Advanced Maintenance Management

Presented By : RADA

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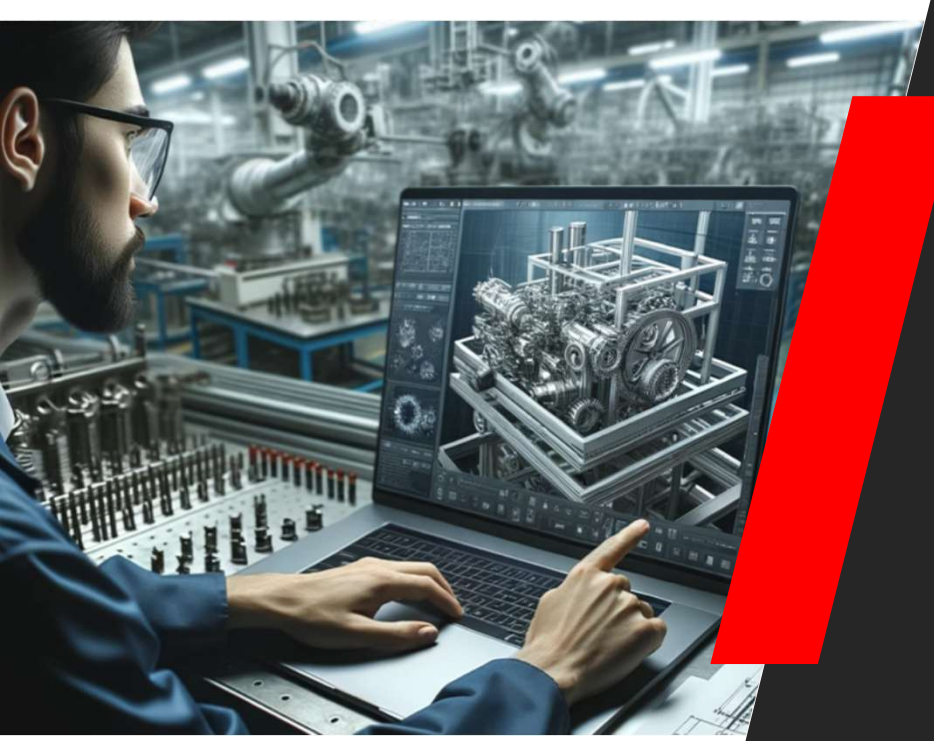

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Am2
Advanced Maintenance Management

Presentation

This product has been developed through collaboration with expert maintenance technicians from important multinational manufacturing companies. It is currently being used in dozens of facilities by hundreds of maintenance personnel, with whom we continuously work to make it more effective and responsive to the practical needs of end users. Any suggestions or modifications proposed by a customer and implemented by RADA become shared knowledge for all **AM2** users, a group to which we hope your company will also want to join.

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PURPOSE OF MAINTENANCE

UNI 9910 Standard

UNI 9910 standard defines maintenance as « the combination of all actions, technical and administrative, including supervision, aimed at keeping or restoring an entity to a state in which it can perform the required function».

The purpose and objective of maintenance is to ensure the «availability» of the system or equipment; these entities must be able to perform the required function under established conditions for a certain period of time. Availability is fundamentally dependent on maintainability, reliability, and maintenance logistics, while external resources required (except for logistics) do not influence it.

To achieve good availability, the Mean Time Between Failures (MTBF) should be as high as possible in relation to the Mean Repair Time (MRT).

Additionally, maintenance activities should ideally and, in some cases, necessarily be associated with the collection of information and data that allow for verifying and monitoring how the system performs throughout its useful life, in order to predict extensions or shortenings of the MTBF.

Therefore, the purpose of maintenance is to: reduce the rate at which the asset deteriorates; extend its operational life; collect information on defects or causes of deterioration to eliminate or prevent them.

REDUCE PLANT DETERIORATION

By ensuring maximum operational availability and monitoring the Mean Time Between Failures (MTBF) and its evolution.

COLLECT DATA THROUGHOUT THE PERIOD OF OPERATION OF THE PLANT

Monitor defects and causes of deterioration, for continuous improvement and to report issues to the designers of future plants.

