



Abstract

PMS (Product Manufacturing System), a system that can be classified into the MES (Manufacturing Execution System) area, allows supervision, control and Management of manufacturing activities and field systems.

PMS Description

PMS was created as a high-performance system for the management and monitoring of the manufacturing and production activities of a plant.

It can therefore be divided into completely integrated macro-modules that allow a centralised management of shop-floor activities.

The system offers functions that range from the filing of central master data (e.g. Part Numbers, factory calendar,...) to production scheduling, production progress monitoring and management of the finished products' shipments.

Therefore, the PMS system allows activities involving queries and control of production performance, quality check of finished products and configuration of central master data as well as typical operation-oriented activities such as production scheduling and shipment (all through a Web-type user interface).

The PMS system is generally a non-critical system for manufacturing activities, as it establishes a communication with the board line systems that directly and physically handle production progress.

In fact, it is a centralized system for production supervision and governance system, delegating operation activities to these systems individually. In this way, relatively short breakdowns of the PMS system have a low impact on productivity.

A decentralization of the operation orders that govern the production process means that PMS has an even greater possibility of being considered a centralized system for plants located in different geographic areas.

On the contrary, centralizing of operation coordination services for production activities on Power SMS increases the need for a constant availability of the system.

PMS Modularity

As mentioned previously, PMS is logically composed of macro-modules:

- **LEG. INT.:** manages communication with central Legacy systems
- **MAS:** manages centralised masters related to factory products/materials
- **CAL:** manages the factory calendar
- **MAP:** manages the composition of the assembled and finished product (bill of material)
- **PP:** manages production planning and scheduling
- **PC:** manages production plan changes, communication and data acquisition from field systems
- **PPQ:** manages quality data and the traceability of the finished product
- **SH:** manages activities relating to the storage and shipment of the finished product
- **PM:** manages monitoring of the individual line machines (e.g. Op) as far as the working efficiency of production progress and shipment management of the finished product are concerned.

Leg. Int. (interface with legacy systems)

This module manages acquisition and sending of information to the company central systems as far as both the central masters and the plant production trends are concerned.

In the event of acquisition, (if necessary, processed) information is available for the other PMS modules on which later configurations can be applied by the system user, thus enabling running and use of these configurations.

In the event of shipment, information relates to the plant production trend and ranges from sending the production quantity volume to managing the movements of each finished product during the whole production cycle within the plant.

Usually, communication with these systems takes place via a file exchange or via Code, therefore future acquisition or shipment requirements are integrated in the PMS system through new interface definition towards the central systems.

Following a short list of the data exchanged between the PMS system and the Legacy systems.

From Legacy to PMS:

- Code lists and relevant characteristics, part numbers setting out the specific types and finished products they refer to
- Preparation and organization (material composition list according to part number) of finished products
- Shipment requirements.

From PMS to Legacy:

- Goods available in shipping warehouse
- Production counters of specific areas (e.g. intermediate material transfer frequency, expenses)
- Shipment counters.

MAS (Central Masters)

This module can be considered a services module for the PMS system and, in any case, a central module.

In fact, that is of primary importance for the operation of all the other modules since it is responsible for the configuration of the logical entities of the system (Areas, Lines, Ops, etc.) and for the type classification of parts envisaged for the production of the finished product.

Thanks to configuration capabilities complying with a set business checks, the other PMS modules envisage the possibility of error reduction during the relevant activity executions.

Moreover, these configuration capabilities enable to adapt the system to the different plant-specific situations, increasing the possibility of using them on new situations by adding, if necessary, configuration-specific features.

Following, a short list of the managed masters:

- Logical plant entities (Areas, lines, sub-lines, stations, ops)
- Special types to be produced/managed
- List of special codes (part numbers)
- Coding of particular groupings (families of part numbers)
- Coding of finished product groupings
- Assignment of part numbers on the relevant production lines
- Master Management of corrections (e.g. for scrapping, inventory actions, etc.)
- Sending of masters to the board line systems using this data.
- Capabilities available to the PMS user are envisaged via suitable screens on the user interface.

CAL (Plant Calendar)

The calendar module allows defining a general plant calendar, possibly differentiated by production area or line.

The calendar enables to define:

- The start of the working day within the plant
- The length of work shifts
- Configuration of production and non-production working time, so as to allow the PM module to calculate the operation efficiency of the machines
- Capabilities available to the PMS user are envisaged via suitable screens on the user interface.

MAP

(Preparation and organization of an assembled product)

Management of the MAP module allows describing (Master Template) the production operations of each single line, basing on preparation and organization data (components assembly), operation data (measurements, results), traceability data (serial numbers of assembled parts), related to a each specific finished product.

It also allows differentiating (Part Template) information used by the machines operating on the line, according to the type of finished part (e.g. engine or transmission part number) that must be produced.

Usually, this buffer on the line is written on magnetic tags (via RFID technology).

The data contained in the buffer refer to the input of the production line and can be used by the single machines, which, in turn, can write the results of their work in specific locations of the same buffer.

Once the operations on the whole line are completed, if the buffer is available to the PMS (e.g. sending via a board line system managing the relevant output), it is interpreted according to the specified structure (Master Template) making the information available on the PMS system through the PPQ module.

