Transportation Cost Reduction for Herbal Product Distribution  
A Case study in Prachinburi Province

Kanchana Kanchanasuntorn¹, Maisopha C.², 
Chancharoen P.³, and Singhawiboon W⁴.

¹Department of Logistics Engineering 
School of Engineering 
University of the Thai Chamber of Commerce (UTCC) 
126/1 Vibhavadee-Rangsit Road, Dindaeng, Bangkok 10400, Thailand. 
Tel: (+66-2) 697-6000 Fax: (+66-2) 276-2126 
Email: kanchanasuntorn_k@yahoo.com 

²,³,⁴Faculty of Industrial Technology and Management 
King Mongkut Institute of Technology North Bangkok 
126/1 Tambon Nernhorm, Amphur Mueang, Prachinburi 23000, Thailand.

Abstract
As herbal product is one of the most important products of Thailand development project. This study aims to reduce distribution costs of a variety herbal products produced in the east part distributed to the metropolitan of Thailand or Bangkok area. As the current finished goods warehouse situated in the Prachinburi province make a long delivery route, this study suggests a new warehouse closer to customers.

Form preliminary data collection involve of product delivery in Bangkok area, it shows the high delivery cost. Solution calls for a new additional warehouse in Bangkok situated in Chatuchak area according to its most appropriate performance from various factor perspectives. Factor analysis technique based on weight-scored method is applied to compare between several sites. After decision, delivery cost for new situated facility is calculated with the same method applied to that of present delivery method. The delivery cost of new method are then compared to that of the current method.

The study results show that the new facility offers delivery costs reduction by 50.82%. Although, considering the other expenditure might show a small cost reduction, the other benefits effect in long term. These include proximity to customers, short delivery lead time, increasing of customer and demand and future increasing of oil price; making delivery from Prachinburi province to Bangkok area inhibitive expensive.

Keywords: Transportation cost; Herbal product; Distribution

1. Introduction
Under today competitive environment, transportation planning plays an important role on every business sectors. For small and medium size organization, especially, lowest transportation cost is required for their competitive potential and hence for their survival.

As Thailand is agriculture based country and herbal product is one of the most popular products of Thailand, it is considered as one of Thailand development project, which is called One Tambon One Product (OTOP) project. Most of those herbal product industries in Thailand are characterized as small and medium size enterprise (SMEs). As a result, in this paper, we focus on this type of industry. Our case study is a herbal product manufacturer for a brand name of Chaophya Abaiphubet.
Herbal Products. Its factory and warehouse is now situated in Prachinburi province, which is the eastern part of Thailand. The study aims to reduce delivery costs of its product from manufacturing warehouse to customers in the metropolitan or Bangkok area. As the current finished goods warehouse situated in the Prachinburi province make a long delivery route, this study suggests a new warehouse closer to customers.

2. Analysis of current distribution system and cost

In the present day, in order to support a number of customers in Bangkok area, Chaophya Abaiphubet’s warehouse has to deliver its herbal products directly to Bangkok area to about 20 trips per month using one 4-wheel truck. In addition, for the highest volume customer, another 6-wheel truck is used once a month. Even though, there are a number of customers situated in Bangkok area, this study focuses on 13 customers that has the high ordering volume which consume about 58% of the whole. Moreover, from the past data, it also shows that all these customers make the most ordering frequency.

For cost analysis, we make an assumption that for each time the product is delivered from the central warehouse, they are shipped to one customer. Although, this assumption is not practical, it is effective for cost calculation and especially for cost comparison. For consistency, we will apply the same assumption to calculate the cost after the new warehouse is proposed. Table 1 presents details of transportation distance, delivery frequency, and total monthly transportation distance for each customer. In table 1, number 0 refers to the central warehouse at Prachinburi province, 1 refers to company’s gateway at Bangkok, while others refer to each site of customer.

To calculate current total transportation cost, oil consumption rate for each type of truck must be known. In his study, base on truck’s specifications and current conditions, we use oil consumption rate for 4-wheel and 6-wheel trucks at 10 and 4 kilometers/liter, respectively. In addition, we use average value of oil price within the past three months from November 2005 to January 2006 which equals to 24.13 bahts / liter as a reference price for cost calculation. The total transportation cost based on the fuel cost only is then calculated as:

\[
\text{Total transportation cost} = \frac{\text{total transportation distance} \times \text{oil price}}{\text{oil consumption rate of truck}}
\]

Therefore, the total transportation cost for the 4-wheel and 6-wheel trucks are:

\[
\begin{align*}
\text{Total transportation cost for the 4-wheel truck} & = \frac{(6,646.52 \times 24.13)}{10} \\
& = 16,038.05 \text{ bahts / month} \\
\text{Total transportation cost for the 6-wheel truck} & = \frac{(1,183.36 \times 24.13)}{4} \\
& = 7,138.62 \text{ bahts / month}
\end{align*}
\]

From the above calculation, we find that the overall transportation cost is \(16,038.05 + 7,138.62 = 23,176.67\) bahts.

