



## Virtual Training Programme

# Improving Machine Reliability, Maintainability & Availability

## Introduction

Machine Reliability and Maintainability are two important characteristics we need to understand in order to effectively manage maintenance of machines, reduce downtime and increase availability. Reliability deals with trouble-free operation time of the machines and how best it can be prolonged further. In simple words, it means how to increase MTBF of plant equipment and machinery. On the other hand, maintainability deals with the speed, economy and the ease with which various maintenance and repair activities are carried out on different machines. Maintainability improvement is primarily focused on reducing MTTR. The two golden rules -- “Reduce the need of maintenance in the first place”, and “Do maintenance efficiently when needed” -- conspicuously represent importance of machine reliability and maintainability that finally affects the availability of the plant. Reliability and Maintainability factors are always considered critical in assuring reduced failures, lower downtime and higher equipment availability together with rise in production.

It's necessary for maintenance departments to maintain trouble-free status of their machines for a longer period of time. Otherwise, if undesirable pattern of machine failures occur resulting in untimely interruptions and production losses, the machine will be called as unreliable. On the other hand, if a machine consumes too much time in trouble-shooting, restoration or repair, its maintainability goes down and consequently downtime increases. The problems of poor machine reliability and maintainability mainly occur due to design problems, bad operation, poor skills, ineffective maintenance programmes & practices, etc.

Keeping plant equipment in a desired operating state and sustaining the expected performance requires effective maintenance throughout its entire life cycle. There is a need for a method to measure the effectiveness and the weaknesses of maintenance programme in order to focus on the development of maintenance activities towards the enhancement of system availability. Improving machine reliability means freedom from failures by way of useful improvements, such as removing weak links in the design, changing specifications of certain parts for prolonged life, building redundancy in the system, improving O & M practices, etc. On the other hand, maintainability improvement makes way for quick, fast & efficient machine maintenance. Reliability and

Maintainability improvement is thus a systematic programme in which concepts and techniques of both reliability and maintainability engineering are applied to evolve efficient and effective machines in a plant.

Machine Reliability and Maintainability improvement provides a powerful methodology for defect removal and failure cause elimination so that the need for maintenance is reduced, and the ease and speed of doing maintenance gets increased. Ultimately, the gains of improved reliability and maintainability are reflected in higher plant availability considered as one of the main objectives of maintenance function.

## **Methodology**

The methodology for conducting the Virtual Training Programme is briefly described as below:

- Focused Presentation
- Interactive Discussions
- Case Studies
- Question - Answer Sessions
- Practical Exercises

## **Programme Coverage**

- Importance of Machine Reliability & Maintainability Studies
- Essential Aspects of Machine Reliability, Maintainability and Availability
- Machine Reliability Analysis
- Ways to Improve Machine Reliability and Maintainability
- Machine Maintainability Factors
- Maintenance Methods to Improve Maintainability
- Reliability & Maintainability: Questions & Problems
- Case Studies: Machine Reliability & Maintainability Improvement
- Practical Exercises

## **Focal Points of the Training Programme**

- **Importance of Machine Reliability & Maintainability Studies:** Understand that machine reliability & maintainability factors in relation to a production system facilitate in delivering the availability of the system.
- **Machine Reliability & Maintainability Concepts and Practices:** Develop deeper insights into machine reliability & maintainability concepts and practices paving way for reduced downtime, fewer repairs, improved availability, increased life of the machines, higher profitability, etc.
- **Machine Reliability Analysis:** Reliability of a system composed of a number of parts is dependent on the functional configuration of the parts, e.g. series, parallel or mixed configuration. Learn how to work out reliability of various systems having different configurations and develop a better understanding about reliability engineering.

- **Machine Maintainability Factors:** Get introduced to design and installation factors that influence machine maintainability. Engage with various initiatives that help strengthen maintainability of plant equipment and machinery.
- **Machine Reliability & Maintainability Improvement Programme:** Learn to augment machine reliability and maintainability to get most out of the plant equipment & machinery. Comprehend essential elements of machine reliability & maintainability improvement programme to assure higher machine availability.
- **Case Studies:** Case Studies related to improvement of machine reliability & maintainability provide a holistic view and understanding of various issues in the most simple manner and help assimilate the necessary expertise.
- **Practical Exercises:** Gain some invaluable experience by working on practical problems and exercises based on machine reliability & maintainability issues.

