

Maintenance for Enhanced & Sustainable Profitability

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ABSTRACT

The dynamics of Globalization and Information Technology have made economic boundaries disappear providing global players, smaller multinationals and local companies unlimited growth opportunities. These opportunities have been further multiplied by a booming Indian economy. To best utilize these opportunities, an organization must enhance its productivity through streamlined and efficient production processes. Productivity is vital in improving competitiveness, market position and achieving the prime objectives of any business organization i.e. enhanced and sustainable profitability.

INTRODUCTION

Continuous availability of production equipment and utilities, capable of delivering services at the required levels goes a long way in improving productivity. The quality, commitment and performance of the human resources, correct marketing and financial strategies are the other equally important factors.

In an equipment's life time, its initial capital cost is very little compared to its life cycle operation and maintenance cost. An effective maintenance management system can ensure maximum availability, prolonged equipment life, low life cycle costs, minimum production loss and no safety risk while keeping the maintenance costs at optimum level.

Traditionally, maintenance was seen as an unwanted but necessary "cost". A paradigm shift is happening now and organizations are viewing maintenance, not as a cost producer but as a profit generator.

SIMAIN-A maintenance Concept, features & benefit

In line with the changing paradigm, Siemens has developed a highly successful maintenance concept **SIMAIN**. This concept has been developed through an in depth technical knowledge, experience and successful experimentation of maintenance experts.

The two basic products of most maintenance process are Uptime/Availability and Reliability.

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Availability is a direct function of maintenance activity. It is the ratio of 'net operational time' to 'net available time'.

Net Available Time = Mean Time between Failures (MTBF)
Net Operational Time = MTBF + Mean Down Time (MDT)
MDT = Mean Time Taken to Repair (MTTR) + Mean Waiting Time (MWT)

Availability = $MTBF / (MTBF + MTTR + MWT)$

- **Factors influencing MTBF**
 - Machine reliability
 - Preventive / on line maintenance/inspection
 - Parallel function/redundancy
 - Operating conditions
 - Quality of spares or maintenance job
- **Factors influencing MTTR**
 - Severity of defect/ failure
 - Machine maintainability
 - Maintenance tools and jigs
 - Maintenance procedures
 - Maintenance skills
- **Factors influencing MWT**
 - Organization
 - Systems and procedures
 - Availability of maintenance resources (tools, spares and manpower)
 - Diagnostic techniques and trouble shooting skills

Reliability is a possibility that a machine when used under stated conditions will perform its functions for a stated period. For a machine to be reliable, the strength of the machine design parameters should always be more than the load condition for which the strength has been designed.

SIMAIN maintenance concept focuses on six key result areas.

- **Availability:** Availability of equipments for production through minimizing down time.
- **Reliability:** Ensuring reliability of equipments and systems.
- **Performance:** Continual improvement in performance.
- **Efficiency:** Optimized utilization of human, energy and material resources.
- **Safety:** Safe and environment friendly operations.
- **Transparency:** Monitoring control and functional transparency.

A synergistic impact on these areas results in continuous and efficient production leading to **enhanced and sustainable profitability**, the prime objectives of any business organization.

SIMAIN is a combination of several modular services and packages that can be used independently or as a customized package to suit individual company's immediate and long term requirement.

SIMAIN is developed as product independent, manufacturer independent, industry independent and system independent. Same concept is applicable for switchyards; power distribution systems; production systems; utilities; engineering, manufacturing, assembly or process industries. It can be used across the industry segments like paper, cement, metals, oil & gas, chemicals & petrochemicals, mining, material handling, food & beverages, ports, airports, infrastructure, power plants and so on.

Broadly, SIMAIN is divided in to two categories:

(a) Maintenance Services: These services can be used to supplement an industry's own maintenance team as needed—always precisely matched to the individual equipment and production & maintenance process.

