# Optimizing LPG Cylinder Delivery Duration Using Six Sigma Methodology

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## Abstract
Customer fulfillment and on-time delivery are now more important than ever before in today's competitive and fast-paced businesses, and both are now vital to the future survival of every business. Consumers today want effective solutions delivered directly to their fingertips and place greater emphasis on speed, ease of use, and smooth access to service than pricing. Hindustan Petroleum Corporation Limited (HPCL) has certain challenges in ensuring on-time LPG cylinder delivery, while being inspired by major corporations such as Amazon, which have established the benchmark for superior customer service. With 2,962 distributorships and over 33 million domestic customers, HPCL experiences obstacles, particularly among smaller towns where 29% of its consumer base sits. Operational efficiency has been impacted by problems like poor route planning, inconsistent loading and unloading protocols, and stock variation at inventory to find a solid solution for HPCL's B2C business segment we are provided with part of the data which service 45,000 consumers with a fleet of 2 big trucks and 12 delivery vehicles. This analysis combines the DMAIC Six Sigma methodology with smart logistics and operational approaches. Within six months, the work intends to reduce delivery times by 20%, enhancing transportation costs, and improve customer satisfaction by 10%.

## Keywords
Customer Service Centers (CSC's), Decentralized Hub Service (DHS), Liquified petroleum Gas (LPG), and Extra Managed Reserve (EMR).

## 1. Introduction
A desire to use best practices in process improvement while learning the Six Sigma methodology as part of a master's degree program is what motivated this research. Along with improving understanding of fundamental concepts, how to make use of the DMAIC (Define, Measure, Analyze, Improve, Control) methodology shows tangible benefit of organized problem-solving for businesses. The inspiration is derived from illustrating how Six Sigma, when used effectively, can result in major improvements, streamline operations, and ultimately contribute to business performance.
Hindustan Petroleum Corporation Limited (HPCL) is one of the biggest players in India's LPG distribution business and is the focus of the chosen case study. Despite with its broad footprint and robust infrastructure, HPCL still has trouble maintaining timely delivery. Operational efficiency and customer satisfaction are compromised by problems like insufficient route planning, inconsistent loading and unloading steps, and inventory variability. We are provided with part of the business which serves16 to 18 towns within a 90 km radius in India. The company handles the daily delivery of approximately 1,000 LPG cylinders, essential for domestic and commercial use. To manage this operation, HPCL utilizes a two-tier logistics system: 2 large trucks, each with a capacity of 450 cylinders, transport LPG cylinders from the refilling plant to storage facilities, and 12 smaller vehicles, each carrying 40 cylinders, distribute the cylinders to customers' doorsteps. While HPCL meets customer needs on most days, there has been increasing demand for faster deliveries, with many customers now requesting immediate service after placing their orders. This challenge is particularly pronounced for customers located over 50 km away, where meeting the company's 2-hour delivery target is difficult.

## 2. Objectives

The following objectives outline the scope and key contributions of the study:
Optimize Delivery Times**:** The goal is to optimize LPG cylinder delivery to consumers within a 50-kilometer radius by reducing the average delivery time by 20%.and meet the target of delivering cylinders within 2 hours upon booking.
Develop Scalable and Sustainable Solutions: To improve last-mile connectivity, introduce micro warehouses with current Customer Service Centers (CSC) to form decentralized service hubs (DSHs). the solutions must be flexible for wider adoption across HPCL's distribution network, particularly for small towns.
Enhance Inventory Management: Develop predictive inventory management systems that will ensure consistent availability of cylinders at distribution points and Distribution Centers. That can be achieved by allocating 10–15% surplus cylinders (EMR), to minimize stock variability.
Use of Technology for Customer Engagement: The Vitran+ App introduction provides consumers with an easier service that includes booking, online payment, real-time tracking, and feedback features on a single platform. For additional convenience, the app will have multi-language support to satisfy a variety of users.
Improve Loading Unloading methods: Simplify the distribution center's loading and unloading processes to reduce wait times and maximize vehicle usage. Introduce semi-automated tools for cylinder handling to reduce manual effort and related costs.

