

# PlantMaster

## Manufacturing Execution System (MES)



**PLANTMASTER** is a leading MES system for discrete manufacturing. It is a powerful and extensive yet flexible tool enabling managers to achieve operational excellence and rapidly respond to changing conditions. **PLANTMASTER** is at

the heart of Industry 4.0 and the Smart Factory offering a suite of MES modules with connectivity, powerful storage and secure communication.

**01**

Increased efficiency

**02**

Transparent logistic processes

**03**

Reduced scrap rates

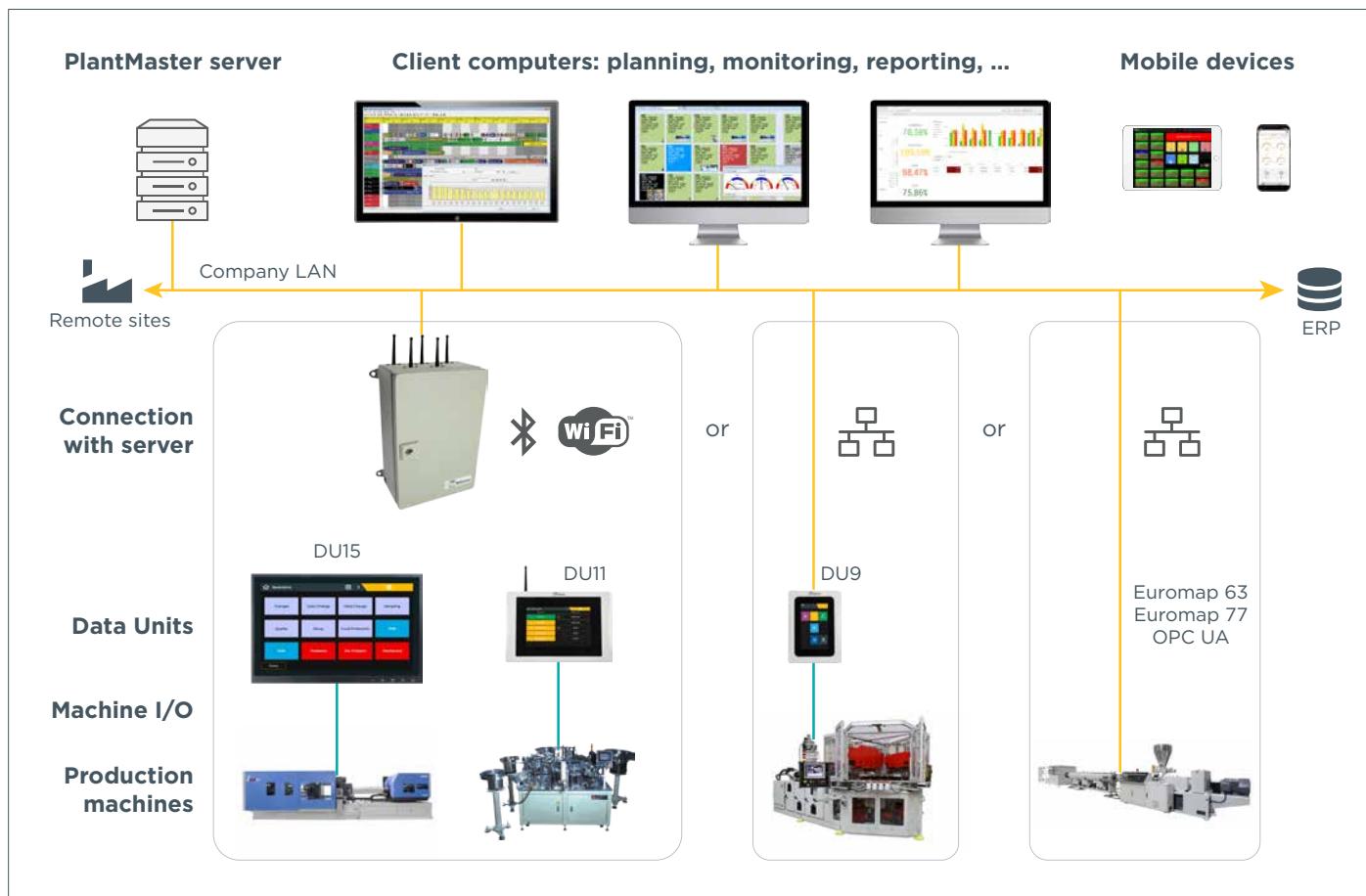
**04**

Reduced energy consumption

**05**

Increased customer satisfaction

## PlantMaster concept



## Networking the machines

PLANTMASTER supports both cabled and wireless networks to connect the machines to the central server. Machines are equipped with one of BMSvision's Data Units (see next page) for automatic as well as manual data collection or linked directly to the server through their Ethernet interface.

## Connecting remote sites

PLANTMASTER supports the connection of multiple plants to one central server. On remote sites, the BMSvision Data Units are connected to the PLANTMASTER system via the company's multi-site LAN. A dedicated "multi-site consolidation module" on the central PLANTMASTER server allows integrated reporting for all sites into one single reporting environment.

## System requirements

PLANTMASTER is Windows based and can be installed both on physical systems and in a virtualized environment. Application and database can run on separate servers. The database is Oracle or SQL driven. Also Terminal Services like Citrix are supported.

## ERP system integration

PLANTMASTER is easily integrated with the customer's ERP system. Through a standard interface, order and product data is transferred from the ERP system and imported into the PLANTMASTER database.

The integrated export functionality allows a straightforward upload of production data, calculated production schedules, work in progress and performance indicators from PLANTMASTER to the ERP system.