Following, a short list of the module capabilities:

- Master Template definition for each single line
- Version Management of the Master Template for each single line
- Version Management of the Part Template for each single line
- Capabilities available to the PMS user are envisaged via suitable screens on the user interface.

PP (Production Planning)

The PP module is responsible for planning and scheduling the quantities to be produced for a finished product (e.g. engine, transmission).

Scheduling and planning of quantities can be carried out bearing in mind the following parameters:

- Plant requirements
- Plant calendar (shifts, production and non-production days)
- Production times (e.g. times for crossing the line)
- Specific aspects of the production time/cycle of a type (part number) of the finished product
- Production balances

Operating capabilities are:

- Scheduling on a weekly basis
- Daily planning taking into account weekly scheduling and production balances
- Confirmation of daily planning
- Sending of planning to the PC module so that it can be implemented into a feasible production program to be sent to the line systems
- Macro scheduling for manufacturing and pre-assembly lines
- Capabilities available to the PMS user are envisaged via suitable screens on the user interface.

PC (Production Control)

The PC covers a central role in the PMS system, since it can be considered as a link between production scheduling activities, sending of the production program and production progress. Moreover, it also allows acquiring most of the quality data collected on the line, making them available to the relevant module (PPQ) for future analysis.

It also defines interfaces towards the line systems for the data exchange in both directions.

The module capabilities are:

- Conversion of the production planning received from the PP module into a production program composed of a list of batches to be produced (each having information about quantities and part numbers)
- Changing and planning capabilities of the running production program
- Sending of production batches to the systems controlling the inputs of the setting lines

- Acquisition of production data from board line systems controlling inputs/ outputs and intermediate transits
- Acquisition of quality data (traceability, results, measurements, tests) contained on the magnetic tag, through communication with the systems that control the line outputs
- Management of production results per shift compared to the result of acquisitions from the above-mentioned line systems
- Management of the creation of accounting balances following the result of acquisitions from the above-mentioned line systems
- Sending of plant production data to Legacy systems, via the LEG. INT. module
- Traceability reports and history of the finished product (and also of pre-assembly products)
- Quantity reports of the finished product, stored on the line at the end of the line and in the various plant areas (when controlled and capable of communicating the passing to the PC module)
- Quantity reports on the line and line end for processing and pre-assembly products
- Capabilities of inventory and correction of line end quantities for processing and pre-assembly products
- Interaction with the capabilities available on the screens of the PPQ module
- Manual capabilities for scrapping and final approval of finished product
- Manual capabilities of return from shipment warehouse.

PPQ (Process Product Quality)

The task of the PPQ module is to analyze the process and traceability data of each single product (serial number). The analyzed data result from the operations of the line machines.

Data are acquired mainly in two different ways:

- Via magnetic tag, through the PC module
- Via files in (DBMS1) format produced by 'gauges' that operate on the line, released on PC to the line in folders shared and that can be accessed remotely (active directory)
- Traceability and product quality reports (scraps, measurements, test results, ...)
- Traceability reports considering the parts not produced by the plant (buy components)
- Integration with the QS-Stat third parties product, for statistical analysis.

SH (Shipments)

This is a strongly operational module that manages the shipment of the finished product and/or pre-assembly/manufacturing parts.

In the first case, shipment is made by managing the movement of the single product (serial number), while in the second case it is carried out by quantities grouped by part number.

It manages the movements in the whole shipping area from the time the products have been approved in Accounting by the PMS system (in the case of finished products).

Shipment management complies with the shipment requirements that the customer notifies to the plant and that is acquired in the PMS via the Legacy interface module.

Since it is a module that offers field functions (reading and printing of the finished product final label and delivery notes) it normally uses wireless readers and is also composed of a client component (including the task of providing the printouts necessary for shipment and storage) installed on the PC physically present in the area where the module operates.

Briefly, the envisaged functions are:

- Packing products onto pallets and removing from pallets
- Storage of products
- Update of production and stock meters in the movement of finished products, via the PC module
- Sending of shipment meters to Legacy systems via the LEG. INT. module
- Update of finished product history, via the PC module
- Shipment operation according to customer requirements
- Function of return from shipment (due to quality or surplus).

PM (Monitoring)

In some cases on the PMS system, the integration of a particular module called Monitoring (PM) may be required, which is responsible for controlling the individual machines on the production line (e.g. Op) acquiring data referring to working times, volumes and statuses, offering final reports that allow defining the working efficiency of the single machine.

Following, a list of the main capabilities features to be managed by this module:

- Acquisition of the production meters of the individual machines
- Acquisition of each machine status from the monitored ones
- Management of the plant Andon boards
- Graphic representation of the layout of the monitored lines
- Historical and current reports on acquired data

CF (Administration Functions)

Some administration functions of the PMS Web user interface exist.
These are:

- Multilanguage Description Management, with possibility of selecting the required language
- Log of the activities that are carried out on the system by the different modules, both by background processes and by Web user actions
- Configurations of users, groups and roles to define accessibility to the system and to its functions, differentiating them by competence
- Validation of the user access to the user interface through domain or configured only locally on the PMS.

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