## 3. Literature Review

Indra (2020) investigated the use of Six Sigma DMAIC to address quality issues in the roof panel packaging process at PT TMMIN, a large automotive manufacturer. They discovered major problems such as rust and scratches using tools like Pareto analysis and Fishbone diagrams. Implementing solutions such as standard operating procedures for anti-rust spraying and improved operator training lowered the DPMO from 33,500 to 2,050 while raising the sigma level from 3.33 to 4.37. This demonstrates DMAIC's capacity to increase process stability and minimize faults, which aligns with HPCL's goal of improving LPG supply efficiency and reducing delays. Neha (2013) implemented DMAIC in a yarn manufacturing company's winding department to improve product quality and eliminate faults. To find issues, tools including control charts, Pareto analysis, and cause-and-effect diagrams were employed. Operator training, machine parameter optimization, and changes to standard operating procedures were among the solutions that raised sigma levels and reduced defect rates. These tactics highlight the value of employee involvement and process uniformity, both of which support HPCL's goals for logistical efficiency. In their investigation of Six Sigma DMAIC, Marques and Robert (2016) reduced the rate of rejection in aluminum die-casting from 72% to 20% while raising the sigma level from 2.2 to 3.4. Critical quality issues were found using important methods such as SIPOC analysis, Pareto analysis, Cause-and-Effect diagrams, and Design of Experiments (DOE). Strict quality control and molten alloy temperature adjustment were among the solutions. The focus on SIPOC analysis and CTQ identification aligns with HPCL's objectives of improving delivery quality and optimizing resource allocation.

Raman et.al., (2018) used Six Sigma DMAIC to successfully lower defect rates in the manufacturing of automobile components. The sigma level increased from 2.67 to 4.11 and defect rates decreased from 121,550 PPM to 4,263 PPM through the use of SIPOC analysis, FMEA, and process capacity evaluations. Similar to HPCL's requirement to address delivery inefficiencies, operational stability was improved via statistical process controls, condition monitoring, and adherence to SOPs. Methodically Monika and Beata (2017) used methods like root cause analysis, SMED, and TPM to increase production efficiency in a printing company's Kolbus BF 511 machine. Bottlenecks were resolved through employee training and process capability assessments, which increased output and decreased downtime. These techniques support HPCL's goals of resolving supply chain problems and ensuring on-time delivery. With an emphasis on root cause analyses such as Pareto and Cause-and-Effect diagrams, Ankesh et.al., (2023) used Six Sigma DMAIC to lower rejection rates in rubber weather strips. The sigma level rose from 3.9 to 4.45 as a result of actions including operator training and mold cleaning schedules, which decreased rejection rates from 5.5% to 3.08%. This methodical approach provides HPCL with a framework for enhancing customer satisfaction and delivery efficiency through permanent improvements.

## 4. DMAIC Methodology

Define, Measure, Analyze, Improve, and Control (DMAC) is a structured, data-driven approach to Six Sigma process improvement and quality development.
The Define phase defines the project scope and objectives, with the focus on important consumer demands and deliverables. It is crucial for establishing a clear foundation for improvement projects. Its main components include Project Charter, Voice of the Customer (VOC), Critical to Quality (CTQ) Requirements, SIPOC Diagram, Project

Scope. The Measure phase includes collecting essential data for current performance baselines and ensuring that future assessments are grounded in factual data. During the analyze phase, data gathered is used to determine the root causes of defects. Tools such as cause-and-effect diagrams and statistical analysis are utilized.
The Improve phase is the fourth step in the DMAIC methodology. It focuses on developing, testing, and implementing solutions to address the root causes of problems identified in the Analyze phase. This phase focuses on turning analysis into action by generating and selecting feasible, impactful solutions, testing them through pilots, and implementing them sustainably. The Control phase, the final step of DMAIC, ensures sustained improvements by establishing systems to monitor and prevent regression. Key concepts include process monitoring to maintain stability, standardizing procedures for consistency, and thorough documentation of improvements, control plans, and training materials. Tools like control charts track performance and reinforce long-term success.
Using the DMAIC methodology allows to improve processes, making it more efficient as well as successful.

