A New Integrated Systems for Real-time Groundwater Monitoring and Management

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The ever-increasing usage of groundwater resources (WWAP, 2009; Ross and Martinez-Santos, 2009), along with the lack of appropriate hardware and software for groundwater monitoring and management – as emphasized by USGS (1977) – lead our world towards the most disastrous aspects of our future, an entirely dry earth. While over-drafting and unsustainable usage of groundwater resources has received immense attention, there are few practical suggestions for resolving the problem (WWAP, 2009; USGS, 1977; Zekri, 2009). Thanks to the recent improvements in instrumentation and remote measuring solutions, now, new opportunities for proactively facing the disaster have emerged (Moazedi et al., 2011). In this article, it is intended to introduce an integrated measurement and control system for groundwater resource management. This system consists of three subsystems: (a) a set of measurement/control instruments installed in the field, (b) a communication medium and related equipments, (c) a data center that performs data processing, and through the communication medium collects the field data and sends necessary commands to local instruments (for more details see Fig. 1)

While the data center undertakes the most critical job of the system (i.e. the decision-making), the main idea of the system lies in a device called IEWM –Intelligent Energy and Water Meter (Taravat et al., 2010). IEWM, being installed in the power circuit of the water-well's electro-pump, is a substitution for both water and electricity energy meters installed for groundwater monitoring. It simultaneously measures the flow and the energy values, and through its built-in quota-controlling device, controls water/energy consumption. For instance, wherever allowed, the government agencies are able to program the meter with a multi-tariff structure (i.e. to impose pecuniary penalties), or even configure it to cut the overdraft or overconsumption directly. Moreover, IEWM incorporates remote reading/controlling facilities (i.e. two-way communication). This additional feature, through appropriate communication media/protocols (e.g. GSM, GPRS, ZigBee, RFmesh, and PLC), enables the meter to send and receive data/commands to/from the data center (Moazedi et al., 2011). The data center, which conceivably incorporates national/regional water management policies, employs the available real-time field data to analyze the situation, to predict the trends, to

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decide about the quotas (or pricing policies), and to send the appropriate commands to the meter. The DSS, on the other hand, is supposedly equipped with a modeling tool –such as the system dynamics model developed by Keshavarzi et al. (2012). The DSS simulates the hydro-socio-economic system (of the groundwater consumption) and, using the actual real-time data, predicts the probable consequences of different scenarios/policies. As a result, the proposed system, as a sustainable common resource management tool, is supposed to be of the greatest helps for more informed decision-making.

The system depicted in Fig. 1 is not just a hypothetical scheme, but for each hardware or software used in the system, a commercially available choice can be introduced. The simple cost-to-benefit analysis performed in this study, as preliminarily evidence, shows that the solution is quite worthy of consideration. Yet, its worthiness needs to be studied in practice (i.e. through pilot projects).

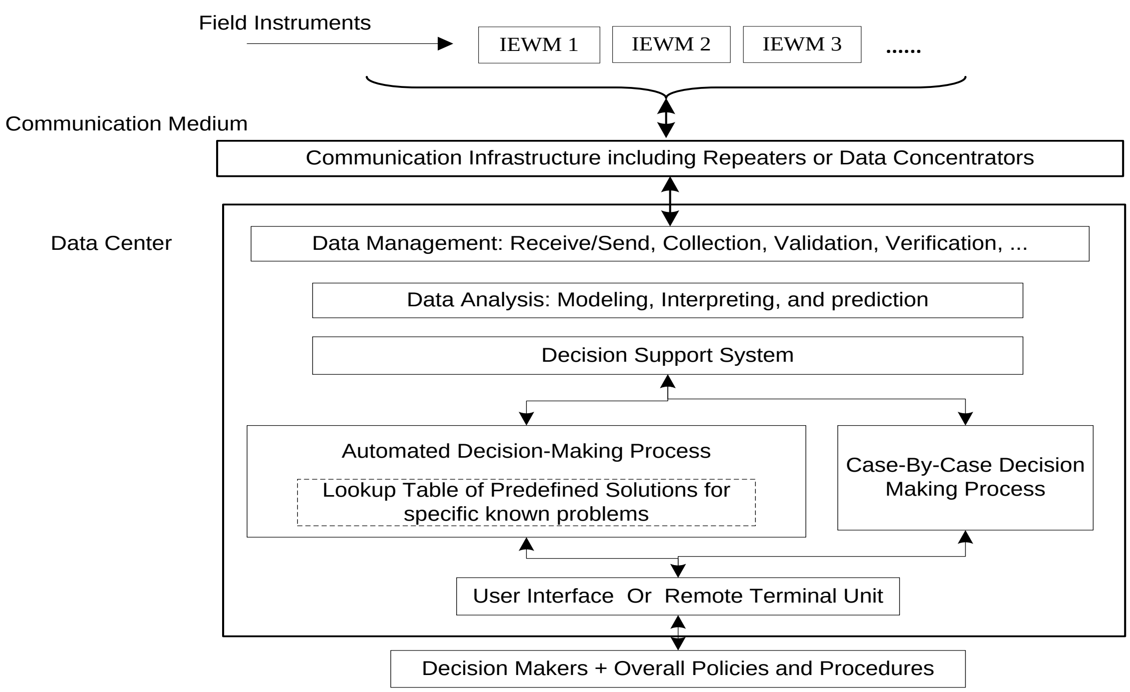

Figure1: System Structure

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