ROUTING PROBLEM OF OUTBOUND LOGISTICS IN FMCG SECTOR

Dissertation submitted to College of Management & Economic Studies for the partial fulfillment of the degree of

MBA (LOGISTICS AND SUPPLY CHAIN MANAGEMENT)

Guided by:

Dr. Neeraj Anand

H.O.D (LSCM)

College of Management and Economics Studies

University of Petroleum & Energy Studies

Dehradun – 248001

Submitted by:

Upshi Grover

Enrollment No: R600213062

SAP ID: 500026266

College of Management and Economic Studies

University of Petroleum and Energy Studies,

Dehradun, Uttarakhand, India

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DECLARATION BY SUPERVISOR

This is to certify that the project titled "**Routing Problem Of Outbound Logistics In FMCG Sector"** submitted to University of Petroleum & Energy Studies, Dehradun, by Upshi Grover, in partial fulfillment of the requirement for the award of degree of Masters of Business Administration (Logistics & Supply Chain Management), is a bonafide work carried out by him under my supervision and guidance. This work has not been submitted anywhere else for any other degree.

To the best of my knowledge, he has made an earnest and dedicated effort to accomplish this project.

Date:

Dr. Neeraj Anand
H.O.D (LSCM)
University of Petroleum
& Energy Studies
Dehradun

UNDERTAKING

I hereby declare that the Dissertation entitled "**Routing Problem Of Outbound Logistics In FMCG Sector**" submitted in partial fulfillment of the requirements for the award of the Degree of Masters in Business Administration is a record of original research work done by me under the supervision & guidance of Dr. Neeraj Anand and the Dissertation has not formed the basis for the award of any Degree/Diploma/ Associate ship / Fellowship or similar title to any candidate of this or any other University.

Place : Dehradun

Date : Upshi Grover

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UPSHI GROVER

R600213062

MBA-(Logistics and Supply Chain Management)

EXECUTIVE SUMMARY

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Often it is required that a company would like to get a guideline on their fleet requirements without having to perform an in-depth data analysis, and without having to perform a routing and scheduling type model to determine trucking requirements. A tool needs to be developed to determine fleet requirements, without the need for advanced studies, complex modelling or external expertise.

The model is required to provide an accurate solution for determining the relationship between the cost drivers and fleet requirements, without the need for routing and scheduling tools or any application of specialist skills. A tool, such as an index or algorithm, for future guidance on fleet requirements must be based on concise or limited data input. The factors that influence fleet requirements need to be determined before the relationship between fleet inputs and outputs can be investigated. A trial and error type approach can be used in order to limit the mathematical computations required to determine fleet requirements. This may be achieved by building on, or modifying, previous literature that addresses this problem and studying current fleets in operation. Ultimately, there needs to be a simpler, faster and cheaper way to determine tactical fleet costs and/or requirements.

Specifically, Volition Consulting is looking for a tool or model that can be used to investigate:

1. The fleet mix, which is the quantity of each truck type in the fleet

2. The distance each truck with have to travel

A base line model will be developed; this will use data from an actual trucking fleet from a disclosed client. Most importantly cost drivers for trucking fleets will have to be determined. Initially, the relationship between cost drivers and fleet requirements can be tested using fleet modelling software such as OPSI PLATO.

The aim is to develop a method to quantify the impact of variable cost drivers on tactical fleet requirements. To do this, a study needs to be conducted on industries best practices to set a benchmark for the methodologies that will need to be developed in this project. Data relating to past tactical fleet modelling will need to be used in order to identify key variables that impact a fleet's variable elements, and to determine accurate baseline rates for different fleet activities.

Only the most influential cost drivers will be used in the modelling of fleet costs. There are simply too many variables that effect fleet cost to include all of them in a model. Determining how fleet variable and fixed costs change based on input cost drivers will be the focus of this project.

A key issue will be to address the tactical fleet requirements specifically. The purpose of this project is to develop a tool or model which may be used to determine the tactical fleet outputs, such as equipment requirements, which relates to fixed cost as initial capital expenditure, and mileage of each truck, which relates to variable expenses. Costing studies could be an additional method for determining fleet requirements. Developing costs in the trucking industry requires use of many data sources. Secondary data sources include data for equipment, trip and industry characteristics. The inputs of this approach will be factors that affect the tactical elements of a trucking distribution process.

It must be noted that the objective of this project is not to develop a tactical fleet modelling tool that can be implemented in industry, but rather to investigate factors that influence trucking fleets through experimentation and sensitivity analysis.

