Ten Years of Excellence

OPERATIONS CASEBOOK

2024-25

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Acknowledgement

We extend our sincere gratitude to everyone who contributed to the development of this Operations Casebook. Their collective efforts and insights have played a crucial role in creating a comprehensive resource for future batches to strengthen their understanding of operations management and case-solving techniques.

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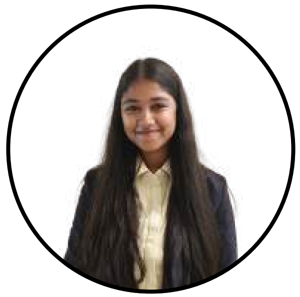

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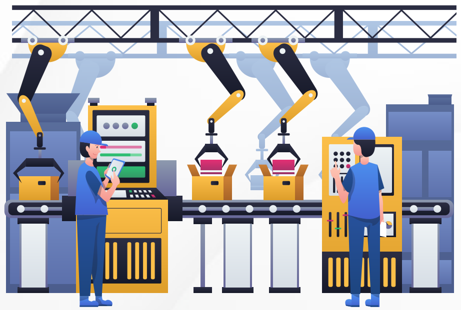
OPERATIONS MANAGEMENT

Operations management is a critical area within business administration that deals with designing, overseeing, and controlling the production processes and the redesign of business operations in the production of goods or services. It ensures that an organization’s operations are efficient in terms of using as few resources as needed, and effective in terms of meeting customer requirements. It is concerned with managing the process that converts inputs (in the forms of materials, labor, and energy) into outputs (in the form of goods and/or services).

Operations management involves planning, scheduling, and controlling all activities that directly affect an organization’s goods and services. Key functions include product design, production planning, process design, quality control, capacity, inventory management, and logistics. These functions require constant monitoring and evaluation to enhance productivity and quality while reducing costs.
The scope of operations management ranges from strategic to tactical and operational levels. Strategically, it involves the long-term decisions related to production processes and technology. Tactically, it involves the organization and coordination of activities necessary to achieve the desired quality, cost, and timing of goods and services. Operationally, it includes the day-to-day management of resources, troubleshooting, and continuous improvement.

In essence, operations management is central to maintaining a competitive edge in the global market, ensuring that operations are run effectively, and adapting innovatively to changing market and technological demands.



Introduction

OPERATIONS MANAGEMENT

Operations management is like the behind-the-scenes work that makes sure things run smoothly in a business. It's about planning, organizing, and controlling how a company produces goods or services.

Imagine a factory making cars. Operations management is what makes sure the right parts are in the right place at the right time, the workers have the tools they need, and the cars are built to the highest quality standards. It's about making sure everything is efficient, so the company can produce cars quickly and affordably.

But operations management isn't just about factories. It applies to all kinds of businesses, from restaurants to hospitals. For example, a restaurant's operations manager might be in charge of scheduling staff, managing inventory, and ensuring food is prepared and served efficiently.

In short, operations management is the backbone of any successful business. It helps companies stay competitive, keep costs low, and deliver high-quality products and services to customers.

KEY ASPECTS

Capacity Planning:
This involves determining the capacity needed to meet the demand for products or services. It includes decisions about the size of production facilities, equipment, and workforce.

Process Design and Improvement:
This encompasses designing efficient production or service processes and continuously improving them. Techniques like Lean Six Sigma are often used to identify and eliminate inefficiencies and defects.

Quality Management:
Ensuring that products or services meet or exceed customer expectations. Quality control and quality assurance processes are implemented to maintain consistency and excellence.

Inventory Management:
Managing inventory levels to ensure products are available when needed while minimizing carrying costs and stockouts.

Project Management:
Planning, organizing, and executing projects to achieve specific objectives within defined constraints such as time, cost, and scope.
Mass customization: The ability of a company's operations management division to highly personalize its goods and services at large quantities.

Operations management (OM):
OM used to be known as production and operations management (P&OM) or just production. It is a corporate function that refers to the transformation process of converting raw materials into finished goods and services. As the field expanded from being mostly tactical (e.g., making inventory and scheduling decisions on the manufacturing floor) to strategic (today, many CEOs coming from the OM field), the terminology began to refer to operations rather than just production.

Reengineering:
The process of restructuring a company's processes in order to improve efficiency, quality and cut costs. Many businesses follow a set of procedures that have been passed down through the generations. In a company's reengineering initiatives, operations management is a critical component.

Environmental Sustainability:
Incorporating practices that minimize the environmental impact of operations, such as reducing waste and energy consumption.

Supply Chain Management:
Overseeing the entire supply chain, from suppliers to manufacturers to distributors, to ensure smooth flow of materials and information.

Scheduling:
The process of agreeing on the scheduling and utilization of resources inside a business; it answers questions like who will work on what schedule and in what order jobs will be processed.

Logistics:
Managing the movement of goods, services, and information within an organization or between organizations. This includes transportation, warehousing, and distribution.

Continuous Improvement:
Embracing a culture of ongoing improvement, often through methodologies like Kaizen, to enhance processes and systems over time.

Forecasting:
Predicting future demand for products or services to make informed decisions about production and resource allocation.

Risk Management:
Identifying potential risks that could impact operations and developing strategies to mitigate or respond to them.

Technology and Automation:
Leveraging technology and automation to increase efficiency, accuracy, and speed in operations. This could include robotics, AI, and software solutions.

KEY TERMS AND JARGON

Agile Operations: A flexible approach to operations that can quickly adapt to changing market conditions.

Batch Processing: A method of processing tasks or orders in groups (batches) rather than individually, often used to improve efficiency in manufacturing.

Bottleneck: A point in a process where the capacity is limited, causing a slowdown in overall production.

Capacity Planning: Determining the resources needed to meet demand.

Capacity Utilization: The extent to which a company's production capacity is being used to produce goods or services.

Critical Path: In project management, the sequence of activities that determines the shortest time needed to complete a project.

Demand Forecasting: Predicting future customer needs with help predictive mathematical tools

Discrete Manufacturing: Producing products in distinct units, such as cars or electronics.

Economic Order Quantity (EOQ): The optimal order quantity that minimizes total inventory costs.

Efficiency: The ability to accomplish tasks with minimal waste, including time, resources, and effort.

Enterprise Resource Planning (ERP): A software system that integrates various business processes .

Facility Layout: The physical arrangement of equipment and resources within a facility.

Facility Location: The geographical location of a manufacturing facility.

Inventory Management: Controlling the level of inventory to balance supply and demand.

Just-In-Time (JIT): A strategy that involves producing and delivering products or services just in time to meet customer demand, thereby minimizing inventory costs

Kaizen: A Japanese term meaning "continuous improvement," referring to the practice of making small, incremental improvements to processes over time.

Kanban: A visual system used to manage and control production flow by signalling when to produce or replenish items based on actual demand.

KPI (Key Performance Indicator): Metrics used to evaluate the performance and success of a specific aspect of operations, such as production efficiency, quality, or delivery times.

Lead Time: The time it takes to complete a process from start to finish, including waiting time, processing time, and transportation time.

Lean Manufacturing: A methodology focused on minimizing waste in production processes, resulting in increased efficiency and reduced costs.

Lean Manufacturing: A philosophy aimed at eliminating waste and improving efficiency.

Lean Operations: An approach that focuses on minimizing waste, reducing inefficiencies, and improving processes to enhance value and quality while reducing costs.

Location Analysis: Evaluating potential locations for facilities based on various factors.

Manufacturing Cell: A group of machines or workstations arranged to produce a specific product or family of products.

Manufacturing Process: The sequence of activities involved in transforming raw materials into finished products.

Operations Strategy: Aligning operational activities with the overall business strategy.

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Operations Strategy: Aligning operational activities with the overall business strategy.

Outsourcing: Contracting with an external party to perform certain business functions.

Process Mapping: Visualizing the steps involved in a process to identify inefficiencies.

Project Management: Planning, organizing, and controlling projects to achieve specific goals.

Quality Control: Inspecting and testing products to ensure they meet quality standards.

Quality Control: The process of ensuring that products or services meet specified quality standards through inspections, testing, and corrective actions.

Service Operations: Managing the delivery of services, such as healthcare or hospitality.

Six Sigma: A data-driven approach to quality improvement that aims to achieve near-perfect results by minimizing defects and variations in processes.

Strategic Sourcing: Identifying and selecting suppliers for materials and services.

Supply Chain Management: Coordinating the flow of goods and services from suppliers to customers.

Supply Chain Network: The interconnected network of organizations involved in the flow of goods and services.

Supply Chain: The network of organizations, people, activities, information, and resources involved in moving products or services from suppliers to customers.

Total Quality Management (TQM): A comprehensive approach to quality that involves everyone in the organization.

Value Stream Mapping: A visual representation of the steps involved in delivering a product or service, highlighting areas of waste and inefficiency.

Warehouse Management: Managing the storage and retrieval of goods in a warehouse.

ROLES AND OPPORTUNITIES

Roles and opportunities available in the Operations domain

Operations Manager: Responsible for overseeing the day-to-day operations of a business. This includes managing resources, optimizing processes, and ensuring production meets quality and efficiency standards.

Production Supervisor: In charge of supervising the production process, ensuring that products are manufactured efficiently, on time, and according to quality standards.

Supply Chain Manager: Manages the entire supply chain, from sourcing raw materials to distributing finished products, to ensure smooth and efficient flow of goods and information.

Quality Control Inspector: Monitors and tests products or services to ensure they meet established quality standards and specifications.

Logistics Coordinator: Coordinates the movement of goods, manages transportation and warehousing, and ensures timely delivery to customers

Inventory Manager: Manages inventory levels, tracks stock movements, and optimizes inventory turnover to balance supply and demand.

Process Improvement Specialist: Analyzes existing processes, identifies inefficiencies, and implements improvements using methodologies like Lean or Six Sigma.

Operations Analyst: Analyzes operational data and trends to provide insights that inform decision-making and drive operational improvements.

Procurement Officer: Responsible for sourcing and acquiring the necessary materials, goods, and services for the organization's operations.

Demand Planner: Analyzes historical sales data and market trends to forecast future demand, helping the organization plan production and inventory levels.

Production Manager oversees production efficiency, schedules, and quality standards. Manages teams, optimizes processes, and troubleshoots issues.

Quality Assurance Manager: Ensures that products and services meet or exceed quality standards. This role involves designing and implementing quality control processes, conducting audits, and continuously improving quality management systems.

ROLES AND OPPORTUNITIES

Procurement Specialist/Manager: Focuses on sourcing and acquiring the necessary materials, goods, and services for a business. This role involves supplier selection, negotiation, and ensuring a reliable supply chain

Continuous Improvement Manager: Leads efforts to establish a culture of continuous improvement within an organization. This involves implementing strategies like Kaizen and driving initiatives to enhance processes and systems.

Facilities Manager: Manages the physical assets of a business, including buildings, equipment, and maintenance. This role ensures that facilities are optimized for efficient operations.

E-commerce Operations Manager: Manages the operations of online businesses, including order fulfillment, customer service, and optimizing the online shopping experience.

Service Operations Manager: Focuses on managing the operations of service-based industries such as healthcare, hospitality, and financial services, ensuring efficient service delivery and customer satisfaction.

Project Manager: Manages specific projects within operations, overseeing resources, timelines, and budgets to successfully deliver projects that improve processes or implement new technologies. .

Logistics Manager: Manages the movement, storage, and distribution of goods. This role involves optimizing transportation routes, managing warehouses, coordinating with suppliers and customers, and ensuring timely deliveries.

KEY AREAS TO FOCUS

Operations management is a vital field of management that focuses on designing, planning, executing, and controlling the processes and resources involved in producing goods and services. It aims to optimize efficiency, quality, and customer satisfaction while minimizing waste. Key terms and concepts include KPIs, Lean manufacturing, Six Sigma, supply chain management, value stream mapping, and more. Various roles within operations management include operations managers, supply chain managers, production managers, quality assurance managers, and logistics managers. Opportunities span industries like manufacturing, retail, healthcare, and technology, offering a range of careers centred around optimizing processes, managing resources, and ensuring the effective delivery of products and services.

- **Supply Chain Management**
- **Lean Management**
- **Quality Management**
- **Logistics and Transportations**
- **Green Operations and Sustainability**
- **Data Analytics and Technology Integration**
- **Production Planning and Scheduling**
- **Supply chain management**

1. Supply Chain Management:

This is one of the core areas in operations which deals with the strategic coordination and integration of various processes, activities, and stakeholders involved in the creation, movement, and distribution of goods and services from raw materials to delivery of finished goods to the customer. The primary goal of supply chain management is to optimize efficiency, cost-effectiveness, and customer satisfaction throughout the entire supply chain network. **Key Components include Bullwhip Effect, Bottleneck, Supplier Relationship Management (SRM), Collaborative Planning, Forecasting, and Replenishment (CPFR), Risk Management, Total Cost of Ownership (TCO)**

2. Lean Management

Developed by Toyota Production System (TPS), it is also known as Lean Manufacturing or Lean Production, which mainly focuses on maximizing value by reducing or eliminating activities and practices that do not add value to the final product or service, thereby enhancing efficiency, reducing costs, and improving overall quality. Lean management involves different methodologies that streamline an agile operational environment that responds effectively to customer needs and market changes. Some of the main principles are **JIT(Just-In-Time), 5S Methodology, Kaizen, and Pull System. Etc.**

A. Plan Do Check Act - PDCA Cycle

The Plan Do Check Act Cycle was suggested by Eduard Deming as a well-formed approach for quality systems, problem-solving, and kaizen initiatives. The PDCA cycle is a shortened version of the PDCA cycle. The PDCA cycle is an essential component of lean manufacturing and continuous improvement projects. It's especially useful when dealing with problems that are difficult to diagnose, have several core causes, and necessitate a concentrated effort in performance management and long-term sustainability. The PDCA cycle consists, as its name suggests, of the following stages or steps:

- Plan: The issue statement, objectives, data collection, and project scope specification are all part of the planning process.
- Do: Define the issue, problem, or quality concern with a process, product, or plant in the do stage. Other problem-solving concepts and techniques, like fishbone diagrams, Pareto charts, and root cause analysis, are frequently employed in the Do stage to establish the most likely source of the problem, issue, or lack of performance.
- Check: The validity of the possible causes of the issue or problem, as well as the outcomes of the activities and modifications proposed above, is examined at this step.
- Act: This is the stage in which steps and activities are put in place to permanently address the problem, issue, or improve the process or plant.

After the Actions have been implemented, they are reviewed for efficacy and, if applicable, performance improvement. If the results are not satisfactory, the PDCA cycle is repeated; in most circumstances, the process will back to the Do stage; however, starting from the planning stage may be more feasible.

KEY AREAS TO FOCUS

B. Just in time - JIT and Kanban systems

Just in time (JIT) production system aims to increase output by fulfilling customer orders promptly to reduce inventory costs such as handling, depreciation, and storage. JIT minimizes waste by producing goods only when needed, aligning with lean manufacturing principles.

It is a manufacturing approach that tries to accomplish high-volume production while keeping inventories to a minimum. The key to this strategy is to supply parts inventory to each workstation at precisely the right time. Combining the JIT mindset with TQM (total quality management), which constantly monitors for the causes of defects and eliminates them all at once, is a good idea. JIT (just-in-time) delivery is a pull system delivery because products are only delivered when an order or Kanban signal is received.

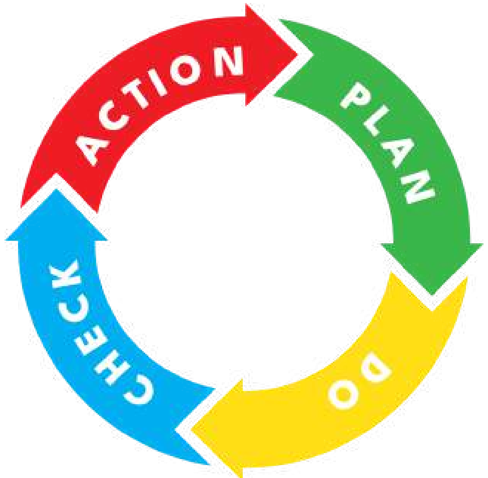
C. Kaizen and continuous improvement

Kaizen is a Japanese concept that refers to continuous improvement in a business, operations, or manufacturing process. Kaizen is a Japanese concept that aims for continual improvement in all parts of a manufacturing process, from raw material procurement to production procedures. The term "Kaizen" is most often used to describe focal projects or efforts aimed at addressing and improving process concerns. It is one of the most significant phrases in lean manufacturing and operations management, and it should be at the top of most corporate leaders' and managers' priority lists if they want to maintain a competitive advantage in their market and become industry leaders.

Kaizens focus areas The following are some of the areas where kaizen activities and programs are more regularly used and can be very beneficial:

- Performance of individual plants and machines, including throughput and dependability
- Entire production lines, including bottlenecks, production rates, changeovers, etc
- Raw material procurement and utilization Labour utilization
- Communication, including Andon systems
- Quality
- Production processes and tasks
- Housekeeping and 5S
- Inventory management and control
- Inventory costs and warehousing
- Supply chain management

Kaizen employs a variety of lean manufacturing and problem-solving tools, techniques, communication, and interaction methods, including Kaizen boards, data collection and analysis, root cause analysis, process flow charts, Pareto charts, fishbone diagrams, and the 5 whys, among others, to achieve long-term improvements and efficiencies with the same or fewer inputs into the production process. Kaizen, like many other lean approaches, is not restricted to manufacturing or production processes. It can be used in any process in any business. The principles may be used across industries because the end goal is to make better use of inputs to produce better, more efficient outputs through a focused team approach.



KEY AREAS TO FOCUS

Kaizen initiatives and framework

There are numerous approaches to fostering a continuous improvement culture and emphasis among employees and management. It is highly dependent on the industry, staff experience, resource availability, manager preferences, and drive to develop for everyone. There is no one-size-fits-all approach to organizing a kaizen activity, plan, or program; what matters is that there is a clear framework that the entire team knows and can readily follow in order to produce long-term results.

Some general Kaizen general frameworks can include:

- Individual-specific projects run by team leaders or managers.
- Focused initiatives run by managers in conjunction with team members.
- Team member-initiated kaizen initiatives supported by managers.
- Kaizen blitzes in specific areas.
- Larger scale kaizen projects involving all staff.

D. Kanban System in Just-in-Time Production

Kanban or a Kanban is a sort of signalling system that is used in a process and/or an EOQ system to manage WIP and/or inventory between processes or tasks. The signalling system can be cards, containers, or squares to denote where supplies are stored. When the containers or squares are empty, the cards or the container itself can be utilized to signal to the operators that an additional product is needed.

3. Quality Management:

This area deals with the systematic processes, practices, and strategies which are implemented to ensure that products, services, and processes consistently meet or exceed established quality standards and customer expectations. Its main aim is to enhance customer satisfaction by delivering products and services that are reliable, defect-free, and consistent in meeting specified requirements It is a crucial component for maintaining competitiveness, building a positive reputation, and minimizing costs associated with defects and rework. Some of the Key elements in Quality Management are Quality Control (QC), Quality Assurance (QA), Total Quality Management (TQM), and Statistical Process Control (SPC)

Total Quality Management:

TQM stands for Total Quality Management, which refers to the process of controlling an organization's whole supply chain to satisfy both internal and external consumers. It aspires to be the best in all elements of its operations and to give clients exactly what they want. It is a component of the value. No index entries were found. Stream's continuous improvement process, quality culture and should be ingrained in the company's culture, involving all employees from executives to shop floor workers. TQM acquired a lot of traction in the 1980s when the quality of American-made items was inferior to Japanese-made products in several industries

TQM aspires for quality at the source of production and puts the responsibility for one's own work and the production process on the person. It strives to decrease quality flaws through statistical quality control, internal quality audits, teamwork, quality standards, and partnership with suppliers and consumers to ensure that the final product meets all requirements. Total quality management is a road that requires thorough data collection, process checks, analysis, resources, and dedication from everyone in the organization to attain the ultimate aim of satisfying and exceeding the expectations of customers.

KEY AREAS TO FOCUS

4. Logistics and transportation:

These two play a critical role in operations by ensuring an efficient and effective flow of products from suppliers to consumers. These components involve planning, execution, and control of the movement, storage, and distribution of goods, materials, and information throughout the supply chain. Learning in Deep Logistics is a process of managing the flow of goods, services, and information from the point of origin to the point of consumption which involves inventory management, warehousing, order processing, packaging, and distribution.

Whereas Transportation is nothing but the physical movement of goods and materials from one location to another by various means such as road, rail, air, sea, and even emerging technologies like drones. It is mainly used in the supply chain. Effective management of these functions contributes to improved coordination, reduced costs, and enhanced service levels throughout the entire product lifecycle.

5. Green Operations and Sustainability:

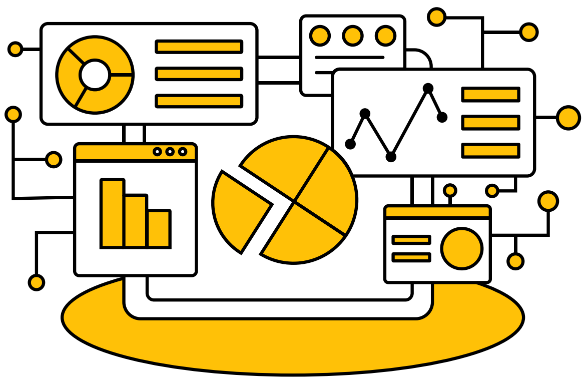
It refers to the practice of integrating environmentally responsible and socially conscious principles into various aspects of business operations to minimize negative impacts on the environment, society, and economic well-being. Its main aim is to minimize waste generation, reduce carbon emissions and contribute to the long-term health of the planet and communities. The main key concepts of green operations are Carbon Footprint Reduction, Innovation and Technology, Green Marketing, and Regulatory Compliance.

6. Data Analytics and Technology Integration:

By combining data analytics and technology integration, organizations can gain a competitive edge by making more informed decisions, improving resource allocation, reducing operational costs, enhancing customer experiences, and driving innovation across their operations. In operations management, data analytics focuses on using historical and real-time data from various sources to gain a deeper understanding of processes, identify areas for improvement, and make informed decisions. Key aspects of data analytics involve Descriptive Analytics, Predictive Analytics, Prescriptive Analytics, Real-time Monitoring, and Key Performance Indicators (KPIs). Technology integration involves the seamless incorporation of various technological solutions, such as software, hardware, sensors, and automation, into existing operational processes to enhance efficiency and effectiveness. Key technologies include the Internet of Things (IoT), Cloud Computing, Big Data, Artificial Intelligence (AI).

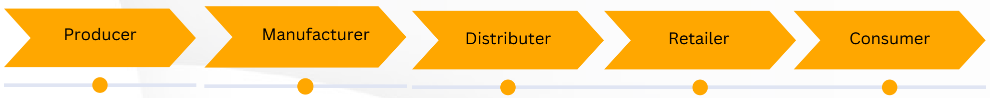
7. Production Planning and Scheduling:

Production planning is the process of determining what products to produce, in what quantities, and over what timeframe to meet customer demand while considering available resources and capacity. It involves making decisions about production levels, inventory management, and resource allocation. Key aspects of production planning involve Demand Forecasting, Master Production Schedule (MPS), and Materials Requirement Planning (MRP). Whereas Production scheduling is the process of creating a detailed timetable for carrying out production activities based on the production plan. It involves determining the order and timing of specific tasks and activities to ensure that production runs smoothly and efficiently. Job Sequencing, Machine Scheduling, Lead Time Management



8. Supply chain management

Supply Chain Management can be described as the control of the flow of goods and services from the point of manufacture to the point of consumption. It also includes the transportation and storage of raw materials used in work-in-progress, inventories, and fully furnished goods. Supply chain management's major goal is to keep track of and connect the production, distribution, and shipment of goods and services. Companies having a good and tight grip over internal inventory, production, distribution, internal productions, and sales can do this.



