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Development of a framework for implementation of World-class Maintenance Systems using Interpretive Structural Modeling approach

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Abstract

The purpose of this paper is to develop a framework for the implementation of World-class Maintenance Systems (WMS) with the help of Interpretive Structural Modeling (ISM) methodology. In our earlier work, the framework for WMS was proposed, which explained what constitutes WMS. As a follow up paper, an attempt has been made to present a detailed description about how an organization can implement WMS. To accomplish the same, a standard template is provided for describing the implementation of each and every element and their contextual relationships are also described by ISM methodology which shows driving power and dependence of each element. It is believed that such a normative presentation of the framework would benefit the managers in providing proper guidance and direction during implementation of WMS.

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Keywords: World class Maintenance Systems; Total Productive Maintenance; Interpretive Structural Modeling; Driving power; Dependence.

1. Introduction

With the increasing demand on productivity, quality and availability, machines have become more complex and capital intensive. Labib [1] noted that developing and implementing a maintenance program is a difficult process as it often suffers from lack of a systematic and a consistent methodology. The reason being that no two organizations are similar and each organization follows its own methodology of dealing with maintenance problems. Similarly, maintenance consultants from different countries have proposed different best practices, which were implemented in their client's organization and claim that such practices constitute world-class maintenance systems. However, Mishra et al. [2] proposed a framework earlier, describing the best practices in maintenance as elements of WMS as a solution to overcome the shortcomings of Total Productive Maintenance (TPM). The framework of WMS is built based on the underlying concepts of TPM, but incorporated the best practices within each element of it.

One of the drawbacks of TPM is that a proper implementation model is not available. Nakajima [3] has proposed a 12 step implementation methodology; however what tools and techniques to be implemented in each stage has not been explained properly. Furthermore, different implementation frameworks proposed by various consultants are complicated and confusing, making the organization to fail in their attempt to adopt TPM. Hence, the purpose of this paper is to develop a systematic framework for implementation of WMS. To accomplish this, Interpretive Structural Modeling (ISM) approach is adopted. ISM is an advanced interactive planning methodology that allows a group of people, working as a team, to develop a structure that imposes order and

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direction on the complex relationships among elements in a set [4].

2. Elements of framework for implementation of World-class Maintenance System

The framework for implementation of WMS is developed by ISM, based on literature review, discussions with experts and domain knowledge about the maintenance systems all elements are identified. As mentioned earlier, it is built on the basics of TPM; however this framework provides the practitioners with a number of best practices, drawn mainly from the experiences of organization in general and the failures and problems the organizations/consultants faced in particular, which were obtained from the case studies and literature. A definition of best practices adapted to the maintenance process can be referred as "maintenance practices that enable an organization to achieve a competitive advantage over its competitors and thereby achieve a status of world-class." Similar to any other function in an organization, maintenance too has different sub functions/activities/practices such as: spares parts management, inventory and procurement, operational involvement, etc. A complete list of elements and their associated practices/activities has been identified in the proposed framework for implementation of WMS. These elements/practices/activities are derived based on existing TPM knowledge and the implementation of best maintenance practices in various organizations as reported in the literature. Such information may assist or encourage organization to use these practices to improve the maintenance efforts and overall production performance. It should be noted that each WMS elements and its sub elements/practices/activities, tools and techniques are described briefly in Table 1.

Table 1: Elements under each stage of implementation of WMS

S.NO	Elements/Practices/Activities
1	Productivity
2	Ownership maintenance
	o Autonomous inspection
	o Operator involvement
	o Initial cleanup/ adjustments/ lubrication/ tightening
	o Participative management
	o Troubleshooting
3	Policies and objectives /goals
	o Training and development
	o Manpower planning and staffing
	o Cross-functional co-operation / co-ordination
	o Incentive plans and benefits
	o Performance management
	o Enhancing employee relations
4	Long term commitment of top management and employee
5	Quality
6	Process quality maintenance
	o Variation reduction in work processes
	o Quality assurance
	o Standardization of materials, methods and tools.
	o Continuous improvement
7	Design of master plan
8	Self analysis
9	Delivery
10	Safety, health and environmental systems
	o Regulatory compliance
	o Environmental systems
	o Safety systems
	o 5S philosophy
	o Occupational health systems
11	Flexibility
12	Leadership and change management
	o Organization culture
	o Maintenance strategy and policy deployment
	o Cost distribution and financial control
	o Participative management
	o Empowerment
	o Operator involvement
	o Management support/commitment
13	Maintenance systems / practices / procedures
	o Preventive maintenance
	o Predictive maintenance
	o Reliability centered maintenance
	o Corrective maintenance
	o Pro-active maintenance
	o Planned/routine maintenance
	o Maintenance standardization and documentation
14	Human resource development
	o Training and development
	o Manpower planning and staffing
	o Cross-functional co-operation / co-ordination
	o Incentive plans and benefits
	o Performance management
	o Enhancing employee relations
15	Cost
16	Eliminative maintenance
	o Research and development of new process/ equipment
	o Life cycle analysis
	o Supporting / common facilities
	o Initial control for process / equipment / product
17	Support systems improvement
	o Work flow management
	o Spares management
	o Supporting / common facilities
	o Contract /outsourcing management
	o Supply chain management