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INTRODUCTION

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Fast Moving Consumer Goods popularly known FMCG includes everything from food items like flour, biscuits, ice creams, etc to body products soaps, face creams to cigarettes to beverages, etc. Consumers need these things in their everyday life so they invests a good portion of their income in these things. There are so many companies which are dealing in FMCG products like HUL, Dabur, Calvin Care, AMUL dealing in dairy products, etc. By the very nature of the product the companies are seeing this as a great source of income. As large number of companies are looking this sector as a profitable venture, so for sustaining there position and gain new market they have to bring something unique in their products or services to gain position in the market or to sustain there.

Planning a fleet correctly needs to be done at a strategic and tactical level. If it is done correctly an organisation's transportation cost can be reduced. A reduction on transportation costs have a positive impact on the broader organisation or supply chain in terms of profit margin and return on assets.

Minimising transportation costs has a major significance of an organisation and supply chain as a whole. This is because it accounts for the majority of logistics and distribution costs. This may be accounted to the high operating variable cost attributed to trucking. Fuel and maintenance costs make trucking an expensive mode of transport. A study by CSIR and Imperial Logistics in 2007 revealed that 55.2% of total logistics cost of trucking within the secondary sector are accounted to the physical transportation of goods.

Over the last decode in India transportation costs have continued to increase. Transport remains the biggest contributor to the costs of logistics and the biggest challenge in India.

Trucking is India's predominant mode of land transportation. Within the Metropolitan topology of transport, almost all freight distribution relies on trucking due to the accessibility to customers that this mode of transportation offers. High logistics costs are seen as a barrier to trade and foreign direct investment, and thus to economic growth. The answers lie in better processes, higher-quality services and the operating environment.

India was ranked 124th based on domestic logistics costs. The high logistics costs are due to the high transportation costs of goods, which will continue to increase in the short term, firstly due to the geographical nature of India's market and secondly, due to global factors such as higher oil prices. Therefore, to reduce logistics costs in the supply chain, efficiencies should be realised in other areas of operation. The optimal design of trucking fleets can have major advantages on transportation efficiency and a minimisation in overall logistics expenditure.

One of the primary functions of tactical fleet planning is to determine the optimal mixture and size of each vehicle fleet. The most important element of this project is to develop a methodology for decreasing transportation costs to make it more competitive in the Indian FMCG market. The approach that will be used in this project is through experimentation with OPSI PLATO to determine how elements within a trucking operation work together as a system.

In order to develop a successful trucking operation it is important to look at the broader picture and understand how trucking plays a role in industry and what is it that a fleet requires to be optimal and have a real world application. When designing a fleet at a tactical level, external considerations have to be explored before fleet specifics can be determined. Considerations for optimising fleet operations and decreasing fleet cost need to be linked to wider concepts that influence a fleet's success.

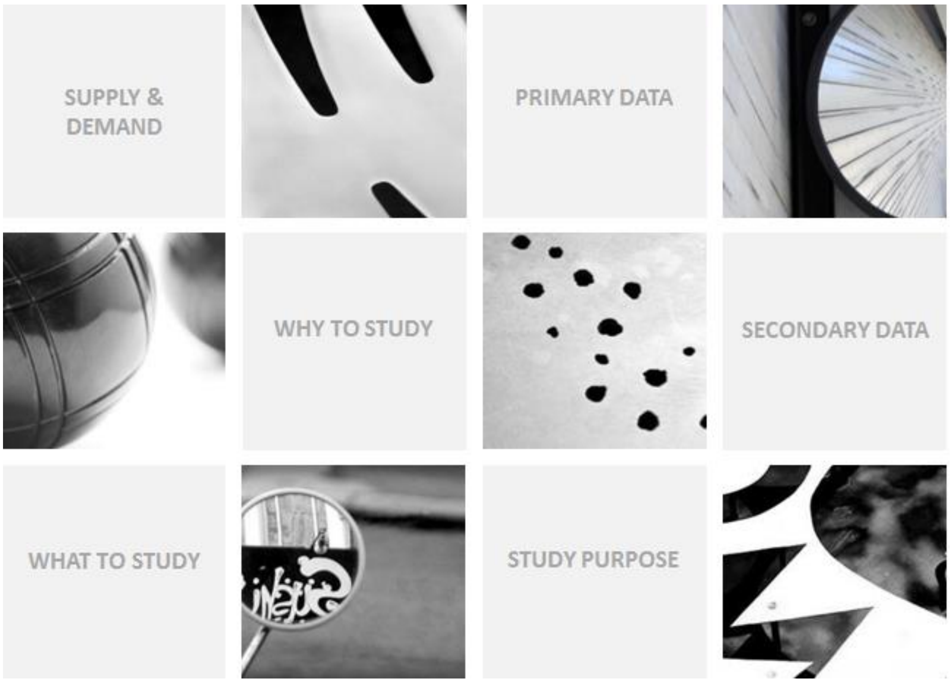
The design of a trucking fleet needs to be in line with current market trends, globally or regionally, and the economic position of their target market. These factors influence the scale of the trucking operation, cost, distribution strategy and other tactical considerations that need to be made.

