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Improving Production Efficiency and Product Costing at reCharkha Eco Pvt. Ltd

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Abstract - Small and medium-sized enterprises (SMEs) play an important role in economic development by creating employment, supporting local communities, and introducing innovative products and business models. In recent years, sustainable smes have gained increasing attention as businesses seek to balance profitability with environmental and social responsibility. However, maintaining sustainability while controlling operational costs can be challenging, particularly for businesses that use labour-intensive production processes and sustainable raw materials. Effective cost management therefore becomes essential for improving profitability without compromising product quality or sustainability objectives. Key areas such as production efficiency, material consumption, labour productivity, product costing, and packaging costs can significantly influence the overall financial performance of a sustainable SME.

in this context, operational cost optimization provides an opportunity to identify inefficiencies and improve the utilization of available resources. Time and motion studies can help establish standard operation times and realistic daily production targets based on worker capabilities and skills. Similarly, a weekly master production schedule (MPS) can support better coordination between manpower, worker skills, production requirements, and raw material availability. Another important area is the rationalization of bills of materials (BOMs), particularly when an organization manages a large number of SKUs. Comparing standard material consumption with actual usage can help identify overstated quantities and opportunities to reduce material costs. Comprehensive product costing models covering direct material, labour, and overhead costs can further support informed pricing and profitability analysis.

Keywords: Production Efficiency, Time and Motion Study, Operational Cost Optimization, Master Production Scheduling (MPS), Bill of Materials (BOM), Product Costing, Labour Productivity, Sustainable Manufacturing.

I. INTRODUCTION

This study focuses on reCharkha Eco Pvt. Ltd. and examines opportunities to improve operational cost efficiency while maintaining its sustainable business positioning. The study covers time and motion analysis across key product lines, development of production targets and weekly MPS, and rationalization of BOMs across more than 40 SKUs. It also evaluates complete product costs and contribution margins in relation to current MRP to identify products with margins below the targeted 40% level. In addition, a make-or-buy analysis is undertaken for the Coasters product line by comparing in-house production costs across two facility options with outsourced vendor costs. The study also evaluates sustainable packaging alternatives based on their cost implications and alignment with the company's sustainability positioning. Through these analyses, the research aims to identify practical interventions in production, costing, materials, pricing, and packaging that can improve operational efficiency and overall profitability.

II LITERATURE REVIEW AND THEORITICAL BACKGROUND

A. LITERATURE REVIEW

Jang and Choi propose an SME BOM-management system based on product families and common parts, supporting BOM rationalization.

Nishioka and Ayaki link manufacturing-BOM structures with cost estimation for small-volume, high-variety products. Liu presents a BOM/BOP-oriented product-cost planning model using combined top-down and bottom-up budgeting.

Thombre and Chaudhary emphasize value engineering, value analysis, supplier-cost review, and BOM review for manufacturing cost reduction.

Kocakulah et al. explain how activity-based costing can improve SME product-cost accuracy and managerial decisions while identifying implementation challenges. Hughes develops an ABC/ABM profitability model for SME clothing and textile manufacturers.

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Gupta and Tripathi examine ABC adoption in an Indian SME and discuss its implementation framework.

Werner and Xu show that activity-based cost drivers can improve overhead allocation accuracy and encourage genuine cost reduction.

Parindingan et al. review ABC applications and report benefits for cost control, budgeting, and resource optimization.

Diaz et al. combine 5S, Kanban, TPM, and circular reuse to reduce variable costs in a small plastics business. Caldera develops a Lean and Green Strategy Model for cost-effective sustainability investment in SMEs.

Caldera, Desha, and Dawes use case studies to create a lean-green matrix for selecting SME sustainability tools. Caldera, Desha, and Dawes identify enablers and barriers affecting lean-green implementation in SMEs.

Caldera, Desha, and Dawes further propose a strategic-enablers model for sustainable business adoption. Nadeem et al. introduce the C-Lean framework, integrating circular economy and lean methods for manufacturing SMEs.

Darmandieu et al. find that greater production circularity is associated with lower SME production costs, particularly when supported by eco-innovation.

Afum et al. show that lean management and circular production improve zero-waste performance and green competitiveness in manufacturing SMEs. Save applies SMED and parallel work to reduce changeover time and production cost. The stamping-unit case study evaluates TQM, TPM, JIT, value engineering, lean, Kaizen, vendor involvement, and productivity improvement for cost reduction.

Azemi et al. examine CAD/CAM/CAE-enabled lean manufacturing as a route to lower product cost and improve SMME performance.

