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CHALLENGES IN LAST MILE DELIVERY – CASE OF FMCG INDUSTRY

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ABSTRACT

This was live case-based research at an FMCG warehouse based in Mumbai, Maharashtra. The area of focus was towards B2B last-mile delivery.

The research had two major objectives: Study the last-mile delivery present process to understand the gaps and shortcomings experienced. Also, focus on issues faced by the software existing at the warehouse for vehicle planning and routing.

Initial phase was exploratory research to arrive at the various last mile delivery options that are used by different industries. Then the attention was directed towards FMCG industry exclusively. Later, primary research was carried out by two methods – firstly, the process of observation being at the warehouse and learnings from the day-to-day tasks; Secondly – detailed interviews at the warehouse were taken of the personnel involved in the tasks.

All the area of concerns were listed as per interactions with the personnel implanting the software. To map down the problems faced to its core, the framework of the software was studied in detail.

Keywords: Warehouse, last mile delivery, supply chain, vehicle planning, routing, FMCG, logistics

INTRODUCTION

Modern day Last Mile Delivery

Every stage of the logistics process of delivering goods is crucial from the time a parcel leaves the hands of the Sender up to the moment it arrives at its destination.

While each step of the way should be taken seriously, there is no point higher priority than that of the last mile delivery stage, where the goods from a transportation hub move to their final delivery destination.

The goal of last mile delivery is to transport an item to its recipient in the quickest way possible. This has been driven by the continuously evolving market and demand for convenient customer experience across industries such as e-commerce, food, retail and many more.

Last mile delivery has been a key factor for businesses across the globe where businesses have established a need for a more effective delivery service. Consumers easily look for

alternatives if their logistics partners come up short in providing top-notch supply chain services including last mile delivery software. This is crucial in building brand loyalty that could help companies take a huge slice of the market share.

There are important elements involved in the last mile delivery process that customers are looking for namely the speed, timeliness, accuracy, and precision of the product deliveries after reaching their endpoint.

It is quite ironic that the shortest and quickest leg of the whole logistics process is also the most crucial, so it covers a lot of territories.

Before the boom of e-commerce, the delivery endpoint of goods is the brick-and-mortar store where consumers must go to and purchase the goods physically. But now, the last mile delivery has made things more complicated since the goods must be delivered to each of the consumers who purchased the goods at different destinations.

To ensure cost effectiveness, faster and efficient, a transparent and friction free delivery to the consumers, the location of warehouse also plays an important role. Referring to Figure [1] it is observed that the warehouses are located outside Mumbai city, serving as central warehouse.
Major clusters of warehouses are at Bhiwandi & Panvel.

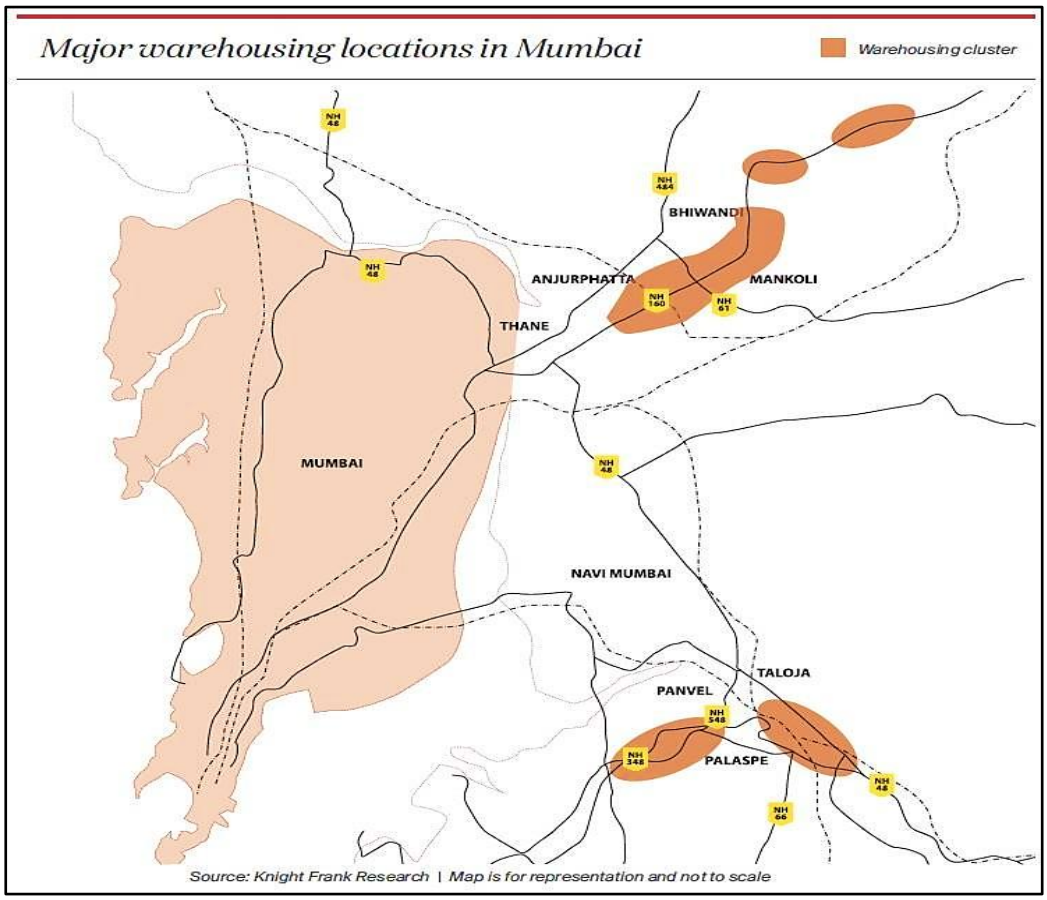

Figure [1] Major Warehousing locations around Mumbai[1]
Source: Knight Frank Research

SIGNIFICANCE OF THE STUDY

It is important that a study regarding the relationship between all the factors involved in the supply chain pertaining to outbound logistics are studied. This will open many gaps in the current chain and give a clear picture – location of gap, impact caused, and cost involved if neglected.

