"Technological and Management Complexity of Water Resources in Developing Countries: A Case study of On Farm Water Management in Khyber Pukhtunkhwa, Pakistan."

By

Engr. Salim Javed, School of Electrical Engineering, Iqra National University, Peshawar,Pakistan.

Dr. Engr. M.Mehbbob Alam, Dean, Faculty of Engineering,Technology and Architecture, City university of Science and information Technology,Peshawar,Pakistan.

The proposed paper mainly deals with problems associated with the Civil Engineering area and therefore the methods as well as problems have been selected with emphasis on applications to Civil/Construction Engineering topics. And also as nowadays very popular Project Complexity Management (PCM) w.r.t. Water Management, will be presented as one of the possible ways how to solve today's challenging project management problems that we are often facing. First of all, two main Project Complexity tasks are described - the Project Complexity as a "management" problem and the Water Management as an "engineering" one. Several categories among Project Complexity problems are described and some solutions from the Project Complexity area are cited. Next, a new classification for Evolutionary Progress of Project Complexity is presented. It is based on the well-known notation developed for Project Complexity [Davide @all, 2000] and appropriately modified. The leading idea is that every Project Complexity can be described by a combination of the three basic operations, namely **recombination**, usually presented by different cross-overs, **mutation** and **selection** mechanisms. Traditionally, the **PC**s have been developed for single-objective problems (**SOP**s) and therefore they are not so suitable for problems coming from engineering practice where we usually deal with **multi-objective**, **constrained** and often **mixed integer-continuous Project Complexity** problems (P**CP**s). Solutions for all the three phenomena are presented: multi-objective nature can be solved by Ladder approach of Nash for Project Complexity approaches, constraints by penalty functions and different types of variables by an appropriate encoding. Several other possibilities are discussed in the text as well. Based on the above mentioned notation, On Farm Water Management (OFWM) Department, the tertiary component of the irrigation system, have a key role in the productivity enhancement of the agriculture sector through the appropriate availability of water to agriculture fields. The OFWM dept of KPK was initiated as a project in 1975 by the government and was made regular attached dept. in 2008. During this period many mega projects were initiated with multiple diagnosed productivity enhancement objectives. The successfully phased projects have culminated the fruitful result after completion of the tertiary irrigation system. Yet, the journey from project to department has a long history and needs to be addressed properly. Therefore, the present effort is to highlight these issues with Technological and Management Complexities. The developmental projects are invariably complex therefore; this complexity from project to department needs to be studied.

Certain project characteristics provide a basis for determining the appropriate managerial actions required to complete a project successfully. This indicates a practical acceptance that complexity makes a difference to the management of projects. It is not surprising that complex projects demand an exceptional level of management and that the application of conventional systems developed for ordinary projects are inappropriate for complex projects.

The next part is devoted to the application of the presented Project Complexities (**PCs**) methods to the design of Water Management problems. Generally, this task is multi-modal, multi-objective and

highly constrained. To solve this problem as a whole, it is shown that this inevitably leads to an integer formulation of the problem and hence presented qualities of multi-objective Project Complexities (**PCs**) are utilized. As an illustrative result, typical examples are solved and the Ladder Approach in terms of the total PCs of Water Management Problem against its differentiation and integration are depicted. A new system of Project Complexity problems (P**CP**s) solution is also presented as an addition to the multi-objective integration and adoption domain in the shape of ladder approach on the basis of scientists (Nash,1995 & Davide 1999).

As an engineering example of a Single-Objective Project Complexities (**SOPCs**) problem, Water Users Associations (**WUAs**) of On Farm Water Management (**OFWM**) and its use for a PCs &WM model parameters prediction is presented. A traditional method for WUAs training used herein is the well-known Background ladder method, which uses an umbrella based approach of project application and adaptation to the prevailing scenario and locale to minimize an output error. As a novel approach, umbrella approach of complex project can be used here for the same purpose. It is shown that obtained errors are much lower than the outputs obtained from the Background ladder method. Next, an identification of the integration of complex projects in Davide model [Davide et al., 2000] is investigated. This model is a fully three-dimensional approach of Linear, Horizantal and Vertical Project Complexities and Water Management at different combinations of Project Complexities and Water Management along with the development of new model in the shape of Ladder Approach. The rather severe disadvantage of the Ladder Approach model is an extreme demand of Complex Projects solution & Adoption and, therefore, an appropriate procedure is on demand. To define the problem more formally, the Project Complexity's goal is to find an appropriate approach from a statistical analysis of the proposed model in an experiment are designed, experimented/ &concluded. The objective function is then the Project Complexities (**PCs**) function, which contains differences between the values of a known Project Complexities (PCs) Approach and values from the plotted PCs WM model. Several approaches are tested here to solve the introduced problem. Estimation by a statistical analysis in the experimented project and on approximations of the tested project for Project Complexities (**PCs**) Shows that some properties can be predicted well but a significant error in other coefficient is obtained. Next, a parallel version of the adoption of Project Complexities (**PCs**) -based on the already identified Ladder Approach of Davide & Nash is directly used to obtain required parameters by varying them within a new project for complexity analysis and adoption.

The first main result is that this complex project adoption and adoptation of complex projects in water management in third world areas e.g. KPK of Pakistan can be solved by a parallel analysis in reasonable time & locale. The second outcome is the fact that the objective function corresponding to the identification problem has several local minima, which are characterized by similar values but are far from each other. To solve the above mentioned obstacles and in the view of recent research in this domain, a new methodology is also presented: an application of an Umbrella Approach of Project Application and adoption method as well as statistical analysis are applied not only to investigate the influence of individual Project Complexity parameter and water management, but also to minimize the need of training of locale peoples for a Water Management Project's work. Several promising results along with some concluding remarks are presented.