
Abstract

Within the operations management literature, quality management (QM) has been one of the most popular research areas over the last few decades. The impact of QM practices on firm performance has been the subject of constant interest and challenge among researchers. Last such review was done in 2002 based on QM related articles published between 1994 and 1999, primarily on TQM. In the last 15 years, QM system–performance relationships have been studied covering other QM systems also such as ISO 9000 Quality Management System standard, TPM, Lean Manufacturing, TOC, and Six Sigma. A literature review of 237 papers published in 17 reputed journals during the period 2000 to 2015 reflecting study of different QM systems, type of research designs used, performance categories and metrics considered, and application of tools/techniques revealed gaps and calls for further research on (i) empirical longitudinal case studies, (ii) implementation of multiple QM practices, (iii) use of lead indicators of firm's performance (iv) standardization of performance measures, (v) the differences in the QM practices on firm's performance for manufacturing vs. service organizations, (vi) application of QM practices in developing countries including Asian countries, and (vii) impact of ISO 9001 QMS on firm's performance.

With an objective of studying quality management systems at an integrated steel plant in India, the efficiency and Malmquist productivity indices of 10 integrated steel plants for the period 2008-13 was studied using Data Envelopment Analysis considering multiple input and output factors and the best performing plant was identified. Further research on the quality management systems adopted by these 10 steel plants revealed that the best performing plant has implemented all the quality management systems in a systematic manner and has also been recognized for its quality management systems globally. Analysis of past 20 years performance of the best performing plant on key quality characteristics using change point model, it could also be confirmed that the intervention of QM systems has made positive impact on these performance metrics confirming the positive relationship between the adoption of QM systems and the business performance of the plant.

The quality management system adopted in the best performing steel plant was further studied to identify the most critical process (iron making through blast furnaces) and a prediction model for the output of this process (hot metal silicon) was developed using both linear and non-linear (using machine learning techniques e.g. multiple linear regression, neural network, support vector machine and random forest) regression models. The models were further optimized using genetic algorithm. The prediction accuracy of these models was compared using model evaluation statistics and it was observed that models using multiple linear regression and support vector machine provided best prediction accuracies. The prediction accuracy of linear regression model was observed similar to non-linear models, which is contrary to most past research studies, primarily due to systematic selection of predictor variables based on past studies/subject matter experts as well as extensive pre-processing of past data used to develop these models. The developed model has been accepted for use by the operation/quality people of the integrated steel plant for an effective process control and scientific decision making.

Keywords: Quality Management System, Firm's performance, Data Envelopment Analysis, Predictive Analytics, Hot Metal Silicon, Integrated Steel Plant

