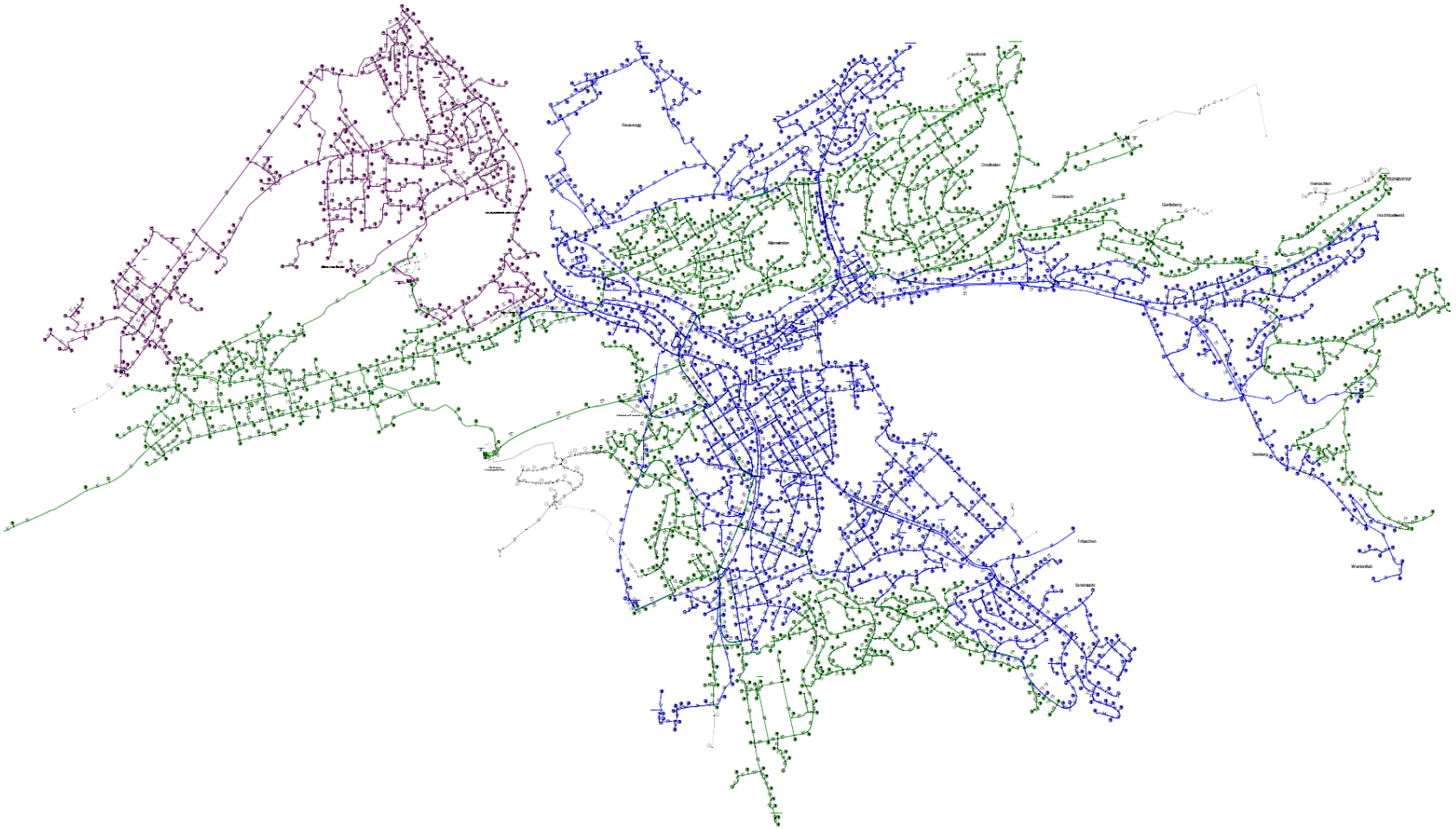
Agenda

1. water works of Lucerne
2. strategy and strategic questions
3. risk-oriented rehabilitation strategy
4. best-net-oriented rehabilitation strategy
5. status of realization the rehabilitation strategy
6. prospect

Water Network of Lucerne



Strategy

To do the right thing

- planned and purposefully maintenance (e.g. leakage detection every year) and systematic renewing of the network
- risk- and best-net-oriented rehabilitation

Strategic Questions

- how much has to be invested in rehabilitation in order to reduce the risk of damages?
- which cost of damages are expected in the next years?
- which line section of the network have to be selected for rehabilitation in order to reduce the risk of damages?
- what is the potential for cost reduction in the network?

