OPTIMIZATION OF A DISTRIBUTION NETWORK OFA BEVERAGE INDUSTRY IN PAKISTAN

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Abstract

The project is about the franchise of Pepsi Co. Northern Bottling limited, located in Hayatabad Industrial area, KPK. The core aim of almost every organization is to reduce cost and bring efficiency in their supply chain. Northern Bottling Company wants the same. Northern Bottling Limited perform procurement, manufacturing and distribution of products. They have local and international suppliers, state of the art production plant and a fleet of 250 vehicles to cater the demand of their customers. The customers in this case are distributors since they only deliver products to their distributors and distributors then further deliver them retailers, hotels and restaurants.

After carefully analyzing the data collected and reviewing all the interviews conducted, we identified some problems in the processes. By solving these problems cost can be reduced and company can operate in a productive way. The major problem is in the logistic department. The distribution network is spread all across KPK province. It needs optimization along with proper utilization of vehicle capacity and appropriate number of vehicles for the products distribution. Plant is located in Hayatabad along with one warehouse located near it and other is located in Kahuta Islamabad. The products are moved in pallets from plant to warehouse and from warehouse to distributors. NBL has divided their KPK region in 4 sections: South, Central, Base and North. Each section has different number of distributors and hence generate different sales values.

As demand is different every month so we have kept the monthly data in account and applied the multi period linear programming method by keeping time period of 12 months. The data collected and researched on is of the year 2019.

The results clearly shows that the company is using more vehicles then required and they have to change some practices to make their logistics department more efficient and deliver in timely manner. The finding along with recommendation are mentioned in the project for further analysis and for the use by similar industries to solve their logistics problems, lower costs, and gain completive advantage.

Keywords: Vehicle capacity, Logistics, Multi period linear programming, KPK region

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Abbreviations

NBL	Northern Bottling Limited
KPK	Khyber Pakhtunkhwa
PAF	PepsiCo America Foods
PAB	PepsiCo America Beverage
PI	PespiCo International
OTC	Order to Cash
OFT	Online Fund Transfer

Chapter 1

1.0 Introduction

1.1 Background

PepsiCo was established around 1895. PepsiCo is dominating the world's food and beverage market. It is operating in more than 200 countries. For centuries, the organization has developed according to the need and demand of the customers. It is providing happiness to people for decades. Initially it was just a cola company but as time passes, it penetrated the market by its products such as soft drinks, snacks and restaurants. PepsiCo has attained many loyal customers and a huge market share. The main aim of the organization is to grow by focusing on the good will of the environment, social and economic factors and improve the world. The commitment, dedication and the focus on the wellbeing of the consumers has led Pepsi to attain the status of the world's renowned company. There are around 185,000 people currently employed by PepsiCo. The main organization includes "PepsiCo America Foods" (PAF), "PepsiCo America Beverage" (PAB) and "PespiCo International" (PI). As the name indicates, PepsiCo America Foods deals with all the snacks that came under the name of Pepsi. PepsiCo America Beverage deals with the beverage business and PepsiCo International deals with businesses on international level like in Asia, Africa, and Europe etc.

PepsiCo has developed a vision to be the global leader in terms of beverages and snacks by attaining a loyal customer base. To move forward with this vision, the organization plans to become more aggressive in their approach by targeting more customers and by supplying the best product.

The mission of the organization is to develop smiles on the faces of their customers. This mission statement is based solely on the goodwill of customers. Since it is an international company operating in different countries, dealing with different customers with different backgrounds and different cultures. PepsiCo make sure that they cater the need of each and every customer efficiently and they develop a strong bond with their customers throughout the world.

1.1.2 PepsiCo Headquarters

The head quarter of PespiCo is located in New York. In Pakistan PepsiCo has head quarter in Lahore.

PepsiCo in Pakistan operates under franchise bottlers' agreement. Whereby each franchise is assigned one specific area. There are 8 franchises all over Pakistan. Below are the names of franchises and areas assigned to them:

Franchise Name	**Area**
Haidiri Beverages	Islamabad & Rawalpindi
Northern Bottling Limited	KPK
Naubahar Bottling Company	Gujranwala
Riaz Bottlers	Lahore
Pak beverages	Karachi
Sukkar Beverages	Sukkar
Shamim and co	Multan
Punjab beverages	Faisalabad

Table 1 Franchises in Pakistan Source: PepsiCo.com

1.2 Northern Bottling Company Private Limited, Pakistan

The Northern Bottling Company Group was set up in 1998 and is Pepsi's only selling entity for the region of Khyber Pakhtunkhwa. The main factory along with production capacity is in the Hayatabad Industrial Estate, Peshawar. It is concerned with the delivery of products to distributors. The distributors further deliver it to retailers, restaurants, hotels, cafes and caterers etc. As it is the franchise of PepsiCo. the northern bottling company has made its business strategies according to the strategies of parent company. The strategic objectives are parallel to the strategic objectives of PepsiCo. It helps Northern Bottling Company to achieve the target sales in targeted areas with efficiency and in a timely manner. The primary business processes of the Northern Bottling Company is manufacturing and the delivery of products without delays. The organization has a

strong competitive strategy and a strong supply chain to tackle the problems effectively. The main departments include sales, human resource and information technology department.

1.2.1 Products of NBL

The core products of Northern bottling company include:

- Carbonated soft drinks: Pepsi, 7Up, Miranda, 7Up mint, Pepsi black, Mountain dew
- Juices: Slice, Tropicana
- Mineral water: Aquafina, Gatorade
- Energy drink: Sting, sting rush gold

All products have all the SKUs available. There are total of 73 SKUs.

Figure 1 products of Pepsi Source: PepsiCo.com

Below is the detail of the packaging in which these products are available:

PACKAGE
1000 ML PET
1500 ML PET
2250 ML PET
250 ML CAN
250 ML RB
300 ML CAN
300 ML PET
345 ML PET
500 ML PET
1500 ML PET - AQUAFINA
500 ML PET - AQUAFINA
240 ML – STING
250 ML CAN - STING
500 ML – STING
200 ML - TETRA PACK

Table 2 Packaging of Products Source: NBL franchise

1.2.2 Organizational Hierarchy

Northern Bottling Company follows strong organizational hierarchy. The decision making is centralized involving only top management. There are more than 700 employees in NBL and 250 are daily wagers. The sales hierarchy is in the table below:

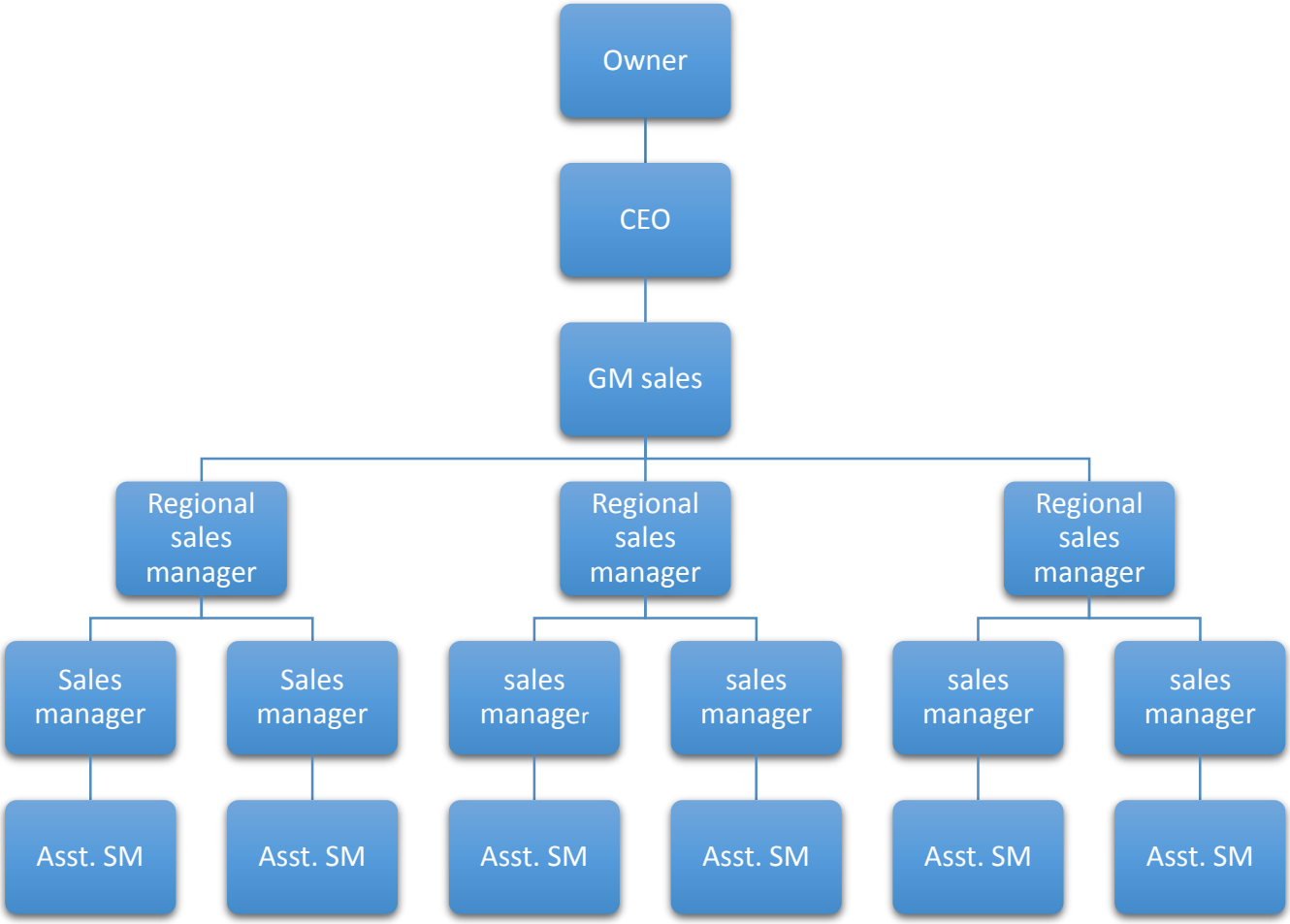


Figure 2 Organizational Hierarchy Source: NBL

1.2.3 Operations

The main operations of the company include procurement, manufacturing and distribution. The procurement is from the trusted suppliers across Pakistan. The manufacturing is done in the plant. NBL has state of the art production facility located in Peshawar to cater the needs of KPK market and some areas of Islamabad and Rawalpindi. The production department is headed by Production Manager. There are two lines installed, one is PET (Plastic) line and the other is RB Glass line. Both lines are fully automated from start to finish. The unit used for planning is cases. One case on average has 9 liters. The company do forecasting every month for the next three months. This is based on the data and sales of last three years, investment of the company in current year and any new product induction. Another important factor in forecasting is the effect of season as

summers have more demand while winters have less demand. This forecasting aid the procurement department to get the raw materials in advance for the production. The main raw materials include sugar, concentrate, bottle caps and plastic bottle. This forecasting is reviewed every month and changes are made accordingly. Daily demand forecasts are taken from sales team on regular basis so the products are produced. Below is the data for the production/supply in 2019:

MONTHS	**PRODUCTION (cases)**
Jan	600,000
Feb	1,900,000
Mar	2,200,000
Apr	3,300,000
May	4,600,000
Jun	5,000,000
Jul	4,800,000
Aug	4,500,000
Sep	3,400,000
Oct	2,000,000
Nov	1,000,000
Dec	600,000

Table 3 Production data (cases) Source: NBL

Figure 3 Production Plant Source: NBL

1.2.4 Warehouse

From the production plant, the final products then go to warehouses in pallets. There are two warehouses catering the need of the distributors. NBL has one warehouse in the Hayatabad industrial estate close to the manufacturing plant. It caters to the 10 units of the KPK area. While Capital region has also only one warehouse that cater the area of Islamabad and Rawalpindi. It is located in Kahuta.

The capacity for each warehouse is:

KPK: =Warehouse | 65000 SQFT (5600 PALLETS) = 750,000 cases

ISB: Warehouse | 125000 SQFT (9000 PALLETS) = 12, 00,000 cases

The products are stored in crates and stacked on pallets.