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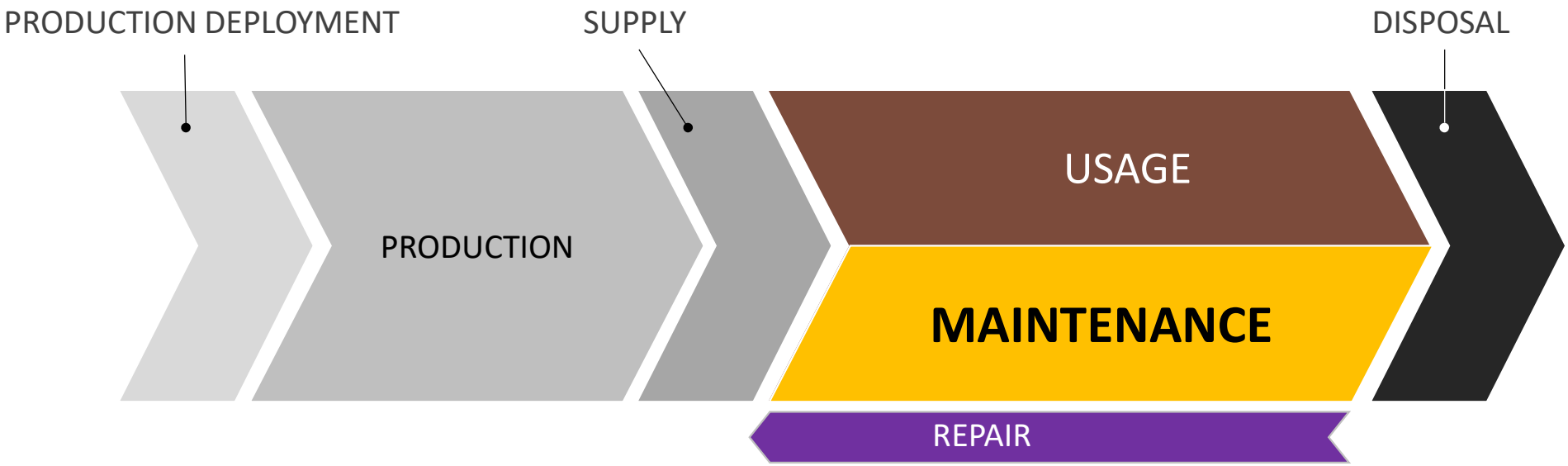
LIFE CYCLE OF AN ASSET



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WHAT?

HOW?

MAINTENANCE

WHAT - HOW

MAINTAIN THE PLANT AT A PROGRAMMED LEVEL OF EFFICIENCY

EXTEND THE LIFESPAN OF THE PLANT

REMEDY, WHERE POSSIBLE, DESIGN FLAWS

WITH THE LOWEST POSSIBLE COSTS, BOTH IN TERMS OF DIRECT MAINTENANCE COSTS, AND IN TERMS OF INDIRECT COSTS DUE TO PLANT DOWNTIME FOR MAINTENANCE ACTIVITIES

