MAINTENANCE MANAGEMENT TOOLS

SCADA

CMMS

BIM, BAM, BOOM

DEPARTMENT PROCEDURES

WORK ORDER SYSTEM

EQUIPMENT INVENTORY

ENERGY LOGS

MAINTENANCE MANAGEMENT

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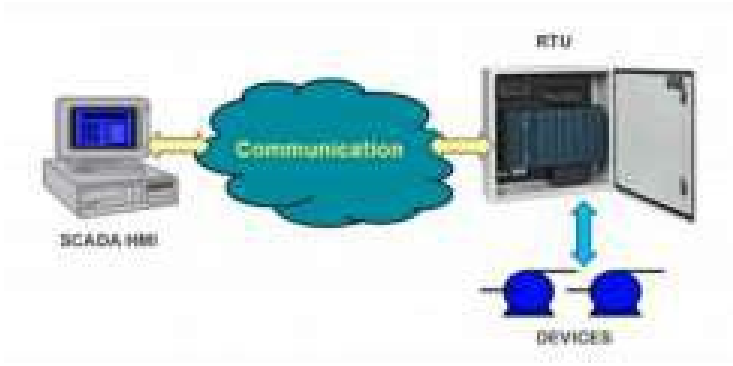
MAINTENANCE MANAGEMENT TOOLS

SCADA

Enable the **monitoring**, **control**, and optimization of a wide range of industrial and infrastructure processes. These systems play a vital role in various sectors, including manufacturing, utilities, transportation, and **energy management**.

Supervisory Control and Data Acquisition (SCADA) systems

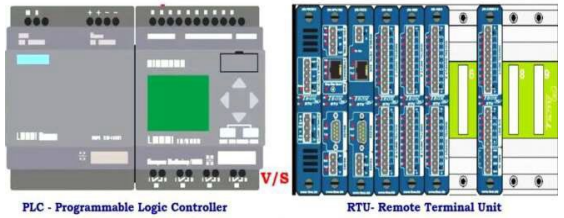
KEY COMPONENTS



Remote Terminal Units (RTUs)
Field devices that collect data from sensors and send it to the central control system.

Human-Machine Interface (HMI)
Graphical user interface that allows operators to monitor and control the system.

Programmable Logic Controllers (PLCs)
Industrial computers that perform local control and data processing tasks.



Communication Network
Infrastructure that enables the transfer of data between the various components of the SCADA system.

Master Terminal Unit (MTU)
Central control station that gathers data from the RTUs, processes it, and displays it on the HMI.

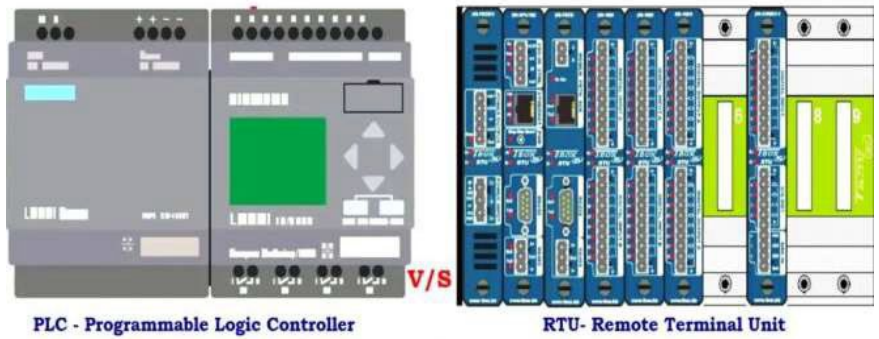
MAINTENANCE MANAGEMENT TOOLS

SCADA

Remote Terminal Units (RTUs)
Field devices that collect data from sensors and send it to the central control system.

Programmable Logic Controllers (PLCs)
Industrial computers that perform local control and data processing tasks.