Stacking: stacking is pyramid
Pallets size: 1.52 meter length
0.91 meter width

1.2.5 NBL Distributor

NBL as per the vision of PepsiCo believes in distributor led businesses. Fast moving consumer goods companies today are staring at a major disruption in their distribution model. Other than some basic technology interventions to track primary sales (sales from the FMCG company to their Wholesalers), and in some cases, secondary sales (sales from the Wholesaler to the Retailers), very little changed over the decades. Products go from brands' manufacturing facilities to their Distribution warehouse (DC), on to C&F agents in each city, on to the hundreds of Distributors (DB) in that city, and finally on to the retailers, where consumers/shoppers purchase them. NBL business is led through the distributors. The franchise only distributes the products to distributors. The distributors then distributes them to retailers. The selection criteria of distributors are through distribution experience, their financial status, area potential, distributor investment and short term and long term assessment of distributor.

There are total of 65 distributors currently working with NBL. The region has stretched from Peshawar to D.I.Khan (South region) and Chitral belt (North region). Each and every town has at least one distributor strategically placed. Distributions are made on the basis of town capacity. Large towns like Peshawar, Noshehra and Mardan has more than two distribution and sometime even three. Smaller towns has usually one distribution.

Below is the data of the region with their cities and distribution name:

REGION	UNIT	DISTRIBUTOR_NAME
BASE	Peshawar	JEHAN BROT
BASE	Peshawar	IMDAD ENTERPRISES
BASE	Peshawar	PRO MARKETING SERVICES
BASE	Peshawar	LIMAR TRADERS (NOWSHERA)
BASE	Peshawar	ALMAN TRADERS (NOWSHERA)
BASE	Peshawar	SEER KHAN TRADERS – PABBI
BASE	Peshawar	HAJI UL-ALLAH & CO
BASE	Peshawar	ASLAM
BASE	Peshawar	ASHFAQ & CO
CENTRAL	Noshehra	MAND TRADERS (CHARSADA)
CENTRAL	Noshehra	MEEN TRADERS – CHARSADDA
CENTRAL	Noshehra	NAN TRADERS DARGAI
CENTRAL	Noshehra	AB TRADERS – SAHAKOT
CENTRAL	Noshehra	SKY
CENTRAL	Noshehra	SHAH AND SONS – SHABQADAR
CENTRAL	Noshehra	KP ENTERPRISES – CHARSADDA
CENTRAL	Mardan	SUMMER ZONE TRADERS SWABI
CENTRAL	Mardan	NEW MARDAN TRADERS
CENTRAL	Mardan	OWAIS TRADERS
CENTRAL	Mardan	UMAIR TRADERS-SHEWA ADDA SWABI
CENTRAL	Mardan	PHILANTHROPE-MARDAN
NORTH	Chakdara	ARSALAN TRADERS
NORTH	Chakdara	SHAH TRADERS-MATTA
NORTH	Chakdara	ANWAR TRADERS-SWAT
NORTH	Chakdara	AK TRADERS-MINGORA SWAT
NORTH	Mingora	ANWAR TRADERS - LOWER DIR
NORTH	Mingora	MEHBOOB TRADERS
NORTH	Mingora	SHAH BROTHERS

NORTH	Mingora	ZEESHAN TRADERS
NORTH	Mingora	AMIN TRADERS-TIMERGARA
NORTH	Mingora	ARZAIN TRADERS
NORTH	Chitral	ABDULLAH TRADERS
NORTH	Chitral	TAKBEER KHAN ENTERPRISES
NORTH	Chitral	FARMAN & ASSOCIATE
NORTH	Chitral	DROSH TRADERS
NORTH	Chitral	MIAN TRADERS - UPPER DIR
SOUTH	Bannu	WAZIRISTAN COLD DRINKS COMPANY
SOUTH	Bannu	HAJI HAMEEDULLAH JAN AND BROTHERS
SOUTH	Bannu	LUCKY TRADERS (BANNU)
SOUTH	Bannu	QARI TRADERS
SOUTH	Bannu	NAYAB TRADERS
SOUTH	Bannu	NAS TRADERS (BANNU)
SOUTH	Bannu	AIK DRAZ (BANNU)
SOUTH	Bannu	HR ENTERPRISES
SOUTH	D.I. Khan	KUN TRADERS
SOUTH	D.I. Khan	DALI TRADERS
SOUTH	D.I. Khan	AIM TRADERS
SOUTH	D.I. Khan	ANA TRADERS
SOUTH	D.I. Khan	ALA TRADERS
SOUTH	Kohat	HAJI GUL TRADERS
SOUTH	Kohat	KOHA TRADERS
SOUTH	Kohat	SHO TRADERS
SOUTH	Kohat	HAMMAD TRADERS-KARAK
SOUTH	Kohat	KK BRO – KARAK
SOUTH	Kohat	BASEER TRADERS
SOUTH	Kohat	AN BROTHERS
SOUTH	Kohat	AFRIDI ENTER

SOUTH	Kohat	SYED TRADERS (KOHAT)
SOUTH	Kohat	GASH ENTERPRISES
SOUTH	Kohat	ZAIN ENTERPRISES-PARA CHINAR
SOUTH	Kohat	SAN TRADERS – HANGU
SOUTH	Kohat	HAN TRADERS-DOABA

Table 4 Distributors data Source: NBL

Below diagram explains the operations of the company from plant to distributors:

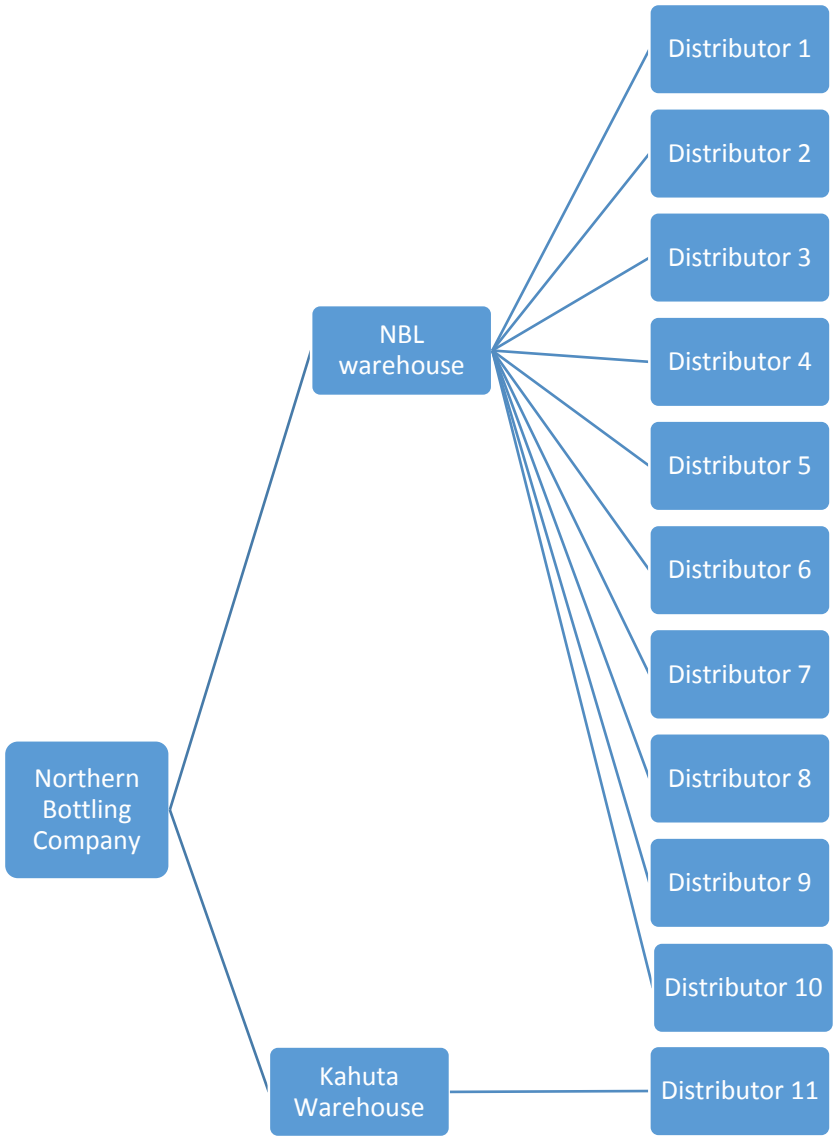


Figure 4 Distribution center chart

1.3 Order Management

Company makes decision regarding individual customer orders. The goal of supply chain operations is to handle incoming customer orders in the best possible manner. During this phase, firms allocate inventory or production to individual orders, set a date that an order is to be fulfilled, generate pick lists at a warehouse, allocate to shipping, and set delivery and so on. There is less uncertainty about demand. At NBL, the production, sales and supply chain departments get together to decide the inventory usually on a daily, weekly and monthly basis.

Company has introduced order management methodology through Order to Cash (OTC). Due to this distributor can place orders over the internet from any place. Every distributor has given separate login ID and password

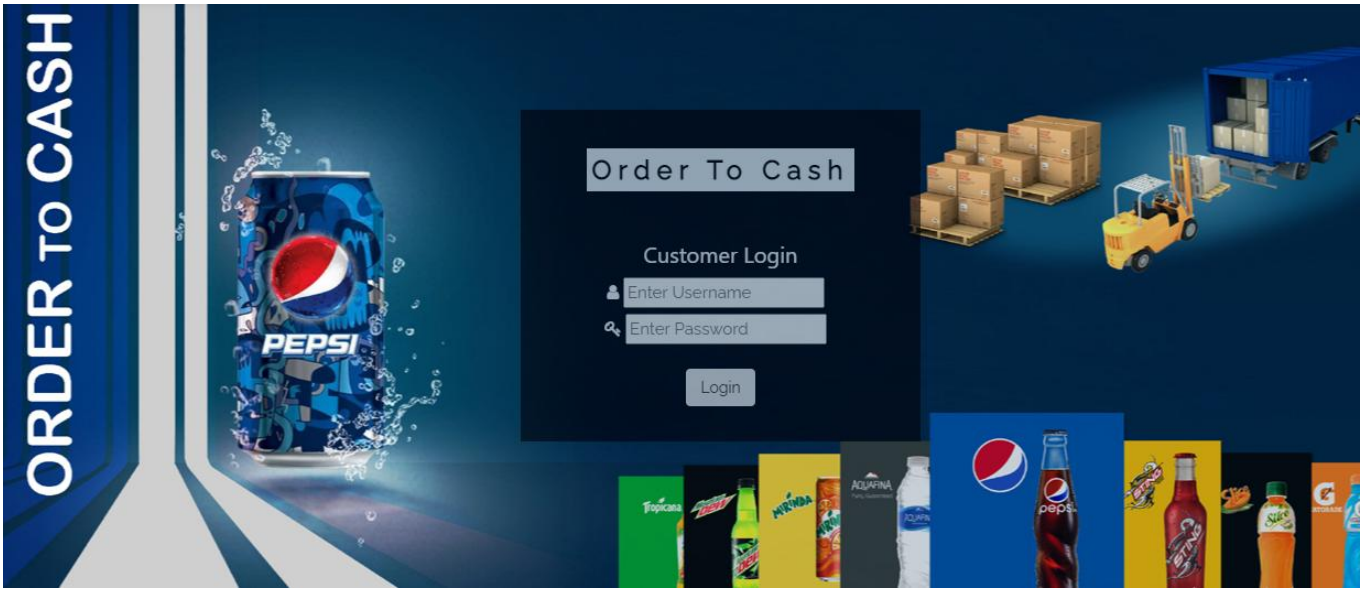


Figure 5 Distributors portal Source: NBL

When distributor enters his credentials then below pages is shown to every distributors.

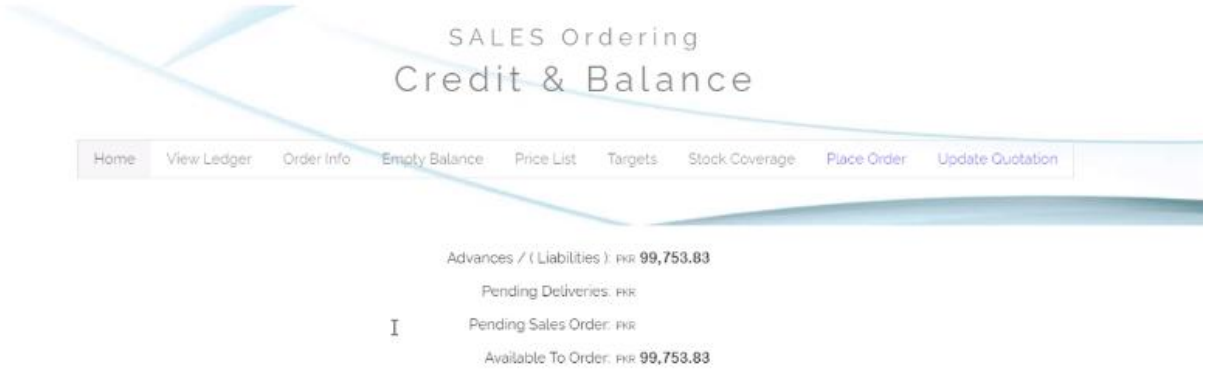


Figure 6 Distributors portal Source: NBL

Distributors can place order on place orders button.

