

Manufacturing Just in Time with MES



Automotive



Food



Life Sciences



Beverage & Brewing



Others

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Manufacturing Just In Time

Manufacturing Just-in-time was the concept first used by the Ford Motor Company during 1920s, but the technique was subsequently adopted and publicized by Toyota Motor Corporation of Japan as part of its Toyota production System (TPS). In 1954 Japanese giant Toyota implemented this concept in order to reduce wasteful overstocking in car production..



It is a philosophy which eliminates waste associated with **time**, **labor**, and **storage space**. Basics of the concept is that the company produces only what is needed, when it is needed and in the quantity that is needed. The company produces only what the customer requests, to actual orders.

Just-in-time manufacturing goes hand in hand with concepts such as **continuous improvement** and total quality management (TQM).

Just-in-time production requires intricate planning, in terms of procurement policies and the manufacturing process, if its implementation is to be a success.

Highly advanced technological support systems provide the necessary back-up that Just-in-time manufacturing demands, with production **scheduling software and electronic data interchange** being the most sought after.

Introduction to MES

Manufacturing Execution Systems (MES) are computerized systems used in manufacturing. MES can provide the right information at the right time and show the manufacturing decision maker "how the current conditions on the plant floor can be optimized to improve production output." [1] MES work in real time to enable the control of multiple elements of the production process (e.g. inputs, personnel, machines and support services).

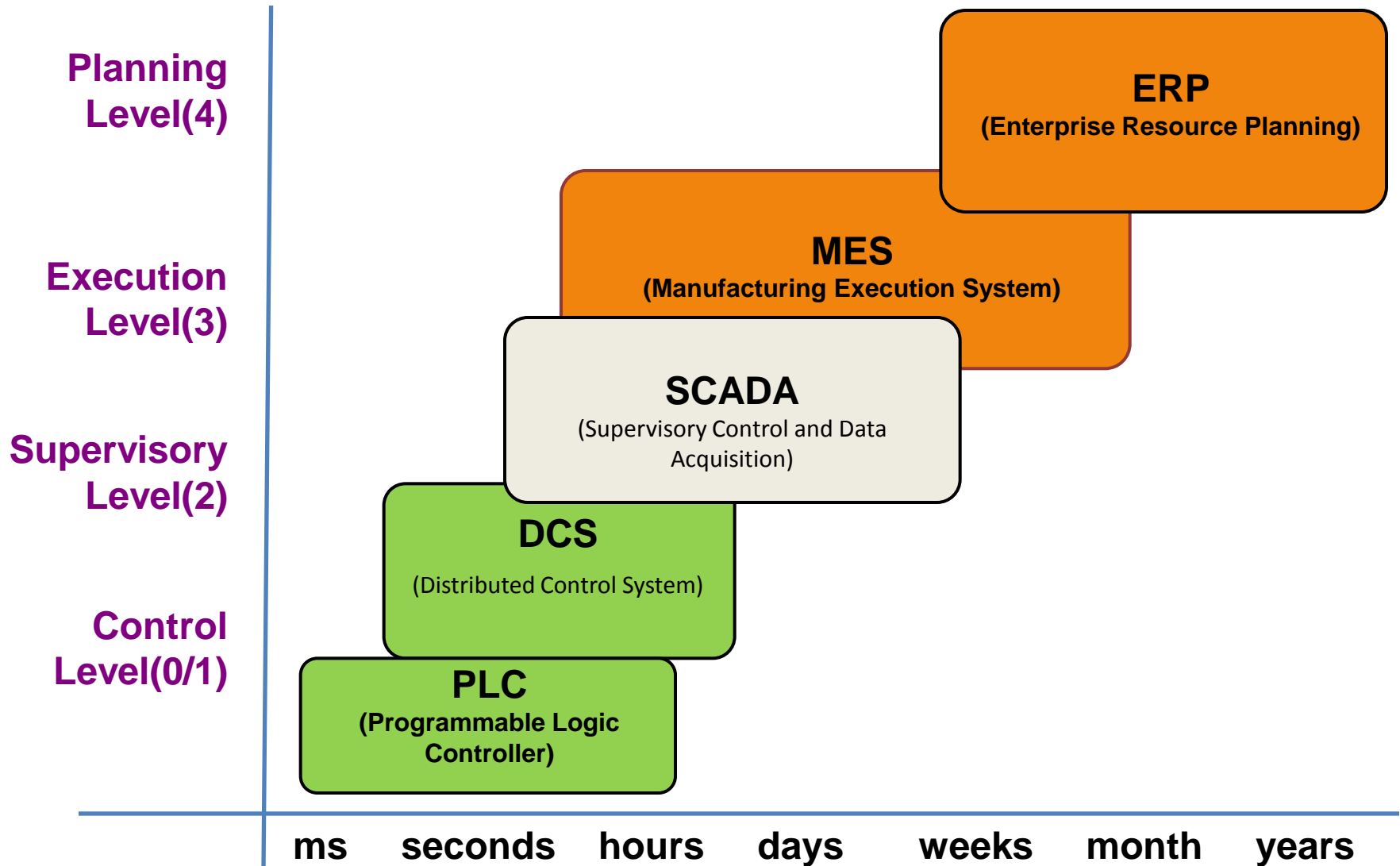
MES might operate across multiple function areas, for example: management of product definitions across the **product life-cycle**, **resource scheduling**, **order execution** and **dispatch**, **production analysis** for Overall Equipment Effectiveness (OEE), and materials track and trace.