- Downtime & breakdown costs can be reduced & avoided
- No need to keep experienced but rarely needed specialists
- Increased reliability of production, measuring & protection equipment
- Reduced bound capital by optimizing spare parts' stocks
- Economically ensure plant availability & optimally exploit the potential of technical equipment

The driving force behind these services is ensuring full functionality of the systems and plant equipment using external technical expertise.

(b) Business Based Maintenance focuses on the corporate objectives of industries to develop best possible maintenance strategies and to shape and coordinate all processes and measures in a targeted way.

- Identification & exploitation of cost reduction potential in maintenance
- Improved budget planning & maintenance cost **transparency**
- Optimized maintenance cost per produced unit
- Demand oriented **availability** and optimal **performance** of your system
- Reduction of energy costs
- Enhanced **productivity**, plant **reliability** & **profitability**.

With SIMAIN, industries can optimize operation & maintenance costs, while ensuring the availability of plant & equipment

Components of SIMAIN:

1. Servicing, Trouble Shooting, Repairing, Overhauling, Retrofitting, Upgradation, Refurbishment, Recommissioning and Testing
2. Reliability Centered Maintenance
3. Energy Optimization
4. Inventory Management
5. Maintenance Business Review and Improvement
6. Integrated Maintenance Management

(C) Integrated Maintenance Management (Maintenance Contracting)

World wide, most industries want to focus on their core areas, generally production & quality assurance and out source non core activities. Maintenance is one such area which is very critical, affects the bottom line but still is a non core activity.

Most of the green field projects and many brown field ones have found advantage in tying up world class organizations like Siemens to develop an outsourced maintenance organization which is aligned with the prime business objective of **enhanced and sustainable profitability**.

This allows companies to focus on their own core strengths and activities. Also, this allows them to incorporate world class maintenance management systems through organizations whose core activity is maintenance.

This out sourcing is completely different from the conventional maintenance out sourcing which is more in form of man power supply at skilled, semi skilled and unskilled levels. Here, right from strategy to resource mobilization to performance monitoring to inventory management is a part of the package.

Stages of Integrated Maintenance Management

1. Strategy Development and Optimization
 - o Review of equipment function
 - o Review of failure mode, effects and consequences (FMEA, FMECA)
 - o Determination of optimum maintenance strategy and tasks
 - o Root Cause Analysis
 - Fault Tree Analysis (top down)
 - Cause & Effect Diagram (Ishikawa or Fish Bone Diagram)
 - Why – why technique
- FMEA: Failure Mode Effect Analysis
 - Piece Part FMEA
 - Functional Assembly FMEA
- FMECA: Failure Mode Effect Criticality Analysis

Criticality: Risk Priority Number = SF x FF x PF

SF: Safety Factor
FF: Frequency Factor
PF: Severity Factor
2. Documentation
 - Generated at Project Stage

- i. Equipment
 - List
 - Criticality Status
 - Name Plate Details
 - Test / Commissioning Reports
 - Warranty / Guarantee Details
- ii. Single Line Diagram (as-built)
- iii. P&I Diagrams
- iv. Panels' Schematic & Wiring Diagrams (as-built)
- v. OEM's Operation & Maintenance Manuals
- vi. Cable Schedules & Route Drawings
- vii. Relay Settings
- viii. Interlocks
- ix. Trip Settings
 - Generated & Maintained by Maintenance Organization
- i. Activity & Observation Log Sheets/Books
- ii. Work Permit and Electrical Isolation & Energizing Procedures
- iii. Standard Operating & Maintenance Procedures
- iv. Trouble Shooting & Testing Procedures
- v. Risk Assessment & Precautions
- vi. Safety Checklists
- vii. Criticality Based Maintenance Schedules & Checklists
- viii. Periodic Condition Monitoring Checklists
- ix. Look, Listen & Feel – Checklists
- x. Shutdown Register
- xi. Work Permit Records
- xii. Electrical Lock Out Records
- xiii. Spares Consumption Records
- xiv. History Cards
- xv. Safety & Technical Suggestions
- xvi. Near Miss & Accident Reports
- xvii. Tool Box Talk: topics, Formats & Records
- xviii. Competency Matrix, Training Plan & Records
3. Operation, Shift Manning & Monitoring of Power Distribution Systems and DG Power Plants
4. Predictive Condition-Based Maintenance
 - On Line Condition Monitoring and Analysis
 - OffLine Condition Assessment
 - Lightning, Surge and Static Protection
 - Installation and Safety Audits
 - Power Quality Improvement
 - Power System Reliability and Strengthening:
5. Criticality Oriented Scheduled and Chance Based Preventive Maintenance
6. Corrective / Breakdown