Modern day consumer expects fastest and most efficient delivery with precise order tracking, safety and security of their goods and the goods be delivered at their convenient time and place. This leads to increased constraints at the logistics end. However, these are to be met as much as possible to have a happy customer under one's umbrella.

OBJECTIVES OF THE STUDY

The study takes account of the Last Mile-Delivery. The specific objectives of this study are:

(1) To understand different methods of Last Mile Delivery of products used by FMCG industry.
(2) Challenges faced in terms of Logistics and Distribution of various products.

LITERATURE REVIEW

Theoretical Framework Review

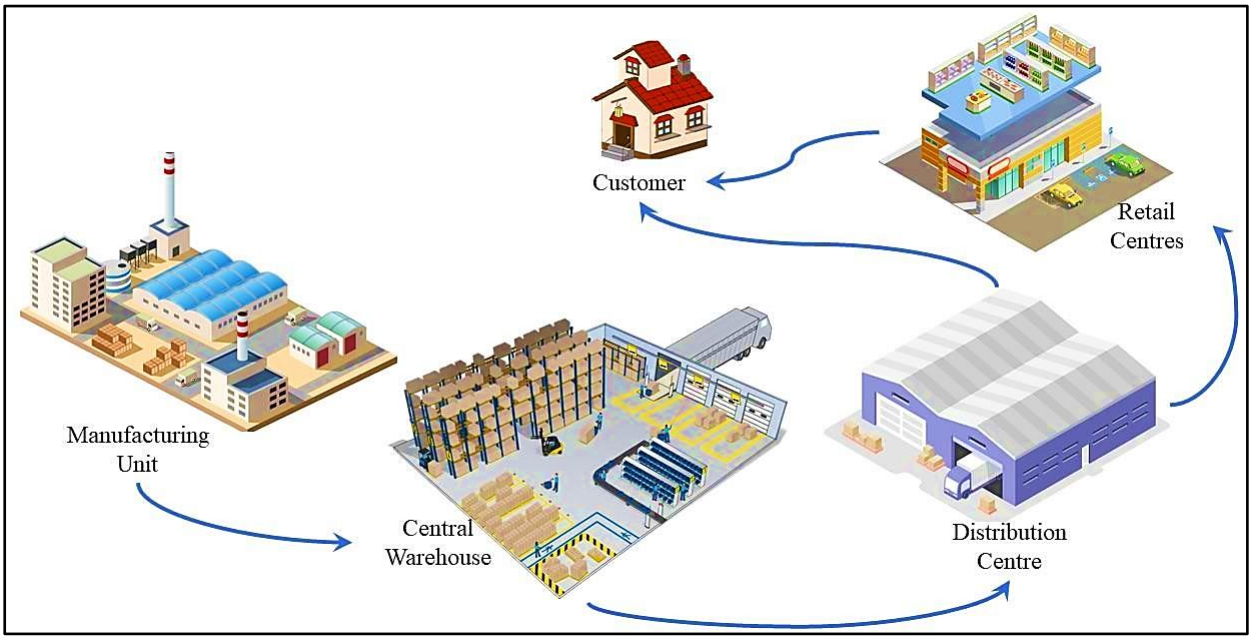

Figure [2]: Framework for Outbound Logistics
Source: Author understands of Outbound Logistics

Warehouse

The FMCG warehouse is complex, comprising many areas such as frozen or fresh produce sections, and fast and slower moving items areas with different handling conditions; this makes it vital for operatives to receive accurate and specific instructions. Communicate is real-time with the warehouse management system (WMS) with solution that streams commands from the WMS direct to the picker's terminal, directing them to their next

pick. On reaching their destination, the operative is also able to confirm the product with the system, ensuring that correct items are sourced [2] .

Response Time
The time between when a customer makes a delivery order and when he or she receives his or her product delivery is called response time. Order visibility is an especially important ability in delivery process since customers could track their order from placement to delivery, which would affect customer experience [3].

Lead-time Gap
The length of the time that customers prepare to wait is called order cycle, and the time from when the order is started delivery to when it be received is called logistics lead time. In some cases, this may be measured in months but in others it is measured in hours [4].

Vehicle Routing Problem
When express companies arrange a delivery, they have to set up specific routes for carriers, and the route problem is another one during the delivery process, which is called VRP – Vehicle Routing Problem [4]. Current logistics systems in urban area are usually unable to delivery products with full delivery efficiency. The delivery activities increase the number of freight carriers or trucks in city region, which leads to congestion and other traffic issues in cities. Customers will not pay the full cost caused by the inefficiency of transport system [5].

Last Mile Delivery
It takes place within a predefined delivery area (e.g., urban area); including the upstream logistics to the last transit point until the destination point of the parcel. It involves a series of activities and processes, of critical value to all the involved stakeholders (e.g., Customer, Industry and Institution) within the delivery area" [6].

Review of Related Studies / Papers
Today's customers begin to demand responsiveness as an integral part of service. As consumers increasingly turn to e-commerce for all their shopping needs, a quick response service becomes a critical mission for logistic companies and retail partners across the world. The delivery companies face a fierce competition for survival challenges in the rapid delivery market. Therefore, such companies are forced to restructure their delivery or service network to overcome the cost and delivery speed problems [7], [8] .

There are numerous challenges in Logistics and Distribution industry, and to cater to these obstacles, various solution providers are available. And the distribution problem is incurred by several reasons like the logistic infrastructure, customer characteristics and management ability, so finding a way to solve this problem and adopting a set of applicable methods will facilitate the companies to gain competitive advantages in FMCG logistics market.

