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DESIGN AND IMPLEMENTATION OF AN INTEGRATED ALGORITHM FOR THE VEHICLE ROUTING PROBLEM WITH MULTIPLE CONSTRAINTS

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ABSTRACT

Title: Design and Implementation of an Integrated Algorithm for the Vehicle Routing Problem with Multiple Constraints.

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Supply Chain Management could be defined as the practice of analysing all aspects of acquiring, storing, moving, and delivering materials from the time they are acquired through any conversion or production processes through to the time final products are used or sold. Due to the expansion of online retail and online Business To Business (B2B) transactions, there is a great need for companies to invest in effective solutions that will aid them in ensuring that their supply chains, and particularly the distribution side of the supply chain, work as effectively and seamlessly as possible. A company will battle to be successful if it has the best products but a poor fulfilment side to its business. It is evident that there are at present a number of shortfalls within the fulfilment environment. There is thus scope for an effective, all-encompassing order fulfilment engine that addresses all problems, and ensures that all the positive aspects are maintained.

There exist a need in the industry for an affordable service, which can assist with the optimization of distribution routes. Not all businesses have a large enough fleet to verify the costs associated with a fleet management system that includes optimization. Such a system normally requires a skilled operator, that add to the cost. A solution to this problem is the implementation of an optimization server

in public domain. This is done by implementing a routing engine on an Application Service Provider (ASP). The ASP is a web-enabled distribution and fulfilment planning and optimization system that assist its users in the fulfilment of their customers' orders. This allows the provider to manage the system from one centralised server that allows other users to access the system via the Internet.

The Vehicle Routing Problem (VRP) is an important problem occurring in many distribution systems. VRP can be described as the problem of designing least cost routes from one depot to a set of geographically scattered points. The basic VRP is not sufficient enough for implementing in distribution systems. Additional constraints such as multiple time windows, heterogeneous fleet, double scheduling, stop priority and route length must be added to the basic problem.

Designing an algorithm that is efficient to solve the VRP with the required additional constraints, as well as effective in an ASP environment involves the extension of existing methods as well as designing new ones. This research implements a Tabu Search heuristic in a two-stage process to solve the problem. The Tabu Search was selected because of its memory capabilities.

Key words: Fulfilment; Vehicle Routing Problem; Application Service Provider; Tabu Search; Multiple constraints; Multiple Time Windows; Heterogeneous fleet; Double scheduling; Supply Chain Management; Business to Business.

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GLOSSARY

AMP. Adaptive Memory Procedure.

ASP. Application Service Provider.

GA Genetic algorithms

MDVRP Multi-Depot Vehicle Routing Problem

NP-hard Non-polynomial hard

SA Simulate annealing

SIH Sequential Insertion Heuristic

TS Tabu search

TSP Travelling Salesmen Problem

VFM Vehicle Fleet Mix

VRP Vehicle Routing Problem

VRPM Vehicle Routing Problem with multiple uses of vehicles

VRPMC Vehicle Routing Problem with Multiple Constraints

VRPHE Vehicle Routing Problem with Heterogeneous Fleet