## 5. Case Study

Hindustan Petroleum Corporation Limited (HPCL), India's biggest supplier of LPG services, encountered serious difficulties in fulfilling its ambitious two-hour delivery target, notably at one of its major distribution centers. This facility, which is responsible for distributing 1,000 LPG cylinders per day throughout 16 towns, encountered inconsistencies, resulting in delivery delays. These delays not only brought in significant consumer disappointment and a spike in complaints, but they also resulted in financial losses of almost $2,500 each day. The ongoing issue emphasized the need for operational adjustments to keep up with increased consumer expectations while decreasing the financial and reputational risks associated with these delays.

**5.1. Define:** The Define phase in the DMAIC process is important for establishing a clear foundation for improvement projects. Business has a two-tier delivery system to deliver LPG cylinders from the refilling plant to Consumer. Process Includes, 2 trucks which transport 450 cylinders each, while 12 smaller vehicles with capacity of 40 cylinders each deliver to customers doorsteps. Approximately 180 consumers (18% of daily deliveries) do not receive their LPG cylinders on time. This issue get worst during peak demand hours. Due to this, the Business is always under pressure of losing loyal consumers to competitors. For this distribution area company is losing between $1,000 and $2,000/Month because of the delays in deliveries. Constant delivery delays are resulting in negative consumer feedback and potential loss of repeat business. Resolving these issues is important for the Business. We must identify a solution that improves delivery efficiency, restores customer trust, and promotes company reputation. The goal here is to reduce delivery times and ensure that 95% of LPG cylinders are delivered within 2 hours over the next 6 months. To get to the bottom of this, we held several meetings with distributorship staff to find the main causes of these delays. There have been several inconsistencies in the operational process. The entire system, from trucks arriving at the storage facility to cylinders being delivered to customers, required to be broken down into smaller phases to identify the main reasons at each stage. To achieve the goal, company will need to analyze its delivery operations, optimize routes, increase capacity, and maybe introduce real-time tracking Service. Success in this program will result in better retention of consumers, improved brand reputation, and Long-term operational efficiency.

Table 1 SIPOC Analysis

| Supplier | Input | Process | Output | Consumer |
|---|---|---|---|---|
| HPCL Refilling Plant | LPG Cylinders | 1.Receive cylinders from refilling plant | Delivered LPG cylinders | End Consumers |
| Vehicle Maintenance | Delivery Trucks and Small Vehicles | 2.Load Cylinders onto trucks | Customer Satisfaction and Feedback | HPCL Management |
| Warehouse Inventory Management | Delivery orders | 3.Transport cylinders to inventory | Updated Delivery Records | HPCL (for tracking) |
| | Fuel for Vehicles | 4.Assign small vehicles for deliveries | | |

| | | | | |
|---|---|---|---|---|
| | Route Planning Information | Deliver cylinders to customers | | |
| | | Record delivery completion and feedback | | |

**5.2. Measure:** In Measure Phase, we mainly focus on collecting and analyzing quantitative data to determine current delivery performance levels. To ensure precision, accuracy, and consistency in data interpretation and reporting, the following key operational steps have needed to be implemented

**Operational definitions:**

Order Placement Time stamp marks that give us exact time when order is placed, while Delivery Completion Time stamp indicates when it is delivered. Delivery Duration is calculated as the difference between the delivery completion timestamp and the order placement timestamp, showing the time taken to complete the customer's orders. A limit was set to separate delivery into short and long-distance categories. Deliveries that exceed 50 kilometers are classified as long-distance, which aids in the examination of the effect of travel distance on delivery times. These definitions provide a framework for analyzing and improving delivery performance.

**Data Collection Plan:**

We develop well-structured data collecting plan for collecting significant (around 1,32,000 Entries) and relevant data entries on delivery times. The primary goal was to establish a valid baseline for delivery durations, identify bottlenecks, and offer practical solutions to reduce delivery times.