B2B Supply Chain
B2B chain and e-commerce chain receives considerable importance owing to its performance implications. Due to the exponential growth of online purchasing and delivery markets, and with the increase in order numbers, the retailers are under pressure to manage their stock and to provide efficient delivery in terms of speed, price, service, and quality. Bopage et al believe that when it comes to customer satisfaction, delivery has the power to make or break the relationship.

In B2B there is often a need for the companies to educate the customers more than in B2C. Differences between B2B and B2C market can lead to the conclusion that keeping existing customers happy and developing the relationships within the accounts to gain more sales plays an extremely important role in B2B sales.

Last Mile Delivery

Therefore, last mile delivery should be considered as one of the priorities in supply chain management, to sustain the business. It is the last process, which includes several activities and procedures that are necessary from the distribution center to the final receive point of a supply chain. It can affect the supply chain operation on several aspects: environment, cost-effectiveness, safe unattended delivery, and traffic congestion [10], [11] .

Last-mile distribution is the last part of the supply chain logistics process, which involves a set of activities that are necessary for the delivery process from the last transit point to the final drop point. Last-mile distribution is critical because it is responsible for the delivery of products to end customers and is currently regarded as one of the most expensive, least efficient, and most polluting sections of the entire logistics chain [12], [13], [14], [15], [16], [17] .

The core of the last mile logistics system consists of three central components: last mile fulfillment, last mile transport, and last mile delivery. Last mile logistics can be described as the process of planning, implementing, and controlling efficient and effective transportation and storage of goods, from the order penetration point to the final customer. Last mile distribution is associated with the handling, movement, and storage of goods to the point of consumption through various channels. Last mile fulfillment is the process of executing an order by making it ready for delivery [18].

Factors involved in Last Mile Delivery

Based on a comprehensive study addressed by Ewedairo et al [19] , it has been advised that the effectiveness of last mile delivery depends heavily on five key decisions. These decisions include facility location decision: number of distribution centers; inventory decision: inventory in each facility; inventory policy; transportation policy: number of vehicles, route planning, capacity of vehicles and scheduling; and distribution decision.

Souza et al. [20] examined that the nearer to the aggregated point (delivery destination), the more cost and higher loss in capacity and efficiency. This last process of the supply chain may face serious constraints in fulfillment, higher social, environmental, and economic costs, and increased complexity in operational arrangement.

Gevaers et al. [21] evaluated the density and market penetration of the delivery region creating the important effect on the efficiency in last-mile delivery. Duin et al. [22] clearly stated that it is possible to improve the efficiency of the last-mile delivery in markets by implementing some changes in delivery processes such as changes in location, time, route, and consumer behavior.

Area of Study

Consumers have come to expect the same or next-day delivery. Expectations on the B2B side are also rising, with buyers demanding the same convenient experience they are used to as consumers. Of the total cost in supply chain, last mile delivery takes up to 41% of the overall cost as per a Capgemini Research Institute [23] .

On the B2B side, shippers deal with much larger purchase orders and deliveries that are more consistent over an extended period due to customer contracts. Handling these deliveries poorly can result in damaged relationships.

B2B sellers do monitor the delivery process closely; however, it can be difficult for small-to-midsize companies to monitor their operations and deliveries efficiently and cost-effectively. And while there are too many factors involved in last-mile delivery for a single solution to address, new logistics approaches backed by technology are helping businesses improve their

B2B deliveries processes and gain a competitive edge, especially during this challenging time. We will be focusing on the B2B challenges of the Last Mile Delivery from FMCG point of view.

RESEARCH METHODOLOGY

At this stage of the study, the approach that will make this study feasible will be described through which the results obtained, and objectives could be met.

Research Design

Research design specifies the details of the procedures necessary for obtaining the information needed to structure and/or solve the marketing research problem. The initial phase of the research will be "Exploratory Design" as an attempt was made to understand the problem statement while relating issues with FMCG Logistics and distribution.

To understand the impact of Logistics on last mile delivery, the research was carried out with an FMCG company Warehouse based out in Bhiwandi. The warehouse uses SAP Technology Platform for maintaining stock-data, Warehouse Management System (WMS) for ease of stock racking, 3rd party enabled Sales Orders & supply chain services that enable ease of business. This technology is designed to aid in customer satisfaction with better response and lead-time. 3rd party manages the entire Sales process as they control and build healthy, ethical supply chains.

OBJECTIVE OF RESEARCH

A research design is the specific plan used to guide a research study towards its objectives. In this project, research objectives in this study are already existing, so all research and investigate are based on empirical data at Bhiwandi Warehouse from current situation, but not subjective speculation.

TYPE OF RESEARCH

This case study at FMCG warehouse would give a hands-on experience on the end-to-end process of logistics from Central Warehouse to Retail Distributors and the Retails Shops. As this is a case study-based project, "Qualitative Research" method would give a better perspective to this. Process of Observation along with One-on-One Interview would be used to understand the challenges in FMCG B2B delivery, and the level of impact it creates in last mile delivery.

Focus Groups could also be considered, subjected to the availability of the domain expertized personnel and the time they can spare for discussion at site. Using this research method will allow for the study to be more diverse and look at different angles of logistics, which will result in having a better understanding of this B2B phenomenon.

Data collection

Primary data collection will be done on-site via information received from the personnel involved in the day-to-day activities, besides from one-on-one interview. Secondary data is gathered through other research papers, business reviews, articles, e-papers and understand trends from research reports.

Scope of Study

The scope of study was to understand the issues in the last mile delivery and where does this warehouse stand in terms of industry standard in meeting the customer requirements. Being a live project, the primary focus was to understand the issues faced by stakeholders right from Central Warehouse to Retail Shops.