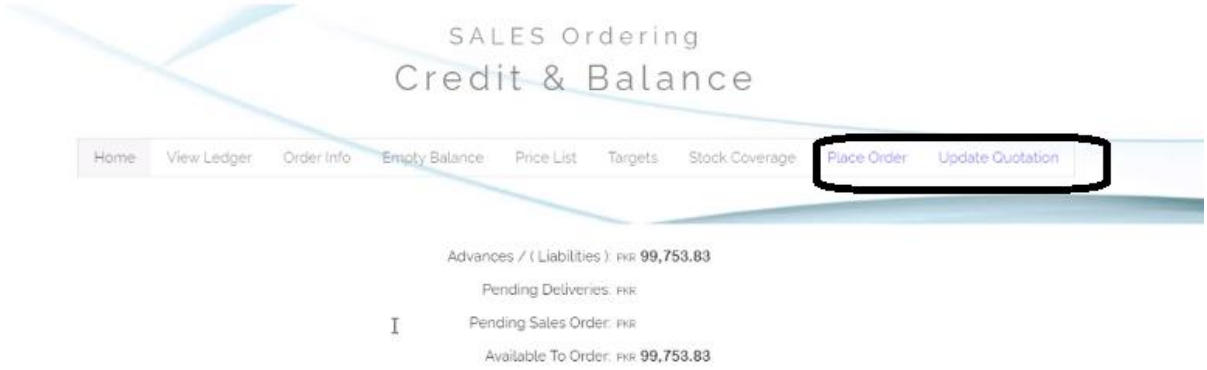


Figure 7 Distributors portal Source: NBL

Orders has to be as per pallet size. Orders other than pallet size are not entertained. Also the minimum order that a distributor can give cannot be less than seven pallets. This table shows the quantity of product per pallet. It is taken from the filled stock report that is generated every year.

FILLED STOCK Report (Standard Per Pallet wise QTY) 26-02-2019	
SKU	**Standard Per pallet QTY**
PEPSI - 250 ML G (24)	**50**
MIRINDA - 250 ML G (24)	**50**
7-UP - 250 ML G(24)	**50**
M. DEW - 250 ML G (24)	**50**
PEPSI CAN250ML(12)	**280**
MIRINDA CAN 250ML (12)	**280**
7-UP CAN 250ML (12)	**280**
MOUNTAIN DEW CAN 250ml (12)	**280**
PEPSI DIET 250ML CAN(12)	**280**
7-UP FREE 250ML CAN(12)	**280**
M. DEW - 300 ML P (12)	**224**
PEPSI - 345 ML P (12)	**216**
MIRINDA - 345 ML P (12)	**216**
7-UP - 345 ML P(12)	**216**
PEPSI - 500 ML P (12)	**168**
MIRINDA - 500 ML P (12)	**168**
7-UP - 500 ML P(12)	**168**
M. DEW - 500 ML P (12)	**132**
PEPSI-DIET - 500 ML P (12)	**144**
7-UP FREE - 500 ML P (12)	**144**
PEPSI - 1000 ML P (6)	**165**
MIRINDA - 1000 ML P (6)	**165**
7-UP - 1000 ML P (6)	**165**

M. DEW - 1000 ML P (6)	**165**
PEPSI - 1500 ML P (6)	**130**
MIRINDA - 1500 ML P (6)	**130**
7-UP - 1500 ML P(6)	**130**
M. DEW - 1500 ML P (6)	**130**
7-UP FREE - 1500 ML P (6)	**104**
PEPSI - 2250 ML P (4)	**112**
MIRINDA - 2250 ML P (4)	**112**
7-UP - 2250 ML P(4)	**112**
M. DEW - 2250 ML P (4)	**112**
AQUAFINA - 500 ML P (12) LOC	**168**
AQUAFINA - 1500 ML P (6) LOC	**104**
BERRY BLAST - 240 ML G (24)	**50**
BERRY BLAST - 500 ML P(12)	**154**
BERRY BLAST - 250 ML CAN (12)	**280**
SLICE MANGO - 200 ML T (24)	**242**

Table 5 Filled stock report Source: NBL

1.4 Assigning vehicle

When order is received from distributors and the payment is made through the online fund transfer (OFT). Finance department confirms this and gives OK signal to the shipping department. The shipping department appoints vehicle to order as per order quantity.

According to the interviews with the transport department manager, the assigning of vehicles is done on daily basis. This decision is not automated. The route, vehicle, pallets loaded on the vehicle is done by transport department team on daily basis. Whenever an order is received, the vehicle is loaded according to it. It is also mentioned that they generally just load the vehicle

according to the order and sent it to distributor. NBL does not wait for the vehicle to be fully filled before delivery.

It takes 15 to 20 minutes in loading. Forklifts are used for loading and unloading of pallets.

Every driver must have three documents before going to the delivery along with the petty cash issued for the tolls and petrol in the way. The three documents are shipping note, excise and taxation document and the gate pass. Shipping note has 2 copies. One copy is submitted to distributor and one is signed by distributor upon receiving of the order and the driver then takes it back to the company.

1.5 Distribution

NBL has its own vehicles for distribution of the products. There are 9 types of vehicles used for distribution and the total number of vehicles are 250.

1.5.1 Types of vehicles

The 9 types of vehicles include:

- Bedford
- Hino
- Ten wheeler
- Mazda 1000
- Mazda 800
- Suzuki
- Shazoor
- Container
- Single Hino

Capacity in term of pallets

Below is the capacity of each vehicle in terms of pallets. This shows how much pallets each vehicle can carry at a time.

Vehicles	Pallet capacity	Total number of vehicles
Bed ford	8	80
Mazda 1000	7	10
Mazda 800	6	20
Container	30	30
Single Hino (Flat Bed)	10	48
Ten Wheeler	16	40
Hino	11	12
Shazoor	3	7
Suzuki	2	3

Table 6 Vehicle data Source: NBL

There is no specific vehicles assigned for any specific areas or distributors. Vehicle allocation is based on the demand/load from the distributors.

1.5.2 Area Division

NBL has divided Khyber Pakhtunkhwa region into 4 main categories:

1. Base
2. Central
3. North
4. South

These four regions are further divided into Unit level. These units are basically the main cities in KPK. Units in this project are referred as distribution centers. Total units are 10. Units are then divided into different small towns.

REGION	UNIT
SOUTH	Bannu
SOUTH	D.I. Khan
SOUTH	Kohat
CENTRAL	Charsada
CENTRAL	Noshehra
CENTRAL	Mardan
BASE	Peshawar
NORTH	Chakdara
NORTH	Mingora
NORTH	Chitral

Table 7 Region data Source: NBL

This plant also distributes to Islamabad and Rawalpindi. But this is not divided in region and units.

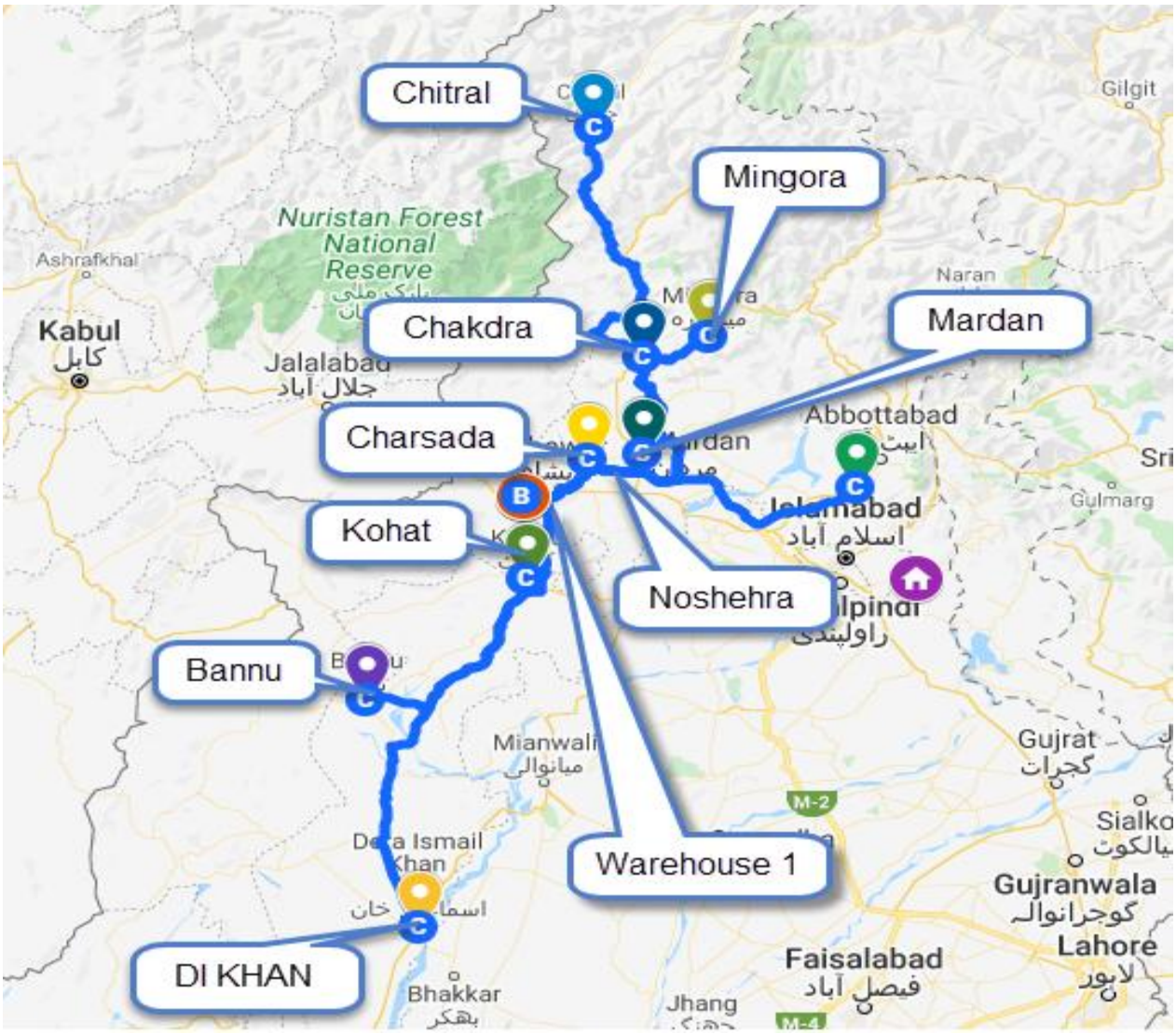


Figure 8 KPK map Source: Google maps

This map explains the area division of the NBL. Point B is the warehouse and all the points C on the map are the units/ distribution centers.

1.6 Process View of Supply Chain

The processes in a supply chain are divided into a series of cycles, each performed at the interface between two successive stages of a supply chain.

Cycle View of Supply Chain

There are five stages in the supply chain (Supplier, Manufacturer, Distributor, Retailer and Customer) and four supply chain process cycles i.e. customer order, replenishment, manufacturing, procurement cycle (Koberg & Longoni, 2019)

Figure 9 Logistics Source: PepsiCo.com

Understanding the Supply Chain of Pepsi

The main purpose of supply chain management of any organization is to satisfy customers with best product in minimum costs (Parilla & Abadilla, 2021). In this section we conduct a brief analysis of the basic supply chain management functions of Northern Bottling Company.

Supply Chain Strategy or Design

In this step, the organizations have to make tough decisions like what products to be manufactured, where they should be stored and how will they be distributed. It includes all the decisions like procurement, plant production capacity, location and number of warehouses, making the distribution network, number and types of vehicles used and most importantly which technology should be implemented. These decisions are made carefully since they are long term expensive decisions and they cannot be changed on regular basis or during short time period as many major costs are involved in this. These decisions are made according to company's policies, mission and long term achievable objectives (Sabouhi et al., 2018).

In order to ensure a good supply chain strategy, Northern Bottling Company plans two years in advance. It has several contracts with manufacturers, and receives raw material on a convenient basis. The company also decides where production plants are to be placed. NBL has production

plant at Peshawar. The production process is 100% automated. The company has to provide and manage transport for the delivery of products as well as the arrangement of third-party services for the procurement of products. The shipping department handles orders and the transport department decides the vehicles for safe delivery.