Risk-oriented Rehabilitation Strategy

- since **2004** risk-oriented rehabilitation strategy
- development of "manual method" for risk assessment for evidence of the necessary investments
- valuation of risk (damage potential and probabilities)
- 2004 to 2008
  - forced rehabilitation of the gas network
  - postpone forced rehabilitation of water network

Risk-oriented Rehabilitation Strategy

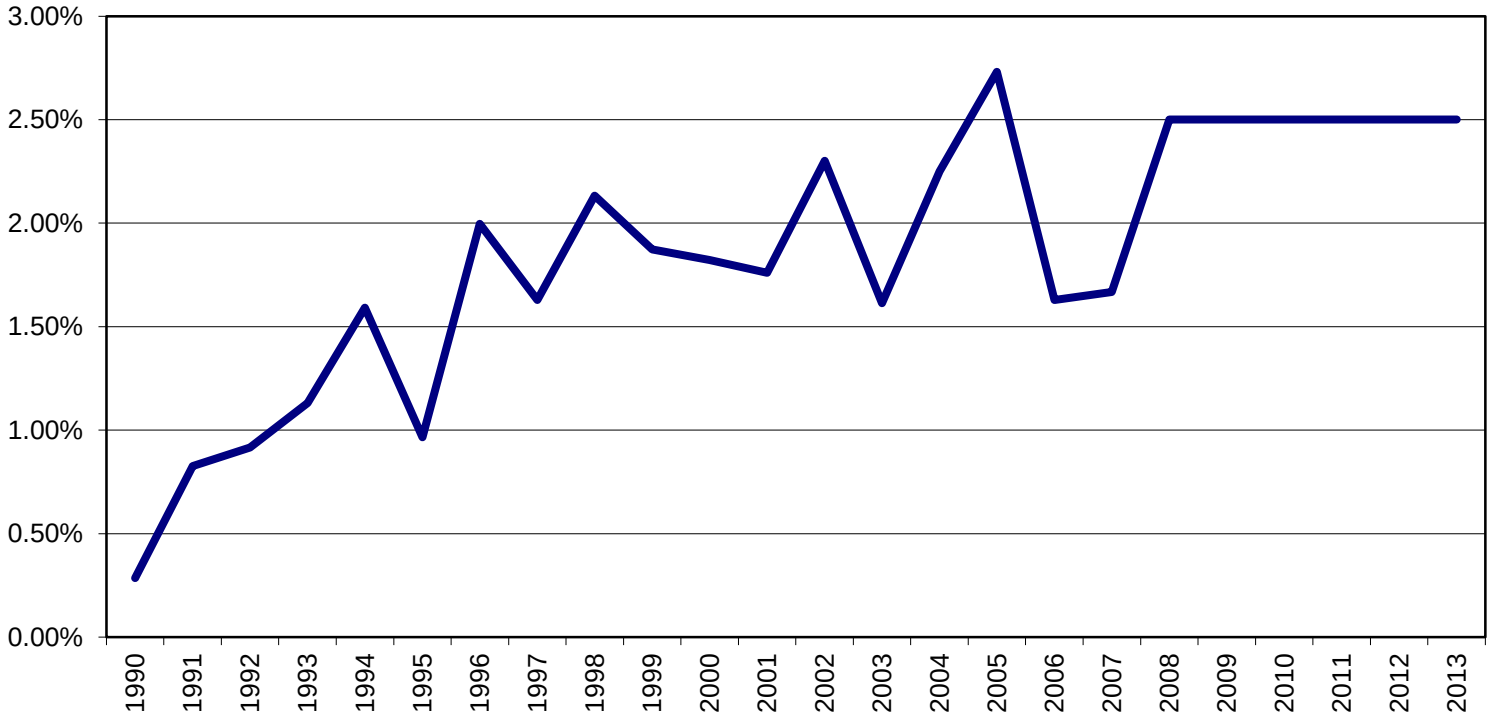
2008 start of forced and risk oriented rehabilitation strategy.

goals:

- drastical reduction of image relevant damages (media, traffic trouble, supply interruption)
- renewal rate 2.5 % and annual investment 4 ÷ 5 Mio. CHF
- from 2020:
  - annual damage cost less than 300’000 CHF/a
  - annual number of damages less than 25 /a