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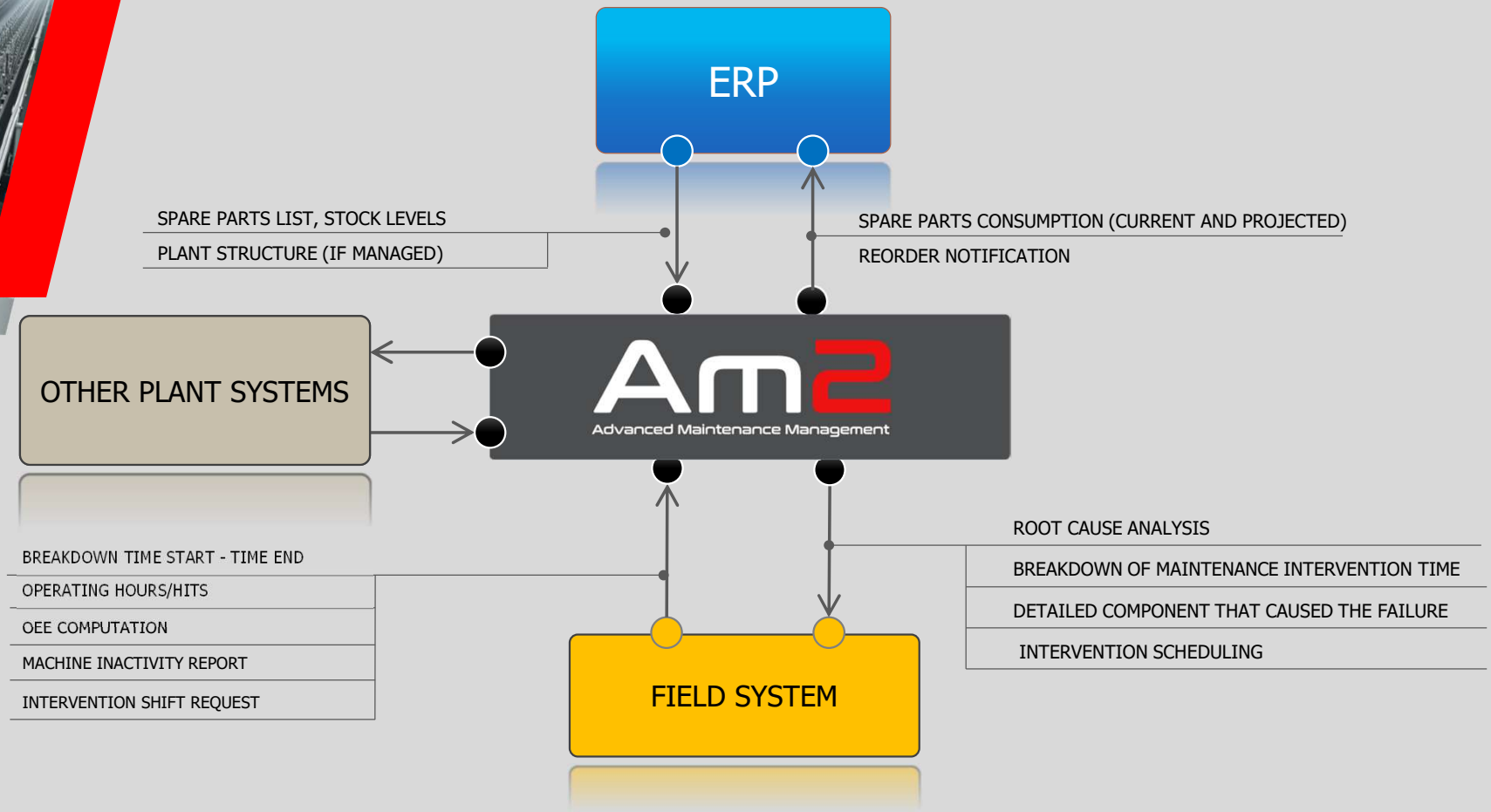
AM2

AM2 has been developed by RADA in close collaboration with the Maintenance teams of major industrial companies. The ability to *customize* and share developments and new functionalities are features that make it a unique product in the CMMS (Computerized Maintenance Management System) software scenario. In the following slides, a quick overview of other specific functionalities of **AM2**.

SCHEMA AM2 – OTHER SYSTEMS



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FUNCTIONS OF AM2

- USER AND AUTHORIZATION MANAGEMENT
- MAINTAINER SKILL MANAGEMENT
- PLANT STRUCTURE WITH DETAIL ON SPARE PARTS
- CLASSIFICATION OF MACHINES AND COMPONENTS IN REACTIVE PHASE
- CLASSIFICATION OF MACHINES AND COMPONENTS IN PROACTIVE PHASE
- STD COMPONENT LIBRARIES MANAGEMENT
- FACILITIES MANAGEMENT

BDM CORRECTIVE MAINTENANCE

- Manual EWO Creation (unconnected machine)
- Automatic EWO Creation from field system
- Management of EWO cancellation/suspension
- Assignment of EWO to maintenance team
- Real-time EWO Reporting (Tablet)
- Breakdown of intervention times
- Root Cause Analysis of the failure
- Management of spare parts in the intervention
- Break Down Map
- MTTR (Mean Time To Repair)
- MTTR Stratification
- TBF - MTBF
- Total costs
- Tablet Mode

PM PREVENTIVE MAINTENANCE

PM

- SMP Creation (Standard Maintenance Procedure)
- Management of SMP Documents
- Management of SMP Document Editions
- Comparison between Planned Times and Actual Times
- Total Costs
- Automatic Creation of Work Orders
- Real-time Reporting of Work Orders
- Closely Monitor
- Material and Tool Management
- PM Calendar
- Management of Activity Handover to AM

AM

- Creation SAMP(Std. Autonomous Maintenance Procedure)
- Management and editing of SAMP
- Management of Unscheduled Activities (upon request)
- Autonomous Maintenance Cycle (CILR) Management
- Route AM Activity Management
- Closely Monitor
- Material and Tool Management
- Creation of AM Calendar
- Comparison between Planned Times and Actual Times
- Total Costs
- Tablet Mode

CM CORRECTIVE MAINTENANCE

TAG

- Creation of Corrective Maintenance Report (TAG)
- TAG Management
- Assignment of TAGs to Functions
- Corrective Maintenance Intervention Reporting
- TAG Analysis
- Cost/Benefit Calculation
- Total Costs
- Impact Analysis

