SUMMER INTERNSHIP PROGRAM

Final Report

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Submitted To:

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Company Name: Ford India Pvt. Ltd.

Project Title: Reduction in B562 imported parts inventory

Address: Survey No. 1, Sanand Taluka, Ahmedabad District, North Kotpura, Gujarat, India

Date of report: 12th July, 2021

Purpose of report: To reduce the inventory of parts which have been procured from outside India for B562 product line

Prepared for: Institute of Management, Nirma University

Submitted to: Prof. Tirthank Shah

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I wish to express my heartfelt gratitude to all the people who have played a crucial role in this project. Without their active cooperation, the preparation of this project could not have been completed within the specified time limit.

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Table of contents

Abstract

The project which I have been associated with Ford India Pvt. Ltd. is titled as **"Reduction in B562 imported parts inventory".** In manufacturing, certain minimum level of quantities is needed to avoid any interruptions to the production process. The management has the difficult task of determining how many items of each kind of inventory are to be in stock at a particular moment. Inventories should be kept to a minimum level to prevent over-stocking and over-investment.

Holding inventory is important for the following reasons:

- Achieving economies of scale
- Minimizing uncertainties in the demand and order cycle
- Balancing supply and demand
- Ensuring stable employment
- Buffering

However, Inventory carrying costs are to be considered by the management as well and a decision is taken on whether it will be cheaper and more efficient to hold a certain level of inventory.

Most important inventory carrying costs are:

- Capital costs
- Inventory risk costs
- Storage space costs
- Inventory service costs

Ford, being a global MNC, has to maintain an optimum level of inventory so as to avoid interruptions in production due to stockout as well as reducing holding/carrying costs. Some advantages of a reduced inventory are:

- Reduced inventory enables the firm to respond to quick market and industry changes
- Reduced inventory saves the company money on shipping, storage, and transit between warehouse locations
- Inventory reduction removes outdated or obsolete stock, which if not sold might even go to waste
- Lowering inventory costs will result in decreased expenses, which will contribute to higher profit

Ford Motor Company

Ford Motor Company is an automobile manufacturer based in Dearborn, Michigan. It designs, manufactures, markets, and services a wide range of Ford pickups, trucks, SUVs, and Lincoln luxury automobiles and has over 186,000 employees with the Sanand Vehicle Assembly Plant (SVAP) having approximate 3,000 current total employees.

Automotive, Mobility, and Ford Credit are the company's three segments. The Automotive segment deals with developing, manufacturing, distributing, and servicing Ford and Lincoln cars, as well as their parts and accessories. The Mobility segment mainly consists of Ford's autonomous vehicle production and related businesses. Argo AI, a developer of autonomous driving technologies, and Spin, a micro-mobility service provider, are also owned by the corporation. Lastly, on a consolidated basis, the Ford Credit segment mainly consists of vehicle-related lending and leasing activities. Ford Credit provides a wide range of automotive financing options to and from dealers all around the world.

The majority of Ford Motor Company's earnings comes from the selling of automobiles under its two primary marques, Lincoln and Ford. Ford is the automaker's most popular brand, as well as the most valued in the United States. It is also one of the most valuable automobile brands in the world. In 2020, according to Statista, Ford Motor Company's revenue was around 127 billion dollars.

Sector Overview

Sector: Manufacturing

An economy's manufacturing sector is its backbone. It boosts productivity, creates jobs, and improves the agricultural and service sectors. The growth in distribution systems and information technology across the world has resulted in a massive expansion of global manufacturing networks. Consequently, the low waged and efficient workforce of India acts as an advantage in for this sector. In India, Manufacturing stands among the high growth sectors. Programs like the Make in India, Skill India, and National Manufacturing Policy are intended to establish India on the world map as a manufacturing hotspot and give global recognition and boost to the Indian economy. Consequently, a CAGR of 5% was recorded from FY16-FY20 according to the national income given by the Government of India. The aim of the Indian govt. is to create 100 million+ new jobs in the sector by the end of FY 2022-23.

Health

According to the first advanced estimates for FY21, the sector's Gross Value Added (GVA) at current prices was projected to be US$ 350.27 billion. This indicates a drop from a provisional estimate of US$ 380.7 in FY20. Also, going by a recent report by *Centre for Monitoring Indian Economy,* manufacturing sector has seen a drop of about 46% in employment from 5.1 crore in 2016-17 to 2.73 crore in 2020-21. India has envisaged of achieving 25% GDP from the manufacturing sector by 2025, but judging by these number which go past the pandemic period achieving this feat seems unlikely as currently the sector has 17% contribution to GDP.

However, things are not so grim for the sector as with the help of Make in India drive, India looks to become the hub for hi-tech manufacturing and attracting global giants such as GE, HTC, Siemens, Boeing, Toshiba etc. who have already set up or in process of setting up manufacturing plants in India. They would try to capture India's market of more than a billion consumers and an increasing purchasing power.

Notable Investments

India has emerged as one of the most lucrative manufacturing investment destinations. Between April 2000 and September 2020, cumulative Foreign Direct Investment (FDI) in India's manufacturing sector amounted to US$ 91.28 billion. The following are some of the most significant investments and innovations in this sector in recent years:

- In mid-February 2021, Amazon India has announced that it will begin manufacturing electronic goods in India, beginning with the Amazon Fire TV handle. By the end of

2021, the company expects to begin manufacturing in Chennai with contract manufacturer Cloud Network Technology which is a subsidiary of Foxconn.

- In January 2021, under the government's Flexi-MoU Scheme, Toyota Kirloskar Motor (TKM) signed a Memorandum of Understanding (MoU) with the Directorate General of Training (DGT), Ministry of Skill Development and Entrepreneurship, to improve skills among the youth.
- Also, in January 2021, Amazon announced its partnership with Startup India, Sequoia Capital India and Fireside Ventures to initiate an accelerator programme called 'Propel' to support entrepreneurs. The programme aims at selling and delivering products to global audiences and is rapidly improving India's exports and helping develop Indian brands.

Industry: Automotive

By 2026, India is projected to be the third-largest automotive industry in the world in terms of volume. It contributes approximately 7.1 percent to India's GDP, making it a significant manufacturing sub-sector. India is the world's largest tractor manufacturer, second-largest bus manufacturer, and third-largest heavy truck manufacturer. It also holds the summit for the two wheeler and three wheeler manufacturing across the globe.