The flow of commodities, services, and information from the producer to the consumer is depicted in the diagram above. The illustration demonstrates the flow of a product from the producer to the manufacturer, who then sends it to the distributor for distribution. The distributor then sends it to the wholesaler or retailer, who then distributes the items to various stores where customers can easily obtain them. Supply chain management essentially combines demand and supply management. It employs a variety of tactics and methodologies to examine the complete chain and perform efficiently at each and every phase. Every unit involved in the process should strive to reduce expenses and assist organizations in improving their long-term performance while also adding value to their stakeholders and consumers. This method can help reduce rates by eliminating superfluous costs, moves, and handling

It's important to understand that supply chain management and supply chain event management are not the same things. Supply Chain Event Management addresses the reasons that could disrupt an efficient supply chain's flow; various situations are evaluated, and remedies are designed appropriately.

Advantages

Supply chain management is critical in this era of globalization, as organizations compete to give the greatest quality products to clients and meet all of their requests. All businesses rely heavily on a well-functioning supply network.

Let's take a look at some of the primary benefits of supply chain management. The following are the main advantages of supply chain management:

- Improves client service and relationships.
- Develops more efficient distribution mechanisms for in-demand items and services
- Enhances efficiency and business processes
- Lowers the cost of storage and transportation
- Reduces both direct and indirect expenditures
- Assists in the timely delivery of the correct products to the correct location.
- Supports the successful execution of just-in-time stock models by improving inventory management
- Assists businesses in adjusting to globalization, economic turmoil, rising consumer demands, and other differences
- Assists businesses in reducing waste, lowering costs, and increasing efficiencies throughout the supply chain

These are just a few of the many benefits of supply chain management. Let's have a look at the major goals of supply chain management after we've looked at the concept and benefits of supply chain management.

Goals

Every company attempts to match supply and demand as quickly as possible while making the most efficient use of resources. The following are some of the essential objectives of supply chain management:

- Supply chain partners collaborate at many levels to increase resource productivity, standardize processes, eliminate duplication of effort, and reduce inventory levels.
- Minimizing supply chain costs is critical, especially when organizations are facing economic uncertainty and want to save money.
- While cost-effective and low-cost items are vital, supply chain managers must focus on creating value for their consumers.
- The best way to satisfy customers is to consistently exceed their expectations.

KEY AREAS TO FOCUS

- Client expectations for more product variety, customized goods, off-season inventory availability, and quick fulfilment at a price equal to in-store options should be met.
- To achieve customer expectations, retailers must see inventory as a shared resource and use distributed order management systems to fulfil orders at the most efficient node in the supply chain.

Finally, supply chain management attempts to contribute to an organization's financial performance. It aims at leading organizations leveraging the supply chain to improve differentiation, grow sales, and reach new markets, in addition to all of the points mentioned above. The goal is to increase competitive advantage and shareholder value.

Process

Companies employ supply chain management to guarantee that their supply chains are efficient and cost-effective. A supply chain is the series of procedures taken by a corporation to convert raw materials into finished goods. The following are the five basic components of supply chain management

Plan:
The planning stage is the first step in the supply chain process. In order to address how the products and services will satisfy the expectations and necessities of the customers, we must design a plan or strategy. At this point, the planning should primarily focus on devising a profit-maximizing approach. Companies must develop a strategy to manage all of the resources required for designing products and offering services. The main focus of supply chain management is on planning and generating a set of measurements.

Develop (Source):
The development stage in supply chain management involves laying the foundation for a robust and efficient supply chain network. This critical phase entails identifying and selecting reliable suppliers, negotiating favorable terms and conditions, and building strong relationships with key partners. Additionally, it requires designing an optimal supply chain structure, optimizing inventory management strategies, and implementing effective transportation planning. By carefully considering these factors, businesses can create a supply chain that supports their operations, minimizes costs, and delivers exceptional value to customers.

Make:
The production or making of customer-demanded products is the third step in the supply chain management process. The products are created, manufactured, tested, packaged, and synchronized for delivery at this step. The supply chain manager's job is to schedule all of the tasks required for manufacturing, testing, packaging, and delivery preparation. This segment of the supply chain is the most metric-intensive, with enterprises able to assess quality levels, production output, and labour productivity.

Deliver:
The delivery stage is the fourth stage. The provider delivers the merchandise to the customer at the specified location. This is essentially the logistics stage, where consumer orders are approved and goods delivery is scheduled. The logistics stage, where organizations collaborate to collect orders from clients, construct a network of warehouses, select carriers to deliver products to customers, and set up an invoicing system to receive payments, is often referred to as the delivery stage.

Return:
The return is the final and most important stage of supply chain management. The customer returns defective or damaged items to the provider at this step. Companies must deal with client inquiries and concerns, among other things. For many businesses, this stage of the supply chain is a source of frustration. Supply chain planners must devise a responsive and adaptable network for receiving damaged, faulty, and additional products from customers, as well as expediting the return procedure for customers who have concerns with delivered products.

Warehousing

Warehousing is an important part of the supply chain. The demands and expectations of customers are changing dramatically in today's economy. We want everything to be just outside our door and at a reasonable price. We can state that warehousing function management necessitates a distinct fusion of engineering, IT, human resources, and supply chain expertise. Accepting supplies in an immediately storable conveyance, such as a pallet, case, or box, is great for neutralizing the efficiency of inbound functions. The types and quantities of orders processed are required for labelling the structure, tool selection, and business process. In addition, the quantity of stock-keeping units (SKUs) in the distribution centre is an important factor to consider.The Warehouse Management System (WMS) directs the products to the appropriate storage location. Following that, the necessary functionality for the completion and optimization of receiving, storing, and shipping functions are provided.

KEY AREAS TO FOCUS

Performance Measure

A supply chain performance metric is a method for evaluating the efficiency of a supply chain system. There are two basic categories of supply chain performance indicators:

• Qualitative indicators: Customer happiness and product quality, for example.

• Quantitative measures: order-to-delivery lead time, supply chain reaction time, flexibility, resource usage, and delivery performance are just a few examples. Only quantitative performance measures will be considered here. A multidimensional approach, which addresses how the organization needs to provide services to varied consumer expectations, can improve the performance of a supply chain.

Networks

The physical organization, design, structural architecture, and infrastructure of the supply chain are all determined by the network design. The number, location, and size of production plants and warehouses, as well as the assignment of retail outlets to warehouses, are all key considerations to be taken here. Other key sourcing decisions are also made at this stage. Many significant decisions affecting the long-term location, capacity, technology, and supplier selection must be made while taking into account the potential for market expansion to be fraught with uncertainty, as well as changing economic and regulatory situations.

The development of multi-stage stochastic optimization methods necessary for decision support under demand, freight rate, and exchange rate uncertainty is the focus of network design in the supply chain. We will cover numerous ways of studying uncertainty and scenario modelling in this section.

Warehouse location: When a company expands its branches to new sites, it often needs new storage facilities. The corporation is having trouble finding a warehouse facility. Within the range of possible locations, the one that has the lowest fixed and operational costs while meeting the demand is picked.

Traffic network design: Cities are becoming more congested as the population grows. Because of the increased demand for transportation, traffic networks must also be expanded. Because the cash available is frequently limited, the main challenge is deciding which projects should be built to improve traffic flow inside a network.

Reshoring: This tendency has just lately emerged as a result of growing costs and other factors. It is the process of returning outsourced items and services to the point of origin from where they were originally supplied. It explains how to return some or all of the production to its original location.

Inventory Management

One of the main aims of supply chain management, as stated under the major objectives of supply chain management, is to ensure that all operations and functions within and across the firm are managed efficiently. There are times when inventory efficiencies, or more precisely, maintaining inventory reduction efficiency, can assure supply chain efficiency. Despite the fact that inventory is viewed as a liability in supply chain management, supply chain managers recognize the importance of inventory. The unspoken guideline, however, is to maintain inventories to a bare minimum. Many solutions are being developed with the goal of reducing inventory investment and simplifying stocks beyond the supply chain. Because of inventory investment, supply chain managers try to keep stocks as low as possible. Owning inventories has a high cost or investment associated with it. These expenses include the monetary expenditure for purchasing inventory, the costs of acquiring inventory (the cost of investing in inventory rather than something else), and the costs of inventory management.

Back Ordering

It is the process of sending a purchase order to a supplier for a product that is temporarily out of stock in your warehouse but has already been requested by your customers. Backorders are commonly used in high-demand situations and for slow-moving products that experience a sudden surge in demand.

Bill of Lading

It is the process of sending a purchase order to a supplier for a product that is temporarily out of stock in your warehouse but has already been requested by your customers. Backorders are commonly used in high-demand situations and for slow-moving products that experience a sudden surge in demand.

Blanket Order

A method in which the customer agrees to acquire a particular number of one or more things over a specified time (which might range from a few days to many months) without specifying their exact shipment dates at the time of purchase. Within this time frame, the vendor can dispatch the products in pieces and on any dates that are convenient for him.

Bonded Warehouse

A facility where you can store taxable items and imports subject to tariffs for commercial purposes that are overseen by the customs agency or government authority. Taxes must be paid only when the products are removed from the warehouse. This is especially beneficial for shops that import a large number of items into the country, as it allows them to spread out their tax load by deferring it

Carnet

A legal document that allows you to temporarily export things to another country and reimport them into the US without paying import duties within a year. Except for consumables (such as food, oils, and other liquids), agricultural products, mail, explosives, and disposables, this document is acceptable in over 80 nations.

Consignment

It is the process of sending a purchase order to a supplier for a product that is temporarily out of stock in your warehouse but has already been requested by your customers. Backorders are commonly used in high-demand situations and for slow-moving products that experience a sudden surge in demand.

Cross-docking

When a business owner receives items from vendors, he or she can send them to clients with little to no storage time. This system often employs a single dock or platform with the best access to both cargo loading and unloading zones, allowing items unloaded from a single set of trucks to be inspected, sorted, and divided into groups based on destination.

Electronic Data Interface (EDI)

It is a means of transmitting transactions from one computer system to another by transforming the data into a standard that all systems can understand. It is most employed in situations where two or more parties communicate information on paper. It could be utilized in situations when a seller sends the third party printed copies of invoices or orders.

Groupage

t is a means of combining many shipments from various sellers (each with their own bill of lading) into a single container. When individual shipments are less than the container load or when they are not large enough to fill a full container, this is done. The freight costs are divided between various sellers in this way.

The Harmonized Set of Codes (HS)

It is a set of internationally recognized codes that assist businesses and government agencies in identifying things when buying or selling them around the world. Depending on where they are used, these codes usually include four to ten digits.

Hitchment

This is the practice of connecting two or more shipments into a single shipment that is identified by a single bill of lading, even though they did not originate from the same location. Only if two conditions are met can this be done: All individual shipments have the same sender and receiver. It has been approved by the authorities in charge of shipping tariffs.

The International Maritime Dangerous Goods Code (IMDG)

A method in which the customer agrees to acquire a particular number of one or more things over a specified time (which might range from a few days to many months) without specifying their exact shipment dates at the time of purchase. Within this time frame, the vendor can dispatch the products in pieces and on any dates that are convenient for him.

PADAG

"Please authorize my delivery against guarantee" is a document that is used when a consignee is unable to provide the shipper with necessary shipping documentation (such as the bill of lading). In exchange for releasing the items in their care, the shipper receives a personal or financial guarantee from the consignee.

Landed Cost

The overall cost of ownership of an item is known as the landed cost. This includes the purchase price, delivery costs, customs duties, taxes, and any additional fees the buyer was responsible for.

Waybill

A document prepared by the seller on behalf of the carrier that defines the shipment's origin, the transacting parties (buyer and seller) information, the route, and the destination address

Just-in-time (JIT)

It is a method of inventory optimization in which each batch of items arrives "just in time" to meet the needs of the following stage, which could be a shipment or a production cycle.

Knocked Down

An item that has been deconstructed into two or more components to make transportation easier. Before delivery, these components will be fitted together.

5S METHODOLOGY

5S is a system for organizing workspaces so that work may be done quickly, efficiently, and safely. This technique emphasizes putting things back where they belong and keeping the workplace clean, making it easier for individuals to complete their tasks without wasting time or causing damage.

The term 5S comes from five Japanese words:

- Seiri (Sort)
- Seiton (Set in Order)
- Seiso (Shine)
- Seiketsu (Standardize)
- Shitsuke (Sustain)

Six Sigma

Six Sigma is a quality-control methodology developed in 1986 by Motorola, Inc. It was originally developed as a management method to work faster with fewer mistakes. It has now become an industry standard with certifications offered to practitioners. Six Sigma emphasizes cycle-time improvement while at the same time reducing manufacturing defects to a level of no more than 3.4 occurrences per million units or events. Six Sigma projects follow two project methodologies, each with five phases.

DMAIC

- Define the system, the voice of the customer and their requirements, and the project goals

- Measure key aspects of the current process and collect relevant data; calculate the "as-is" process capability.

- Analyze the data to investigate and verify cause and effect. Determine what the relationships are in an attempt to ensure that all factors have been considered. Seek out the root cause of the defect under investigation.

- Improve or optimize the current process based upon data analysis using techniques such as the design of experiment, poke yoke or mistake proofing, and standard work to create a new, future state process. Set up pilot runs to process capability.

- Control the future state process to ensure that any deviations from the target are corrected before they result in defects. Implement control systems such as statistical control processes, production boards, visual workplaces, and continuously monitor the process. This process is repeated until the desired quality level is obtained.

DMDV

- Define design goals that are consistent with customer demands and the enterprise strategy.
- Measure and identify CTQs (characteristics that are Critical to Quality), measure product capabilities, production process capability, and measure risks.
- Analyse to develop and design alternatives
- Design an improved alternative, best suited per analysis in the previous step
- Verify the design, set up pilot runs, implement the production process and hand it over to the process owner(s).

Six Sigma employs a variety of well-established quality-management methods inside the different phases of a DMAIC or DMADV project.

5 Whys
Cause & effects diagram (also known as fishbone or Ishikawa diagram)
Control chart/Control plan (also known as a swim lane map)/Run chart
Cost-benefit analysis
Pick chart/Process capability/Rolled throughput yield
Quality Function Deployment (QFD)
Root cause analysis SIPOC analysis (Suppliers, Inputs, Process, Outputs, Customers) COPIS analysis (Customer-centric version/perspective of SIPOC)
Taguchi methods/Taguchi Loss Function

CAPACITY UTILISATION

Objective of Capacity Utilization

- The capacity utilization rate serves as a valuable tool for companies, offering insights into production value and resource usage at any point in time.
- It assesses the company's capability to handle an increase in output without incurring additional costs.
- A decline in the rate suggests an economic downturn, whereas an increase indicates economic growth.

Capacity utilization is a key performance metric that measures how efficiently a company is using its production capacity. The formula for capacity utilization is:

Basic Formula:

Capacity Utilization(%)=(Maximum Possible Output/Actual Output)×100

Machine Utilization:

Machine Utilization(%)=(ActualMachine Utilization(%)=(Total Available Machine Hours/Actual Machine Hours Used)×100

Labor Utilization:

Labor Utilization(%)=(Actual Labor Hours Worked/Total Available Labor Hours)×100

Economic Capacity Utilization Rate (ECUR):

ECUR=(Observed Output at Lowest Cost/Capacity Output at Lowest Cost)×100

Interpreting Capacity Utilization

- Above 85%: High efficiency, but may risk overuse of resources.
- 70% - 85%: Ideal range for most industries.
- Below 70%: Indicates underutilization and inefficiencies.

Maximum Production Capability

- Rated Capacity: Theoretical output at full speed, with no downtime.
- Effective Capacity: Adjusts for efficiency and utilization of scheduled hours.

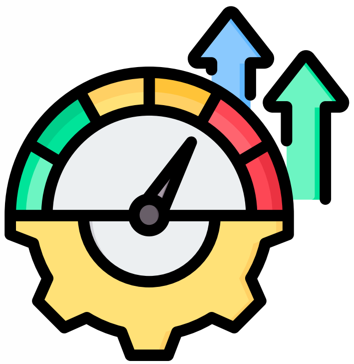
Effective Daily Capacity

Effective Daily Capacity = (No. of Machines or Workers)×(Hours per Shift)×(No. of Shifts)×(Efficiency)

Load Percent = (load / capacity) × 100%

Theoretical vs. Practical Capacity Utilization:

- Theoretical Capacity Utilization assumes 100% efficiency (no breakdowns, idle time, or inefficiencies).
- Practical Capacity Utilization adjusts for maintenance, changeovers, and other operational realities.



1. Objectives of Inventory Management

- Minimize Costs: Holding, ordering, and shortage costs.
- Maximize Service Levels: Ensure product availability for customers.
- Optimize Inventory Levels: Balance between overstocking and understocking

2. Types of Inventory

- Raw Materials: Inputs for production.
- Work-in-Progress (WIP): Partially finished goods.
- Finished Goods: Ready for sale.
- Maintenance, Repair, and Operations (MRO): Supplies for maintenance

3. Inventory Costs

- Holding/Carrying Cost: Cost of storing inventory (e.g., warehousing, insurance).

Formula

- Holding Cost = Average Inventory × Holding Cost per Unit
- Ordering Cost: Cost of placing and receiving orders.

Formula:

- Ordering Cost = Number of Orders × Cost per Order
- Shortage/Stockout Cost: Cost of not having inventory when needed (e.g., lost sales).

4. Economic Order Quantity (EOQ)

- Optimal order quantity to minimize total inventory costs.

Formula

$$EOQ = \sqrt{\frac{2DS}{H}}$$

Where:
D = Annual demand (units)
S = Ordering cost per order
H = Holding cost per unit per year

5. Optical Production Quantity (EPQ)

Formula

$$EPQ = \sqrt{\frac{2DS}{H \cdot (1 - \frac{d}{p})}}$$

.

Where,
d = Demand Rate
p = Production Rate

6. Safety Stock

- Extra inventory to prevent stockouts due to demand variability or supply delays.

Formula

Safety Stock = Z * σLT

Where:
Z = Z-score (based on desired service level).
σLT = Standard deviation of demand during lead time.

7. Reorder Point (ROP)

- Inventory level at which a new order should be placed.

Formula

ROP= d * L

Where:

- d = Demand
- L = Lead Time

ROP = d * L + SS
Where,
SS - Safety Stock

8. Total Inventory Cost

- **Sum of holding, ordering, and shortage costs.**

Formula

$$Inventory\ Cost = \left(\frac{D}{Q} \cdot S\right) + \left(\frac{Q}{2} + Safety\ Stock\right) \cdot H$$

Where:
Q = Order quantity

9. Inventory Turnover Ratio

Measures how efficiently inventory is managed.
Formula

$$Inventory\ Turnover\ Ratio = \frac{Cost\ of\ Goods\ Sold\ (COGS)}{Average\ Inventory}$$

10. Maximum Inventoy Level

Formula

$$I_{max} = Q^* \left(1 - \frac{d}{p}\right)$$

Material Requirements Planning (MRP)

Material Requirements Planning (MRP) is a systematic approach for determining what materials are needed, how manyare needed, and when they are needed, so that production schedules can be met efficiently while minimizing inventory costs.

MRP Processes

- **BOM Explosion:** Expand the BOM to list all required components.
- **Inventory Netting:** Subtract on-hand inventory and scheduled receipts from gross requirements.
- **Netting**: Compute net requirements by removing available quantities.
- **Lot Sizing & Time-Phasing:** Determine order quantities and timing.

Projected On-Hand Inventory (End of Period t)

Projected On-Hand(t)=Projected On-Hand(t−1)+Scheduled Receipts(t)+Planned Order Receipts(t)−Gross Requirements(t)

Net Requirements (Period t)

Net Requirements(t)=max{0,[Gross Requirements(t)]−[Projected On-Hand(t−1)+Scheduled Receipts(t)]}

In other words, if existing on-hand plus scheduled receipts cannot satisfy gross requirements (plus any safety stock), the shortfall is the net requirement.

If **Safety Stock (SS)** is required, modify gross requirements as:

Net Requirements(t)= max{0,[Gross Requirements(t)+SS]−[Projected On-Hand(t−1)+Scheduled Receipts(t)]}

If **Safety Stock (SS)** is required, modify gross requirements as:

Net Requirements(t)= max{0,[Gross Requirements(t)+SS]−[Projected On-Hand(t−1)+Scheduled Receipts(t)]}

Inventory Netting
Projected On-Hand(t)=On-Hand(t−1)+Scheduled Receipts(t)−Gross Requirements(t)

Lot Sizing & Time-Phasing

Planned Order Receipts(t)=Lot-Sizing Function[Net Requirements(t)]

Planned Order Releases(t−L)=Planned Order Receipts(t)

FORECASTING

1. Naive Forecasting

Formula:

$$F_{t+1} = A_t$$

Where:

F_{t+1} = Forecast for next period

A_t = Actual demand of current period

2. Moving Average (MA)

Formula (for n-period MA):

$$F_{t+1} = \frac{A_t + A_{t-1} + \ldots + A_{t-(n-1)}}{n}$$

Where:

n = Number of periods

A_t = Actual demand in period

3. Weighted Moving Average (WMA)

Formula:

$$F_{t+1} = w_1 A_t + w_2 A_{t-1} + \ldots + w_n A_{t-(n-1)}$$

Where:

w_n = Weight assigned to each period (sum of all weights = 1)

4. Exponential Smoothing

Formula:

$$F_{t+1} = \alpha A_t + (1 - \alpha) F_t$$

Where:

α = Smoothing constant (0 < < 1)

5. Trend-Adjusted Exponential Smoothing (Holt's Method)

Level Update:

$$L_t = \alpha A_t + (1 - \alpha)(L_{t-1} + T_{t-1})$$

Trend Update:

$$T_t = \beta (L_t - L_{t-1}) + (1 - \beta) T_{t-1}$$

Forecast:

$$F_{t+k} = L_t + k T_t$$

Where:

L_t = Smoothed level

T_t = Trend component

β = Trend smoothing constant

6. Seasonal Forecasting (Multiplicative Model)

Formula:

$$F_t = (T_t \times S_t)$$

Where:

T_t = Trend component

S_t = Seasonal factor

7. Simple Linear Regression (for Trend Forecasting)

Equation:

$$Y = a + bX$$

Where:

Y = Forecasted demand

X = Time period

a = Intercept

b = Slope

Slope Formula: $b = \frac{n \sum XY - \sum X \sum Y}{n \sum X^2 - (\sum X)^2}$

Intercept Formula: $a = \frac{\sum Y - b \sum X}{n}$

8. Mean Absolute Deviation (MAD)

Formula:

$$MAD = \frac{\sum |A_t - F_t|}{n}$$

Where:

A_t = Actual demand

F_t = Forecasted demand

9. Mean Squared Error (MSE)

Formula:

$$MSE = \frac{\sum (A_t - F_t)^2}{n}$$

10. Mean Absolute Percentage Error (MAPE)

Formula:

$$MAPE = \frac{100}{n} \sum \left| \frac{A_t - F_t}{A_t} \right|$$

QUALITY FUNCTION DEPLOYMENT

Quality Function Deployment (QFD) is a structured methodology used to translate customer requirements (CRs) into appropriate technical requirements (TRs) at each stage of product or service development. It ensures that customer needs are prioritized throughout the design, manufacturing, and delivery processes.