ANALYSIS AND RESULTS

Process of Observation

Warehouse

The FMCG warehouse is a part of Logistics Park based out in Lonad Village at Bhiwandi. It is capable of handling around 7,500 wooden pallets with an area coverage of over 88,000 sq. ft. The warehouse has 2 types of storage facility – Ambient as well as Cold Storage since the products are sensitive and non-durable.

The warehouse employs 10 docking stations out of which 4 have dock levelers. A rack-based storage system with Ground + 4 level is in place and various Material Handling Equipment (MHE) are used for stacking goods on racks. The MHE includes Hydraulic Hand Pallet Truck (20 nos.), Battery-Operated Pallet Truck (5 nos.) and Battery-Operated Forklift (4 nos.) There is a well-defined Standard Operating Procedure (SOP) that is a must-follow while loading and unloading of the goods from and into the warehouse. We will go through the unloading process – inbound and loading process – outbound in detail.

Inbound Process

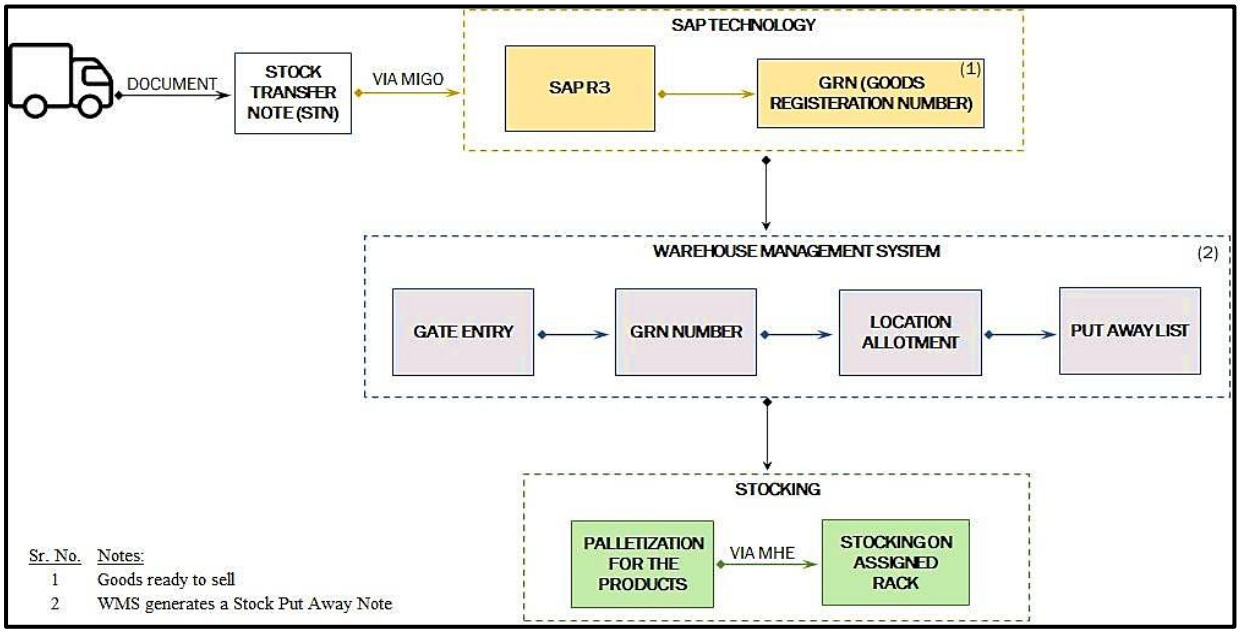

Figure [3] Inbound Process at Warehouse
Source: Standard Warehouse Process

Outbound Process

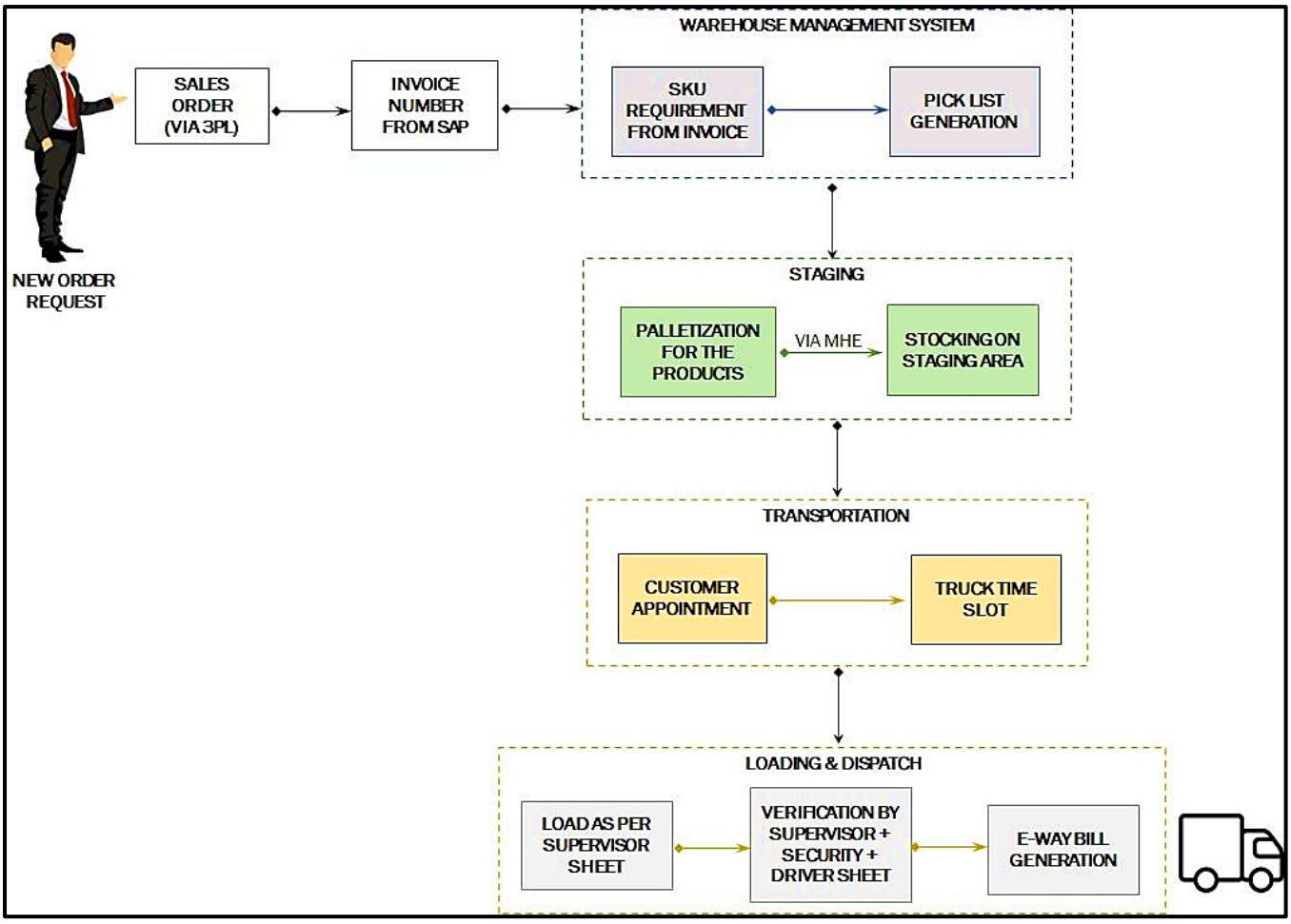

Figure [4] Outbound Process at Warehouse
Source: Standard Warehouse Process

One-on-One Interviews

To have better insights on the current process of Loading stock, Dispatch Process and Transportation, the employees involved in daily activities were interviewed. These interviews helped in mapping out the existing system that is in place for Logistics and B2B as well as B2C Last-Mile Delivery. The following are the inputs received from the interviews:

A. SAP& WMS Operator

The customer requests are received in 4 types:

- **General Orders**

These orders are different every time and depends on the demand and consumption level at the end.

- **Continuous Replenishment System (CRS)**

There are several Retail Distributors (hereafter RD) who have their fixed order norms and they have been assigned a Permanent Dispatch Plan (PDP) from the Bhiwandi Distribution Centre (hereafter DC). It is in the form of Continuous Replenishment System from time to time and their orders are processed every day or alternate days.

- **Out of Norms (OON)**

It so happens that the Retail Distributor has orders other than the regular ones and to meet these additional customer requirements, RD raises order request. However, the PDP cannot be altered as this is only a temporary requirement. So, these temporary orders are processed but these are out of PDP norms.

- **Out of Terms (OOT)**

Now, it may also be possible that the RD needs some orders as per requirements, but it is a non-PDP day. The PDP being a fixed plan, the DC processes these orders under out of PDP terms.