**Data Requirements:**

Order Date and Time: A timestamp indicating the start of the delivery process.

Delivery Date and Time: A timestamp when order is delivered.

Area: Delivery area/ location and distance from distribution center

Delivery Staff: Details about delivery man.

**Data Sources and Collection Methods:**

Data was collected from the company's distribution center system, which records particularly orders and delivery timestamps. Automated database queries were used to assure the correctness of the data, minimizing errors.

Sample Size and Period: Yearly data was captured and then data was filtered to 400-500 records for desired month in which deliveries are consistent. This sample size was then filtered, and data cleaning is performed for examining trends and fluctuations in delivery times.

**Data Analysis Plan:**

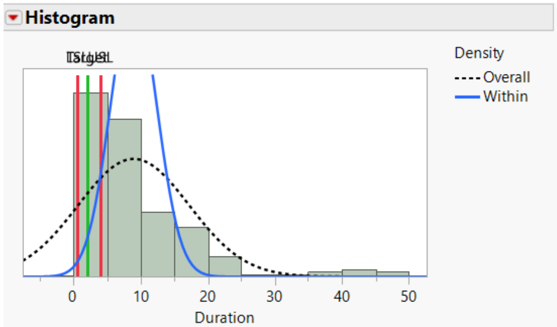
The collected data was examined using a combination of statistical and graphical Analysis to visualize trends and underlying reasons of delays.

Descriptive Statistics: Standard measurements such as mean, median, and standard deviation were calculated to better understand average delivery durations and their variability.

Visualization: The distribution of delivery times was placed on histograms and line charts, focusing on trends and outliers.

Process Mapping: To detect bottlenecks and delays, an detailed process map was created that explains every step of the delivery process, from ordering to final delivery.

Root Cause Analysis: A Fishbone Diagram was used to categorize potential reasons of delays.




**Process Summary**

| | |
|---|---|
| LSL | 0.5 |
| Target | 2 |
| USL | 4 |
| N | 949 |
| Sample Mean | 8.947937 |
| Within Sigma | 3.456925 |
| Overall Sigma | 8.272524 |
| Stability Index | 2.39303 |

Within sigma estimated by average moving range.

**Within Sigma Capability**

| Index | Estimate | Lower 95% | Upper 95% |
|---|---|---|---|
| Cpk | -0.477 | -0.512 | -0.443 |
| Cpl | 0.815 | 0.763 | 0.866 |
| Cpu | -0.477 | -0.512 | -0.442 |
| Cp | 0.169 | 0.159 | 0.178 |
| Cpm | 0.064 | . | . |

**Overall Sigma Capability**

| Index | Estimate | Lower 95% | Upper 95% |
|---|---|---|---|
| Ppk | -0.199 | -0.222 | -0.176 |
| Ppl | 0.340 | 0.314 | 0.367 |
| Ppu | -0.199 | -0.222 | -0.176 |
| Pp | 0.071 | 0.067 | 0.074 |
| Cpm | 0.046 | . | . |

**Nonconformance**

| Portion | Observed % | Expected Within % | Expected Overall % |
|---|---|---|---|
| Below LSL | 2.7397 | 0.7267 | 15.3579 |
| Above USL | 71.3383 | 92.3830 | 72.5119 |
| Total Outside | 74.0780 | 93.1097 | 87.8698 |

Figure 1. Current process Capability

The data shows an important variation in delivery times, ranging from -4 to 48 hours, with an average of 8.95 hours and a standard deviation of 8.27 hours, indicating a high level of inconsistency. The average delivery time is 6.7 hours, with 25% finished in less than 3.7 hours and another 25% taking more than 11.5 hours. The process capability indices (Cpk and Cp) are both less than 0.5, and Ppk is -0.199, suggesting a considerable misalignment with the target delivery time of two hours. More than 71% of deliveries exceed the upper specification limit of 4 hours. The occurrence of a multimodal distribution with maxima at 5, 14, and 41 hours indicates distinct delivery trends or underlying causes of delays, such as inefficiencies in route planning, varied driver performance, and operational challenges require specific changes.