LITERATURE REVIEW

LITERATURE REVIEW

Authors	Context	Inferences/ Parameters
Wouter bonte	Optimization Of Fleet Design For Cyclic Inventory Routing Problems.	The aim of this paper is to determine a distribution plan that minimizes the total cost without causing any stock-out situations at the customers.
Erel Zerman	Multi Item Inventory-Routing Problem For An FMCG Company.	The aim of this paper is to redesign distribution system by locating regional warehouses between production plants and customers.
Yaw Chang and Lin Chen	Solve The Vehicle Routing Problem With Time Windows Via Genetic Algorithm	The aim of this paper is to deliver a set of customers with known demands on minimum cost routes originating and terminating at the same depot.
Ante Galic, Tonči Carić and Juraj Fosin	The Case Study Of Implementing The Delivery Optimization System At A Fast-Moving Consumer Goods Distributer	The rich vehicle routing problem model is discussed and the effects of implementing the delivery optimization system are presented.
Kaushar R Ghanchi and Ajay D Shah	An Anlytical Approach For Fast Movingconsumer Goods (FMCG)	This paper basically deals with identifying frequent patterns from large amount of stock data of FMCG (Fast Moving Consumer Goods).
Michael Rebelo	Tactical Requirements and Cost Driver Analysis of FMCG Trucking Fleets	This project aims to determine and investigate the factors (cost drivers) that affect fast moving consumer goods trucking (FMCG) fleet costs and requirements (mix and mileage) at a tactical level.

RESEARCH METHODOLOGY



OBJECTIVES OF THE STUDY

- To develop a method to quantify the impact of variable cost drivers on tactical fleet requirements.
- To use an automated planning tool which would reduce total cost incurred in out-bound logistics.

RESEARCH DESIGN

This is a kind of descriptive research study because it describes what is going on or what exists in the FMCG industry and is supported by secondary data.

TYPE OF DATA

For the purpose of the study secondary data has been collected from various sources.

METHOD OF DATA COLLECTION

The study is carried out through secondary sources of data through research papers, industry reports, business journals, published articles, business magazines, newspaper articles etc.

SAMPLING DESIGN

As per objectives of the study; theoretical sampling technique is adopted.

TOOLS FOR DATA ANALYSIS

For the purpose of this study, simple conventional methods of tabular analysis are used. Analysis is also done on basis of general observation and by drawing inferences.

SCOPE OF THE STUDY

The scope of the project is limited because the study will consider only the fleet management and related issues in Indian market for FMCG products and will not include other factors which are affecting the cost and selection of routing being done in Indian FMCG sector.

LIMITATION OF THE RESEARCH

- Primary research has not been conducted in this case due to the wide area of the study, given the cost, time and budget constraints.
- Since the data for study is collected from various sources and studies by different groups, there may be variations compared to actual situation. However, the degree of discrepancies has been kept to the minimum.

CURRENT SCENARIO

CURRENT SCENARIO

An accounting approach has been used to determine fleet requirements based on the cost of the operation. This is done by exploring different options and determining which set of trucks will be cheapest based on their fixed and operating costs. This method relies on standardised industry costs involved in distribution and picking within the supply chain.

This method for cost analysis looks at each element of the trucking operation in terms of its financial viability. Factors that would be considered include:

- The net present value of acquiring assets (trucks)
- The variable cost of each truck type
- Profit and loss statements for the organisation based on projected or actual fleet activities

Often the impact of costs is not fully understood, and each element is looked at in isolation. Complexities arise when the cost impact of an operation has to be evaluated on how its elements interrelate and affect one another when they interact in a system. Often this approach uses estimated costs and does not consider how different factors (elements) internal or external to the operation effect cost. This is why it is important to evaluate the underlying issue: what impacts the cost of a trucking fleet?

The second method incorporates the financial components of a cost analysis with the variable workings (specifics) of a fleet. This methods work well when a fleet is already in operation and detailed specifics of the fleet are known. Mathematical modelling has been successful in quantifying how the many factors and constraints within a trucking operation affect cost. It is also useful when determining day to day activities when planning out routing and scheduling procedures. The mathematical commutations to derive such answers are complex and require intensive data input. Mathematical models are not flexible in the sense that they are entirely fleet specific. For a given model to be applicable to a trucking operation the details specifics of such a fleet would have to be known. This includes the mapping and location of all clients, the fuel economy of each truck, turnaround time, loading constraints, order picking and on-time delivery. A company has to invest time and money to collect and analyse this above mentioned data before it can be used in the model. It combines operational elements with tactical requirements, in great detail. The result is a complicated model that is very labour intensive and requires expertise.

