# ROWAS: A RULES-DRIVEN OBJECT-ORIENTED SIMULATION MODEL FOR WATER RESOURCES SYSTEM

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Along with the rapidly increasing social-economic development, there are more factors involved in water resources system. Man-induced impacts on natural hydrological process have been increasing the complexity. A new conception, therefore, is needed to recognize the system clearly by taking the coupling process formed by natural water cycle and man-made water cycle into consideration as a whole. Simulation model is a feasible method to realize the simulation and assist planners to make corresponding rational decisions.

Based on the summarization and comparison of previous researches on theory and application of simulation for water recourses system, in this paper a framework (figure 1) describing the basic elements in water resources system and their mutual relations and a modeling technique integrated of conceptual simulation and rules control are presented. In this framework, various elements are represented by abstracted conceptual objects which are described by different parameters. There are two kind basic elements in the conceptual system, one is node, and the other is line. The complex process of water system could be described by adjusting relevant rules and respective parameters with experiences and pragmatic demands.

The rule set gives principles to design conceptual network of studied area and control the concrete processes of movement and conversion of different water flow, including water allocation among different water users. Various rules provide respective constrains for system simulation, which make the calculation under predefined basic thoughts and the detailed process controllable. Basic rules construct the fundamental framework for simulation. Conceptual rules provide the gist to transfer the reality into solvable mathematic model. Meanwhile the operating rules present the concrete arithmetic to carry out the projects' running in the system. Furthermore, designers can add or modify these rules according to the real condition and demands to reflect studied system more accurately.

Since the conceptual framework is in accordance with the basic thoughts of Object-Oriented Technology (OOT), the Object-Oriented programming (OOP) is adopted to realize construction of this model. Through the rule-driven model, the users' requirement can be taken into account conveniently and the rules are flexible to adjust with experiences and real conditions.

Finally, this model is applied to solve the water resources planning in Hainan Island in South China. Based on the conceptual water system network, the comprehensive results

are simulated through the model and rational strategy for water exploitation is recommended for planners after comparison of different scenarios.

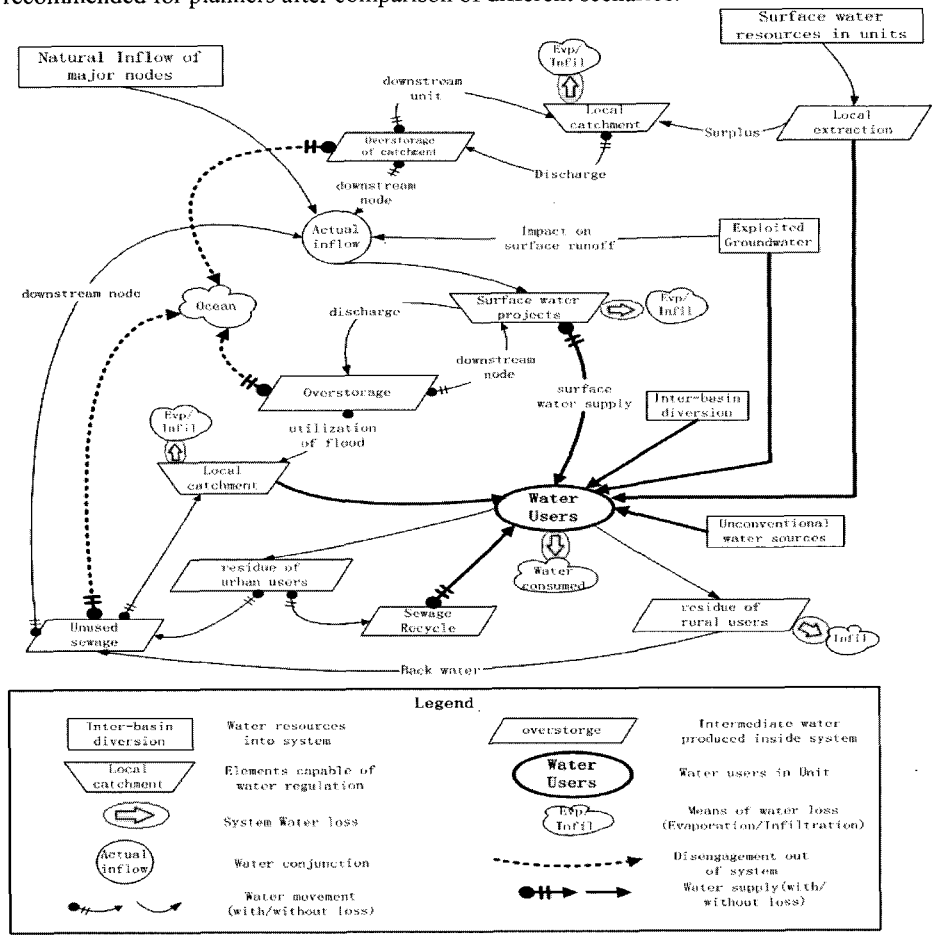


Fig. 1 Framework of Water movement in conceptualized water system

## REFERENCES

Fedra K. (2002), "GIS and simulation models for Water Resources Management: A case study of the Kelantan River, Malaysia". *GIS Development*,Vol.6, pp.39-43.

GAN Hong, YOU Jinjun, WANG Lin, HUANG Shouxin (2004). Water resources system simulation based on object-oriented technology. *4th International Symposium on Environmental Hydraulics and 14th Congress of Asia and Pacific Division IAHR*, Hong Kong, China, Vol.2, pp.1305-1310.

René F. Reitsma, John C. Carron (1997). "Object-oriented Simulation and Evaluation of River Basin Operations". *Journal of Geographic Information and Decision Analysis.* vol.1, pp. 9-24.

Jha, M. K. and Das Gupta, A. (2003), "Application of Mike Basin for Water Management

Strategies in a Watershed", *Water International*, Vol. 28, pp. 27-35.

Kheireldin K., El-Dessouki (1999). "Object Oriented Programming: A Robust Tool for Water Resources Management". *Seventh Nile 2002 Conference, Comprehensive Water Resources Development of the Nile Basin: The Vision for the Next Century*, Cairo, Egypt.

McKinney D.C., and X. Cai, (2002), "Linking GIS and Water Resources Management Models: An Object-Oriented Method", *Environmental Modeling and Software*, Vol.17, pp.413-425.

Victor Shetern et.al (2000), *Core C++: A software engineering Approach*, Prentice Hall PTR.