**5.3. Analyze:** The main objectives of the Analyze phase are to use data and analytical tools to uncover what is causing the issues identified in the Define and Measure phases. To identify the root causes of delivery inefficiencies, we broke down the entire delivery process into smaller, more controllable components. The most helpful tool for reading the reasons is a fishbone diagram. To identify potential causes of delays, we conducted a brainstorming session involving key team members, from delivery staff to management. The main areas identified are detailed below, along with specific factors within each category.

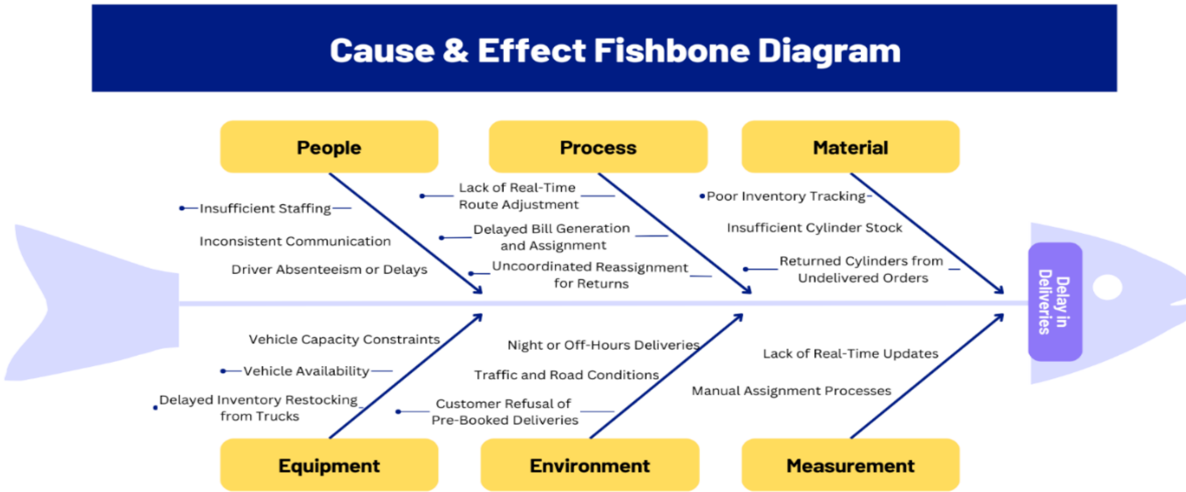



Figure 2. Fishbone Diagram

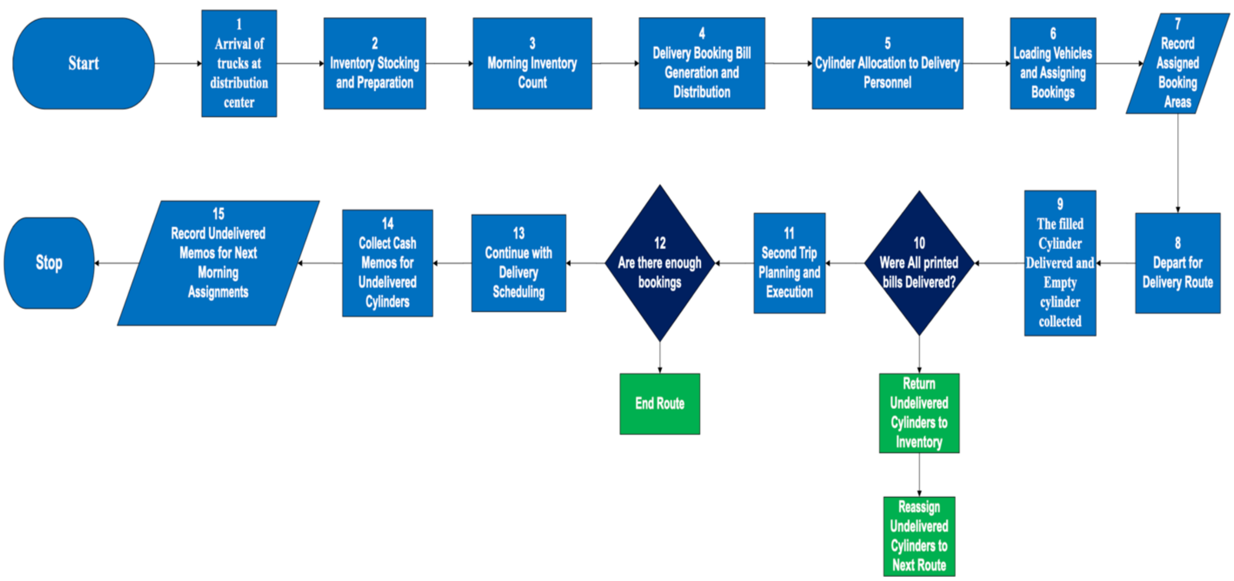



Figure 3 Detailed Process Map

**People**: Insufficient delivery staff during peak times leads to delays, as available drivers are often overloaded with too many deliveries. Late arrivals of drivers in the morning delay the start of the delivery schedule, impacting efficiency.

**Process:** Poorly optimized scheduling is wasting time by failing to prioritize deliveries based on proximity of the delivery area from distribution center and urgency of booking, which leads to Poorly planned routes. Moreover, following fixed routes sometimes leads to unnecessary delays because it cannot adjust to real-time conditions like traffic. Day start operations, such as the Delay in generating and distribution of booking bills, will impact on dispatch and disrupt delivery schedules. Creating manual route reassignments for second trips or returned cylinders further reduces overall efficiency and delivery speed overall.

**Materials:** A shortage of filled cylinders during peak hours often causes delays, as drivers must wait for restocking the cylinders in Distribution center. Additionally, as there is no inventory tracking system of filled and empty cylinders, that often leads to supply mismatches, which further increasing driver idle time and disrupting the delivery process.

**Equipment:** A limited number of delivery vehicles during high-demand periods
forces drivers to wait for available vehicles. Vehicle loading and unloading is perform traditionally using manpower only. Inefficient vehicle loading can result in underloaded or overloaded vehicles, leading to more trips and potential delays.

