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Development of a Framework for Implementation of Maintenance Tools and Techniques Using Interpretive Structural Modeling

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Abstract

Maintenance tools and techniques (MTTs) are increasingly implemented by many Indian SMEs to improve their performance and to obtain the competitive advantage with long time stability in the stern global market in terms of productivity, cost, and quality. But, implementation of right MTTs is not an easy task. There are different maintenance tools and techniques and their proper implementation will help in improving SMEs competitiveness. The main objective of this paper is to understand the mutual interaction of these MTTs and identify the ‘driving MTTs’ (i.e. which influence the other MTTs) and the ‘dependent MTTs’ (i.e. which are influenced by others). In the present work, this study identifies the important tools and techniques of maintenance through a literature review. Later, five experts from the manufacturing and service industry and academia took up ISM of the MTTs, based on the interrelationships among these MTTs. The industrial practitioner/decision makers will be benefited by this framework to implement right MTTs for Indian SMEs.

Keywords: Interpretive Structural Modeling (ISM); Maintenance Tools and Techniques (MTTs); Digraph; Interrelationship; Small Medium Enterprise (SMEs).

1. Introduction

In today highly competitive and stern market, not a single concept for any industry is fit in all terms hence maintenance tools and techniques (MTTs) may be adopted synergistic to improve the SMEs competitiveness.

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A small medium enterprise (SMEs) is the backbone of any industrialized nation [1,2]. A country’s level of SMEs directly related to its economic health [3,4,5]. Indian SMEs are so engaged in their day to day’s management issues that they don’t have time and resources to dedicate a strategic understanding of the need and acquiring means of various MTTs which would help them in enhancing their performance and hence being competitive in the world market [6]. The recent competitive trends and ever increasing business pressures have been putting maintenance function under the spotlight as never before [7]. Kumar et al., (2014) feel the necessity of proper tool and techniques those monitor, manage and optimize equipment utilization and eventually maximizing throughput by reduced cycle time, improve product quality and manufacturing yields [8]. There are different techniques of waste reduction and performance enhancement like total productive maintenance (TPM), just-in-time (JIT), total quality management (TQM) and Kaizen [6]. However, selection of appropriate maintenance tools and techniques, with their applicability, incorporation and acceptance within operations is a major problem for many companies [2,10,11,12]. Furthermore, measuring the performance gives information about the present status of the company, identifies the bottleneck, reducing the cycle time and gives opportunities for improvement [13]. According to a questionnaire based survey study, 71 per cent respondents considered that maintenance could be used as a tool to get advantage for enhancing SMEs competitiveness [14]. An appropriate method to study the interrelationship among these MTTs would be the use of technique of ISM [15,16]. Based on these interrelationships, action plan can be developed to ease these MTTs and to help industries in implementation of suitable MTTs [17]. The main objective of this paper is to identification of the MTTs concern with SMEs performance and finds the relationship among them through ISM and suggests guidance's for future research. Further, the organization of the paper is as follows: after a brief introduction, the identification of major MTTs is provides in Section 2. The research methodology is discussed in Section 3. Section 4, discusses Cross-Impact Matrix Multiplication Applied to the Classification (MICMAC) analysis. Section 5 presents conclusion.

2. Identification of Maintenance Tools and Techniques

The literature review of publications on MTTs identified several MTTs for Improving SMEs Competitiveness [1,2,3,4,6,9,11,12,13,18,19]. From these, some were found to be popular and have high frequency like Total Productive Maintenance (TPM), Overall Equipment Effectiveness (OEE), Five S, Total Quality Management (TQM), Lean Manufacturing (L Mfg), Six Sigma, Continuous Improvement (CI) and Just In Time (JIT). Appendix A shows the summery on feature worldwide of these MTTs.

3. Research Methodology

The study identifies the important tools of maintenance through a literature review of publications on MTTs. Later, five experts from the manufacturing and service industry and academia took up Interpretive Structural Modeling (ISM) of the MTTs, based on the interrelationships among these MTTs. These experts have thorough knowledge about MTTs and applied ISM to framework many complex MTTs. However a questionnaire-based review and ISM approach may be used to achieve the objectives of this research.

3.1 Interpretive Structural Modeling (ISM)

ISM was developed in the period 1971–1973 by John N. Warfield as a computer aided methodology to study complex issues and to structure them in terms of words and directed graphs which can be easily understood. ISM is a process which transforms unclear, poorly articulated mental models of systems into visible and well-defined models [16]. Many researchers have used ISM to develop relationship among issues/enablers/barriers in different fields [15,17,20,21,22]. The steps drawn in Interpretive Structural Modeling are shown as flow chart in Figure 1. After a brief literature review eight MTTs have been identified for pair wise relationship then developed Structural Self-Interaction Matrix (SSIM). The expert opinions from industries and the academia are consulted in identifying the nature of contextual relationships among the various MTTs as shown in Table 1.
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