B. THEORITICAL BACKGROUND

The theoretical background of this study is based on the principles of lean manufacturing, time and motion study, cost accounting, production planning, and sustainable operations. Lean manufacturing, developed from the Toyota Production System, focuses on maximizing customer value by reducing waste such as waiting, unnecessary movement, over-processing, excess inventory, and defects (Ohno, 1988; Womack, Jones & Roos, 1990). These principles are relevant to small-scale artisan production, where efficient use of labour, materials, and workplace resources can directly influence operational costs and productivity.

Time and motion study, based on the work of Frederick Winslow Taylor (1911), provides a systematic approach to measuring the time required for individual production activities. Establishing standard operation times helps organizations set realistic worker-wise production targets, improve productivity, and develop standard work practices. In addition, Master Production Scheduling (MPS) supports the planning of production according to customer demand, available manpower, worker skills, and raw material inventory (Chopra & Meindl, 2016).

Cost accounting provides the foundation for analysing direct material, direct labour, and overhead costs to determine the total cost of a product (Horngren, Datar & Rajan, 2015). BOM rationalization and material variance analysis help identify differences between standard and actual material consumption, while contribution margin analysis supports evaluation of product profitability. Make-or-buy analysis further assists in comparing internal production costs with external vendor costs. Together, these theories provide a framework for evaluating operational efficiency and identifying cost optimization opportunities while maintaining the sustainability objectives of reCharkha Eco Pvt. Ltd

II. .MATERIALS AND METHODS

A. Objective of the Study

The study aims to examine operational cost optimization and production efficiency at reCharkha Eco Pvt. Ltd. The objectives are to conduct time and motion studies across key product lines to establish standard operation times and daily production targets per worker; design a weekly Master Production Schedule (MPS) based on manpower, worker skills, and raw material availability; rationalize Bills of Materials (BOMs) across 40+ SKUs by comparing standard and actual material consumption; develop product costing models covering direct material, labour, and overhead costs; and analyse contribution margins against current MRP. The study also aims to conduct a make-or-buy analysis for the Coasters product line, evaluate sustainable packaging alternatives, and identify SKUs with margins below the 40% target for suitable pricing or design interventions..

B. Research Design and Data Collection

A **case study-based, quantitative and applied research methodology** was adopted for the study. Primary data were collected through direct observation of production activities, time and motion studies, discussions with workers, and assessment of material usage and packaging practices. Secondary data were obtained from internal BOM records, production data, product costing sheets, MRP details, worker salary information, overhead costs, raw material inventory records, and vendor quotations. Multiple observations were taken for selected production operations to establish representative standard operation times.

C. Data Analysis and Methods

The collected data were analysed using descriptive and comparative methods. Standard operation times were calculated from observed production times with appropriate allowances for personal needs, fatigue, and unavoidable delays. A weekly MPS was developed by matching production requirements with available manpower, worker skills, and inventory. BOM analysis compared standard and actual material consumption to identify material variances and cost-saving opportunities. Product costing and contribution margin analysis were conducted for the available SKUs. The Coasters product line was evaluated through make-or-buy cost comparison, while packaging alternatives were assessed based on cost and sustainability considerations. The results were used to identify operational inefficiencies and recommend measures for improving productivity, reducing costs, and increasing product profitability.

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III. DATA ANALYSIS AND DISCUSSION

TABLE I. TIME AND MOTION STUDY AND PRODUCTION OUTPUT ANALYSIS

Product	Operator & Standard Time		
Shop-n-Go	Gudiya Didi; 35 min/unit	Belt + label final stitch – 12 min	12 → 15–20 units/day (+25–65%)
Basket Tote	Mohammad Kaka; 91 min/unit	Astar fitting & stitching – 13 min	~5 → ~5 units/day
Cutlery Kit	Gudiya Didi; 15 min/unit	Fabric cutting – 3 min/piece	40 → 43 units/day (+7.5%)
Wrist-it	Pournima Didi; 15 min/unit	Final stitching – 7 min	v 20 → 28 units/day (+40%)
Beach Bag	Gudiya Didi; 40–45 min/unit	Multiple pocket assembly – 18 min	12 → 12–15 units/day
Laptop Sleeve 14"	More Kaka; ~45 min/unit	Dog belt stitching – 30 min	10 → 10 units/day
Pencil Pouch	Gudiya Didi; ~10 min/unit	Label stitching + cutting – 3 min	40+ → 42 units/day

Table I highlights variations in production efficiency across seven product categories at reCharkha Eco Pvt. Ltd. The analysis identifies significant opportunities for productivity improvement through standardised work practices and bottleneck reduction. Shop-n-Go demonstrates potential output improvement from 12 to 15–20 units daily, representing approximately 25–65% growth. Wrist-it shows a 40% improvement potential, increasing production from 20 to 28 units, while Cutlery Kit output may increase by 7.5%. Beach Bag production could improve from 12 to 15 units daily through better assembly coordination. However, Basket Tote and Laptop Sleeve show limited improvement potential due to lengthy production processes and time-consuming stitching operations. The findings suggest that eliminating unnecessary movements, improving workstation organisation, and standardising critical operations can enhance labour productivity. Overall, the analysis provides a basis for establishing realistic production targets, optimising worker allocation, and improving operational efficiency without compromising product quality or sustainable manufacturing practices.