**Environment:** Driving on narrow or blocked roads takes extra time, adding to delivery delays. Bookings scheduled for night or off-hours may face delays due to reduced staffing and limited resources.

**Measurement:** Assigning efficient delivery routes makes it difficult to identify recurring issues, while the lack of real-time tracking for consumers stalls quick adjustments to routes. Additionally, relying on manual processes for order assignments and tracking often leads to delays caused by human error and slower processing times.

**5.4. Improve Phase**: The Improve Phase of our Six Sigma DMAIC process focused on implementing targeted solutions that we have concentrated to address the root causes identified during the Analyze Phase. The focus is to streamline LPG cylinder delivery operations, reduce delivery times, and enhance customer satisfaction. This section outlines the key improvements, their implementation strategies, and the anticipated benefits. We came up with innovative and implementable improvements and their expected effects:

1. Decentralized Service Hubs (DSH) using exciting CSC’s:
Concept:
Hybrid centers that merge the functions of Customer Service Centers (CSCs) and micro-warehouses in areas with high demand.
Implementation:
Partnered, make official agreement with local CSC centers to manage bookings, distribution of stock, and coordination with customers.
Provide training for staff in CSCs and establish accountability through centralized verification of delivery invoices.
Partner with local delivery personnel and maintain a localized stock of cylinders for faster last-mile deliveries.
Impact:
Decreases last-mile delivery times by 32%.
Improves accessibility in rural communities.
Reduces operational expenses without sacrificing service quality.