The idea of MES might be seen as an intermediate step between, on the one hand, an Enterprise Resource Planning (**ERP**) system, and a Supervisory Control and Data Acquisition (**SCADA**) or process control system on the other; although historically, exact boundaries have fluctuated.

In the early **1980s**, MES concepts originated from data collection systems. A wide variety of systems arose using collected data for a dedicated purpose. Further development of these systems during the 1990s introduced overlap in functionality. Then the **Manufacturing Enterprise Solutions Association (MESA)** introduced some structure by defining functions that set the scope of MES.



Various Levels of Automation



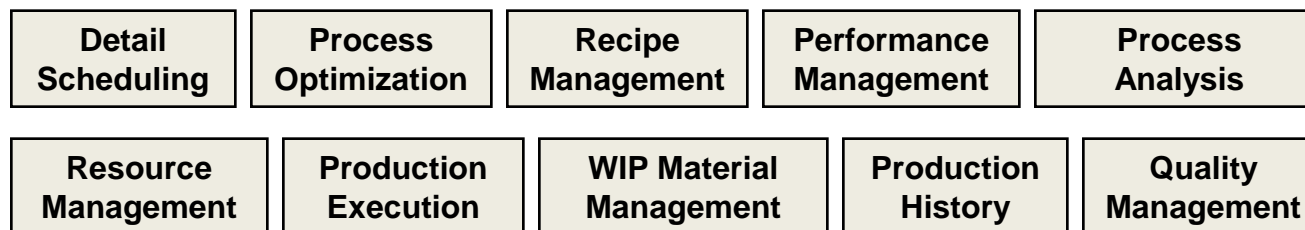
Various Business Functions

Enterprise Resource Planning



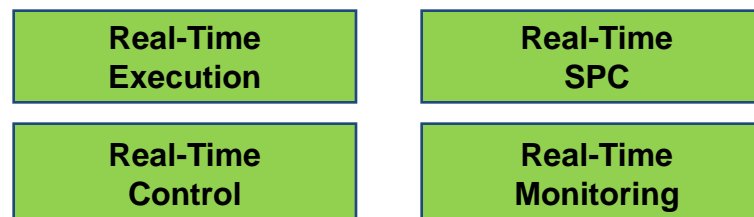
Level 4
Business
Planning &
Logistics

Manufacturing Execution Systems



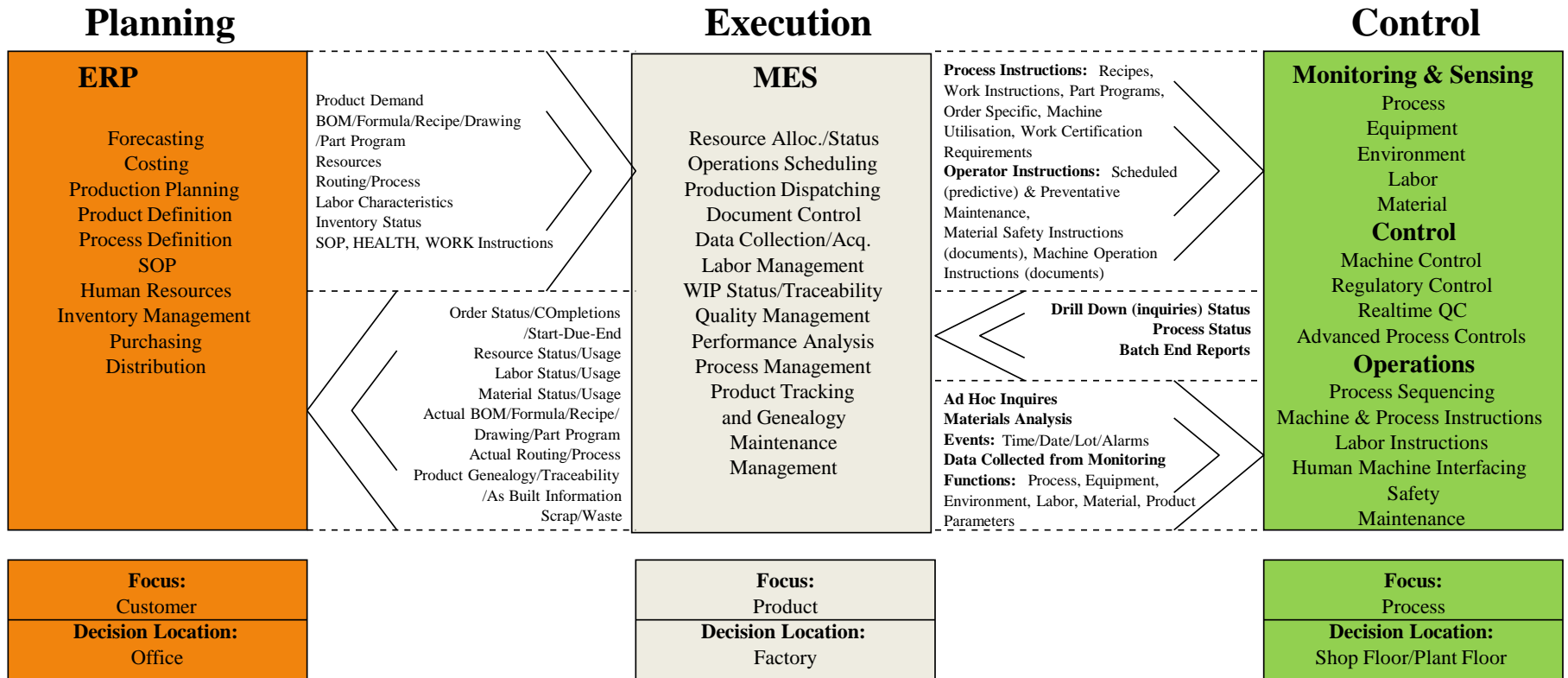
Level 3
Manufacturing
Operations

SCADA / PCS Systems



Level 2 /1/0
Plant Floor
Control

Data Flow within various level



Manufacturing Just In Time Strength



It keeps stock holding costs to a bare minimum. The release of storage space results in better utilization of space and thereby bears a favorable impact on the rent paid and on any insurance premiums that would otherwise need to be made.