Key highlights:

- Between FY16 and FY20, domestic automobile production grew at a 2.36% compound annual growth rate (CAGR), with 26.36 million vehicles manufactured in the country. During the same period , domestic automobile sales grew at a 1.29% compound annual growth rate (CAGR), with 21.55 million vehicles sold in FY20.
- • Automobile exports increased at a CAGR of 6.94% from FY16 to FY20, reaching 4.77 million vehicles. Two-wheelers accounted for 73.9%, with passenger vehicles being 14.2%, three-wheelers being 10.5 percent, and commercial vehicles making 1.3 percent of all vehicles exported.
- By 2026, the $118 billion automobile industry is projected to be worth $300 billion.
- The Government has a vision of low-cost electrical vehicle expansion with 100% electrical mobility by 2030. Firms like Hero Electric, Rapido, Ola Electric, Siemens, Mahindra & Mahindra Ltd, Ashok Leyland and many more have already installed or in process of setting up investments in this segment.
- India's carbon footprint is expected to be reduced by 33-35 percent by 2030 under the Bharat Stage VI norms, which were enforced in 2020.
- GST has had a positive influence on the automotive industry as well, with lower overall costs.

Road Ahead

The automotive industry benefits from a variety of factors, including low-cost skilled labour, strong R&D centres, and low-cost steel production. The sector also offers excellent investment prospects as well as direct and indirect jobs to skilled as well as unskilled workers. By 2026, the Indian automotive industry along with components manufacturing is estimated to be worth Rs 16-18 trillion. After recovering from the impact of the COVID-19 pandemic, the Indian auto industry is projected to expand rapidly in the 2nd half of 2021-22. Electric vehicles, especially two-wheelers, are expected to record better sales figures as well.

Part-B

Project Work

Problem Statement

From May'21 to Dec'21 inventory turns expected to be lower than the forecast. Apr'21 Turns-Actuals is19.55 which is less by 3.15 against the target (22.7).

Inventory Turn

Inventory turns measures the number of times inventory is sold or used in a specific time period.

Inventory turnover rate = COGS or Sales/Avg. Inventory

Scope of the project

Top 100 SVAP (Sanand Vehicle Assembly Plant) Imported parts by valuation using ABC Classification.

(Parts which have been procured for the production of B562 product line from outside India)

Proposed Tasks

The project entails the following tasks:

1. Identifying and analyzing the high value imported parts inventory
2. Analyzing the reasons behind the excess stock of identified part
3. Checking whether the part inventory can be reduced or not
4. Supporting the Supply Chain team to reduce the high-value inventory
5. Carry out a complementary research project on a related topic

Project Objectives

Reduction in high-value imported parts inventory by identifying and analyzing the reasons behind the excess stock

Project Deliverables:

- 10% reduction in the high-value import parts inventory by September 2021
- To reduce the 4-wall inventory from $10.11mn (May'21) to $9.10mn (Sep'21)

Parameters to be considered:

Inventory of import parts can be reduced only after working out on certain parameters. They are:

- **Transit time:** Transit time is the elapsed time from when a shipment leaves the supplier facility to the time it arrives at the plant. Transit time is commonly measured in hours or days depending on the mode of transportation. Air freights cut down the transit time but at a higher cost as a premium has to be paid for shipping through the air route. While, land and sea route are cheaper options but naturally with a much more transit time.
- **MOQ:** It is the acronym for Minimum Order Quantity. The Minimum Order Quantity (MOQ) of a supplier is defined as the least number of units they are willing to make (or sell) at one time. Each supplier has their own MOQs for various parts and the management sometimes has to negotiate with them in order to reach a consensus according to the inventory they want.
- Shipping Quantity
- Shipping frequency
- **Pre-Pull Inventory:** The inventory which has been accumulated/stored in plant in lesser number of shipments than desired according to the planned release. This is usually done to save freight cost and better container utilization.
- **Variable Float:** Variable Float is a pull ahead of future requirements. It varies with requirements, but is expressed in terms of DAYS. Variable Float can be applied to parts in a manufacturing plant or pocket of manufacturing in an assembly plant. By "pocket of manufacturing" it is meant that these parts are sold to an outside customer or used in an assembly or end item that is shipped to an outside customer. As long as there are requirements to cover this float, the system schedules to keep it in inventory.
- Over-shipping/under-shipping

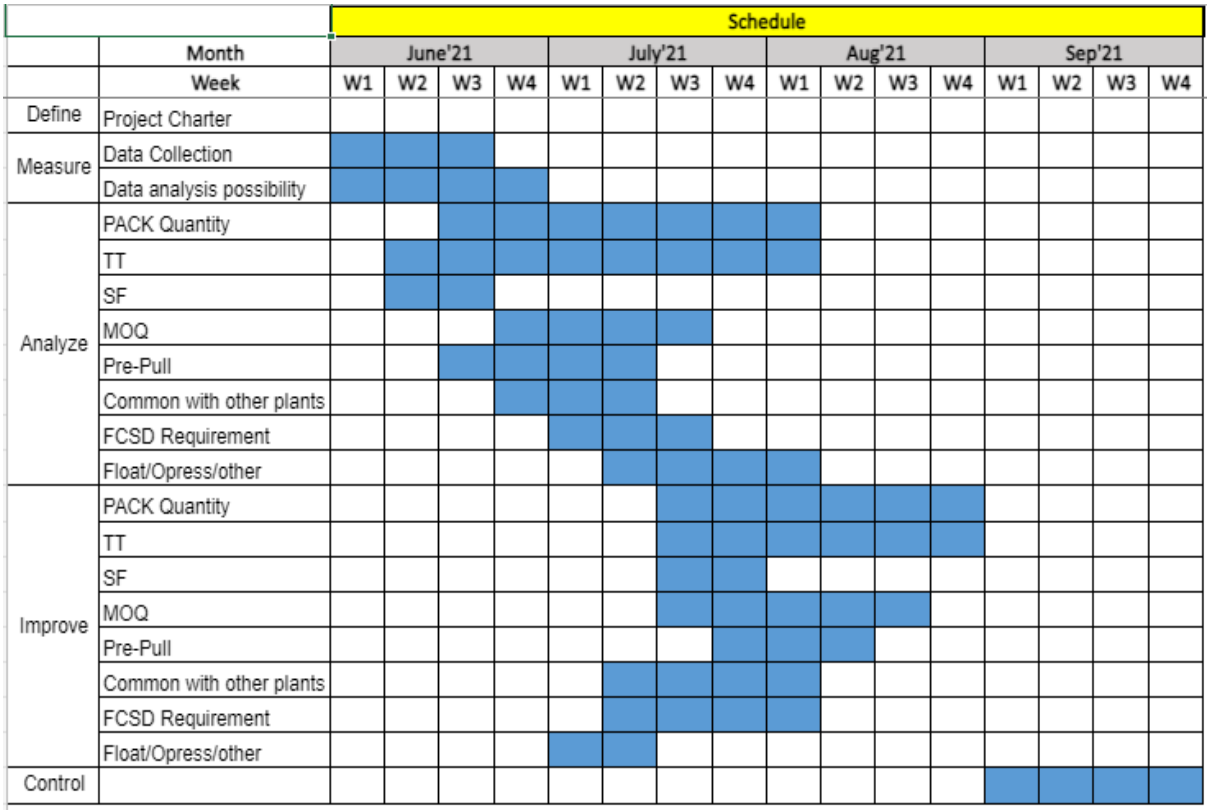
- Spare parts with post-sales requirement (FCSD)
- Parts with the requirement common with other Ford plant facilities