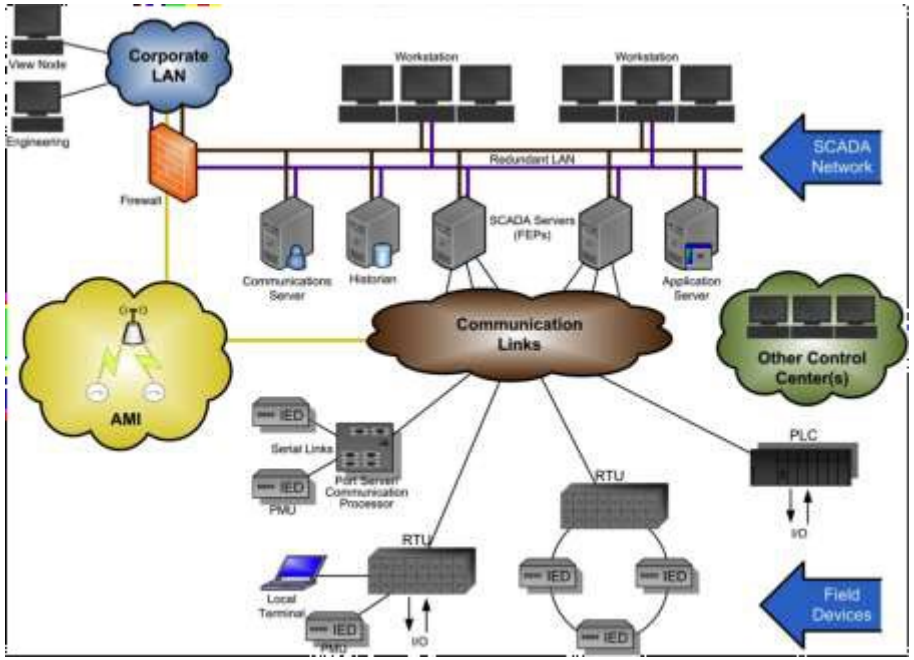
- ✓ PLCs are industrial computers that perform local control and data processing tasks.
- ✓ PLCs provide more advanced control capabilities compared to basic RTUs.
- ✓ PLCs can execute complex control algorithms, perform data analysis, and make autonomous decisions based on input from sensors and preset logic.
- ✓ PLCs can be programmed to handle specific control functions, such as equipment start/stop sequences, proportional-integral-derivative (PID) control, or interlocking safety systems.
- ✓ Collet data from sensors, such as temperature, pressure, flow, and level, and transmit this data to the central control system.
- ✓ Receive control commands from the central system and execute them to control the field equipment, such as opening/closing valves or starting/stopping motors.
- ✓ Typically located at remote sites, such as substations, pumping stations, or manufacturing facilities, and communicate with the central system via a communication network.

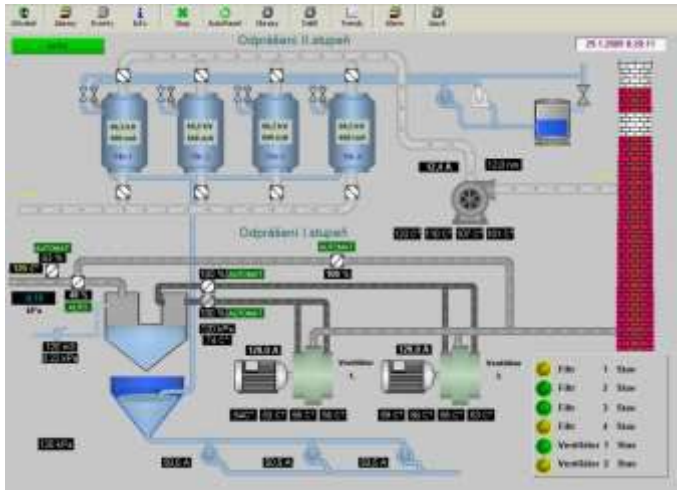


MAINTENANCE MANAGEMENT TOOLS

SCADA

- ✓ The HMI is the graphical user interface that allows operators to monitor and control the SCADA system.
- ✓ It provides a visualization of the process or system being managed, displaying real-time data, alarms, and control options.
- ✓ The HMI can be a standalone computer application, a web-based interface, or integrated into a control room display.
- ✓ Operators use the HMI to monitor system status, acknowledge alarms, change setpoints, and initiate control actions.
- ✓ There can be several HMI inside the same SCADA system.





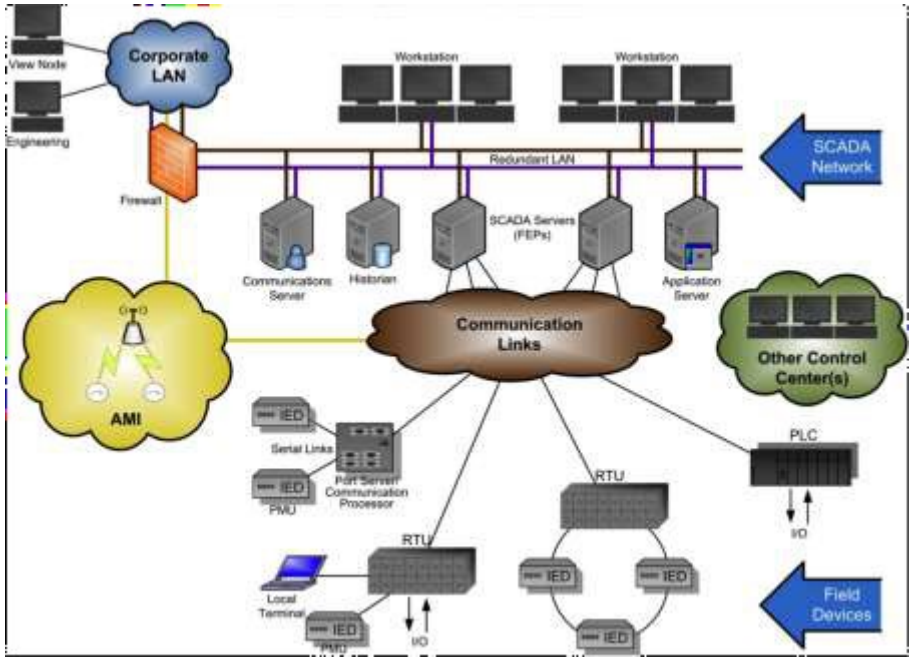
Human-Machine Interface (HMI)
Graphical user interface that allows operators to monitor and control the system.

