Optimizing Production Efficiency and Data Management in Hydraulic Manifold Manufacturing

A Proposal report for the BDM capstone Project

Submitted by

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Contents

Declaration Statement

I am working on a Project Title “Optimizing Production Efficiency and Data Management in Hydraulic Manifold Manufacturing”. I extend my appreciation to Dynamic Hydraulic Services, for providing the necessary resources that enabled me to conduct my project.

I hereby assert that the data presented and assessed in this project report is genuine and precise to the utmost extent of my knowledge and capabilities. The data has been gathered through primary sources and carefully analysed to assure its reliability.

Additionally, I affirm that all procedures employed for the purpose of data collection and analysis have been duly explained in this report. The outcomes and inferences derived from the data are an accurate depiction of the findings acquired through thorough analytical procedures.

I am dedicated to adhering to the information of academic honesty and integrity, and I am receptive to any additional examination or validation of the data contained in this project report.

I understand that the execution of this project is intended for individual completion and is not to be undertaken collectively. I thus affirm that I am not engaged in any form of collaboration with other individuals, and that all the work undertaken has been solely conducted by me. In the event that plagiarism is detected in the report at any stage of the project's completion, I am fully aware and prepared to accept disciplinary measures imposed by the relevant authority.

I agree that all the recommendations are business-specific and limited to this project exclusively, and cannot be utilized for any other purpose with an IIT Madras tag. I understand that IIT Madras does not endorse this.

Signature of Candidate: (Digital Signature)

Name: S Sharmile

Date: 03/02/2025

1. Executive Summary and Title

Dynamic Hydraulic Services is a small-scale mechanical manufacturing company located at Mannurpet, Chennai specializing in hydraulic manifolds—both custom and standard designs. Operating for over 20 years, the company primarily serves the B2B and B2C sectors in the manufacturing industry. The workflow involves order placement, raw material delivery, production (multiple machining processes), quality checks, packing, and delivery.

The company faces several critical challenges that impact its efficiency and profitability. These include machine breakdowns, power cuts, tool failures, and inventory mismanagement leading to material wastage. Additionally, deviations in product dimensions result in rejections, affecting customer satisfaction. Furthermore, a lack of structured data tracking results in delivery delays and inefficiencies in order management.

This project aims to analyse production inefficiencies, improve inventory management, and implement a structured data-tracking system. This study will be conducted through primary data collection, including direct observations and existing inventory data analysis. The expected outcomes include optimized production processes, waste reduction, cost minimization, and enhanced customer satisfaction, ultimately leading to increased profitability and growth.

2. Organization Background

Dynamic Hydraulic Services is a small-scale mechanical manufacturing company specializing in hydraulic manifold production. Established over 20 years ago, the company caters to both industrial (B2B) and individual (B2C) clients.

The company's primary revenue source is machining labour charges from industrial customers. It operates with a daily production capacity of one manifold and follows a structured workflow that includes order placement, raw material handling, machining (softening, shaping, marking, drilling, tapping, chamfering, quality checks, surface grinding, and coating), packing, and delivery.

With its expertise in producing both custom and standard-designed manifolds, the company has built a strong presence in the manufacturing segment, delivering precision-engineered hydraulic components to its clients.

3. Problem Statement

3.1 Problem 1: Production Inefficiencies Affecting Profitability

- Machine breakdowns and power failures lead to delays, reducing overall production output and revenue.
- Frequent tool failures (e.g., drill bit breakage) increase downtime and maintenance costs.

3.2 Problem 2: Inventory Mismanagement Causing Financial Loss

- Incorrect designs result in wasted raw materials, leading to increased operational costs.
- Lack of stock tracking results in over-purchasing or stock shortages, impacting cash flow.

3.3 Problem 3: Customer Retention and Revenue Loss

- Dimensional deviations lead to order rejections, reducing customer satisfaction and repeat business.
- Inconsistent delivery timelines harm the company's reputation, affecting future sales.

4. Background of the Problem

Dynamic Hydraulic Services has relied on manual processes for production and inventory management, leading to frequent inefficiencies and financial losses. The industry requires high precision, and even slight deviations in dimensions can result in product rejection, impacting revenue and customer satisfaction.

The company faces challenges in handling unexpected machine failures and power cuts, leading to production downtime and delays. Additionally, incorrect machining leads to material wastage, increasing costs. Since no formal inventory tracking system is in place, repeated mistakes occur, reducing efficiency and profitability.

To address these issues, this study aims to analyse key inefficiencies, propose inventory optimization techniques, and suggest improvements in production planning to enhance operational efficiency and business profitability.

5. Problem-Solving Approach

5.1 Data Collection Methods

- Production Logs & Downtime Data: Manual records of machine usage time, breakdown occurrences, and repair times. (Source: Business owner's logs)
- Defect & Rejection Records: Records of product rejections and deviations from design specifications. (Source: Quality check reports)
- Inventory Usage & Scrap Rates: Data on material wastage and incorrectly machined products. (Source: Inventory records and scrap reports)
- Customer Feedback & Order Timelines: Information on delayed deliveries and customer complaints. (Source: Order tracking records and customer discussions)

