TRIANGULAR BACKHAUL TO REDUCE COST

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ABSTRACT

Freight transportation charge is a major expense for this focus exporting company in a competitive market. Data analysis revealed that the company is under-utilizing its vehicles due to empty truck trips. The company looked for ways to minimize these empty runs, by considering a backhauling strategy. The company selected the triangular backhauling form as it has the best combination of inbound packaging material and outbound delivery of finished goods. The proposed strategy was tested on the transportation reports for 2014, using Excel, to calculate the reduced empty run kilometers and the cost savings benefit. The company must redesign the transportation routing and change the type of truck used to transport packaging material from a six-wheel truck to a 40 foot container truck. This solution was developed by the company's export team, in collaboration with the packaging supplier, to provide a loading plan and loading equipment. There was also collaboration with a third party logistic provider on pricing.

บทคัดย่อ

เพื่อเพิ่มขีดความสามารถในการแข่งขันในปัจจุบัน บริษัทผู้ส่งออกจึงให้ความสำคัญกับค่าใช้จ่ายในการขนส่งสินค้า เนื่องจากค่าใช้จ่ายส่วนนี้เป็นหนึ่งในค่าใช้จ่ายที่สำคัญของการส่งออกของบริษัท ซึ่งคาดว่าหากลดค่าขนส่งได้ บริษัทจะสามารถลดต้นทุนการขนส่งและสามารถทำกำไรได้มากขึ้น การวิจัยฉบับนี้ได้ทำการศึกษาบริษัท SC พบว่าบริษัทต้องรับผิดชอบค่าขนส่งของรถเที่ยวเปล่า ซึ่งเป็นค่าขนส่งที่ไม่สามารถทำกำไรหรือสร้างรายได้ให้กับบริษัท การเสนอให้บริษัทใช้วิธี "ขนไปและขนกลับแบบสามเหลี่ยม" โดยปรับเส้นทางการเดินรถและประเภทของรถขนส่ง โดยให้รถลากตู้ขนาด 40 ฟุตไปรับวัสดุในการผลิตสินค้าไปส่งที่โรงงาน และนำสินค้าจากโรงงานส่งไปยังชายแดนไทย-มาเลเซียโดยใช้ขนส่งรถคันเดียวกัน พบว่าสามารถลดจำนวนรถเที่ยวเปล่า ลดระยะทางการเดินรถและลดค่าขนส่งของทางบริษัทได้

INTRODUCTION

The company in this case study is a leading household brand located in Bangkok, Thailand, called "SC Company" (a pseudonym for confidentiality). It is a 'fast-moving consumer goods company. 50% of its products are exported, by ship, plane and truck. The company decided to

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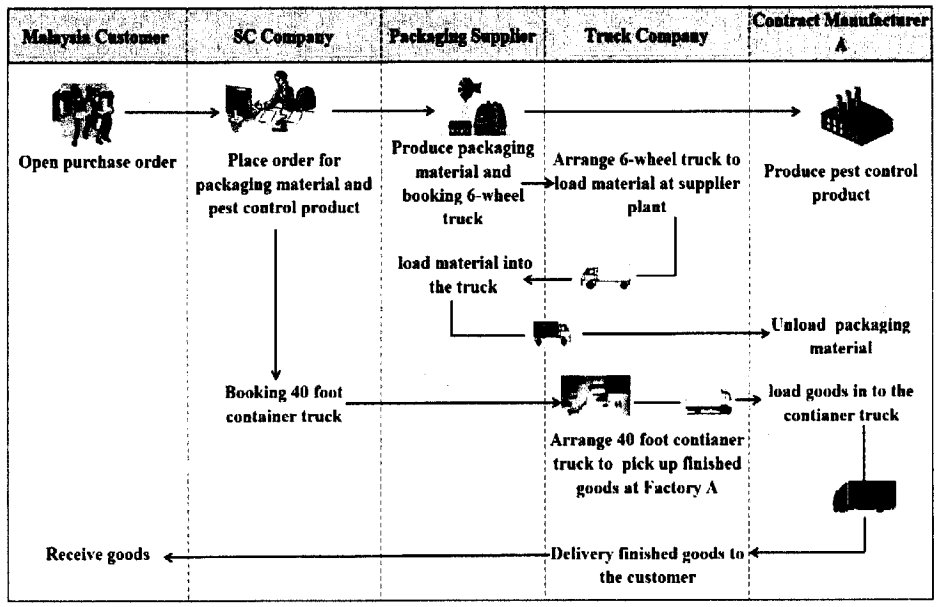
outsource the manufacture of its products to external suppliers, called contractors. These products include domestic cleaning, pest control, and domestic storage. Each contractor would make products from one category, such as pest control products by factory A, domestic cleaning by factory B, and so on.