Master Terminal Unit (MTU)
Central control station that gathers data from the RTUs, processes it, and displays it on the HMI.

- ✓ The MTU is the central control station that acts as the "brain" of the SCADA system. Software.
- ✓ It gathers data from the various RTUs and PLCs, processes the information, and makes decisions based on predefined control logic.
- ✓ The MTU is responsible for data collection, storage, and analysis, as well as issuing control commands to the field devices.
- ✓ It typically runs specialized SCADA software that integrates the data from multiple sources, provides a centralized view of the system, and enables supervisory control.
- ✓ The MTU is often located in a central control room or a dedicated facility, where operators can monitor and manage the entire SCADA system

MAINTENANCE MANAGEMENT TOOLS

SCADA



A variety of communication technologies can be used, such as wired networks (e.g., Ethernet, serial connections), wireless networks (e.g., Wi-Fi, cellular), or a combination of both. The communication network should be reliable, secure, and capable of handling the data volume and latency requirements of the SCADA system. The choice of communication network depends on factors such as the geographic distribution of the system, data throughput needs, and cybersecurity considerations.

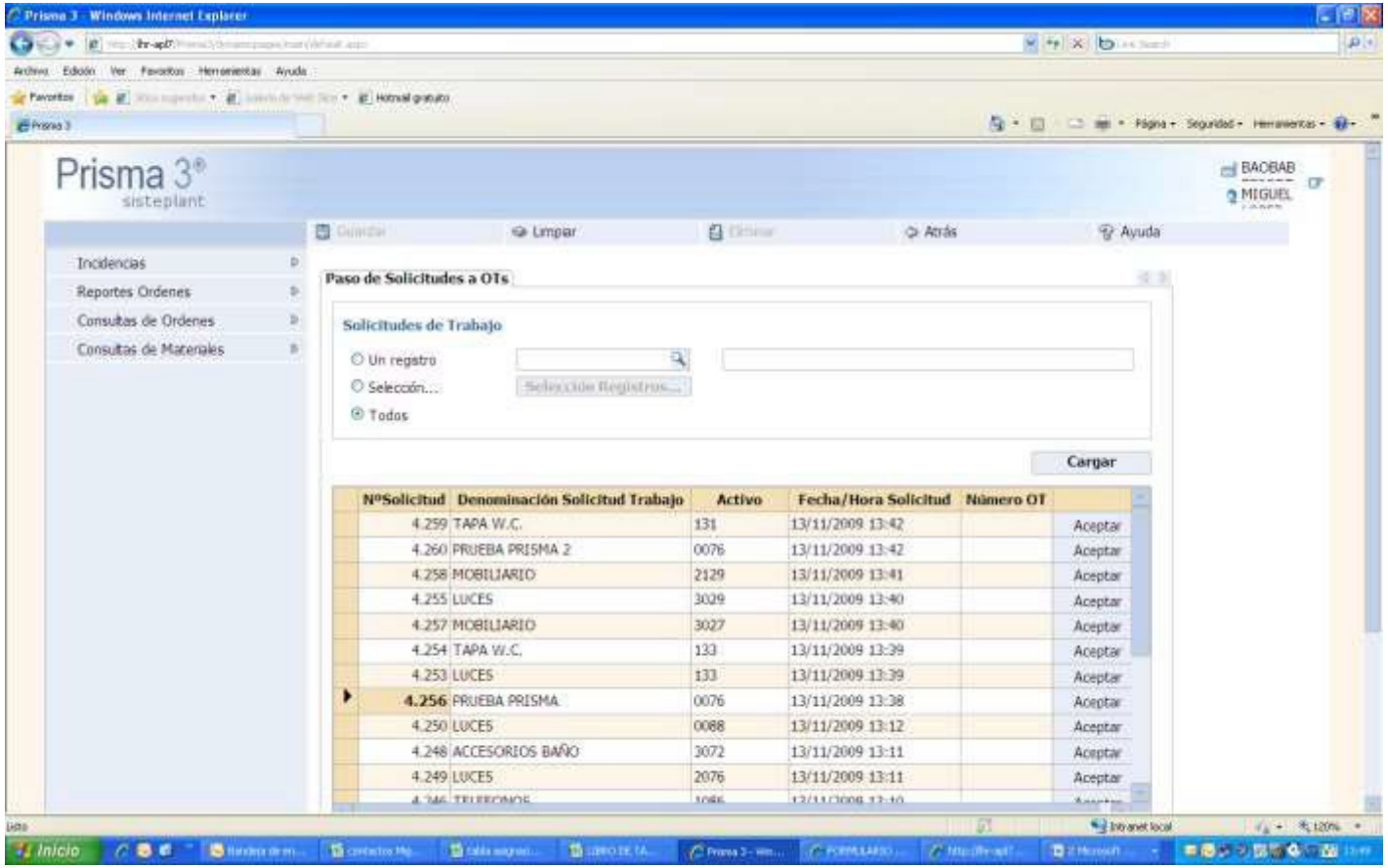
Communication Network
Infrastructure that enables the transfer of data between the various components of the SCADA system.