Six Sigma: DMAIC Methodology

The project is being carried out using the DMAIC approach. The abbreviation "DMAIC" stands for Define, Measure, Analyze, Improve, and Control, which are all Six Sigma business performance criteria. When employed as a whole, the process becomes a powerful instrument for driving a company to higher performance standards and may be utilized to effectively streamline resources and define corporate goals.

- **Define:** The major goal of this stage is to define the project's scope as per the agreement of all concerned stakeholders on the project's parameters.
- **Measure:** The objective here is to collect data pertinent to the scope of the project.
- **Analyze:** this stage aims at revealing the root cause of business inefficiencies.
- **Improve:** At the end of this stage, the major goal is to perform a test run of a change that will be widely implemented. Teams and stakeholders come up with solutions to the process flaws discovered through the data analysis. Improvements are continuous and include a feedback analysis along with stakeholder participation.
- **Control:** The last stage of the methodology aims to create metrics that will assist leaders track and document their progress.

Project Schedule:



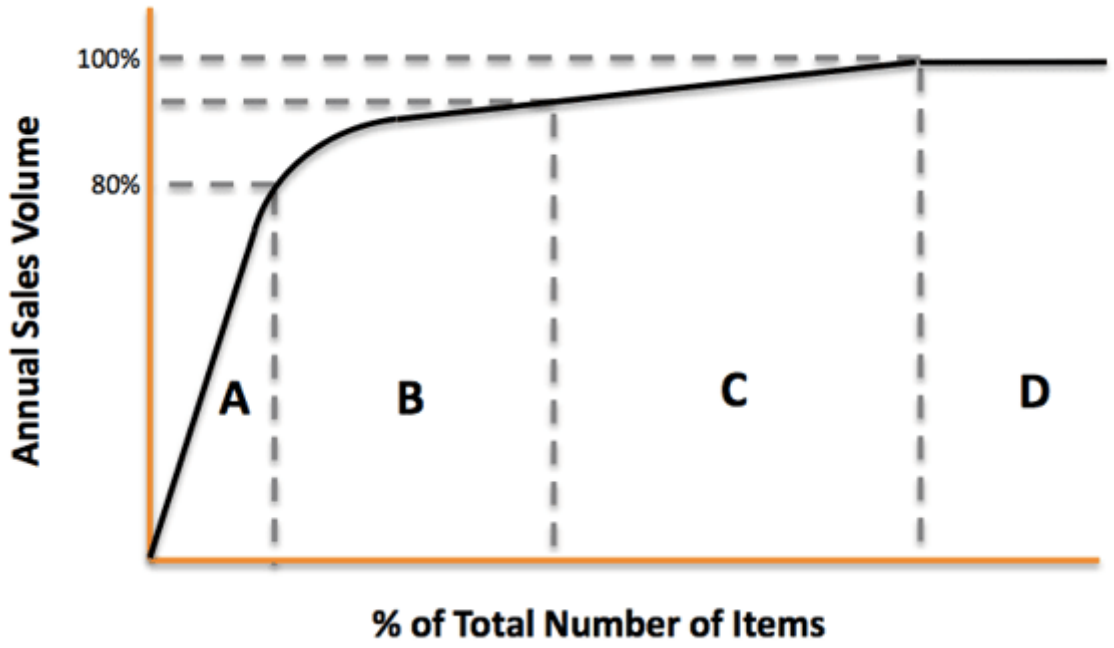
The Project has started with the 'Measure' phase from June'2021 and it is supposed to end by the last week of September. I, as an intern, has supported the project till the first week of July with the 'Measure' and 'Analysis' phase.

Data Collection:

After the project charter had been **defined** by the higher management with the consensus of all key stakeholders, the next step is to **measure**. This essentially translated to collecting data about the inventory levels and the supplier releases.

There are around 586 import parts that Ford Sanand Vehicle Assembly Plant(SVAP) deals with. These parts were sorted based on their valuation using the ABC classification and top 100 parts have been considered for the inventory reduction project.

ABC Analysis: ABC inventory analysis is a method for categorizing a company's stock products into three groups depending on their worth to the company: A, B, and C. A items are most valuable to the company while C items are least valuable. ABC inventory analysis is crucial because it allows managers to concentrate their efforts on their most valuable/essential items and adjust their inventory control procedures accordingly. This is also called as the Pareto analysis or 80/20 rule of thumb.



The data is collected from the Ford's CMMS system (Common Material Management System). It is essentially a database that contains all details about the inventory levels of all parts used in different plants worldwide, supplier details, release dates, daily average volume required for production, safety stock etc. To gather the data, one has to navigate through different CMMS screens to check and record the parameters that are required for the analysis.