On receipt of these orders, Sales Orders are generated via 3 rd party and SAP system via Invoice number helps in preparation of Sales Invoice. A single order contains x-number of invoices depending on the number of products involved. These invoices help in easy segregation and identification of Cold Storage products from Ambient Storage products as well as in vehicle loading plan.

B. Dispatch Supervisor

There is no fixed time for loading or unloading of the goods. However, as a standard practice, the loading of goods for dispatch takes place in the morning from 06:00 hrs. to 15:00 hrs. and the unloading of goods for storage in the warehouse takes place after 14:00 hrs. till midnight. On further discussion with the Supervisor, we understood that there are 7 different types of trade occurring from the DC. They are:

- **Canteen Stores Department (CSD)**

It is owned by the Government of India under the Ministry of Defence and are a profitable source of retail chain. Frequency of these CSD trade order is once at every month end in bulk. General Purchase Orders (hereafter PO) are received from the CSD's and the DC dispatches as per their requests.

- **E-commerce**

Every time individuals and companies are buying or selling products and services online, they are engaging in ecommerce. These ecommerce players have their own warehouses, and they deliver the products it to the end user. Some examples of such ecommerce players that deal with this Bhiwandi warehouse are – Amazon, Flipkart, Nature Basket, and many more.

- **Modern Trade – Direct**

Direct type of Modern Trade involves groups of businesses with giant players such as supermarket chains and hypermarkets who deal directly with the end customer. It is a B2C type of trade relation and one common example of such Direct Trade is D-mart which almost everyone has experienced.

- **Modern Trade – Away from home**

Public places such as bus stations, railway station, airports and others also need to be supplied with FMCG products on a daily basis. Hence, the RD's that trade with these entities is termed 'Away from Home' – Modern Trade and has B2C transaction.

- **Modern Trade – indirect**

Indirect type of Modern Trade includes stocking of material by RD and supply it to other small RD's in the area. These RD's deal in B2B transactions as the warehouse has a CRP in form of a PDP.

- **Traditional Trade**

This trade type is a distribution network of small – retailers, hawkers, open market traders, wholesalers, and distributors. Examples of this trade are mini-supermarkets and other retail chains which have B2B type transaction. They deal with this network; besides, they have a PDP as per defined norms.

- **Others**

In the Other trades, it usually is deployed to the staff.