- ✓ Protocols like Modbus, DNP3, and IEC 60870-5-104 are commonly used in SCADA systems, as they offer features like error checking, retransmission, and time synchronization to enhance data reliability.
- ✓ To ensure reliability, SCADA communication networks may employ redundant communication paths, such as using primary and backup communication channels.
- ✓ SCADA communication networks employ various security measures to protect the data transfer and prevent unauthorized Access (firewalls, encryption techniques, segmentation in multiple zones, logging control, etc.)
- ✓ Network topologies, such as ring or mesh configurations, can also improve the resilience of the communication network by providing alternative routes in case of a single point of failure.
- ✓ Redundant communication equipment, such as routers, switches, and modems, can further enhance the reliability of the SCADA network.
- ✓ SCADA communication networks are designed to be resilient and flexible to accommodate changes in the system or the environment.
- ✓ Modularity and scalability are important features, allowing the addition or removal of field devices, remote sites, or communication channels without disrupting the overall system.
- ✓ This modular approach to network segmentation allows the SCADA system to adapt to changes in one part of the network without impacting the entire system.
- ✓ New RTUs, PLCs, or other field devices can be seamlessly integrated into the existing communication network without disrupting the entire system.
- ✓ Standardized communication protocols and open interfaces enable the integration of equipment from different vendors, providing flexibility and minimizing vendor lock-in.
- ✓ Remote access and maintenance capabilities, such as secure VPN connections, allow for efficient management and troubleshooting of the SCADA system from a central location.

MAINTENANCE MANAGEMENT TOOLS

CMMS

A Computerized Maintenance Management System (CMMS) is a software application designed to help organizations manage and optimize their maintenance operations. CMMS solutions provide a centralized platform for planning, scheduling, and tracking maintenance activities, as well as managing maintenance-related data and resources.



Computerized Maintenance Management System (CMMS)

KEY FEATURES

Asset Management
Maintaining a detailed database of all equipment, machinery, and other physical assets, including information such as asset specifications, maintenance history, and replacement parts.

Work Order Management
Creating, assigning, and tracking work orders for preventive, predictive, and reactive maintenance tasks

Preventive Maintenance Scheduling
Automating the scheduling of routine maintenance activities based on time, usage, or other triggers

Inventory Management
Tracking the availability and usage of maintenance parts, supplies, and tools, and generating purchase orders as needed

Reporting and Analytics
Generating reports and dashboards to provide insights into maintenance performance, costs, and trends

Prisma®
CMMS/GMAO

MAINTENANCE MANAGEMENT TOOLS

CMMS

The analysis of the key performance metrics of a Computerized Maintenance Management System (CMMS) can reveal valuable opportunities for improvement. By analyzing some metrics like those, the organization can prioritize and address the most significant improvement opportunities, which will optimize the long-term performance of the CMMS.

- Availability of Assets: If availability is low, root causes can be investigated, such as preventive maintenance issues, high failure frequency, or delays in repairs. This may indicate the need to adjust maintenance plans.
- Maintenance Cost: If total costs are higher than expected, the composition of these costs (labor, spare parts, outsourcing, etc.) can be analyzed to identify areas for optimization. This can lead to reviewing inventory levels, renegotiating service contracts, or improving task planning and scheduling.
- Compliance with the Preventive Maintenance Plan: A low compliance percentage indicates problems in the execution of the preventive maintenance program. Causes can be investigated, such as insufficient resources, lack of prioritization, or deficiencies in task scheduling.
- Mean Time Between Failures (MTBF) and Mean Time to Repair (MTTR): If MTBF is low and MTTR is high, this suggests opportunities to improve asset reliability and repair efficiency. Failure patterns can be analyzed, maintenance plans optimized, diagnostic and repair procedures improved, or staff competencies strengthened.
- Inventory Accuracy: Low accuracy indicates inventory management problems, which can lead to cost overruns and delays. The processes of reception, management and consumption of spare parts and supplies can be improved.
- User Satisfaction: Low user satisfaction may point to usability, functionality, or training issues. Users can be involved to identify areas of improvement and optimize the CMMS interface and workflows.

Computerized Maintenance Management System (CMMS)

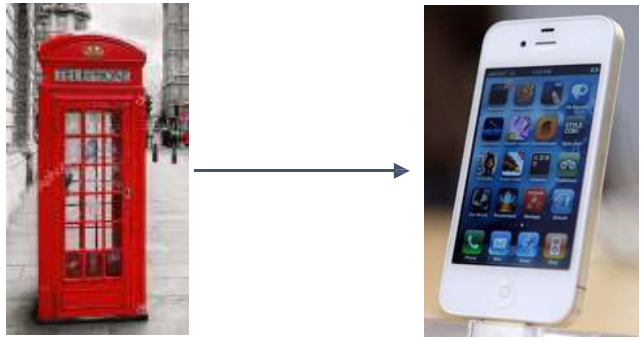
BENEFITS

- *Improved Asset Reliability*: By proactively scheduling and tracking maintenance, CMMS can help extend the lifespan of equipment and reduce unexpected breakdowns.
- *Increased Efficiency*: CMMS automates many maintenance-related tasks, such as work order generation and parts ordering, leading to more efficient use of maintenance resources.
- *Cost Savings*: Effective maintenance planning and inventory management can help organizations reduce maintenance-related costs, such as unplanned downtime, unnecessary repairs, and excessive spare parts inventory.
- *Enhanced Compliance*: CMMS can help organizations track and document maintenance activities, which is crucial for compliance with industry regulations and standards.
- *Improved Decision-Making*: The data and analytics provided by a CMMS can inform better maintenance-related decisions, such as equipment replacement strategies and resource allocation