The SC Company distributes its products to local and export markets, but this case study will focus on the export market, and specifically Malaysia which is the biggest sales customer, the core product being pest control conveyed by an average of 100 trucks per month. The company sends the goods to Malaysia by land using trucks since the transit time is only three days. The terms of the delivery contract are that SC bears all inland costs such as delivery costs and export clearance costs until the goods reach the border with Malaysia. Then, the customer bears the transport cost and risk within Malaysia. The supply chain for this is below.

Figure 1: Supply Chain Mapping of SC Company



Source: Author

When a purchase order is received, SC Company places an order for packaging material to the supplier located outside Bangkok and sends to Factory A an order for the pest control product. There is a 4 week lead time for packaging material and an 8 week lead time for the pest control product. The packaging will be delivered to Factory A using a 6-wheel truck booked by the packaging supplier, but SC company is responsible for the cost of this transportation. After the finished goods are ready to load, SC company books an empty 40 foot container truck (from a selected truck agent) and sends it to Factory A for loading the packed product and

transportation to the customer in Malaysia. The 40 foot container truck is what the customer specifies.

The SC transportation cost for these exports to Malaysia were 66% of total transportation costs (while other product categories were 34%). The cost of transportation consists of 6-wheel trucks that deliver packaging material from the supplier plant outside Bangkok to Factory A in the provinces, and the container trucks that transport goods from Factory A to the delivery point at the border with Malaysia. The transport routing for packaging material delivery is managed by the supplier while the routing for finished goods is managed by the SC Company. The participants who manage the transportation network may lack knowledge of the strategy for transportation routing, which may lead to inefficient transport management.

From analysis of the as-is transportation process of pest control products to Malaysia, the researcher found that there are empty truck trips both in transporting packaging material and finished goods. These empty trips resulted in unutilized truck capacity, a waste of the company's resources since the company had to pay empty trip distances charges to the trucking company, yet these empty loads did not generate any revenue.

The research studies triangular backhaul techniques, and analyses transportation cost reports for 2014, to decide whether using a triangular backhaul technique would reduce the number of empty truck trips and transportation costs.

REVIEW OF RELATED LITERATURE

The physical distribution of goods is one of the key success factors in the fast moving market of today (Ala-Risku, Kärkkäinen & Holmström, 2002). Freight transport is one of today's most important activities, with increasing influence on the performance of all other economic sectors (Crainic & Laporte, 1997). Distribution and transportation costs account for about 20% of the total cost of consumer goods. National studies report that 30% of trucks on European roads are fully loaded while 40% of the trucks are moving empty. So it is important to improve distribution and transportation processes for cost savings through efficient solutions for goods distribution (Reimann & Ulrich, 2006).

Meixell and Norbis (2006) mentioned that transportation in the manufacturing business not only creates costs but also the opportunity to be more competitive. Transportation efficiency leads to better performance of company logistics functions. A company could improve its logistic performance by consolidating shipments across vendors, by optimizing the mode of transportation, and by matching inbound and outbound shipments to reduce the number of empty backhauls.

