6. CONCLUSIONS

In this thesis, we propose the Probability Traveling Salesman Problem model with Time Window constraints and the idea of Double Horizon to deal with a local logistics problem with three different kinds of customers. An *a priori* route is constructed to avoid the cost of operations changing due to route optimization while reducing the total traveling time. In addition, the idea of slack time accumulation in the long-term horizon is introduced into the model to make the *a priori* route more flexible for coping with the immediate requests which possibly occur when the vehicle is *en* route. To solve the PTSPTW, which is almost impossible be solved in reasonable time, a two-stage heuristic algorithm is developed. In the first stage, we try to construct a feasible initial TSPTW route. And route improvement is done in the second stage. Based on the computational results in Chapter 5, we summarize the following results:

1. Although there exist 0.22% - 5% differences between the performances of the proposed heuristic algorithm and the best known heuristic on the TSPTW without regular customers, the proposed heuristic algorithm is much more efficient, especially in the complicated case. It is suitable and applicable for solving the PTSPTW with slack time concern, which is a more complicated problem.
2. Once slack time is introduced into the model, we can find apparent improvement on average number of accepted immediate requests. On the other hand, because of the flexibility, the total traveling time of the route with slack time consideration is smaller than which without slack time consideration in most cases. It means that the proposed model is effective in this problem.
3. As the weight of slack time in the objective function increases, we can observe that average number of accepted immediate requests also increases. At the

same time, there are not obvious differences on total traveling times.

4. Under the needs of satisfying immediate requests as many as possible, the total traveling time of the *a priori* route with slack time consideration is gradually less than the one without slack time consideration by increasing number of immediate requests. Therefore, we should introduce the criterion of slack time accumulating into the PTSPTW model when the proportion of immediate requests is large.
5. The differences of numbers of accepted immediate requests between the *a priori* routes with and without slack time accumulating criterion are more obvious in the cases with narrower time windows. Accordingly, we should accumulate slack time in these cases.
6. In the case in which regular customers have lower request probabilities, the difference of numbers of accepted immediate requests between the *a priori* routes with and without slack time are more obvious. Therefore, the slack time should be considered in these cases.

The further research topics are suggested in the following directions.

1. In this research, the time windows of daily and regular customers are fixed in advanced. The problems with stochastic or dynamic time windows may be considered in the real world.
2. Since the slack time must be provided from the begin to the end of the route, we must compute the slack time in each possible request condition of regular customers when we evaluate the objective function. The calculating time of the algorithm we proposed in this thesis still grow exponentially as the size of regular customers increases. Therefore, a more efficient algorithm for PTSPTW with slack time should be investigated.