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Application of Expert System in Sewer Network Management

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ABSTRACT

Usually the cost of sewer rehabilitation is large but the budget is limited. Owing to the importance of sewer networks in the functioning of society, the current state of the networks, and given the enormous cost of replacement of these systems, actions need to be taken to restore and/or improve the systems and to prolong their service-lives. For a holistic and sustainable rehabilitation planning, a reliable assessment model is needed which grades existing defects according to the real defect severity and gets most out of the exiting information, being tolerant to imprecise data. Hence, engineers can limit rehabilitation costs by producing software components based on asset management systems and assess thousands of kilometers of sewer each year. Little effort to date has focused on devising methodologies for gathering information about the condition of pipelines. It was not until the mid-1980s that the use of decision support tools emerged as an important element in pipeline rehabilitation. The tools range from simple ranking algorithms to information management systems and rehabilitation models. However, the basic concept of assessing the condition is to measure the type and extent of deterioration that the sewer is currently experiencing. This paper reviews some widespread decision support systems used in sewer asset management and the stages they cover. It also reviews the related studies on sewer network management in Iran. In addition, the article presents a framework and future research's needs in this field. It is argued that the methodology presented in this paper would help the decision makers/sewer inspectors enormously.

KEYWORDS
Infrastructure, Expert System, Sewer Network, Assessment.

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1- BRIEF INTRODUCTION

Sewer networks, valuable assets that absorb popular attentions merely when they are getting out of service, continuously are aging and although it is expected to continue their serviceability, the performances are being affected by efforts to reduce maintenance costs. Usually the cost of sewer rehabilitation is large but the budget is limited. Owing to the importance of sewer networks in the functioning of society, the current state of the networks, and given the enormous cost of replacement of these systems, actions need to be taken to restore and/or improve the systems and to prolong their service-lives. Currently, there are several sewer asset management decision-support tools available. These tools are varied in their scope and focus. Figure 1 shows the current available tools and the stages they cover in the complete infrastructure asset management system that categorized into 3 main groups. The asset management decision-support tools under group 1 refer to those tools that deal mainly with performance modeling include "Baik model", "Bengassem & Bennis model", and "Hasegawa et al. model". In group 2, tools cover the first three stages of the complete asset management system from data collection, to performance modeling and decision analysis. In this group tools are "APOGEE", "AQUA – WertMin", "Edmonton model", "KureCAD", and "PRISM". Finally, group 3 represents comprehensive sewer asset management system that covers all the stages of the complete infrastructure asset management system and includes "CARE-S", "Hydroplan".