MACHINE LEDGER

- Automatic Creation and Compilation
- Component Management Detail
- Automatic Management of Scheduled Cycles
- Automatic Management of Failure Interventions
- Automatic Management of Corrective Interventions (TAG)
- Automatic KPI Calculation
- Display of TBM - HBM

SPARE PARTS

- Import from ERP Spare Part Management
- Calculation of Actual and Planned Consumption
- Advanced Warehouse Management

KPI

- Breakdown
- MTBF
- MTTF
- OEE
- Maintenance Cost Trend

KAI

- AM/PM Tag completed
- Managed Work Orders (Open, Completed, Analyzed)
- Distribution of Root Causes
- Scheduled/Executed SAMP
- Created MP Information
- Activities Transferred from PM to AM

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A CHANGE IN
PARADIGM

The production of documentation is a cost.

With the methods and tools currently used by most complex industrial entities, it is unsustainable; it would require resources and financial availability that nobody can afford.

A significant amount of resources is wasted in the activity of documenting and managing documentation, resources that are taken away from their primary task: keeping the machines efficient.

A change in paradigm is needed.

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THE FUNDAMENTAL PIECE:
THE SPARE PART

The spare part is the fundamental piece on which the entire maintenance logic is based.

AM2 is designed to adhere to this logic and to exploit it in a cost reduction perspective.

Standard procedure cards (SMP) are focused on spare parts and describe the methods for replacement or inspection of the component. SMPs must be drafted in a way that can be applied to all spare parts belonging to a certain type and when the standard SMPs are linked to the individual spare part, the user can "customize" them by adding specific instructions. This working method significantly reduces the burden of document drafting, consequently reducing the overall maintenance management costs.

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STANDARD
DOCUMENTS

If the Standard Maintenance Procedures (SMP) are generated correctly, they can be used for all components of a certain type. For example, the SMP for replacing a pneumatic cylinder can be adopted for all pneumatic cylinders in the facility, with the precaution of making adjustments when connecting it to a real component that requires a different activity than the standard one. For instance, if the cylinder is particularly heavy and needs to be hooked and secured during replacement operations. By using standard methods, a significant reduction in the documents to be produced and maintained can be achieved, resulting in reduced time and costs.

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Standard Maintenance Procedure

A plant with hundreds of machines must manage thousands and thousands of spare parts. Documenting the replacement and inspection procedures for each individual spare part would involve a tremendous amount of documentation, practically unmanageable for maintenance teams.

There is a solution, which involves documenting not the individual spare parts, but only the categories to which the spare parts belong.

Not one document for each individual spare part

But one document for each type of spare part

With this working method, applied systematically to all assets, there is a significant reduction in the number of documents to be drafted and managed, resulting in a reduction in time and costs.

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LESS DOCUMENTS
MORE SIMPLE

The only concrete way to allow teams to manage the entire system by controlling and organizing activities and monitoring costs promptly is to reduce and simplify documentation.

The task of maintenance software should be to support technicians and, in this sense, **AM2** represents a concrete answer to a real problem.

- Cost reduction
- Simplification of documentation

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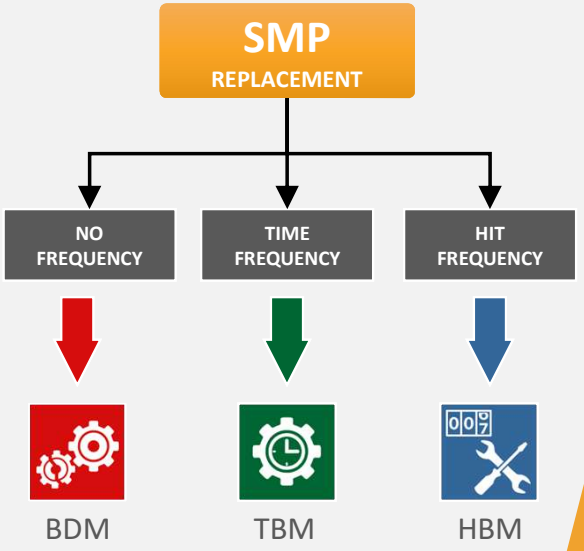
Standard Maintenance Procedure

One single Spare Part Management (SMP) per type of replacement. Not one for each component, but one for all components of a type.
With a single replacement SMP, three different maintenance strategies can be managed.