Sno	Part No	Description	GSDB	Supplier	Current TT as on 24-May	Prevoius TT	Difference in TT	Saving in TT Yes / No	Cost Impact Saving due to curretion in TT
1	L7B15H270BA	CONV & PRTCLT FLTR A	T2A1A	FORD MOTOR CO OF SOUTHER	61	59	2	YES	2428211
2	L7B15F297AA	SHL ASY EXH CONV EXT	T2A1A	FORD MOTOR CO OF SOUTHER	61	59	2	YES	3266618
3	J7BP7000BA	TRANS & CONV ASY (6F	GMP5N	FORD MOTOR CO SA DE CV	92	85	7	YES	4224382
4	J7B15F297CA	SHL ASY EXH CONV EXT	T2A1A	FORD MOTOR CO OF SOUTHER	61	59	2	YES	1151919
5	J7BP7000EB	TRANS & CONV ASY	3264K	CHANGAN FORD AUTOMOBILE	53	47	6	YES	10776743
6	J7BJ18K810BA	RECV ASY RADO	HH50A	GUANGDONG CREATOR & FLYA	66	60	6	YES	796081
7	H6BH19D629CA	COMPR & CL ASY A/C	GP0AA	PT DENSO SALES INDONESIA	51	42	9	YES	2768610
8	L7B512A650ZC	PROCS ASY ENG ELETR	2953B	FORD WERKE GMBH	58	51	7	YES	2688045
9	J7BJ18B955BA3FAV	DSPLY RADO RECV DIGT	HH50A	GUANGDONG CREATOR & FLYA	66	60	6	YES	1025521
10	J7BT18D815FJ	RECV ASY RADO W USB	GK0VF	FORD MOTOR CO THAILAND L	42	54	-12	no	0
11	HS7T15K601DD	TRANS ASY ALRM & LK	GMP5N	FORD MOTOR CO SA DE CV	92	85	7	YES	214019
12	J7BJ18B955BA37AE	DSPLY RADO RECV DIGT	HH50A	GUANGDONG CREATOR & FLYA	66	60	6	YES	1911546
13	ESFM1C229A	GREASE-FLUORINATED L	IE0EB	FORD IEO TO INDIA	85	73	12	YES	67555195
14	GN119N454CA	SHLD ASY EXH MANF HT	3382Q	FORD MOTOR CO BRASIL LTD	72	65	7	YES	0
15	J7BT18B955GE	DSPLY RADO RECV DIGT	D6AQR	SHARP ELECTRONICS CORP	58	52	6	YES	4838547
16	W718574S439	BOLT&WSHR M10X35 HF	3382Q	FORD MOTOR CO BRASIL LTD	72	65	7	YES	6975

Measure & Analyze:

1. Transit time – The transit time data has been collected for the 100 import parts. The parts having a variation in transit time in the CMMS system from the initial stage (planned release) and the latest transit time data dump from the bot reports are identified. The difference in the initial (TT) and new transit time (TT') multiplied with the daily average volume (DAV) would give the total cost benefit that can be attained by maintaining the original transit time.

Total cost benefit = Incremental Transit time * Unit Cost * DAV

= (TT'-TT) * Unit Cost * DAV

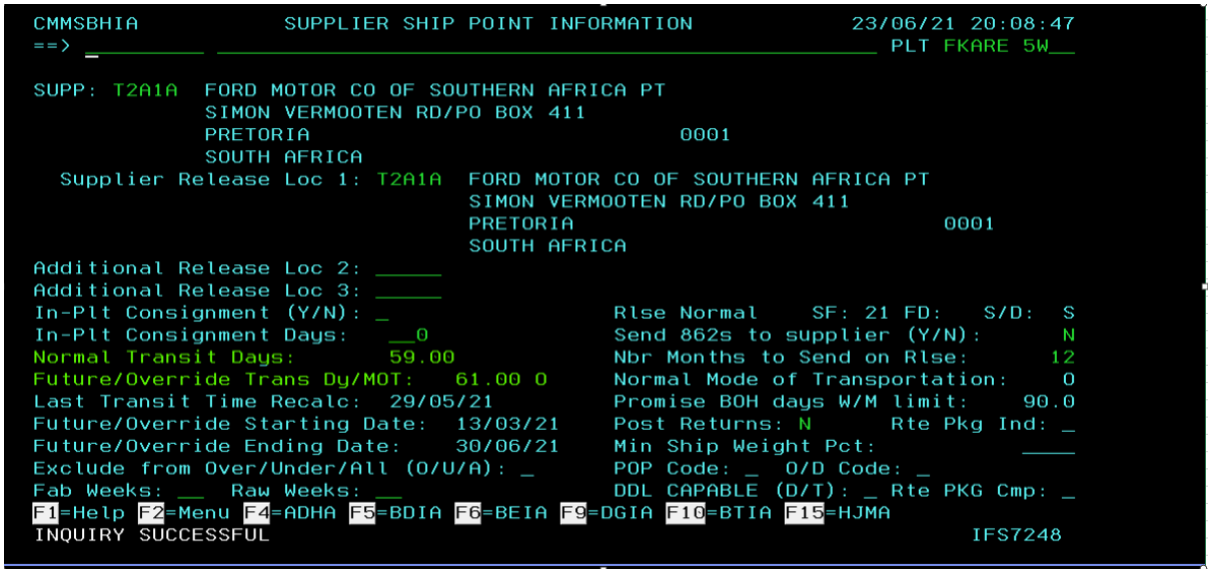
where TT' is the increased transit time and TT is the original planned transit time.

Work-around for Transit time:

Sno	Part No	Description	GSDB	Supplier	Current TT as on 24-May	Prevoius TT	Difference in TT	Saving in TT Yes / No	Cost Impact Saving due to currection in TT
1	L7B15H270BA	CONV & PRTCLT FLTR A	T2A1A	FORD MOTOR CO OF SOUTHER	61	59	2	YES	2428211

The above snapshot is from the excel sheet containing data about the 100 import parts. It shows an import part details like part no., description etc. along with the transit time data.

The part has a change in its transit time days from 59 to 61. This means the incremental transit time (TT'-TT) becomes 2. So, the cost saving becomes the product of this incremental transit time, the unit cost of the part and the daily average volume (DAV) required. Both DAV and Unit cost of the parts which can be extracted by navigating to relevant screens on the CMMS system.



The above snapshot is from the CMMS system from where all the data has been extracted. The system has a large number of screens that contains data about different parameters e.g. DAV can be seen from ‘eena’ screen, supplier releases from ‘aaia’ screen etc. After collecting the data, and determining the scope of cost saving the following calculation is done.

Cost saving = (TT’-TT) * Unit Cost * DAV = 24,28,211

After following the same procedure for all the parts in scope, a total cost benefit of about ₹1CR has been identified and proposed which can be attributed to the parameter of transit time.

Similarly, calculations have been done after identifying parts matching the parameter and considering their unit costs.

2. MOQ – After analyzing the data, there was no opportunity or scope of cost saving found by tweaking the Minimum Order Quantity of the selected import parts.

3. Packaging – For proper utilization of space, pack quantity needs to be optimized. This is done based on considering various container details like pieces per container, container per layer, pieces per layer etc.

In the above snapshot, you can see the various container details for a given part number. Considering these details and our VDBA requirement, we check if there is any possibility of cost saving by utilizing more of the space in a container or shipment. Consequently, post-analyzing, a release level among 3 (1,2, or 3) levels is assigned and no. of import parts change from the package according to each release level. This, in some cases, leads to lesser parts incoming and hence less inventory cost to hold them. Around ₹90 lakh of cost saving has been identified in Packaging.