Maintenance

7. Planned Shutdown / Turn Around Maintenance
8. Equipment Performance Review & Improvement
 - Effectiveness
 - Protection
 - Energy Consumption
 - Safety
 - Life Cycle Costs
9. Identification, recommendation and execution of upgradation & modification.
10. Work Force Management
11. Spare Parts' Inventory Management
 - Identification of requirement
 - Interchangeability, Standardization & Indigenization
 - Minimum stock/order level
 - Minimum order quantity
 - Consumption analysis
 - Raising purchase requisition
 - Vendor development
 - Technical evaluation of offers
 - Pre-dispatch & post receipt inspections
 - Managing of stores
 - i. record keeping
 - ii. receipt/issue of material
 - iii. inventory preservation
12. Maintenance Management Systems' Review and Optimization
 - Weekly/Monthly/Quarterly/Annual Reports
 - Quality & Safety Audits
 - Failure Analysis and Lessons Learnt
 - Maintenance Business Review and Improvement

13. CMMS

We can not improve what we can not measure. Maintenance is often organized and performed without proper measures. To determine its impact on the business's success, we need

- Consistent and reliable data
- High quality analysis
- Clear presentation of the information

This is possible with a powerful and effective Computerized Maintenance Management System (CMMS). Such system can help us monitor:

- General
 - Actual Budget v/s Forecast
 - Maintenance Costs: overhead, labor, contractors, spare parts as a % of sales or per unit produced
 - Safety and Environmental Performance
- Inventory
 - Inventory Turnover
 - Inventory Accuracy Level
 - Inventory Service Level
 - % Downtime Due to Stock Outs
 - Materials v/s Labor Ratio
 - Dormant Stock Items
 - Excess Stock Items
- Organization
 - Ratio of contractors to company employees
 - Ratio of production to maintenance employees
 - Maintenance employees per supervisor
 - Maintenance employees per planner
 - % overtime hours
 - % absenteeism
- Work Order Management
 - Work Order Lead Time
 - Workload (backlog) Level
 - by craft
 - by priority
 - by type
 - Man Hours per Work Order
 - Daily Schedule Completion
 - % Emergency, Corrective, Preventive and Predictive Maintenance of Total Activity

Performance Parameters

- Uptime (high MTBF, low MTTR and MWT)
- Inventory
- Maintenance costs
- Energy Costs & Power Factor
- Accidents: near miss, unreportable and reportable
- Compliance of maintenance schedules
- Adherence to safe and standard maintenance & operating procedures
- Compliance of statutory norms
- Immediate response to breakdowns/tripping
- Availability of sufficient, qualified, experienced and trained manpower
- Availability of proper tools, tackles and instruments
- Availability of back up support from head office, OEMs and other agencies

(D) Benefits: (Technical and Financial)