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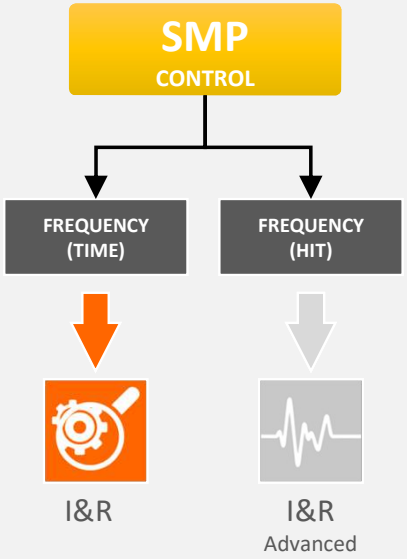
Standard Maintenance Procedure

With a second control SMP, «Inspection & Repair» strategies can also be implemented.



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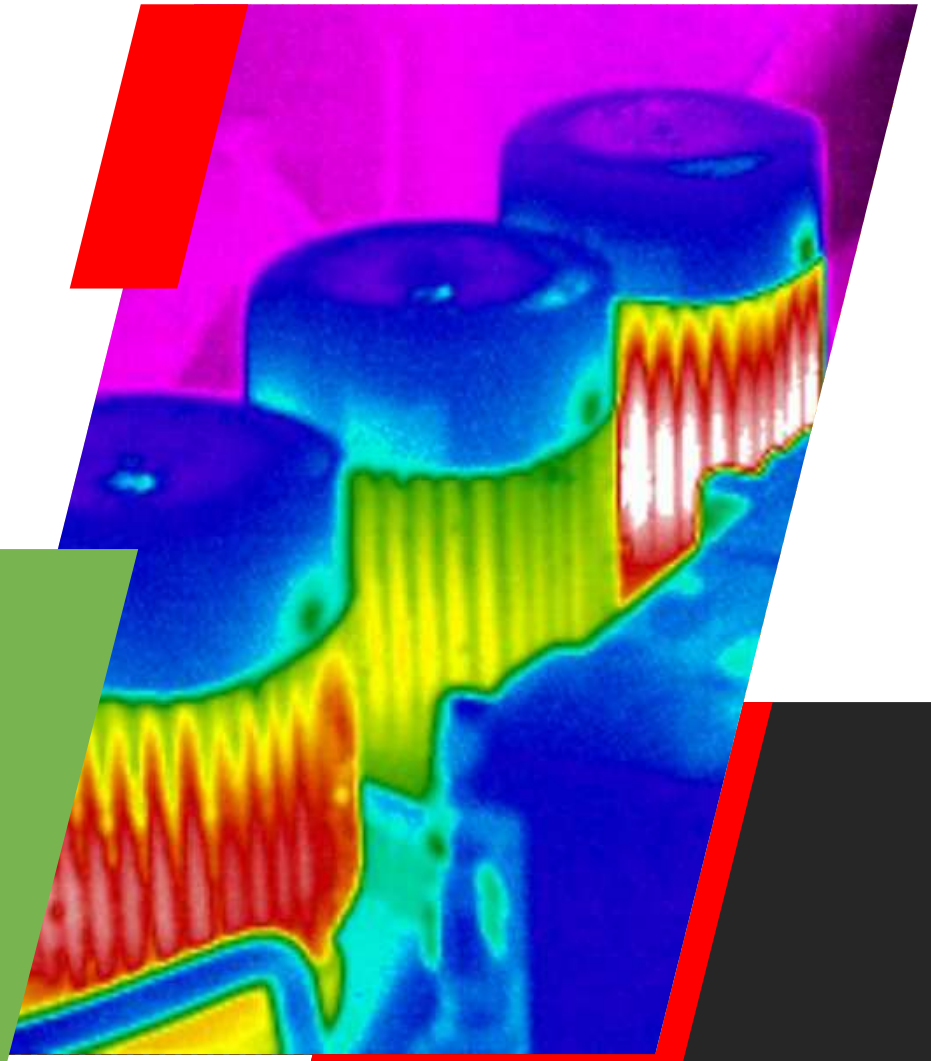
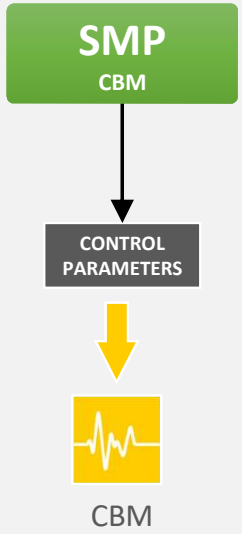
Standard Maintenance Procedure