It eliminates waste, as out-of-date or expired products; do not enter into this equation at all.

As under this technique, only essential stocks are obtained, less working capital is required, to finance procurement. Here, a minimum re-order level is set, and only once that mark is reached fresh stocks are ordered, making this a boon to inventory management too.

Due to the afore-mentioned low level of stocks held, the organizations return on investment would generally be high.

It encourages right first time concept, so that inspection costs and cost of rework is minimized.

High quality products and greater efficiency can be derived from following a just-in-time production system.

Close relationships are fostered along the production chain under a just-in-time manufacturing system.

Constant communication with the customer results in high customer satisfaction.

Manufacturing Just In Time Weakness



Just-in-time manufacturing provides zero tolerance for mistakes, as it makes re-working very difficult in practice, as inventory is kept to a bare minimum.

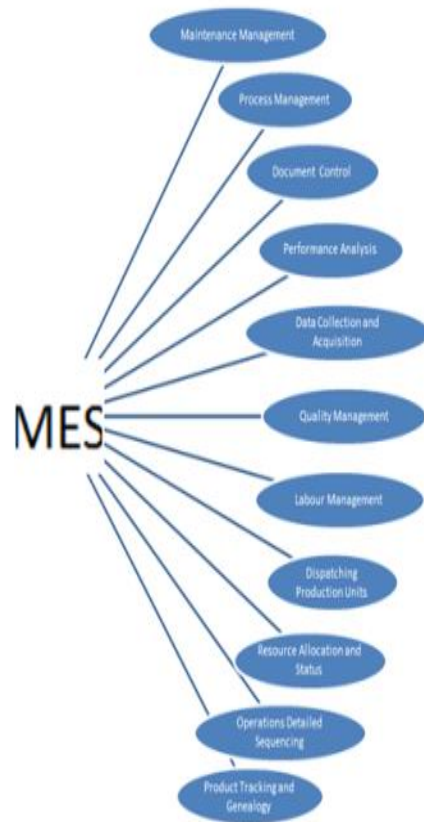
There is a high reliance on suppliers, whose performance is generally outside the purview of the manufacturer.