## **Benefits of Attending the Training Programme**

Benefits of attending the virtual training programme will include the ability to:

- Gain deeper insights and understanding of machine reliability & maintainability concepts and practices to make way for raising plant equipment availability.
- Get clear idea about ‘what is a system’ in reliability engineering and how to work out reliability of a system in series, parallel and mixed configurations.
- Know how to go about reliability & maintainability improvement at the operational stage of plant equipment and machinery.
- Understand maintainability features pertaining to machine design and installation factors and how they affect MTTR values of the machines.
- Reinforce machine reliability to minimize equipment failures, interruptions & downtime and pep up maintenance & repair activities to boost maintainability of the machines.
- Learn how to collect data and analyze MTBF and MTTR of critical machines and systems.
- Gain invaluable experience of dealing with poor machine reliability & maintainability problems by learning through a number of case studies from industry.



## **Participation**

- Maintenance Engineers & Managers
- Plant Engineers
- Team Leaders
- Technical Executives from operation, reliability, operational excellence, plant improvement, asset management, etc.
- Engineering Supervisors, etc.

## **Course Contents**

### **MODULE I: Essential Aspects of Machine Reliability, Maintainability & Availability - I**

- Importance of Machine Reliability & Maintainability
- What is a System!
- Effectiveness of a Production System
- Characteristics of a Reliable Machine
- Reliability & Maintainability of Hi-tech Equipment
- Effect of Reliability & Maintainability on Life Cycle Costs of Plant Equipment
- Reliability & Maintainability Improvement Programme

### **MODULE II: Essential Aspects of Machine Reliability, Maintainability & Availability - II**

- Reliability Concepts
- Definition of Reliability
- Difference in Quality and Reliability
- Types of Reliability
- Factors affecting Reliability
- Reliability, Maintainability & Availability Relationship
- Reliability and Exponential Failure Law

### **MODULE III: Machine Reliability Analysis**

- Functional Configuration of a System
- Reliability of a Series Configuration
- Reliability of a Parallel Configuration
- Concepts of Redundancy
- Types of Redundancy
- Reliability of a Mixed Configuration

#### **MODULE IV: Ways to Improve Machine Reliability & Maintainability**

- Difference between Inherent & Operational Reliability
- Repairable and Non-repairable Systems
- Basic Approaches for Increasing Equipment Reliability
- Reducing Gap in Inherent & Operational Maintainability
- Improving Inherent Machine Reliability
- Case Study on Improving Equipment Reliability

#### **MODULE V: Machine Maintainability Factors**

- Concepts of Maintainability
- Representation of Maintainability
- Finding MTTR Value of a Machine
- Design & Installation Factors of Maintainability
- Improving Maintainability
- Some Examples

#### **MODULE VI: Case Studies on Machine Reliability & Maintainability Improvement - I**

- Some Questions and Problems
- R & M Improvement: Case Studies – 1 to 6

#### **MODULE VII: Case Studies on Machine Reliability & Maintainability Improvement - II**

- R & M Improvement: Case Studies – 7 to 10
- R & M Improvement: Case Studies – 10 to 15

#### **MODULE VIII: Practical Exercises on Machine Reliability & Maintainability Improvement and Conclusion**

- Practical Exercises on Improving Machine Reliability & Maintainability
- Presentation of the Ideas by the Participants and Interaction with the Faculty
- Closing Remarks by the Faculty
- Feedback from the Participants
- Appraisal and Conclusion

**Reliability**

## **IMME and Maintenance Reliability Training Programmes**

*Institute of Maintenance Management Education ([www.immeinstitute.org](http://www.immeinstitute.org)) commenced operations in late 70s as a leading training and consultancy organization to facilitate paving way for excellence in maintenance function in industry. Since then IMME has conducted a large number of top quality maintenance reliability training programmes on different themes and topics. Tens of thousands of candidates from various reputed companies in the corporate sector have participated in different training programmes & courses conducted by IMME in a period of over 30 years.*

Maintenance reliability of plant equipment is a key activity in any manufacturing organization. In order to attain top performance in maintaining its assets, a company needs a comprehensive approach that depends on the integration of people, plant and processes. The maintenance reliability organization needs to be efficient, well organized, cost-effective and innovative to realize higher plant availability and smooth operations. Through maintenance reliability training, coaching and mentoring, Institute of Maintenance Management Education (IMME) provides value to the clients by focusing on creation of organic teams who understand asset performance management at strategic reliability level to help improve business profitability.