- **Customer Requirement Weighting Formula**

$$I_j = \Sigma(w_i * r_{ij})$$

Where:
I_j = Importance score of Technical Requirement (TR) j
w_i = Weight/importance of Customer Requirement (CR) i
r_{ij} = Relationship strength between CR i and TR j (values: 9-strong, 3-medium, 1-weak)

- **Overall Quality Score Calculation**

$$Q = \Sigma(w_i * \Sigma(r_{ij} * x_j))$$

Where:
Q = Overall quality score
x_j = Engineering characteristic j value

- **Normalization Formula for Competitor Benchmarking**

$$N_i = S_i / \max(S)$$

Where:
N_i = Normalized score for competitor i
S_i = Raw score for competitor i
max(S) = Maximum score among competitors

- **Target Value Calculation**

$$TV_j = (\Sigma(r_{ij} * w_i)) / \Sigma r_{ij}$$

Where:
TV_j = Target value for Technical Requirement j

- **Relative Weight of Technical Requirements**

$$RW_j = I_j / \Sigma I_j$$

Where:
RW_j = Relative weight of Technical Requirement j
I_j = Importance score of TR j

- **Quality Improvement Ratio (QIR)**

$$QIR_j = TV_j / CP_j$$

Where:
QIR_j = Quality Improvement Ratio for TR j
TV_j = Target value for TR j
CP_j = Competitive positioning score for TR j

- **Final Decision Matrix Calculation**

$$DM = \Sigma(TPS_j * TRV_j)$$

Where:
DM = Final decision matrix score
TRV_j = Technical Requirement Value for TR j

- **Competitive Positioning Score**

$$CP_j = (\Sigma(r_{ij} * C_{ij})) / \Sigma r_{ij}$$

Where:
CP_j = Competitive positioning score for TR j
C_{ij} = Competitor's rating on TR j

Logistics company

Q: Good afternoon, how's it going?

A: Good afternoon, ma'am It is going well.

Q: Excellent, so your resume says you have active interest in Operations Management. So, we have a delivery company as a client who is facing decline in his profits. Could you help us in resolving it?

A: Yes sir, I would like to contribute to resolving it. Could you provide me with more specifics. What is the geography they operate in? Is it an impact due to cost side or price side? Also, is it an industry wide phenomenon or only with our client?

Q: They operate in single country for now. The impact is due to cost side and this issue is currently for our client only.

A: Okay sir, so I would like to proceed with the value chain analysis of it and therefore I would seek problems in the inbound & outbound logistics and the operations part of it. Do you want me to explore some other areas as well?

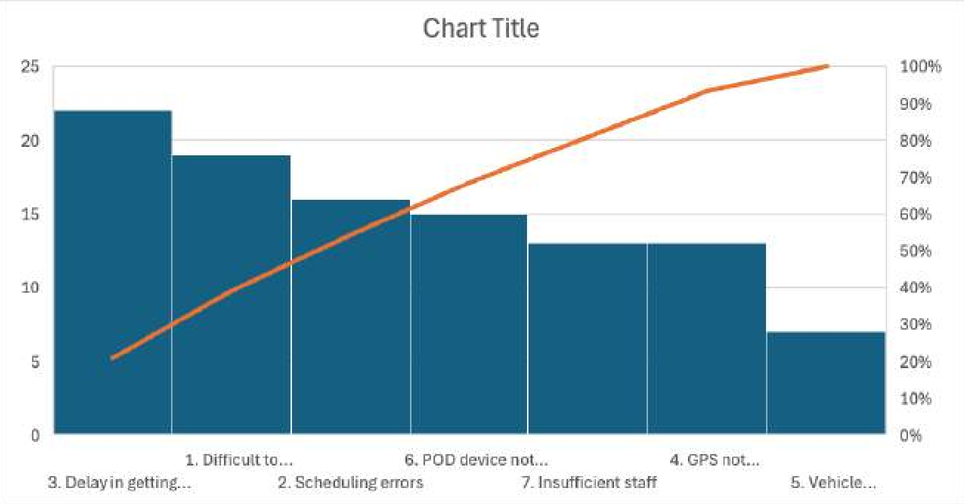
Q: Seems you are on track and surely you can work out with the operations and costing part of it.
PUB Delivery operates in two locations, Downtown and Suburbia, offering package pickup and delivery within a 15-mile radius.

Scan below QR for the excel sheet

- They promise a 15-minute time window for service, with a full rebate if missed.
- Pricing is $5 per package + $1 per pound (max 50 lbs).

- They handle ~200 packages daily, averaging 35 lbs each.
- Over the past six months, 35% of customers have complained about missed timelines.
- While customers appreciate the rebate, they prefer on-time deliveries.

A: Sure sir, I made a pareto chart for the 7 problems that we are facing and what I would look at is the top 3 that have shown up which majorly impact our client.
1. Delay in getting right transport 20.71%
2. Difficulty in tracing addresses 17.85%
3. Scheduling errors 15.52%

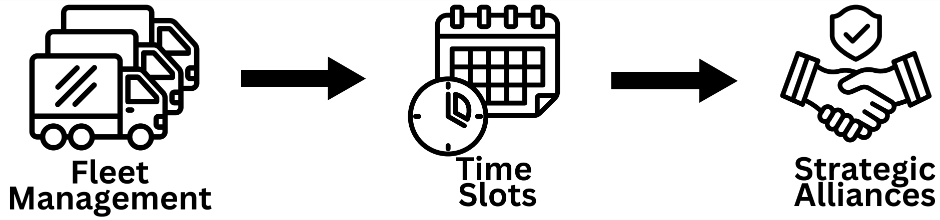


Logistics company

Q: You are on right track could you continue your analysis on it.

A: Sure ma'am, Furthermore I can see that the weight category 30-40 kgs is the main problem causing segment for us.

- I can suggest assigning a fleet management SOP to ensure timely deliveries for this segment that is choosing a right time slot and type of vehicle assigned.
- Secondly due to our issues with tracing the right addresses we can form a strategic alliance with a local partner and meanwhile resolve our technical issues.



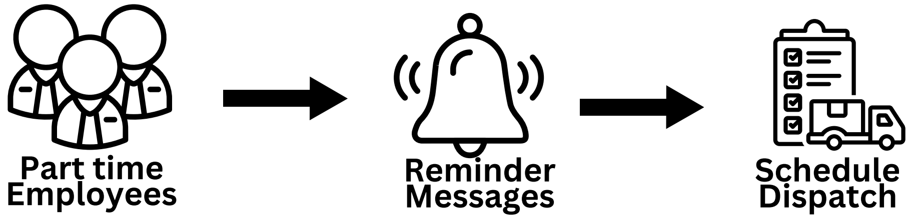
Q: You are right, could you also propose a solution for resolving scheduling errors as well?

A: So the current data doesn't specify as to why the scheduling errors might have occurred and therefore I would like to assume that its either due to

1. Unavailability of delivery partners
2. Under staffing at dispatch
3. Customer unavailability or Revised schedule for delivery from customer
4. Smaller fleet to accommodate orders.

Q: Your assumptions are well aligned. What are the solutions that you can think of to resolve them?

A: The Cost benefit analysis of our Strategic Alliances or procuring new fleet to resolve the scheduling of vehicles and partners.
Hiring part time employees for the time slots that we have faced as bottlenecks for the processes.
For the problem related to the customer unavailability we can send a reminder message for the confirmed slots of delivery and based on the response we can plan to load and dispatch their deliveries accordingly.



Q: Fine, you have done a good job.

A: Thanks ma'am, have a nice day.

Logistics company

Case Statement:

- PUB Delivery, specializing in package pickup and delivery (≤50 lbs), is experiencing a rise in customer complaints.
- 35% of customers report missed 15-minute commitment windows, impacting satisfaction despite the rebate policy.

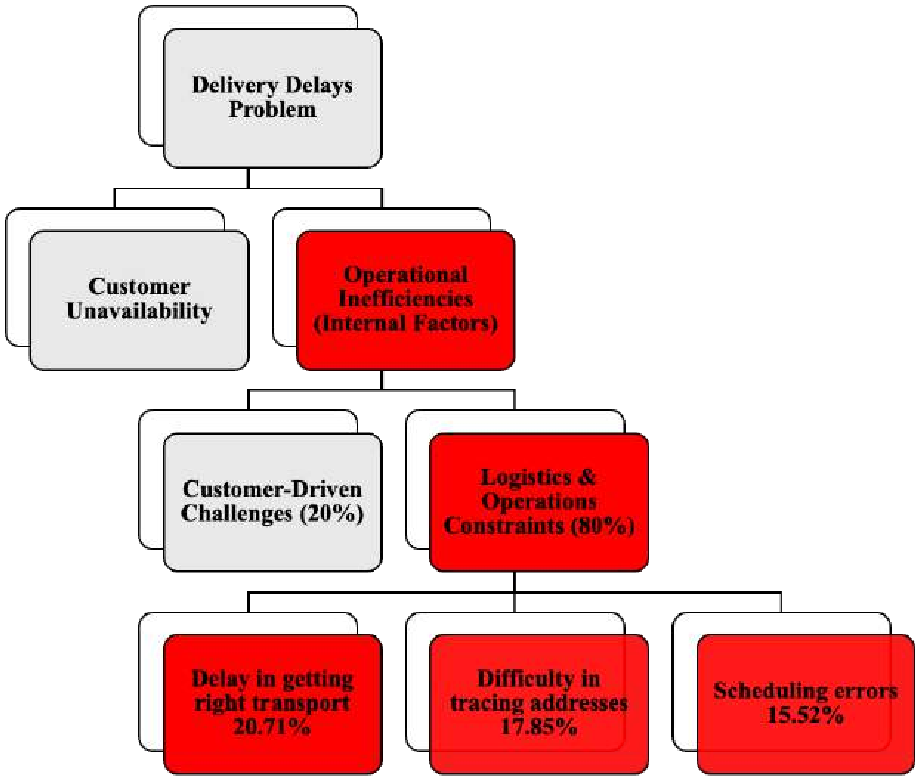
Interviewee Notes

- **Customers:** Homes & Small Businesses
- **Delivery Mode:** Trucks & Bicycles
- Operations: Downtown & Suburbia (15-mile radius)
- **Key Issue:** 35% late deliveries despite price rebate policy
- **Business Model:** $5 per package + $1 per pound (max 50 lbs)
- **Customer Preference:** Timely delivery > Rebates

Key Takeaways

- Customers value timeliness over rebates
- Optimized routing & additional workforce can reduce delays
- Live tracking & customer coordination enhance experience

Structure/Framework



VastraFab Ltd.

VastraFab Ltd., based in Surat, India, is a renowned textile manufacturing company specializing in high-quality cotton shirts. Over the past two decades, the company has earned a strong reputation in both domestic and international markets for its superior craftsmanship, premium fabrics, and impeccable stitching standards. The company caters to global retail chains, fashion brands, and wholesalers, making it a crucial player in the Indian textile industry.

CHALLENGES FACED BY VASTRAFAB LTD.

Despite its rich legacy and market presence, VastraFab has been facing increasing operational challenges over the past few years. The shirting department, responsible for nearly 40% of the company's total revenue, has become a bottleneck in production, leading to:

- **Missed deadlines:** Late deliveries resulting in penalties and strained client relationships.
- **Escalating operational costs:** Unoptimized production processes leading to higher manufacturing expenses.
- **Declining productivity:** Inefficiencies in the sewing process causing wastage of time and resources.
- **Quality control issues:** Rising defect rates impacting customer satisfaction and returns.

To address these challenges, Arjun Mehta, a dynamic operations manager with expertise in industrial engineering, is brought in to analyze and optimize the production process. He embarks on a time and motion analysis to identify inefficiencies and drive systematic improvements.

KEY OBSERVATIONS

- Average cycle time = 5.18 min/garment
- Average idle time = 42.5 min/day
- Average changeover time = 30.6 min/day
- Average downtime = 56.5 min/day
- Average defect rate = 2.08%
- Average machine utilization = 68.3%
- Average operator defect rate = 1.45%
- Average labor cost per garment = INR 11.90

PROBLEM STATEMENT

After conducting on-floor observations and data collection, Arjun identifies four major inefficiencies within the sewing operations:

- **High Idle Time:** Machines remain inactive due to material shortages and delayed fabric feeding.
- **Long Changeover Times:** Switching between different shirt styles takes too long, slowing production.
- **Frequent Downtime:** Machines frequently break down due to poor maintenance practices.
- **High Defect Rate:** A significant percentage of garments are rejected due to stitching defects.

These issues contribute to high operational costs, shipment delays, and lower productivity, significantly affecting VastraFab's profitability and competitiveness.

BACKGROUND AND DATA COLLECTION

To quantify the inefficiencies, Arjun collects 5 days of operational data for 10 sewing machines, focusing on key performance indicators (KPIs) such as:

- **Cycle Time:** Average time taken to stitch one garment.
- **Idle Time:** Time lost due to lack of materials or operator delays.
- **Changeover Time:** Time spent switching between different product types.
- **Downtime:** Time lost due to machine breakdowns.
- **Defect Rate:** Percentage of garments rejected due to quality issues.

VastraFab Ltd.

DATA

Machine ID	Cycle Time (min/garment)	Idle Time (min/day)	Changeover Time (min/day)	Downtime (min/day)	Defect Rate (%)	Machine Utilization (%)	Operator Defect Rate (%)	Labor Cost per Garment (INR)
M001	5.2	45	30	60	2	65	1.5	12.50
M002	5.0	30	25	45	1	70	1.0	11.80
M003	5.5	60	40	75	3	60	2.0	13.20
M004	4.8	20	20	30	0.5	80	0.5	10.50
M005	5.3	50	35	65	2.5	68	1.8	12.00
M006	5.1	40	28	55	1.8	72	1.2	11.50
M007	5.6	65	42	80	3.5	58	2.5	13.50
M008	4.9	25	22	35	1.2	75	0.8	11.00
M009	5.4	55	38	70	2.8	62	2.2	12.80
M010	5.0	35	26	50	1.5	73	1.0	11.20

SCENARIO: DEMAND EXCEEDS MANUFACTURING CAPACITY

Current Production Capacity:

- Working Hours per Day: 480 minutes (8 hours)
- Available Production Time per Machine: 480 - (Idle Time + Changeover Time + Downtime) = 480 - (42.5 + 30.6 + 56.5) = 350.4 min/day
- Daily Production per Machine: 350.4 / 5.18 = ~67.6 garments/day
- Total Daily Production (10 machines): 67.6 × 10 = 676 garments/day

Customer Demand:

- Daily Demand: 740 garments/day
- Monthly Demand: 740 × 24 = 17760 garments/month

Gap Analysis:

- Daily Shortfall: 740 - 676 = 64 garments/day
- Monthly Shortfall: 64 × 24 = 1536 garments/month

This shortfall is causing missed deadlines, penalties, and strained client relationships.

IMPLEMENTATION PLAN: SOLUTIONS FOR IMPROVEMENT

Based on root cause analysis, Arjun formulates a structured improvement strategy focusing on four key areas:

Reducing Idle Time

Root Cause:

- Poor inventory management leads to material shortages.
- Lack of coordination between cutting and sewing teams.

Solution:

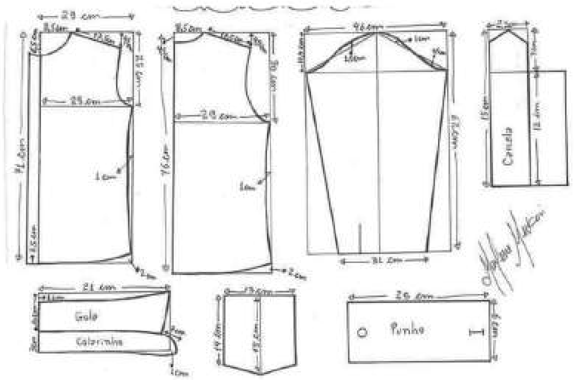
- Implement a Just-in-Time (JIT) system to ensure fabric is available exactly when needed.
- Improve coordination between the cutting and sewing departments.
- Introduce a Kanban System where color-coded bins indicate material readiness.
- Implement TAKT Time Analysis to reduce Idle Time.

Calculations:

- New Idle Time = 42.5 × (1 - 0.5) = 21 min/day
- Total Time Saved = 42.5 - 21 = 21.5 min/day
- Additional Production Possible = 21.5 ÷ 4.8 = ~4.48 garments/day
- Monthly Additional Production = 134 garments/month

Results:

- Idle time reduced to 21 min/day
- Extra 134 garments produced per month



VastraFab Ltd.

Reducing Changeover Time

Root Cause:

- Operators lack standardized setup processes.
- Frequent manual machine adjustments.

Solution:

- Implement SMED (Single Minute Exchange of Die) techniques.
- Create pre-set machine adjustments for each shirt style.
- Train operators on rapid changeover processes.

Calculations:

- New Changeover Time = 30.6 × (1 - 0.5) = 15 min/day
- Total Time Saved = 15.6 min/day

Results:

- Changeover time reduced to 15 min/day

Reducing Downtime

Root Cause:

- Poor maintenance schedule leads to frequent breakdowns.
- Operators lack troubleshooting skills.

Solution:

- Implement a preventive maintenance schedule.
- Train operators on troubleshooting basics.
- Stock essential spare parts to minimize repair time.

Calculations:

- New Downtime = 56.5 × (1 - 0.47) = 30 min/day
- Total Downtime Saved = 26.5 min/day

Results:

- Downtime reduced to 30 min/day

Reducing Defect Rate

Root Cause:

- Operator fatigue and lack of quality control training.
- Poor-quality raw materials causing stitching defects.

Solution:

- Conduct operator training sessions on stitching accuracy.
- Implement quality checkpoints at each stage.
- Ensure better sourcing of high-quality raw materials.

Calculations:

- New Defect Rate = 0.5%

Results:

- Defect rate reduced to 0.5%

Improved Production Capacity

New Production Capacity:

- Available Production Time per Machine: 480 - (21 + 15 + 30) = 414 min/day
- Daily Production per Machine: 414 / 5.18 = ~80 garments/day
- Total Daily Production (10 machines): 80 × 10 = 800 garments/day

Customer Demand:

- Daily Demand: 740 garments/day
- Monthly Demand: 740 × 24 = 17760 garments/month

Gap Analysis:

- Daily Shortfall: No shortfall because of improved capacity.

The improved production capacity now meets the daily and monthly demand.

Batch Size Determination

To optimize production, Arjun determines the batch size using the following formula:

Batch Size = (Demand × Lead Time) / Number of Production Runs

- Daily Demand: 740 garments
- Lead Time: 1 day
- Number of Production Runs: 2 (to ensure flexibility and reduce changeover time)

Batch Size = (740 × 1) / 2 = 370 garments per batch

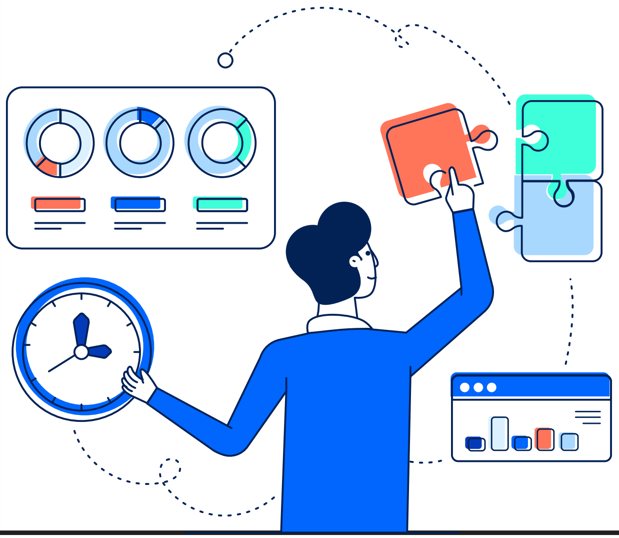
This batch size ensures efficient production while minimizing idle time and changeover time.

Summary of Implementation Results

Metric	Before	After	% Improvement
Idle Time (min/day)	42.5	21	50%
Changeover Time (min/day)	30.6	15	50%
Downtime (min/day)	56.5	30	47%
Defect Rate (%)	2.08%	0.5%	76%
Machine Utilization (%)	68.3%	82%	20%
Operator Defect Rate (%)	1.45%	0.6%	59%
Labor Cost per Garment (INR)	11.90	10.50	12%

Overall efficiency improved by 20%

By implementing the proposed solutions, VastraFab Ltd. has successfully increased its production capacity to meet the growing demand. The batch size of 370 garments per batch ensures efficient production while minimizing idle time and changeover time. The company is now better positioned to fulfill customer orders on time, reduce costs, and improve overall profitability.



HydraForge Pvt. Ltd.

HydraForge Pvt. Ltd., a medium-sized manufacturing company specializing in hydraulic press machines, has faced challenges in meeting growing customer demand. The company operates a production plant in Andhra Pradesh, India. It has been experiencing inefficiencies in its assembly line, leading to high work-in-progress (WIP) inventory, production delays, and an inability to scale output effectively.

The company's leadership focuses on improving productivity by implementing lean manufacturing techniques and assembly line balancing. The plant manager, Sameer, and the assembly manager, Shubham, have been tasked with identifying bottlenecks and proposing changes to streamline operations.

Process Overview

HydraForge Pvt. Ltd. manufactures hydraulic press machines for various industrial applications. The production process involves multiple sub-assembly stations that feed into a final assembly line. The current assembly line operates in two shifts of 8 hours each, with a daily production target of 30 units per shift.

The assembly process is structured as follows:

- **Workstations:** 4 existing workstations handle sub-assemblies, testing, and final assembly.
- **Workforce Allocation:** Each shift has 3 workers handling sub-assembly, testing, and final assembly.
- **Material Handling:** Workers move raw materials and replenish inventory at their workstations.
- **Batch Production:** Sub-assemblies are produced in batches before moving to the next workstation.

The following table shows the activities and the worker allocated to each of the activity, also the table shows the precedence of the activities:

Sr. No.	Sub-Assemblies	Precedence	Cycle Time per unit(sec)	Workers Allotted
1	Sub-Assembly 1		35	A
2	Sub-Assembly 2	1	36	
3	Sub-Assembly 3		165	
4	Sub-Assembly 4	2,3	277	
5	Testing	4	590	B
6	Sub-Assembly 5		43	C
7	Sub-Assembly 6		30	
8	Sub-Assembly 7	6,7	146	
9	Sub-Assembly 8	8,9	76	
10	Final Assembly	8,9	201	

Note: Number in Precedence is per Sr. No. of the Sub-Assemblies.

Initial Layout of the Assembly Line

The movement of materials and across the four workstations and the position of workers viz. A, B, and C at their respective workstations is shown in Fig A. The workers bring the required materials from the Bill of Materials (BOM) room to the inventory at their workstation and start assembling the sub-assemblies in batches. The movement of the workers is shown in Fig. B.