Due to there being no buffers for delays, production downtime and line idling can occur, which would bear a detrimental effect on finances and on the equilibrium of the production process.

Transaction costs would be relatively high, as frequent transactions would be made.

Just-in-time manufacturing may have certain detrimental effects on the environment, due to the frequent deliveries that would result in increased use of transportation which in turn would consume more fossil fuels.

MES Key Functionality



Dispatching and Production

- Manages the flow of production in the form of jobs, orders, batches, lots and work orders by dispatching production to specific equipment and personnel.
- Includes information that is presented in the sequence in which the work needs to be done.

Quality Management

- Provides real-time measurements collected from manufacturing to assure proper product quality control and to identify problems requiring attention.
- Includes SPC / SQC tracking and management of offline inspection operations

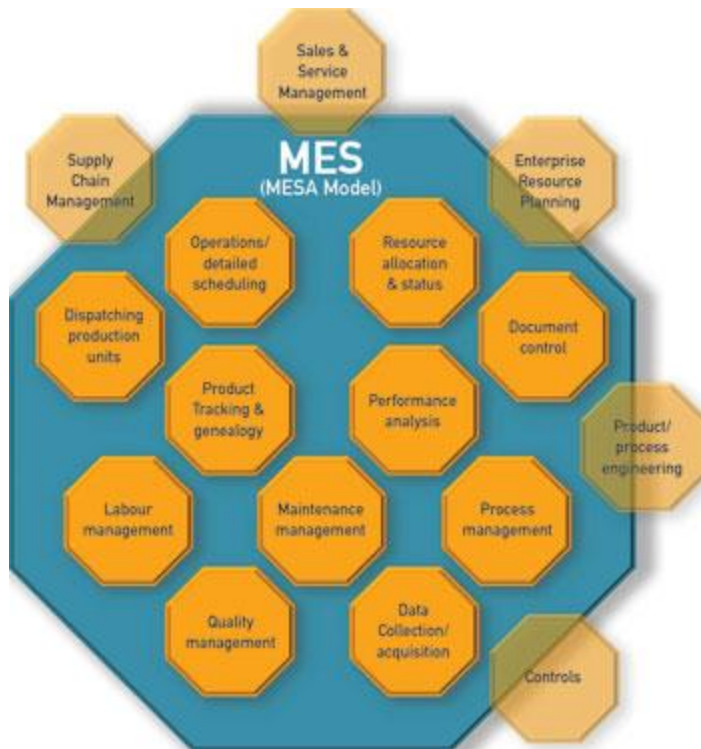
Data Collection & Acquisition

- Obtains operational production and parametric data associated with production equipment and processes.
- Provides real-time statuses of production equipment and processes

Labor Management

- Provides status of personnel.
- Includes time and attendance, certification tracking, as well as preparation work as basis for activity-based costing.
- May interact with resource allocation for optimal assignments.

MES Key Functionality



Process Management

--Monitors production and either automatically corrects or provides decision support to operators for correcting and improving in-process functions. It may include alarm management to handle process deviations

Production Tracking & Genealogy

--Provides status of production and disposition of work.
--Status information may include personnel, materials used, current production conditions. Includes recording of production information to allow forward and backward traceability.