MAINTENANCE MANAGEMENT TOOLS

Paradigm shift

Analogic → Digital

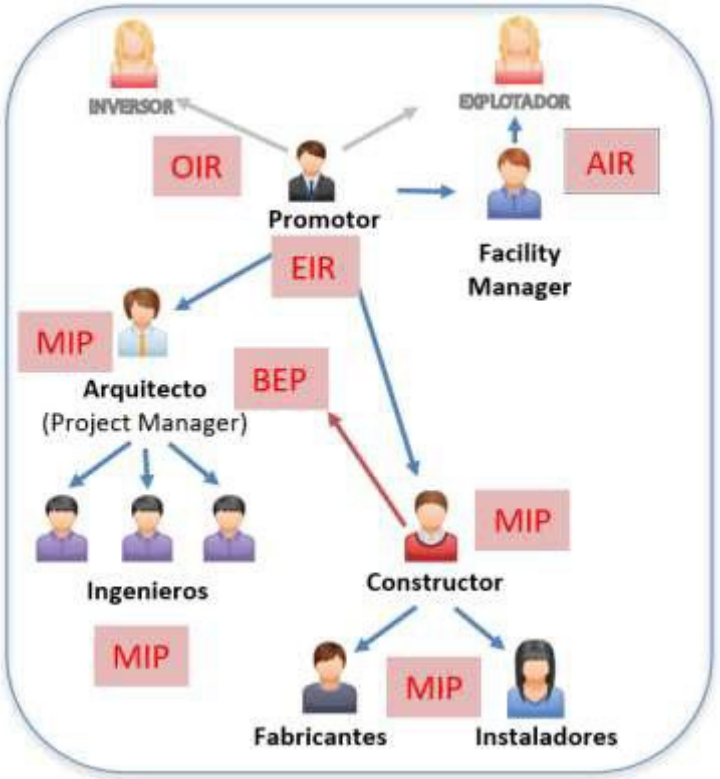


BIM, BAM, BOOM

BIM is a work methodology, based on collaborative digital processes that aim to create a virtual representation of a construction, with graphic and non-graphic information (data).

MAINTENANCE MANAGEMENT TOOLS

BIM, BAM, BOOM

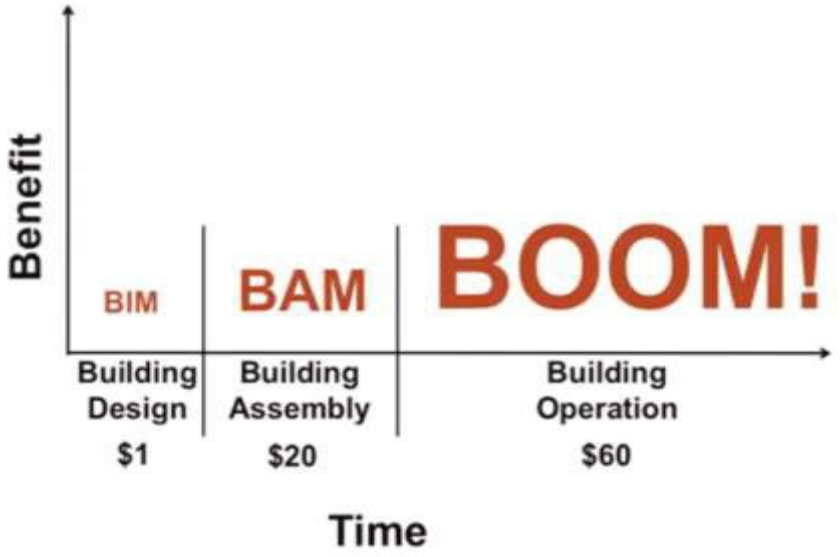


B.I.M = Building Information Model
B.A.M = Building Assambly Model
B.O.O.M = Building Operation Optimization Model

