STREAMLINING THE WORKFLOW FOR MAXIMUM PRODUCTIVITY

A Midterm Submission report for the BDM capstone Project

Report by

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EXECUTIVE SUMMARY

The objective of this project is to suggest recommendations for SHREEVARI ENERGY SYSTEMS (P) Ltd, a blade tool manufacturing company, to enhance its productivity by streamlining the workflows during production. For this purpose, the necessary datas like, production stages, defect rates, and operational inefficiencies are collected and analyzed.

An in-person factory visit was conducted to gather essential information about the factory operations and workforce. Observations were made on the workplace and key factors, such as the production process, workforce dynamics, and raw material availability.

This report begins with an exploration of various data, including a detailed description of the data collection process. Multiple factors hindering the achievement of monthly targets were analyzed. Additionally, a video conference was conducted with Mr. L. Sanjay Gandhi, Head of Quality and EHS at Shreevari Energy Systems, during which insights on the factory layout, workforce, and supplier-customer details were shared. Snapshots of the factory and work areas are also included for reference.

The groundwork for this analysis includes Pareto analysis and process mapping, supplemented by trend analysis, to better understand the root causes of deviations from production targets. These insights aim to address current issues while paving the way for long-term growth and enhanced operational efficiency.

PROOF OF ORGINALITY OF COLLECTED DATA

The datas are collected directly from the production head department by 3 days of in-person visit to the factory and conversation with the Assistant General Manager. The details of workflow process, manpower, factory size, business details, time plan for reaching the targets were gathered.

Given below are the pictures of BLADE TOOL which is the supporting component for transportation of Tower's blade. The main product that is manufactured in the Shreevari energy systems is the blade tool component (Fig. 1, 2 & 3). By this report the manufacturing process of blade tool right from raw materials to complete product is fully analyzed time to time with the historical datas.

Fig. 1: Blade Tool Finished Product Front View

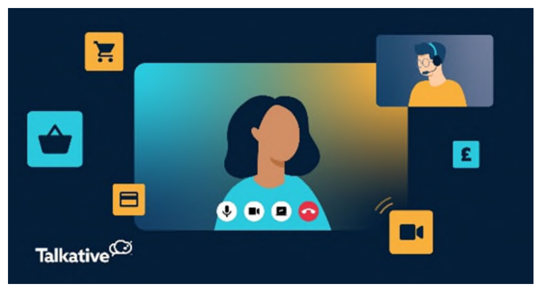
Fig. 2: Blade Tool Finished Product Side View

Fig. 3: Blade Tool Dispatch

The more pictures & videos are included in the drive: 📂 (or)
https://drive.google.com/drive/folders/1BQoR2hJxxi206469QLX3sxwcc7zRDVyY?usp=drive_link

The letter from the company (Fig. 4) & the conversation with the company AGM are enclosed here:

Fig. 4: Acknowledgement Letter



Interaction Video (Please click above)

META DATA AND DESCRIPTIVE STATISTICS

Work Force Interaction:

I have conducted the survey among the workers to understand better about the difficulties that they are facing in achieving the production target (refer fig 5).

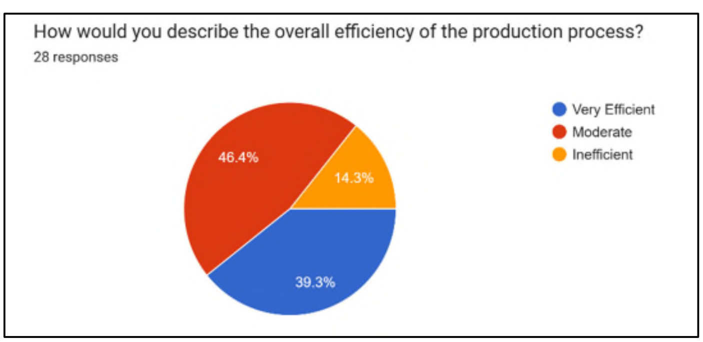


Fig. 5: Employee Survey for Process Efficiency

Survey Question & Responses are Attached Here:

Please click here →

Shop Floor Observation:

The below given are the various process that are followed in the blade tool production. From the factory shop floor visit, it was understood that all these are manual process not semi/fully automated.