Islam and Olsen (2013) stated that the under-utilization of container trucks could be defined as the empty trip problem, which may happen in both head-haul (out full) and backhaul (return empty). An empty trip is the most noticeable form of vehicle underutilization. In addition, the number of empty runs is wasteful economically and is environmentally harmful. It is estimated that in 2003, an extra 1.1 million tons of carbon dioxide was emitted into the atmosphere by trucks (McKinnon & Ge, 2006; Sankaran, Gore, & Coldwell, 2005). Backhaul is acknowledged

as a key priority in reducing inefficient capacity utilization. The results, when backhauling was used, were improvement of overall operation efficiency, reduced pollution, and less traffic congestion.

Armstrong (2009) stated that a balanced lane situation occurred when there was head-haul freight movement from point of origin to the final destination and a backhaul on the return trip loaded with whatever goods were required to fill the truck to capacity. Since imbalance lanes occurred in the market (head-haul trips more than return trips), truck loading companies either charge the freight rate at high enough price to cover all costs from point of origin to final destination and back. Or they find another customer with loads close to the original destination that require moving to a site near to the point of origin, covering the costs of the return trip. Due to competitive market conditions, that truck company could not charge a freight rate high enough to cover all costs of transportation that included an empty return trip. This led the company to develop a truck load network with sufficient lane balance to minimize the empty trip distance.

According to Ling and Wei (2014), the vehicle routing problem means "to design- an appropriate route according to customers demand and under a series of constraint conditions such as demand volume, dispatched volume, vehicle capacity limitation, trip limitation and time limitation to achieve certain objectives such as the shortest mileage, the smallest expenditure and the fewest dispatched vehicles". The objectives of vehicle routing solution were to develop the vehicle route to improve transportation costs by minimizing the total travelled time, minimizing the distance of the travelled route and reducing the number of vehicles (Toth & Vigo, 2002).

McWilliam and James (2007) mentioned that fuel consumption could cost around 30% of total vehicle operating costs, so making the best use of the available load space can help to reduce the cost through back-loading, load consolidation, load stacking, and the use of multiple-decked vehicles.

O'Leary and Iredale (1974) explained that the increase in transportation costs was a consequence of unutilized truck capacity, which could be attributed to four sources:

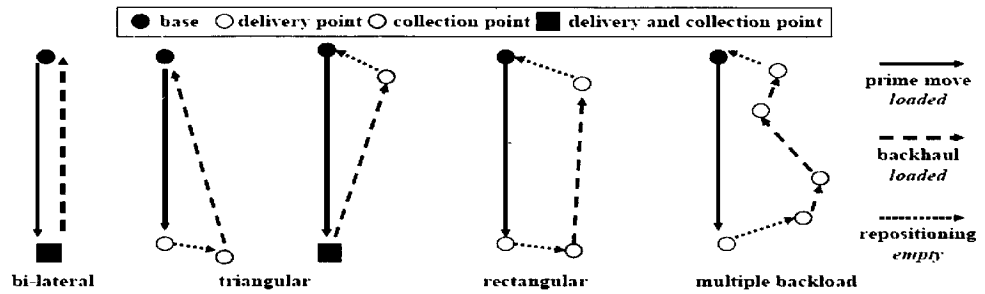
1. Trucks running empty on the return trip to the plant.
2. Trucks standing idle part of the time.
3. The ratio of truck load to capacity is not maximized.
4. Trucks not following the least-cost route in servicing customers.

Empty running was the main indicator of poor vehicle capacity utilization. Around a third of vehicle-kilometers were for empty runs. This occurred when the company could not find a return load. There are several ways in which a company can increase the levels of back-loading, including logistical initiatives, use of freight procurement services and installation of vehicle tracking systems (Waters, 2010).

McKinnon and Ge (2006) commented that all freight consignments move in one direction, from point of production to point of consumption. This creates a major logistic challenge in order to find back-loads for the return trip of the vehicle. In the absences of a backload, the vehicle must return empty, which is capacity underutilization. Empty running also generates a wasted resource that does not generate any economic revenue. The two authors propose that there are four types

of backload operations: bi-lateral, triangular, rectangular, and multiple backload. This case study focuses on a triangulation route in which another leg is added into the route to avoid an empty haul back to the point of origin. The four types of backhauling, including the triangular type, are shown in Figure 2 below.