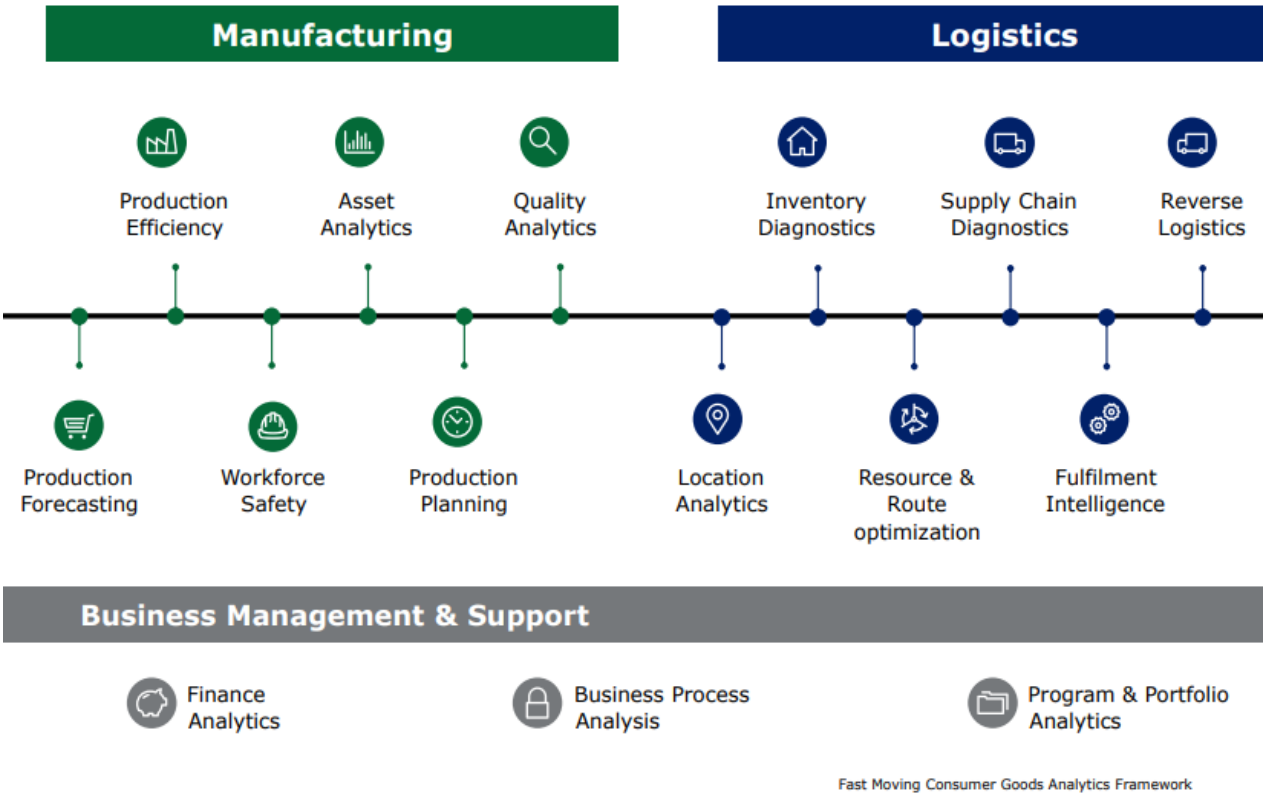


Figure 10 Logistics Source: FMCG framework

Logistics

The main concern for the project is the logistics side. It is discussed in detail below:

Location Analytics

This aid organizations to analyze geographical data and search for optimal production plants and warehouse locations for achieving strategic objectives (Wang). This analytics helps NBL to develop a more detailed understanding of their customers and to cover more area for their products. NBL has one functional warehouse built close to the production plant in Peshawar. One warehouse is in Kahuta.

Resource & Route Optimization

The planning of routes is based on the basis of the demand by the distributors. To make this process efficient and to use the resources effectively, NBL works according to advanced ordering methodology where distributor has to put order 24 hours before delivery.

Reverse Logistics

In case of defective product, company has the process of reverse logistics. This process is time consuming and not fully functional as the rest of the processes since the defective product has to be verified before bringing it back.

Fulfilment Intelligence

The company aims to deliver the product on time and in good condition. Supply chain is analyzed often for pointing out any barriers that stops the organization in delivering the orders on time.

Supply Chain Diagnostics

It gives NBL opportunity to analyze supply chains for any disruptions and to work on supply chain so that lead time can be reduced and processes are carried out efficiently.

Supply chain diagnostics helps organizations to bring sustainability in their processes and to gain competitive advantage (Bastas & Liyanage, 2019)

Inventory Diagnostics

This helps organization to determine the optimal inventory level. This is an important thing so that customers receive their products on time and there are no delays. This aid companies to keep low costs of ordering and holding (Kourentzes et al., 2020).

At Northern bottling company, material planning and procurement is carried out efficiently. They have selected both local and foreign suppliers after a rigorous process and have long term contracts with them. Forecasting is done on daily, monthly and yearly basis and capacity planning is done on its basis.

NBL has a procurement budget around Rs 2.9 billion. Approved suppliers cannot go beyond this budget. NBL has a strong quality assurance department that audit each supplier carefully so that customers get the best product. NBL select each distributor by itself. The company has increased its distribution capacity from one to six filling lines during the last few years lending it a competitive edge over Coca Cola.

Supply Chain Planning

All the planning is done according to the above mentioned criteria in NBL. The major goal of this planning is to gain competitive advantage, satisfy customer needs, timely delivery of best quality product and to manage each process of supply chain efficiently by reducing costs, increasing customer loyalty and company profits.

Northern bottling company starts planning by above criteria and the demand forecasts by the local distributors keeping in mind the government policies for the upcoming year and the factor of organic growth as well.

1.7 Market Scenario

The share of PepsiCo in Pakistan is 63%. The biggest rival of PepsiCo is coca cola having a market share of 35% (Business Finance article, 2020). Every year Coca Cola gives a tough competition to Pepsi. Northern beverage limited sets its objectives that run parallel to the complete business strategies. With the help of some good competitive strategies and a good distribution network, the organization is keeping an efficient supply throughout the region. The main aim of the group is to make high quality products to increase the sales and for the growth of the share in the market and be a productive part in the growing economy of Pakistan.

1.8 SWOT Analysis

The SWOT analysis of pepsi is given below:

Strength

- As pepsi is a well established brand so it has strong market presence and has loyal customers.
- They maintain the best quality product all over the world
- It offers variety of products from water to soft drinks, energy drinks and juices.

- It uses proper planning and forecasting techniques to determine the current demand of the market and to deliver the products to consumers on time.
- Strong advertising and rigorous promotional activities.

Weakness

- Pepsi rely heavily on carbonated soft drinks.
- Difficult to maintain quality of the products all across the globe and in all franchises.
- Not supplying directly to retailers, hotels and restaurants.

Threats

- Decreasing trend of carbonated soft drinks in customers.
- Aggressive competition from competitors all across the globe.
- Any pandemic situation like Covid 19 that caused reduced sales

Opportunities

- More demand of the healthy and organic drinks
- Increasing market share by aplying strong distribution strategy
- Expansion in snacks business.

1.8.1 Future Plan

The future plan of Northern bottling company is customer oriented. It wants to gain more loyal customers and to provide them with the best quality product in town. NBL wants to expand its facility in future and is trying to get connected with retailers by itself. This link will aid NBL to achieve its strategic goals more easily. Also NBL wants to work for the betterment of its employees by giving them more incentives and a comfortable work place.

Contact Person

The contact person for this project is the General Manager of Sales and Marketing in NBL.

Chapter 2

2.0 Problem Statement

2.1 Scope

With the increasing competition in all the industries and the decreasing consumer income and household spending, organizations are forced to lower costs in order to make profit. Companies are trying to cut the costs from various business processes. The major cost cutting can be done from the logistics side. Many organizations are moving towards third party logistics while some are making their in-house logistics department strong. Timely delivery of the products in lower costs is the main aim of supply chain management (Kewill white paper, 2020).

After several interviews from the sales department, logistics department, GM sales and marketing, truck drivers, loaders, delivery management, the main conclusion was that NBL has distribution problems and logistics department needs improvement. The management also believes that their logistics system needs changes so that costs can be saved and they can deliver products more efficiently. The management was quite open to new ideas regarding the changes in delivery network design. As it was mentioned earlier, the delivery is done by NBL itself. The organization has its own 250 vehicles with different capacity. They are filled with the required order and sent to the distributor. These vehicles are not filled completely and some vehicles are used only during some occasions. There is no proper software for the logistics network. The major problems faced by logistics department are:

- Vehicles are not properly utilized for delivery of the products from plant to warehouse and from warehouse to distributors. Network design is not properly planned.
- Damage to product during handling.
- No proper training of drivers and loaders.

2.1.1 Costs Related To Logistics

1. Costs of Loading Pallets In Vehicle

COST OF LOADING 1 PALLET IN VEHICLE	
All vehicle -loading/unloading by Forklift which are operated by LPG	PKR.
SALARY	
a. Forklift Operator Salary (Monthly)	35,000
b. Working Days per month	26
c. Forklift Operator Salary / Day (a/b)	1,346
d. Average number of Vehicles Load per day	50
e. Average number of Pallet per Vehicle	10
f. Total Pallets Loaded / Unloaded per day (d*e)	500
g. **Forklift Operator Salary / Pallet**	**2.7**
FUEL COST OF FORKLIFT	
h. Gas Per Cylinder (KG)	12
i. Average Cost per Cylinder PKR.	1,265
j. Per KG cost (i/h)	105.4
k. In One Kg GAS distance cover in Km	8.00

l. Distance cover to load one Vehicle in Km (warehouse)	0.18
m. Total vehicles loaded by 1 cylinder (k*h)/l	533
n. Per cylinder no of pallets loaded (m*10)	5333
p. Cost Per Pallet Loaded (i/n)	**0.24**
Total cost of loading per pallet (PKR) in vehicle (g + p)	**2.93**

2. Fixed Cost of Vehicles

VEHICLES	Loading Capacity		Total Number of vehicle (b)	per Vehicle Price (PKR) (c)	Fixed Cost per Month			(g) Vehicle Loading cost per month (a*26)*2.93
	In Pallets (a)	In Cases			Depreciation Per Month PKR (C*0.2)/12 (d)	Driver Salary PKR (e)	(f) TOTAL FIXED COST PER MONTH (d+e)	
Bed ford	8	1040	80	2,200,000	36,667	35,000	71,667	609
Mazda 1000	7	910	10	2,400,000	40,000	35,000	75,000	533
Mazda 800	6	780	20	2,100,000	35,000	35,000	70,000	457
Container	30	3900	30	14,000,000	233,333	60,000	293,333	2,285
Single Hino (Flat Bed)	10	1300	48	9,000,000	150,000	45000	195,000	762
Ten Wheeler	16	2080	40	11,000,000	183,333	52000	235,333	1,219
Hino	11	1430	12	4,800,000	80,000	45,000	125,000	838
Shazoor	3	390	7	1,600,000	26,667	30,000	56,667	229
Suzuki	2	260	3	1,100,000	18,333	25,000	43,333	152

3. Fuel Consumption Of Vehicles

VEHICLES	Fuel Consumption per Month				
	Avg Fuel Price (Diesel) In PKR (N)	Mileage / Ltr (O)	(P) Cost / KM PKR (N/O)	Avg. KM Covered in a Month ** (Q)	FUEL CONSUMPTION per month (P*Q)
Bed ford	112	7	16	5200	83,200
Mazda 1000	112	8	14	6500	91,000
Mazda 800	112	9	12	6500	80,889
Container	112	6	19	5200	97,067
Single Hino (Flat Bed)	112	7	16	5200	83,200
Ten Wheeler	112	7	16	5200	83,200
Hino	112	6	19	9100	169,867
Shazoor	112	10	11	3900	43,680
Suzuki	112	11	10	2340	23,825

4. Total Costs Of Vehicles (Per Day, Per Month And Yearly)

Vehicles	Total Number Of Vehicle (A)	Fixed Cost Per Month	Vehicle Loading Cost Per Month	Fuel Consumption Per Month	Per Month Total Cost (Fix+Loading +Fuel) (B)	Per Day Cost By Supposing 1 Vehicle Operate 1 Load Daily (B/26)	Cost Of Each Type Of Vehicle In 1 Year (A*B)
Bed ford	80	71,667	609	83,200	155,476	5,980	12,438,080
Mazda 1000	10	75,000	533	91,000	166,533	6,405	1,665,330
Mazda 800	20	70,000	457	80,889	151,346	5,821	3,026,919
Container	30	293,333	2,285	97,067	392,685	15,103	11,780,550
Single Hino (Flat Bed)	48	195,000	762	83,200	278,962	10,729	13,390,176
Ten Wheeler	40	235,333	1,219	83,200	319,752	12,298	12,790,080
Hino	12	125,000	838	169,867	295,705	11,373	3,548,455
Shazoor	7	56,667	229	43,680	100,575	3,868	704,026
Suzuki	3	43,333	152	23,825	67,311	2,589	201,933

So the approximate costs of logistics is PKR. 59,545,549 in one year on the basis of assumption that one type of vehicle is loaded once a day (312 working days)

2.1.2 Objectives

The main objectives that can be achieved by solving the above mentioned problems are:

1. The main objective to achieve by solving the above mentioned problems is cost reduction in logistics section of the organization. This cost reduction will aid NBL to achieve its strategic objectives easily and to gain a competitive advantage.
2. Another objective is to deliver the products on time and in the best quality. This will help organization to attain more loyal customer base.