Table 1: Production Process with Operation mode

S. No	Process	Type
1	Raw Material Inspection	Manual
2	Marking	Manual
3	Cutting	Manual
4	Fitup	Manual
5	Fitup Inspection	Manual
6	Welding	Manual
7	Visual Inspection	Manual
8	Final Dimension	Manual
9	Blasting	Manual
10	Painting	Manual
11	Stencilling / Anme plate Fixing	Manual
12	Assembly / Rubber Fixing	Manual
13	Final inspection	Manual
14	DCN	Manual
15	Dispatch	Manual

Production process Understanding:

Among the different process involved, The Fitting, Welding, Blasting & Painting are the process where most of the defects are found. The below given survey chart shows the major defect contributor (refer fig 6).

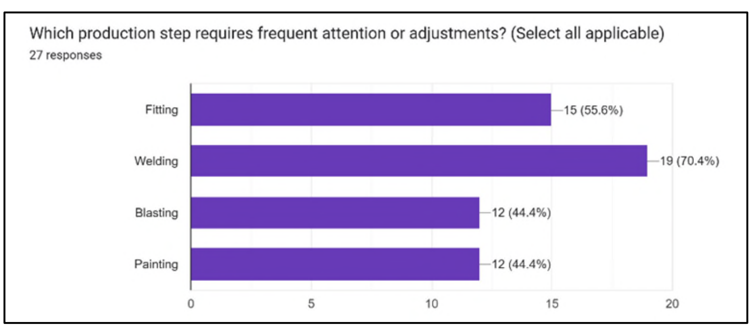


Fig. 6: Employee Survey for Rework

Raw Materials Used:

The list given below are the raw material requirements to produce the blade tool.

Fig. 7: Raw Material

- ERW Square/Rectangle Hallow Section
- Plate (Thk - 12,10,16mm)
- Rod (Dia - 12,20,60,100mm)
- Weldable Eye Bolt
- Rubber
- Toolbox Sealing
- Fastener (Nut, Bolt, Rivet & Washer)
- Name Plate
- Dentrite Paste

Production Plan vs Actual Analysis:

The following analysis evaluates the production performance over the five-month period from July to November 2024, highlighting the productivity trends, shortfalls, and areas of improvement.

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Table 2: Monthly Target & Achievement

Plan vs Actual				
Month	Target Qty	Achieved Qty	Productivity %	Observations
Jul-24	40	28	70	The productivity was the lowest during July, potentially due to initial process inefficiencies and a learning curve.
Aug-24	80	67	83.75	Productivity improved, reflecting better alignment of resources and minor optimizations.
Sep-24	80	76	95	Peak performance was achieved, indicating stable operations and effective use of manpower and machinery.
Oct-24	100	94	94	Productivity remained high, but the slight shortfall suggests capacity limitations or unforeseen delays.
Nov-24	100	85	85	A decline in productivity due to seasonal factors (e.g., weather) and resource availability.

Production Process Lead Time:

Below is the breakdown of the total time taken for the production process, detailing each stage and its respective duration. This analysis identifies potential roadblocks and areas for improvement to optimize efficiency.

