



The Implementation of Lean Production and Environmental Sustainability Practices in the Indian Apparel Manufacturing Industry

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In response to global environmental issues and stiffer business competition, the last few decades have witnessed a tremendous increase in the awareness of environmental impact and the usage of production management systems such as lean production. A focus on reducing adverse impact on the environment has promoted the use of sustainable business practices. Sustainability, which promotes harmonious coexistence of the human race and nature, allows for development without unintended negative consequences on the environment and natural resources (EPA, 2012). Lean production utilizes lesser workforce, capital, infrastructure, and time to reach the goal of customer satisfaction with smaller amount of waste in comparison to traditional manufacturing systems (Womack, Jones, & Roos 1990). By eliminating waste and streamlining the manufacturing processes, lean production seeks to achieve the shortest possible cycle time and increase profitability.

Lean production if implemented adequately can help developing nations remain competitive and grow economically in the market. Implementing lean production and environmental sustainability practices in Indian textiles and apparel industry, which employs over 35 million people and contributes significantly to the country's economic growth (Ministry of Textiles, 2012), would strengthen the economic stability of India. This study evaluated the extent of implementation of lean production and environmental sustainability practices in the Indian apparel manufacturing industry. The research explored management policies/practices for cost of production and waste management, and identified the policies/practices that favored the implementation of either or both of the lean production and environmental sustainability. Barriers to implementation of both the manufacturing practices were also examined.

Out of the 200 professionals who were invited to participate in the online survey, a total of 51 complete responses were deemed usable for further analysis. Using SPSS 18.0, a series of ANOVA, paired t-tests, post-hoc analysis, and descriptive analysis were conducted to analyze the data. Following Shah et al. (2008), the extent of implementation of fourteen lean practices were measured. To identify the extent of implementation of environmental sustainable practices, ten environmental sustainable polices developed by the University of Delaware's Sustainability Apparel Initiative (UDSAI, 2009) were utilized. Most of the respondents were from garment manufacturing (88.0%) and merchandising (41.2%), and work at a company with production capacity per month between 1,000-100,000 pieces (53.0%) with the average length of professional work experience of 3.6 years.

The results indicated that majority of the Indian apparel manufacturing companies had less than moderate implementation of lean production ($f=29$ or 56.9%), and moderate level of implementation of environmental sustainability practices ($f=33$ or 66.0%). The mean scores of the lean practices indicated that quality management ($M=3.1$, $S.D.=1.4$), bottleneck constraints remover ($M=2.7$, $S.D.=1.5$), and maintenance optimization ($M=2.6$, $S.D.=1.4$) were the top three lean practices implemented in the Indian apparel manufacturing industry. The ANOVA results showed that none of the lean practices were significant, suggesting there is no difference in the usage of the lean practices by the implementation level of lean production. The top three environmental sustainability policies include: following all accepted national and international safety and environmental regulations to protect workers and consumers ($M=3.2$, $S.D.=1.4$), implementing an A.C.L. (Admit it, Correct it, and Learn from it) approach ($M=2.9$, $S.D.=1.3$), and eliminating waste at all points of the supply chain ($M=2.8$, $S.D.=1.1$). The ANOVA test revealed that the overall implementation level of environmental sustainability practice significantly determined the usage of most of the environmental sustainability policies ($F=3.62-11.57$). Paired t-test revealed that nine out of twenty cost of production and waste management policies/processes similarly influence companies in implementation of lean or environmentally sustainable policies, while, eleven have significantly different impact on implementation of both manufacturing practices. Descriptive analysis showed that the Indian apparel companies are struggling to adopt lean practices due to their operational set up, employees' resistance and lack of knowledge; whereas environmental sustainability implementation is obstructed due to lack of financial benefits and budget constraints.

The results suggest that there is a great scope of improvement for Indian apparel manufacturing sector to fully adapt lean production and environmental sustainability in its core processes. The findings of this study regarding cost of production and waste management suggest that some of the goals of lean and environmental sustainability are common. The results also imply that up to a certain extent incorporating environmental sustainability policies in the apparel manufacturing sector can lead towards lean production and vice versa. Through efficiently tackling barriers identified in the study, extensive implementation of lean and environmental sustainability can be possible in the Indian apparel manufacturing sector. This will not only help the industry to grow economically but also sustainably.

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