Risk-oriented Rehabilitation Strategy

renewal rate



Risk-oriented Rehabilitation Strategy

2009 introduction of computer aided rehabilitation planning with RIKA (cooperation with the Rechenzentrum für Versorgungsnetze Wehr GmbH, Düsseldorf; based on GIS and simulations).

goals:

- Verification of an sustainable renewal of the network at ewl towards stakeholders (VR, GL, insurance and customers)
- Demonstration the development of risk and damage costs (FKZ)
- Justifying of the necessary budget
- Presentation in the coordination committee of Lucerne to document and present the urgency und needs from the perspective of our company

Risk-oriented Rehabilitation Strategy

method of RIKA

- improved algorithms for the evaluation of the probability of a damage
- Simulation of damages
- calculation for every line section:
  - probability of a damage
  - potential damage cost
  - risk (probability x potential damage cost) in CHF

Risk-oriented Rehabilitation Strategy

- selection of line section to be renewed
  - risk > given level
  - probability > given level
- priorities:
  first reduction of damage cost
  afterwards reduction of defect rate
  (different approach as at DVGW W 403: «accepted defect rate» or IWA with estimation of water loss in the network)
- simulation of the development of risk, probability and cost with different investment strategies

Risk-oriented Rehabilitation Strategy

- Enhanced method for calculating probability of damage
  - Material-dependent damage rate, age, diameter, calibrated to the specific network
  - Corrosion behavior (soil aggressiveness, stray currents)
  - Mechanical stress by ground movements (lakeshore zone, road load, slope / tilt), trees, ground water etc.
  - Analysis of hot-spots of damages (operating experience, suspected pre-damages, installation failures, etc.)