With a third control SMP, «Control Parameters» strategies can also be implemented





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MANAGEMENT OF ALL MAINTENANCE STRATEGIES

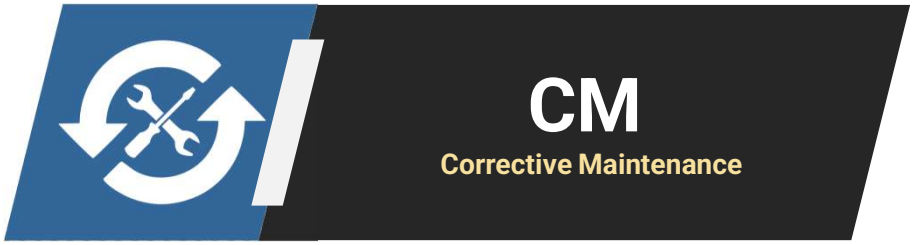
BDM
Break Down Maintenance

TBM
Time-Base Maintenance

I & R
Inspection and Repair

HBM
Hit-Based Maintenance

CBM
Condition-Based Maintenance



CM
Corrective Maintenance

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MAIN FUNCTIONS

The plant structure can be imported from other software systems or built and managed directly in **AM2**. The detail is that of the spare part, a fundamental component of maintenance activity.

For each replacement part, a maintenance strategy can be defined that can be changed and adjusted to optimization needs. The choice of strategy, with the related standard document available, is very simple and can be done with just one click.

With the **TAG** tool, which any user, even if not part of the maintenance team, can create to report a problem with the plant that can be corrected to improve efficiency and prevent future issues.

01 MANAGEMENT OF PLANT STRUCTURE

02 DEFINITION OF MAINTENANCE STRATEGIES

03 MANAGEMENT OF CORRECTIVE MAINTENANCE INCIDENT

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MAIN FUNCTIONS

For machines not connected to an automatic field system, the opening of Emergency Work Orders can be done manually in **AM2**.

For machines connected to a field system, the fault notification is directly received by **AM2** which generates a provisional EWO document. It is the maintenance team's responsibility to decide whether it should only be accounted for with time and spare parts used or if it should be analyzed to find the root cause of the fault.

Cyclical maintenance interventions, TAGs, and EWOs can be assigned to maintenance teams by defining work orders. **AM2** simplifies the work of the maintenance manager by automatically checking the necessary skills for interventions and the level of team saturation.

04 CREATION OF MANUAL EWO

05 MANAGEMENT OF AUTOMATIC EWO

06 ASSIGNMENT ACTIVITY

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MAIN FUNCTIONS

07 CALENDAR OF PROFESSIONAL MAINTENANCE

All periodic maintenance interventions are automatically displayed in a calendar that allows an overview for the maintenance manager.

08 MANAGEMENT OF SPARE PARTS INVENTORY

AM2 connected to an ERP software or warehouse management system receives information about the availability of spare parts, allowing for the verification of the feasibility of interventions. The punctual and projected consumption of components is communicated by **AM2** to the connected system in order to proceed with the correct management of stocks and replenishment of spare parts.

09 AUTOMATIC CREATION OF MACHINE LEDGER

The MACHINE LEDGER as a summary report of all maintenance activity is generated by **AM2** automatically and kept constantly updated. The overall status of a machine's condition can be viewed at any time. All interventions whether cyclic, breakdown or corrective maintenance are reported with the corresponding times. All indicators such as MTBF and MTTR are calculated in real time and displayed on the Machine Ledger.

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MAIN FUNCTIONS

One module of **AM2** is dedicated to AUTONOMOUS MAINTENANCE and the creation of the necessary documentation to manage its activities. Standard Autonomous Maintenance Procedures (SAMP) and cleaning, lubrication, and inspection routes can be created by the plant conductor. A specific calendar allows for easy management of scheduling.

With **AM2**, it is possible to keep maintenance costs under control through a punctual comparison of expenses and a comparison between planned and actual costs, with the aim of continuous improvement to make the maintenance service increasingly efficient and functional

A Business Intelligence module connected to **AM2** allows for an advanced visualization of maintenance Key Performance Indicators (KPIs). **AM2** can use the tool already in use by the client for this purpose, and the **AM2** team will develop the dashboards designed with the client during the program implementation phase. In case a BI suite is not available, some basic monitoring pages can be directly integrated into **AM2**.