2.2 Significance of the Problem

2.2.1 Financial

The financial advantage by solving these problems is cost reduction, time saving and minimum stock outs as by optimizing distribution network can lead to an efficient supply chain.

2.2.2 Economical

Beverage industry has a major role in the economy of Pakistan. Pakistan is estimated to be among the top 10 beverage consumption markets in the world that is paying second highest indirect taxes of 27.5 per cent on retail price of carbonated soft drink to the government exchequer. This project will aid similar industries to use their vehicles efficiently. The results will be replicated in other industries with weak/ un optimized distribution networks (Statista, 2021).

2.2.3 Existential

By solving these problems, the company will gain competitive advantage in the industry. It will help to optimize distribution network, better customer management, and minimization of stock outs and processes efficiency.

Chapter 3

3.0 Methodology

3.1 Tools and Techniques

The basic tools and techniques to gather data is through the interviews. Detailed interviews are conducted from the sales team, logistics department, drivers and loaders as well.

Northern bottling company uses SAP for data management. The required data is converted in excel sheets and is then used in the project. The data of distributors' names, their region, units, production by NBL, sales by NBL, and distances between warehouse and distribution centers, vehicles capacity, types and costs of logistics is being used in this industrial project. The data is of year 2019. All the data used is in pallets form.

For the optimization of distribution system we are using the optimization model. In this project we are using multi period linear programming model. The findings along with some other recommendations will then be forwarded to the NBL management for review and implementation.

3.2 Literature Review

Supply chain has become an integral part for the organizations to gain a competitive advantage and to improve their business processes. Firms can have a greater control over their procurement, manufacturing and distribution by improving their supply chain management (Sukortpromme & Onputtha, 2019). There is a lot of improvement in the information technology sector from the last two decades. Now companies are facing severe competition especially in the industry of food and beverage. The most important part is now logistics as most of these organizations are concentrating more on logistics side as the last string to gain competitive advantage and to sustain their market share (Widodo, 2019).

The term logistics costs shows variation in case of different organizations. But most common costs that are covered in this term and form the basic major costs of supply chain are warehousing costs, transportation costs, and packaging. These are the core costs that are covered in this term (Pratap et al., 2020).

In all businesses, supply chain network design is displaying significant importance. This research paper exhibits a multi objective mathematical model to minimize costs, supply demand balance and time saving with four echelon. The results help the organizations in strategic and tactical decision making (Wang et al., 2021)

A nonlinear integer mathematical model is used in this research paper. In this model, problem is defined in Math type with constraints and parameters. After defining these, model is applied to get the results. Production planning and supply chain optimization are the main goals of this model (Samizadeha, 2019)

A mixed integer linear programming approach is used by considering all the real world constraints. This is used for the problem of network design of logistics. But the method is complex and the results are difficult to interpret. Easier way is algorithms as compared to this model (Bo et al., 2021)

Supply and demand uncertainty causes inventory mismanagement. This is a very critical problem for many organizations. Proper forecasting and use of proper methods can help firms to avoid such situations but the risk is always there. This problem cannot be mitigated by roots however, it can be reduced many folds. The research paper uses Matlab software to build a network design by linking inventory levels so that supply and demand uncertainty can be reduced and an efficient supply chain can be achieved (Sharma & Singhal, 2018).

The case study of Coca Cola- improved customer service through territory management states that coca cola manages its distribution network by estimating the demand of its customers. This demand is continuously changing during the entire year. By establishing warehouses and making a strong distribution network across the country. The company uses direct and indirect distribution to achieve competitive edge over its competitors.

The case study on distribution network design and materials handling 2019 suggest that new ways to improve distribution network is to use technology to manage big data. By gaining information about customers and by applying analytics recommendations and suggestions could be achieved to optimize distribution network.

Chapter 4

4.0 Multi period linear programming

4.1 Model

Initially the sets, parameters, constraints and objective function are typed according to Math type. Objective function is to minimize total cost.

4.1.1 Sets

p	plant	$p = 1, 2, 3, ..., P$
w	Warehouse	$w = 1, 2, 3, ..., W$
d	Distributor	$d = 1, 2, 3, ..., D$
v	Vehicle	$v = 1, 2, 3, ..., \mathrm{V}$
t	Time period	$t = 1, 2, 3, ..., T$

4.1.2 Decision Variables

Q^t_{pwv}	Quantity of pallets moving from plant " p " to warehouse " w " by using vehicle " v " in time period " t "
Q^t_{wdv}	Quantity of pallets moving from warehouse " w " to distributor " d "by using vehicle " v " in time period " t "
n^t_{pwv}	Number of vehicles moving from plant " p " to warehouse " w " in time period " t "
n^t_{wdv}	Number of pallets moving from warehouse " w " to distributor " d " in time period "t"

4.1.3 Parameters

$\in_{pw}$	Distance from plant " p " to warehouse " w " (km)
$\in_{wd}$	Distance from warehouse " w " to distributor " d " (km)
FC_v	Fixed cost of vehicle ($/vehicle)

ED_d Expected demand from distributor "d" (pallets)

η_v Vehicle capacity (pallet/vehicle)

α Seasonality factor

PC_p Production capacity of plant "p" in time period "t" (pallets)

γ_r Fuel consumption rate of vehicle "v" (ltr/km)

F Unit fuel price ($/ltr)

4.1.4 Objective Function

Minimize TC =

$$\sum_{p=1}^{P}\sum_{w=1}^{W}\sum_{v=1}^{V}\sum_{t=1}^{T}\left(\gamma_v \times F \times \frac{Q_{pwv}^t}{\eta_v} \times \in_{pw}\right) + \sum_{w=1}^{W}\sum_{d=1}^{D}\sum_{v=1}^{V}\sum_{t=1}^{T}\left(\gamma_v \times F \times \frac{Q_{wdv}^t}{\eta_v} \times \in_{wd}\right)$$

$$+ \sum_{p=1}^{P}\sum_{w=1}^{W}\sum_{v=1}^{V} FC_{pwv}^t \times n_{pwv}^t + \sum_{w=1}^{W}\sum_{d=1}^{D}\sum_{v=1}^{V} FC_{wdv}^t \times n_{wdv}^t$$

4.1.5 Constraints

Supply constraint

$$\sum_{w=1}^{W} Q_{pwv}^t \qquad \forall_p, \forall_w, \forall_v, \forall_t \qquad \text{(i)}$$

Transshipment constraint

$$\sum_{w=1}^{W} Q_{pwv}^t = \sum_{d=1}^{D} Q_{wdv}^t \qquad \forall_w, \forall_v, \forall_t \qquad \text{(ii)}$$

Demand constraint

$$\sum_{w=1}^{W} Q_{wdv}^{t} = ED_{dt} \qquad \forall_d, \forall_v, \forall_t \qquad \text{(iii)}$$

Number of trucks constraint between plants and warehouse

$$n_{pwv}^{t} = \frac{Q_{wdv}^{t}}{\eta_v} \qquad \forall_p, \forall_w, \forall_v, \forall_t \qquad \text{(iv)}$$

Number of trucks between warehouse and distributor

$$n_{wdv}^{rt} = \frac{Q_{wdv}^{rt}}{\eta} \qquad \forall_w, \forall_d, \forall_v, \forall_t \qquad \text{(v)}$$

Truck capacity constraint

$$n_{pwv}^{t} \leq AT_v \qquad \forall_p, \forall_w, \forall_v, \forall_t \qquad \text{(vi)}$$

$$n_{wdv}^{t} \leq AT_v \qquad \forall_w, \forall_d, \forall_v, \forall_t \qquad \text{(vii)}$$

$$Q_{pwv}^{t}, Q_{wdv}^{t}, n_{pwv}^{t}, n_{wdv}^{t} \geq 0 \qquad \text{(viii)}$$

4.2 Result

To find an optimum solution to the problem, we have defined the parameters, constraints and decision variables so that multi period linear programming could be applied. We have obtained the following results:

4.2.1 Quantity of Pallets Moving From Plant to Warehouse 1 (Q_{pw})

Period	Quantity (Pallets)
1	4982
2	12927
3	16947
4	24641
5	32412
6	33325
7	37266
8	35992
9	24734
10	15015
11	7002
12	4318

Table 8 Source: Calculation extracted from multi period linear programming

The above table shows the periods from 1 to 12 i.e. from January till December and the total quantity that is moving from the Northern bottling company plant till their warehouse 1 located close to factory in Peshawar. This is our decision variable Q_{pw}.

4.2.2 Number of Vehicles Moving From Plant to Warehouse 1 (n_{pw})

	Periods											
Vehicle	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Bed ford	36	38	40	42	44	45	46	45	42	38	30	34
Mazda 1000			3	2	1	1	2	2	2	3		
Mazda 800	10	10	8	8	8	9	10	9	8	8	10	10
Container	1	2	3	4	4	4	5	5	4	3	2	1
Single Hino	5	8	8	10	12	12	13	13	10	8	8	6
Ten Wheeler	4	5	4	3	3	3	3	3	3	4	5	4
Hino						1	1	1				

Table 9 Source: Calculation extracted from multi period linear programming

The tables describes that NBL requires following number of vehicles to move the pallets from plant to warehouse 1. This is from January till December.

4.2.3 Quantity of pallets moving from warehouse 1 to distribution centers (Q_{wd})

	PERIODS											
Distributors	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1 (Bannu)	348	1126	2228	4009	4825	4953	4847	4089	2812	1834	622	531
2 (Di Khan)	291	637	1054	1174	2013	1819	1554	1475	1207	740	467	180
3 (Kohat)	670	1136	1944	2807	3606	3906	4000	4242	2591	1513	876	498
4 (Noshehra)	725	1310	1874	2769	2319	3485	3269	2935	2352	1179	591	432
5 (Charsada)	640	1620	1934	1806	1631	2591	3561	3241	1862	1139	806	412
6 (Mardan)	503	1366	1940	3121	3510	4014	4130	3510	2782	1525	529	441
7 (Chakdara)	26	419	877	1679	2902	1743	2821	2873	2107	1228	559	239
8 (Chitral)	253	575	1415	1735	2595	2353	2344	2342	1851	891	387	280
9 (Mingora)	242	1369	1910	2132	3147	3151	3630	4156	2394	1730	749	307
10 (Base)	1284	3369	1717	3409	5864	5310	7110	7129	4776	3236	1416	998
11 (Isl)	0	0	0	0	0	0	0	0	0	0	0	0

Table 10 Source: calculation extracted from multi period linear programming

The table gives result of the pallets moving from the warehouse 1 to Northern bottling company's 11 distribution centers which are mentioned with names.

4.2.4 Number of vehicles from warehouse to distribution centers (n_{wd})

Distribution Centre	Period 1						
	Bed Ford	Mazda 1000	Mazda 800	Container	Single Hino	Ten Wheeler	Hino
1 (Bannu)				2			
2 (Di Khan)				2			
3 (Kohat)				4			
4 (Noshehra)					2	10	
5 (Charsada)					3	13	
6 (Mardan)					2	8	
7 (Chakdara)							2
8 (Chitral)				4			
9 (Mingora)				2			
10 (Peshawar)	15	4					

Table 11 Source: calculation extracted from multi period linear programming

The table describes the number of different types of vehicles used to in January to take pallets from warehouse 1 to 10 distribution centers.