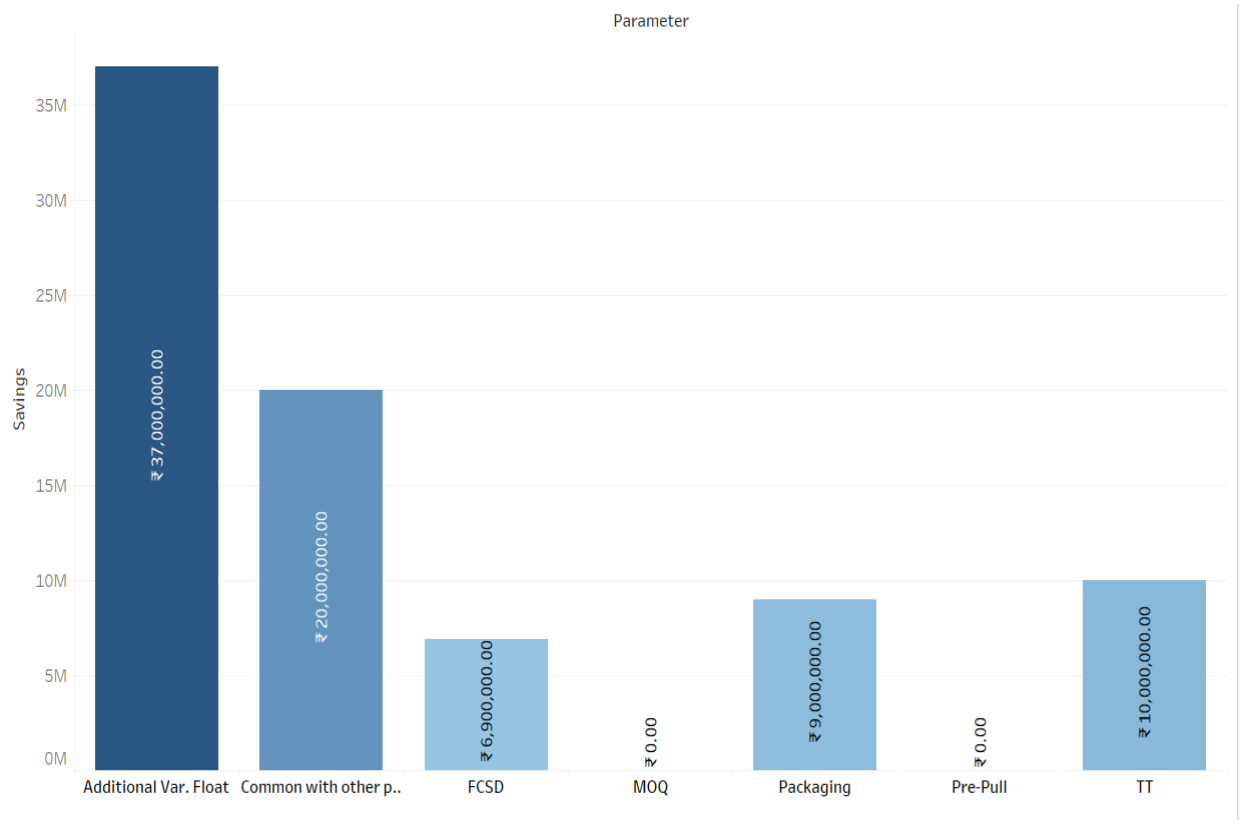
4. Pre-Pull – After analyzing the data, there was no opportunity or scope of cost saving found by making any changes to the pre-pull quantities. Although, initially, some recommendations were made but the changes could not be agreed.

5. Parts common with other plants – Some parts are available more than their requirement potentially due to release drops. However, the demand and daily average volume varies across different plants. ₹2 CR worth of such parts were identified which can be shipped to other plants in order to save on holding costs.

6. FCSD – It is the parameter that covers offloading of spare parts to the dealers with can adhere to post-sales requirement. The cost saving is achieved when the Sanand plant fulfils the dealers' spare part requirement instead of them procuring these parts through suppliers' Spare Part Division (SPD). This helped in liquidating some inventory. We could determine around ₹69 lakhs worth of import parts fitting this parameter for cost-saving.

7. Additional Variable Float – Fixed float is specific quantity of parts that a plant wants to keep on hand to cover its manufacturing process. The float is kept by the system as long as it can identify sufficient customer requirements to cover this quantity. As long as there are requirements to cover this float, the system schedules to keep it in inventory. However, ₹3.7 CR worth of additional variable float inventory was identified which can result in cost saving if reduced. Two such parts were identified.

					TT		
Sno	Part No	Description	GSDB	Supplier	South Africa to India	Sanand to Faureica Chennai and back with lead time	Additional Quantity in Variable float in Nos
1	L7B15F297AA	SHL ASY EXH CONV EXT	T2A1A	FORD MOTOR CO OF SOUTHER	61 days	15.9 days	1120
2	J7B15F297CA	SHL ASY EXH CONV EXT	T2A1A	FORD MOTOR CO OF SOUTHER	61 days	15.9 days	640



Total Proposed Cost Saving = ₹ 8,29,00,000 (₹8.29 CR)

Improve and Control phase of the project are still going on and a final value of actual cost-saving would be determined post its completion in September. Along with this project, I was engaged in an additional theoretical project about the usage of advanced technologies in SCM and logistics.

Part-C

Advanced Technologies in SCM

Introduction

A **supply chain** is the interconnected network of people, organizations, resources, activities, and technology that are involved in the production and distribution of a product or service. The distribution of raw materials from a supplier to a manufacturer begins the supply chain and it culminates with the delivery of the finished product or service to the end consumer.

The process of coordinating the many activities required to produce and distribute goods and services to a company's customers is known as **supply chain management**. This might include tasks like monitoring the manufacturing of a product, transporting the goods by air, sea, or land, ensuring that it fulfils quality requirements, and delivering the product to clients, depending on the business.

Supply chain management is necessary since it helps in the achievement of numerous company's business goals. Controlling manufacturing processes, for example, may enhance product quality while lowering the danger of recalls and assisting in the development of a strong consumer brand. Controlling shipping methods and procedures, on the other hand, enhances customer service by preventing expensive shortages or periods of inventory overstock. Overall, supply chain management allows businesses to increase their profit margins in a variety of ways, and it is especially critical for businesses with big and multinational operations.