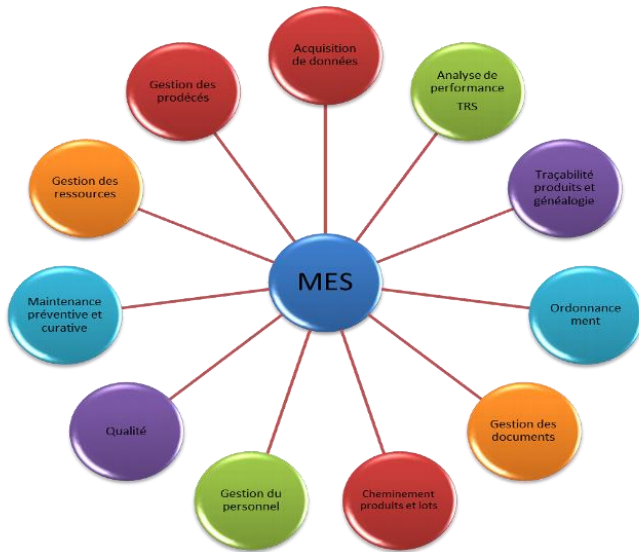
Document Control

--Control records and forms that must be maintained with the production unit.
--Includes work instructions, recipes, drawings, standard operating procedures (SOP), batch records, shift to shift communication.
--It sends instructions down to operations and device controls

Maintenance Management

--Functionality for maintaining equipment and tools.
--Ensures equipment and tools availability for manufacturing.
--May also include scheduling for periodic or preventive maintenance.

MES Key Functionality



Performance Analysis

- Provides real-time reporting of actual manufacturing operations results along with comparisons to past history and expected results.
- Performance results include resource utilization, resource availability, cycle time, conformance to schedule and standards.
- May include SPC / SQC analysis

Operational Detail Scheduling

- Provides sequencing based on priorities, attributes, characteristics and production rules.
- It is finite and it recognizes alternative and overlapping operations to calculate timing of equipment loading

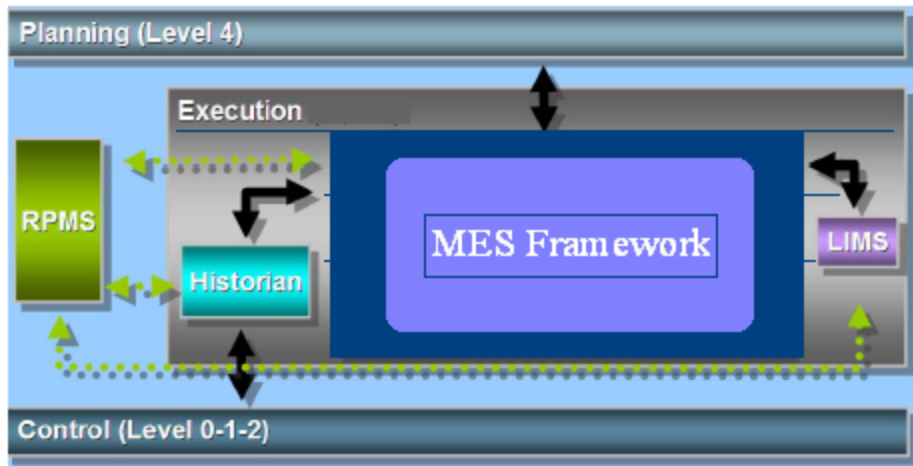
Resource Allocation & Status

- Manage the resources directly associated with control and manufacturing.

MES Vendors



MES Customized Solution : System Architecture



Planning (Level4): ERP systems (front office / accounting / financial etc)

Execution (Level3): Coordinating/ Scheduling/ trending/tracking systems

Control (Level 0,1 & 2): Process control systems SCADA/PLC/DCS

Historian : It gathers, archives, and processes operational data from automation & control systems. It also provides a comprehensive infrastructure to link the automation & control systems with the MES.

Laboratory Information Management System (LIMS)
It is used in the laboratory to manage samples, laboratory users, instruments, standards and other laboratory functions.

RPMS is the best-selling sales analysis, commission reconciliation, order tracking, and data import software for manufacturers'

MES Framework is an application framework that encompasses the software life cycle from conception to deployment.

MES Customized Solution : Software Architecture

There are three levels and two component categories:

Entity components : a business entity, represents an entity within a domain. A customer, sale item, and employee are all typical examples of these entities.