Figure 2: Backhauling Operation Types



Possible Source of Delay				
Re-loading at original delivery point	◇			
Off-loading at vehicle base	◇	◇		
Repositioning journey leg(s)		◇	◇◇	◇◇◇◇
Loading at separate collection point		◇	◇	◇◇
Off-loading at separate delivery point			◇	◇◇

Source: McKinnon and Ge (2006)

To explain the four types in Figure 2:
1) **Bi-lateral** is where the truck runs fully loaded from point of origin to the delivery point, and is loaded with goods back to the point of origin.

2) **Triangular** is where the transportation routing looks like a triangle, with the truck running fully loaded to the delivery point, then running empty to pick up another consignment at a collection point, and then running back to the point of origin with a loaded truck. Another variation of this triangular type would be where the loaded truck runs from the point of origin to the delivery point, unloads the goods and picks up other goods at the delivery point, then runs with a full truck to the a collecting point, unloads, and finally runs empty on the return trip to the point of origin.

3) **Rectangular** is where there are four nodes of truck stops: the point of origin: two delivery points and one collection point. The loaded truck run from the point of origin to the delivery point, off-loads the goods, runs empty to the collection point and then runs with a full truck to the second delivery point where it unloads, returning empty back to the point of origin.

4) **Multiple** backload is the most complicated, as more than four legs of travel are used in the transport routing. The truck would run to deliver goods to three delivery points and pick up another consignment at two different collection points and run empty back to the origin.

This present case study focuses on reducing the number of empty hauls as well as minimizing transportation costs by using a backhauling technique. The Table below shows several previous studies with methodologies, solutions, and results after implementing backhauling techniques.

Table 1: List of Literature Reviewed

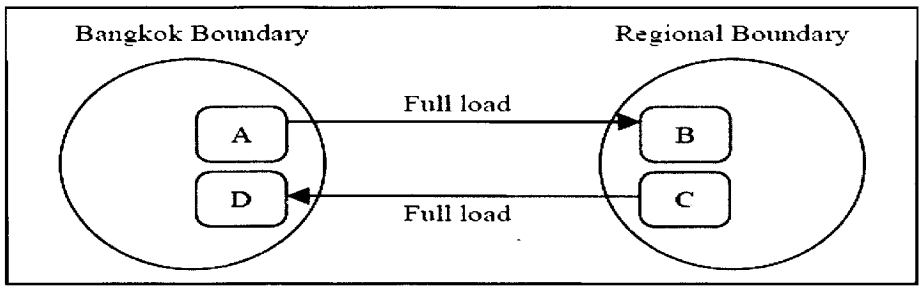
Literature	Objectives	Research Questions	Result
Shakantu, Muya,Tookey, and Brown (2008) "Evaluating truck empty running in construction."	To reduce number of empty runs to increase transportation efficiency levels through back-loading	Study the movement of delivery material and removal of waste, integrating those movements in the same routing.	About 36% of all traffic resulting from movement of construction vehicles on the roads could be removed.
Peetijade and Bangviwat.(2012) "Empty truck run reduction in the Bangkok area toward sustainable transportation."	To reduce a Bangkok manufacturer's empty truck runs and lower its transportation cost.	Study the number of empty truck runs in Bangkok, and how to solve the empty run problem.	The empty truck runs can be reduced by 14.59% of total distance by matching head haul and backhaul processes
Carlsson and Rönnqvist (2007) "Backhauling in forest transportation."	To study and identify a set of efficient backhauling routes.	How does the model and solution of backhauling route perform in a realistic case?	The efficient backhauling route could reduce both direct cost and pollution.
Zumerle (2013) "Coca-Cola transportation and distribution."	To use backhauling to reduce the delivery distance and carbon emissions	Continue to expand backhauling by collaboration with customers and suppliers	Two million road kilometers and 1,900 tons of carbon had been removed.
Gardner (2013): "Reverse logistics for vinyl flooring."	To manage the empty truck trips and reduce wasted materials.	How to manage the vehicles that run empty after delivering material to the construction site.	The number of head haul and back haul including cost and carbon were reduced.
Verhoeven (2008) "Backhauling: the optimal road to Everest"	To understand more about cross border routing networks and look for opportunities for cost savings through backhauling.	How to organize a cross border routing network and what are the improvements and benefits to optimize the network	In balancing export and import, open or closed backhauls are the main factors that influence cost saving.