Challenges

Supply chain managers face increasing problems in developing and maintaining efficient and effective supply chain processes. Some of the most pressing supply chain issues are:

1. **Customer service –** Supply chain management is all about getting the right product to the right place at the right time in the appropriate amount. It appears simple but can easily and quickly get complicated.
2. **Cost control –** Rising energy/fuel and freight expenses, a growing number of worldwide consumers, technology, rising labor rates and new laws, and rising commodity prices all put a strain on operating costs.
3. **Planning & risk management –** Periodic reviews and redesigns are required in order to stay as efficient and successful as possible. These adjustments are in reaction to market developments, such as new product releases, global sourcing, credit availability, and the need to safeguard intellectual property. In order to minimize and reduce these risks, they must be recognized and quantified.
4. **Supplier relationship management –** To better understand current performance and possibilities for improvement, it is necessary to create, understand, and adhere to

mutually agreed upon standards. Using two different methods to measure and communicate performance and outcomes is a waste of time and effort. A mutual structure must be put in place and trusted to ensure consistent results and to better supplier relationships.

5. **Talent –** Finding competent and enthusiastic individuals is getting increasingly challenging. Supply chain leaders must have a thorough grasp of the core skills and tasks required for supply chain management positions, as well as the ability to quickly source particular skill sets and techniques for training future leaders.
6. **Single sourcing –** Many firms have concentrated on single-sourcing methods for a variety of reasons, including the perception that this was the most cost-effective option. Unfortunately, this also implies that businesses are susceptible if suppliers experience shortages or manufacturing disruptions. When there is a disruption, single sourcing is a sure way to lose sales. Instead, businesses should concentrate on risk mitigation techniques in order to anticipate and mitigate supply chain issues and hazards.
7. **Lack of Actionable Data and Insights –** A recurring problem in business leadership, and particularly in supply chain management, is a lack of adequate information to make informed decision. Furthermore, the complexity of the supply chain makes it difficult to analyze various choices, trade-offs, and situations in order to make the best or correct decision. While traditional transactional-based ERP excels at managing massive amounts of data, the way information is gathered, processed, and stored makes it difficult to utilize for spotting long-term patterns. The same can be said for most business analytics, which are great for reporting what happened in the past but offer little insight into future supply chain challenges.

Opportunities

Accurate inventory management

The appropriate flow of commodities in and out of a warehouse may be ensured through accurate inventory management. In general, there are various inventory-related variables, such as order processing, picking, and packing, which can be time-consuming and error-prone. Overstocking, insufficient supply, and unexpected stock-outs can all be avoided with proper inventory management.

Efficiency in the warehouse

An effective warehouse is an important aspect of the supply chain, and automation can help with the prompt retrieval of items from warehouses and the smooth delivery of goods to

customers. AI systems can also address a variety of warehouse problems faster and more precisely than humans, as well as simplifying complex procedures and speeding up work. Additionally, AI-driven automation efforts can drastically reduce the need for, and expense of, warehouse staff, in addition to saving important time.

Increasing Resiliency

While the ability to weather change has always been important for supply chain performance, recent trends have resulted in an emphasis on lean procedures over the kind of redundancies that may make changes simpler to manage. As a result, supply chains appear to be less robust overall; they are frequently working with less safety stock than ever before, striving for just-in-time inventory replenishment, manufacturing, and delivery, and ultimately living with higher levels of risk. Ditching these lean techniques can incur considerable costs and ongoing capital commitments, but the recent disruptions are forcing firms to reconsider their lean supply chain and production strategies. Ultimately, it comes down to balancing. We must recalculate our estimates about the likelihood of risk through disruptions and shortages, review risk tolerance, and then balance the buffer stock at key touchpoints to meet that risk tolerance.

Improving Supply Chain Measurements

Identifying the right set of Key Performance Indicators (KPIs) and Key Performance Predictors (KPPs) which actually impact the business is the most difficult and important task while considering to monitor supply chain performance, identifying risks and minimizing costs. Introducing predictive business intelligence can help create, manage, and react to KPIs better for an organization.

Operation costs reduction

This is a significant advantage of AI systems in the supply chain. Automated intelligent activities, from customer service to warehousing, can function error-free for longer periods of time, lowering the number of errors and workplace mishaps. Warehouse robots are faster and more accurate, resulting in improved output.

Delivery on time

AI technologies can assist in reducing reliance on manual labour, making the entire process faster, safer, and more intelligent. This facilitates prompt delivery to the consumer in accordance with the agreement. Traditional warehouse procedures are accelerated by automated technology, removing operational bottlenecks along the value chain with minimal effort to meet delivery targets.

Key Technologies in SCM

1. Automated Warehousing-

AI is increasingly being used to revolutionize warehouse activities such as data collection and analysis, as well as inventory processing. As a result, AI aids in improving productivity and profit. Artificial intelligence is being utilized to forecast demand of products. Post that, the business sends high-demand products to regional warehouse reducing transportation cost. Furthermore, the artificial intelligence system can manage the work as well as perform a variety of everyday activities.

Ocado: It's an online supermarket based in the United Kingdom. This organization has created an automated warehouse using a robot called 'hive-grid-machine' that carries off the orders a lot faster as compared to workers. 'Hive-grid-machine' can fill 65,000 orders or replace around 3 million food products in a week. These robots help with tasks like moving, lifting, and sorting. Following that, Ocado staff packs and ships orders. As a result, the time it takes to ship an order is cut in half.

Computer vision is used in automated warehouses. This technology enables the things to be recognized and organized. Furthermore, computer vision will help manage quality control in the future without the need for human intervention. If the chain has many warehouses, artificial intelligence may connect them to identify the most efficient way to move the inventory.

2. Autonomous Vehicles

Transportation can benefit from artificial intelligence. Self-driving cars are changing the supply chain and helping to cut logistical costs. Self-driving cars are the first that strikes the mind, but AI allows the automation of a wider range of vehicles. Trucks, vans, and buses, for example, may all be automated in order to transport products. Vehicles of this type can function alone or in coordination with humans. In many nations, however, the government believes that the

driver must be present in the car in order to completely manage the situation on the road and assess potential dangers. This declaration may, of course, alter in the future.

Rolls-Royce: This company collaborates with Intel to create self-driving ships. Since the 2010s, Rolls-Royce has been developing this technology. In 2018, Intelligence Awareness was launched. This tool offers a lot of cool features like detecting and identifying things in the water, check engine status, and pick the optimal routes. As a result, the delivery speed increases.

3. Smart Roads

Several businesses are developing smart roadways. In order to meet regional demands, these businesses tend to provide a variety of solutions. For example, roads with solar panels and LED lighting have been built. These roads can generate power or employ bright lights to alert drivers to changing road conditions. Another advantage of solar panels is their capacity to heat. As a result, the roadways aren't as slick as they would be in the winter.