C. Vehicle Routing Planner

FMCG goods are delivered to numerous places from the Bhiwandi Warehouse as it is Central DC. The Route Planner must bear in mind all the different cities, talukas, and even remotely situated villages to be able to provide the best possible way for the vehicle to be able to deliver in minimum time with maximum effectiveness.
The Planner has divided routes in 3 different sections, and they are:

- **Local**

If the consignment can be delivered in a day, these are usually termed as 'local routes'.
Some examples are as mentioned:

- Mumbai – Central such as Chembur, Dadar, Haji Ali and more
- Mumbai – Western such as Palghar, Dahanu, Boisar, and more
- Vashi – Panvel – Kamothe
- Ambernath – Karjat – Khopli
- Asangaon – Shahapur

- **Up-Country**

If the consignment takes up more than a day, these are usually termed as 'Up-country routes'.
Some examples are as mentioned:

- Nashik – Dhule
- Mahad – Raigad
- Ratnagiri – Sawantwadi

- **State**

If the consignment belongs to any state other than Maharashtra, these are usually termed as 'State Routes'. Currently, only these two states are under Bhiwandi jurisdiction:

- Gujarat
- Daman & Diu

As per the invoice, the Planner takes in consideration the weight of the boxes and number of boxes that must go into one truck load. Also, another factor to consider is that – if the truck load for one RD is only half a truck or less, then clubbing of another RD with similar loading is done to ensure that the maximum vehicle utilization is done.

The only issue is the priority sorting. Bhiwandi warehouse caters to Maharashtra as well as Gujarat, it becomes much more crucial that the planners give equal priority to both the states. In the priority list, at the top is – Modern Trade followed by Gujarat orders, the later ones are Local and Up-Country orders.

D. Quality Auditor

Even before the vehicle is loaded and is docked at the station, the vehicle condition is inspected thoroughly. It is inspected from inside for cleanliness, dust, dirt & foul odor, traces of chemical, fertilizers or any other harmful substances. As from outside, condition of side walls, tires, doors, or any other protruding part that might result in damage of the goods is inspected.

Depending on the type of goods being transported, the vehicle type either AC or Non-AC is selected. However, it is the prime responsibility of the Auditor to ensure that the temperature-controlled product is loaded and dispatched only in AC vehicle.

If an AC vehicle is assigned, it is crucial that it is inspected for the effective working of AC, besides for any dripping water from AC inside that might potentially damage the goods. To ensure the quality of the material inside the package, the temperature inside the vehicle is maintained at a range of 18℃ – 24℃.

E. Vehicle Allocation Planner

There are various transporters who have their contracts with the FMCG company for the delivery of goods. Generally, 7 different types of delivery truck are made available at the Bhiwandi Warehouse. Refer Table [1] for details for types of truck.

The planner has a hectic job that involves number of variables. It is safe to say that the planner is a person who won't be seen sitting around idle under any circumstances and a change is needed, otherwise overburden could lead to poor decision making.

Some of them are listed below:

- Check available vehicles regularly by contacting the transporter for next day deliveries,
- Keep track of vehicles in transit by contacting the driver for timely updates to keep the customer informed of the expected time of delivery arrival,
- Allocation of AC and non-AC vehicles depending on the material being transported,
- On unavailability of vehicle from dedicated transporters, contacting the market vehicles to avoid delays in delivery,
- Check which RD's can be clubbed to ensure maximum vehicle utilization,
- Loading the non-temperature sensitive material in AC vehicle under situation of normal truck being unavailable,
- Ensuring that the temperature sensitive product is not loaded in non-AC vehicle under any circumstances as it will lead to damage of the goods,
- Making alternate vehicle available as the assigned truck not being safe on the grounds of failure to pass the inspection test.

Table [1] Standard Truck Details

Sr. No.	Truck Type	#Capacity (in kgs.)	#Dimensions–L*W*H (inm.)
1	Mini Van	625	2.13 * 1.42 * 0.3
2	Max Truck	1,000	2.43 * 1.52 * 1.4
3	407 Truck	3,000	3.96 * 2.07 * 1.88
4	709 Truck	3,200	4.57 * 1.85 * 1.79
5	909 Truck	DNF	DNF
6	1109 Truck	6,000	5.79 * 1.92 * 1.52
7	Full Truck Load	DNF	DNF
#Capacity & Dimensions of the vehicle may vary as per the manufacturer's standard. Values mentioned in the table are only for reference considering average capacity and dimensions of trucks available in the market.			

Source: Standard Data for Trucks

PROJECT FOCUS AREA

As it is evident from the above discussions with Vehicle Routing Planner and Vehicle Allocation Planner, have a lot of burden to ensure that the planning is done a day prior for the next day operations. These are repetitive activities and minimal changes are needed on daily basis to have an effective plan. However, it became a human dependent activity even after being a repetitive one and unless the allocation planner shares the plan with the team, no one has a clue for the subsequent day planning. It usually by the previous night on the close out of the last invoice raised, the planner starts his work of vehicle allocation along with the route planner. To simplify the lives of these planners, the warehouse demonstrated a "Network Software for Route Optimization". The software works on basic inputs and some constraints which can be altered to meet the customer demands.

Let's consider a simple example – RD situated at Haji Ali demands 3 ton of 'temperature sensitive packed food' on non-PDP day. To meet this customer demand, the SOP for Outbound process will be followed starting with raising a 'PO – under OOT' followed by invoice generation via SAP. As soon as the invoice number is indicated on SAP, the WMS person starts his routine to ensure that the goods to be dispatched are staged on the day of delivery. In the meanwhile, the planners pick the information of RD location and SKU count – boxes and weight from the invoice. They will look out for an AC vehicle, being a temperature sensitive product; with capacity above 3 tonnes in their list of available vehicles, besides assign the driver a route to be followed. That's all!