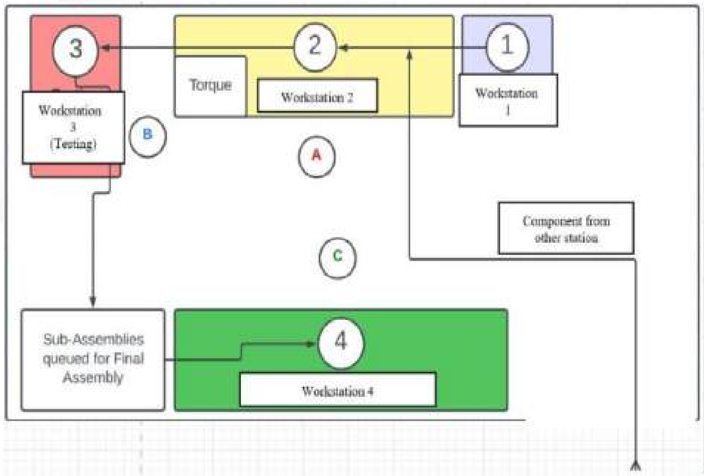


Fig. A: Movement of Materials

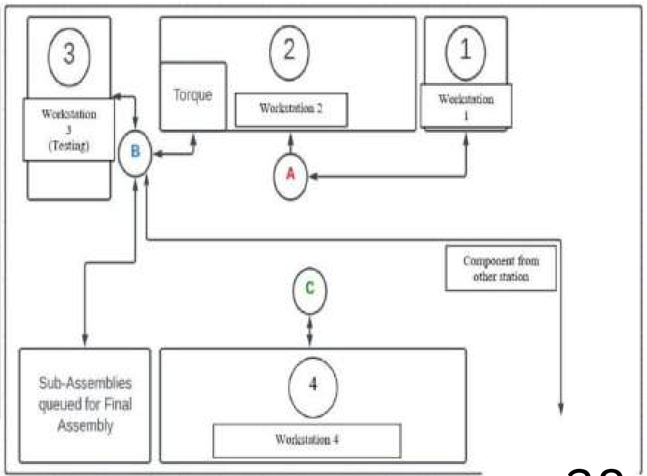


Fig. B: Movement of Workers

Lean Manufacturing Implementation

Lean tools were applied to minimize waste and optimize workflows:

- **Eliminating Unnecessary Motion:** Introduced a dedicated helper to replenish materials and prepare sub-assemblies, reducing worker movement.
- **Reducing Bottlenecks**: An additional testing workstation was added to prevent delays in sub-assembly validation.
- **Standardizing Work Procedures:** Defined fixed cycle times for each process to ensure consistency.
- **Implementing Just-in-Time (JIT) Inventory:** Material replenishment shifted from batch production to a pull system based on demand.

Proposed Assembly Line

The assembly section will comprise five workstations: three for producing sub-assemblies and two for testing them before final assembly, which will occur at the last workstation. The workforce will include five workers per shift: two for sub-assembly, two for both testing and sub-assembly, and one for sub-assembly and final assembly. Operations will run in two eight-hour shifts. A designated 'helper' (H) will manage sub-assemblies 1 and 2, ensuring the required quantity per shift.

Worker A, stationed at workstation 2, will focus on sub-assembly 3 until its target is met. Once the first sub-assembly 3 is completed, Worker B will handle sub-assembly 4 and move it to workstation 3 for testing, repeating this process for each completed unit. Worker C will follow the same steps as Worker B when the next sub-assembly is ready at workstation 2. Both Workers B and C will continue this cycle until Worker A achieves the target for sub-assembly 3. After this, Worker A will take over sub-assembly 4, processing all queued sub-assembly 3 units, while Workers B and C will shift exclusively to testing. Worker C's routine remains unchanged. The 'helper' will also manage inventory replenishment and mark sub-assemblies, ensuring other workers stay focused on their tasks without leaving their stations.

Standard time calculations were performed to optimize efficiency by analyzing cycle times and identifying tasks that can be done simultaneously. Overlapping tasks were assigned to Workers B and C to minimize idle time and reduce downtime, ensuring a smooth and balanced workflow. The table below outlines the activities, worker allocations, task durations, and operational sequence to maintain an efficient assembly line.

Sr. No.	Sub-Assemblies	Workstation Number	Workers/Helper Allocated	Cycle Time/unit (Sec)
1	Sub-Assembly 1	1	H	35
2	Sub-Assembly 2		H	36
3	Sub-Assembly 3	2	A	165
4	Sub-Assembly 4		A	277
5	Testing 1	3	B	590
6	Testing 2	4	C	590
7	Sub-Assembly 5	5	D	43
8	Sub-Assembly 6		D	30
9	Sub-Assembly 7		D	146
10	Sub-Assembly 8		D	76
11	Final Assembly		D	201

HydraForge Pvt. Ltd.

Proposed layout of the assembly line

After thorough calculations and careful consideration of all constraints, a new and improved layout for the assembly unit was developed. This redesigned layout ensures optimal utilization of available space while maintaining an uninterrupted flow of workers and materials, even with an extra workstation. The revised structure eliminates bottlenecks, improves efficiency, and enhances the workflow, allowing seamless coordination between different assembly stages.

The new layout effectively organizes the movement of materials across the five workstations while strategically positioning the helper and workers—designated as A, B, C, and D—at their respective stations. This arrangement minimizes unnecessary movement, enhances productivity, and ensures a streamlined assembly process. The movement of materials across the workstations while the movement of workers within the assembly line showcases the optimized workflow and enhanced coordination within the production environment.

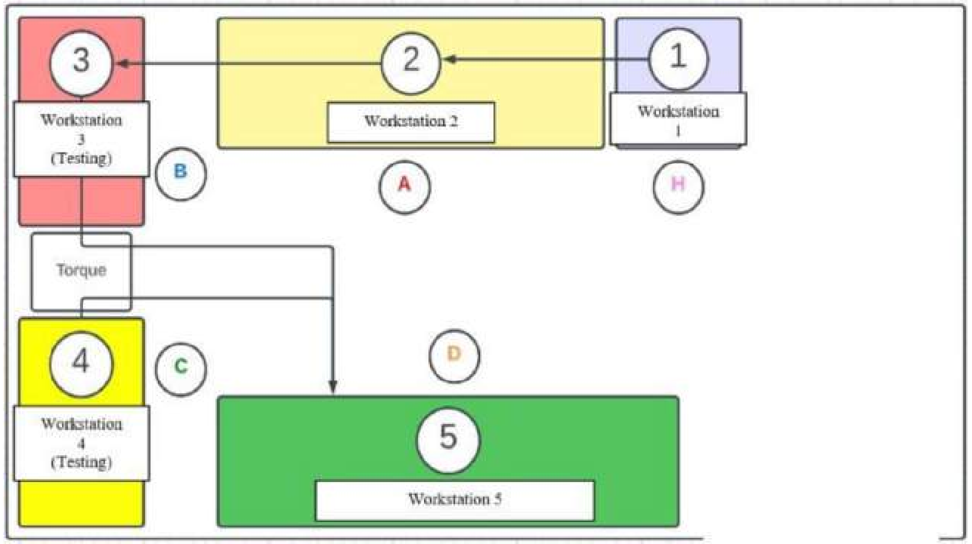


Fig. A: Movement of Materials

Improvement in Productivity

The existing assembly line, hindered by unstandardized working methods, currently produces approximately 30 units per shift. However, after implementing line balancing and an improved assembly layout, the entire process has been optimized to enhance efficiency significantly. The newly designed workflow eliminates inefficiencies by reducing cycle times, wait times, downtime, excessive worker movements, and production delays.

As a result, the proposed assembly line can now produce close to 45 units per shift, marking a 50% increase in productivity. This substantial improvement ensures higher throughput, better resource utilization, and a more streamlined manufacturing process, ultimately enhancing the overall efficiency of the production system.

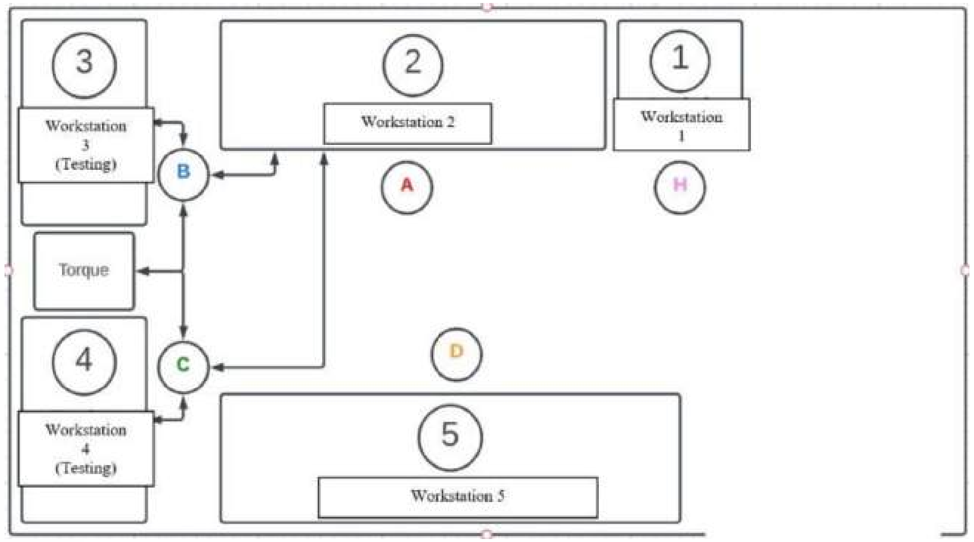


Fig. B: Movement of Workers

HydraForge Pvt. Ltd.

Management Concern

Sameer, the Plant Manager, and Shubham, the Assembly Manager, recognize that the current production system is unsustainable given the increasing demand for hydraulic presses. They are under pressure from senior management to increase production capacity without adding significant costs.
The goal is to optimize the assembly process, eliminate waste, and improve productivity.

Discussion Questions

1. What are the critical inefficiencies in HydraForge Pvt. Ltd.'s current assembly line setup?
2. Which operations management tools can be used to optimize the production process?
3. What lean manufacturing tools can be applied to reduce WIP inventory and improve workflow?
4. How can worker movements be minimized to enhance efficiency?
5. What role does standardized work play in improving productivity?

Solution

Identifying and Analyzing Inefficiencies

To enhance productivity at HydraForge Pvt. Ltd., an in-depth analysis of the current assembly line process was conducted, revealing the following key inefficiencies:

1. **Unbalanced Workstations:** Unequal cycle times caused delays and bottlenecks.
2. **High Work-in-Progress (WIP) Inventory:** Batch production led to excessive inventory between workstations.
3. **Excessive Worker Movement:** Workers fetched materials instead of focusing on assembly tasks.
4. **Lack of Standardized Work Methods:** Variability in operations led to inconsistent production rates.
5. **Lean Wastes Identified:** Non-value-added tasks such as unnecessary waiting, motion, and overproduction impacted efficiency.

Implementation of Lean Manufacturing and Line Balancing

Current bottleneck is Testing workstation with Cycle time of 590 seconds

Process Capacity = Total Available Work Time/Cycle Time = 420*60/590 = 42.71 units

Effectively the system was able to handle the demand of 42 units per shift.

Current utilization = 30/42 = **71.428%**

To address these challenges, Lean Manufacturing and line-balancing techniques were applied.

After the addition of additional testing station with a new worker and helper that will handle the sub-assembly 1 and 2 and replenishment of Bill of Materials (BOM), the new bottleneck is now the workstation 4 with cycle time of 496 seconds

New process capacity = Total Available Work Time/Cycle Time = 420*60/496 = 50.8

Now the system will be able to handle a demand of 50 units.

Expected utilization = 45/50 = **90%**

SYNCOVIA PVT. LTD.

BACKGROUND

Syncovia Pvt. Ltd. is a mid-sized consumer electronics manufacturer specializing in smart home devices. The company faces challenges in inventory management and supply chain operations, including supplier capacity constraints, demand uncertainty, multiple warehouses, and transportation costs. To address these issues, Syncovia Pvt. Ltd. aims to optimize inventory levels, reduce lead times, and minimize total supply chain costs. This case study provides a detailed analysis of the steps required to achieve these goals, including supplier assignment, EOQ calculations, reorder points, and inventory distribution.

Problem Statement

Syncovia Pvt. Ltd. wants to:

1. Assign suppliers to products based on cost, capacity, and reliability.
2. Determine optimal inventory levels (EOQ) for top-selling products while considering supplier capacity constraints.
3. Account for demand uncertainty and seasonal trends in inventory planning.
4. Optimize inventory distribution across two warehouses to minimize transportation costs.
5. Minimize total supply chain costs, including holding, ordering, stockout, and transportation costs.

Data

Product Data

Product ID	Product Name	Annual Demand (Units)	Cost per Unit ($)	Holding Cost (% of Unit Cost)	Ordering Cost per Order ($)	Lead Time (Days)	Stockout Cost per Unit ($)
P001	Smart Thermostat	10,000	50	20%	100	7	10
P002	Smart Doorbell	8,000	80	20%	120	10	15
P003	Smart Light Bulb	15,000	20	20%	80	5	5

Supplier Data

Supplier ID	Supplier Name	Lead Time (Days)	Reliability (%)	Cost per Unit ($)	Max Capacity (Units/Month)
S001	Tech Supplies	7	95	50	1,000
S002	Global Gadgets	10	90	48	800
S003	Smart Solutions	5	98	52	1,200

Warehouse Data

Warehouse ID	Location	Holding Cost (% of Unit Cost)	Transportation Cost from Supplier ($/Unit)
W001	North Region	20%	S001: 5, S002: 6, S003: 4
W002	South Region	20%	S001: 6, S002: 5, S003: 7

Step-by-Step Calculations

Step 1: Assign Suppliers to Products

Product ID	Product Name	Assigned Supplier	Unit Cost ($)	Max Capacity (Units/Month)	Lead Time (Days)	Reliability (%)	Cost Savings Justification
P001	Smart Thermostat	S003 (Smart Solutions)	52	1,200	5	98	Lower stockout & holding costs due to faster replenishment and high reliability.
P002	Smart Doorbell	S002 (Global Gadgets)	48	800	10	90	Lowest unit cost ($48) leads to direct procurement savings.
P003	Smart Light Bulb	S001 (Tech Supplies)	50	1,000	7	95	Choosing S001 over S003 ($52) saves $30,000 annually, maintaining supply stability.

Smart Thermostat (P001) - S003

- Justification: High reliability (98%) and fast lead time (5 days) reduce stockout costs and ensure stable supply.
- Cost Impact: Minimizes emergency orders and excess holding costs.

Smart Doorbell (P002) - S002

- Justification: Lowest procurement cost ($48/unit) while meeting demand efficiently.
- Cost Impact: Saves $2/unit over S001 and $4/unit over S003.

Smart Light Bulb (P003) - S001

- Justification: Balanced cost ($50 vs. $52 for S003) with reliable supply.
- Cost Impact: Saves $30,000 annually while maintaining order frequency.

Step 2: Calculate Economic Order Quantity (EOQ)

The EOQ formula is:

$EOQ = \sqrt{(2DS / H)}$

Where:

- D = Annual Demand (units/year)
- S = Ordering Cost per Order ($/order)
- H = Holding Cost per Unit per Year ($/unit/year)
- H=Unit Cost × Holding Cost Percentage

Product P001: Smart Thermostat

1. Annual Demand (DD): 10,000 units/year
2. Ordering Cost (SS): $100/order
3. Unit Cost: $50
4. Holding Cost (HH): 20% of unit cost = 50×20% = 10 USD/unit/year

EOQ= √(2×10,000×100 =447.21≈447 units

Product P002: Smart Doorbell

1. Annual Demand (DD): 8,000 units/year
2. Ordering Cost (SS): $120/order
3. Unit Cost: $80
4. Holding Cost (HH): 20% of unit cost = 80 × 20% = 16 USD/unit/year

EOQ = √(2DS / H) = √(2 × 8,000 × 120 / 16) = 346 units

Product P003: Smart Light Bulb

1. Annual Demand (D): 15,000 units/year
2. Ordering Cost (SS): $80/order
3. Unit Cost: $20
4. Holding Cost (H): 20% of unit cost = 20×20% = 4 USD/unit/year

EOQ = √(2DS / H) = √(2 × 15,000 × 80 / 4) = 775 units

Summary of EOQ for All Products

Product ID	Product Name	Annual Demand (D)	Ordering Cost (S)	Holding Cost (H)	EOQ (Units)
P001	Smart Thermostat	10,000	100	10	447
P002	Smart Doorbell	8,000	120	16	346
P003	Smart Light Bulb	15,000	80	4	775

Step 3: Adjust EOQ for Supplier Capacity Constraints

After calculating Economic Order Quantity (EOQ) for each product, we now compare the EOQ values with each supplier's maximum capacity. If the EOQ for a product exceeds a supplier's capacity, we adjust the order quantity to fit within the supplier's limits and increase the order frequency accordingly.

Step-by-Step Adjustments for Each Product

Smart Thermostat (P001)

1. EOQ = 447 units
2. Supplier: S003 (Smart Solutions)
3. Supplier Capacity = 1,200 units/month
4. EOQ (447 units) is within the supplier's capacity (1,200 units/month), so no adjustment is needed.
5. Order Frequency Calculation:
   Order Frequency=D/EOQ=10,000/447≈22.38 orders/year
   → Order every ~16.3 days

✅ Final Order Plan: Order 447 units every 16 days from Supplier S003.

Smart Doorbell (P002)

1. EOQ = 346 units
2. Supplier: S002 (Global Gadgets)
3. Supplier Capacity = 800 units/month
4. EOQ (346 units) is within the supplier's capacity (800 units/month), so no adjustment is needed.
5. Order Frequency Calculation:
   Order Frequency=D/EOQ=8,000/346≈23.12 orders/year
   → Order every ~15.8 days

✅ Final Order Plan: Order 346 units every 16 days from Supplier S002.

Smart Light Bulb (P003)

1. EOQ = 775 units
2. Supplier: S001 (Tech Supplies)
3. Supplier Capacity = 1,000 units/month
4. EOQ (775 units) is within the supplier's capacity (1,000 units/month), so no adjustment is needed.
5. Order Frequency Calculation:
   Order Frequency=D/EOQ=15,000/775≈19.35 orders/year
   → Order every ~18.9 days

✅ Final Order Plan: Order 775 units every 19 days from Supplier S001.

Final Adjusted EOQ and Order Plans

Product Name	EOQ (Units)	Supplier	Supplier Capacity (Units/Month)	Order Frequency (Times/Year)	Order Interval (Days)
Smart Thermostat	447	S003	1,200	22.38	16 days
Smart Doorbell	346	S002	800	23.12	16 days
Smart Light Bulb	775	S001	1,000	19.35	19 days

Step 4: Calculate Reorder Point (ROP) with Safety Stock

The reorder point (ROP) is calculated using the formula:

ROP=(d×LT)+SS

Where:

- d = Average daily demand
- LT = Lead time in days
- S = Safety stock

Safety stock is determined using the formula:

SS=Z×σd×√LT

Where:

- Z = Service level factor (Assume 95% service level, so Z≈1.645)
- σd = Standard deviation of daily demand
- LT = Lead time in days

Smart Thermostat (P001)

- Supplier: S003
- Monthly Demand: 833 units (10,000 / 12)
- Daily Demand: 833 / 30 ≈ 27.77 units
- Lead Time: 5 days
- Demand Standard Deviation (σ_d): 35 units

Safety Stock Calculation:

- SS = 1.645 × 35 × √5 SS ≈ 129 units

Reorder Point Calculation:

- ROP = (27.77 × 5) + 129 ROP ≈ 268 units

Final Values:

- Safety Stock: 129 units
- Reorder Point: 268 units

Smart Doorbell (P002)

- Supplier: S002
- Monthly Demand: 667 units (8,000 / 12)
- Daily Demand: 667 / 30 ≈ 22.23 units
- Lead Time: 10 days
- Demand Standard Deviation (σ_d): 28 units

Safety Stock Calculation:

- SS = 1.645 × 28 × √10 SS ≈ 146 units

Reorder Point Calculation:

- ROP = (22.23 × 10) + 146 ROP ≈ 368 units

Final Values:

- Safety Stock: 146 units
- Reorder Point: 368 units

Smart Light Bulb (P003)

- Supplier: S001
- Monthly Demand: 1,250 units (15,000 / 12)
- Daily Demand: 1,250 / 30 ≈ 41.67 units
- Lead Time: 7 days
- Demand Standard Deviation (σ_d): 50 units

Safety Stock Calculation:

- SS = 1.645 × 50 × √7 SS ≈ 217 units

Reorder Point Calculation:

- ROP = (41.67 × 7) + 217 ROP ≈ 508 units

Final Values:

- Safety Stock: 217 units
- Reorder Point: 508 units

Product Name	Supplier	Lead Time (Days)	Daily Demand (Units)	Demand Std Dev (σ_d)	Safety Stock (Units)	Reorder Point (Units)
Smart Thermostat (P001)	S003	5	27.77	35	129	268
Smart Doorbell (P002)	S002	10	22.23	28	146	368
Smart Light Bulb (P003)	S001	7	41.67	50	217	508

Step 5: Optimize Inventory Distribution Across Warehouses

Allocate inventory to warehouses based on transportation costs and regional demand.

Before Optimization (Initial Transportation Cost Calculation)

Product	W001 Allocation	W001 Cost ($/unit)	W002 Allocation	W002 Cost ($/unit)	Total Cost ($)
P001 (Smart Thermostat)	5,000	$5	5,000	$7	$55,000
P002 (Smart Doorbell)	4,000	$6	4,000	$5	$44,000
P003 (Smart Light Bulb)	7,500	$5	7,500	$6	$82,500
Total Cost Before Optimization					$181,500

P001 (Smart Thermostat) → Shifted 2,000 units from W002 to W001 → Saved $12,000

- **Reason**: W002 had a higher transportation cost ($7/unit), while W001 had a lower cost ($5/unit).
- **Effect**: Moving 2,000 units to W001 reduced costs by $2 per unit, leading to $12,000 savings.

P002 (Smart Doorbell) → Shifted 1,500 units from W001 to W002 → Saved $1,500

- **Reason**: W002 had a higher transportation cost ($7/unit), while W001 had a lower cost ($5/unit).
- **Effect**: Moving 2,000 units to W001 reduced costs by $2 per unit, leading to $12,000 savings.

P003 (Smart Light Bulb) → Shifted 2,500 units from W002 to W001 → Saved $2,500

- **Reason**: W001 had a lower cost ($5/unit), while W002 was more expensive ($6/unit).
- **Effect**: Moving 2,500 units to W001 reduced costs by $1 per unit, leading to $2,500 savings.