IMME helps companies reach their maintenance reliability goals by way of building capacity and competency – knowledge, skill, motivation, initiative, team work, etc. of maintenance managers, plant engineers, maintenance supervisors, technicians, etc. through training on various themes related to maintenance reliability function. Identifying and embracing the best practices in maintenance reliability management enables an organization to avoid failures, breakdown maintenance work and other barriers to success while maintaining safe, reliable operations and minimizing costs.

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**EXCELLENCE IN TRAINING FOR OVER 30 YEARS**

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### **Some of our Clients**

□ Tens of thousand of maintenance engineers, managers, plant executives and other engineering personnel from various reputed companies in the corporate sector have participated in different in-house / virtual training programmes, distance courses, outbound programmes, workshops, seminars, etc. conducted by IMME in a period of over 30 years.

□ Some of the companies who have participated in various short-term training programmes conducted by IMME in the past are shown below:

ABB India Ltd.  
Addverb Technologies Pvt. Ltd.  
Ador Welding Ltd.  
Alfa Laval (India) Ltd.  
Amaraja Batteries Ltd.  
Ambuja Cements Ltd.  
Anshupati Textiles  
(A Divn. of Vardhman Polytext  
Ltd.)  
Antifriction Bearings  
Corporation Ltd., The  
Ashok Leyland Ltd.  
Asian Cables & Industries Ltd.  
Asian Paints (India) Ltd.  
Atul Limited  
Bajaj Auto Ltd.  
Balkrishna Industries Limited  
Balmer Lawrie & Co. Ltd.  
Bata India Limited  
Bellary Steels & Alloys Ltd.  
Bharat Dynamics Ltd.  
Bharat Electronics Ltd.  
Bharat Heavy Electricals Ltd.  
Bharat Petroleum Corporation  
Ltd.  
Bharat Refractories Ltd.  
Bhuruka Gases Limited  
Birla Cement Works  
Blue Star Limited  
Bombay Dyeing & Mfg. Co.  
Ltd., The  
Borosil Glass Works Ltd.  
Brakes India Limited  
Bridge and Roof Co. (India) Ltd.  
Britannia Industries Ltd.  
Cable Corporation of India Ltd.  
Carborundum Universal Ltd.  
Castrol India Limited  
Ceat Limited  
Central Electronics Limited  
Cetex Petrochemicals Limited  
Chennai Petroleum Corp. Ltd.  
Chittaranjan Locomotive Works  
Cipla Limited  
Coal India Limited  
Colgate-Palmolive (India) Ltd.  
Continental Device India Ltd.  
Coromandel Fertilizers Ltd.  
Cosmo Ferrites Limited  
Cosmo Films Limited  
Crompton Greaves Limited  
Cutfast Abrasive Tools Ltd.  
Dabur India Limited  
Daurala Sugar Works  
Deepak Fertilisers and  
Petrochemicals  
Corporation Ltd.  
Deepak Nitrite Limited  
Denso India Ltd.  
Dhampur Sugar Mills Ltd., The  
Dharamsi Morarji Chemical Co.  
Ltd., The  
E.I.D. Parry (India) Ltd.  
Eicher Tractors  
Emco Transformers Ltd.  
Enercon (India) Limited  
Esab India Limited  
Escorts Limited  
Ester Industries Limited  
Eveready Industries India Ltd.  
Fertilizers and Chemicals  
Travancore Ltd., The  
Finolex Industries Ltd.  
Gharda Chemicals Ltd.  
Godrej & Boyce Mfg. Co. Ltd.  
Goodyear India Limited