Mathematical models are most applicable to optimising existing fleet by refining its operations, time of shipments, routing strategy etc. It becomes very complicated when a new fleet needs to be implemented. Evaluating potential costs and values to use in the model may be very difficult to quantify, even with extensive market analysis.

FMCG Industry is characterized by a well-established distribution network, low penetration levels, low operating cost, lower per capita consumption and intense competition between the organised and unorganised segments.

The biggest challenge in FMCG industries are:

1. Cost reduction at processing, transportation

2. Inventory levels at each point in supply chain

3. Delivery time of product

4. Product availability or substituting the products

FMCG distribution works on a less-than-truckload policy where carriers move multiple shipments (orders) ranging from 70kg – 7000kg. A hub-and-spoke network is used to sort and consolidate shipments in a particular area.

TACTICAL CONSIDERATIONS FOR TRUCKING FLEETS

The following elements shape the nature of FMCG trucking fleets:

Lack of affordable supply chain training to SMMEs (especially from the private sector), such as inventory management, supply chain improvement, value chain creation, outsourcing of non-essential functions and information sharing, hinders the development of effective supply chain management for SMMEs.

Cost effective transportation helps companies gain access to higher quality, lower priced materials and realize economies of scale in production. Trucking operations with lower transportations costs will be able to offer products with a lower landed cost, which will make the product more competitive within its market.

Carriers struggle to keep up with freight growth, whether it be hiring and retaining enough truck drivers or putting enough trucks into service. The outcomes of a capacity crunch include higher freight rates, shipment delays, and limited negotiating capabilities.

This project aims to look at ways of reducing transportation costs by determining an optimal fleet based on customer requirements. This will be achieved through conceptualizing factors that affect trucking operations.

Benefits of Improved Distribution:

Direct Benefits

- Reduction in fleet size
- Reduced costs
- Imporoved fleet and staff utilisation
- Reduction in fuel and operating costs

Indirect Benefits

- Increased customer service
- Imporoved customer service levels as a result of dependable on-time-delivery
- Imporved realistic and acdhievable vehicle routing
- Reduced carbon footprint

SWOT Analysis of FMCG Trucking Organisation in India

Vehicle Routing Problems

The basic fundamental of fleet modelling is the travelling salesman problem (TSP). It is a popular vehicle routing method that has been used numerous times to address trucking fleet modelling, and often, it naturally arises as a sub problem in many transportation and logistics applications. The basis of the travelling sales man problem is to minimise the travel cost, distance or number of trucks by finding the best possible way of visiting all the customers and returning to the starting point, given a set of customers and the cost of travel or distance between each possible pairs. The TSP is the basis from which all vehicle routing problems (VRP) are formulated. The model in this project will be based on a VRP scenario that looks at the distribution of goods between a central depot and a network of customers.

A TLT policy implies that truck can carry a maximum load just below the vehicle's available loading capacity. Generally TLT fleets work with smaller loads of up to 9 tonnes, which is a realistic assumption for most FMCG fleets. The nature of TLT fleets is the picking of multiple customer orders and consolidating them into a single shipment. The benefits of LTL are that they generally offer lower per-unit rates as opposed to other trucking methods such a full-truck-load (FTL) policy. The problem with this type of order is the optimal consolidation of customer orders.

Definition of Modelling Heuristics

A heuristic modelling approach has been use in many logistical problems. Tactical requirements are harder to solve mathematically because they involve a lot of considerations that are external to the business, such as prospective suppliers or market trends. In order to solve such solutions heuristics are used because they adopt an experience-based approach to problem solving, which usually speeds up the time it takes to find a suitable solution. The fundamental basis of a heuristic model is to rely on trial and error methods and mental short cuts to ease the cognitive load and analysis requirements of deriving a solution (T. G. Crainic and G. Laporte, 1997). It is most beneficial where an exhaustive approach is impractical. Examples of heuristic methods include rule of thumb, educated guessing, intuitive judgment or common sense. The following heuristics have been used before to model VRP based problems. They make use of logical strategies to make the model more realistic. These heuristics add flexibility to the model, making it adaptable many routing challenges.

Sequential Heuristic

Sequential heuristics have been used before to address an array of VRP scenarios. When a set of trucks of various size are available to serve a predetermined amount of customers, often the largest trucks are sent first. Through industry experience, it is noted that larger trucks have lower variable cost per unit volume. Assuming that both trucks are full, it will be cheaper to supply the goods in a large truck rather than a small one. This works because the revenue earned through delivering the payload usually outweighs the additional fuel and maintenance cost you would incur on a larger truck.