Source: Author

Peetijade and Bangviwat (2012) also studied the empty truck runs of a manufacturer in Bangkok with the aim of lowering transportation costs of the manufacturer and improving the efficiency of the energy used. From the survey, he found that 210,193 km or over 80%% of the total distance was run empty (and could be reduced by 14.59%). The return trip was the cause of unutilized truck capacity, high transportation cost, and waste of energy and pollution issues. Therefore, this

case study suggested using backhauling to solve the problem by using the matching process shown in the Figure below.

Figure 3: Transportation Matching Process



Source: Peetijade and Bangviwat (2012)

In this Figure, the truck is run from the original point A to the destination point B fully loaded, and carries goods back from point C to point D within the same region and routing. The inefficiency of transportation resources could be removed by using the matching process and the cost and the distance would also be reduced due to minimization of empty truck trips.

Carlsson and Rönnqvist (2007) studied backhaul in forest transportation. They looked at transportation from the harvest area (supply point) to industries (demand points) such as paper mills, saw mills and heating plants. The basis for transportation planning is often integrated with harvest scheduling so problems occur when the company has to decide which supply point should deliver to which demand point. This leads to the transport order for haulers who must decide actual routes for their vehicles. To achieve higher transport efficiency, backload is the method to support reductions of empty hauling by matching supply delivery with demand delivery. The result of applying backload is not only reduction in empty runs but also reduction in transportation costs.

Zumerle (2013) studied the transportation and distribution of the Coca-Cola Company. He found that the total run distance was more than 106 million kilometers creating 7% of total carbon emissions. Therefore, the goals of the research were to reduce the company road distance and carbon emissions. The company decided to use backhauling as a strategy to lower road distance and carbon emissions. Collaboration between customers and suppliers was required, to combine delivery legs with collection legs to avoid empty running. With this collaboration, a backhauling strategy could save the company two million road kilometers and 1,900 tons of carbon emission in 2013.

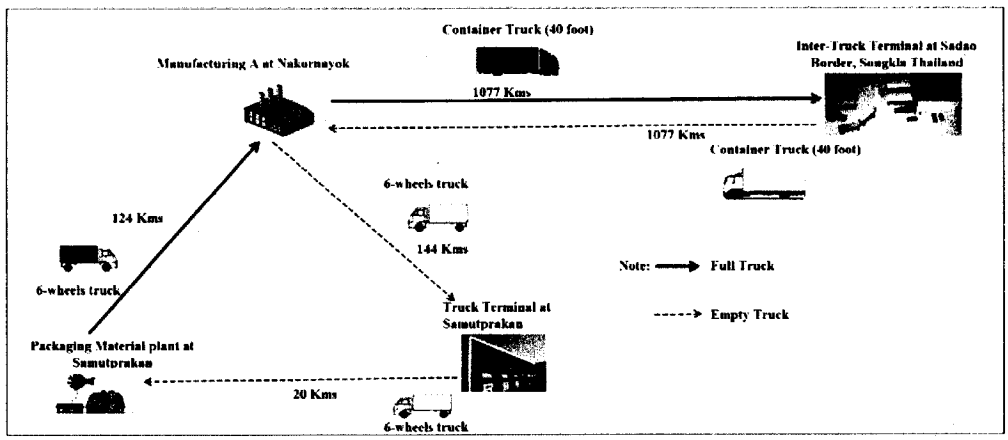
METHODOLOGY

There were five main steps: data collection, data analysis, opportunity analysis, and proposal of a model. Face-to-face interviews were held, with a sales-person who works for the packaging supplier, a customer service officer and an inter-truck manager of the transportation service provider. Data was analyzed for the total sales and transportation costs of each product category

exported to Malaysia. An opportunity analysis reviewed the current process of material delivery to the contract manufacturer A and the export process of finished goods to the customer. It was found that the company had wasted truck capacity due to running empty. Finally, the researcher proposed a backhauling technique, including a new routing design, to reduce empty truck trips.