2. Enhanced Buffer Stocking with Predictive Replenishment
Concept:
Introduce a predictive inventory system, EMR (Extra Managed Reserve), to avert stock shortages during peak demand periods.
Implementation:
Leverage historical data and seasonal patterns for forecasting demand.
Set aside a rolling buffer stock (10–15% of additional cylinders) for critical periods.
Utilize RFID tracking and automated replenishment triggers for real-time inventory oversight.
Impact:
Lowers inventory-related delivery delays by 80%.
Guarantees stable supply chain performance during high-demand phases.

3. Vitran+ App for Digital Transformation
Concept:
A digital platform that allows real-time tracking, booking, payment processing, and customer feedback.
Implementation:
Launch all in one service app featuring GPS-based route optimization and adaptive rerouting capabilities. Offer support in multiple languages to accommodate diverse users.
Impact:
Enables drivers to accomplish 14% more deliveries on a daily basis.
Decreases delivery times by 20% through optimized routing.

Encourage transparency by delivering cylinders to customers who actually booked the cylinder and trust with real-time tracking and feedback mechanisms.

4. Optimized Delivery Attempts
Concept: A dual-level delivery attempt strategy that gives one extra attempt of delivery to consumer to receive the cylinder in case they were not able to receive in first attempt
Provide alternative delivery solutions, including local pickup points for undelivered cylinders.
Mandate confirmations prior to rescheduling delivery attempts to minimize unsuccessful deliveries.
Impact:
Cuts down repeated delivery attempts by 40%.
Improves customer satisfaction through more flexible delivery options.

Table 2. PUGH Matrix

| | Baseline | Solution 1 | Solution 2 | Solution 3 | Solution 4 |
|---|---|---|---|---|---|
| Criteria | Current Process | DSH | Predictive Inventory Stocking | Route Panning | Vitran App |
| Feasibility | 5 | 1 | 1 | 0 | 1 |
| Cost | 4 | 1 | 0 | 1 | 0 |
| Long term benefits | 1 | 1 | 1 | 0 | 1 |
| Maintainability | 3 | 0 | 1 | 1 | 1 |
| Resource Availability | 2 | 1 | 0 | 1 | 0 |
| Sum of all Positives | | 4 | 3 | 3 | 3 |
| Sum of all Negatives | | 0 | 0 | 0 | 0 |
| Sum of all Neutrals | | 0 | 0 | 0 | 0 |
| Totals | | 4 | 3 | 3 | 3 |

**5.5. Control Phase:** The Control Phase aims to verify that the solutions suggested in the Improve Phase will remain effective over time. In Control Phase creating simple, reliable monitoring systems, checklists, and documentation to keep the improvements because the solutions have not yet been applied in real-world situations.

**Operational Checklist for Daily Operations:**

1. Morning Stock Inspections:
- ✓ Are both filled and empty cylinders inspected for quality and quantity at the beginning of the day?
- ✓ Is there a clear inventory log for all cylinders (both filled and empty)?
  Route Assignments and Efficiency:
- ✓ Are route assignments reviewed and optimized for maximum delivery efficiency each day?

2. Vehicle Preparedness:
- ✓ Are any vehicles requiring maintenance flagged and taken offline for servicing?
  Cylinder Distribution to CSCs and Record Count:
- ✓ Are CSCs notified of their daily or weekly cylinder requirements based on inventory and demand?
- ✓ Is a copy of the distribution record provided by the CSC are kept for company records?
- ✓ At the end of each day, are the empty cylinders reconciled against the deliveries for the day's booking?

3. End-of-Day Delivery Bill Validation:
- ✓ Are delivery bills reviewed at the end of the day for accuracy?
- ✓ Is there a system in place to ensure that any undelivered orders are tracked and documented for future action?

4. Order Updates and Prioritization:

- ✓ re regular updates provided on orders that have not been delivered, to rank them for prioritization the next day.
- ✓ Is there a process for re-prioritizing urgent or emergency orders
  Regular updates on orders that have not been delivered to rank them for the next day.
- ✓ Cylinder distribution to CSC's and record count of distributed cylinder

5. Performance Monitoring Metrics

- ✓ Delivery time per cylinder on average i.e., target: less than two hours
- ✓ 10–15% buffer stock as EMR are maintained for peak seasons
- ✓ Measurements of route efficiency and fuel consumption.
- ✓ Measures for Sustainability
- ✓ Work together with CSCs to ensure there working is according to standards and rule specified.
- ✓ Review financial and operations daily to make sure they are in line with the objectives.