Additionally, sequential heuristics include a nearest neighbour approach which plans trips out such that they always start at the depot. The trip is defined as an 'open path' meaning it is not bound to visit customers in a predetermined order. The method is to plan the trip out so that the nearest feasible customer is always visited next. A customer is determined as feasible if they have not been visited yet by any other truck in the fleet. This heuristic ensures that the truck will make it back to the depot in time.

A best insertion heuristic (BIH) is used to visit a set of customers but will consider making detours to additional feasible customers if the detour would result in a total reduction in the fleets travel time. In essence it aims to send a set of trucks out so that they visit all customers while minimising total travel time.

A heuristic developed by Mole and Jameson (1976) is structured so that a truck is sent to the furthest feasible client first, after which the cost implications of travelling to the next client (the next node in the network) is considered. Objectively, the trip with the lowest costs incurred will be selected. This cost decision is considered before leaving each node.

Merge Heuristics

Merge heuristics (MER) are based on the Sconcept of fulfilling a client's order and then returning to the depot. Whilst doing so, it aims to merge the trip with other customers' orders so more than one client can be visited per trip. A variation of a heuristic by Clarke and Write (1998) can address a routing method for heterogeneous fleets. It considers the various orders sizes made by customers and arranges them into descending order. It considers filling up the trucks of various loading capacity before sending them out to deliver the orders.

Modelling Software

OPSI PLATO

OPSI PLATO is a useful software tool used in logistical distribution based businesses. It has many features that help to streamline business operations such as cost and time reduction. This software may be used to determine the relationship between a given set of customer requirements and the fleet requirements to fulfil them. It achieves this by looking at the following aspects that are applicable to tactical fleet modelling.

Plato can be used for customer order management. The software is designed to monitor and organise high volumes of orders that need to be transported to customers. Orders can be combined or spread over multiple loads in order to optimise the fleet. Tools may be used to reduce the distance travelled by the trucks in the fleet by testing for alternative routes.

The planning element of Plato uses algorithms to decrease the cost of trucking trips. It considers relevant distribution network data and the performance of previous trips to select the best fleet make-up to fulfil the distribution requirements. The utilisation of the truck in the fleet can be better utilised by planning customer loads more effectively.

The software has an option to create or destroy loads. Whether the loads created or destroyed are fictitious or not, the resultant effect on the fleet requirements can be observed. Therefore PLATO can be useful in investigation the effects customer requirements, or other inputs, have on fleet requirements.

PLATO has useful data management capabilities that allow a user to store client, hauler and a variety of logistics related information. This database facility can be used to store relevant input for a fleet requirements model.

Microsoft Excel

MS Excel can be used to model fleet requirements provided that the customer data sets are not too large. The program has many formulas to model an array of statistical distributions, which will be appropriate to approximate inputs that are stochastic. It does however have 28 limited built-in functions to adhere to the computational requirements for most tactical models. In this instance, Visual Basic for Application (VBA) allows the user to write code for tasks Excel cannot perform. The piece of code can be called to run by Excel. The code is referred to as a ‘macro’ in Excel. Programs such as @Risk can also be used as a plug in for MS Excel. @ Risk software is a statistical package add-on for MS Excel. In the context of this project, it is a useful tool for graphing results and performing sensitivity and regression analysis.

MODEL FORMULATION

MODEL BASICS

To understand the effects that certain factors and constraints have on a fleet mix, experimentation will be done in OPSI PLATO. The PLATO model to be developed needs to represent a generic FMCG distribution scenario that is realistic. The objective of the PLATO model is to give an optimum fleet mix to perform a given set of tasks by the customer. This model will be run under many different scenarios to determine the impact that cost drivers have on fleet requirements. The results will determine the ideal fleet mix for these different scenarios. The PLATO algorithm tries to minimised mileage and total transportation costs whilst ensuring all customer demand is met.

Transportation is just a sub-system within an organisation. For a solution to be practical and of most significance to a business the fleet should not be optimised at the expense of other related logistical areas. The best approach to achieve a transportation system that will have an overall improvement on a business is to identify the trades-offs that exist between transportation and other facets such as organisation work hours and customer satisfaction.

The model will determine the required fleet mix to ensure demand is fulfilled. In other words, transportation capacity and customer demand must be matched. Provided that the model applies to FMCG distribution, the fleet must be flexible enough to cater for demand fluctuations, which are common in the FMCG industry.

The general strategy is to determine which set of trucks best suit the requirements of the customer. This tactical decision requires the analysis of the best fit and balance between truck capabilities, product characteristics, service requirements and transportation cost.