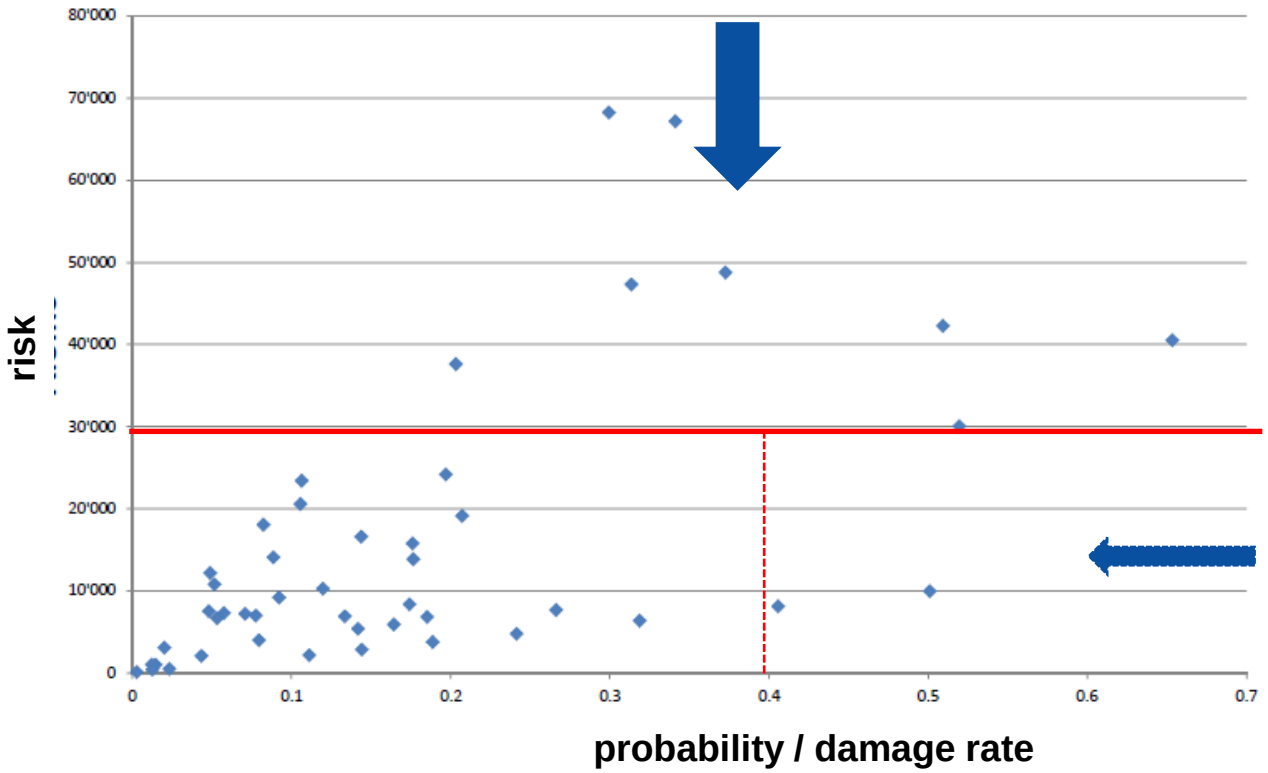
Risk-oriented Rehabilitation Strategy

- Simulation of damage for each line section
  - volume od water discharge taking into account material, diameter, pressure (result of pipe network calculation)
  - affected buildings, consideration of inclination of terrain (with GIS intersection)
- Simulation of follow-up costs
  - repair cost
  - Third-party cost depending on building sensitivity classes
  - Monetized personal injury, image damage (traffic disruption, supply interruption, etc.)

Risk-oriented Rehabilitation Strategy

Method of RIKA: **reduce risk**

Risk is defined as
«damage potential * probability»
or
«damage potential * damage rate»



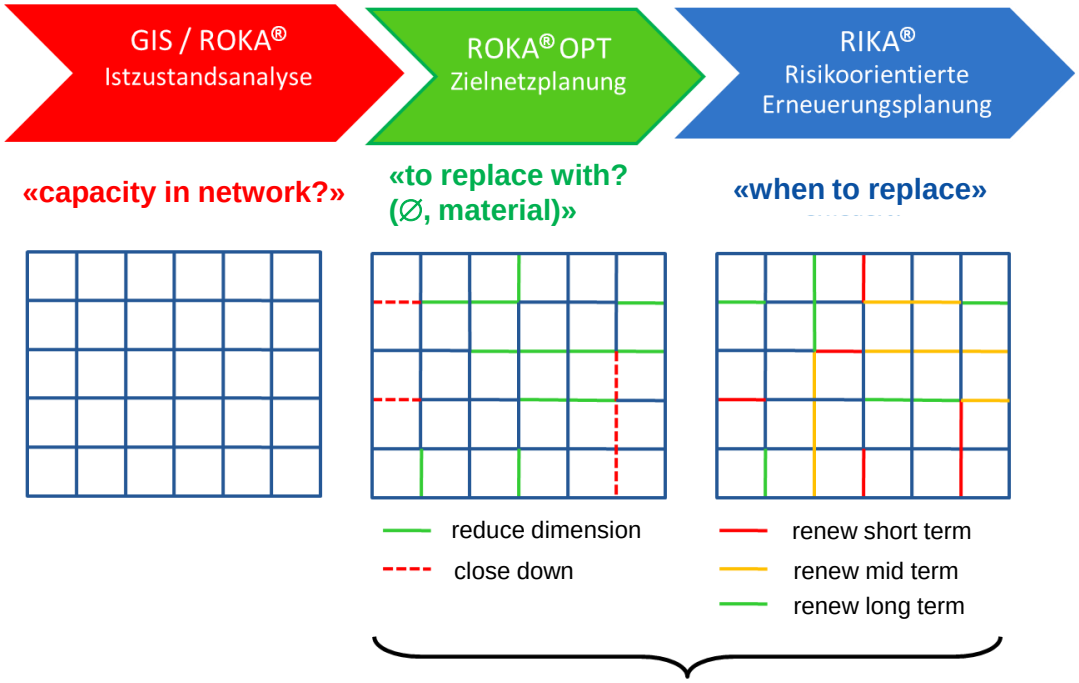
Risk-oriented Rehabilitation Strategy

- **2010** first simulation of network renewal with RIKA
- comparison of results of simulation with planning of operation department
  = high matching
- deviation mainly due to data errors and special environment conditions (e.g. wood pad, slope position)

Best-Net Rehabilitation Strategy

replace line section? If yes, which diameter?