It was found that 94% of the delivery cost was for the transportation cost. The transport cost of the 6-wheel trucks for packaging material was US$ 700,000 (28%) involving 2,375 trips, and the container trucks cost was US$ 1million (66%), involving 1,236 trips. The transportation routing identified, is shown in Figure 4.

Figure 4: Current Transportation Routing of Pest Control Product



Source: Author

As depicted in Figure 4, transportation is divided into the packaging material delivery process and the finished goods delivery process.

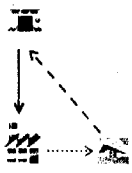
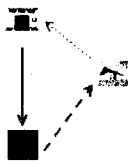
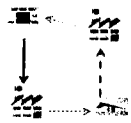
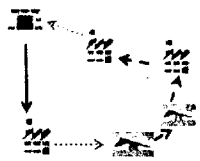
The researcher found that there were three routing legs that involved empty trucks. These empty truck legs included:
* a six-wheel truck travelling from the truck terminal, to pick up material at the packaging supplier plant, an empty return trip of the six-wheel truck to the terminal after unloading packaging (164 km empty running or 56.94% of the total six-wheel truck route); and
* an empty 40 foot container truck run from inter-truck terminal to pick up finished goods at Manufacturer A (with 1,077 km empty return).
These empty truck trips resulted in unutilized truck capacity and a waste of the company's resources since the company needed to pay for the empty trip distances charged by the trucking company even though this these empty load distances did not generate any revenue.

OPPORTUNITY ANALYSIS

The researcher found that the costs of transporting the pest control product amounted to 94% of the total delivery costs. This presented an opportunity to reduce the transportation costs of SC

Company by reducing the total distance travelled by empty trucks. Thus, the objective of this research was to analyze transportation data and determine a more suitable routing technique. The solution was to incorporate a backhaul technique. That way the backload capacity of the trucks could be used to improve transportation capacity, increasing transportation efficiency and reducing the transportation cost (Islam & Olsen, 2013; McKinnon & Ge, 2006; Lohatepanont & Adulyasak, 2006). From the relevant literature and techniques that could be used to solve the existing problem, the researcher matched the current delivery process against the four types of backhauling to find the most appropriate form to fit the company.

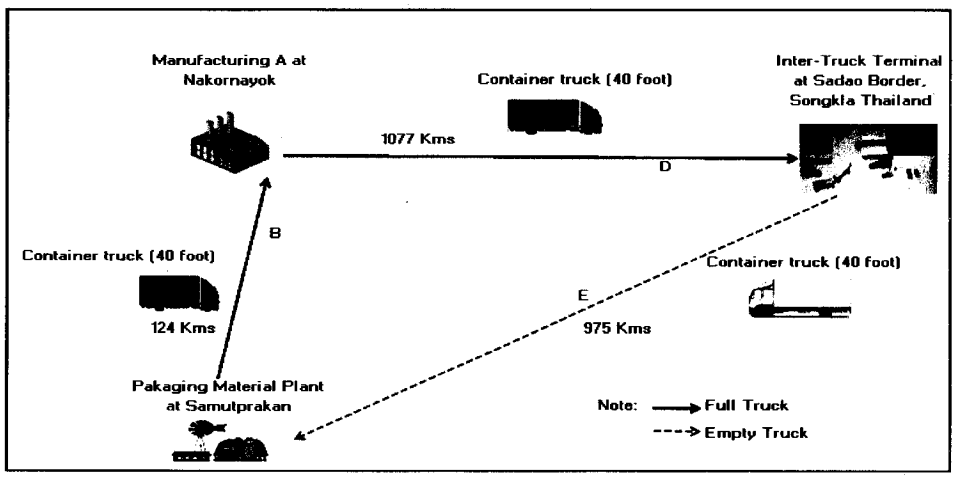
Table 2: Four Categories of Backhaul Operation