TABLE II. MASTER PRODUCTION SCHEDULE FRAMEWORK

MPS Component	**MPS**		
	Implementation at reCharkha	***Purpose***	***Key Outcome***
Planning Horizon	Weekly, Monday–Saturday	Plan production and materials in advance	Formal weekly planning introduced
Worker Allocation	Based on skills, speed and quality	Match workers with suitable products	Reduced skill-product mismatch
Target Setting	Time-study standards × available hours × 0.85 factor	Establish realistic targets	Standardized target-setting
Daily Monitoring	Morning target vs evening actual	Identify production variance	Same-day corrective action
Material Planning	Production matched with raw material inventory	Prevent material-related delays	Better inventory alignment
Review System	Daily 2-minute and weekly 15-minute review	Maintain operational visibility	Regular management monitoring

Table II presents a structured Master Production Schedule (MPS) framework designed to improve production planning, resource allocation, and operational coordination at reCharkha Eco Pvt. Ltd. The weekly planning horizon facilitates advance scheduling of production activities and raw material requirements. Worker allocation based on individual skills, speed, and quality performance helps minimise skill-product mismatches and improve productivity. Standardised production targets, calculated using time-study benchmarks and an 85% efficiency factor, provide realistic expectations for daily output. Comparing morning production targets with actual evening performance enables timely identification of deviations and corrective actions. Integrating production schedules with raw material inventory helps prevent material shortages and unnecessary production interruptions. Furthermore, brief daily reviews and weekly performance assessments strengthen operational visibility and management control. Overall, the proposed MPS framework supports systematic decision-making, efficient utilisation of manpower and materials, improved production consistency, and better coordination between operational planning and execution, contributing to sustainable productivity improvements.

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IV. FINDINGS, CONCLUSIONS

A. *Findings of the study*

The study at reCharkha Eco Pvt. Ltd. identified opportunities to improve production efficiency, labour productivity, resource utilisation, and operational cost management. Time and motion analysis revealed variations in production times across different product lines, highlighting the importance of standardised operations and worker-specific production targets. The Shop-n-Go product demonstrated potential productivity improvement from 12 to 15–20 units daily, while Wrist-it production showed an estimated increase from 20 to 28 units per day. The Cutlery Kit also indicated scope for improvement from 40 to 43 units daily. Activities such as stitching, fabric cutting, pocket assembly, and finishing emerged as important contributors to production cycle times. The proposed weekly Master Production Schedule provided a structured framework for allocating workers according to their skills, production requirements, and raw material availability. Daily performance monitoring and periodic reviews were identified as useful mechanisms for improving production coordination. Furthermore, the study highlighted the importance of rationalising Bills of Materials across more than 40 SKUs, evaluating direct and indirect production costs, and identifying products requiring contribution margin improvements. Make-or-buy decisions and sustainable packaging alternatives were also recognised as important considerations for cost optimisation. Overall, the findings emphasise the potential benefits of integrating production planning, standardised processes, and systematic cost management.

B. *Conclusions of the study*

The study concludes that improving production efficiency and operational cost management is essential for strengthening the financial and operational sustainability of reCharkha Eco Pvt. Ltd. Time and motion analysis demonstrated that systematic measurement of production activities can help establish realistic output targets, identify time-consuming operations, and improve labour productivity. The proposed Master Production Schedule offers a practical mechanism for coordinating manpower, worker capabilities, material availability, and production requirements. Standardised production targets, regular performance monitoring, and structured reviews can contribute to improved operational control and resource utilisation. Additionally, rationalisation of Bills of Materials and comprehensive product costing can support accurate material planning, cost identification, and informed pricing decisions. Contribution margin analysis provides a basis for identifying products requiring cost reduction, product redesign, or pricing adjustments. Make-or-buy evaluation and sustainable packaging assessment can further support cost-effective operational decisions without compromising environmental objectives. However, the projected productivity improvements and anticipated cost benefits require validation through actual implementation and continuous monitoring. The study emphasises that sustainable manufacturing enterprises can strengthen their competitiveness by integrating lean manufacturing principles, effective production planning, and systematic cost accounting. Overall, the proposed improvements provide a practical foundation for enhancing productivity, profitability, operational efficiency, and long-term sustainable business performance.

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