PERFORMANCE MEASUREMENT

In order to ensure that the base case FMCG distribution model will have a respectable level of realism it is important that it is designed in such a way that it aims to satisfy the following elements which are used to measure the performance of FMCG transportation activates:

- Increase on-time delivery
- Utilise capacity
- Reduce empty miles
- Reduce transportation spending

OPSI PLATO EXPERIMENTATION

The links in the distribution network will be quantified by the actual distance between nodes (customer sites). Actual customer site locations have been provided by Volition Consulting. PLATO has the ability to plot these sites on a map and use GPS trucking routes to determine the actual distance trucks will have to travel. For the most part, links will not be bound; this implies a truck could travel between any two given nodes within the distribution network.

A cause and effect analysis will be used to further investigate and conceptualise the interrelation of customer requirements, cost drivers and fleet requirements.

An analysis of how the base case inputs affect fleet requirements will provide insight into modelling logic for developing a tool that helps to determine fleet requirements. Results in PLATO will be graphed or tabulated as part of a sensitivity and regression analysis.

An investigation will be done to find any positive correlation between various cost drivers and fleet requirements. The aim of the investigation is to determine which cost drivers have the greatest impact on FMCG distribution fleets.

OPSI PLATO MODEL DEVELOPMENT

Model parameters include product type, delivery windows, customer demand and the geographic location of clients and depots. Important cost drivers will be evaluated based on the users input.

The output of each modelled scenario will be a tabulated display of

X: Truck type in units

Y: Truck type in terms of loading capacity (tonnes)

D: The average distance travelled by each truck type

MODEL DEFINITION

The data set provided by Volition Consulting will be used to create a generic FMGC distribution model in OPSI PLATO. The base model will be used to conduct a scenario analysis, by changing elements that affect fleet cost drivers. The impact of these cost drivers can be measured by running many instances (scenarios) of the base model, where the cost driver is the independent variable that is changed in each instance.

The distribution network of a given data-set will be modelled as a hub-and-spoke network using a TSP approach. Clients will be scattered around one central distribution centre. Each customer will have a stated delivery rate. The distribution centre will have to visit each customer according to their respective delivery rate requirements. PLATO is used primarily as a daily scheduling tool. The objective of the problem is to minimise the number of trucks that can be used to satisfy all customer orders, and the distance in which they need to travel.

The fleet consist of an unrestricted number of each truck type defined in PLATO. This is so that the optimum fleet mix will be selected to do the job.

The trucks will be able to operate on a less than truck load (LTL) policy which is most applicable to FMCG trucking. As a result the model will be less constrained and a vast array of customer orders can be assigned to a single shipment.

COSTING WITHIN TRUCKING DISTRIBUTION

Real cost data from previous fleets will be programmed into the PLATO model. This is so that PLATO selects vehicles in a logical and realistic manner. For example the variable cost of running a 16 ton vehicle will be higher than a 1 ton vehicle. This logic needs to be programmed into the model under each vehicles property.

ASSUMPTIONS

The OPSI PLATO model will need to address a variety of FMCG product types for transportation. Product demand and truck payload capacity need to be defined in terms of a standard unit. This standard metric unit needs to be used to quantify the amount of product loaded onto the trucks for shipment. Within FMCG trucking, loading weight is usually the limiting factor before loading volume is filled up. FMCG’s include many products with a moderate density; however, there are a few exceptions, such as polystyrene which has a very low density. Most importantly, kilograms are suitable unit of measure from which to gauge the size of the truck required. This model will give the output of the trucks size in terms of its maximum loading weight. Demand and truck loading capacity will both be defined in kilograms to simplify the model.

The actual dimensions of the truck are irrelevant in most cases, unless an unusual type of product is being transported. For example, if a set of heavy products such as bricks are be transported, the width of the loading bay will be of concern. The product will need loaded over an appropriate amount of axels to distribute weight evenly. This consideration is not highly applicable to FMCG's as they (generally) comprise of lighter goods.

CONSIDERATIONS

We need to consider the operating hours of the central depot and the hours in which trucks can be sent out. This will impact the number of trucks required.

The trucks should be loaded as close to maximum capacity so as to maximise the utilisation of the trucks. Ideally, each truck should be at least half full before it leaves the depot in order to keep the payload revenue per trip sufficient, and to lower the total amount of trips. This will lower the variable expenses of the fleet.

Where demand is deterministic, as it is in this model, the objective is to balance the utilisation of each customer order or load over a set of trucks within the fleet. We assume that the smallest truck in the fleet can serve the largest order a customer may place. It is so that there will always be one or more orders per truck, according to a LTL trucking policy.