3. Warehouse planning

From the above analysis, it shows that delivery cost of the current distribution system is too high. This suggest the another choice to construct a new warehouse in Bangkok area. This new warehouse is expected to be a distribution center that can support customer requirement in Bangkok area. In order to select the warehouse location, we apply two phase methodology. In the first phase, some various factors concerning warehouse or distribution center’s location are considered by warehouse manager. From this study, we roughly select four areas as the most appropriate locations. Those locations are in Bangsue, Chatuchak, Dindeang, and in Dusit area as can be shown in Figure 1

In the second phase, we define 7 important factors that most likely to affect warehouse location decision. The factors are proximity to customer, transportation infrastructure, labor availability (including labor cost), land and construction cost, variety of communication and transportation channels,
environment, availability of other facilities, and tax and law. The four pre-selected areas obtained from the first phase are then compared among using factor analysis technique. So, in this phase, we collect some more data relatively to each area corresponding to each factor. Much information are gathered from various methods and sources such as site

**Table 1** Transportation data for any shipment to each of 13 customers

<table>
<thead>
<tr>
<th>From – To (facility code)</th>
<th>Distance (kilometer)</th>
<th>Frequency (in month)</th>
<th>Round per shipment (rounds)</th>
<th>Total distance (kilometers/month)</th>
</tr>
</thead>
<tbody>
<tr>
<td>For 4-wheel truck</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-1</td>
<td>108.13</td>
<td>20</td>
<td>2</td>
<td>4,325.20</td>
</tr>
<tr>
<td>1-2</td>
<td>9.87</td>
<td>2</td>
<td>2</td>
<td>39.48</td>
</tr>
<tr>
<td>1-3</td>
<td>22.96</td>
<td>3</td>
<td>2</td>
<td>137.76</td>
</tr>
<tr>
<td>1-4</td>
<td>34.53</td>
<td>3</td>
<td>2</td>
<td>207.18</td>
</tr>
<tr>
<td>1-5</td>
<td>36.75</td>
<td>1</td>
<td>2</td>
<td>73.50</td>
</tr>
<tr>
<td>1-6</td>
<td>40.36</td>
<td>2</td>
<td>2</td>
<td>161.44</td>
</tr>
<tr>
<td>1-7</td>
<td>40.90</td>
<td>1</td>
<td>2</td>
<td>81.80</td>
</tr>
<tr>
<td>1-8</td>
<td>48.54</td>
<td>1</td>
<td>2</td>
<td>97.08</td>
</tr>
<tr>
<td>1-9</td>
<td>56.95</td>
<td>1</td>
<td>2</td>
<td>113.90</td>
</tr>
<tr>
<td>1-10</td>
<td>41.83</td>
<td>2</td>
<td>2</td>
<td>167.32</td>
</tr>
<tr>
<td>1-11</td>
<td>49.73</td>
<td>3</td>
<td>2</td>
<td>298.38</td>
</tr>
<tr>
<td>1-12</td>
<td>32.24</td>
<td>1</td>
<td>2</td>
<td>64.48</td>
</tr>
<tr>
<td>1-13</td>
<td>42.30</td>
<td>1</td>
<td>2</td>
<td>84.60</td>
</tr>
<tr>
<td>Total transportation distance for 4-wheel truck</td>
<td>6,646.52</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| For 6-wheel truck        |                      |                      |                             |                                   |
| 0-14                     | 147.92               | 4                    | 2                           | 1,183.36                          |
| Total transportation distance for 6-wheel truck | 1,183.36 |

![Figure 1 Customer and pre-selected warehouse location](image1.png)
survey, government official interview, information provided by government, website, and google earth map. It is found from this information that there is no significant difference between each site corresponding to two factors; availability of important facilities, and tax and law. As a result, these two factors are then eliminated from our analysis. The left factors are then be evaluated and weighted in the order of their vital effect to decision. The evaluation for the weights is done by 3 experts who work in the warehouse using the relative scores ranked for each factor. Information relative to each site are then analyzed and concluded in term of score corresponding to each of the 6 factors. Table 2 shows the vital weight of each factor together with the score obtained by each site for each factor.