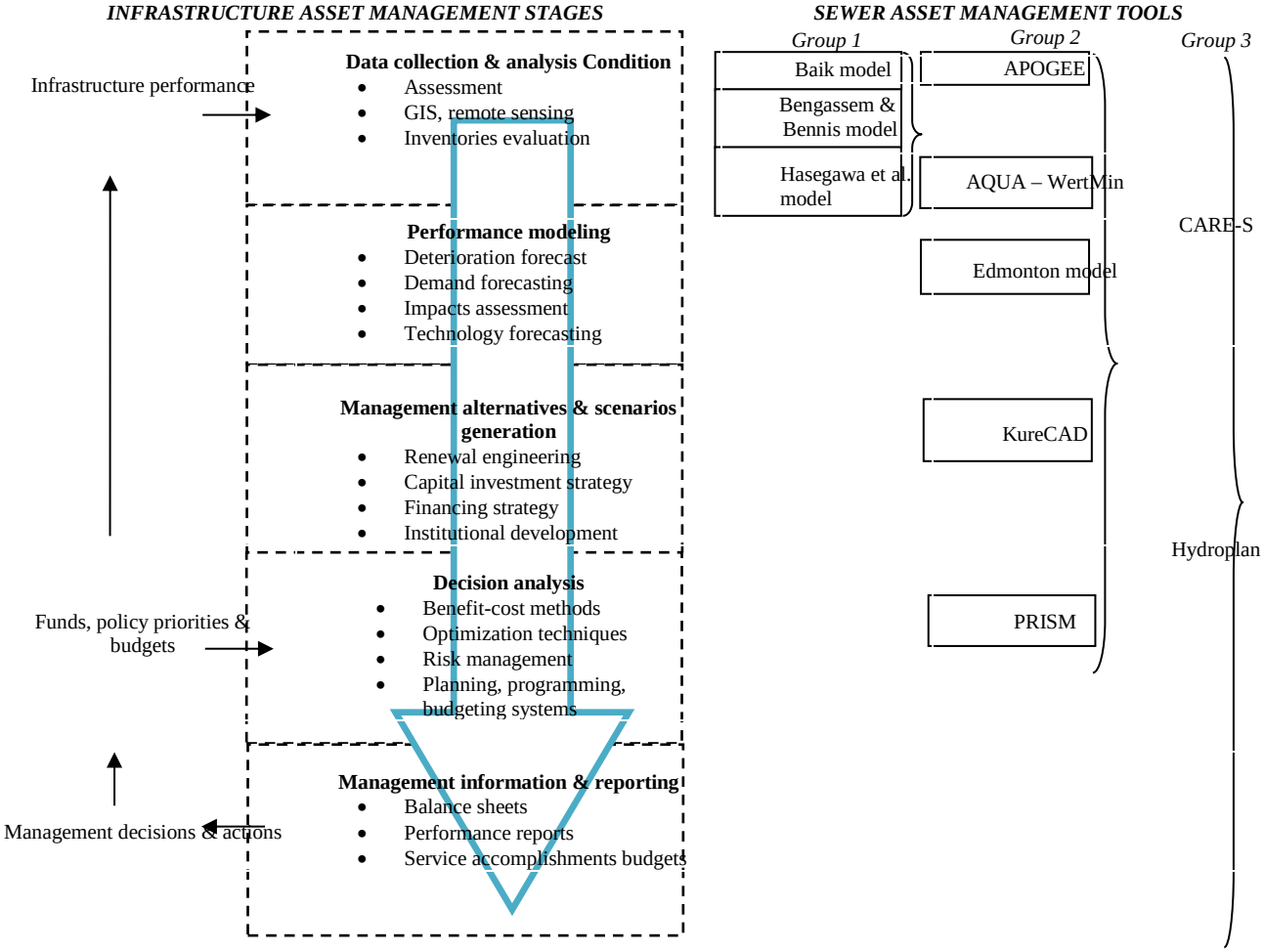

Figure 1. The general infrastructure asset management system with the corresponding sewer asset management tools applicable at different stages [2].

2- METHODOLOGY

The tools are grouped according to their functionalities and capabilities. The central concept behind each tool is described and its corresponding data requirements are identified. Moreover, due to growing needs of these tools in Iran, the framework of a decision support system is represented.

3- MAIN CONTRIBUTIONS

Based on the review of decision support tools, a framework for sewer asset management in Iran is proposed. This tool covers Infrastructure performance as group 1 does. In 'Data collection & analysis condition' stage, GIS method of data gathering by CCTV base on WRc code, in 'Performance modeling', the transition probabilities of different condition states in Markov chain-based deterioration model, and in 'Decision analysis', a fuzzy based model represents.

4- CONCLUSION

It is concluded that the structure of sewer network asset management decision-support tools are relatively more complex in comparison with other types of decision-support tools. An extremely varied set of data that some tools need as input makes them impractical due to the expenses. This encourages researchers to study less complex, more flexible, and more practical models of decision-support tools for sewer network management to develop.

It is worth mentioning that most developed models in the world so far are based on the estimation of costs in future regarding the economic situation of their own countries. Therefore, it is inevitable to adopt those models according to internal economic situations before using them in Iran.

The suggested framework for sewer asset management decision-support tool include 1- Data collection and analysis, 2- Capacity modeling, and 3- System analysis which only cover the first step of a comprehensive asset management system.

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