PROCEDURE

The initial step is to investigate the relationship between cost drivers and the resultant fleet mix and cost. A series of base models will be provided from which to conduct correlation and regression analysis. A FMCG type trucking scenario will be modelled using PLATO to determine initial fleet requirements. Using the capabilities of PLATO, the relationship between the cost and drivers fleet mix will be investigated. Excel will be used to plot the relationship between a selection of cost drivers and fleet mix. Through testing and analysis, the groups of cost drivers that have the most significant impact on fleet composition and mileage will be determined.

MODEL DEVELOPMENT

BASE MODEL CONSIDERATIONS

A respectable model has been designed in OPSI to represent a generic FMCG trucking fleet. It represents a medium to large scale FMCG fleet with 100 customers.

Demand is defined in weight, with an average demand of 250kg per customer per order. This is a realistic order size if a fleet was delivering to medium sized supermarkets.

PLATO ALGORITHM ABILITIES

Many of the tactical and operational concerns of selecting a fleet are designed into PLATO. When determining the fleet most applicable (with the lowest operational cost) to a given fleet scenario PLATO will do the following:

 Automatically cluster clients into groups based on their locations and their demand and select the best way to service them.

 Balance each trucking fleet over a customer group and redistribute trucks based on changes in the demand amount on/or customer groups.

 Use the merge heuristic to plan trips for heterogeneous fleets. The demand for each trip will be balanced over an array of truck types.

To ensure the demands are realistic the monthly demand for an undisclosed client was converted into a daily average. Fleet demand fluctuations will be simulated to determine its impact on fleet requirements.

COST ASSUMPTION

In the testing of results, the effect of cost drivers has on the variable operational costs of operating the fleet are analysed. We treat the fixed cost, such as purchasing the truck, as sunk costs. OPSI PLATO is designed to select an ideal fleet mix that has minimum transportation costs. The average trucking fleet life is 10 to 20 years. Due to the high variable costs of trucking that add up over time, the assumption is that savings on variable costs, by selecting an optimal fleet based on minimum variable costs, will cover initial fixed costs long before the fleet life is over. As a result initial fixed cost is not considered. This is a long term and tactical concern for making profits in the future.

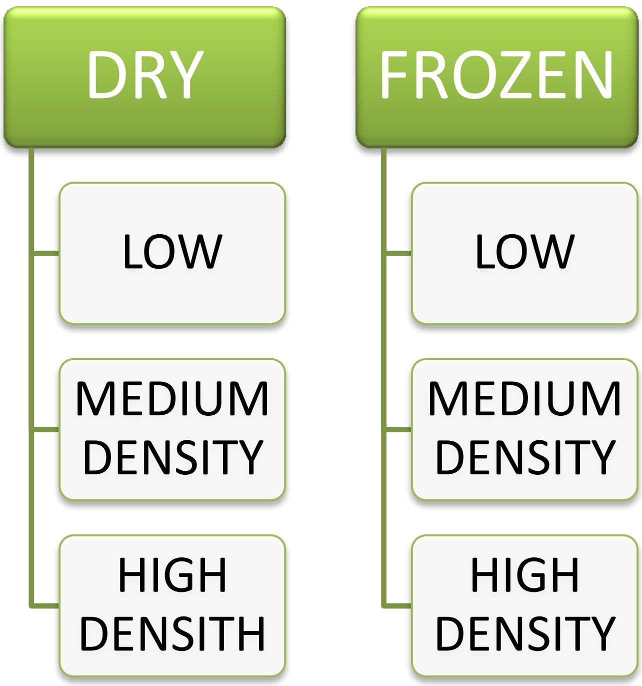
MODELLING OF PRODUCTS

FMCG product types can be divided into two broad categories:

 Dry goods: this includes clothes, toiletries, cleaning products, stationary, electronic gadgets and all the other goods you will find in a supermarket that do not require any form of refrigeration during transport.

 Chilled/Frozen goods: this includes food and beverage that require refrigeration during transport.

The product types are defined in density to represent wide array of products to be transported as this model needs to be applicable to most FMCG trucking applications. The products defined in the model are:



VEHICLE PROPERTIES

All the trucks used in the FMCG trucking model are defined as ridged vehicles. This is a reasonable assumption as most trucks with a payload in the range of one to sixteen tonnes (as defined in this model) are rigid. A truck and trailer set up is commonly used or larger trucks from the sixteen ton range upwards. The trucks where uploaded to the OPSI PLATO database to be used for selection once the modelling scenario is running.

VEHICLE COMPARTMENTS

Vehicle compartments are a function of product type. Goods that require refrigeration generally have a separated 'frozen-food' and 'chilled' compartment. A trucks loading bay may be compartmentalised for loading/unloading purposes.

