CHAPTER 6

CONCLUSION AND RECOMMEDATION FOR FURTHER STUDY

In this chapter, the conclusions on the research and recommendations for the further study have been mentioned.

6.1 Concluding Remarks

Decisions about the distribution system are the key strategic issues for almost every company. The problem of locating facilities and allocating customers covers the core components of distribution system design. Industrial firms must locate their manufactures and assembly plants as well as warehouses in order to satisfy organization's goals. In every case, the quality of the services depends on the location of the facilities in relation to other facilities.

The problem of locating facilities is not new to the operation research field. The challenge of where to place the best facilities to the suitable customers has inspired a rich, colorful and ever growing body of literature. Research on facility location problem is abundant and many models have been studied to formulate the problem. To cope with the multitude of applications encountered in the business world and in the public sector, an ever expanding family of models has emerged. Facility location models cover formulations which range in complexity from simple linear, single-stage, single-product, uncapacitated, deterministic models to non-linear probabilistic models.

There are many kinds of the facility location problems presented in various literatures, such as in p-median problems, p-center problems, capacitated facility location problems and uncapacitated facility location problems. Those problems have been classified based on the restriction assumed, objectives, constraints, solutions and other attributes. However, the approaches which have been proposed to solve the problem can be divided into two main categories; exact approaches such as branch and bound (B&B), and heuristic approach such as Lagrangian, simulated annealing, genetic algorithm, etc..

One of the facility location models which fruitful in application is the single-source capacitated facility location problem (SSCFLP). Many companies worldwide have applied the SSCFLP into many business areas such as communication network, manufacturing, transportation business. As a result, this research has intended to study the SSCFLP with a special characteristic, that is, the uncover demand cost will be included into a pre-proposed SSCFLP model. The new model has been proposed in objective to minimize the total cost of establishing facilities, transportation cost, and uncovered demand cost which is considered as penalty cost in case of some customer cannot be served by any facility after the assignment has been done. The proper assignment will be operated without violating the capacity constraints of the facilities.

From the past researches, many searching approaches have been developed to solve SSCFLP such as Lagrangian relaxation, genetic algorithm (GA), Lagrangian heuristic and so forth. Unfortunately, among various literatures ant colony optimization (ACO) approaches have not been applied to facility location problems. It is a big challenge to apply ACO to these problems. Nevertheless, from the literature survey, ACO has been applied to generalized assignment problem (GAP) which has many basic characteristics similar to SSCFLP. Therefore, it can probably apply the concept of ACO to SSCFLP.

The proposed SSCFLP model has been constructed. It has concerned the relation between facilities and customers. The adequate assignment will be determined through the system. The concept and algorithm of ACO have been adapted to suit for the proposed model. Furthermore, three simple heuristic algorithms have been constructed to compare with the proposed ACO algorithm. From numerical experiments, the proposed ACO algorithm has performed excellently compared with the other referenced approaches. Moreover, the performance of a proposed ACO algorithm has been evaluated by comparing with the optimal solution which has been obtained by the enumeration method using the small size problem. The results have indicated that the proposed ACO has performed very well within a reasonably short time.

Three reference algorithms are too simple so the results from ACO are absolutely better than those algorithms. Consequently, for the large size problems another heuristic approach has been promoted to compare with the proposed ACO algorithm. Simulated Annealing (SA) algorithm has been selected and some parameters have been fine tuned to suit for the proposed SSCFLP model. The simulation tests have been conducted to evaluate the performance of ACO and SA in many cases of environment. Furthermore, the proposed SA method also has been compared with the optimal solution in a small size problem. It has given the worse results while comparing with the optimal solution and the solution obtained from the proposed ACO. For the proposed ACO, it has given optimal solution quite often within reasonable time. From the simulation tests, the results have indicated that the proposed ACO has performed better than SA. The proposed ACO has given satisfactory results more than the result from SA in many cases especially in the large size of problems. However, the proposed ACO has spent more running time than to solve the problem than SA.

According to all of experiments which have been conducted in this research, the proposed ACO algorithm for SSCFLP has performed very excellent in both cases of environment; small and large size problems.

With respected to the results of this research, ACO can be applied to solve a single-source capacitated facility location problem (SSCFLP). It has given the satisfactory results (near optimal) within a reasonable time. Considering the contribution of this research, the researcher does hope that this research will be a useful reference for other researchers who want to research about Supply Chain Management, especially, the facility location problem and the logistics problem. Consequently, this research will be useful for applying the concept of ACO on facility location problem such as uncapacitated facility location problem, p-median facility location problems and so on. Additionally, these concepts of ACO on SSCFLP can be distributed into various applications such as vender selection, location and sizing of offshore platform for oil exploration, database location in computer network, cluster analysis, location of bank accounts and so on.

6.2 Recommendation for Further Study

Since the limit of time in this study is very short, therefore, there are still several areas in which this study can be further extended. Some of these topics have been listed as follows.

6.2.1 Multiple Source Capacitated Facility Location Problem

It would be quite interesting to see the effect of the proposed approach on a full system of supply chain which is the multiple source capacitated facility locations problem in real world business. This research has focused only on single-source capacitated facility location in which each customer can only be supplied from only one facility so it is not too realistic as the multiple-source capacitated facility location problem. Multiple-source has more complicated while increasing the number of related conditions in the system such as multi-activity, multi facility and so forth. Considering a multiple-source capacitated facility location problem while the customer can be supplied from more than one facility would be an interesting topic.

6.2.2 Uncapacitated Facility Location Problem

This research can be extended to the uncapacitated facility location problem in which the capacity of each facility have not been considered as a constraint. If this research has not considered capacity constraint it will be called a single-source uncapacitated facility location problem.

6.2.3 Different Types of Demand Distribution and Variation

In additional, all demand patterns are generated based on the normal distribution. Different demand patterns (e.g., Exponential distribution, Poisson distribution, etc.) or perhaps with lumpy type of demand may generate the different outcomes.

6.2.4 Additional Cost concerned

More concerning cost can be added into the objective function to make the problem more practical such as inventory cost, material handling cost, labor cost, etc. It depends on the expected goals of any business.

6.2.5 Other Kinds of Optimization Techniques

In this study, ACO has been adapted to suit for the proposed SSCFLP but it can not guarantee the optimal result. Although the proposed ACO has given a good result (often optimal), as comparison, it may be interesting to compare to the results generated from other kinds of optimization techniques (exclude Simulated Annealing which is worse than the proposed ACO) such as Particle Swarm, Genetic Algorithm or Tabu Search.

6.2.6 Hybrid Method

The results from this research can be used to be an initial solution of another heuristic method to improve the quality of solutions. For improving the result of this research, it is possible to use the hybrid approach by adding another algorithm to solve the problem such as Genetic Algorithm (GA), Simulated Annealing (SA), Tabu Search (TS) and so on. These methods will make the results more accurate.