UNIVERSITI TEKNOLOGI MARA

ARTIFICIAL BEE COLONY WITH SAVINGS ALGORITHM FOR SOLVING MULTI-OBJECTIVE INVENTORY ROUTING PROBLEM

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ABSTRACT

This research tackled Multi-Objective Inventory Routing Problem (MOIRP) as the components are crucial aspects of Supply Chain Management. Inventory Routing Problem (IRP) encompasses two main components: inventory management and routing. Routing involves homogenous vehicles to efficiently collect and deliver products from suppliers to meet the demand requested by the assembly plant. Simultaneously, vehicles may carry more than the demand, resulting in inventories to be managed. Solving IRP aims to minimize both inventory and transportation. This research also solved three variants of IRP, which are single-objective IRP, bi-objective IRP and tri-objective IRP (also known as Green IRP). Artificial Bee Colony with modified Clarke Wright savings algorithm (ABCSA) was proposed. ABC is a swarm intelligence algorithm based on the behavior of bees in a colony, where information is shared through waggle dance. ABC consists of three phases; employed bee phase, onlooker bee phase, and scout bee phase. The savings algorithm was modified to consider vehicle capacities and the quantities carried. The employed bee phase considers the trade-off between the inventory cost and transportation cost (and fuel consumption cost for tri-objective IRP). The single-objective IRP's mathematical formulation was extended to bi-objective IRP to find trade-off solutions between transportation and inventory. Hence, the proposed ABCSA incorporated the weighted sum approach to solve the bi-IRP. Tri-objective IRP included additional objective to minimize fuel consumption cost, which is proportional with minimizing CO2 emissions. The ABCSA was tested on a benchmark dataset of an automotive parts supply chain. Results of the proposed ABCSA outperformed previous literature by 2.93% for single-objective IRP. The modified Clarke Wright savings algorithm yielded a more effective routing sequences with more vehicles. The bi-objective IRP showed a slight increase of 0.0427% when compared to single-objective IRP. The increase is anticipated as the objectives were considered separately. The Pareto optimal solutions were successfully obtained for small dataset S12, with the Inverted Generational Distance value of 0.09, nearly to zero, indicating the good quality of the solutions found. The tri-objective IRP results showed a clear trend of decreased inventory cost when higher priority was given to the inventory objective and resulting in increased in

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CHAPTER 1
INTRODUCTION

This chapter provide the background of routing problem and supply chain system, followed by the discussion on the problem solved, which are Inventory Routing Problem (IRP) and its variants. Then, the motivation of this research being carried out is presented and the objectives are discussed. Finally, the significance and contribution of knowledge is presented, and a summary is given to conclude the chapter.

1.1 Background of Study

A routing problem refers to a class of optimization problems that involve finding the most efficient way to navigate from a starting point to one or more destinations while satisfying certain constraints. Routing problems arise in various fields, such as transportation, logistics, telecommunications, and computer networking. Solving routing problem aims to determine the optimal path or sequence of actions to minimize costs, time, or other objectives while adhering to limitations such as vehicle capacity, time windows, and environmental factors (Bozkaya et al., 2011). Routing problems are closely intertwined with inventory management, especially in the context of supply chain management (SCM).

SCM is the strategic coordination and integration of all the activities involved in the sourcing, procurement, conversion, and logistics management of goods and services. It encompasses the planning and management of all activities involved in sourcing raw materials, manufacturing or production, storage, transportation, and distribution of finished products to customers (Power, 2005). SCM is a complex and challenging system that has drawn the interest of many researchers in both practitioners and academics. SCM stands at the heart of a multitude of industries, presenting both immense opportunities and complex challenges. Since there are many changes in the business environment, sustainable SCM remains a topic that attracts researchers including Green SCM (Choi, 2023). When the SCM's activities are properly coordinated, a company's logistics will become more effective, and this will help the company to remain competitive in the industries (Lewis & Voehl, 2020).