Distributors	PERIOD 2						
	Bed Ford	Mazda 1000	Mazda 800	Container	Single Hino	Ten wheeler	Hino
1 (Bannu)				3		1	
2 (Di Khan)				2		1	
3 (Kohat)				3		1	
4 (Noshehra)					4	10	
5 (Charsada)					5	12	
6 (Mardan)					1	9	
7 (Chakdara)			3				4
8 (Chitral)				2			
9 (Mingora)				4			
10 (Peshawar)	15	6					

Table 12 Source: calculation extracted from multi period linear programming

The table describes the number of different types of vehicles used to in Febuary to take pallets from warehouse 1 to 10 distribution centers.

Distributors	Period 3						
	Bed Ford	Mazda 1000	Mazda 800	Container	Single Hino	Ten Wheeler	Hino
1 (Bannu)				4	2	1	
2 (Di Khan)			1	2		1	
3 (Kohat)				3		2	2
4 (Noshehra)					6	10	
5 (Charsada)					4	12	
6 (Mardan)						9	4
7 (Chakdara)			5		1	1	
8 (Chitral)				2	1		1
9 (Mingora)				4			3
10 (Peshawar)	16	6			1		

Table 13 Source: calculation extracted from multi period linear programming

The table describes the number of different types of vehicles used to in March to take pallets from warehouse 1 to 10 distribution centers.

Distributors	PERIOD 4						
	Bed Ford	Mazda 1000	Mazda 800	Container	Single Hino	Ten wheeler	Hino
1 (Bannu)	2			5	3	1	
2 (Di Khan)			1	2		1	
3 (Kohat)				4		2	2
4 (Noshehra)					7	10	
5 (Charsada)					5	12	
6 (Mardan)		1				10	5
7 (Chakdara)			5		1	1	
8 (Chitral)				2	1		1
9 (Mingora)				4			4
10 (Peshawar)	17	7			1		

Table 14 Source: calculation extracted from multi period linear programming

The table describes the number of different types of vehicles used to in April to take pallets from warehouse 1 to 10 distribution centers.

Distributors	Period 5						
	Bed Ford	Mazda 1000	Mazda 800	Container	Single Hino	Ten Wheeler	Hino
1 (Bannu)	2		2	6	3	1	
2 (Di Khan)			2	2		1	
3 (Kohat)				5		2	2
4 (Noshehra)					7	10	
5 (Charsada)					5	12	
6 (Mardan)		2				10	5
7 (Chakdara)			6		1	1	
8 (Chitral)				2	1		1
9 (Mingora)				4			4
10 (Peshawar)	18	7			1		

Table 15 Source: calculation extracted from multi period linear programming

The above table shows the pallets moving from warehouse 1 Peshawar to 11 distribution centers in KPK region during the month of May.

Distributors	Period 6						
	Bed Ford	Mazda 1000	Mazda 800	Container	Single Hino	Ten Wheeler	Hino
1 (Bannu)	2		2	6	4	1	
2 (Di Khan)			2	2		1	
3 (Kohat)				6		2	1
4 (Noshehra)					7	10	
5 (Charsada)					5	12	
6 (Mardan)		2				10	5
7 (Chakdara)			6		1	1	
8 (Chitral)				2	1		1
9 (Mingora)				4			4
10 (Peshawar)	19	7			1		

Table 16 Source: calculation extracted from multi period linear programming

The above table shows the pallets moving from warehouse 1 to 11 distribution centers in KPK region during the month of June.

Distributors	Period 7						
	Bed Ford	Mazda 1000	Mazda 800	Container	Single Hino	Ten Wheeler	Hino
1 (Bannu)	3		2	7	4	1	
2 (Di Khan)			2	2		1	
3 (Kohat)				6		2	1
4 (Noshehra)					8	10	
5 (Charsada)					5	12	
6 (Mardan)		1				10	5
7 (Chakdara)			6		1	1	
8 (Chitral)				2	1		1
9 (Mingora)				4			4
10 (Peshawar)	19	7			1		

Table 17 Source: calculation extracted from multi period linear programming

The table describes the number of different types of vehicles used to in July to take pallets from warehouse 1 to 10 distribution centers.

Distributors	Period 8						
	Bed Ford	Mazda 1000	Mazda 800	Container	Single Hino	Ten Wheeler	Hino
1 (Bannu)	3		2	7	3	1	
2 (Di Khan)			2	2		1	
3 (Kohat)				6		2	1
4 (Noshehra)					8	10	
5 (Charsada)					5	12	
6 (Mardan)		1				10	5
7 (Chakdara)			6		1	1	
8 (Chitral)				2	1		1
9 (Mingora)				4			4
10 (Peshawar)	18	7			1		

Table 18 Source: calculation extracted from multi period linear programming

The table shows the result of number of vehicles utilized in month of August for moving pallets from warehouse to distribution centers.

Distributors	Period 9						
	Bed Ford	Mazda 1000	Mazda 800	Container	Single Hino	Ten Wheeler	Hino
1 (Bannu)	3		2	6	3	1	
2 (Di Khan)			2	1		1	
3 (Kohat)				5		2	1
4 (Noshehra)					7	10	
5 (Charsada)					5	12	
6 (Mardan)		1				10	5
7 (Chakdara)			4		1	1	
8 (Chitral)				2	1		2
9 (Mingora)				3			4
10 (Peshawar)	18	7			1		

Table 19 Source: calculation extracted from multi period linear programming

The above table shows the pallets moving from warehouse 1 Peshawar to 11 distribution centers in KPK region during the month of September.

Distributors	Period 10						
	Bed Ford	Mazda 1000	Mazda 800	Container	Single Hino	Ten Wheeler	Hino
1 (Bannu)	1		2	4	2	1	
2 (Di Khan)			2	1		1	
3 (Kohat)				4		2	1
4 (Noshehra)					5	10	
5 (Charsada)					4	12	
6 (Mardan)		1				9	3
7 (Chakdara)			2		1	1	
8 (Chitral)				2	1		2
9 (Mingora)				3			4
10 (Peshawar)	15	4			1		

Table 20 Source: calculation extracted from multi period linear programming

The above table shows the pallets moving from warehouse 1 Peshawar to 11 distribution centers in KPK region during the month of October.

Distributors	Period 11						
	Bed Ford	Mazda 1000	Mazda 800	Container	Single Hino	Ten Wheeler	Hino
1 (Bannu)				3	1		
2 (Di Khan)				1			
3 (Kohat)				3		1	1
4 (Noshehra)					4	9	
5 (Charsada)					3	11	
6 (Mardan)		2				9	
7 (Chakdara)			2		1	1	
8 (Chitral)				2	1		
9 (Mingora)			1	2			3
10 (Peshawar)	13	4			1		

Table 21 Source: calculation extracted from multi period linear programming

Above table describes vehicles moving pallets from warehouse to distribution centers in November 2019.

Distributors	Period 12						
	Bed Ford	Mazda 1000	Mazda 800	Container	Single Hino	Ten Wheeler	Hino
1 (Bannu)				3	1		
2 (Di Khan)				1			
3 (Kohat)				3		1	
4 (Noshehra)					3	9	
5 (Charsada)					2	10	
6 (Mardan)		1				9	
7 (Chakdara)			2		1	1	
8 (Chitral)				2	1		
9 (Mingora)				1			3
10 (Peshawar)	12	4			1		

Table 22 Source: calculation extracted from multi period linear programming

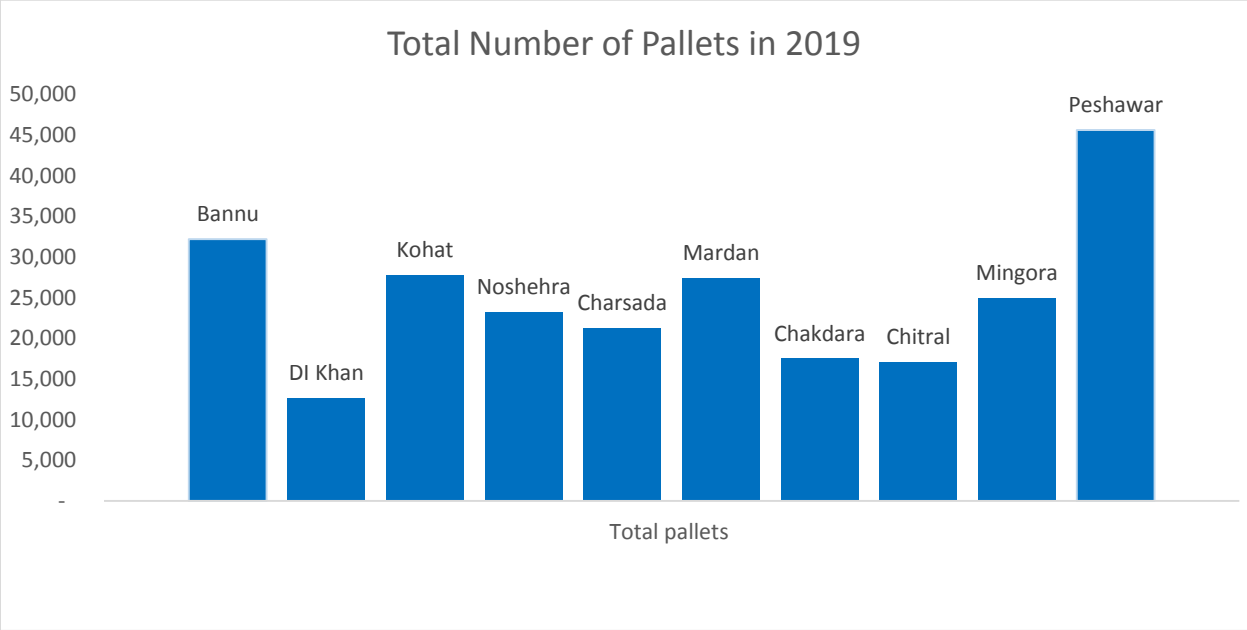
Above table gives number of vehicles moving pallets from warehouse to distribution centers in the month of December.

4.3 Analysis

The above data is analyzed to get the best results and lowering of logistics cost. Starting from the quantity of pallets moving from plant to warehouse 1. It can be seen in the results that distribution center 11 is showing no result since NBL distributes to warehouse 2 in Kahuta and distribution center 11 only when the demand exceeds the supply in case of peak season, and in 2019 no uncertainty if demand occurred hence there was no supply to distribution center 11.

From the quantity tables we have analyzed the major distribution centers in the KPK region that are catering to more sales for NBL. Below table shows the distribution center/unit along with total number of pallets demand from that unit in the year 2019.

Distribution center	Total pallets
Bannu	32,224
DI Khan	12,611
Kohat	27,789
Noshehra	23,240
Charsada	21,243
Mardan	27,371
Chakdara	17,473
Chitral	17,021
Mingora	24,917
Peshawar	45,618

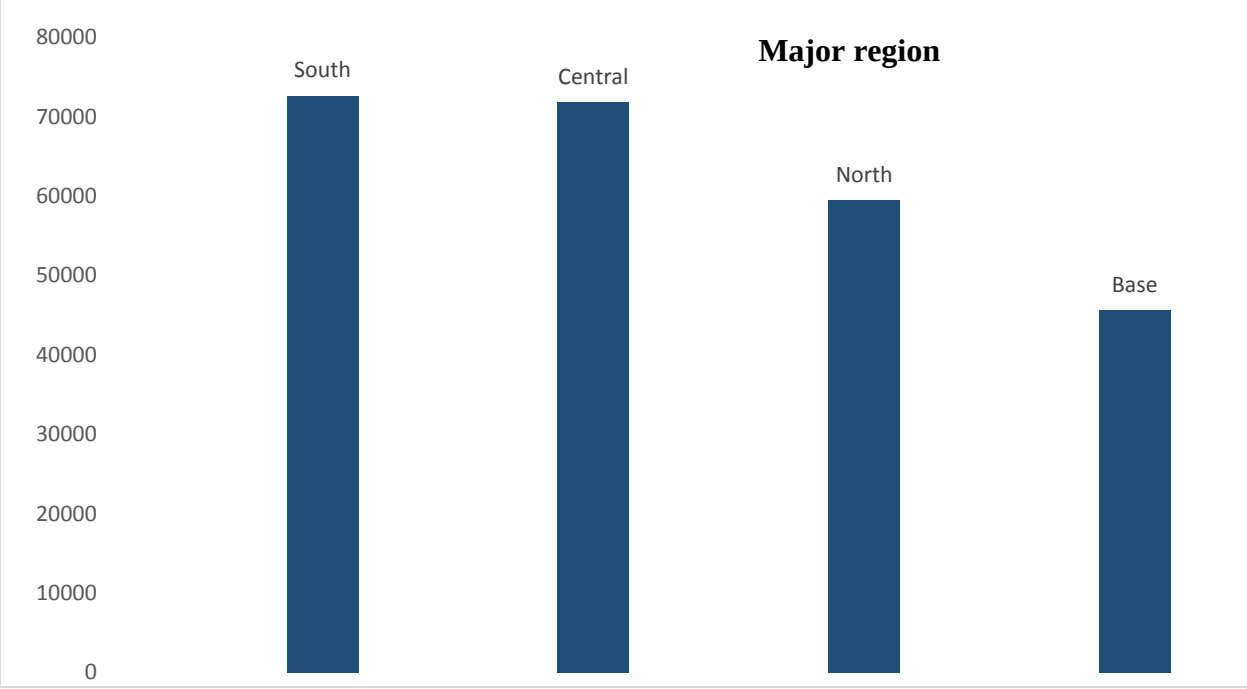


The major distribution centers are Peshawar, Bannu and Kohat.

