

SOME STRATEGIES TO REDUCE OPERATIONAL COST IN SOLID WASTE COLLECTION: A PROTEAN MODELLING AND ANALYSIS APPROACH

by

Ravindraw Bappoo

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Department of Applied Mathematics

Faculty of Applied Sciences

National University of Science & Technology

Bulawayo, Zimbabwe

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SUMMARY OF THE THESIS

In this thesis, some problems of practical importance related to the collection of solid waste have been investigated. The overall aim of the thesis is to develop strategies for a sound management of solid waste collection for municipalities in the developing world. Most municipalities are faced by financial constraints and lack of appropriate technology to cope with the ever rising cost of managing the solid waste produced every day at minimal cost and at the same time satisfy the environmental demands. Thus, in the thesis we examine some of the problems faced by the City of Bulawayo and suggest some alternatives to reduce operational cost in the collection of solid waste. Where analytical methods will either fail or may prove to be too tedious to yield a good solution, we have resorted to heuristic approaches.

The thesis consists of eight chapters. A brief introduction to the thesis is given in Chapter 1. The protean modelling and analysis philosophy, which is rather a new concept of attempting real life problems, is also explained in this chapter. In Chapter 2, we discuss some heuristic methods which we feel are most appropriate for the modelling and analyses of solid waste collection. In Chapter 3, an algorithm is designed and an appropriate software program developed that can be used in the deployment of refuse vehicles. This method maximizes the use of the operational vehicles and hence minimizes the number required daily and thus reduces extra capital expenditure.

Chapters 4, 5 and 6 deal with the protean systems. In Chapter 4, the deployment of refuse vehicles is considered when the number of refuse vehicles available is less than the number of tasks to be completed on that day. A heuristic approach is proposed to deal with such a case so that a maximum number of tasks is carried out at no extra expenditure. Chapter 5 deals with the shortest routes problems in a

protean network which has its applications in many real life problems, including the solid waste collection system, which is modelled as a network in graph theory. In Chapter 6, we devise a general method of finding the k-th best solution in a given protean network. This method ranks the solutions obtained in any given system in a certain order as may be required by the objective in a given situation. Thus, in the context of solid waste it allows us to find the next best solution when the best solution, for example, cannot be implemented due to circumstances beyond control.

Chapter 7 gives a report on the investigation carried out on solid waste collection and its related complexities in the City of Bulawayo. The methods developed in Chapters 2 to 6 are found to be of practical importance to the City's solid waste collection related problems. Real case illustrations to reduce operational cost have been demonstrated. Finally, in Chapter 8 some concluding remarks pertaining to this thesis have been presented. Future research in the field has been suggested and some recommendations, for the City of Bulawayo to consider, are also proposed.