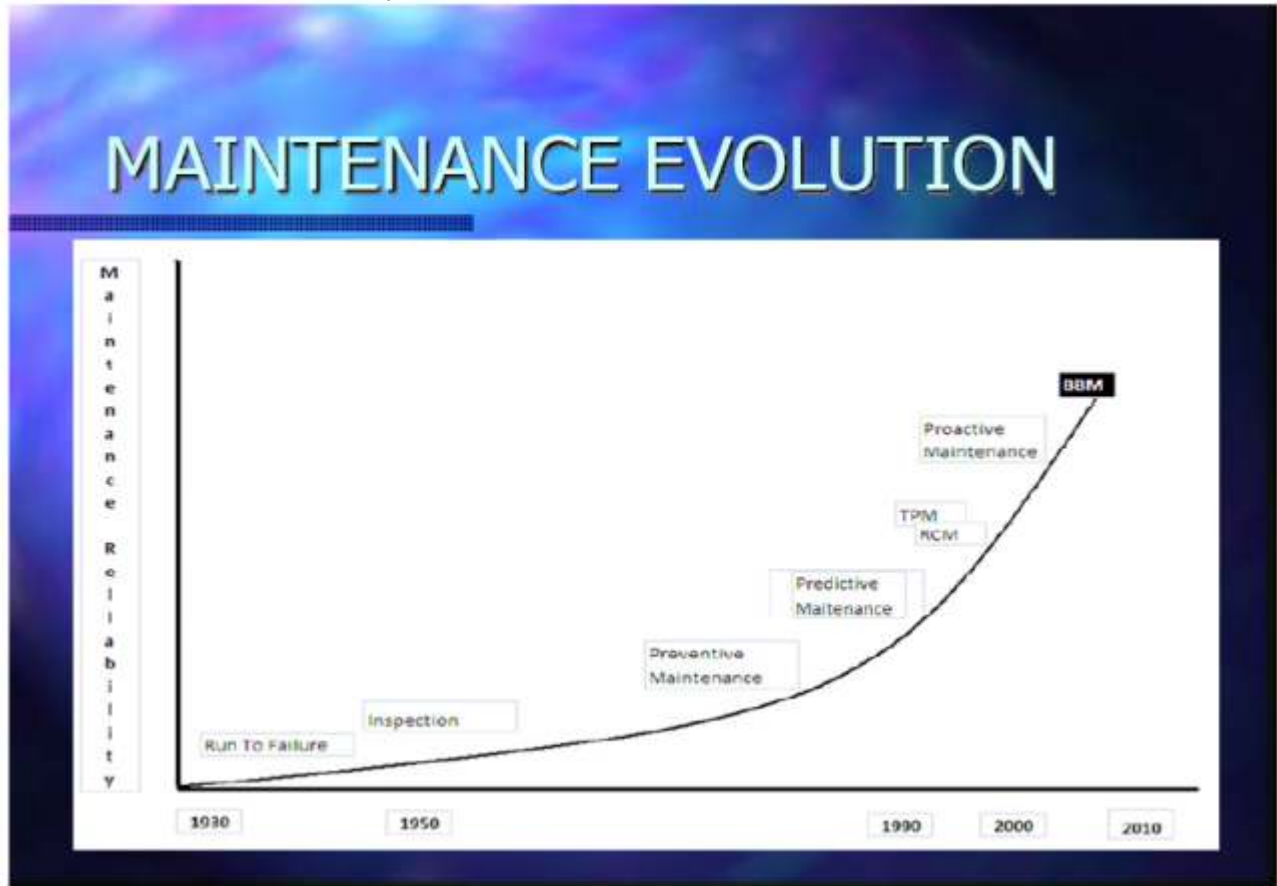
Industries stand to gain several advantages at one shot by opting for SIMAIN.

- Single source for all professional maintenance services.
- Customized maintenance contracts to suit your requirement.
- Sharing international best practices.
- High technical competency and vast experience of maintenance experts.
- Additional resource mobilization as and when required.
- Better utilization of existing maintenance personnel.
- Higher equipment availability, improved safety & very low unplanned downtime
- Extended equipment life & lower life cycle costs.
- Higher efficiency and thus lower operating costs.
- Reduced cost intensive corrective maintenance & repairs.
- Reduced capital costs (e.g. investment in testing & monitoring instruments, training).
- Reduced inventory of spares and excess capacity through better inventory management.