Now that being only one order, it was quite easy of the planners to map it out and wrap it up quickly. Bhiwandi warehouse being an important and busiest DC, one can only imagine the number of transactions happening on daily basis. The software is thus designed to assist these planners by reducing the repetitive work of going through the list of vehicles, monitoring the vehicle locations, checking for vehicle availability, keep track of routes, real-time vehicle

tracking, clubbing of RD's with less orders, decide the route to be chosen, assign AC/Non-AC vehicle depending on SKU, indicate vehicle utilization and many other notable features.

It's been a while since the system is put to use, but the planners prefer carrying out the activities in a traditional manner rather than using the software. The planners have observed certain limitations with the software rendering it unusable at this moment. Our focus would be to list down in detail, the problem areas in the software and its implementation.

PROBLEM AREAS

It is hard to imagine that a system that will only benefit the warehouse has yet not found its place into the vehicle route and allocation planner's workspace. Though the route optimization software has been designed to reduce human efforts and give out the best possible solution just by entering the required data, it has been through a rough journey on its way into the warehouse. To begin with, there are 7 categories of delivery trucks available. This is a basic constraint that the software can interpret and work on it. The problem arises because of the various 3rd party transporters. Model of the truck may be similar, nonetheless the dimension of the truck varies as the manufacturer standard. This leads to the issue of available volume for storage as the software might give inputs as a standard input dimensions where in practicality there might not be sufficient space available or even more than required space may be available for storage.

Now, basis the vehicle dimensions input the software has stored, it would be easily able to give us a value of the "Vehicle Occupancy". But these transporters make it difficult to understand the unutilized space due to the variants of trucks in market. Adding to the misery are norms for stacking which are mentioned on the boxes and an easy input for the software as stacking height depending on the goods inside the package. The planner overrides these norms of height by adding on a layer or two above it to ensure maximum material being transferred during a trip. If it was as per software, maybe another vehicle might have been needed however the planner avoided it by manual intervention.

There are situations such as the vehicles that have been allotted by the 3rd party transporter solely to this warehouse has left the premises in the evening and is not available for the next day delivery. In this scenario, there are two things that are bound to occur – either the transporter will arrange another of his vehicle to maintain the agreed trip count for full payment at the end of month or it may be possible that the transporter is out of vehicle and to meet this trip, the warehouse requires another market vehicle as the order cannot be delayed. These market vehicles are not a part of the software as these are temporary solutions and no provision is currently being made for it under the available vehicle section.

Moving further, we have the issue of vehicle tracking – real-time data of location. Yes, the software has the tracking option but in vain unless the truck has a system of GPS tracker on it. As on date, only the AC vehicles can be tracked with the least time interval being 5mins! Sole reason being able to do so is a sensitive product being handled, it has a temperature sensor installed that act as a remote indicator whether the required environment is maintained. It is done by 3rd party software that is responsible only for temperature, the tracker is an additional feature for their use. These vehicles aren't tracked by the warehouse network routing software. Real life scenarios such as vehicle breakdown cannot be predicted even after scheduled maintenance.

This leads us to another problem of vehicle condition. A very relatable example is that the vehicle has completed its delivery by afternoon and taken up next order of same day for another customer. Chances are that the traces of the goods being transported in the next order are not suited for our FMCG products. Although the software has assigned this x-vehicle to deliver packages and the vehicle is available, the vehicle is not safe for use because the traces might affect the quality of the products – resulting in not fit for use. Now the software might have some contingencies in place, but never will it allocate an extra vehicle for such scenarios. So human intervention becomes essential.

A single RD's PO will not necessarily fill out a complete truck. In such cases, the software has an amazing feature of clubbing such small orders together to optimize vehicle occupancy. Although imagine clubbing 3-4 orders together only to realize that the vehicle won't be able to make the deliveries leaving the goods out in unsafe environment. Vehicle unavailability of the next day aside, but the uncertainty of duration of delivery is another pain point. Besides, RD's have their own time slots in which they accept the goods. There are situations where the vehicle must halt at some RD's due to unavailability of labor on arrival of vehicle and can't be ignored. In a real-world case, best to best a single vehicle can be allotted is a maximum of 2 RD's. Majority of these clubbed orders are dispatched early morning to cater for waiting time given by the customer during their busy day and all the driver can do is wait patiently.

Last but not the least, the software has a GPS enabled route and is aware of the terrains that the vehicle has to pass through. Even so when it comes to cities, there are restrictions which need to be considered. Timing is a barrier laid down by the Transport Authorities to avoid hiccups in main city roads caused by goods transport vehicle. Also, imagine being in city during morning where people are rushing to work and a 40ft container is blocking the road at place of unloading. As the software had assigned this vehicle, doesn't mean that the responsible person neglects these real circumstances and thus human intervention becomes essential. The software had assigned to ensure that it gives out the effective solution however, this may cause more issues than solve it.

The above-mentioned problems were limited to the shortcomings caused by software but there is also human factor that contributed to certain extent. The vehicle route and allocation planners have different school of thoughts. They are of the opinion that what a human can do with ease and flexibility, cannot be done with the aid of network software. They feel that there are numerous constraints to be included in the software. Rather than wasting efforts on software which won't be able to generate the apt output and regarded unusable, a human would invest time but cater to a practical output. There is a resistance to change observed among the planners.

It is the responsibility of the planners to ensure that the necessary inputs to the software are fed, reducing the errors caused one-by-one. As the software is flexible enough to take the constraints, the planners need to take charge and make the changes required so that with time, it would be able to cater to practical solutions.

SUGGESTIONS FOR IMPROVEMENT

As these problem areas were identified on the implementation front by the personnel from the warehouse, it became essential to delve deeper. To understand the framework of "Network Software for Route Optimization", the service provider was contacted. Post the discussion, it was observed that the constraints / problems faced by the personnel could be resolved. Let us

discuss individual area of concern in detail to apprehend the level to which they could be condensed or deciphered.