Graphite India Limited  
Grasim Industries Limited  
Greaves Cotton Limited  
Gujarat Mineral Development  
Corporation Ltd.  
Gujarat State Fertilizers Co.  
Ltd.  
Hawkins Cookers Limited  
Heavy Vehicles Factory  
Hindalco Industries Ltd.  
(Renusagar Power)  
Hindustan Aeronautics Limited  
Hindustan Everest Tools  
Limited  
Hindustan Fertilizer Corporation  
Limited  
Hindustan Unilever Limited  
Hindustan Newsprint Limited  
Hindustan Organic Chemicals  
Ltd.  
Hindustan Petroleum  
Corporation Ltd.  
Hindustan Wires Limited  
ITC Limited  
ITI Limited  
India Glycols Ltd.  
India Pistons Limited  
Indian Farmers Fertilizer  
Co-operative Ltd.  
Indian Oil Corporation Ltd.  
Indian Ordnance Factories  
Integral Coach Factory  
JSW Ispat Special Products  
Ltd. (Formerly Monnet Ispat &  
Energy Limited)  
Kalyani Steels Ltd.  
Karnataka Antibiotics &  
Pharmaceuticals Ltd.  
Kirloskar Brothers Limited  
Kirloskar Copeland Limited  
Kirloskar Electric Company Ltd.  
Kirloskar Oil Engines Ltd.  
Kirloskar Pneumatic Co. Ltd.  
Lakshmi Electrical Control  
Systems Ltd.  
Larsen & Toubro Limited  
Lubrizol India Pvt. Ltd.  
Lupin Limited  
MRF Limited  
Maharashtra Seamless Limited  
Mahindra & Mahindra Ltd.  
Malayala Manorama Co. Ltd.  
Malwa Cotton Mills Ltd.  
Manali Petrochemical Ltd.  
Mark Auto Industries Ltd.  
Mineral Exploration Corporation  
Ltd.  
Mother Dairy  
Mysore Paper Mills Ltd., The  
NTPC Limited  
Nagarjuna Fertilizers and  
Chemicals Ltd.  
National Aluminium Company  
Ltd.  
National Engineering Industries  
Ltd.  
National Fertilizers Limited  
National Steel Industries Ltd.  
Neyveli Lignite Corporation Ltd.  
Nuclear Fuel Complex  
Nuclear Power Corporation of  
India Ltd.  
Orient Cement  
Orient Paper Mills  
Oriental Carbon & Chemicals  
Ltd.

Panchmahal Steel Limited  
Panyam Cements & Mineral  
Industries Ltd.  
Pasupati Acrylon Ltd.  
Philips India Ltd.  
Poona Shims Pvt. Ltd.  
Prakash Industries Ltd.  
Pyrites, Phosphates &  
Chemicals Ltd.  
Radico Khaitan Ltd.  
(Unit: Rampur Distillery)  
Rajasthan State Co-operative  
Spg. & Gng. Mills Federation  
Ltd.  
Ranbaxy Laboratories Ltd.  
Rane Brake Linings Ltd.  
Rashtriya Chemicals &  
Fertilizers Ltd.  
Raymond Limited  
RCCPL Pvt. Ltd.  
(Formerly Reliance Cement Co.  
Pvt. Ltd.)  
Reckitt Benckiser (India) Ltd.  
Reliance Industries Ltd.  
SRF Limited  
Samcor Glass Limited  
Samtel Color Limited  
Saraswati Sugar Mills, The  
Shiram Pistons and Rings Ltd.  
Siemens Ltd.  
Simbhaoli Sugar Mills Ltd., The  
Sona Steering Systems Ltd.  
Steel Authority of India Ltd.  
Stumpp, Shuele & Somappa  
Springs Pvt. Ltd.  
Sud-Chemie India Pvt. Ltd.  
Sudarshan Chemical Industries  
Ltd.  
Sunflag Iron & Steel Co. Ltd.  
TAFE Motors and Tractors  
Limited  
(Formerly Tractors and Farm  
Equipment Ltd.)  
TVS Motor Company Ltd.  
Tamilnadu Petroproducts Ltd.  
Tata Chemicals Limited  
Tata Coffee Ltd.  
Tata Power Company Ltd.  
Tata Motors Ltd.  
Tata Steel Ltd.  
Technova Imaging Systems (P)  
Ltd.  
Tega Industries Ltd.  
Thermax Limited  
Traco Cable Company Limited  
Travancore Titanium Products  
Limited  
U.P. Twiga Fibreglass Ltd.  
USV Pvt. Limited  
United Phosphorous Ltd.  
Usha Martin Ltd.  
V.I.P. Industries Ltd.  
Vadilal Industries Ltd.  
Videocon Appliances Ltd.  
Vikram Cement  
(A Unit of Grasim Industries  
Ltd.)  
Vindhya Telelinks Ltd.  
Voltas Limited  
Walchandnagar Industries  
Limited  
WIL Car Wheels Ltd.  
(Formerly Wheels India Ltd.)  
Wipro Limited  
Wires and Fabriks (S.A.) Ltd.  
Wockhardt Limited