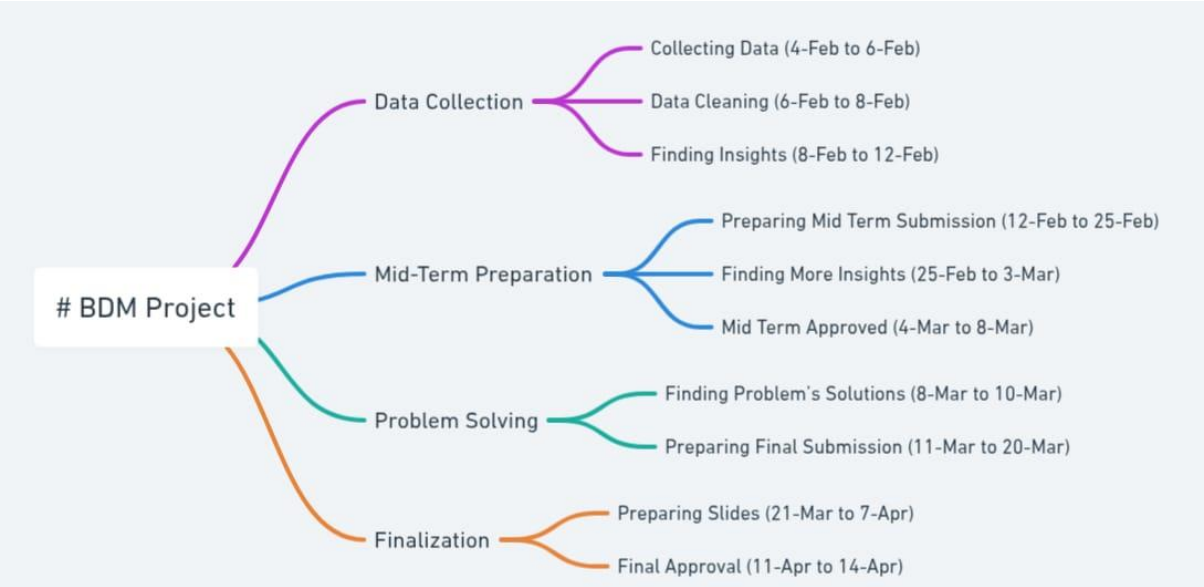
5.2 Data Analysis Tools & Techniques

- Excel (Pivot Tables, Charts) & Python (Pandas, Matplotlib): For summarizing and visualizing production inefficiencies.
- Descriptive Statistics: To analyse defect rates, machine downtime frequency, and material wastage percentages.
- Pareto Analysis: To identify the most common causes of defects and delays.
- Root Cause Analysis (5 Whys, Fishbone Diagram): To pinpoint key production inefficiencies.

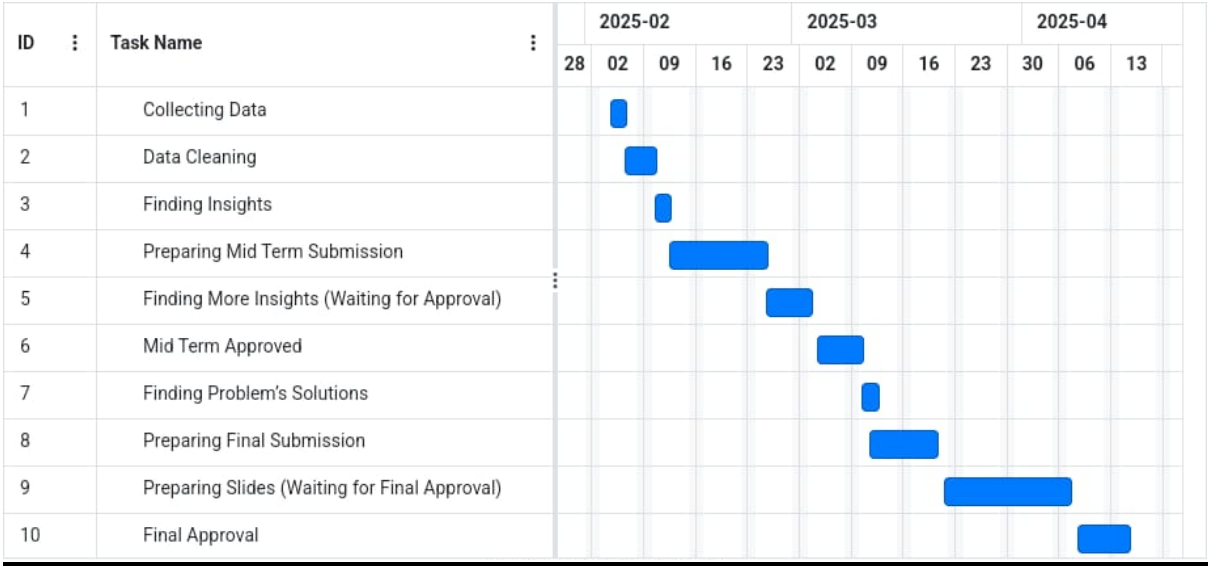
5.3 Proposed Solutions & Justifications

- Preventive Maintenance Scheduling: Using downtime logs to schedule timely machine maintenance and reduce failures.
- Defect Reduction through Process Optimization: Identifying recurring defects and improving machining accuracy to minimize rejections.
- Inventory Waste Minimization: Analysing material wastage data to optimize raw material usage.
- Order Fulfilment Improvement: Using order delay records to refine workflow and ensure timely deliveries.

6. Expected Timeline



Picture 1.1: Work based structure of expected timeline of completion of project



Picture 1.2: Gantt chart of expected timeline of completion of project

7. Expected Outcome

- Better inventory tracking through software-based order management.
- Reduced production downtime due to improved machine maintenance.
- Minimized material wastage by repurposing incorrect designs.
- Improved customer satisfaction through accurate production and timely deliveries.
- Higher profitability through cost-saving and process optimization.