

## “OEE and MES in Industry”

### How can a Manufacturing Execution System (MES) help my efficiency ?

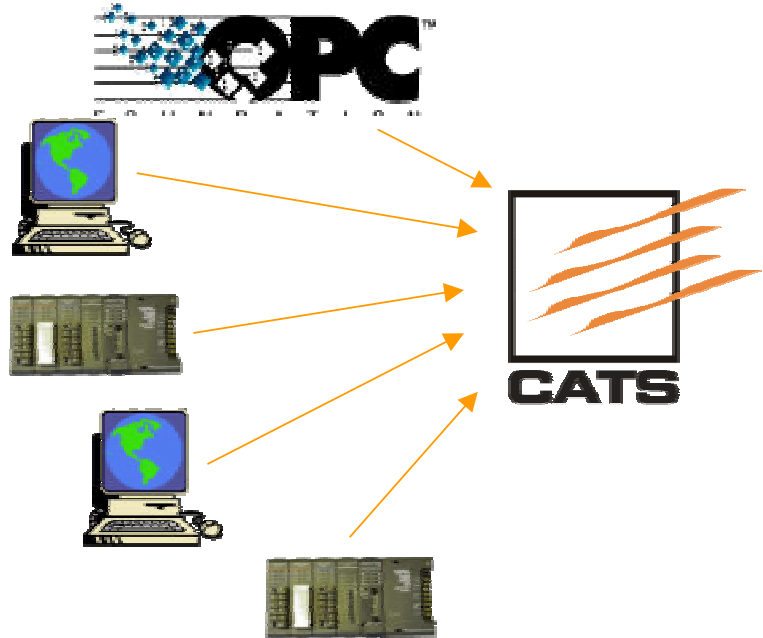
In any manufacturing or process company operations and processes will exist that you do not get the maximum utilisation and efficiency from. You probably do not have a set of standards to measure them against and do not have the facilities to monitor and correlate information. A MES system provides the tools to achieve this in a structured manor. MES systems are able to gather and coordinate the operations of a plant and provide measurable information.

From the measured information Key Performance Indicators (KPIs) can be determined and using these KPIs actual performance can be monitored, assessed and improved.

Another area typically covered by MES relates to the handling of Overall Equipment Efficiency (OEE) and Overall Plant Efficiency (OPE). As the names suggest these features are designed to measure the performance of either individual pieces of equipment or combined plants against a set of defined targets. Performance can be measured in real-time with summary reports being produced which allow instant or planned action to be taken. This will be discussed in more detail later .

*“Improving efficiency and reduce operating costs while improving or maintaining quality” - is this not everyone’s goal???*

**From where and how does MES draw its data?.** - One of the major considerations when implementing a MES solution relates to how the required data will be gathering and via what communications media. Over the last 20 years industry has invested heavily in the automation of its major processes, introducing PLC and RTU technologies to most plants and installing local and wide area networks through which process data can be centralised to a common SCADA or telemetry system.



Many of today’s SCADA and telemetry systems have embraced IT office technology, in their basic form allowing their data to be shared with other sub-systems, in more complex solutions allowing the merging of third-party

packages with them, giving a combined, cohesive and consistent solution.

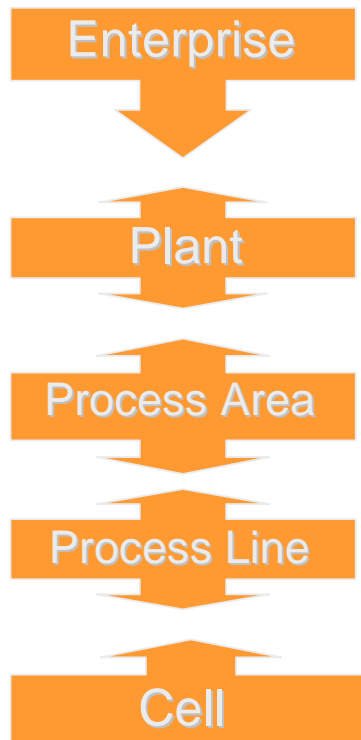
The single biggest advance in recent years has been the introduction of OPC (OLE for Process Control). In simple terms OPC defines the **standard** interface through which a piece of equipment and a user of that equipments' data can communicate. A PLC can be communicated with using an OPC driver installed on a standard PC and by gaining access to that PC any number of distributed applications can monitor the PLC/Plant.