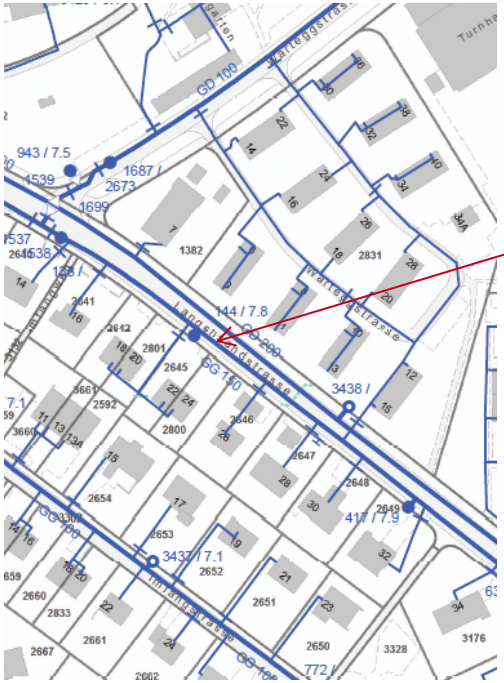
→ Optimization algorithm with defined redundancies and failure scenarios



Effect of Best-Net Calculation: Example 1

actual: 2 parallel line sections diameters DN 200 und DN 150

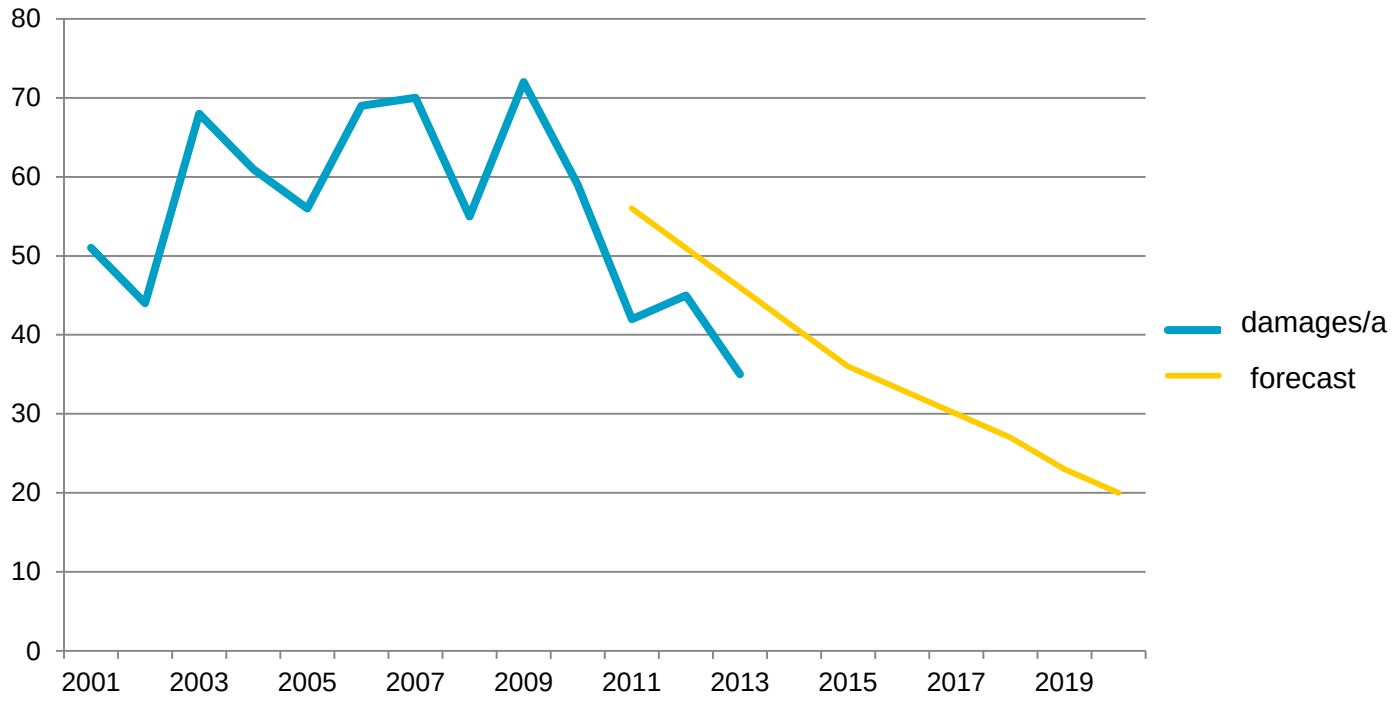
Best-Net: 1 line section DN 200
saving CHF 300’000, lower residence time in mains