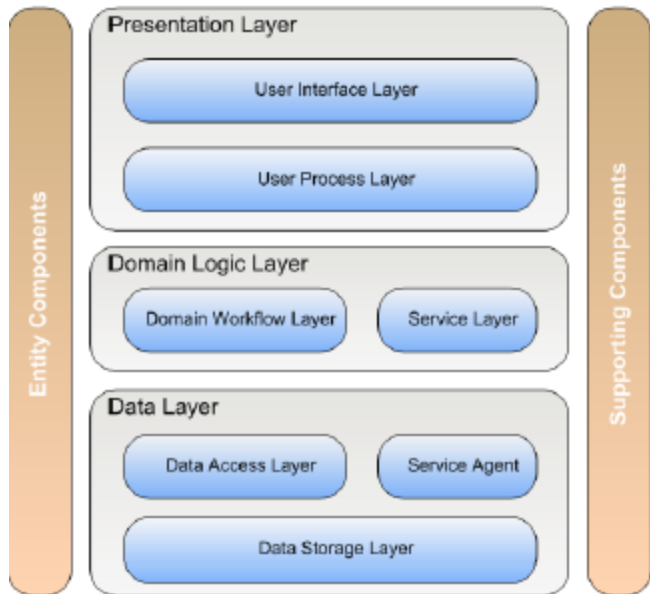
Data layer broken into three parts.

The **data storage layer** provides the mechanism for storing and managing application data. The data storage layer consists of a Microsoft SQL Server relational database, a Historian, and external systems. The **data access layer** provides the mechanism to retrieve and manipulate application data. **Service agents**, also referred to as proxies, access information to and from external systems (e.g.: ERP, LIMS, etc)

Domain logic layer to mimic what would be performed by a person. The domain logic layer processes all the rules and validation required to perform an action. the data is validated against the domain logic and then passed to the data access layer to be saved in the database.

Presentation layer to what the user sees on the screen. The presentation layer consists of two sub layers, namely, the user interface layer and the user process layer. User interface layer will contain all the user interface components such as Web or Windows forms User process layer handles the common user such as wizards

Supporting components are components commonly found in enterprise applications. They provide application wide services and enforce a consistent way of executing common tasks.



MES Customized Solution: Data Point Manager

Data Point Manager is the central entity that serves all Data Point related requests. Its purpose is to bring together all the Data Point Providers and expose them through a single access point programmatic interface. All Data Points are exposed through Data Point Manager by a Data Point Provider; a connector between the source system and the Data Point Manager.

The Data Points exposed by the Data Point Providers are grouped by family; a family is a group of Data Points that implement the same set of functions. The list of functions exposed by a Data Point Family is determined by what makes sense for the specific data that is exposed.

Specific Data Point Providers offer support for Filter Expressions, textual formulas that can be evaluated to either true or false. When used, functions only perform their calculations on the raw data corresponding to the periods where the Filter Expressions evaluate to true.

Specific Considerations

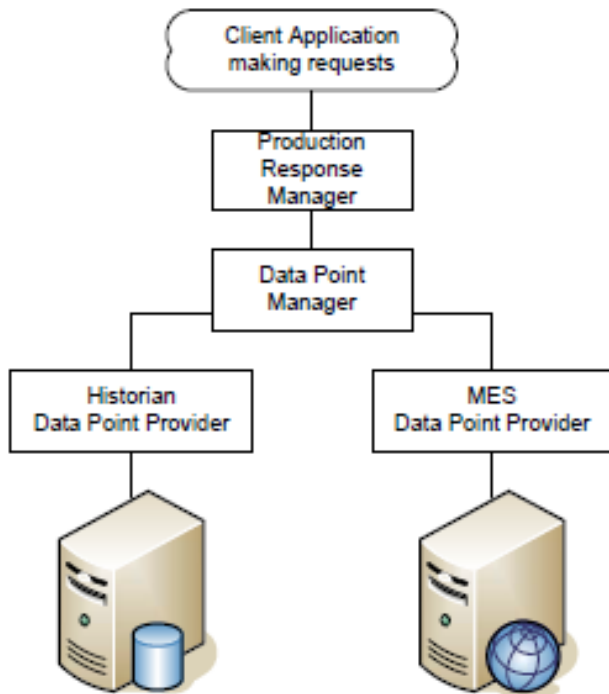
All Data Point requests are served by this component.

Data Point values in future may not be supported by all Data Point Providers.

Filter expressions are not supported by all Data Point Providers.

Errors in calculations are returned to clients as null values.

The absence of data is returned to clients as a null value.