Most mainstream SCADA systems can now act as OPC servers, allowing external access to gathered plant information and information derived within SCADA to make it more specific to the operation of the plant. Through this availability of data a MES application can be simply connected to the existing plant-based SCADA system, gaining access to already installed, connected and tested plant data sources.

**Will this impact on the existing SCADA?.** - In our experience, most industries under-utilise their SCADA and telemetry systems, allowing them to sit in the background generating alarms whilst being generally ignored for most of the time. What is actually done with the wealth of information that those systems can provide? - Probably nothing as the current generation of SCADA systems have not been designed to deliver flexible management Information in a simple and modular manner, their

primary goal being to provide real-time system operation at a basic level.

**So why MES?.** - Do you know what are the top ten alarms on your plant?. If not, why not? - This type of information can be simply generated through the integration of a MES solution. Information gathered by the MES system is saved, analysed and published in a format that can be easily emailed to you, your operations and your maintenance staff. We will cover the distribution of data in more detail later so read on.



Hopefully by now we have established three main drivers for MES –

***a need for information, a means of collecting the data and a cost effective method of implementation.***

***What does MES offer?.***

How much does your plant cost you to run and how efficient is it really?. You may have an overall figure but where are the hot spots? how much does each area of plant cost to run and how does this vary with different products and shifts ? Does the way in which

certain operators control the plant achieve a greater level of efficiency, requiring less energy, less chemicals, less support man power.

At this point it is necessary to introduce **SP95**, a model specified by **ISA** which breaks the operational plant areas down into an equipment hierarchical model and



through which the scope and usage of a MES application can be defined.

**GEMBA uses the SP95 model for storing and evaluating all MES data.**

SP95 says that information should be saved in a five-tier model, those tiers being **Enterprise, Plant, Area, Production Line** (Process Cell) and Production **Cell** (Process unit).

Use of this standard model ensures a data structure which provides a granularity of data that can be examined in detail or summarised to provide rapid analysis of your plant, allowing informed decisions to be made.

**An explanation of OEE**

There are standard calculations for OEE and OPE their general format being:-

- ***OEE = Availability \* Performance \* Quality***

At GEMBA solutions our **“CATS”** MES product allows users to define additions to these standard calculations to build their own **business rules**. CATS allows other information and conditions to be associated with the OEE results, thus expanding the effectiveness of the resultant information. Examples of information used are:

- Operation and technical staff login / shift periods
- Production schedules / products being run
- Outside influence such as climatic conditions
- Flexible plant configuration

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**World Class OEE**

OEE is calculation based on a ratio of three key parameters:

- ***OEE = Availability \* Performance \* Quality***

By Multiplying the components of the calculation the overall result of OEE is challenging. From the table below the overall OEE would be 65.5%.

<b>OEE Factor</b>	
<b>Availability</b>	86.0%
<b>Performance</b>	79.0%
<b>Quality</b>	96.5%
<b>Overall OEE</b>	65.5%

Every plant and manufacturing process is different. If you operate a policy of Six-Sigma you would not be happy with quality levels at 96.5 %. 99.99% would be a better target to achieve.

Worldwide accepted levels for the average OEE score in manufacturing plants is between 45-60%. A world class level for manufacturing should be targeted at 85% or better. CATS downtime and efficiency model will help you achieve this through online and historical reporting

The components of OEE are well defined and are briefly explained as follows. CATS allows additions to these calculations to include relationships to products, shifts and people.

## Calculating OEE

### Availability

Availability is the parameter that takes into account downtime. When a machine is not running due to a fault you are losing planned running time :

$$\text{Availability} = \text{Operating Time} / \text{Planned Production Time}$$

### Performance

Many companies use a variation here using a Nett/Cycle calculation:

$$\text{Performance} = (\text{Ideal Cycle Time} * \text{Pieces Produced}) / \text{Operating Time}$$

*Ideal Cycle Time* is the maximum speed the machine can run at expressed as a unit cycle time. It is sometimes called *Name Plate Cycle Time*.

*Performance* is capped at 100%, This will ensure if a cycle time is specified to low the performance figure will not distort the calculation.

### Quality

*Quality* takes into account wastage due to poor **Quality**.

$$\text{Quality} = \text{Good Pieces} / \text{Pieces Produced}$$

Many companies use the quality component to recharge suppliers if externally sourced components are faulty.