**Brainstorming Results:**
A brainstorming session revealed key delivery inefficiencies. Delays occur when customers aren't home, pushing orders to the next day, and inefficient route utilization causes drivers to wait for enough bookings before proceeding. Vehicle and supply chain delays, such as maintenance or traffic affecting cylinder trucks, further disrupt schedules. Route planning gaps, where clustered and outlying orders are mixed, force drivers to deviate from efficient paths. Additionally, single-cylinder dependency creates urgency when customers run out, leading to unplanned requests. Encouraging customers to maintain a second cylinder could balance demand, streamline planning, and enhance delivery efficiency across all operations.

## 6. Conclusion and Future Work

**Conclusion:** After successfully showcased the application of Six Sigma's DMAIC methodology in solving real-world operational challenges within HPCL's LPG delivery network, this approach identifies inefficiencies and also provided actionable solutions to improve delivery speed, customer satisfaction, and cost-effectiveness. By integrating advanced tools like predictive inventory management, dynamic route optimization, and a user-friendly digital platform, this project has laid the groundwork for a more robust and customer-centric delivery system.

**Future Work**: Our project focuses on a segment of the business that currently manages 45,000 customer holdings. Upon successful implementation and practical validation during the control phase, and after establishing standardized operations, we will seek approval from the company to expand these developments across all distribution channels. This includes 2,962 distribution points, enabling the company to apply these strategies in alignment with their infrastructure, delivery capabilities, and customer requirements. This expansion is expected to significantly enhance customer satisfaction for the 33 million consumers, positioning the company to set a new benchmark in the market.

- ✓ Implement the proposed solutions, Vitran+ App and Decentralized Service Hubs, in a pilot phase to measure their actual impact.
- ✓ Scaling the solutions to other HPCL distributorships across different geographies to replicate the success
- ✓ Using AI and machine learning to refine predictive inventory systems and improve route planning further.

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## Biographies

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**Shiva Kumar Bogavalli** has a bachelor's degree in mechanical engineering, now pursuing a master's in engineering management at California State University. I previously worked as a Design Engineer in the manufacturing sector, specializing in AutoCAD 3D designs and prototyping.

**Shubham Suryavanshi** is a graduate in Mechanical Engineering, currently pursuing a master's in engineering management at California State University. As an entrepreneur with expertise in operations and business analytics, successfully handled projects for renowned organizations like IBM and Amazon.

**Sepideh Abolghasem** holds the position of Associate Professor in the Manufacturing Systems Engineering and Management Department. She was previously an Associate Professor at the University of Los Andes in Bogotá, Colombia, in the Department of Industrial Engineering. Dr. Sepideh Abolghasem received her M.Sc. and Ph.D. in Industrial Engineering from the University of Pittsburgh, and her B.Sc. in Industrial Engineering from Sharif University of Technology in Tehran, Iran. Her main areas of interest in study include the nexus between materials science and operations research. Her research focuses on the machining manufacturing process and examines the complex interactions between material microstructures and process factors. She has advanced knowledge that enhances material performance and production efficiency through this research. Dr. Sepideh Abolghasem has broadened the scope of her study in recent years to include the prediction of material properties through the combination of simulation models and machine learning approaches. This novel method allows for more accurate predictions of material behavior, which has ramifications for materials research and industry. As a faculty adviser for the Institute of Industrial and Systems Engineers (IISE) and a representative of Latin America on INFORMS' International Activities Committee, Dr. Sepideh Abolghasem has been a dynamic pioneer in her field. She is regarded as a respected figure in the field of industrial engineering and manufacturing systems because of her commitment to mentoring, research, and international collaboration.