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# Urban Database for the Sewer Networks Management

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## Summary

Sewerage systems ageing is a real problem in old-industrialized countries, since the loss of performances with time results in economic and environmental problems. Sewer systems managers try to rationalize the long-term maintenance, but they lack practical tools to handle this problem. This paper shows how it is possible, from data obtained during video-inspections of unvisitable sewers, to build a statistical model of ageing.
Practically, using statistical models, we will show what cost/benefit balance would be expected if they would be used to plan the inspection strategy and the repairing program.

**Keywords**: Unvisitable sewer system, urban database, ageing model, maintenance, ageing factors.

France accounts for a linear of about 150 000 km of urban sewer networks, constituting a patrimony valued at 45 billions Euros. Facing the high maintenance costs to optimize performance functions, the sewer manager must be able to define essential parameters for a good description of the ageing process. Further these economic stakes, technical stakes appear: to increase performance of future networks, to limit environmental risks (pollution) and urban system dysfunction.
Our effort focus on a database development in order to establish a strategy for the study of the ageing process, with has to allow the optimization of sewer system maintenance. The UCB's (Urban Community of Bordeaux) sewer network (diameter < 1200 mm) served as a basis for our research.

Available information are pathologies listings. Pathologies are interpreted in nature terms (crack, break, and collapse...) but also in gravity terms. The binary rating 0/1 is the simplest way to evaluate the section performance; 0 for a virgin pathology section and 1 if at least one pathology has been tacked, whatever it may be.

Ageing model can be written under the form N(t, *Xi*), N being the average mark of the section population, t the section's age and *Xi* describing of parameters vector that conditions the section performance evolution with time:

$$N(t) = N0(Xi) + V(Xi)*t + f(L/D) + g(location)$$

with N0(*Xi*) is the damaged new section ratio in the *Xi* configuration,
Xi = (backfill height, traffic)

$f(L/D) = 0$ if $L/D \leq 5$

$f(L/D) = 0.179 - 0.0124 * (L/D)$ if $L/D > 5$

and g(location) = -0. 045 if location = Bordeaux (downtown)
g(location) = 0.011 if location = Bordeaux suburbs

Figure 1 compares the experimental data and the model prediction for the two extreme subset. The difference between the two ageing speeds is clear, and we accounted for by the model. One can mark that it remains local differences between model and reality, this noise may be due to factors not accounted for in the model. However, if one aims at a model that can be currently used by the sewers manager, the model must be simple and not to ask for an important quantity of data.

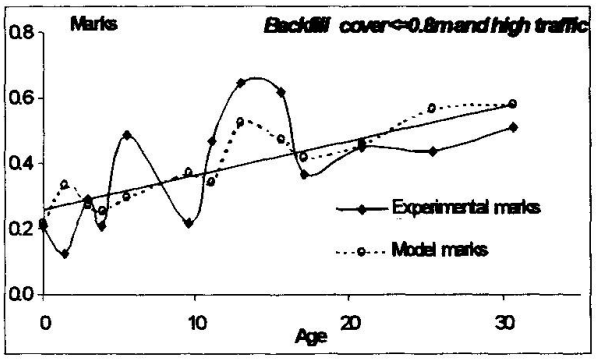
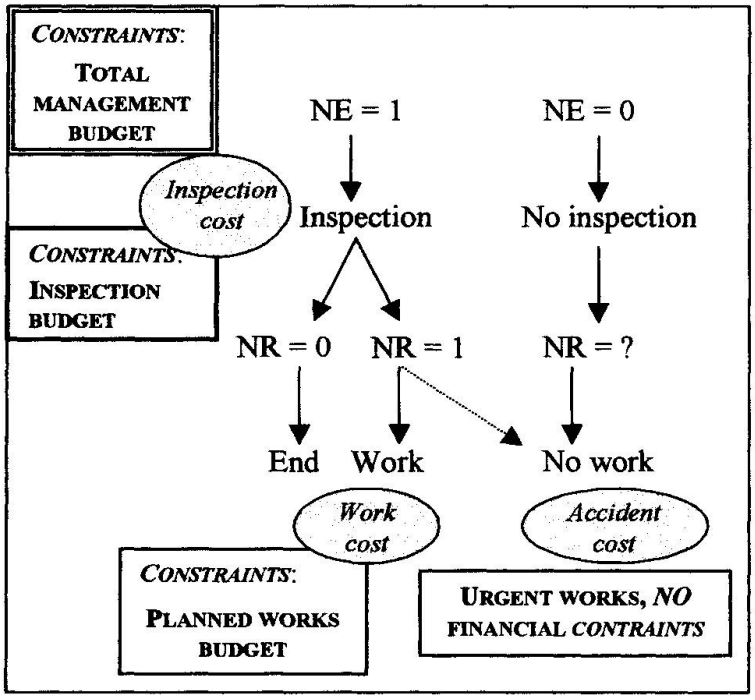



Fig. 1: Backfill cover ≤ 0.8m and high traffic

Ageing model allows to evaluate the network's performance evolution in time using Bayesan probabilities. A short or long term perspective permits, for example, to orient video inspections or work strategies, to simulate future ageing of pipes, to anticipate investments and therefore to optimize the patrimony management.
A first database exploitation will permit to quantify administrator's gain using ageing model. Distance between real performance marks and estimated ones will quantify this information gain.




To quantify replacement strategy's gain using ageing model we put into works a gain function (make up maintenance cost, inspection cost, work and accident cost) to optimize by integrating model contributions and accounting for financial constraints.

Urban database construction for unvisitable network management's optimization comes up against quality and quantity required information. Data from various sources (geotechnical, technological, materials, socio-economical) are often vague, incomplete and uneasily accessible.
A statistical approach, determinist and critical of available information has allowed to establish a first ageing model. This model describes correctly the UCB's individual database behavior. Backfill cover above the pipe, traffic intensity, length diameter ratio (L/D) and section's pipe in the urban fabric have been identified as more influent parameters. More, this study points up indispensable factors to understand the phenomenon, but not documented, relative especially to laying conditions.
Ageing model used for management strategy gives possibility to optimize network administrator's costs.
Which potential database, simulations of inspection and work strategies, show how the manager can improve his knowledge on the system efficiency of alternate managing strategies.