## OEE calculation for Process

- **Quality** = % process outside of control targets
- **Availability** = desired run time – downtime / no raw material
- **Performance** = theoretical throughput \* actual throughput / operating time



**Do your operators really understand the best way to run the plant?. -** Bringing the personal performance of your operational staff into the equation takes this even further - experience of installing MES solutions where human resource is also considered allows comparisons of efficiency to be made from person to person and shift to shift.

Whilst following the same procedures each person will have his or her own set of rules, based on experience, which they will apply over the control system to run the plant.

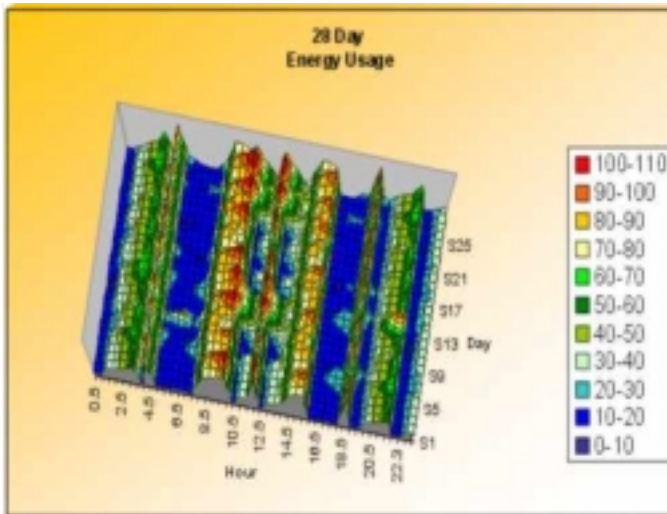
By analysing the effect of adverse conditions on quality and relating this to the operational staff an understanding of individual operators knowledge of the process will be gained. Where high performers are identified their skills can

be drawn on to provide training information, expand the knowledge and experience of others.

## What about plant and equipment performance?.-

With the advent of **Climate Change Levy**, running your process and equipment as efficiently as possible has become paramount in order to achieve reductions in the climate change charges.

OEE provides the means for monitoring the process and, by using energy in the calculation, allows you to pinpoint hot spots and poor-performing equipment.



You may be striving to adopt key suppliers of equipment, each of whom may offer a specialised design. Over time you can monitor equipment offering the same functionality, calculating their efficiency and comparing the results, thus giving an indication to their total cost

of ownership. From the OEE results you can make informed decisions on the process and the suppliers that best perform for you.

Taking it a step further, this approach can also be adopted on a regional scale with data being compared from plant to plant. Remember that the SP95 model includes the storage of information at a "plant level", making plant-to-plant comparisons simple.

**Where's the payback?.** – We've illustrated just a few ideas on how and where MES solutions may be implemented. From our experience you could expect to make efficiency savings of between five and twenty five percent in a period as short as six months from implementation.

**How is MES data stored and accessed?.** - To achieve its goal the MES application requires a structured archiving historical database, which will save information in the SP95 model format and which will allow the flexible interrogation of that data for analysis, report and display at a later stage. This requirement typically excludes the standard SCADA and telemetry products, which tend to be limited in their standard archiving capability.

Also, GEMBA's solutions like most other integrators have years of experience trying to quickly and simply develop reports on SCADA systems to meet your requirements whilst fighting with the functionality of the packages to easily meet the specification. During this time many lessons have been learned.



Within CATS all of the data received is stored in a SQL database. To maximise its performance and minimise the required storage that database should be normalised, its data being broken down into its component parts which are linked through indexes. However, whilst this is good for performance and storage it makes it's reading complex. To address this CATS allows the creation of **views**, each view being a logical group of data taken from several tables and presented to the user in a single package. Through views the data is easily readable, allow the user to simplify its querying and to form new reports. .