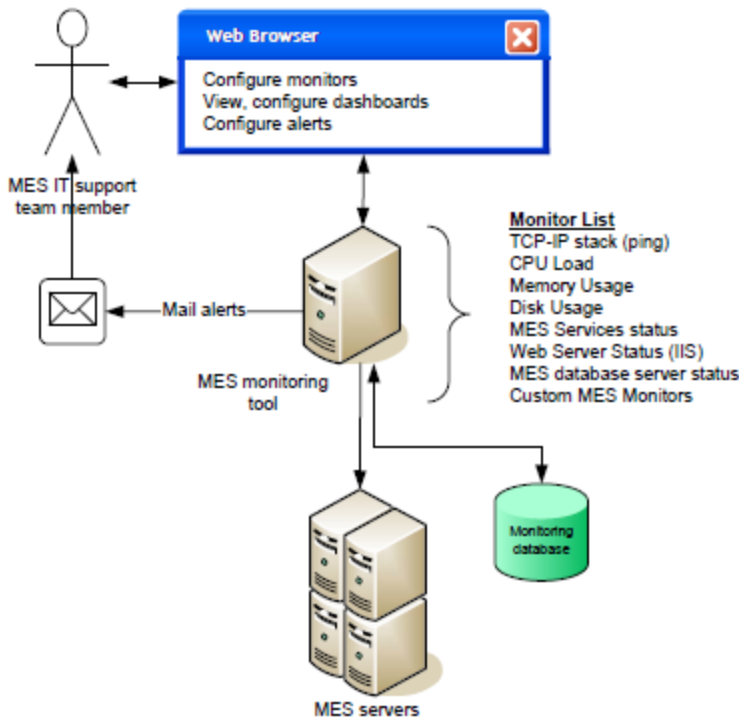


MES Customized Solution: System Monitoring

The overall MES system status and health can be monitored through a **centralized monitoring tool**. This tool is primarily intended for the IT support team and is not part of the MES application itself. Many third party tools that perform this type of instrumentation are available. The goal here is to use such a tool by configuring and customizing it to meet the requirements.

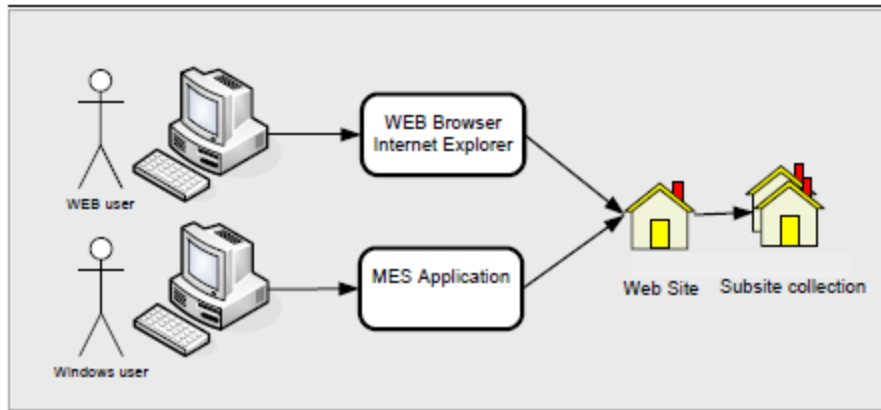
The system monitoring tool is a service deployed on a system other than the **MES servers**. Periodically, it monitors (polls) various system and software properties by using an entity called a monitor. When a monitor reports a failure (communication lost with target, value over/under a given threshold), an alarm can be displayed to an IT support team member through a Web browser application or by sending an alert email to an IT support group. The Web application also provides various dashboards displaying the state of the monitors.

In addition, The tool uses a **dedicated database** to enable monitor history recording. This history can be displayed in a dashboard with charts and statistics



MES Customized Solution: MES Reporting (MyReports)

MyReports allows information broadcasting through the plant. It empowers plant management people to visualize MES information from a single entry point. Less time is spent gathering relevant information from both data sources and people.



MyReports allows the user to create personal WEB pages and reports. The first time that a user access MyReports option, a personal WEB sub site will be created for that user. The personal sub site gives users an opportunity to aggregate MES information as needed. The WEB pages and reports created are local (not public) to the user.

The plant areas WEB pages and reports are also available via hyperlinks. MyReports can be accessed via the MES application or a web browser (**IE, Internet Explorer**).

About the Author:



Mr. Abhishek Dinkar Ekal is an Automation Engineering Consultant (MES consultant) who had work from zero level Automation to level three Automation (i.e. PLC, SCADA, MES (Manufacturing Execution System)) in order to attain manufacturing Just in Time! He has vast experience in this field with well known group in India as well as overseas. Some of them are Larson & Toubro, Bahwan Engineering Company-Dubai, Wipro Technology and KEOPS-Canada.

Thank You!

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