Because of these two major types of transportation for FMCG's, refrigerated and dry vehicles have been made available for each payload capacity, as well as a dual vehicle which includes a refrigerated and a dry compartment divided equally. The truck layouts are as follows:

The maximum loading capacity of defined sections and compartments was programmed into OPSI PLATO under vehicle attributes. Dry and refrigerated trucks comprise of one section with one compartment attributed to that section. A dry/refrigerated truck would have a defined loading capacity in kilograms. For example a 9 ton vehicle would have a 9000kg loading limit. Dual truck has one section with two compartments. Compartments are divided equally between frozen and dry products. This ensures that each section will comprise of half the maximum loading capacity of the vehicle. For example, a 9 ton vehicle will have a 4500kg compartment for frozen goods and for dry good.

TURNAROUND TIMES

The turnaround time refers to the time a truck takes to offload an order at a customer. A fixed (average) turnaround time of 10 minutes was allocated at the depot and each customer. This is a realistic average turnaround time for FMCG fleets because the order size per customer is small so not a lot of time is spent loading or offloading. This accounts for customers where delivery conditions may be unfavourable. For example, if a truck has to park down the street from a client due to parking and size constraints, the truck crew will have to carry or cart the product the distance from the truck to the client store. This will substantially increase offloading time.

SITE VEHICLE RESTRICTIONS

Often FMCG customers are supermarkets and various small to medium sized retailers. They are situated in built up residential areas such as shopping centres. Often this places a constraint on the size of vehicle that can service the customer, due to a lack of infrastructure for large trucks. Therefore, smaller trucks are required to reach (and operate within) customer loading bay areas. Generally, trucks 3 tones and smaller are most suitable to serve customers in shopping centres. A study on the effects of vehicle site restrictions will be conducted in the next chapter, refer to Figure 20: Percentage of Customer Sites with Vehicle Restrictions vs. Service Cost.

DELIVERY WINDOWS

The impact of delivery windows is an important constraint in the model. This is because it is an important consideration in the FMCG sector because perishables are required during very specific delivery windows, and late deliveries are penalised heavily. Often the customer will send the truck back. As a result, the penalty for not meeting delivery windows was heavily weighted.

SPATIAL RELATIONSHIP OF DISTRIBUTION NETWORK

Warehouse location is a tactical and strategic concern for many logistical operations as it has a substantial impact on its performance. This decision is industry dependent. Industries that have few clients spread over large distances will prefer to have a centralized warehouse. Industries that have many clients clustered in various areas will prefer to have a decentralized network of warehouses. The location of warehouse influences the entire dynamics of a distribution network.

FMCG INDUSTRY ATTRIBUTE BREAKDOWN

FMCG COMPANY			
BASIS	A	B	C
Scale of Operation	Small	Medium	Large
Density of Product	low to medium density	Medium density products	Low, medium and high density products
Product Transportation Requirements	Products do not require refrigeration	Includes dry products and products that require refrigeration during transportation	Includes products that require refrigeration during transportation, although the majority of the products transported do not require refrigeration
Product Type	Products include newspapers and magazines	Products include foods and toiletries	Products include foods, clothes, toiletries, furniture and electronics
Truck Type	Only trucks with dry compartments	Dry, refrigerated and dual trucks	Dry and refrigerated trucks, no dual trucks, primarily dry trucks

Truck Size	3 tones and smaller, most widely used vehicle in the fleet are the 1 tone vehicles	2 to 8 tone vehicles, the most widely used vehicles range from 3 to 6 tones	3 to 16 tone vehicles, the most widely used vehicles in the fleet range from 6 to 8 tonnes
Distribution Network	Customer are highly clustered and close to the depot	Comprises of customers moderately close to the depot, customers are usually within few kilometres of one another	Customers are not clustered and far from the depot

CONCLUSION

CONCLUSION

OPSI PLATO model is most applicable to small to medium FMCG operations. The per-kilogram-delivered cost value falls amongst the fleet values for Companies A and B. This may be attributed to the fact that additional cost of resources for loading/offloading unusual products was not built into the OPSI PLATO model. Examples include fragile goods that need additional packaging and goods that cannot be tightly packed into the truck (cannot be stacked on one another) thus demanding more loading space per kilogram of product.

This report suggests the OPSI PLATO model was designed to a respectable level of accuracy and produces results applicable to real world FMCG trucking fleets. Through the validation phase, however, it is evident that the model does not represent a generic FMCG fleet that is applicable to all sized FMCG distribution activities. It is more aligned and to small and medium FMCG operations with conditions similar the attributes of Company A and B.

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