Best-Net: DN 200
(actual: DN 200 and DN 150)

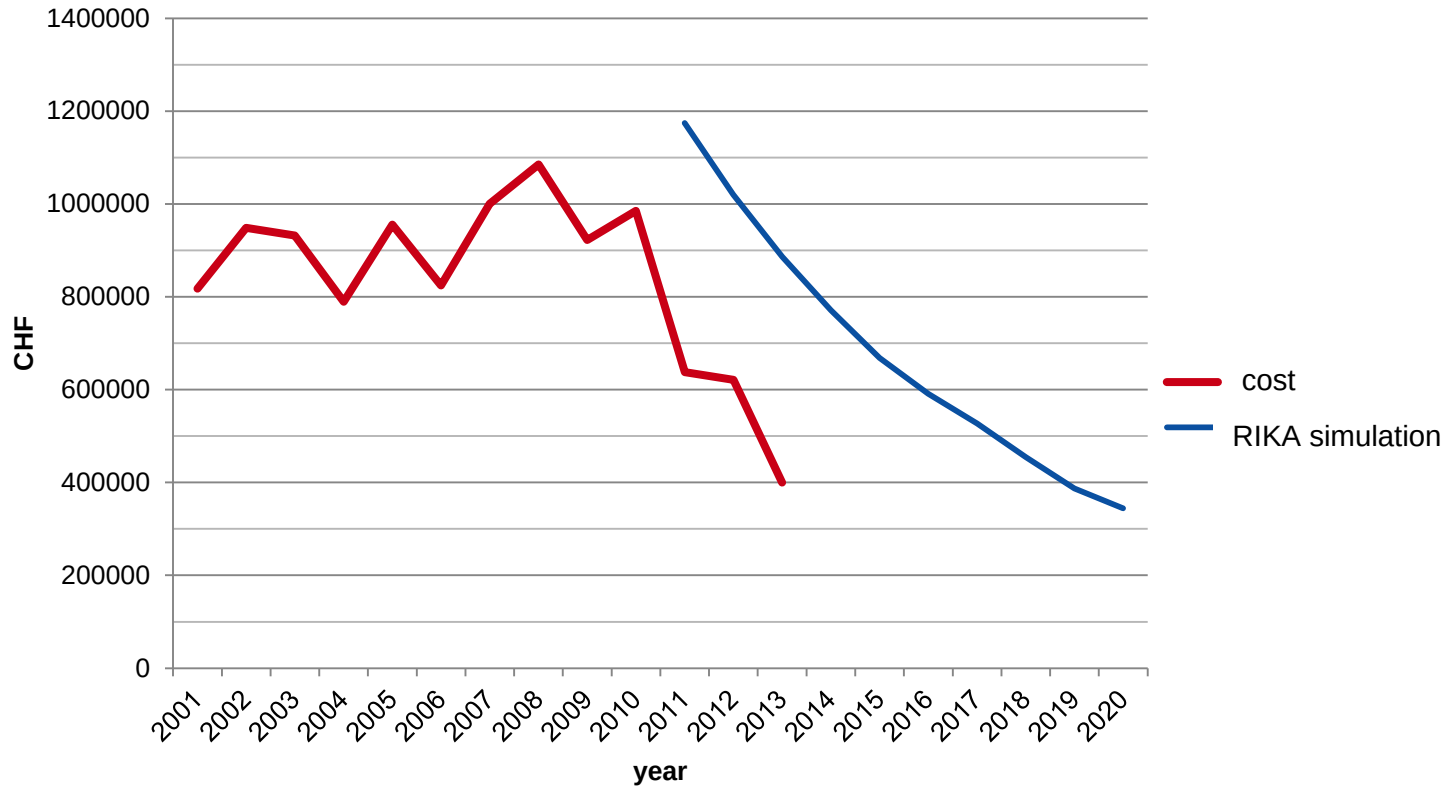
Status of Risk-oriented Rehabilitation

Development of the damages in water network of Lucerne



Status of Risk-oriented Rehabilitation

Development of damage cost of water network of Lucerne



Status of Risk-oriented Rehabilitation

conclusion

- Strategy is effective, damage cost falling strikingly
- no image relevant damages during last two years
- condition of the network clearly improved
- enforced renewal continued during following two years
- after 2016 reduction of orderly renewal rate to 1.25 %
- RIKA and best-net-optimization are established at ewl