A. Vehicle-to-Vehicle variation

Indisputably, every manufacturer in market will have similar model of the truck, nonetheless the dimension of the truck varies. Currently, the software has the standard size vehicle dimensions registered in the memory. Conversely, this can easily be worked out by providing actual dimensions of the registered truck at the warehouse as input to the software. Let us consider an example of the same – a standard 407 truck registered can be separated by rewriting it as 407 – Manufacturer A, 407 – Manufacturer B and so on. Likewise, for all the 7 truck sizes usually arriving at the warehouse.

Apart from this, if the data for distinct categories of products are present in the system with individual box capacity and dimensions, the software would be able to calculate all the permutations and combinations that may be possible while assigning a particular vehicle making it more accurate. This may lead to increased data for number of vehicle types in the software, but then again, all the operator wants is to be able to select the exact vehicle that is made available, and this issue is sealed.

B. Vehicle occupancy

The dimensions provided for x-type of vehicle is used as an input by the software for calculating vehicle occupancy. As perceived from the previous solution for variants of vehicles, it is evident that now the available vehicle volume would be calculated precisely.

As for the planner that over rides the norms of height, can be provided with another constraint in the software, for adding on a layer or two above it to ensure maximum material transfer. It sometimes happens that for a non-standard product, the calculated number of boxes that can fit by software and the actual number of boxes that fit in the vehicle varies and the planner has to be accountable for it. This may be based purely on the experience level of the planner and, inspecting if physically space permits.

Simply – if temperature sensitive packed food to be delivered as calculated by the software is 5 stacked boxes. But it is clear to the planner that another layer of box can easily fit on the stack providing better occupancy, a provision in the software is present to alter the stacking height based on product categories.

C. Vehicle tracking

The vehicles that are permanently assigned to the warehouse can be effortlessly tracked by the network software. Presently, it is not being used because of the following limitations:

- To track the vehicle, the driver of the vehicle must have a smartphone with the software application installed. It is not necessary that all the drivers have a smartphone.
- If the driver has a smart phone, it is not obligatory that the required data connectivity for the application is available.
- Considering, that the driver does not have a smartphone, the company is bound to take responsibility of providing a smart phone.

Owing to these reasons, the tracking of vehicle is an issue. This is a situation where the warehouse needs to take charge if an investment on dedicated smartphone for the successful tracking of vehicle provided the transporter takes accountability for the safety and security of

the investment. Besides, in the event of any external damage to the product including theft or loss, the transporter is liable to compensate the amount to the warehouse.

D. Market Vehicle

As these are temporary solution vehicles used to deliver goods only in times of unavailability of designated trucks, it is difficult to track them and, also assign a specific path that the warehouse planner has provided. A similar situation as the previous problem arises.

This unregistered vehicle can be tracked under two circumstances: firstly, the driver needs to have the application in their smartphone and secondly, GPS integration of the vehicle. As these are market vehicles and are called upon as and when needed, the planner may ask the transporter to assign a driver who has a smartphone to aid the better tracking of this vehicle. At the warehouse, the network application software could be installed on the driver's phone for easy traceability and assigning a predefined path.

E. Unsafe Vehicle Rejection

It so happens that the vehicle is not safe for use because of the traces left back by the order taken up for another customer. This is usually detected at the vehicle docking station by the Quality Officer and to reject the vehicle at this stage means that an alternate option has to be made available.

Now the software has already allocated x-vehicle for delivery. A market vehicle needs to be called upon to make sure that the delivery is not delayed. Under such circumstances, there is a provision available in software to assign a different vehicle. So, the load planned for x-vehicle can be shifted to y-vehicle on the day of delivery.

F. Clubbing orders in a Vehicle

There is an amazing feature of clubbing small orders together so that the vehicle has optimum occupancy. On such days where shipments need to be clubbed, the routing of these RD's is crucial as it must ensure the delivery within time in full.

System can make straight routes and can also prepare curved routes. But sometimes even after considering the traffic and other constraints, if the system can plan two deliveries in an opposite direction on-time, then for the purpose of optimization it will plan it. The user will have the access to change it, if needed.

G. Terrain specific Vehicle

As the software has GPS as integral part, it allocates a vehicle based on truck load. But it must also be aware of the terrains that the vehicle has to pass through. If the same is not considered, then it may lead to blockages and traffics by breaking the rules down by the Transport Authorities.

To avoid this scenario, all the delivery points served by the warehouse can be earmarked basis the type of vehicle which can service them. This helps in a way that when the system plans for the shipment, it considers this constraint and assigns only the earmarked vehicle type or a smaller vehicle.

H. Human Factor

From the previous solutions to the problems flagged by the warehouse personnel, it is evident

that the software is flexible enough to take the constraints with hardly any restricting points to it. It is now on the shoulders of the operators to make the most of this networking software available at the warehouse.

The planners need to shift from the conventional methods to this advanced user-friendly software. This in turn will result in the betterment of the warehouse as well as save a lot of man-hours that are currently being spent on this monotonous and repetitive activity. Besides, the shift will also aid in reduced dependency on any individual and anyone with the basic knowledge of the inputs required for the software would be able to run the daily plan for the vehicles.

This should be seen by the planners as an upgrade in the system and on professional level as stepping out of their comfort zones to learn something new.

CONCLUSION

As stated in the problem areas, numerous limiting factors were stated by the operators for the "Network Software for Route Optimization".

The same framework for the software upgradation was shared with the vendors. This upgradation will ensure that the existing problems can be bridged, and the last mile delivery gaps can be successfully addressed by the FMCG provider.

The pilot testing of the software revealed that many of the challenges faced could now be overcome due to these additional features. This study concludes that many of the challenges in the last mile delivery which is one of the most important aspects of supply chain can be handled with careful observation, use of data and rational use of technology.

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