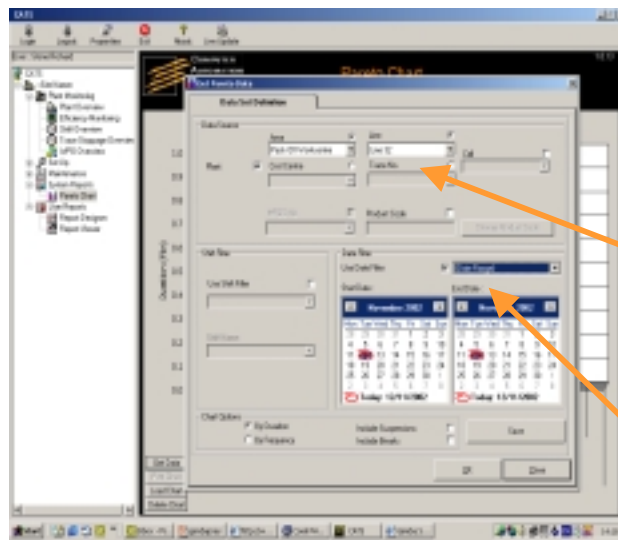
and the package and providing intuitive management of the generation and distribution processes.

Following the trend set by the IT industry Gemba have adopted internet/intranet

Where storage space is a major consideration then the archived data may be further optimised using data compression techniques. Whilst this may be a standard feature of most SCADA historian packages few, if any, allow the data to be saved against the SP95 model which is so critical for its analysis later on, most SCADA Historians simply save the data in a time series format related to nothing but the source.

**How are results generated and distributed?.** - Having gathered the information required by MES systems into a recognised, structured model, or **data warehouse**, we now need the tools to examine and distribute that information.

For the generation of reports we have standardised on the use of Excel, Access and Crystal Reports. Many of you may already be using these packages on your SCADA application and you may find them difficult to use and far from 'user friendly' However, the CATS report module was designed with this in mind, acting as an interface between the user



Report Filters  
 Plant Area  
 Line Cell  
 Shifts Time

and email as the primary tools through which data (reports, analyses, etc.) can be accessed and globally distributed. Most of us have daily access to these tools, making them an ideal medium for the distribution of information.

Many organisations are spread over a large area with many users requiring access to the information that can be generated from a MES system. Using a reporting system that generates

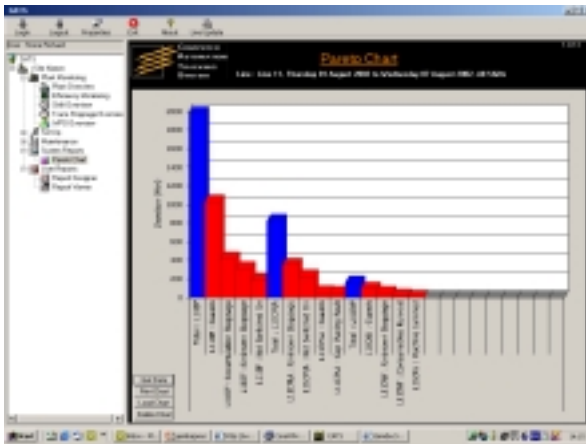
Intranet/internet compatible reports that can be distributed via email opens up a range of options:

Reports can be instantly distributed via email to many users via a tried and tested method.

HTML/XML reports can be generated and posted onto a corporate Intranet WEB site. Most PC's today offer web access through which those reports can be viewed from anywhere in the world.

Using an event driven system, reports can be generated on an event such as low efficiency levels, high critical instrument readings, critical process alarms.

One of the most widely used reports in manufacturing is the Pareto chart. Posted to maintenance staff on a daily



basis a Pareto chart is a stacked histogram showing, typically, the top ten problem areas for the plant, area, etc.. Pareto's can be generated periodically or can be event driven, a chart being generated and published where, say, the plant efficiency falls below a set level. The Pareto chart will typically indicate the main reasons for this in a visual manner and from that the maintenance staff can

start to become more proactive, reacting to accrued problems before they create a major incident.

By using internet service on the MES server a corporate overview of the performance of all plants could be created. A central server could host an intranet site with hyper-links to each individual site, giving users access to a corporate Web-based system without the need for technical knowledge of its structure. Using the SP95 model for storing data reports which comparing the performance of one plant to another is a simple exercise.

There are many other areas covered by MES from which benefits could be seen if the correct system and network infrastructures are adopted. With any industry continuously being pushed to reduce running costs and manpower a MES system properly applied is certain to optimise the efficiency of their operation.

***“the GEMBA Solutions team have been implementing MES systems in the manufacturing industry for over 8 years whilst also being heavily involved in providing solutions for process industry, from ICA through to PLC and SCADA. It is our firm belief that this technology can deliver real value to the user and we would be happy to work with you to make this a reality.”***