10 AUTONOMOUS MAINTENANCE

11 COST CONTROL

12 ADVANCED AND CUSTOMIZED KPI

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AM2 BENEFITS

COST REDUCTION

Simplification of the documentation process

- ❑ A single SMP per type of Spare Part
  - ○ Simpler
  - ○ Easier to create
  - ○ Less expensive
  - ○ Designed to be shared
  - ○ Manages the three different maintenance strategies: Replacement, Inspection & Repair and Parameters Control

SHARED KNOW-HOW

Data collected from the machines of a plant are not wasted, but transformed into shared information

- ❑ Circulation and sharing of the documentation
- ❑ Information is shared to enhance the manufacturing process

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AM2 BENEFITS

DIGITAL TRANSFORMATION SUPPORT

- ❑ Sharing of Maintenance tested and validated solutions
- ❑ Remote Assistance to a maintenance operator
- ❑ Generation of instructions for an operator wearing HoloLens while generating the relevant SMP
- ❑ One of the player for the implementation of the Machine Learning

DEFINITION OF PLANT STRUCTURE

- ❑ Management of the Plant Structure down to the level of spare parts

MAINTENANCE ACTIVITY ASSIGNMENT

- ❑ Automatic check to assess the required maintenance operator skills for interventions and monitor the workload of the maintenance team

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AM2 BENEFITS

ONE UNIQUE TOOL TO MANAGE THE MAINTENANCE PROCESS.

- ❑ The maintenance strategy focuses on the spare parts as an essential element of the maintenance activity.
- ❑ Maintenance Strategy Management
- ❑ Cost Control through comparison between planned and actual costs with the target to make the maintenance service increasingly efficient and functional

AUTOMATIC MANAGEMENT OF MAINTENANCE DOCUMENTATION

- ❑ Management of the Maintenance Calendar
- ❑ Spare Parts Inventory
- ❑ Machine Ledger creation and updating

MAINTENANCE KPI VISUALIZATION

- ❑ Advanced visualization of maintenance Key Performance Indicators (KPIs) through a Business Intelligence module to develop ad hoc dashboards
- ❑ In case no BI suite is available, basic monitoring pages are internally integrated

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AM2
CONCLUSIONS

A single tool to fulfill the Maintenance Process needs

AM2 is a fundamental element for an effective digital transformation

AM2 ensures the automated management of Maintenance procedures, but also allows for the manual input of data

AM2 allows users to define and manage the structure of the plant down to the detail of the spare parts

AM2 manages the effective maintenance strategy by managing only one SMP for each type of spare part, limiting the amount of documentation to be generated and managed, and therefore reducing the costs

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AM2
CONCLUSIONS

A single tool to fulfill the Maintenance Process needs

AM2 with a single SMP for each type of replacement is able to manage various maintenance processes: Replacement, Inspection & Repair and Parameters Control

AM2 ensures automatic management of maintenance calendars and assigns maintenance tasks to the maintenance operators with the appropriate skills and workload

AM2 ensures automatic management of Spare Parts Inventory

AM2 allows for cost control of maintenance interventions through a precise verification of planned and executed interventions

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THANK YOU

The RADA technicians of **AM2** Team will be pleased to answer your questions and requests for clarification.
Please do not hesitate to contact us for a program demo and to plan together the implementation steps of **AM2** in your company.

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BACKUP

NEW
OPPORTUNITIES

New technologies at increasingly lower costs are becoming available for maintenance activities.

The choice of which technologies to use in a specific production setting is complex and is up to the technicians.

What a maintenance software must certainly do is be open and prepared for these new solutions.

AM2 can become the tool for sharing tested and validated solutions.

The advantage of having a development team working closely with plant technicians is the ability to seize all the opportunities offered by technology, without having to rely on expensive customizations or wait for new program editions.

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REMOTE ASSISTANCE

The **AM2** team has experimented with the potential of a module designed to enable remote assistance to an operator. In collaboration with a Microsoft partner, the possibility of using various devices, including HoloLens, to allow a technician to guide a particularly complex intervention remotely, has been verified. On the operator's display, arrows and graphical indications appeared to facilitate the performance of the task.

This functionality is extremely interesting to solve complex problems that require the experience of the machine supplier.

This functionality has proven to be particularly useful during the course of the pandemic.