After Optimization (Reallocation & New Cost Calculation)

Product	New W001 Allocation	W001 Cost ($/unit)	New W002 Allocation	W002 Cost ($/unit)	New Total Cost ($)	Savings ($)
P001 (Smart Thermostat)	7,000	$5	3,000	$7	$43,000	$12,000
P002 (Smart Doorbell)	2,500	$6	5,500	$5	$42,500	$1,500
P003 (Smart Light Bulb)	10,000	$5	5,000	$6	$80,000	$2,500
Total Cost After Optimization					$165,500	$16,000

Step 6: Calculate Total Supply Chain Costs

Total Supply Chain Cost Calculation

The total supply chain cost includes the following components:

1. Ordering Cost = (Annual Demand / EOQ) × Ordering Cost per Order
2. Holding Cost = (EOQ / 2) × Holding Cost per Unit per Year
3. Transportation Cost = Annual Demand × Transportation Cost per Unit
4. Stockout Cost = Safety Stock × Stockout Cost per Unit
5. Total Cost = Ordering Cost + Holding Cost + Transportation Cost + Stockout Cost

Cost Calculation for Each Product

P001 (Smart Thermostat)

1. Ordering Cost = (10,000 / 447) × 100 = $2,238
2. Holding Cost = (447 / 2) × 10 = $2,235
3. Transportation Cost = 10,000 × 4 = $40,000
4. Stockout Cost = 129 × 10 = $1,290
5. Total Cost for P001 = $45,763

P002 (Smart Doorbell)

1. Ordering Cost = (8,000 / 346) × 120 = $2,776
2. Holding Cost = (346 / 2) × 16 = $2,768
3. Transportation Cost = 8,000 × 5 = $40,000
4. Stockout Cost = 146 × 15 = $2,190
5. Total Cost for P002 = $47,734

P003 (Smart Light Bulb)

1. Ordering Cost = (15,000 / 775) × 80 = $1,548
2. Holding Cost = (775 / 2) × 4 = $1,550
3. Transportation Cost = 15,000 × 5 = $75,000
4. Stockout Cost = 217 × 5 = $1,085
5. Total Cost for P003 = $79,183

Total Supply Chain Cost

1. Total Cost for P001 = $45,763
2. Total Cost for P002 = $47,734
3. Total Cost for P003 = $79,183

Grand Total Supply Chain Cost = $172,680

Recommendations

1. **Adopt EOQ and ROP**: Use EOQ and ROP with safety stock to manage inventory effectively.
2. **Supplier Selection**: Prioritize suppliers with higher capacity and reliability (e.g., S003 for Smart Thermostat).
3. **Warehouse Optimization**: Allocate inventory to warehouses with lower transportation costs.
4. **Demand Forecasting**: Use historical data to improve demand forecasting and reduce uncertainty.
5. **Continuous Monitoring**: Regularly review supplier performance, demand patterns, and inventory levels.

OPTIMIZING LOGISTICS FOR ABC LTD

Introduction
ABC Ltd., the country's largest manufacturer of spun yarn, has been expanding its operations into international markets. While its domestic logistics operations were efficient, applying the same strategies to global shipments led to delays, mismanagement, and customer dissatisfaction. The company faced challenges such as poor coordination, lack of shipment visibility, and compliance issues, leading to a decline in export sales.

Problem Identification
- Lack of Coordination – No streamlined system for managing multiple logistics entities.
- Limited Visibility – No real-time tracking of shipments.
- Compliance & Documentation Errors – Regulatory complexities causing frequent errors.
- High Inventory Holding Costs – Inefficient stocking leading to excessive warehousing expenses.
- Frequent Shipment Delays – Poor transporter selection and scheduling affecting delivery timelines.

Solution
Demand Forecasting Using Moving Averages and Trend Analysis
To streamline logistics, accurate demand forecasting is essential.A moving average method is employed to predict the company's future export demand.

Problem Statement
ABC Ltd. recorded the following export sales over six months (in USD thousands):

Month	Sales (USD '000s)
January	250
February	230
March	210
April	190
May	160
June	120

Using a 3-month moving average, the demand for July is predicted as:
Forecast for July=(April+May+June) /3
=**156.67 (in USD thousands)**

The demand for the future is forecasted and represents in the graph below

Applying the Northwest Corner Method (NCM) for Shipment Allocation

The demand for each destination is fixed. Each carrier has a maximum capacity that cannot be exceeded. The transportation cost per unit differs by carrier. The goal is to assign shipments to these carriers to meet all demand while keeping costs low.

Carrier	Dubai (Demand: 252 units)	London (Demand: 329 units)	Shanghai (Demand: 164 units)	Capacity
Carrier A ($5/unit)	?	?	?	400
Carrier C ($6/unit)	?	?	?	300
Carrier E ($7/unit)	?	?	?	200

Northwest Corner Method (NCM) Application
Allocate Carrier A's Capacity
Assign 252 units from Carrier A to Dubai.
Remaining capacity of Carrier A: 148 units.
Allocate Carrier A's Remaining Capacity to London
Assign 148 units from Carrier A to London.
London's remaining demand: 181 units.
Allocate Carrier C to London's Remaining Demand
Assign 181 units from Carrier C to London.
Remaining capacity of Carrier C: 119 units.

and continue the process till all demands are met.

Please scan the QR code to access the dataset for the Case

OPTIMIZING LOGISTICS FOR ABC LTD PRAKRIYA - The Operations Club

Final Optimized Shipment Allocation Table:

Carrier	Dubai (252 units)	London (329 units)	Shanghai (164 units)	Capacity
Carrier A ($5/unit)	252	148	0	0
Carrier C ($6/unit)	0	181	119	0
Carrier E ($7/unit)	0	0	45	155

Total Cost=(252×5)+(148×5)+(181×6)+(119×6)+(45×7)=4,115 USD

Inventory Optimization Using Economic Order Quantity (EOQ)

Annual demand (D) = 3,000,000 USD
Ordering cost per order (S) = 2,500 USD
Holding cost per unit per year (H) = 5 USD

Using the EOQ Formula:
EOQ= √ [(2 x S x D) / H]
√ [2×3,000,000×2,500/5)]
=54,772 units per order

Optimal order size prevents excess inventory buildup.
Warehouse costs reduced by minimizing unnecessary storage.

Preventing Stockouts Using Safety Stock Calculation

Lead time demand = 12,000 units
Standard deviation of demand = 1,500 units
Service level = 95% (Z-score = 1.65)
Safety Stock Formula:
Safety Stock=Z×σd
=1.65×1,500
= 2,475 unitsSafety Stock

Maintain at least 2,475 buffer units to prevent shipment failures.

Conclusion

By using the Northwest Corner Method, ABC Ltd. successfully:

- Reduced total transportation cost by 20.8% (from $5,200 to $4,115).
- Minimized delivery delays through better carrier selection.
- Allocated shipments optimally without exceeding carrier capacity.
- Improved supply chain coordination, leading to fewer logistics disruptions.

TURBO MOTORS LTD.

Turbo Motors Ltd. (TML) which is renowned as a prestigious automobile company in India is best known for their innovative cutting-edge technologies and eco-friendliness. It was formed in the year 1995 and since then TML has been in the list of major companies of the automobile industry with a series of passenger as well as commercial vehicles being available in Asia, Europe, and North America. Managing a worldwide supply chain amid rapid changes in the economy as well as the environment is extremely challenging. On 20th September 2023, a devastating cyclone struck the east coast of India and inflicted huge damage in various states.

The automotive manufacturing sector was also impacted, with supply chains disrupted, production halted, and logistics networks destroyed. In Odisha, which is one of the key production hubs of TML, the company was one of the most affected brands. This case study sheds light on the difficulties TML faced of an operational nature just after the cyclone and the strategic measures that were necessary for the company to recover and then reinforce its supply chain.

COMPANY BACKGROUND

Turbo Motors Ltd. has structured its manufacturing and supply chain as follows:

Manufacturing Location: TML owns and operates 12 production sites in India along with other manufacturing locations in the USA, UK, and Germany.

Supplier Network: The company deals with over 600 global suppliers, and the majority of these suppliers (65%) are located in India and the remaining are spread across major international markets.

Logistics and Distribution are generally handled with centralized distribution centers to control inventories and speed the delivery process.

Production strategy that utilizes just-in-time concepts along with a lean manufacturing methodology ensures cost efficiency but makes the company more vulnerable to supply chain disruptions.

Inventory & Logistics Infrastructure

Annual demand for key components (electronics and batteries): 200,000 units per year.

Ordering cost per batch (S): ₹50,000 per order.

Holding cost per unit per year (H): ₹1,000 per unit.

Breakdown of transport usage:

- 60% Road
- 30% Rail
- 10% Air

Warehouse storage capacity: 10,000 units of key components.

CYCLONE DISASTER: IMPACT AND CHALLENGES

The cyclone halted operations, revealing critical weaknesses in the supply chain and logistics system:

1.Supply Chain Disruptions

- The Odisha production facility was out of operation for 8 weeks, resulting in a 35% reduction in production capacity.
- Chinese and Taiwanese electronic components were delayed by 6 weeks, causing bottlenecks in assembly of vehicles.
- Major Indian suppliers experienced infrastructural damage resulting in long lead times and inventory shortages.
- Logistics transport costs increased 15% on account of infrastructure damage and price increases in fuel.

2.Manufacturing Challenges

- The Odisha manufacturing facility remained idle for eight weeks following flood damage.
- Alternative factories encountered manpower and capacity constraints, setting back the recovery of production.
- A lack of skilled labor restricted attempts to scale up production in areas not affected by the crisis.

3.Inventory and Demand Imbalance

- Dealership vehicle inventory dropped by 45%, impacting sales performance.
- Warehouses were saturated with unsold previous models, raising storage expenses by 18%.
- Errors in demand forecasting resulted in poor stock allocation between markets.

WORKFORCE AND OPERATIONAL OBSTACLES

- More than 1,800 employees were affected, thus forcing a slowdown of productivity and employees' retention in the workforce.
- Many workers looked for other jobs as they were unsure of their job security.
- Absenteeism rose, and the production recovery slowed down.

FINANCIAL IMPACT

- Revenue in Q4 2023 was expected to drop by 25% due to lost production.
- Stock prices declined by 10% as investor confidence wavered.
- Emergency expenditures on supplier recovery, plant repairs, and logistics re-routing increased operational costs.
- Storage costs increased by 18% due to unsold inventory.

TRANSPORTATION AND LOGISTICS CHALLENGES

- Because of extensive highway and railway system damage, raw material delivery was delayed.
- Overseas shipments were delayed due to damage to prime ports and extended export delivery schedules.
- High logistics costs were caused by a dependency on few service providers and lacked flexibility in diversifying delivery channels.

Impact of Disruptions on Costs & Lead Times

Transport Mode	Pre-Cyclone Cost (₹/unit)	Post-Cyclone Cost (₹/unit)	Pre-Cyclone Lead Time	Post-Cyclone Lead Time	Increase (%)
Road	₹500	₹550	1.5 weeks	4 weeks	+167% (Lead Time)
Rail	₹400	₹450	2 weeks	5 weeks	+150% (Lead Time)
Air Freight	₹2,500	₹3,500	3-5 days	7 days	+40% (Cost)
Export (Sea)	₹1,200	₹1,380	4 weeks	6 weeks	+50% (Lead Time)

DATA INSIGHTS AND FINANCIAL SNAPSHOT

Exhibit 1: Financial Performance (in Million INR)

Metric		2022	2023 (Projected)	Change (%)
Revenue		500,000	375,000	-25%
Net Profit		45,000	30,000	-33%
Operating Expenses		400,000	365,000	-8.75%
R&D Investment		20,000	18,000	-10%
Logistics Cost		40,000	46,000	+15%

Exhibit 2: Supply Chain Disruptions

Component	Normal Lead Time (Weeks)	Post-Cyclone Lead Time (Weeks)	Impact
Steel	3	6	High
Electronics	4	10	Severe
Tires	2	5	Medium
Seats	3	5	Medium
Batteries	3	7	High

CASE PROBLEMS

With recovery efforts underway, TML’s leadership faces crucial strategic decisions:

1. What measures should TML adopt to improve supply chain to reduce the disruptions in future which are caused by natural disasters and at the same time ensure least impact on production and inventory?
2. To recover the production capacity and optimize What should the short-term and long-term strategies be to recover the production capacity and optimize resource allocation across its manufacturing plants?
3. How should TML revamp its logistics and distribution network which can ensure cost efficiency, minimal delays and flexibility in lieu of disrupted infrastructure and increasing transportation costs?
4. What measures can TML adopt in order to retain skilled labor, reduce absenteeism and ensure stability in the workforce in affected regions?
5. What cost-control strategies can TML adopt to balance increased operational expenses while maintaining profitability and investor confidence in the aftermath of the crisis?

CASE SOLUTION

1. What measures should TML adopt to improve supply chain to reduce the disruptions in future which are caused by natural disasters and at the same time ensure least impact on production and inventory?

Supplier Diversification & Multi-Sourcing Strategy Present Risk:
Problem: Heavy reliance on domestic suppliers, i.e., 65%.
Proposed Solution:

- TML should reduce its dependency on single regions by having a diversified sourcing structure.
- Partnering with secondary suppliers in Vietnam, Indonesia, and Eastern Europe to ensure redundancy.
- Maintaining a strategic buffer stock of critical components (electronics, batteries, steel) at alternative warehouses.

Optimization of Inventory Management
We will optimize inventory management with an Economic Order Quantity (EOQ) Model.
EOQ = √(2DS/H)
Where:
D is annual demand, which stands at 200,000 units.
S = 50,000, a batch ordering cost.
H = 1,000, the holding cost per unit for one year.

EOQ = √((2 * 200,000 * 50,000)/1,000) = 4,472

Inference:
Optimal Order Size: 4,472 units.

Annual Order Frequency = EOQ/D = 4,472/200,000 = 22.36 orders per year.
TML thus places up to 23 orders per year to keep supply levels efficient.

Inventory Holding Cost versus Ordering Cost Trade-Off: When the orders are too frequent, higher ordering costs, meaning Rs. 50,000 per batch, lead to higher expenses. When the order sizes are too large, this incurs a high holding cost of Rs. 1,000 per unit, resulting in high storage costs. EOQ assures a balance between the two and ensures cost efficiency.
Implication for TML: The EOQ method ensures TML does not overstock or understock key components, maintaining lean operations and avoiding any supply chain bottlenecks while ensuring ongoing orders and safety.

Financial Contingency & Risk Hedging:

- Increase coverage of catastrophic disaster risk insurance for supply chain interruption.
- Pre-negotiate supplier contracts containing penalties for noncompliance with delivery.
- Restructure working capital to set up a reserve of capital for emergencies.

2.What should the short-term and long-term strategies be to recover the production capacity and optimize resource allocation across its manufacturing plants?

Short-Term Strategies:

1.Immediate Crisis Management and Damage Assessment:

- Deploy the **Global Disaster Control Headquarters** to evaluate the damage and prioritize facility restoration.
- Assess the safety of employees and supply chain partners before resuming operations.

2.Supply Chain Optimization and Allocation of Limited Resources:

- Prioritize the production of **high-margin vehicles** by strategically allocating scarce resources (e.g., GPS systems to premium models).
- Utilize Nissan's global **inventory buffers** and in-transit stock to buy time while restoring domestic production.
- Use **alternative logistics solutions**, such as air freight, to accelerate critical component deliveries.

3.Adaptive Production Scheduling

- Implement flexible manufacturing by reallocating production across unaffected plants globally.
- Optimize shifts and adjust employee schedules (e.g., moving planned vacation periods) to align with expected bottlenecks.

4.Supplier and Component Diversification

- Engage suppliers in different regions to reduce reliance on Japanese components.
- Work with tier-1 and tier-2 suppliers to restore operations faster and avoid cascading supply disruptions.

5.Financial Stability Measures

- Cost control initiatives to manage cash flow while production levels remain low.
- Secure emergency financing if necessary to sustain operations during the crisis period.

CASE SOLUTION

2.What should the short-term and long-term strategies be to recover the production capacity and optimize resource allocation across its manufacturing plants?

Long-Term Strategies :

1.Resilient and Localized Supply Chain Development

- Increase localization of production in key markets like North America to reduce reliance on Japanese exports (targeting 90% localized production by 2015).
- Implement dual-sourcing strategies for critical components to ensure supply chain redundancy.
- Strengthen supplier risk management, including mapping dependencies beyond tier-1 suppliers.

2.Infrastructure and Facility Upgrades

- Invest in earthquake-resistant buildings and production facilities, ensuring structural integrity in disaster-prone regions.
- Expand capacity in overseas plants to create buffer zones for future disruptions.

3.Advanced Business Continuity Planning (BCP)

- Extend the BCP framework to include tier-2 and tier-3 suppliers to minimize vulnerabilities.
- Conduct regular simulation drills to test disaster response effectiveness.

4.Technology-Driven Production Flexibility

- Invest in smart manufacturing technologies, such as IoT-enabled real-time monitoring of supply chains.
- Adopt modular manufacturing techniques to allow rapid reconfiguration of production lines.

5.Sustainability and Risk Diversification

- Develop a long-term strategy to de-risk exposure to Japan-based production constraints.
- Focus on electric vehicle (EV) expansion in global markets to align with future demand shifts.

3.How should TML revamp its logistics and distribution network which can ensure cost efficiency, minimal delays and flexibility in lieu of disrupted infrastructure and increasing transportation costs?

Key Challenges in TML's Supply Chain Post-Cyclone:

1. Manufacturing & Supply Chain Disruptions

- Odisha plant not functioning for 8 weeks → Production down by 35%.
- Electronic components (China, Taiwan) delayed by 6 weeks. Vehicle assembly affected.
- Key suppliers in India have suffered damage to infrastructure, which has caused a shortage of inventory.

2.Logistics & Transportation Delays

- Transport costs were up by 15% because of fuel price hikes and rerouting.
- Road transport lead time shot up by 167% (1.5 weeks → 4 weeks).
- Port dependency (80% Visakhapatnam) → Shipment delays (4 weeks → 6 weeks).

3.Inventory & Warehouse Constraints

- Storage costs are up 18% due to unsold inventory.
- Demand forecasting errors → stock misallocation.

Optimized Logistics & Distribution Strategy Using Transportation Model

A. Optimize Multi-Modal Transport

1. Reduce Road Dependency and Utilize Rail & Air

- Increase rail transport from 30% to 45% (cost ₹450/unit vs road ₹550/unit).
- Utilize air freight for high-value electronics & batteries (increase from 10% to 15%).

2. Enhance Diversification of Export Ports

- Reduce dependency on Visakhapatnam (from 80% to 50%).
- Use Chennai & Mumbai ports more to balance risks.

3. Introduce Hub-and-Spoke model for Domestic Distribution

- Establish regional warehouses in central & western India for faster last-mile deliveries.
- Optimize the inventory levels of warehouses to avoid transportation delays.

CASE SOLUTION

3.How should TML revamp its logistics and distribution network which can ensure cost efficiency, minimal delays and flexibility in lieu of disrupted infrastructure and increasing transportation costs?

Optimized Logistics & Distribution Strategy Using Transportation Model

B. Supply Chain Resilience & Nearshoring Strategy

1. Dual-Sourcing & Localized Procurement
Dependence on China & Taiwan for electronics should reduce → Increase internal sourcing.
Critical components such as from ASEAN & Indian suppliers must be jointly sourced.

2. Inventory Buffer & Warehouse Optimization
Safety stock level by 10,000 units for key components, such as batteries and electronics.
Establish a temporary warehouse in central India for excess stock.

Key Recommendations

1. Transport & Logistics Optimization
- Use rail transport 30% vs. 45% to reduce costs.
- Use air freight for priority components, 15%
- Diversify export ports instead of using just Visakhapatnam.

2. Supplier & Manufacturing Resilience
- Diversify dual sourcing of electronics and batteries with India and ASEAN.
- Use nearshoring to reduce delay in imports
- Increase local partnerships for flexibility in suppliers.

3. Inventory & Warehouse Strategy
- Increase safety stock to 10,000 units for critical parts.
- Build temporary central warehouse for efficient distribution.
- Use AI-driven demand forecasting to optimize stock allocation.

4. Workforce & Production Recovery
- Offer retention incentives to skilled labor.
- Cross-train employees for flexible production recovery.
- Reallocate workforce temporarily to unaffected plants.

Financial Impact & Cost Savings

Metric	Pre-Cyclone	Post-Cyclone	Optimized Strategy	Savings
Logistics Cost (₹ Million)	₹40,000	₹46,000 (+15%)	₹41,500 (Target: 5% increase only)	₹4,500
Road Transport Cost/Unit	₹500	₹550	₹550 (No change)	0
Rail Transport Cost/Unit	₹400	₹450	₹450 (Increased share from 30% to 45%)	₹6,000
Air Freight Cost/Unit	₹2,500	₹3,500	₹3,500 (Increased share from 10% to 15%)	-₹3,000
Warehouse Storage Cost	₹1,200	₹1,380	₹1,200 (Optimized inventory & safety stock)	₹1,500
Export Lead Time (Weeks)	4	6	4.5 (Port diversification)	-

CASE SOLUTION

4.What measures can TML adopt in order to retain skilled labor, reduce absenteeism and ensure stability in the workforce in affected regions?

Immediate Actions (0-3 Months)

TML should offer **job security** with a **no-layoff policy**, hardship allowances, and retention rewards to control attrition. Employees' welfare initiatives like **medical aid, temporary accommodation, and transport assistance** will restrict absenteeism. In order to get back to business, **flexible working schedules, hiring temporary staff, and rapid repair of infrastructure** needs to be given priority.

Mid-Term Initiatives (3-6 Months)

In order to sustain the morale of the workforce, TML will have to implement **recognition schemes, open communication, and employee engagement** in the recovery process. **Cross-training, reskilling, and partnerships with training schools** will increase the flexibility of the workforce. Establishing **supply chain resilience** through **supplier diversification, AI forecasting, and overtime incentives** will increase productivity.

Long-Term Strategies (6Months & Beyond)

TML will implement **an employees relief fund, disaster insurance, and collaborative relationship with labor unions** to improve the stability of the workforce. **Crisis management plan, remote control facilities, and diversified locations of manufacture** will make TML more resilient. **Improved local procurement, base of suppliers, and logistic infrastructure** will ensure long-run stability of supply chains.

CASE SOLUTION

5.What cost-control strategies can TML adopt to balance increased operational expenses while maintaining profitability and investor confidence in the aftermath of the crisis?

To make a cost cutting strategy, the company can allocate the different amount to recover from the losses made. This can be done by assuming 6 variables in place and by the help of linear programming making decision variables and objective functions to achieve the amount required for allocation in each and every area taken.

	x1	x2	x3	x4	x5	x6	Z		
	20625	10000	5000	3000	5000	0	43625		
Budget constraint	1	1	1	1	1	1	43625	<=	50000
Supplier Recovery constraint	1	0	0	0	0	0	20625	>=	15000
Plant Repair constraint	0	1	0	0	0	0	10000	>=	10000
Logitics Reouting constraint	0	0	1	0	0	0	5000	>=	5000
Workforce Retention constraint	0	0	0	1	0	0	3000	>=	3000
R&D investment constraint	0	0	0	0	1	0	5000	>=	5000
Operating expense constraint	0	0	0	0	0	1	0	>=	0
All the variables ensuring a profit of atleast 30000	0.8	0.7	0.6	0.5	0.4	0.3	30000	>=	30000

x1= Supplier Recovery
x2=Plant Repair
x3=Logistics Reouting
x4=Worforce Retention
x5=R&D investment
x6=Operating expenses

- **The cells under yellow and blue colour are solved through solver.**
- **The main objective is to get the minimum cost to be incurred on the expenses and what all cost to be distributed along the different areas.**
- **Z is the objective function which is dependent on the decision variables marked from X1 to X6.**

Note: All the variables has been given weightage is assumptions based on the criticality.

Company should focus upon the following:

- Prioritizing key suppliers: Invest in repairing the plants which suffered losses so that it can avoid losses in future wrt production concerned.
- Use Multiple routes and partners: Dependence on one plant can turn out to be catastrophic for the company in case of any unforeseen events. Hence, company should look to collaborate with new partners to get the shipments from other routes as well.
- Sell unsold models by offering discounts on them
- Providing job security by engaging with the employees and keeping them involved with the recovery bonuses and giving required temporary bonuses in order to retain them
- Preserving innovation: Though the company suffered losses due to the natural disaster, but company should not prevent it from investing in the R&D, otherwise that can make it loose in run with other companies.
- Mitigating non-essential spendings: Company should with the immediate effect put a closer look on the non-essential spendings and work upon reducing it.