But as we know that Northern Bottling Limited has clubbed together units to form regions we can analyze on a bigger scale and find out the major region. The number of vehicles allocated on these region then can be further analyzed.

Distribution Center	Total pallets	Total pallets in region	Region
Bannu	32,224	72,624	SOUTH
DI Khan	12,611		
Kohat	27,789		
Noshehra	23,240	71,854	CENTRAL
Charsada	21,243		
Mardan	27,371		
Chakdara	17,473	59,411	NORTH
Chitral	17,021		
Mingora	24,917		
Peshawar	45,618	45,618	BASE

Above table club together distribution centers to from regions. And total number of pallets distributed in each region during the year 2019.



As it is indicated in graph that major regions are South and Central. ‘

The Northern Bottling limited is using 250 vehicles to manage the movement of pallets from plant to warehouse and from warehouse to distributors. The below table shows the total number of

vehicles used in the process in time period 1 to 12 i.e. from January till December calculated from the multi period linear programming method.

Period												
Vehicle	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Bed ford	51	53	56	61	64	66	68	66	63	54	43	46
Mazda 1000	4	6	9	10	10	10	10	10	10	8	6	5
Mazda 800	10	13	14	16	18	19	20	19	16	14	13	12
Container	15	16	18	21	23	24	26	26	21	17	13	11
Single Hino	12	18	22	28	30	31	33	32	28	22	19	15
Ten Wheeler	35	38	40	40	40	40	40	40	40	40	36	34
Hino	2	4	10	12	12	12	12	12	12	10	4	3
Shazoor												
Suzuki												
Total	129	148	169	188	197	202	209	205	190	165	134	126

It can be seen in the table that the highest number of vehicles used in moving pallets from plant to warehouse and from warehouse to distribution center is 209. And the minimum number of vehicles used are 126. From October till March, the low peak season requires less vehicles and from April till September, high peak season requires more vehicles. And maximum number of vehicles used during peak season when demand is high, the total vehicles used are only 209. Also, we have considered here that vehicles are used in their full capacity.

Now we analyze the vehicles that are used in logistics and those vehicles that are not required for any transportation. As we can see in the above table that all types of vehicles are used in transportation in year 2019 except two vehicles that are Shazoor and Suzuki that are not used at all.

Chapter 5

5.1 Findings

From the analysis of results, we have following findings that can be helpful for future references. First of all, we have identified vehicles that are not used at all and those vehicles that are in excess quantity at NBL plant and are not required for transportation. Below table identifies such type of vehicles.

Vehicle	No. of vehicles in NBL	No. of vehicles used	Un used vehicles
Bed ford	80	68	12
Mazda 1000	10	10	0
Mazda 800	20	20	0
Container	30	26	4
Single Hino	48	33	15
Ten Wheeler	40	40	0
Hino	12	12	0
Shazoor	7	0	7
Suzuki	3	0	3
Total			41

We have taken the July data of the number of vehicles used since it the peak season showing biggest chunk of sales in the year 2019 and maximum vehicles are used in this period. The above table describes that Shazoor and Suzuki are never used in transportation and Bedford, Container and Single Hino are in excess and that NBL does not need these vehicles for transportation of pallets from plant to warehouse and from warehouse to distribution centers.

Below is the calculation of the costs with 209 vehicles instead of 250 vehicles. We have inserted the new number of vehicles and removed that vehicles which are not being used. Costs of logistics is already calculated of NBL and now we will calculate it with new number of vehicles.

Vehicles	Total Number Of Vehicle (A)	Fixed Cost Per Month	Vehicle Loading Cost Per Month	Fuel Consumption Per Month	Per Month Total Cost (Fix+Loading+ Fuel) (B)	Per Day Cost By Supposing 1 Vehicle Operate 1 Load Daily (B/26)	Cost Of Each Type Of Vehicle In 1 Year (A*B)
Bed ford	68	71,667	609	83,200	155,476	5,980	10,572,368
Mazda 1000	10	75,000	533	91,000	166,533	6,405	1,665,330
Mazda 800	20	70,000	457	80,889	151,346	5,821	3,026,920
Container	26	293,333	2,285	97,067	392,685	15,103	10,209,810
Single Hino (Flat Bed)	33	195,000	762	83,200	278,962	10,729	9,205,746
Ten Wheeler	40	235,333	1,219	83,200	319,752	12,298	12,790,080
Hino	12	125,000	838	169,867	295,705	11,373	3,548,460

The new costs of logistics calculated by decreasing number of vehicles from 250 to 209 is PKR. 51,018,714.

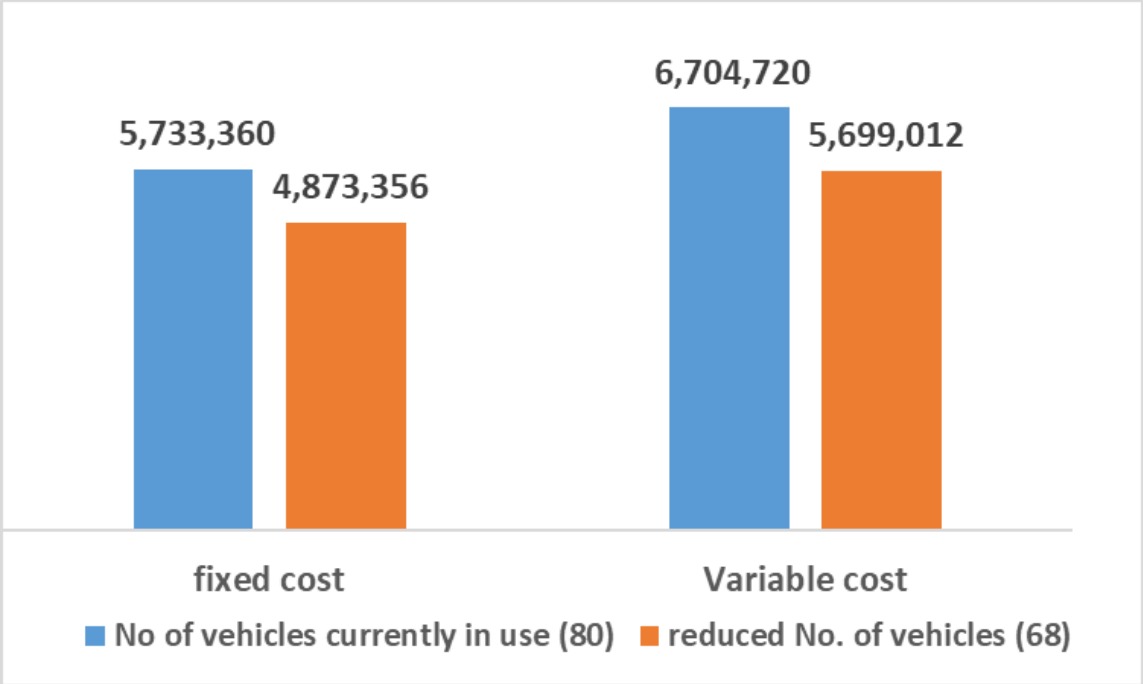
Comparison of previous costs of logistics and new costs of logistics is shown in the table below:

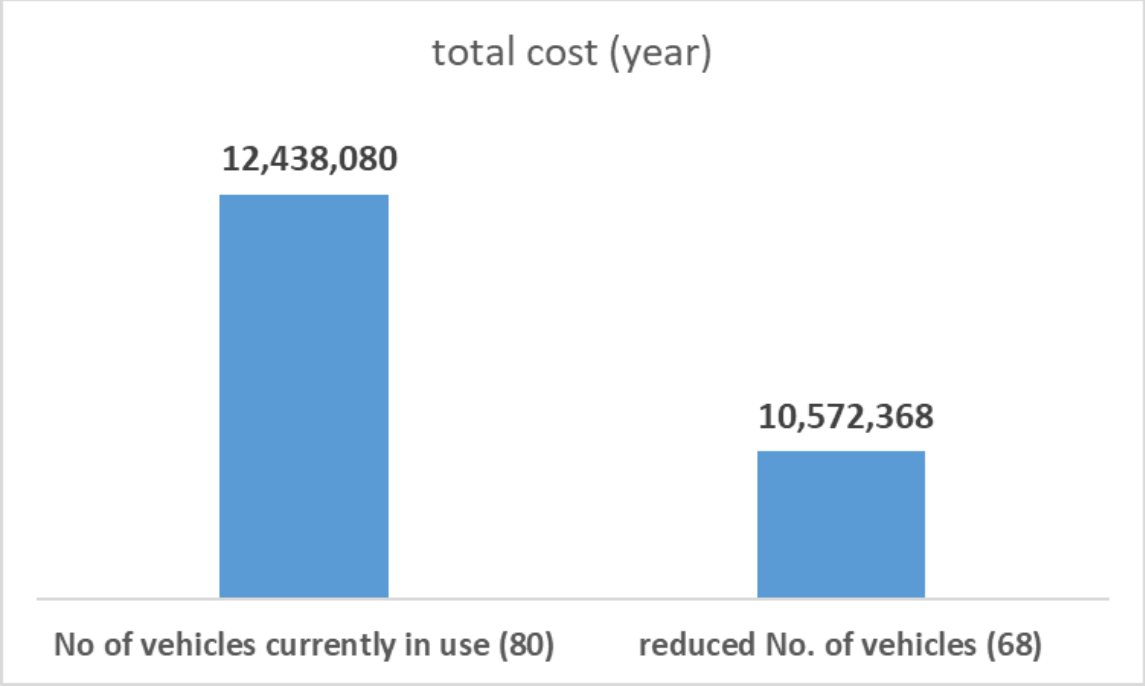
Original Costs	59,545,549
New costs	51,018,714
Difference	8,526,835
%age decrease of costs	14%

5.1.1 Graphical Representation of results

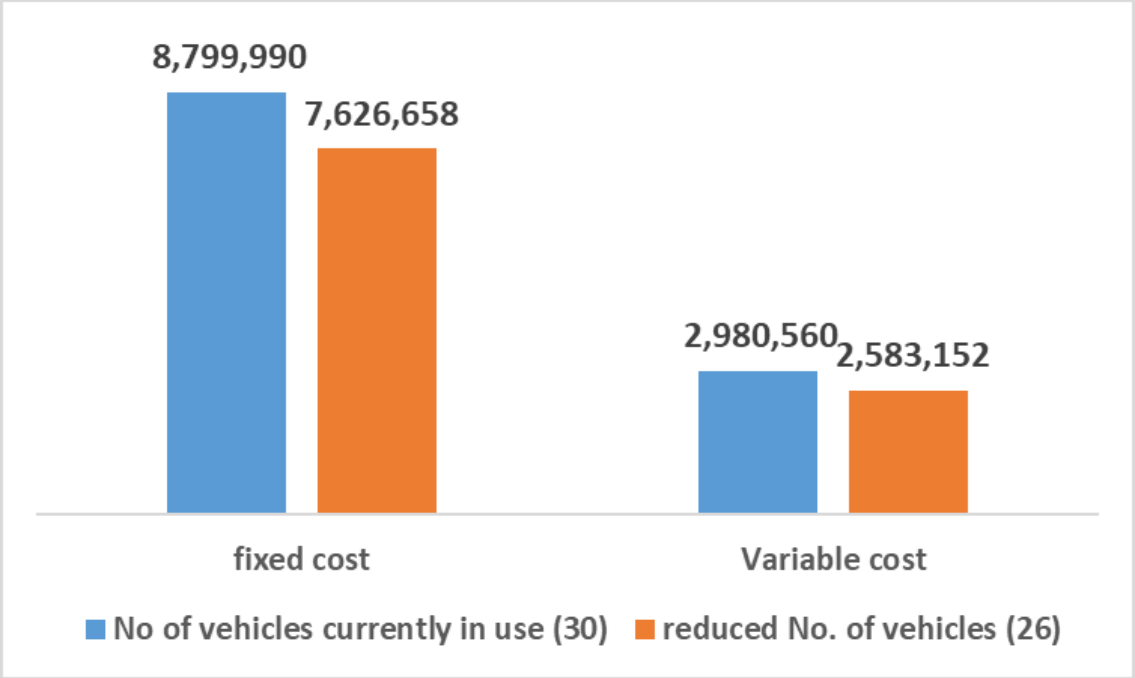
The vehicles that are reduced in numbers are: Bedford, container and single hino. So below graphs show the reduced costs after the multi period linear programming.