Concept / Design
Construction
Users

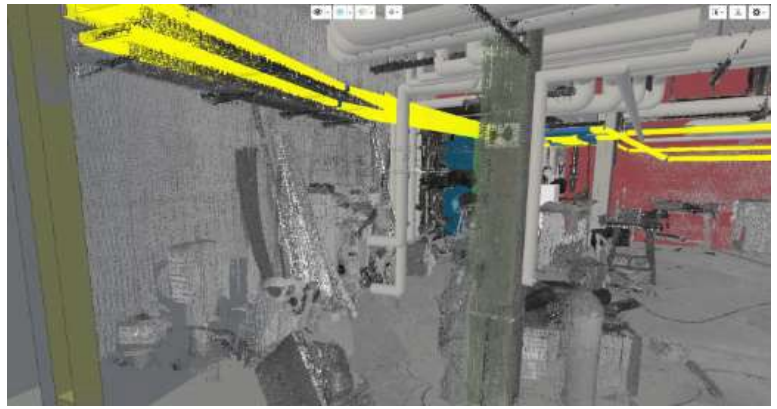
MAINTENANCE MANAGEMENT TOOLS

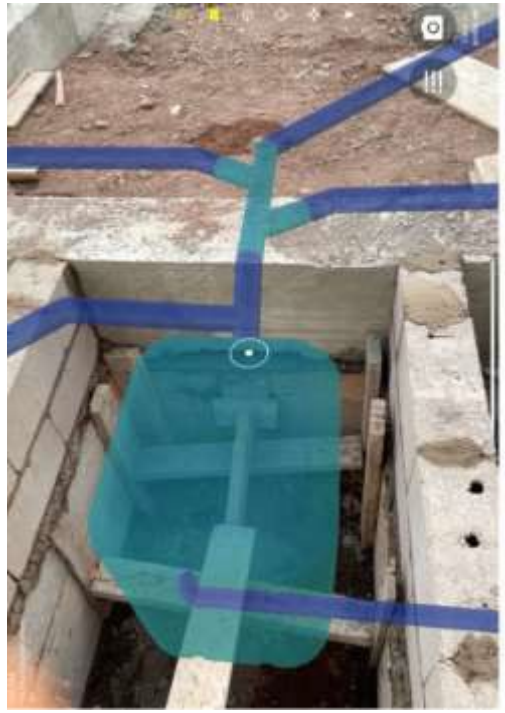
BIM, BAM, BOOM



MAINTENANCE MANAGEMENT TOOLS

BIM, BAM, BOOM





MAINTENANCE MANAGEMENT TOOLS

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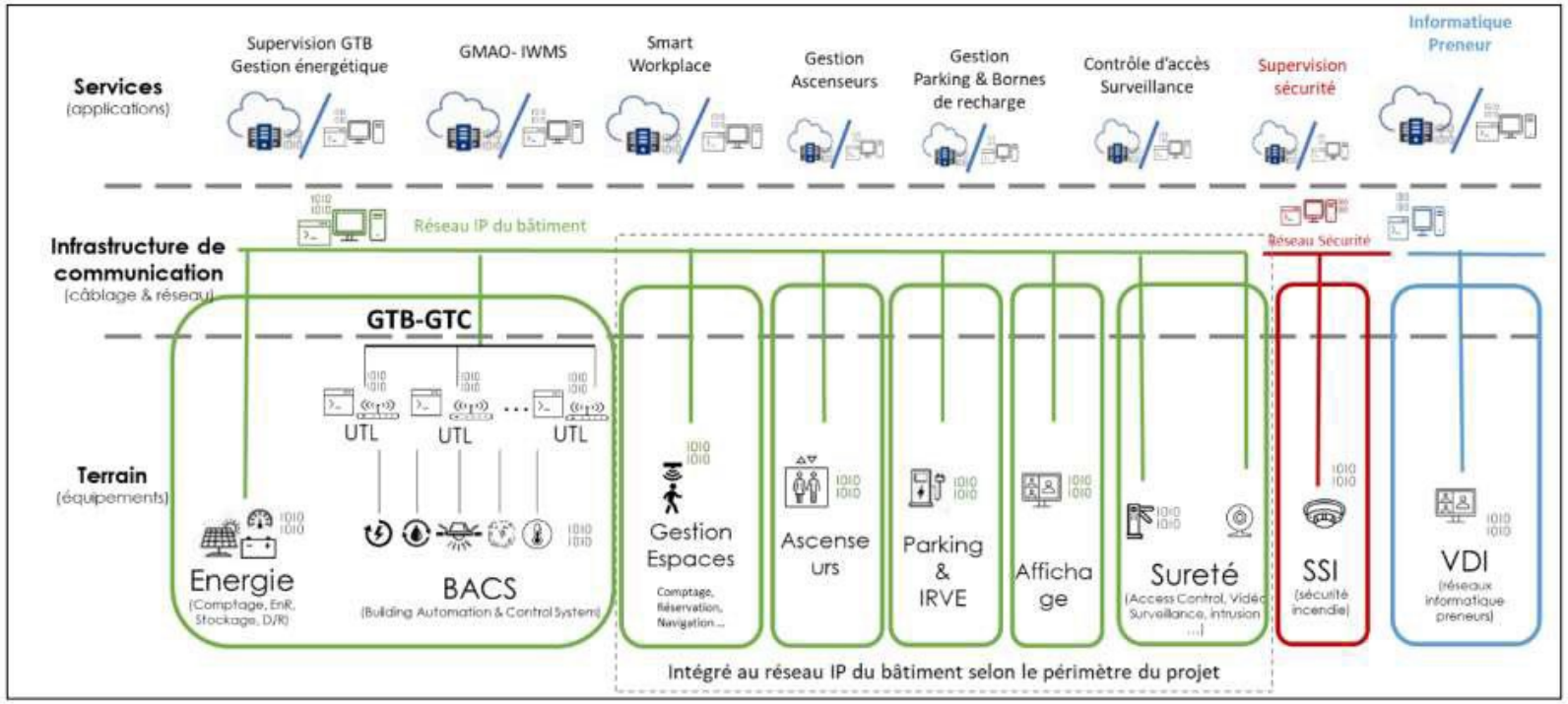