Because there are no delivery delays in the supply chain due to bad weather conditions, the benefits lead to the conclusion that smart roads are beneficial for the logistics industry.

Integrated Roadways: The Smart Pavement system is one of the company's most well-known products. The Smart Pavement System is equipped with a number of beneficial features. For starters, it can connect automobiles on the road to the Internet. As a consequence, drivers may get real-time updates on traffic congestion, accidents, and other issues. Furthermore, the creators believe that their system can sense the location of every vehicle and provide precise directions to drivers. Moreover, these roads can have a life up to 4 times that of regular concrete or asphalt roads.

4. Artificial Intelligence and RPA

For the SCM and logistics, back-office activities are critical. Technologies like AI and RPA (Robotic Process Automation) help the employees to speed up or automate their work processes. Some data-related tasks are performed on a daily basis and can be automated. Back-office automation allows supply chain firms to save time and money.

Cognitive automation is a technique built by combining AI with RPA. As a consequence, businesses may save time, enhance production, and improve accuracy. The major goal of this technology is to reduce the need to employ people in routine activities and save a considerable amount of man hours. The number of human mistakes will also decrease as a result of this substitution.

Application in placing purchase order: Production facilities provide reports on raw material, work-in-process, and finished items inventory levels. An RPA bot can be configured to sync with the company's CRM system by IT. The RPA bot may connect with the relevant supplier through email or buying site to make an order based on the report information. The only thing

the purchasing manager would have to do is keep an eye on the notifications and accept the request. This procedure might happen hundreds of times each day in businesses with many suppliers and high-volume operations.

Apart from this some other applications can be found in Data entry automation, Predictive maintenance, Logistics management, After-sales service, Order management etc.

Ford uses the RPA system and bot to extract part shortage reports as well as Container track reports using Ocean Track BOT. Further plans in this direction are developing chatbots and developing data analytics for estimating premium freight requirements.

5. AI in Predicting the Demand

In the logistics industry, artificial intelligence may be used to forecast demand. To expedite delivery, businesses must forecast the approximate number of items. In another scenario, if there is a limited supply of products but strong demand, the company will lose money.

Traditional forecasting models such as ARIMA, Auto-Regressive Integrated Moving Average, and exponential smoothing methods, where only historical data is considered, are getting outdated because of the increased amount of data generated from businesses and external sources. As a result of the implementation of machine learning into their businesses' supply chain management, companies can improve the accuracy of forecast results and optimize the replenishment process.

AI & Machine learning takes demand forecasting to the next level, allowing for improved projections based on real-time data from internal and external sources including demographics, weather, online reviews, and social media. Supply chain networks, with the help of external data and machine learning algorithms, can outperform networks handled more manually by data analysts and adapt better to external changes. Machine learning forecasting techniques may discover clusters of past goods with similar features and lifetime curves and use those datasets as a substitute to generate forecasts for new items that lack historical data.

Artificial intelligence provides us a better understanding of the elements that influence demand prediction accuracy. After that, this can help with warehouse management as well. Furthermore, AI enhances the consumer experience. Clients will have a more customized experience as a consequence of the use of this technology, and will have a higher level of trust in the firm.

6. Chuck Robot

6 River System is a company that works on and areas around warehouse automation. Chuck is a robot made by the firm. The developers utilized technology that are comparable to those used in self-driving cars. Chuck is now a part of the Management System. The robot can do things like put items away, count them, and even sort them. Chuck is also portable and wireless. As a result, it quickly switches between boxes and may even slow down when personnel or equipment arrive.

7. RFID Asset Tracking

RFID asset tracking is a method of automating the process of managing and locating physical assets. It operates by storing data on an RFID tag and attaching it to a specific item. This information might range from Electronic Product Code (EPC code), weight, description of the pallet content, product dangerousness etc.

An RFID reader can read the data stored on an RFID tag using the tag's pulsing radio waves. Eventually, the data will be collected in a sophisticated asset tracking system where it can be monitored and acted upon.

The ability to automate tracking and monitoring procedures seeks to eliminate the extremely error-prone pen-and-paper and excel spreadsheet techniques. Among the additional advantages are:

- Keeping track of numerous assets at the same time
- Elimination of human intervention
- Data collection in real-time
- Increasing the visibility of assets
- Locating misplaced or lost goods
- Maximizing Inventory accuracy

8. Big data supply-chain analytics

Big data supply chain analytics makes use of data and quantitative approaches to better decision making across the supply chain. It accomplishes majorly two tasks:

1. It broadens the dataset for analysis beyond the traditional internal data kept on ERP and SCM systems.
2. It employs statistical techniques on both new and old data sources which generates fresh insights to complement supply chain decision-making.

Following are the main areas Big data analytics can affect and some use-cases.

i). Sales, Inventory and Operations Planning- There is now tremendous opportunity to modify the planning process by utilizing new internal and external data sources to enable real-time demand and supply shaping. Point of sale (POS) data, inventory data, and manufacturing volumes may all be evaluated in real time to discover supply and demand mismatch. These may then be used to drive activities such as pricing adjustments, promotion timing, or the creation of additional production lines etc.

Blue Yonder, for example, has developed data-intensive forecasting algorithms that are already being used in retail, where 130,000 SKUs and 200 influencing variables yield 150,000,000 probability distributions per day. This has significantly improved forecast accuracy, provided a better understanding of the company's logistical needs, and decreased obsolescence, inventory levels, and stockouts. The recent expansion of third-party cloud-based platforms such

as Blue Yonder makes similar activities more available to other retailers as well. Meanwhile, Amazon has patented an "anticipatory shipping" method in which orders are packed and sent into the delivery network before customers purchase them. Thus, mastering big data forecasting may help in actively shaping demand.

ii). Sourcing- Many businesses simply collect data on procurement volumes and suppliers for a few activities in the sourcing process. Supply data extends beyond the traditional spend analysis and supplier performance assessment annually. Supply processes can be monitored in real time on a transactional basis to discover deviations from regular delivery patterns. Firms are also discovering new avenues for predictive risk management.

Firms are also discovering new avenues for predictive risk management. A company can identify supply interruptions in transportation, or at 2nd or 3rd tier suppliers, and take decisive action before its competitors by mapping its supply chains and leveraging "Google trend"-style information and social data like strikes, fires, or bankruptcies.

iii). Manufacturing- Big data and analytics may also aid in the improvement of manufacturing e.g., energy-intensive production runs might be scheduled to take advantage of fluctuating electricity prices. Manufacturing parameter data, such as the forces used in assembly processes or dimensional discrepancies between components, may be preserved and examined to aid in the root-cause investigation of problems, even if they occur years later.