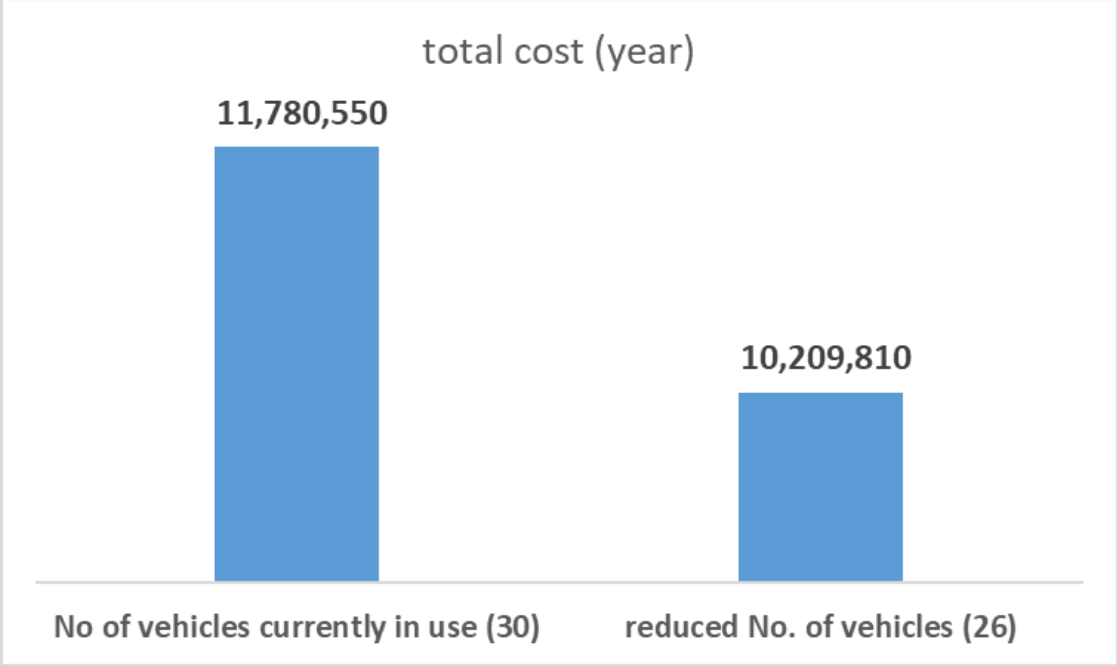
BEDFORD:



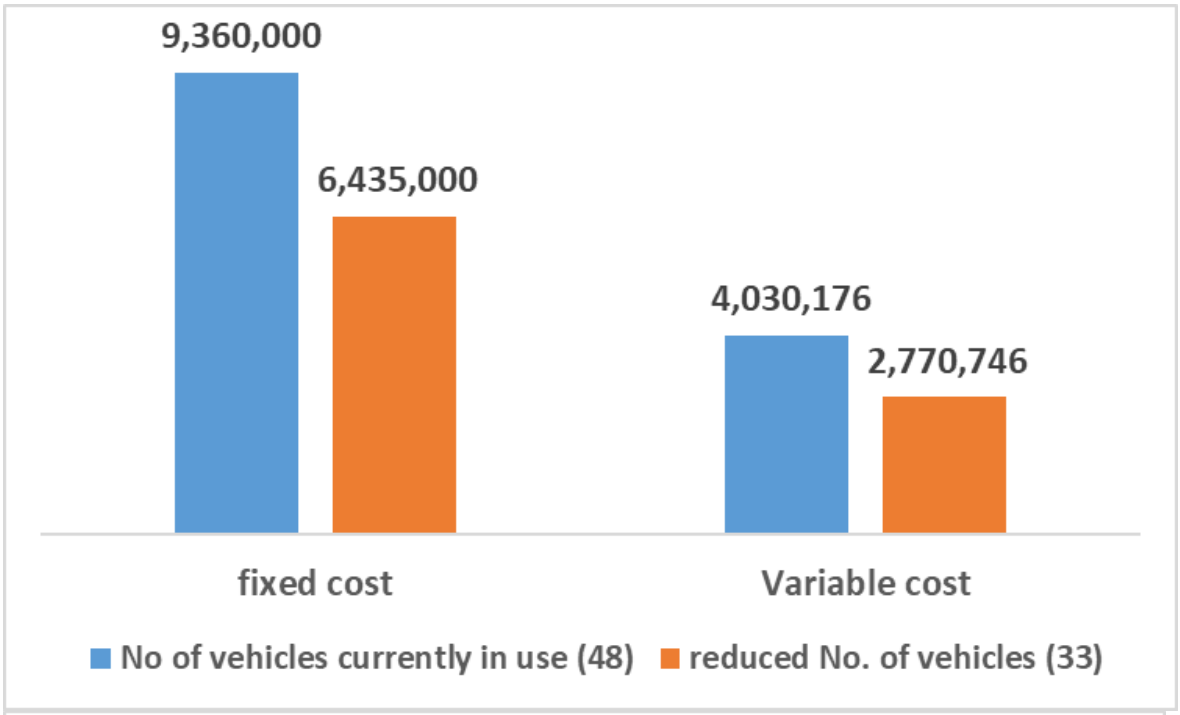


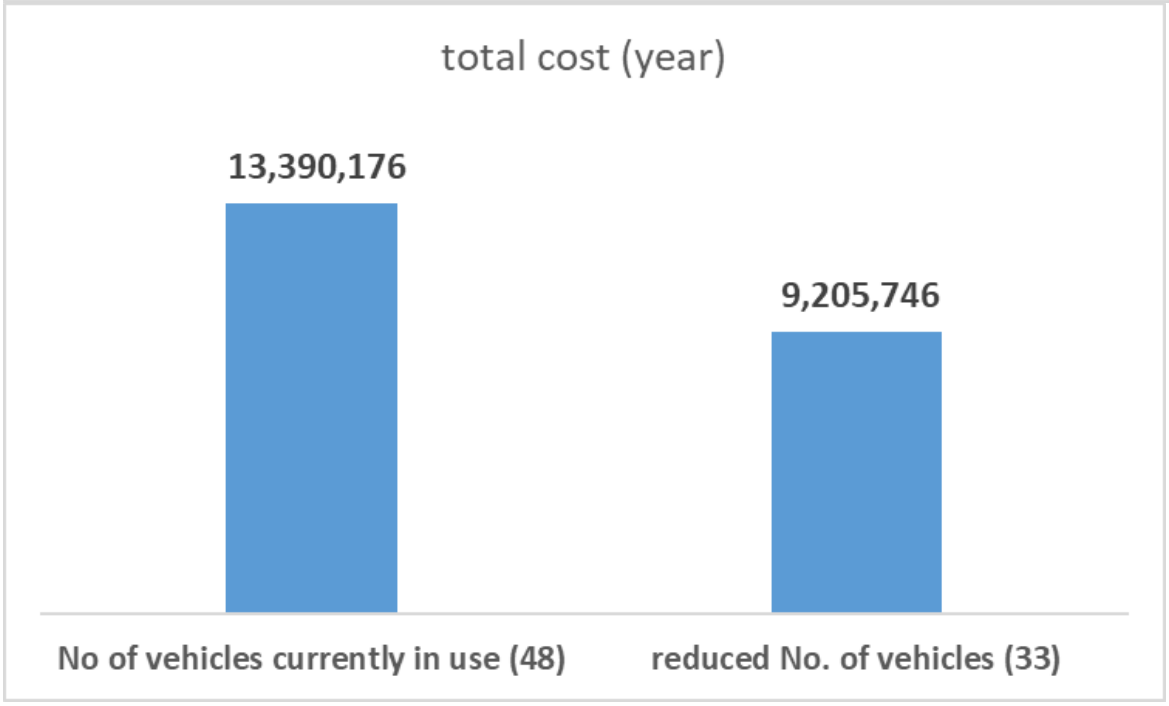
CONTAINER:


8,799,990
7,626,658
2,980,560
2,583,152
fixed cost
Variable cost
No of vehicles currently in use (30)
reduced No. of vehicles (26)


total cost (year)
11,780,550
10,209,810
No of vehicles currently in use (30)
reduced No. of vehicles (26)

SINGLE HINO:


9,360,000
6,435,000
4,030,176
2,770,746
fixed cost
Variable cost
No of vehicles currently in use (48)
reduced No. of vehicles (33)


total cost (year)
13,390,176
9,205,746
No of vehicles currently in use (48)
reduced No. of vehicles (33)

5.1.2 Capacity utilization

PALLETS MOVING FROM PLANT TO WAREHOUSE (yearly):

Vehicles used	Capacity of vehicles (pallets)	Total no. of vehicles used	Capacity utilized
BEDFORD	8	46	368
MAZDA 1000	7	3	21
MAZDA 800	6	10	60
CONTAINER	30	5	150
SINGLE HINO	10	13	130
TEN WHEELER	16	4	64
HINO	11	1	11

Total = 804 *26 = 20,904 pallets per month

= 20,904 * 12 = 250,848 (pallets per year)

Actual pallets moving from plant to warehouse:

= 249561 pallets per year

CAPACITY UTILIZED = Actual capacity used / potential capacity of vehicles

= (249,561/250,848)*100

= 99.4%

Pallets are distributed to 4 regions:

BASE:

Vehicles used	Capacity of vehicle (pallets)	Total no. of vehicles used	Capacity utilized
BEDFORD	8	19	152
MAZDA 1000	7	7	49
SINGLE HINO	10	1	10

Total = 211*26 = 5,486 (pallets per month)

= 5,486 *12 = 65,832 (pallets per year)

Actual pallets from warehouse to base region = 45,618 pallets per year

CAPACITY UTILIZED = (45,618/65,832)*100

= 69.2%

SOUTH:

Vehicles used	Capacity of veh (pallets)	Total no. of vehicles used	Capacity utilized
BEDFORD	8	3	24
MAZDA 800	6	4	24
CONTAINER	30	15	450
SINGLE HINO	10	4	40
TEN WHEELER	16	3	48
HINO	11	1	11

Total = 597 * 26 = 15,522 (pallets per month)

= 15,522 * 12 = 186,264 (pallets per year)

Actual pallets moved from warehouse to south region = 72,624 pallets per year

CAPCITY UTILIZED = (72,624/186,264)*100

= 38.9 %

CENTRAL:

Vehicles used	Capacity of vehicle (pallets)	Total no. of vehicles used	Capacity utilized
MAZDA 800	6	6	36
SINGLE HINO	10	13	130
TEN WHEELER	16	32	512
HINO	11	5	55

Total = 733 * 26 = 19,058 (pallets per month)

= 19,058 * 12 = 22, 8696 (pallets per year)

Actual pallets moving from warehouse to central region = 71,854 pallets per year

CAPACITY UTILIZED = (71,854/22, 8696)*100

= 31.4%

NORTH:

Vehicles used	Capacity of veh (pallets)	Total no. of vehicles used	Capacity utilized
CONTAINER	30	6	180
SINGLE HINO	10	2	20
TEN WHEELER	16	1	16
HINO	11	5	55

Total = 271 * 26 = 7,046 (pallets per month)

= 7,046 *12 = 84,552 (pallets per year)

Actual pallets moving from warehouse to north region = 59,411 pallets per year

CAPACITY UTILIZED = (59,411/84,552)*100

= 70.2%

5.2 RECOMMENDATIONS

- Use of vehicles on full capacity is necessary to lower costs. So instead of using 250 vehicles which are not fully filled while delivery, the company should use 209 vehicles on full capacity to lower their logistics costs.
- Also the major regions South and Central should be assigned vehicles with more capacity like Containers, Ten Wheelers and Single Hino.
- Region closer to warehouse (base) should be assigned smaller vehicles like Bedford, Mazda 1000 etc.
- Give proper training to drivers and loaders so that products are handled carefully and damage can be reduced.
- Fix devices and vehicles with internet so that driver can have access to Google Maps and they can chose the path with less traffic and deliver products on time.
- Drivers should be trained on how to use Google Maps and avoid traffic jam.

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