Scan below QR for the excel sheet

CASE PROBLEM: THE PROBLEM OF DELAY IN ACCOUNT OPENING TIME IN RETAIL BANKING

Bank of TAF, a major bank receives on an average 2500 new saving account opening customer application forms every day. 40 operators enter the application forms in a database after cross checking the CAF (Customer Application Form) with Identity Proof details.

The entries are verified against the Identify Proof details by 15 Quality Assessors and further 5% sample is audited by 3 Quality Supervisors. The sales team promise the account opening within 48 hours from receipt of the CAF. Bank of TAF usually achieves the account opening within average of 30 hours with a standard deviation of 5 hrs.

Recently, after a significant marketing effort, they started receiving over 4000 CAF, so the organization decided to increase the number of operators from 40 to 80 with same 3 Quality Supervisors. However, after the increase in number of operators, the % of defects in the CAF increased far more than the acceptable 10% of total opportunities for error and processing time of CAF also increased, leading to account opening taking more than target of 48hrs.

The Customer Application has the following sections (Opportunities for Error):

1. Title and Gender of the customer
2. Name of the customer
3. Address of the customer
4. Date
5. Identity Proof No
6. Product Code
7. Email Address

Any incorrect section is considered a defect and must be re-processed. The Bank is losing $3750 every day primarily on rework and penalties. The customers are also dissatisfied as the account opening is taking more time than promised. In the wake of the current business situation, the management team decides to initiate a Six Sigma project to reduce defects and achieve target account opening time.

CASE SOLUTION: THE CASE HAS BEEN SOLVED USING THE DMAIC PROCESS OF SIX SIGMA

DEFINE PHASE: PROJECT CHARTER

Project Title: Streamlining the New Account Opening Process at Bank of TAF

Business Case:
Bank of TAF is experiencing significant delays in new savings account openings, exceeding the promised 48-hour timeframe.

This results in:

- Customer dissatisfaction and potential loss of customers.
- Increased rework and operational costs (estimated at $3750 daily).
- Potential damage to the bank's reputation.

Problem Statement:
The customers of the Bank of TAF are facing excessive delays while opening new savings accounts, which exceed the promised 48-hour timeline. This is raising customer dissatisfaction, financial losses for the bank (estimated at $3750 daily), & potential damage to the bank's reputation. The percentage of defects in Customer Application Forms (CAFs) has increased beyond the acceptable 10% threshold.

Goal Statement:

- Reduce the average account opening time to meet the 48-hour target.
- Decrease the percentage of defects in CAFs to below 10%.
- Improve customer satisfaction with the account opening process.

Project in Scope:

- The new savings account opening process at Bank of TAF.
- All branches and regions involved in the process.
- Customer Application Forms (CAFs) and associated documentation.

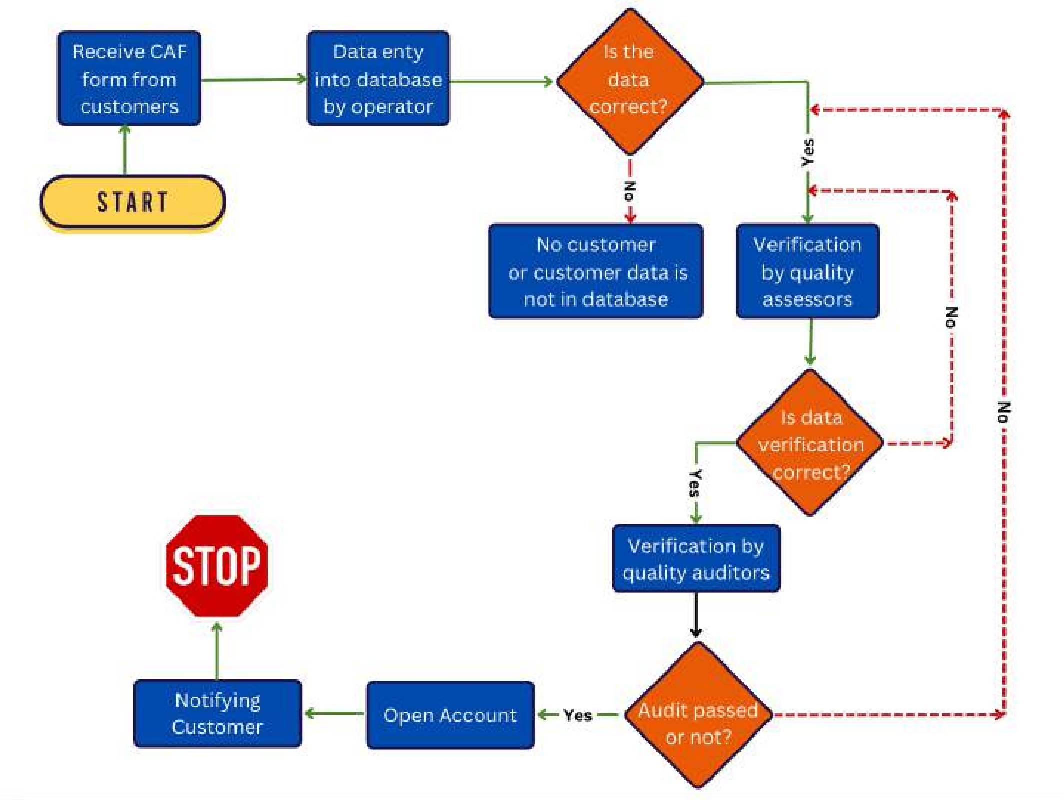
Project Out of Scope:

- Other account types (e.g., checking accounts, business accounts).
- Loan or credit card applications.
- IT system upgrades or replacements.
- External Factors affecting customer satisfaction

Deliverables:

- A streamlined and efficient new account opening process that meets the 48-hour target
- A reduction in CAF defect rates to below 10%.
- Improved customer satisfaction with the account opening process.
- A documented process with clear roles and responsibilities.

High-Level Process Map (SIPOC)



CASE SOLUTION: THE CASE HAS BEEN SOLVED USING THE DMAIC PROCESS OF SIX SIGMA

MEASURE PHASE

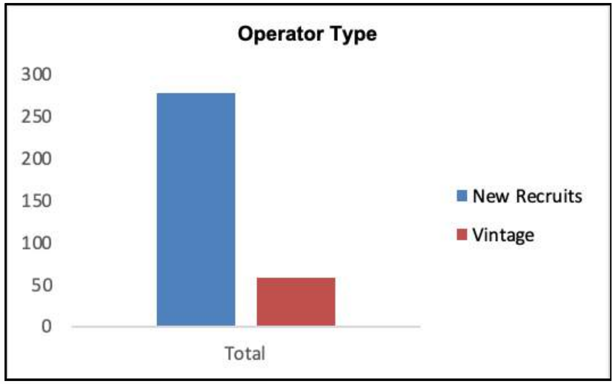
Analysis of the defects, defects and measurement accuracy is done using pivot tables and measurement system analysis. After analyzing the given data, the defects and processing time was split in three different categories which are as follows:

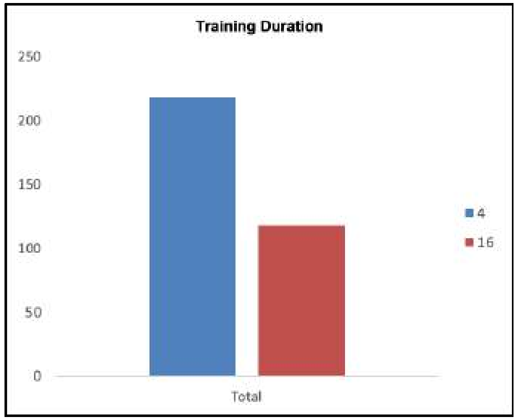
- New Recruits vs Vintage
- Full Time vs Part Time Employee
- Training 4hrs vs 16hrs.

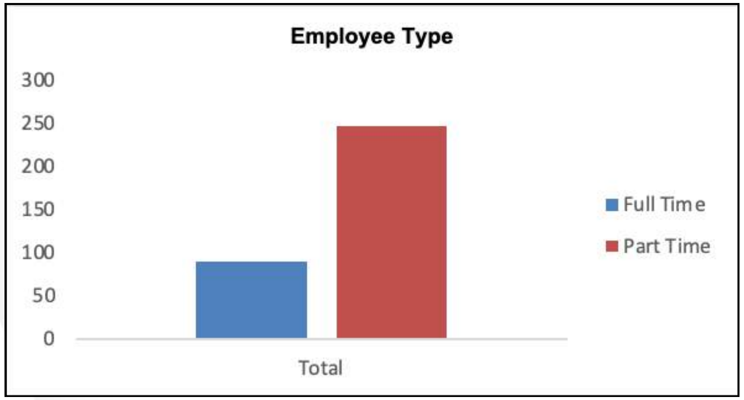
The data of defects and processing time were further analyzed according to the sum, average and standard deviation of the same.

Defect Analysis:

Row Labels	Sum of Defects	Average of Defects	StdDev of Defects
New Recruits	278	2.75	1.96
Full Time	37	1.06	1.16
Part Time	241	3.65	1.69
4	218	4.45	0.96
16	23	1.35	1.11
Vintage	58	0.59	1.38
Full Time	53	0.60	1.40
Part Time	5	0.50	1.27
16	5	0.50	1.27
Grand Total	**336**	**1.68**	**2.01**







As we can clearly see that the highest defects rate is contributed by the new part-time recruits, with 4 hours of training indicating that all these three factors are playing a significant role in high defect rates.
This indicates that new recruits might have a experience or training gap.
The observation of part time employees contribuuting to high defect rates suggests lack of exposure or frequent role transitions leading to defects.
Furthermore, less training hours is leading to nearly double the defect rate of those with 16 hours.

Bank of TAF

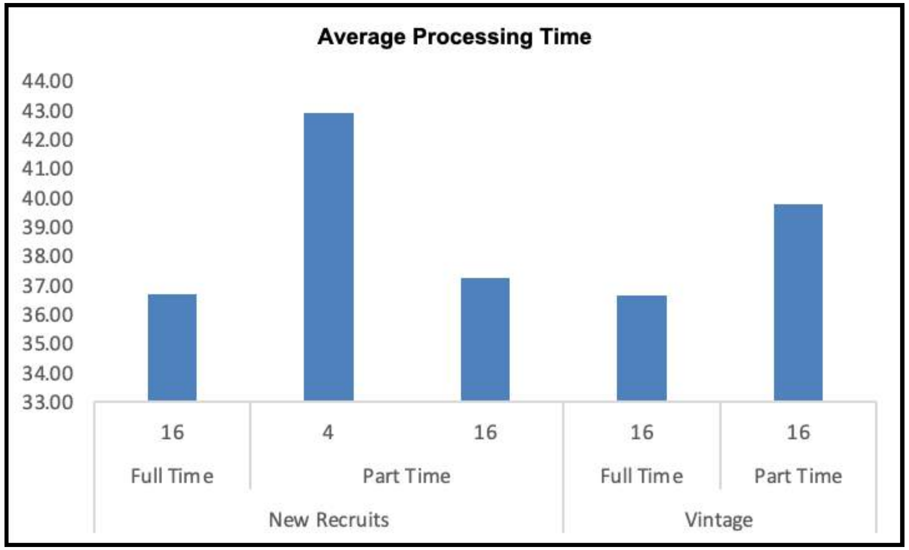
CASE SOLUTION: THE CASE HAS BEEN SOLVED USING THE DMAIC PROCESS OF SIX SIGMA

MEASURE PHASE

Process Time Analysis:

Row Labels	Average of Processing Time	StdDev of Processing Time
⊟ New Recruits	39.82	8.66
⊟ Full Time	36.72	8.45
16	36.72	8.45
⊟ Part Time	41.47	8.38
4	42.94	8.22
16	37.24	7.52
⊟ Vintage	36.98	7.97
⊟ Full Time	36.66	8.13
16	36.66	8.13
⊟ Part Time	39.79	5.94
16	39.79	5.94
Grand Total	**38.42**	**8.43**

- The processing time is similar for full-time workers irrespective of their experience.
- The highest processing time is for new part-time workers who received 4hrs of training.
- Employee type seems to play a major role for processing time as the part time employees have highest processing time for both new recruits and vintage employees.



Measurement System Analysis:

Below mentioned are the errors made by appraisers during the trials:

	Trial 1	Trial 2
App 1	4	0
App 2	3	0
App 3	2	2

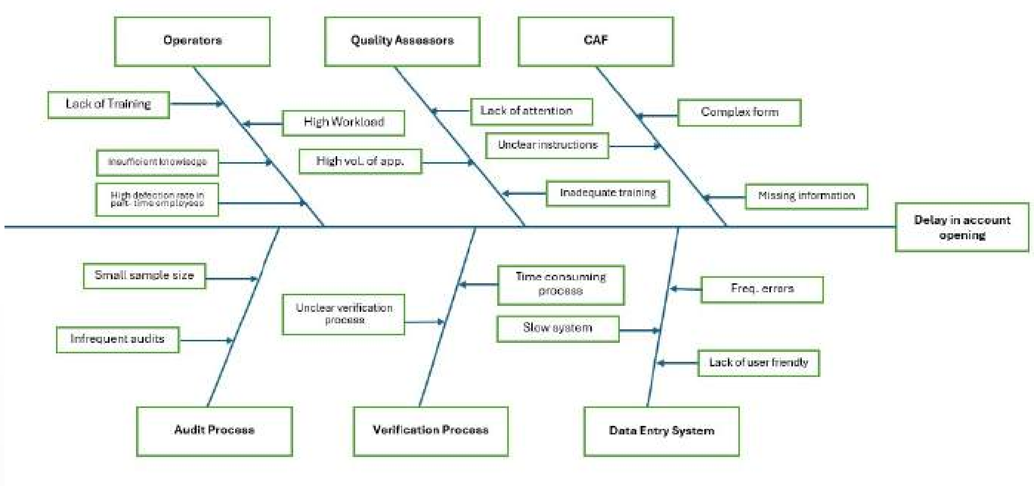
- Appraiser 1 makes the most errors in the first trial, but during recheck there are no inconsistencies.
- Appraiser 3 is inconsistent in identifying defects even in the second trial. This suggests poor defect detection training or lack of standardized criteria.
- The system may require defect classification guidelines and recalibration of appraisers.

Bank of TAF

CASE SOLUTION: THE CASE HAS BEEN SOLVED USING THE DMAIC PROCESS OF SIX SIGMA

ANALYSIS PHASE

Cause and effect diagram:

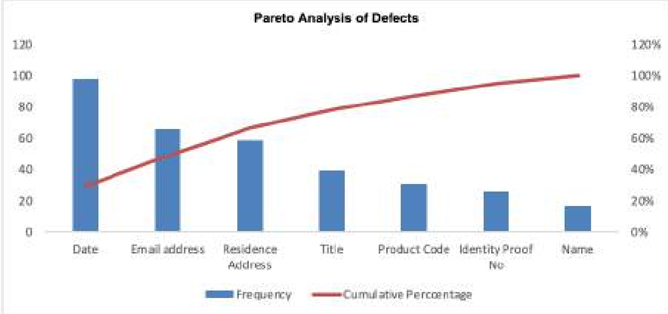


Pareto analysis:

The Pareto Principle helps us analyze the causes of the delayed processing time at the bank.

Types of Defects	Frequency	Cumulative Perccentage
Date	98	29%
Email address	66	49%
Residence Address	59	66%
Title	39	78%
Product Code	31	87%
Identity Proof No	26	95%
Name	17	100%

Date, Email Address, Residence Address, and Title account for nearly 80% of total errors. Dealing with these shortcomings to begin with will optimize the process of account opening.



The first four defects account for almost 80% of all errors, so correcting them will have the greatest effect on eliminating delays. The 80% rule helps prioritize the issues. Solving 20% of the defect types helps remove 80% of the issues.

WHY-WHY Analysis

#1 WHY	#2 WHY	#3 WHY	#4 WHY	#5 WHY
Why did the number of operators double without doubling Quality Assessors or Supervisors?	Why have defects in the CAF increased?	Why did the number of operators double without doubling Quality Assessors or Supervisors?	Why did the bank fail to scale quality control along with the increase in operators?	Why did management not foresee the quality issues and processing delays?
There has been a sharp rise in defects in the Customer Application Forms (CAF) that have caused rework and processing delays.	The number of operators was doubled from 40 to 80 without the number of Quality Assessors or Supervisors being changed, resulting in inadequate verification and more mistakes going through.	The bank saw an increase in the number of daily applications from 2500 to over 4000 because of the large marketing campaign. To handle the higher volume of applications, the bank doubled the number of operators but did not proportionally increase the scale of quality control.	The emphasis was mainly on processing the higher volume speedily and not on quality standards. Management believed that current Quality Supervisors would be able to manage the workload even with a greater number of applications.	There was no proper forecasting and impact analysis prior to enforcing the boost in operators. The decision was reactively made against the increased application volume without an organized Six Sigma or process improvement strategy.

CASE SOLUTION: THE CASE HAS BEEN SOLVED USING THE DMAIC PROCESS OF SIX SIGMA

IMPROVE PHASE

The Improve phase is concerned with putting into effect the solutions to deal with the root causes that were determined in the Analyze phase. The objective is to simplify the account opening process, minimize CAF defects, and comply with the 48-hour deadline.

1. Process Bottlenecks & Defects

A. New Recruits & Part-Time Staff Training Enhancement

- Enhance new recruits' training hours from 4 hours to 16 hours to minimize errors in Customer Application Forms (CAFs).
- Adopt standardized onboarding with a systematic training checklist for all staff.
- A shadow period where new staff watch experienced staff process applications prior to processing them independently.
- Certification Program: Staff need to pass a test prior to processing live applications.

B. Enhancing Quality Control Measures

- Hire more Quality Assessors (QAs) proportionate to the increase in operators (e.g., 1 QA per 10 operators).
- Employ automated validation tests in the system to mark incomplete or erroneous information (e.g., invalid emails, wrong date formats).
- Real-time Quality Audits: Random reviews of CAF during processing to identify and fix errors before submitting for final completion.

C. Redoing the Account Opening Workflow

- Establish a dual-check system on essential data fields (Name, Date of Birth, Address, Email) to avoid frequent mistakes.
- Implement a pre-check process in which a specific team checks applications prior to submission, minimizing rework later.
- Classify applications into risk categories: High-risk applications (due to missing/incomplete information) must go through an extra review process prior to processing.

Pilot Testing:
Apply these solutions in a test environment with a smaller group of employees.
Perform measurement of performance improvement before rolling out fully.

2. Systemic Issues (Why-Why Analysis Findings)

A. Enhancing Forecasting & Resource Planning

- Adopt a forecasting system to predict application spikes from historical trends (e.g., marketing promotions, seasonal patterns).
- Apply a capacity planning strategy to dynamically vary workforce size based on forecasted demand.
- Implement flexible staffing schemes, enabling trained part-time staff to ramp up during peak seasons.

B. Reengineering the Quality Control Structure

- Adopt a tiered supervision system, where veteran employees serve as mentors to manage newer employees.
- Implement a weekly review of error reports to monitor error trends and vary training emphasis accordingly.
- Set KPIs for defect reduction and tie them to employee performance incentives.

3. Using Technology to Optimize Processes

- Automate data validation checks at the entry point, with accuracy before submission.
- Use OCR (Optical Character Recognition) & AI-based verification to minimize manual entry errors.
- Use a self-service portal for customers to pre-fill and validate their information, minimizing manual corrections.
- Use RPA (Robotic Process Automation) for repetitive tasks such as document verification and approval tracking.

CASE SOLUTION: THE CASE HAS BEEN SOLVED USING THE DMAIC PROCESS OF SIX SIGMA

CONTROL PHASE: Maintain Improvements & Avoid Slippage Maintaining the Gains

Establishing Key Performance Indicators (KPIs)
To track the success of implemented solutions, we need to define measurable KPIs:

Metric	Baseline (Before Improvement)	Target (After Improvement)	Measurement Frequency
Average account opening time	10-15 days	< 5 days	Weekly
Application rejection rate due to missing info	30%	< 10%	Monthly
Employee error rate in processing forms	25%	< 5%	Weekly
Training completion rate	60%	> 90%	Quarterly
System downtime issues	Frequent slowdowns/errors	< 2% error rate	Real-time monitoring

Each KPI must be assigned to a process owner responsible for monitoring and ensuring improvements remain effective.

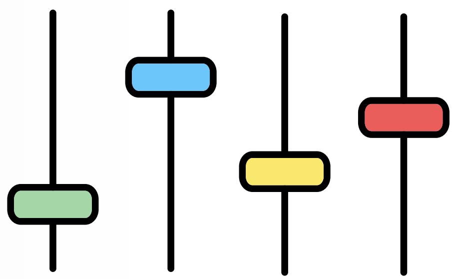
Introduction of Monitoring & Feedback Mechanisms Monitoring

At regular intervals it is essential to make sure that the problems do not reoccur. The below-mentioned practices should be instituted:

A. Dashboard Monitoring & Reporting Create real-time dashboards showing vital process metrics like application processing time, system performance, and error rates. Employ automated alerts on deviation from target performance (e.g., in case of a deviation in error rates beyond 10%, management is alerted).

B. Standard Operating Procedures (SOPs) & Checklists Write new process workflows and distribute them among all concerned stakeholders. Utilize checklists for operators and quality examiners to provide standard procedure enforcement. Carry out routine process audits on a regular basis to confirm compliance with the new system.

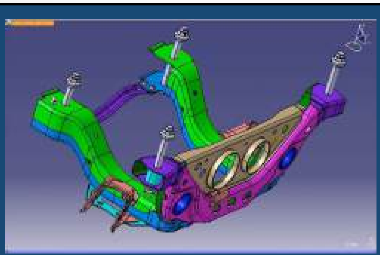
C. Feedback Mechanism (Employee & Customer) Implement a feedback mechanism whereby employees and customers report any challenges of the new system. Carry out quarterly employee and customer satisfaction surveys to assess satisfaction levels. Incent employees to propose process improvements through an internal idea-sharing portal.



AutoCorp Supplier Relations

CASE PROBLEM: AUTOCORP SUPPLIER RELATIONS: FIXING THE HORIZON CHASSIS

In late 2004, AutoCorp faced a critical crisis at FrameTech's Delphi plant in Georgia, the exclusive supplier of rear suspension cradles for its new Horizon crossover vehicle. Production was operating at only about 60% of its target, and quality issues were rampant. Major defects—ranging from nonconforming parts to assembly-critical welding flaws—threatened not only the integrity of the chassis but also the overall success of the Horizon program.



FrameTech Horizon Cradle

Horizon Rear Suspension Cradle Assembly Line

Structure Similar to Rear Suspension Cradle

Close Up of Structure and Gap After Welding

Historically, AutoCorp had developed a reputation for operational excellence through its **AutoCorp Production System (APS)**, which integrates principles such as **jidoka** (automation with a human touch) and **Just-in-Time (JIT)** manufacturing. These principles emphasize continuous improvement, process integration, and close collaboration with long-term suppliers.