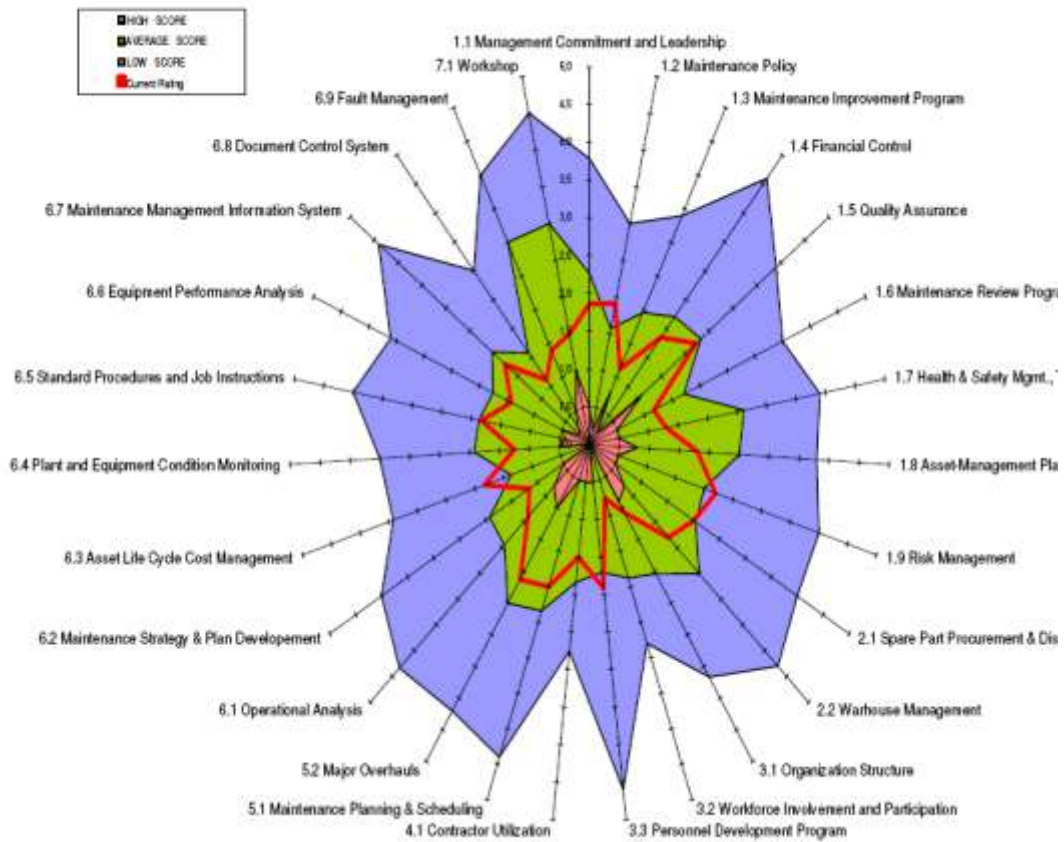
REFERENCES

Currently, several organizations a cross the world are benefiting from SIMAIN. Some of the Indian industries using various services and packages available under SIMAIN are:

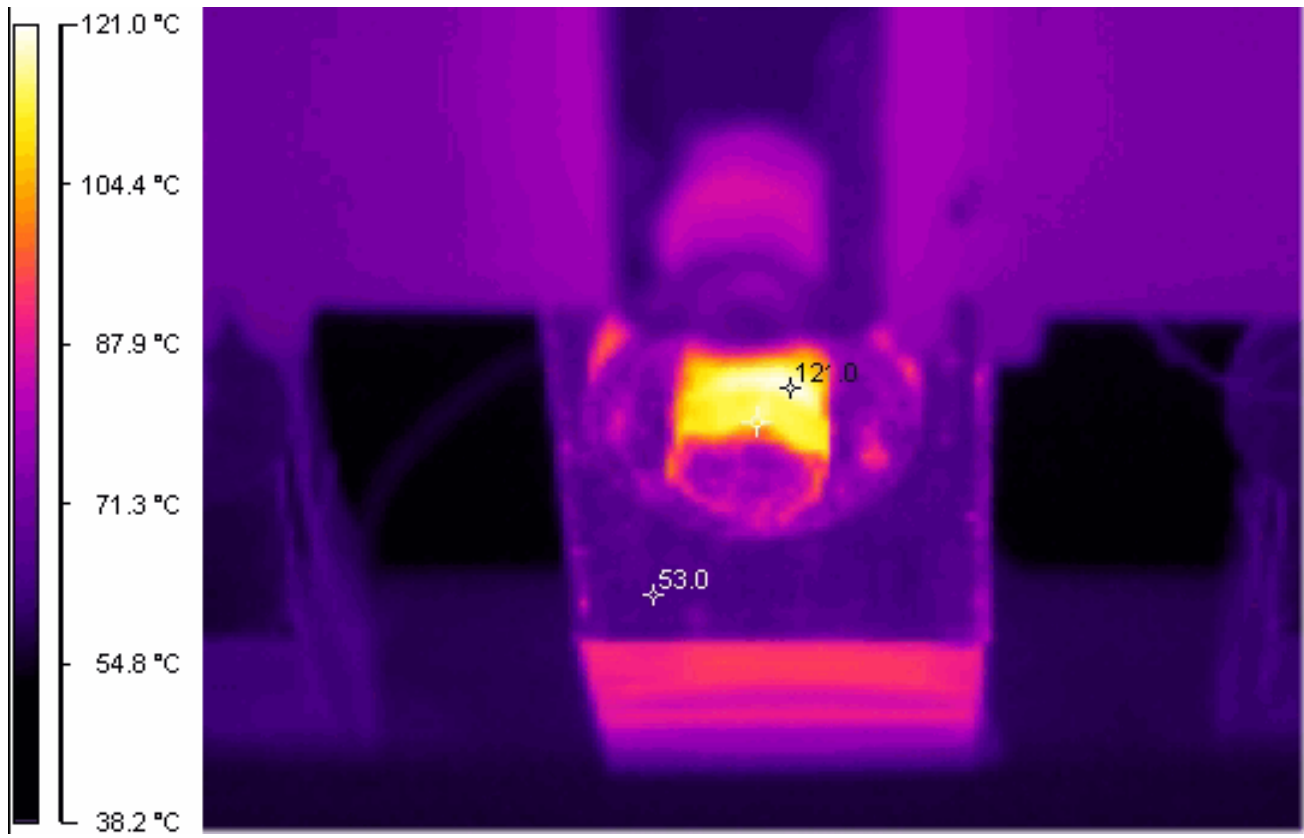
1. Advanced Research Centre International, Hyderabad
2. Asahi Glass, Navi Mumbai
3. Bharat Forge Ltd., Pune
4. Bhushan Steel & Strips, Khopoli
5. Bombay Oxygen, Thane
6. Castrol India Ltd., Silvassa
7. Hikal Chemicals, Navi Mumbai
8. Ispat Industries Ltd., Dolvi
9. ITC, Bangalore & Haridwar
10. Proctor & Gamble, Bhopal
11. Relene Petrochemicals, Navi Mumbai (Till Recently)
12. Reliance Industries Ltd., Kurkumbh
13. Tata Motors Ltd., Uttaranchal
14. Vedanta Alumina Ltd., Lanjigarh
15. WBPDC: Bakreshwar Power Plant



Maintenance Business Review:



Thermogram: Temperature Monitoring Using Infrared Camera



Frequency Spectrum Analysis of Pump Vibrations