Table 3: Production Process with Lead Time

Process		Time (in Hrs)	Observations
1	Raw Material Inspection	2	Delays caused by inconsistent raw material quality from suppliers.
2	Marking	1	Manual marking increases time, automation can reduce delays
3	Cutting	2	Non-availability of advanced machinery like CNC increases manual effort.
4	Fitup	3	Skilled labor shortages result in inefficiencies.
5	Fitup Inspection	1	Inspection times are consistent but can be streamlined with better tools.
6	Welding	5	Welding defects are significant, leading to rework and increased processing time.
7	Visual Inspection	1	Manual inspection prone to errors; can be enhanced with automated systems.
8	Final Dimension	1	Often delayed due to earlier process inefficiencies.
9	Blasting	2	Seasonal delays during monsoon periods due to open blasting yards.
10	Painting	2	Rain affects painting quality and increases rework.
11	Stencilling / Anme plate Fixing	1	Minor but necessary step, dependent on previous stages being on schedule.
12	Assembly / Rubber Fixing	1	Relatively efficient but dependent on timely completion of earlier stages.
13	Final inspection	0.5	Consistent; bottlenecks earlier in the process reduce its efficiency.
14	DCN	-	-
15	Dispatch	0.5	Timely dispatch depends on all prior processes completing on schedule.
Total		23	Current operational model is time-intensive and requires optimization.

Cost Breakdown:

- Raw Materials: 40% of purchase order costs, sourced primarily from NKK Tubes.
- Consumables: 20%, including welding electrodes, grinding wheels, blasting grids, paint, and bolts.
- Labor Costs: 10% allocated to contractor salaries.
- Overheads: 20%, covering staff salaries, transportation, electricity, generator diesel, and crane rentals,etc.
- Profit Margin: Approximately 10%.

Shift and Workforce Analysis:

- Day Shift: Raw material processing to fit-up, involving 40 technicians, 6 staff, 4 QC personnel, and administrative staff.
- Night Shift: Focuses on welding operations, with 10 technicians, 1 QC, and 1 staff.

DETAILED ANALYSIS PROCESS/METHOD

To enhance productivity and operational efficiency at SHREEVARI ENERGY SYSTEMS (P) Ltd, the following comprehensive methodology was applied:

1. Data Collection and Verification

- Conducted a three-day in-person factory visit and consultations with the Assistant General Manager (AGM), Mr. Sanjay Gandhi, to gather operational data.
- Collected production-related data, such as process times, defect rates, manpower allocation, and raw material supply, ensuring authenticity through direct observations and internal records.
- Supplemented data with insights from a video conference with Mr. L. Sanjay Gandhi, Head of Quality and EHS.

2. Shop Floor Observation

- Documented each production stage from raw material inspection to dispatch, identifying bottlenecks and dependencies. All processes were observed to be manual.
- Focused on defect-prone stages: fit-up, welding, blasting, and painting, which accounted for significant delays and quality issues.

3. Statistical and Analytical Tools

Pareto Analysis: Identified high-impact inefficiencies, such as welding delays and seasonal impacts on blasting and painting.

Process Mapping and Lead-Time Analysis: Mapped production stages to calculate the total lead time (23 hours) and pinpoint manual processes for automation opportunities.

Trend Analysis: Assessed monthly productivity trends (July-November 2024), noting fluctuations linked to workforce efficiency, material availability, and seasonal factors.

Defect Breakdown Analysis: Analyzed major contributors to defects across processes to address quality and time losses:

- Welding (40% of total defects): Defects arise from untrained labor, fatigue, and lack of proper equipment.
- Fit-up (30% of total defects): Manual processes and skill gaps result in misalignments and rework.
- Blasting and Painting (20% of total defects): Seasonal delays due to rain and improper surface preparation increase defects.
- Other Stages (10%): Includes minor defects from marking and cutting processes caused by the absence of CNC machines.

4. Root Cause Analysis

Conducted a Cause-and-Effect (Fishbone) Analysis, categorizing issues under "Man," "Machine," "Method," and "Material":

- Man: Workforce skill gaps and lack of training.
- Machine: Absence of CNC machines for cutting/marking, leading to manual inefficiencies.
- Method: Non-standardized processes causing defects and delays.
- Material: Dependence on a single supplier (NKK Tubes) resulting in raw material delays.

5. Workforce and Stakeholder Interaction

- Conducted surveys to understand worker challenges, revealing issues like fatigue, lack of awareness, and the need for training.
- Analyzed workforce efficiency, including shift dynamics, absenteeism trends, and productivity differences between day and night shifts.