MAINTENANCE MANAGEMENT TOOLS

DEPARTMENT PROCEDURES

Maintenance department activities usually include:

- Routine maintenance (daily and weekly) and minor repairs. Reactive corrective Maintenance.
- Preventive Maintenance, normally scheduled at weekly, monthly, quarterly and anual intevals.
- Ordering, inventorying and issuing department supplies and replacement parts.
- Maintaining energy records and administering energy-management programs.
- Minor rehabilitation, such as painting and reparing rooms and public spaces.
- Administration and Management of the department.

EQUIPMENT INVENTORY AND MAINTENANCE LOGS

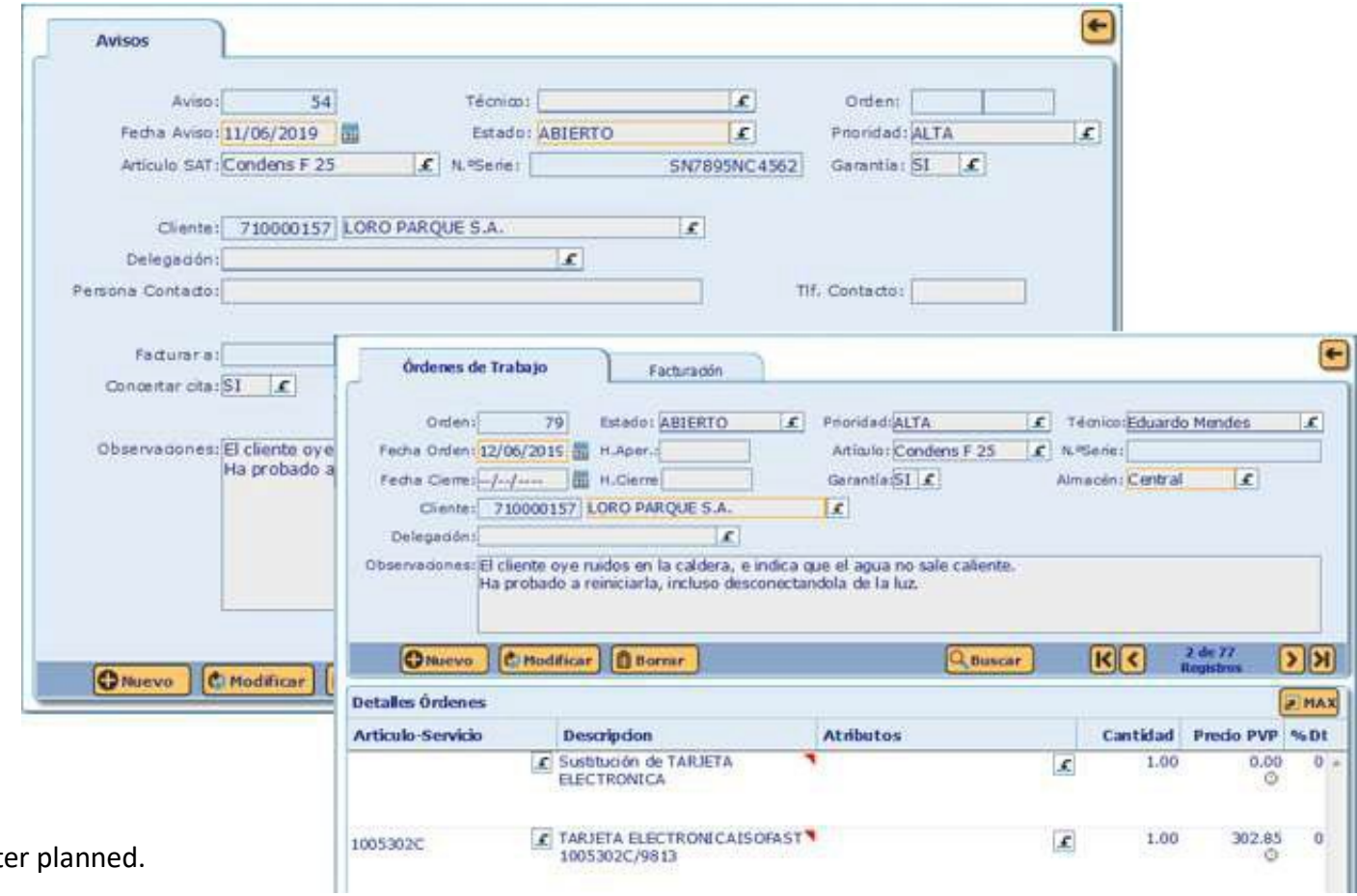
WORK-ORDER SYSTEMS

ENERGY RECORDS

Maintenance department activities also include:

- Safety and security control. Acces control and surveillance.
- Outsourcing control.
- Investment decissions and Execution Works control .
- Internal trainning program.
- Emergency management and evacuation drills.
- Budget Comparison Report and Work Activity Report.