Backload Form	Explanation
1.Bi-Lateral 	The bi-lateral backhaul form is the normal form of backload which has two route legs. The vehicle would run fully loaded from the point of origin to the delivery point, unload the goods and pick up another load of goods from the delivery point hauling them back to the point of origin.
2.Triangular  A	In the triangular backhaul form there are three nodes of delivery points. This method can be broken down into two types: triangular form A, and triangular form B. In triangular form A, the fully loaded vehicle moves from the point of origin to the delivery point, unloads the cargo and runs empty to a collection point, then loads goods at that point and runs back to the point of origin fully loaded.
 B	In the second triangular form B, the vehicle runs fully loaded to the delivery point, unloads and picks up a new load. The vehicle then runs fully loaded to another delivery point, unloads and runs empty back to the point of origin.
3.Rectangular 	In the rectangular backload form, the vehicle runs fully loaded to the delivery point, runs empty to a collection point, then backloads to another delivery point, and then runs empty back to the point of origin.
4.Multiple backload 	The last type is a multiple backhaul. This type of backload is the most complicated form as there are more than four legs in the journey - two collection points and three delivery points.

Source: Adapted from McKinnon and Ge (2006)

The triangular form is the most appropriate form to apply since the existing transportation process of the company had two nodes of loading and unloading goods, as in the triangular backhauling form. After comparing the existing transportation process with triangular forms A and B, the researcher selected triangular B as a model for re-arranging the transportation process. This was chosen because it was possible for the company to apply it by assuming that the inter truck terminal was the point of origin, the packaging material plant was the collection point, and Manufacturer A was the delivery and collecting point. The To-Be transportation process of the company is shown in Figure 5.

Figure 5: To-Be Transportation Process of SC Company



Source: Author

Figure 5 indicates that there is only one empty truck trip left in the transportation process. That leg would be when the container truck runs empty from the inter-truck terminal at the Thai/Malaysian border at Sadoa, Songkla (point of origin) to the packaging material plant at Samutprakan in Thailand (collection point).

The delivery cost of pest control products of SC Company had been reduced after applying a triangular backhaul technique to the company's supply chain to improve the transportation routing network as well as create a new effective routing.. The transportation cost savings shown in the Excel spreadsheet for the year 2014 is around US$ 170,000. Thus, the number of empty truck kilometers would be reduced from 1,241km to 975 km if the company applied a triangular backhaul technique. The results of projected transportation cost savings using the triangular backhaul was then proposed to the top management team of the company as a tool to assist the company achieve cost savings and solve the practical research problem.

CONCLUSION

The researcher found that the cost of transportation consumed the highest proportion of delivery costs. The researcher then analyzed the existing delivery process of SC Company by

interviewing the material supplier and inter-truck forwarder to gather the transportation routing from the supplier plant to the border with Malaysia. Through this, the researcher found that the truck was underutilized and company resources were wasted due to empty load trips. The study explored the use of a triangular backhaul to reduce the number of empty truck trips and the cost of transportation. The delivery cost of pest control products of SC Company was reduced by 13%. The number of empty truck kilometers would be reduced by 21% if the company applied a triangular backhaul technique. The results of projected transportation cost savings using the triangular backhaul was successfully proposed to the top management team of the company as a useful tool to assist in reducing costs in a competitive market.

This research has provided an example of the practice of inland transportation routing management for an exporter of fast moving consumer goods. To implement the proposed model based on a triangular backhaul technique from McKinnon and Ge (2006), the company needs to redesign the transportation routing, change the type of truck to deliver packaging material, and collaborate with the involved parties which are a packaging supplier and a third party logistics provider. Therefore, before implementation of the triangular backhaul technique the top management should consider all issues relevant to the business concern and study the advantages and disadvantages of the proposed technique. Implementation of the backhaul technique without understanding could lead to failure to achieve the success the company wants and deserves.

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