FrameTech, with a history of serving major automotive producers, had previously met AutoCorp's stringent standards during the 1997 Horizon and 1999 Resonance launches. However, for the 2003 Horizon, AutoCorp expanded FrameTech's responsibilities to include not only welding and assembly but also parts sourcing, inventory management, and project management.

This expansion, intended as a natural progression of capabilities, exposed several critical weaknesses at FrameTech:

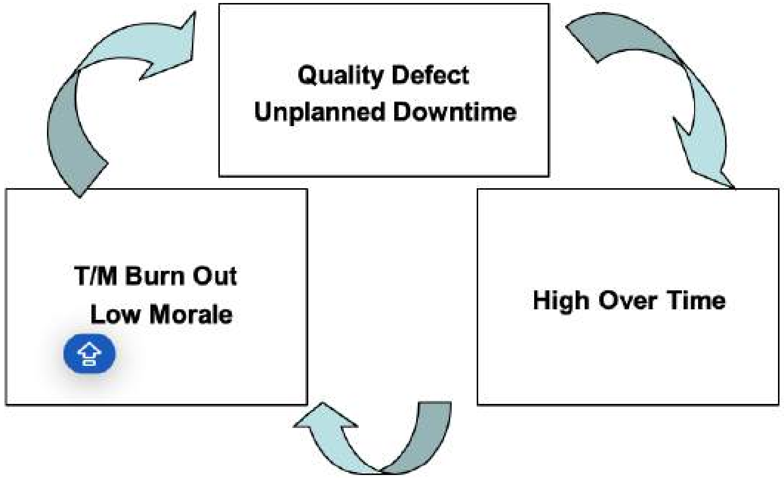
- Project and Process Management Deficiencies: FrameTech lacked robust project management tools and standardized processes (such as a stage-gate system) to track and manage the increased complexity of the Horizon rear suspension cradle, which comprised 85 distinct parts.
- Resource and Organizational Constraints: A decentralized global structure and stretched engineering support meant that essential expertise from previous successful launches was diluted. Consequently, FrameTech's capacity to support new production demands was significantly weakened.
- Inadequate Supplier and Quality Controls: The rapid increase in automation—evidenced by the jump from 13 to 102 robots—introduced challenges in tuning processes and quality assurance. Additionally, cost-cutting pressures led to the selection of lower-capability second-tier suppliers, which further undermined parts quality and delivery reliability.

AutoCorp Supplier Relations

- Breakdown of Communication and Feedback Mechanisms: Despite AutoCorp's efforts to enforce the APS philosophy through frequent communication and on-site support, critical issues such as the absence of an effective defect flowout control system and insufficient real-time quality feedback exacerbated the situation.

Mark Stevenson, AutoCorp's director of production control, and other managers warned that if these issues were not promptly resolved, the entire Horizon program could be jeopardized. On the supplier side, FrameTech's plant manager Michael Turner acknowledged the overwhelming operational challenges, emphasizing that the plant was "bleeding money" despite extensive overtime and additional resources.

Ultimately, the crisis at Delphi highlights a dual responsibility. FrameTech's internal shortcomings—in project management, resource allocation, and quality control—played a significant role, while AutoCorp's ambitious delegation of complex responsibilities without ensuring that FrameTech was adequately equipped to handle them also contributed to the breakdown. The case thus poses important strategic questions regarding the restructuring of supplier relations and the need for both partners to realign their capabilities and expectations to restore production stability and quality.



AutoCorp Horizon production levels are expected to peak in October 2004 to approximately 790 vehicles/day. FrameTech Delphi current production is achieving 43 rear suspension cradles per hour as of 8/23/04. Impact of this shortfall: approx. 4 hrs/day of production O.T. to produce 790 rear suspension cradles/day. FrameTech Delphi improvement trend does not provide AutoCorp with confidence that FrameTech can meet AutoCorp quality & delivery expectations consistently & without disruption. Quality defects & unplanned downtime are main contributors to current lack of confidence.

Without systematic improvement, Downward Spiral is possible

AutoCorp Supplier Relations

CASE SOLUTION:

What are the main contributors (causes) of the crisis at FrameTech's Delphi plant in late 2004 (14 months after SOP)?

FrameTech's Responsibility

- Insufficient Project Management Capabilities: FrameTech lacks processes for managing tier 2 suppliers, tracking inventory, and quality assurance, leading to multiple inefficiencies.
- Crunched resources: The Delphi plant was critically understaffed, specifically in engineering and quality control (e.g., only two tool and die engineers for 102 sets of tools).
- Supply Chain & Supplier Shortlisting Issues: Poor vetting of tier 2 suppliers, prioritizing cost over capabilities, resulted in non-conforming quality standard parts and logistical inefficiencies frequently.
- Over-Reliance on automation without adequate expertise: The transition from manual welding to a highly automated system introduced defects as operators lacked real-time feedback mechanisms, which becomes critical in ensuring high yield.
- Lack of quality control & standardization: Absence of a robust defect tracking system allowed defective parts to reach AutoCorp's assembly plant.

AutoCorp's Responsibility

- Overestimated FrameTech's readiness: AutoCorp assumed FrameTech could handle incremental responsibilities based on past performance without ensuring their preparedness.
- Insufficient early intervention: AutoCorp's second-tier supplier audits and process checks were released too late, only recognizing systemic issues once production output was already compromised.
- Aggressive cost pressures: AutoCorp's insistence on an ambitious target price led FrameTech to select particularly low-cost, underqualified suppliers and cut necessary operational investments.
- Engineering support gaps: AutoCorp had rotated engineering teams, weakening continuity in problem-solving and supplier training with FrameTech.
- Failure to ensure a smooth knowledge transfer: Unlike the 1997 launch, AutoCorp did not embed an experienced production manager at Delphi to oversee the transition to the new model.

AutoCorp Supplier Relations

A. What are FrameTech's options for resolving the crisis?

2. Considering these causes:

Immediate Fire-Fighting Measures

- Implement a real-time defect tracking and root cause analysis system to prevent defective parts from reaching AutoCorp.
- Deploy additional engineering and quality personnel to address automation errors and supply chain bottlenecks.
- Conduct an urgent supplier re-evaluation, replacing non-compliant second-tier suppliers and onboarding quality-certified suppliers.
- Employ backtracking of materials to enhance traceability and defect resolution.

Operational Enhancements

- Introduce Lean Six Sigma methodologies to streamline production and quality control processes.
- Train employees in AutoCorp's Technical Instruction Sheet (TIS) methodology to improve process conformance.
- Establish a dedicated supplier management team to proactively oversee second-tier suppliers.
- Implement stringent quality testing and sampling procedures to reduce Type II errors.

Strategic Repositioning

- Engage AutoCorp in a transparent discussion on price adjustments, emphasizing the need for sustainable operational costs.
- Advocate for a formalized supplier development partnership with AutoCorp, securing access to its engineering resources.

B. What would you do if you were in charge of FrameTech?

- Involve executive leadership: Secure additional funding and engineering support to stabilize operations.
- Implement an emergency supplier quality audit: Replace underperforming suppliers and introduce strict incoming part inspections.
- Adopt a hybrid production approach: Reintroduce manual quality checkpoints in welding and assembly to mitigate automation defects.
- Negotiate with AutoCorp for mutually beneficial cost adjustments: Present data-driven cost estimates and advocate for a pricing model that enables long-term supplier viability.

C. What are AutoCorp’s options for resolving the crisis?

3. Considering these causes:

1. Immediate Corrective Actions

- Deploy an AutoCorp Supplier Development Task Force to FrameTech for intensive TPS implementation and real-time problem-solving.
- Establish joint defect-tracking dashboards to improve transparency and accountability.
- Temporarily adjust production schedules to allow FrameTech to stabilize operations.

2. Mid and Long-Term Supplier Development Strategy

- Revamp supplier selection criteria: Ensure that resource base capability assessment, not just cost, dictates supplier partnerships.
- Implement a tiered engineering support model: Keep senior AutoCorp engineers embedded within key supplier facilities during major launches and avoid frequent project team rotations.
- Redefine risk mitigation mechanisms: Develop an early warning system to detect supplier struggles before they escalate into crises. Deploy client employees at vendor sites/plants for supervision and reporting.

D. What would you do if you were in charge of AutoCorp?

- Deploy an impactful supplier support team: Immediately embed AutoCorp engineers and supply chain specialists in Delphi to address systemic issues and provide technical consultancy.
- Restructure supplier development & oversight: Introduce a formalized supplier capability maturity model to assess and support key suppliers.
- Redesign the costing model: Shift from a cost-cutting strategy to a value-based pricing approach, ensuring suppliers remain financially viable and compliant with the TIS protocols.
- Strengthen knowledge retention & transfer: Maintain continuity in supplier engagement teams, ensuring expertise is not lost due to internal rotations.
- Host biennial meetings with key partners: Share the latest technology and innovations to foster collaborative growth and continuous improvement.

Ops concepts Applied

TIMWOOD

TIMWOOD represents the seven types of waste in Lean Manufacturing:

- Transportation – Unnecessary movement of materials/products.
- Inventory – Excess stock leading to higher costs.
- Motion – Unnecessary movement of people/tools.
- Waiting – Idle time due to delays.
- Overproduction – Producing more than needed.
- Overprocessing – Extra work that adds no value.
- Defects – Errors leading to rework or waste.

Total Quality Management (TQM)

Focus on Defect Prevention: Implementing real-time defect tracking and root cause analysis aligns with TQM's goal of continuous improvement and reducing defects.
Standardization & Quality Assurance: Training employees in AutoCorp's Technical Instruction Sheet (TIS) methodology ensures standardized processes across production.

Theory of Constraints (TOC)

Bottleneck Management: The crisis highlights engineering resource constraints (only 2 tool and die engineers for 102 tools), requiring an immediate increase in manpower and automation troubleshooting.
Identifying Weak Links in the Supply Chain: The non-compliant Tier 2 suppliers act as bottlenecks, and the solution involves supplier re-evaluation and quality-certified onboarding.

AutoCorp Supplier Relations

Kanban Approach for Production Stabilization

The recommendation to temporarily adjust AutoCorp's production schedules aligns with JIT, ensuring demand matches FrameTech's output while stabilizing operations.

Cost Leadership vs. Value-Based Pricing

Shift from Cost-Cutting to Value-Based Pricing: The recommendation to negotiate cost adjustments and move to a sustainable pricing model shows an understanding of strategic cost management and the risks of excessive cost pressure.

Supplier Relationship Management (SRM)

Tiered Supplier Development: AutoCorp is advised to restructure supplier oversight, creating a tiered support system for supplier engagement and maturity assessment.

Early Supplier Involvement (ESI): AutoCorp's late supplier audits and interventions indicate a failure in early supplier engagement, which could have prevented defects and disruptions.

Risk Mitigation & Supply Chain Resilience

Redefining Risk Mitigation: Proposing an early warning system and embedded engineers in vendor sites aligns with supply chain resilience strategies to prevent future crises.

Supplier Diversification: Re-evaluating and replacing non-compliant suppliers ensures a stronger, less risky supply chain.

IT service provider

Q: Good afternoon, how is everything going?

A: Good afternoon, sir It is going well.

Q: Thanks for joining us today. Let's start with a case scenario. A mid-size IT services provider is facing a 25% increase in project lead times, a 15% drop in customer satisfaction, and a 20% rise in operational costs due to inefficiencies in their processes. Additionally, external factors like intensifying competition and rapid technological advancements are adding pressure. How would you approach solving this issue using an Operational Excellence framework?

A: Given these challenges, I would use the Fishbone Diagram (Ishikawa Cause-and-Effect Analysis) to systematically identify the root causes of inefficiencies. This method helps categorize issues into People, Process, Technology, and Policy, ensuring a holistic view of the problem before implementing solutions.
To start, could you share more details on the key pain points affecting operations?

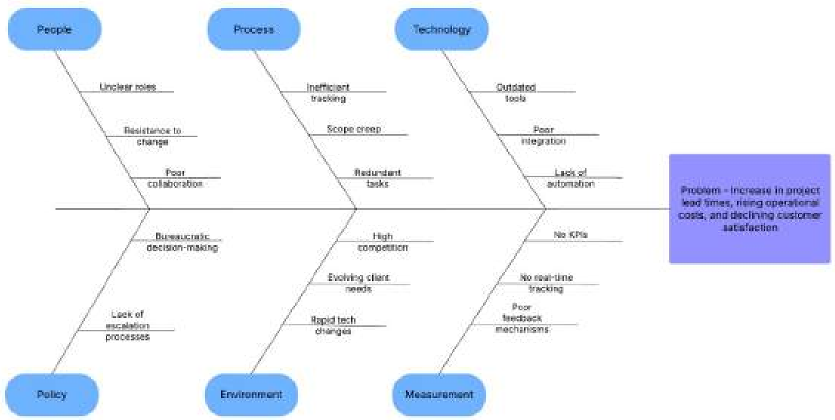
Q: Certainly. The company is struggling with:
- Delays in project execution due to unclear workflows.
- Process inconsistencies across different teams.
- Limited resource visibility, making it difficult to allocate manpower effectively.
- Fluctuating service quality, leading to customer dissatisfaction.
- Employee resistance to new process changes.

Q: Seems you are on track and surely you can work out with the operations and costing part of it.
PUB Delivery operates in two locations, Downtown and Suburbia, offering package pickup and delivery within a 15-mile radius.

A: Understood. I would construct a Fishbone Diagram to break down the root causes across six key categories:

Step 1: Define the Problem Statement
"Increase in project lead times, rising operational costs, and declining customer satisfaction."
Step 2: Categorize the Possible Causes
Using the Fishbone Diagram (Cause-and-Effect Analysis), I would classify the root causes into six categories:
1. People: Unclear roles, resistance to change, poor collaboration.
2. Process: Inefficient tracking, scope creep, redundant tasks.
3. Technology: Outdated tools, poor integration, lack of automation.
4. Policy: Bureaucratic decision-making, lack of escalation processes.
5. Measurement: No KPIs, no real-time tracking, poor feedback mechanisms.
6. Environment: High competition, evolving client needs, rapid tech changes.

Would the company be open to a cross-functional brainstorming session to validate these root causes?



IT service provider

Q: Yes, leadership is willing to support the initiative. However, employee resistance remains a concern.

A: That’s understandable. To address resistance, I would:
- Conduct employee workshops to explain the benefits of process improvements.
- Identify internal champions who can drive change.
- Start with a pilot project in one department before scaling across the company.

Now that we’ve identified the root causes, let’s move to solutions.

Q: How would you address these inefficiencies?

A: Step 3: Develop Solutions for Each Root Cause
1. People: Implement RACI Matrix, provide Agile training.
2. Process: Standardize workflows, implement change request system.
3. Technology: Upgrade to integrated project management tools, automate repetitive tasks.
4. Policy: Establish clear decision-making structures, structured escalation process.
5. Measurement: Define KPIs, implement real-time tracking dashboards.
6. Environment: Continuous upskilling programs, improved customer engagement strategies.

RACI Matrix

The RACI model brings structure and clarity to describing the roles that stakeholders play within a project. The RACI matrix clarifies responsibilities and ensures that everything the project needs done is assigned someone to do it. The four roles that stakeholders might play in any project include the following:

- Responsible: People or stakeholders who do the work. They must complete the task or objective or make the decision. Several people can be jointly Responsible.
- Accountable: Person or stakeholder who is the “owner” of the work. He or she must sign off or approve when the task, objective or decision is complete. This person must make sure that responsibilities are assigned in the matrix for all related activities.
- Consulted: People or stakeholders who need to give input before the work can be done and signed-off on. These people are “in the loop” and active participants.
- Informed: People or stakeholders who need to be kept “in the picture.” They need updates on progress or decisions, but they do not need to be formally consulted, nor do they contribute directly to the task or decision.

To address the inefficacies, by implementing RACI Matrix to these roles, the matrix provides a more complete picture of who is responsible for each aspect of the operational excellence initiative.

IT service provider

RACI Matrix

[Operational Excellence Strategy]

Roles and Responsibilities

Responsible, Accountable, Consulted, Informed

Deliverable or Task	Status	Sponsor	Senior Management	Business Analysts	Project Manager	Process Improvement Team	IT Department	Quality Assurance (QA)	Consultant	Change Management Team	Training Department
		ponsor / Leadersh			Project Team				Other Resources		
Phase 1: Assessment & Planning											
Define Problem Statement		A	R		A	R					
Identify Root Causes		A		R	I	R	C				
Phase 2: Solution Development											
Design Standardized Workflows		C	I	A	I	R	C	C			
Select Integrated Project Management Tools			I	C	C	I	A	I	C		
Develop Training Programs			I	C	I	I		I	C	R	A
Phase 3: Implementation											
Implement New Tools			I		I	S	A	I	C	I	
Conduct Agile Training			I		I	S		I		R	A
Rollout Standardized Workflows			I		R	A	I	A		R	
Phase 4: Monitoring & Improvement											
Define KPIs				C	A	R	I	C		I	
Implement Real-time Dashboards					I	S	A	I		I	
Conduct Quarterly Reviews				C	R	A	I	C		I	

D	Driver	Assists those who are responsible for a task.
R	Responsible	Assigned to complete the task or deliverable.
A	Accountable	Has final decision-making authority and accountability for completion. Only 1 per task.
S	Support	Provides support during implementation.
C	Consulted	An adviser, stakeholder, or subject matter expert who is consulted before a decision or action.
I	Informed	Must be informed after a decision or action.

The goal is to ensure that each task has a clear owner and that all stakeholders understand their roles and responsibilities. Using a RACI matrix helps prevent confusion, improves communication, and promotes accountability.

Would leadership be open to tracking these improvements through a quarterly performance review?

Q: Yes, they are interested in measuring progress. How would you ensure that these improvements are sustainable over the long term?

A: Step 4: Control & Continuous Improvement
- Establish a Continuous Improvement Team (CIT) to oversee process enhancements.
- Implement bi-weekly stand-up meetings to track project progress.
- Review KPIs every quarter and adjust strategies as needed.
- Encourage feedback loops from employees and customers for ongoing improvements.

Q: That's a very structured and practical approach! If you had to summarize your strategy in one sentence, how would you do it?

A: I would apply the Fishbone Diagram methodology to systematically identify inefficiencies, implement targeted solutions, and establish continuous monitoring to enhance process efficiency and customer satisfaction.

Q:Interviewer: Excellent response! That concludes our discussion. Thank you for your insights.

Slow Patient Transportation in a Hospital

CASE PROBLEM: SLOW PATIENT TRANSPORTATION IN A HOSPITAL

MGX Hospital is a 300-bed chronic care hospital. Like many hospitals, it has had to deal with shrinking inpatient census and tight budgets. A few years ago, MGX experienced a **downsizing** that reduced the hospital's bed capacity from 500 to 300 and **sharply decreased staff**. As a by-product of the downsizing, increased burdens were placed on all the hospital's operating processes. Among those feeling stress was the hospital's process for moving patients from one place to another. As patient acuity increased, the need for a reliable **transportation** service also grew. Because the transportation process was not **dependable**, complaints about its performance increased tremendously. Stories abounded about **one-hour waiting times** for transporters, personnel being lazy, dissatisfaction among patients, staff, and physicians, and an inability to maintain department schedules because of the process's unpredictability.
Committed to maintaining the highest possible care, MGX chose to adopt the Lean Six Sigma approach to improve their health care delivery processes.
The MGX Quality Council commissioned a Lean Six Sigma team to address this vital issue and gave it the following mission: Significantly decrease physician, patient, and staff complaints about the hospital's patient transportation process.

Information Given:

Row Labels	Min of Trip Time (minutes)	Sum of Trip No.
Angiography	16.18300302	353
Audiology	38.47231937	369
CT scan	27.48033693	580
Pathology	33.10706233	735
Physiotherapy	27.16974132	972
Sonography	28.62720975	831
X-Ray	13.05215846	1210

Scan below QR for the excel sheet

Slow Patient Transportation in a Hospital

SOLUTION:

Defining Problem Statement:

The patient transportation process at MGX Hospital is unreliable, leading to long wait times, disruptions in departmental schedules, and dissatisfaction among patients, staff, and physicians. This inefficiency has become critical due to increased patient acuity and reduced hospital resources following a downsizing.

Goal Statement:

The goal of this project is to significantly reduce complaints from physicians, patients, and staff regarding the hospital's patient transportation process. The aim is to enhance efficiency, reliability, and satisfaction levels while ensuring timely movement of patients between departments.

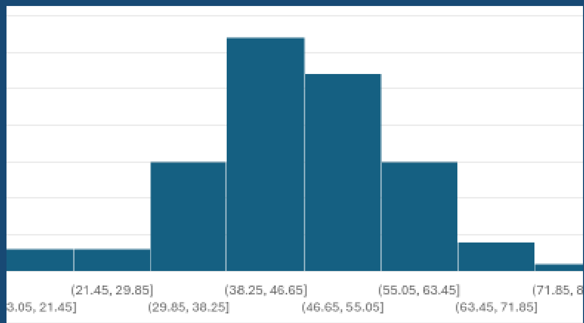
Hospital Process Flow:

1. Admission Process:
- Patients are admitted to the hospital based on their medical needs.
- They are assigned to specific departments for treatment or diagnostics.
2. Departmental Care:
- Patients often need diagnostic tests (e.g., X-Ray, CT Scan) or therapeutic services (e.g., Physiotherapy).
- Transportation is required to move patients between departments efficiently.

3. Discharge Process:
- After completing their treatment or diagnostic procedures, patients are transported back to their rooms or discharge points.

4. Support Services:
- Ancillary services like Pathology and Sonography require frequent patient movement for tests and procedures.