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GUIDE
CARDS

The **AM2** team has tested the possibility of having the program generate instructions for an operator wearing the HoloLens simultaneously with the creation of standard documents (SMP).
For complex operations or during training, instructions for maintenance personnel can be viewed through the HoloLens, allowing for hands-free operation.
This function also allows for recording a video while performing the task, which can then be used as support for future maintenance interventions or during training for new maintainers.

https://dynamics.microsoft.com/it-it/mixed-reality/guides/

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MACHINE LEARNING
DOLPHINS PROJECT

The Manufacturing Leadership Council of the National Association of Manufacturers (NAM), which represents the most important manufacturing industries worldwide, awarded the prestigious annual «MANUFACTURING AWARDS» in 2021 for the Artificial Intelligence and Analytics Leadership category to the project «DOLPHINS», born from a collaboration between CNH Industrial, the Department of Chemistry at the University of Turin, and RADA.
For us, in addition to the pride of such an important recognition, it also verifies our working hypothesis regarding the possibility of using machine data to predict failure events through statistical algorithms.

Dolphins is a module of **AM2** implemented in the Brescia plant of the Iveco Group.

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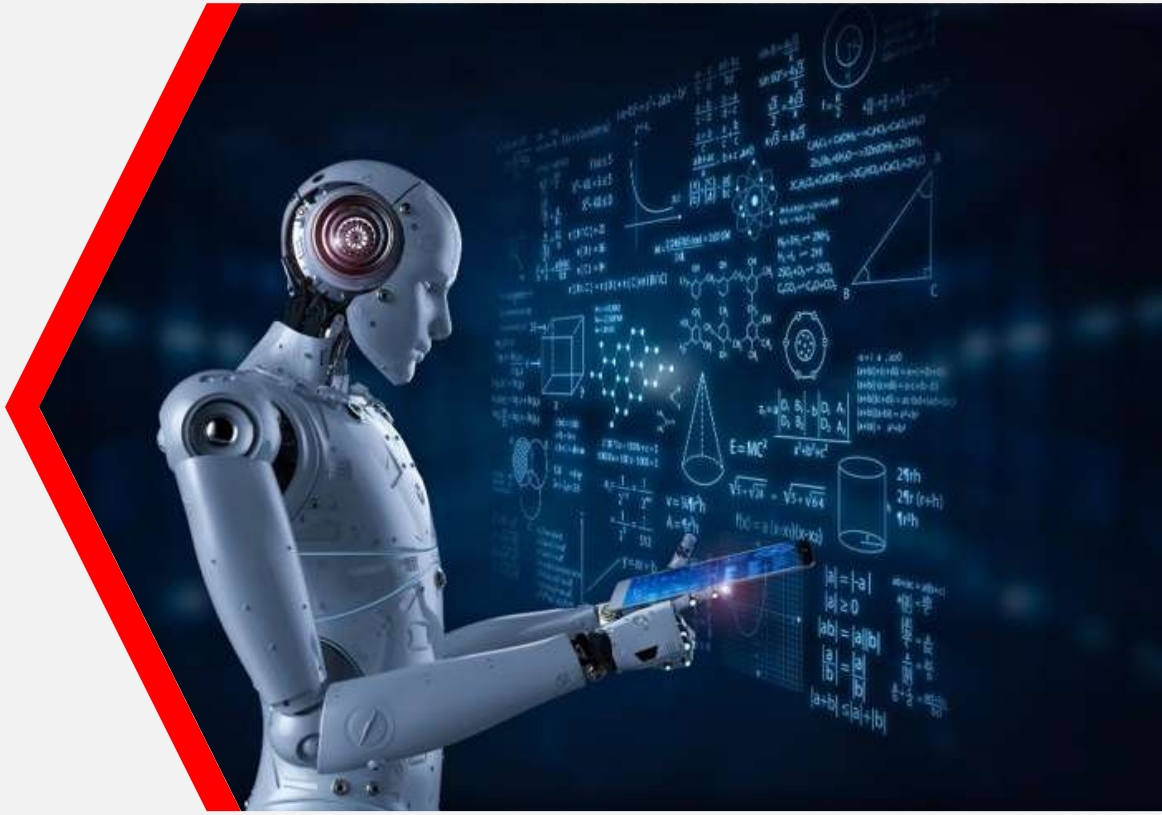
A VERY
NEAR FUTURE

Thinking about an algorithm capable of learning from technicians' choices, understanding the logic behind maintenance assignment, evaluating types of malfunctions by comparing them with the skills of maintainers, and automatically proposing a maintainer for a specific task is not science fiction. It just requires a sufficient amount of data and information.

Monitoring the entire maintenance evolution in a modern facility is a complex task. Why not be assisted by a program that can compare the evolution of different maintenance strategies and notify the responsible party of any changes?



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