To compare the appropriateness between the 4 sites, weight-scored is applied as a major criterion. The more the total weight-score, the more prefer the alternative. The total weight-score of each alternative can be calculated as follow.

\[
\text{Total weight-score of alternative } i = w_i \times S_j
\]

where

\[
i = \text{alternative (} i = 1,2,3,4) \\
j = \text{factor (} j = 1, \ldots,6) \\
w_i = \text{vital weight of factor } j \\
S_j = \text{score of alternative } i \text{ corresponding to factor } j
\]

<table>
<thead>
<tr>
<th>Table 2 Weight - score calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Proximity to customer</td>
</tr>
<tr>
<td>Transportation infrastructure</td>
</tr>
<tr>
<td>Land and construction cost</td>
</tr>
<tr>
<td>Variety of communication and</td>
</tr>
<tr>
<td>transportation channels</td>
</tr>
<tr>
<td>Labor availability</td>
</tr>
<tr>
<td>Environment</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

From the above Table, it is shown that the total weight-score of settling the new warehouse in Bangsue, Chatuchak, Dindeang, and Dusit area are 4.10, 4.14, 2.74, and 3.71, respectively. As a result, Chatuchak is selected as the most preferable area for settling the warehouse.

In order to determine the benefit of the proposed warehouse, transportation cost relatively to new delivery method is calculated. Based on the fact that volume to weight ratio of most of herbal products is low, we can make the assumption that the new warehouse can be used to support a whole month customer demand in Bangkok area. In addition, 6-wheel truck is used twice a month in order to ship the product from manufacturing warehouse to the proposed warehouse and to another large volume’s customer (code = 14). The total average transportation distance and cost are then calculated similarity to those in Table 1.

The calculation results show that the total transportation cost relatively to new warehouse is 11,398.80 bahts. It should also be noted that this reported cost is the average cost of three referent points within Chatuchak area and the analysis focus only on 13 customers. It illustrates that the proposed distribution system can reduce the transportation cost of the current method to 11,777.87 bahts per month or 50.82%.
4. Analysis of the proposed distribution method

To determine the actual economical benefit of the proposed delivery method, not only transportation cost to be considered, but additional cost relatively to new warehouse operating cost should also be taken into account. So, in this part, the other concerned costs is considered, the net present value (NPV) of the proposed transportation methods are determined, and then the indirect benefit of settling the warehouse in Bangkok area is discussed.

Operating cost of the proposed warehouse

The costs related to the operation of the proposed warehouse are as follows.

1. Cost of warehouse officer: in this study, one officer is assigned to the new warehouse. The one who responsible for warehouse operation at the manufacturing warehouse in Prachinburi province is assigned to responsible for the proposed warehouse. As a result, there is no additional operating cost does exist in this proposed delivery system.

2. Cost of facility: in this study, for long term benefit, we decide to invest in the new facility. The cost of this facility is about 2,200,000 bahts. According to this investment, the depreciation cost is calculated only for the building and all material handlings. The depreciation cost in total is about 55,000 bahts per year and the salvage value of this facility at the end of year 10 is about 2,500,000 bahts. These costs are obtained from site survey in Chatuchak area and also government official record involving evaluation cost of facility in this area.

Net present value of the proposed delivery method

In this part, the net present value of the proposed method beyond the existing method is analyzed for ten years. Figure 2 shows the projected cash outflow and projected cash saving of the proposed method. Based on the cash and benefit flow in Figure 2, the net present value can be calculated using discount rate of 3.5 %.

![Figure 2](image-url)

**Figure 2** Cash and benefit flow of the proposed delivery method

From the cash and profit flow in Figure 2, we obtain the net present value 280,488.8 bahts. It should be regarded here that this NPV is derived based on only the fourteen customers in Bangkok area. Actually, there are other small order volume customers that are not involved in the analysis. Thus, it can be concluded that the actual net present value should be higher than the represented figure.

**Indirect Benefit of the proposed delivery method**

In addition of direct benefit in term of transportation cost reduction, there are some other benefits of the proposed delivery method. As the new warehouse is operated, the benefit related to this warehouse is as follows.
1. Increasing customer satisfaction as a result of shorter delivery lead time and lower investment in safety stock.

2. Increasing future demand and sale volume as a result of customer satisfaction and probability lower selling price.

3. Saving higher transportation cost as the oil price continuously increase because increasing of future oil price; making delivery from Prachinburi province to Bangkok area inhibitive expensive.

4. Benefit from the return on investment of new facility in the long term.

5. Conclusion
This paper presents an application of logistic management in order to reduce delivery transportation cost. A case study of herbal product distribution system in Thailand is concerned. Transportation cost analysis result of the current delivery system illustrates a high delivery cost in Bangkok area. The solution calls for an additional warehouse in Bangkok. Based on data obtained from various sources, factor analysis technique is applied in order to evaluate four alternatives site corresponding to important factors. The analysis results propose that Chatuchak area is the most preferable site. Similar transportation cost analysis to that of the current one is performed. The analysis results show that the new delivery system offers delivery costs reduction by 50.82%. Although, considering the other expenditure might show a small cost reduction, the other benefits effect in long term which is shown that NPV equal 280,488.8 bahts. It should be noted that the obtained NPV is derived based on only the fourteen customers in Bangkok area. As a number of customer increase, the NPV is expected to increase. In addition, there are some other indirect interesting benefits such as proximity to customers, short delivery lead time, and may be, increasing of customer and demand in the future.

Reference