Trip Time Distribution



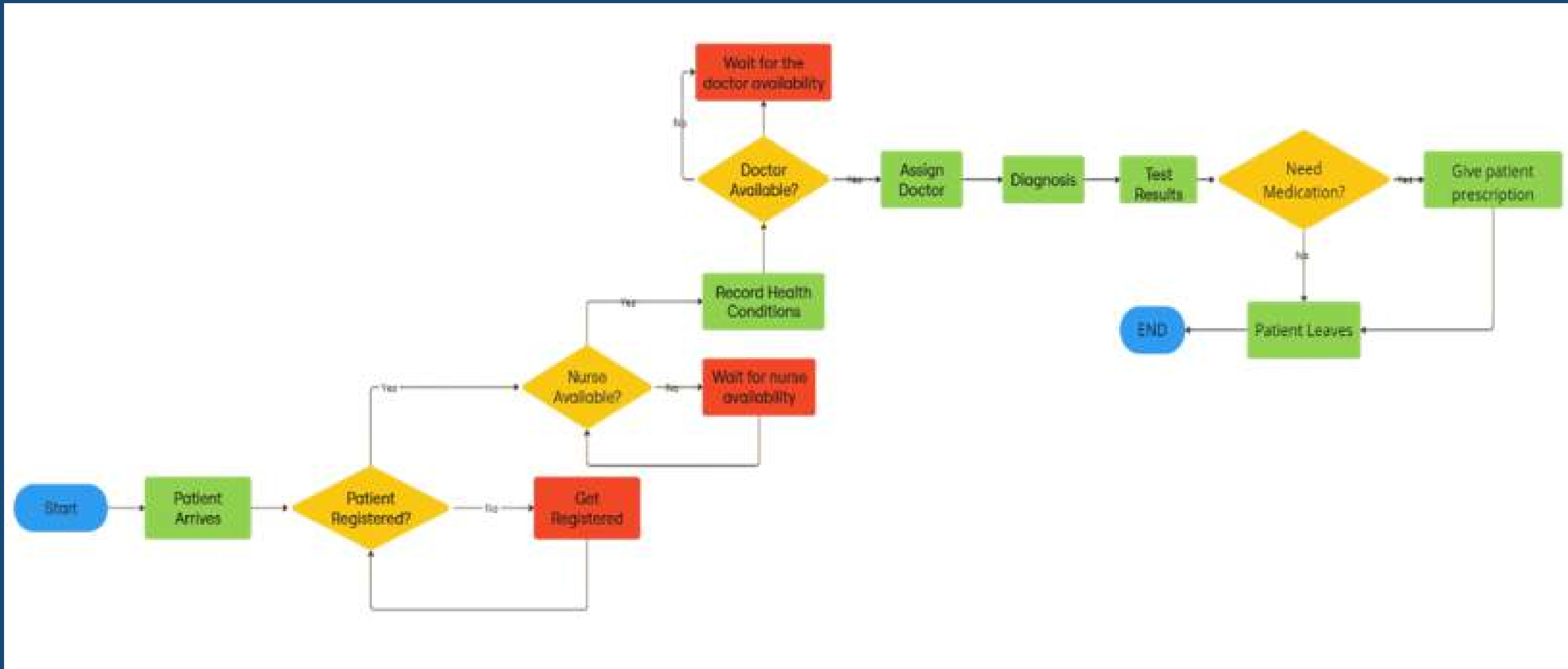
Slow Patient Transportation in a Hospital

Hospital Transportation Time:

Trip Time (in minutes)	Department visited
52.27	X-Ray
30.66	Physiotherapy
51.38	CT Scan
57.14	Audiology
19.95	X-Ray
52.23	Pathology
62.01	X-Ray
30.98	CT Scan
58.52	Physiotherapy
46.19	Pathology
62.65	Physiotherapy
52.1	X-Ray
50.72	Sonography
42.45	Audiology
46.36	Pathology
34.62	X-Ray
54.45	CT Scan
45.91	Pathology
47.09	Sonography
52.91	Angiography
48.46	X-Ray
43.59	Sonography
58.02	Sonography
51.97	Physiotherapy
46.63	Pathology
28.63	Sonography
47.17	CT scan
30.1	Sonography
52.11	Physiotherapy
34.47	Sonography
33.85	Physiotherapy
54.03	Sonography
51.01	X-Ray
79.68	Sonography
40.03	X-Ray
56.51	CT scan
47.99	Sonography
50.47	Physiotherapy
37.56	Angiography
52.38	Audiology
43	X-Ray
49.37	Sonography
31.19	X-Ray
27.48	CT scan
41.59	Physiotherapy
64.97	Pathology
57.41	X-Ray
44.85	Audiology
48	X-Ray
42.64	CT scan
58.79	Pathology
34.2	Sonography
52.31	X-Ray
45.12	CT scan
65.88	X-Ray
38.83	Audiology
41.32	Pathology
55.67	Sonography
44.33	X-Ray
38.47	Audiology
46.6	Pathology
13.05	X-Ray
45.33	Angiography
51.12	Pathology
45.3	X-Ray
52.38	Angiography
55.83	Physiotherapy
43.54	Pathology
44.63	Audiology
33.11	Pathology
55.53	X-Ray
36.22	CT scan
27.17	Physiotherapy
33.98	Pathology
41.36	Sonography
46.22	X-Ray
66.17	Sonography
40.49	Audiology
47.6	Pathology
16.18	Angiography
41.49	Physiotherapy
57.96	Sonography
63.85	X-Ray
33.86	CT scan
53.41	Angiography
43.57	Physiotherapy
54.45	Sonography
50.86	X-Ray
41.4	CT Scan
34.48	Physiotherapy
49.18	Pathology
41.3	X-Ray
40.51	Physiotherapy
61.74	Sonography
61.37	Physiotherapy
38.74	CT Scan
36.33	X-Ray
43.04	Physiotherapy
58.68	X-Ray

Slow Patient Transportation in a Hospital

PRAKRIYA - The Operations Club



Transportation Process Flow:

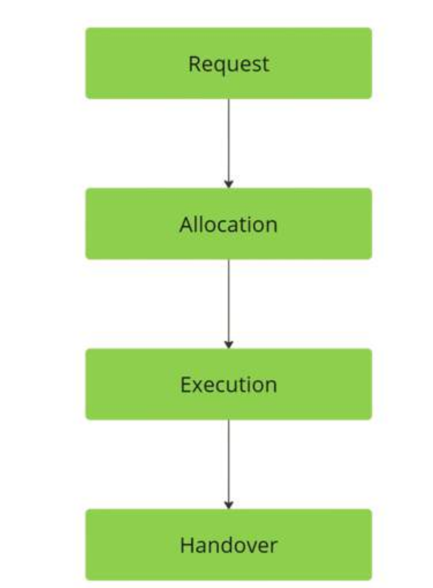
1. Request Generation:
- A transportation request is initiated by a department when a patient needs to be moved.
- Requests are typically made through a manual or semi-automated system.

2. Allocation of Transporter:
- The request is assigned to an available transporter based on availability and priority.
- Delays in assignment can occur due to limited manpower or inefficient systems.

3. Transport Execution:
- The transporter moves the patient from the current location to the destination department.
- Trip times vary significantly depending on the distance, department workload, and transporter availability.

4. Completion and Handover:
- Once the transport task is completed, the transporter's status changes back to "Available."
- Feedback may be collected from staff or patients for process improvement.

Slow Patient Transportation in a Hospital



Measuring Phase:

In the measure phase of the DMAIC process, we analyze the descriptive statistics from the given data to gain insights into the patient transportation process at MGX Hospital. Here's a detailed summary of the key descriptive statistics:

TRIP TIME STATISTICS:

- Mean Trip Time: 46.11 minutes
- Standard Deviation: 11.15 minutes
- Minimum Trip Time: 13.05 minutes (for X-Ray)
- Maximum Trip Time: 79.68 minutes (for Sonography)

These statistics indicate a wide range of trip times, with considerable variability around the mean.

Slow Patient Transportation in a Hospital

PRAKRIYA - The Operations Club

Department	Number of Trips	Average Trip Time (minutes)	Median Trip Time (minutes)	Standard Deviation (minutes)	Max Trip Time (minutes)	Min Trip Time (minutes)	Range (minutes)	Sum of Trip Time (minutes)
Angiography	6	42.96	48.85	14.48	53.41	16.18	37.22	257.76
Audiology	8	44.91	43.54	6.65	57.14	38.47	18.67	359.25
CT scan	12	42.16	42.02	9.21	56.51	27.48	29.03	505.95
Pathology	15	47.17	46.6	8.11	64.97	33.11	31.86	707.53
Physiotherapy	17	45.41	43.04	10.66	62.65	27.17	35.48	771.99
Sonography	18	49.74	50.05	13.17	79.68	28.63	51.06	895.24
X-Ray	24	46.4	48.23	12.85	65.88	13.05	52.82	1113.69
Overall	100	46.11	46.29	11.15	79.68	13.05	66.63	4611.39

KEY INSIGHTS FOR THE ABOVE DESCRIPTIVE STATISTICS:

1. Trip Volume by Department:

- The highest number of trips occurred in the X-Ray department (24 trips), followed by Sonography (18 trips) and Physiotherapy (17 trips).
- Angiography had the lowest number of trips (6 trips), indicating less frequent use.

2. Average Trip Time:

- The overall average trip time across all departments is approximately 46 minutes.
- Sonography has the highest average trip time (49.74 minutes), while CT scan has the lowest (42.16 minutes).

3. Variability in Trip Times:

- The standard deviation for trip times is highest for Angiography (14.48 minutes), indicating significant variability in trip durations.
- Audiology has the lowest standard deviation (6.65 minutes), suggesting more consistent trip times.

4. Maximum and Minimum Trip Times:
- The longest recorded trip time is 79.68 minutes for Sonography, while the shortest is 13.05 minutes for X-Ray.
- The range of trip times is also widest for X-Ray (52.82 minutes) and Sonography (51 minutes), highlighting potential inefficiencies or outliers.

5. Sum of Trip Times:
- X-Ray accounts for the highest total trip time (1113 minutes), followed by Sonography (895 minutes) and Physiotherapy (771 minutes).
- Angiography has the lowest total trip time (257 minutes), reflecting its lower usage.

Additionally, the histogram shows a normal distribution of trip times, with most trips falling between 38–55 minutes. This suggests that while the majority of trips are within a predictable range, outliers significantly affect the overall process.

1. Outliers:
- Maximum trip times, like 79 minutes for Sonography, may indicate inefficiencies or special cases requiring further investigation.
- Minimum trip times, such as 13 minutes for X-Ray, suggest that certain departments operate more efficiently.

2. High-priority departments:
- Based on Pareto analysis, departments like X-Ray, Sonography, Physiotherapy, and CT scan contribute to the majority of transportation activity and should be prioritized for process improvements.

OTHER DESCRIPTIVE STATISTICS:

- Highest Standard Deviation: Angiography.
- The outliers are Max of Trip Time for Pathology (64.97) and Min of trip time for X-Ray (13.05) highlight opportunities to investigate and address bottlenecks or inconsistencies.
- The trip time data follows Normal Distribution.
- Departments like Sonography and X-Ray have high variability in trip times, leading to potential scheduling challenges.
- Departments with higher volume (e.g., X-Ray) require additional resources to handle peak loads efficiently.

Analyzing Phase:

The Analyze phase of the DMAIC process focuses on identifying root causes of inefficiencies in MGX Hospital's patient transportation process by leveraging statistical tools, Pareto analysis, and ABC categorization.
First, looking upon the key observation across the different departments:

1. Trip Volume:
- The X-Ray department has the highest number of trips (24), followed by Sonography (18) and Physiotherapy (17).
- Angiography has the lowest number of trips (6), indicating less frequent use.

2. Average Trip Time:
- Sonography has the highest average trip time (49.74 minutes), indicating inefficiencies or delays.
- CT scan has the lowest average trip time (42.16 minutes), suggesting better efficiency.

3. Variability in Trip Times:
- Angiography has the highest standard deviation (14.48 minutes), showing significant inconsistencies in trip durations.
- Audiology has the lowest standard deviation (6.65 minutes), indicating more consistent performance.

4. Range of Trip Times:
- The widest range is observed in X-Ray (52.82 minutes) and Sonography (51.06 minutes), highlighting potential outliers or bottlenecks.
- The narrowest range is in Audiology (18.67 minutes), reflecting stable operations.

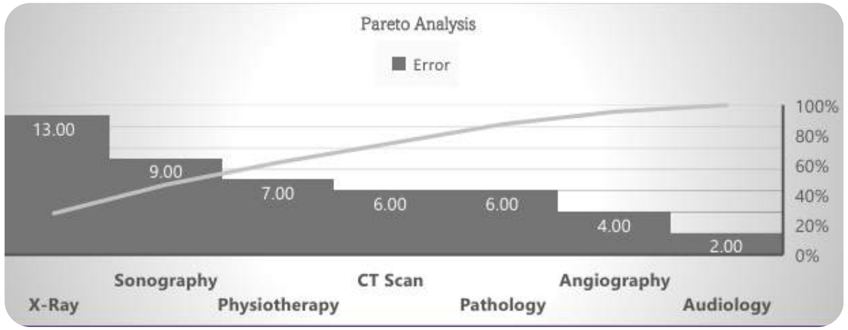
5. Outliers:
- Maximum trip time: 79.68 minutes for Sonography.
- Minimum trip time: 13.05 minutes for X-Ray.

Slow Patient Transportation in a Hospital

Narrowing down to few analyses:
1. Pareto Analysis: Pareto analysis identifies the departments contributing most to transportation inefficiencies.
Key Findings:

- Approximately 20% of causes contribute to 80% of issues.
- Departments identified as critical contributors are:

1. X-Ray
2. Sonography
3. Physiotherapy
4. CT scan



These departments account for the majority of complaints and inefficiencies, making them high-priority areas for improvement. 20% of causes contributing to 80% of issues originate from X-Ray, Sonography, Physiotherapy, and CT Scan departments.

2. ABC Categorization: ABC analysis categorizes departments based on their criticality, variability, and number of trips:

Department	Criticality Score	Category	Priority Level
X-Ray	High	A	High Priority
Sonography	High	A	High Priority
Pathology	Moderate	B	Medium Priority
CT scan	Moderate	B	Medium Priority
Angiography	Low	C	Low Priority
Physiotherapy	Low	C	Low Priority
Audiology	Low	C	Low Priority

Key Findings:

- Departments in Category A (X-Ray and Sonography) are critical and require immediate attention to address inefficiencies.
- Departments in Category B (Pathology and CT scan) show moderate issues but are not as urgent.
- Departments in Category C have lower criticality and can be addressed later.

X-Ray and Sonography departments in Category A are the top priority for issues to be addressed. They are identified as high-priority departments due to their high volume, variability, and criticality scores.
Also, Variability in trip times across departments highlights inconsistent resource utilization pointing to the process inefficiency.

Slow Patient Transportation in a Hospital

Improve Phase:

The Improve phase focuses on implementing solutions to address the inefficiencies identified during the Analyze phase. The goal is to optimize MGX Hospital's patient transportation process, reduce delays, and improve satisfaction among patients, staff, and physicians. Below is a detailed plan for improvement:

1. Hire Additional Staff:

- Assess peak-hour demand using historical trip data.
- Recruit additional transporters to handle high-demand periods.
- Train new staff on hospital protocols and efficient patient handling.

2. Implement a Token-Based Transportation System:

- A token is generated automatically when a department requests transportation.
- The system notifies the nearest available transporter.
- The patient's status changes to "On the way" when transportation begins, and "Completed" upon arrival.
- The transporter's status updates to "Available" after task completion, enabling automatic assignment of the next task.

Benefits:

1. *Reduces manual errors in request handling.*
2. *Tracks every activity for accountability and future analysis.*
3. *Provides real-time data for monitoring and optimisation.*

3. Plan Route Optimization:

- Use hospital layout maps to identify the shortest paths between departments.
- Develop optimized routes for transporters to follow.
- Implement route-testing pilots to validate improvements before full-scale deployment.

4. Relocate High-Trip Departments:

- Analyze department-wise trip volume (e.g., X-Ray: 24 trips, Sonography: 18 trips).
- If outpatient flow is higher, consider relocating departments like X-Ray closer to outpatient areas to reduce travel distances.
- Evaluate feasibility based on hospital infrastructure constraints.

Slow Patient Transportation in a Hospital

Problem	Proposed Solution	Details
Lack of Manpower	Hire Additional Staff	Increase the number of transporters to ensure availability during peak hours.
Lack of Resource Utilization	Implement a Token-Based Transportation System	Automate request generation and assignment.
		Track transporter availability and trip status in real time.
		Provide data for future optimization and reduce inefficiencies.
Inefficient Routes	Plan Route Optimization	Use hospital layout and route data to optimize transportation paths for shorter travel times.
High Outpatient Flow	Relocate High-Trip Departments Closer to OPD (Outpatient Department)	Analyze inpatient and outpatient data to determine if high-trip departments (e.g., X-Ray, Sonography) should be relocated closer to outpatient areas for operational efficiency.

By implementing these solutions systematically, MGX Hospital can address its key transportation challenges effectively. The proposed measures will streamline operations, reduce delays, and enhance satisfaction levels among all stakeholders. We can expect these following benefits from the implementation of the solution:

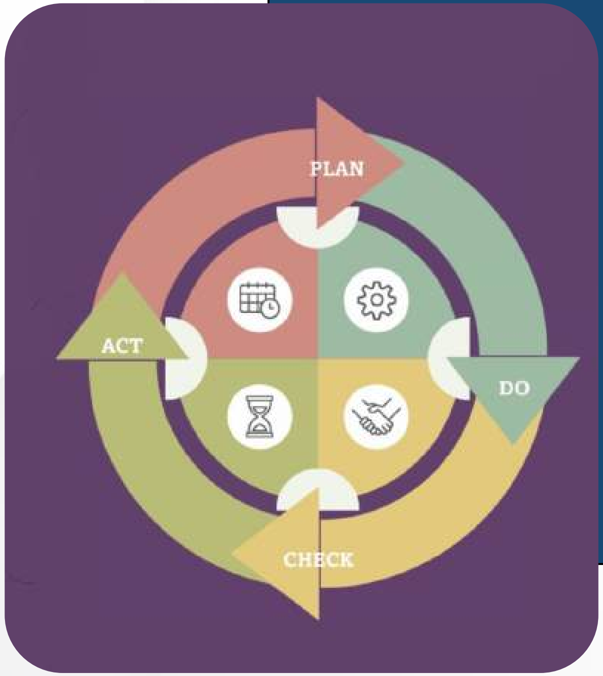
- Reduced the variability in trip times as standardized processes will minimize inconsistencies across departments (e.g., Angiography's high variability).
- Improving efficiency for high-trip departments like X-Ray and Sonography. They will benefit from optimized resource allocation and reduced travel times.
- Enhanced patient satisfaction and faster response times to lead to fewer complaints from patients, staff, and physicians.
- Data-driven decision-making in real-time will provide actionable insights for continuous improvement.

Slow Patient Transportation in a Hospital

Control Phase:

The Control phase ensures that the improvements implemented during the Improve phase are sustained over time. This involves monitoring key performance indicators (KPIs), standardizing processes, and continuously refining the system to maintain efficiency and satisfaction levels. Keys objectives would be to:

- Standardize Processes: Ensure that all departments adhere to the new transportation protocols and SOPs.
- Monitor Key Performance Indicators (KPIs): Regularly track metrics such as trip time, delay rate, and token completion rate to measure the success of improvements.
- Identify and Address Bottlenecks: Use data-driven insights to address recurring issues or inefficiencies.
- Ensure Continuous Improvement: Incorporate feedback from patients, staff, and physicians to further refine processes.



The following are the steps to be taken during the control phase:

1. Document Standard Operating Procedures (SOPs):

- Create detailed SOPs for using the token-based system, assigning transporters, and following optimized routes.
- Clearly define roles and responsibilities for transport management staff to ensure accountability.

2. Define Key Performance Indicators (KPIs):

- Average trip time for each department.
- Delay rate (percentage of trips delayed beyond acceptable limits).
- Token completion rate (percentage of trips completed as per schedule).
- Transporter utilization rate (percentage of time transporters are actively engaged).

3. Establish Control Limits:

- Use Lower Control Limits (LCL) and Upper Control Limits (UCL) for each department based on historical data:

Department	LCL	UCL
Angiography	16.18	42.96
Audiology	38.47	44.91
CT scan	27.48	42.16
Pathology	33.11	47.17
Physiotherapy	27.17	45.41
Sonography	28.63	49.74
X-Ray	13.05	46.4

4. Monitor KPIs:

- Ensure all departments use the token-based system for transportation requests.
- Launch dashboards for real-time monitoring of transporter availability, trip status, and delays.
- Visualize KPIs such as trip times, delays, transporter availability, and token completion rates in real time. Using dashboards to track average trip time, delay rates, transporter utilization rates, and token completion rates.
- Plot average trip times against LCLs and UCLs for each department to monitor process stability and analyze deviation trends from control limits (LCL/UCL) to identify potential bottlenecks or inefficiencies. Investigate trips exceeding UCLs or falling below LCLs to identify root causes.

5. Gather Feedback:

- Implement anonymous feedback forms for patients, staff, and physicians to report issues or suggest improvements. Conduct regular feedback sessions with staff, patients, and physicians to assess satisfaction levels.
- Identify recurring complaints or areas of non-compliance with SOPs. Conduct monthly review meetings with the Lean Six Sigma team to evaluate progress and discuss next steps. Reinforce training for non-compliant staff or departments.
- Perform periodic audits to ensure adherence to standardized processes. Update SOPs based on feedback or new challenges encountered during implementation.
- Use insights from KPI tracking and feedback sessions to develop additional improvement initiatives.

Slow Patient Transportation in a Hospital

The Control phase ensures that all improvements made during the project are maintained over time through proper monitoring, feedback collection, and iterative refinements. Some of the expected outcome for this implementation could be:

1. Sustained efficiency as consistent adherence to SOPs will minimize variability in trip times across departments.

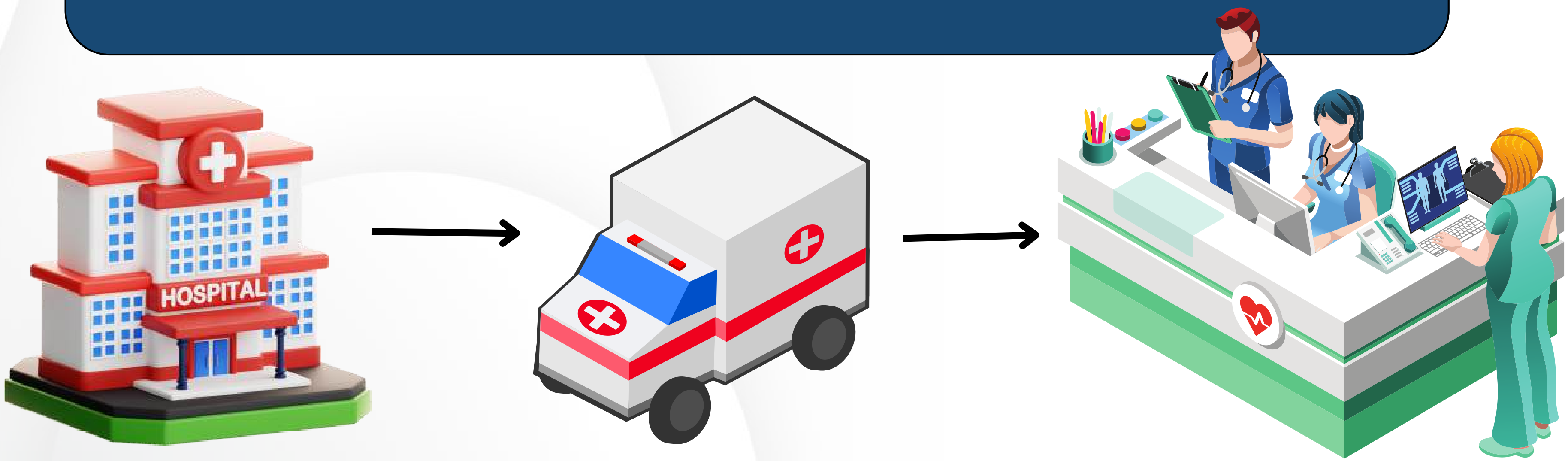
2. Improved satisfaction levels since there are faster response times and better communication through the token-based system enhancing satisfaction among patients, staff, and physicians.

3. Data-Driven decision-making due to continuous monitoring of KPIs, hence providing actionable insights for refining processes further.

4. Regular audits and control charts will gain process stability, help in maintaining stability within acceptable limits (LCL/UCL).

5. The standardized processes can be scaled for its solution across other hospital operations if needed.

By implementing these measures effectively, MGX Hospital can sustain its improved patient transportation process while enhancing operational efficiency and stakeholder satisfaction levels in the long term.



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As you close this casebook, we thank you for exploring the dynamic world of operations with us—a realm where precision, innovation, and continuous improvement drive success. Your journey through these pages is not just an end, but a stepping stone toward greater operational excellence. Please share your valuable feedback so we can refine our strategies and continue to innovate. Thank you for reading and for being an essential part of our evolution.

Operations CaseBook Feedback

-Team Prakriya

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