MAINTENANCE MANAGEMENT TOOLS



A work order is issued as a request for work to be done

WORK ORDER SYSTEM

Work priority can be stablished.

Corrective Maintenance is recorded. Time responses and quality of the work can be evaluated for the department or for a certain worker.

Preventive Maintenance tasks from assets list can be programmed and distributed to internal workers or outsourcing.

Workers Will be charged with a work order list so that individual work can be better planned.

Work orders analysis can be one of the main arguments to justify number of workers and Department Budget.

Performance of outsourced work can be evaluated and contrasted with the contract clauses.

Spare parts, work time, dates and time, status of the job, worker comments,…as much information as posible is valuable, but also time dedicated to the work order filling must be considered. A proper plan and standards must be accomplished.

Acces to the work order system must be planned through hardware and different devices, dependind on the company organization.

A routine must be established to attend to work orders properly. It must include every worker in the Work Order System.

Work orders feed data to Management Reports.

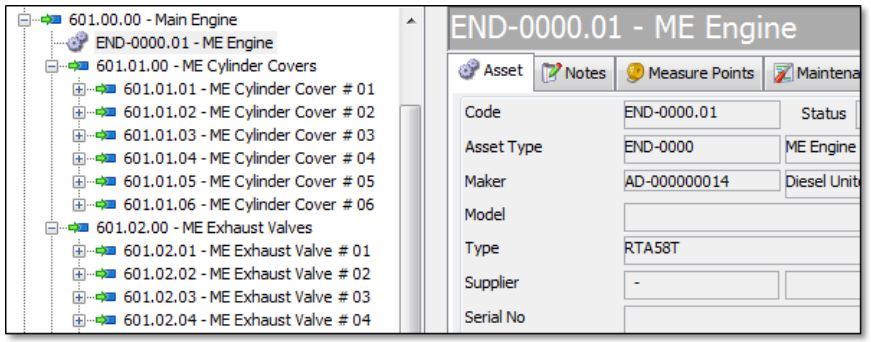
MAINTENANCE MANAGEMENT TOOLS

Equipment list is introduced in the system, and the asset tree is created, so that a reference code is assigned to every physical equip, that can be sorted into groupes, familys, sections, etc. This helps the asset search in the system.

EQUIPMENT INVENTORY

Addiotional data linked to the asset, like blueprints or manufacturer´s guide and certificates can be added. Time inspections and audits certifications may also be recorded.

Preventive Maintenance Tasks and Cheklists for certain machine families that tend to be numerous, like pumps or valves in the water supply system or in the cooling system, can be easily planned and distributed. Work orders can be automatically issued by the system in due time and for the appropiate equipment.



MAINTENANCE MANAGEMENT TOOLS

There is normally a very high inverse correlation between energy consumption and maintenance: for electromechanical systems, as maintenance increases, energy consumption generally decreases.

Energy consumption figures from utility companies must be verified. Periodic mesaurements must be accomplished.

Energy consumption figures from utility companies must be verified. Periodic mesaurements and utility meters reading must be accomplished.

Electrical Main Board must contain continuos electric meters.

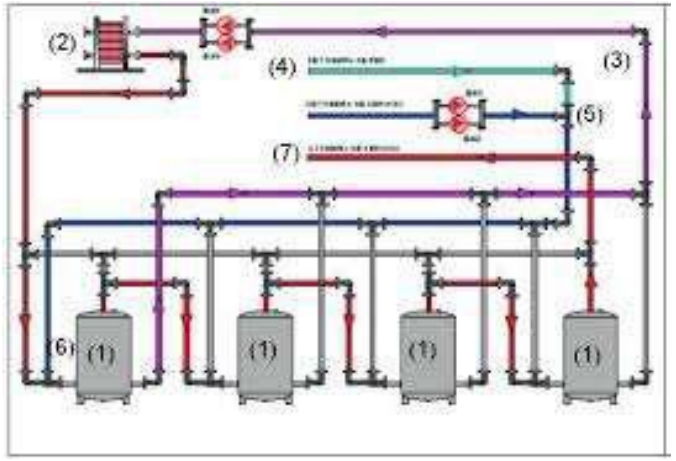
Critical points and selected equipment energy consumption should be measured and monitored for various time periods in order to determine operating efficiency. Th results can be recorded in the equipment log. Then the log can be analyzed to determine if the equipment must be overhauled or replaced.

ENERGY LOGS

Energy use in various sections of a building can be also measured. Large energy consumers can initially be isolated in a section of a building or in a certain timetable.

Heating time selection depending on hot wáter tank dimensions and energy collection systems in the building.

Heat recovering chillers and new energy saving systems can be installed.



Consumption of water, electricity, fuel, etc., should be recorded, not only to assist in measuring the impact of an energy-management program, but also to get valuable insight for future building design and renovation.