With its networks of cameras and sensors on millions of devices, the Internet of Things may open up new industrial opportunities in the future. Finally, real-time data on a machine's condition may prompt the manufacture of a 3D-printed spare component, which is then delivered to the factory by drone to meet an engineer, who may utilize augmented reality glasses for instruction while replacing the part.

iv). Warehousing- New technology, data sources, and analytical approaches are also opening up new warehousing options. A forklift truck may function as a big data hub, collecting all kinds of data in real time and combining it with ERP and Warehouse Management System (WMS) data to detect further waste in the warehouse process. For example, video image analysis acquired by autonomous guided vehicles, along with sensor inputs such as temperature, shelf weight, and forklift weight, may be utilized to evaluate picking accuracy, warehouse productivity, and inventory correctness in real time.

Forklift driving behavior and route selection may also be analyzed and dynamically adjusted to increase picking productivity. The data may also be utilized to do root-cause analysis on picking mistakes based on shape, color, or weight, which can aid in making procedures more resilient.

New 3D modelling technology can also help to optimize warehouse design and simulate new warehouse space configurations to increase storage efficiency and picking productivity. Logivations, a German company, for example, provides a cloud-based 3D warehouse layout planning and optimization tool.

v). Transportation- Analytics are already being used by trucking businesses to enhance their operations. They utilize fuel consumption analytics, for example, to increase driving efficiency, and GPS technology to decrease waiting times by assigning warehouse hubs or docks in real time. Courier firms have begun real-time routing of deliveries to clients based on geo-location

and traffic data from their trucks. UPS, for example, has spent 10 years creating its On-Road Integrated Optimization and Navigation system (Orion) in order to optimize the network's 55,000 routes.

As demonstrated by the examples in this article, big data is already assisting top businesses in improving the performance of their supply chains. However, such techniques are now the exception rather than the rule. Many businesses are hampered by a lack of expertise and a systematic approach to supply chain big data. Big data and advanced analytical tools must be adopted in a more systematic manner if they are to provide larger benefits to more businesses.

Advanced Technologies used in Ford

1. PEGA RPA – Pega Robotic Process Automation is a tool in an organization's digital transformation. It eliminates the need for employees to do repetitive tasks by enabling them to be processed digitally, with higher speed and accuracy.

Pega Robotic Process Automation provides features that enhance productivity and decrease processing backlogs, resulting in lower rework costs.

Ford IMG SCM team uses these bots to perform the following tasks:

- **Shortage reports by RPA:** The bot is used to extract data from CMMS (Common Material Management System) and tabulates it into daily reports which can be used to filter needed part information. This reduces manual effort and saves precious time which can be further used to enquire about the shortage of the concerned part(s). IMG SCM team also uses the bot to support various plant teams with any ad-hoc data requirement. The saved time by the team can be devoted to analyze and determine whether a shipment from suppliers is based on releases or not and the reasons behind under/over-shipping.
- **Container Track Report:** Ocean track bot navigates through relevant websites and daily status reports (DSRs), takes data and updates it into the excel sheet which can be used to track the various parts and containers in transit.

Some other technologies which are in progress and yet to be fully automated by SCM team are are ChatBot, DPA project, and developing data analytics for estimating premium freight requirement and associated value.

2. Blue Yonder/JDA – Blue Yonder is a US-based software and consultancy firm that provides supply chain planning solutions, and helps its clients by transforming transport management systems and warehouse management systems.

RTM (Regional transport management) team uses two modules of the ERP software that Blue Yonder provides.

I. **Transport Management System –** This software is used to take the release data from CMMS and computes how many loads per day are required. The LoadIds are then generated and sent to all the carriers who then execute the plan according to these load

IDs. The corresponding data about the trips is updated in the system by the carrier as well and helps in generating details in the end of the month like trips executed, logistics cost etc.

II. **Transport Design Module –** The team uses this module to refresh their transport network design every 3-months based on changes in factors like demand, volume mix etc. and the what-if analysis.

Recommendations

- **RFID Asset Tracking** saves a lot of manual effort and can be installed in Ford since there is a continuous in-flow of high value physical assets. The tag contains all the necessary details about the product like electronic product code (EPC), weight, dimensions etc. and hence can fasten and increase the visibility of assets.
- **AI in Demand Forecasting**: According to Mckinsey Digital, AI-powered forecasting may reduce errors in supply chain network by 30 to 50%. The increased accuracy leads to a 65 percent reduction in lost sales owing to out-of-stock goods, and warehousing costs are reduced by 10 to 40 percent. Ford can use AI-powered demand planning tools like COLIBRI, amoCRM, FutureMargin etc. to stay ahead of the competition.
- Ford can use **Chuck Robot** or any other robots that can perform pick, place and sort activities on a pilot basis. This can be another step to achieving fully automated warehousing in the future
- Integrating **Big Data Analytics** with different functions of the supply chain like network design, product design and development, demand planning, logistics, inventory management etc. can reap benefits for Ford in both short and long-run.

Learnings:

Throughout my time with Ford, I got to witness Supply Chain Management first-hand and how the various systems and teams collaborate towards maintaining the seamless production line operations. The project I was involved in provided me with the knowledge about inventory management and various factors it depends upon. During the time of production, I was able to visit the Sanand Vehicle Assembly Plant (SVAP) and observe some of the running production lines. I also got a chance to observe interactions with the suppliers and maintaining track of inbound logistics. This is important since Ford follows lean inventory practices and procures some of the parts locally to save up on inventory holding costs.

The interactions with other teams like RTM (Regional Transport Management), IMG SCM (International Market Group), BOT team helped me broaden my knowledge base about logistics, procurement, and some of the technological advancements in the reporting process, respectively. I also got to know about the technological advancements in SCM, in general, and how they are complimenting the legacy systems.

Certificate of Completion

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July 12, 2021

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr. Shivam Thakur** from **Institute of Management, Nirma University** has successfully completed his Internship at Ford India Private Limited –Sanand, Gujarat from **May 3, 2021 to June 30, 2021.**

His assigned project **'Reduction in B562 imported parts Inventory'** was with the Vehicle Operations – Material Planning and Logistics team.

We wish him all the very best for his future endeavors.

For, **Ford India Private Limited - SVAEP**

DocuSigned by:
Vipin, Nair (N.)
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Vipin Nair
Manager - Human Resources

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