Justification for the Methodology

1. Comprehensive Coverage of Key Factors

The methodology integrates operational, workforce, and supplier analyses, ensuring a holistic view of production challenges. By combining process observations, statistical tools, and root cause analysis, it identifies inefficiencies at both macro and micro levels.

2. Data-Driven Decision-Making

- Statistical tools like Pareto Analysis and trend evaluation provide quantitative insights into bottlenecks and inefficiencies.
- Defect Breakdown Analysis focuses on quality challenges that significantly impact production timelines and costs.

3. Focus on Productivity and Quality Improvement

The focus on lead-time reduction, defect prevention, and automation directly addresses key production issues.

4. Alignment with Factory-Specific Needs

Unlike generic approaches, this methodology was tailored to the unique challenges of SHREEVARI ENERGY SYSTEMS, such as:

- Seasonal delays affecting blasting/painting due to open yards.
- Dependency on manual processes across all stages.
- High defect rates in welding and fit-up stages due to skill gaps.

5. Practical and Scalable Recommendations

The recommendations derived from this methodology are feasible and aligned with long-term goals:

- Infrastructure upgrades (e.g., CNC machines) improve scalability and reduce manual errors.
- Supplier diversification (e.g., introducing Poorva) mitigates delays caused by reliance on a single source.
- Workforce cross-training enhances flexibility during demand surges.

Comparison with Alternative Methods

- **Basic Observations:** While less resource-intensive, they lack depth and fail to provide actionable insights into bottlenecks and inefficiencies.
- **Statistical Models Alone:** Pure statistical analysis would overlook qualitative insights, such as worker challenges and material supply chain issues.
- **Standard Lean/Six Sigma Approaches:** These focus narrowly on waste or variability reduction without addressing broader factors like workforce and supply chain dynamics.

PRELIMINARY RESULTS & FINDINGS

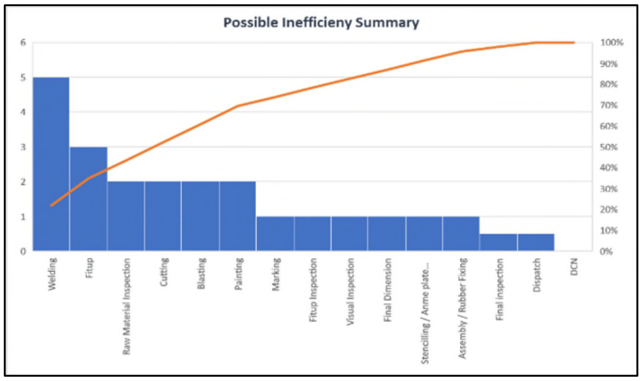

Fig. 8: Pareto Analysis

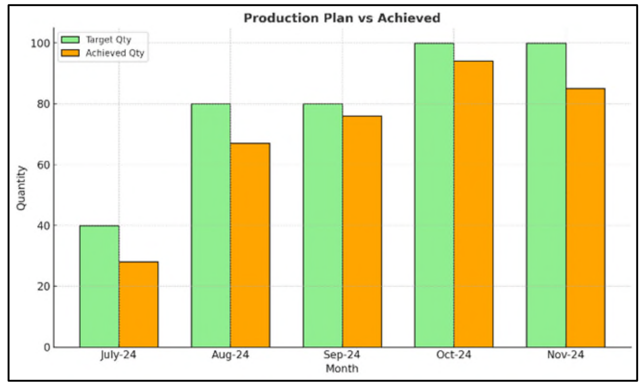

Fig. 9: Trend Analysis

Defect Contributors: Major defects identified in welding, fit-up, and blasting/painting processes due to skill gaps and manual operations.

Productivity Trends: Productivity peaked at 95% in September but dropped to 85% in November due to seasonal delays and resource limitations.

Lead Time: Total production lead time is 23 hours; potential to reduce by 20% with automation and improved processes.

Recommendations: Introduce CNC machines, enhance worker training, and diversify raw material suppliers for better efficiency.

More analysis including the results will be done in the final report.