

MODELLING OF INTEGRATED LEAN AND GREEN MANUFACTURING PRACTICES: CASES FROM INDIAN SMEs

Thanki Shashank Jayantbhai

Supervisor: Dr. J. J. Thakkar

Department of Industrial and Systems Engineering

Abstract

Purpose

In the developing countries like India, small and medium scale enterprises (SMEs) play a critical role in country's economic and social growth, but their operations have significant impact on the environment. Therefore, in addition to their operational efficiency, they also need to align their strategies for enhancing their efficiency in the green dimension. Integration of lean and green practices can help SMEs to improve their competitiveness and profitability along with reduced environmental impact of their production processes.

In this regards, this research aims to develop evaluation frameworks for integrated lean and green performance and also investigates the lean and green manufacturing implementation issues in Indian manufacturing SMEs.

Design/methodology/approach

The study reported in this thesis primarily employs deductive research approach and employs both, quantitative and qualitative methods for the purpose of investigation in the lean and green manufacturing issues in Indian manufacturing SMEs. For the purpose of analysis various multi-criteria decision making (MCDM) tools such as AHP, DEMATEL, ANP, ISM and IRP were used. For investigating the orientation of Indian manufacturing SMEs towards lean and green manufacturing, a holistic approach by integrating multiple case study and DEA was employed. The data collection techniques includes questionnaire survey, experts' opinion, semi-structured interview, observations as well as administrative records and documents of the case organizations.

Findings

This research proposes two methodologies such as a) graphical tool, Value Value-Load Diagram (VVLD) along with a computer based support system (CBSS) for the assessment

of lean-green performance and b) supply chain lean-green performance assessment framework using Fuzzy DEMATEL based ANP approach. The selection of right set of tools/techniques is of prime importance for achieving desired improvement in the performance. In this regards, this study investigates the impact of select lean and green practices on the performance benefits and also evaluates the influence of lean and green paradigms on overall performance of SMEs using an analytical hierarchy process (AHP) methodology. The empirical investigation using multiple case study and DEA approach has displayed the influence of various organizational factors on the operational and environmental efficiency of the SMEs. Moreover, RTS and DTS analysis exhibited the need for attaining the improvement in operational and environmental performance to ensure sustainable growth in Indian SMEs. ISM study pointed that government support through various schemes and policy initiatives backed up by committed top level management and sufficient allocation of funds are extremely significant for successful implementation of lean-green paradigms in Indian SMEs.

Research implications

In the present situation, SMEs are trying to become competitive through enhancing their technological competence and concern on the environmental practices. However, their low volume of business and poor bargaining power in the supply chain restrict the adoption of such practices. The adoption of the proposed approaches for the assessment of lean and green practices and the recommendations drawn from the empirical investigation can help SMEs to enhance their lean-green capabilities. The insights developed through this research should help SMEs to understand their lean-green weaknesses and establish necessary benchmarks for the sustainable implementation of lean and green practices.

Practical implications

The research contribution has significant impact on business and organizations specifically, operating in SME environment. The computer based support system (CBSS) developed for lean-green performance assessment allows ease in the application of the tool and allows the managers to evaluate and tune their processes for improved resource utilization efficiency. The research outcome in the form of linkages between practices and performance could be useful for the companies in selecting the appropriate set of lean and

green practices based on their business priorities. Moreover, increasing damages to scale (DTS) and decreasing returns to scale (RTS) triggers an immediate action for radical technological and managerial transformation in Indian SME operations to ensure sustainable growth.

Originality/Value

There is ample work on lean manufacturing and green manufacturing as an individual paradigm, however research on integration of lean and green manufacturing and in the context of SMEs is rare. In view of this, the research reported in this thesis can be seen as the first attempt in the area of lean and green integration analyzing the research issues specific to Indian SMEs.

Keywords: Lean manufacturing, Green manufacturing, Small and Medium scale Enterprises (SMEs), Performance measurement, Case study, Data Envelopment Analysis (DEA), Multi-Criteria Decision Making (MCDM)