HEURISTIC FORMULATION OF OPTIMAL MULTI-OBJECTIVE QUEUES IN THE PRESENCE OF VOLATILE CONTINGENT VARIABLES

George Otieno Orwa

A Thesis submitted in fulfilment for the Degree of Doctor of Philosophy in Operational Research at the Jomo Kenyatta University of Agriculture and Technology

2008

ABSTRACT

In this thesis, Vehicle Routing Problems (VRPs) subject to time restrictions and time dependent congestions are discussed into adequate depth. Time dependent congestion increases the complications of the problems and makes it challenging even to find feasible solutions,Y & R. (1987) Y. & Gershwin (1991). This means that it becomes difficult to develop a routing procedure that will lead to shortest delays. Said otherwise, it becomes very difficult to find the routes that would lead to the Feasibilty Routes. It also attempts to incorporate other factors that have been known to affect passenger transport in developing a model that can be used in decision making regarding the management of a fleet of vehicles that herein, are assumed to be registered in a company.

It is of concern that problems in which other variables that affect passenger Vehicle-Routing and Scheduling other than Time Restrictions and a mention of time dependent congestions have not been looked at by Operational Researchers, M.B.M. (1988),Courant (1964),T & Z (1987) and Adan & Wal (1989). With this void in mind, in the first part of this thesis we identify a very robust property, which we choose to refer to as the monotone property of the arrival times. This property does allow for the simplification of the said complications arising as a result of introducing the aspect of Time-Dependent Congestions in the VRPs.

It also enhances the performance of existing heuristics, by creating an enabling environment for the introduction of three Feasibility Conditions that are demonstrated

in this thesis. These Feasibility Conditions greatly reduces the computational burden involved in the development of proposed procedures. This is one of the contributions of this thesis to the field of Operational Research. In the second part of the thesis, insights into what causes congestion, what determines the time and locations of traffic flow breakdown, and even how the congestion propagates through the network, are the essential issues considered.

In this context, we have in the thesis proposed a method of considering most of these factors that determine the existence of passenger queues at the various termini in order to come up with a traffic flow model that will ease congestion. The proposal is tested using the Weibull distribution since it is an extreme value distribution and hence provides an allowance for proper extrapolation of results and further, it has allowance for many parameters, atleast three, allowing for the incorporation of other variables. For exact financial implications of how these factors affect the transport system, we have borrowed some concepts from Financial Mathematics, especially that of the Net Present Value (NPV), and used it in derivation of the model that incorporates other factors that affect passenger transport.

Finally, in the thesis, empirical evidence of better performance for the proposed models in comparison to existing methods of addressing similar problems is provided. A conclusion that entails opening windows for future research in the Vehicle Routing Problems is given