# Connecting machines to PlantMaster



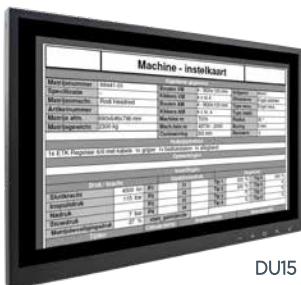
## Touch screen IoT ready Data Units

The IoT ready Data Units **DU9**, **DU11** and **DU15** have been designed for maximum flexibility and optimal user friendliness. They feature a color touch screen and a graphical user interface and can be connected with wired Ethernet, with the proven BMSvision Bluetooth based wireless network interface or through the customer's Wi-Fi network.



The Data Unit registers cycle time, produced quantity, run- and stop time and allows the operator to enter additional information like stop and scrap reasons. Via the configurable display all production and planning data can be shown in real time.

On the **DU11** and **DU15**, documents can easily be downloaded from the server and visualized. This way, quality control documents, setup data, production drawings, ... are available right where the operators need them. This is a major step towards "paperless production".



To connect machines with lower demands, the cost-effective **DU9** is a good alternative for the **DU11** or **DU15**. The **DU9** is also often used as a second terminal for extrusion lines. In this case, a **DU9** is installed on the extruder side for the production data acquisition and input of stop reasons, and a **DU11** or a **DU15** at the packaging side for the display of packaging instructions, the input of scrap and printing of labels.

All Data Units except **DU2P** can be extended with Backup & Recovery, allowing a minimum of 24 hours local data storage in case of server or network breakdown.

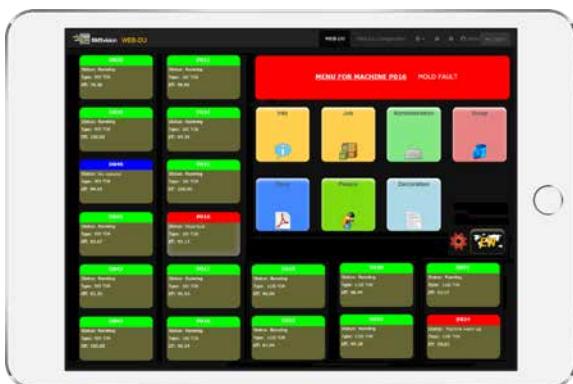
## Machines with Ethernet interface or IIoT

The latest generation of production machines is often equipped with Ethernet interface for host communication. These machines can either be connected by means of a standard Ethernet network (UTP5 cable) or by using the **DU7** Data Unit for wireless communication.

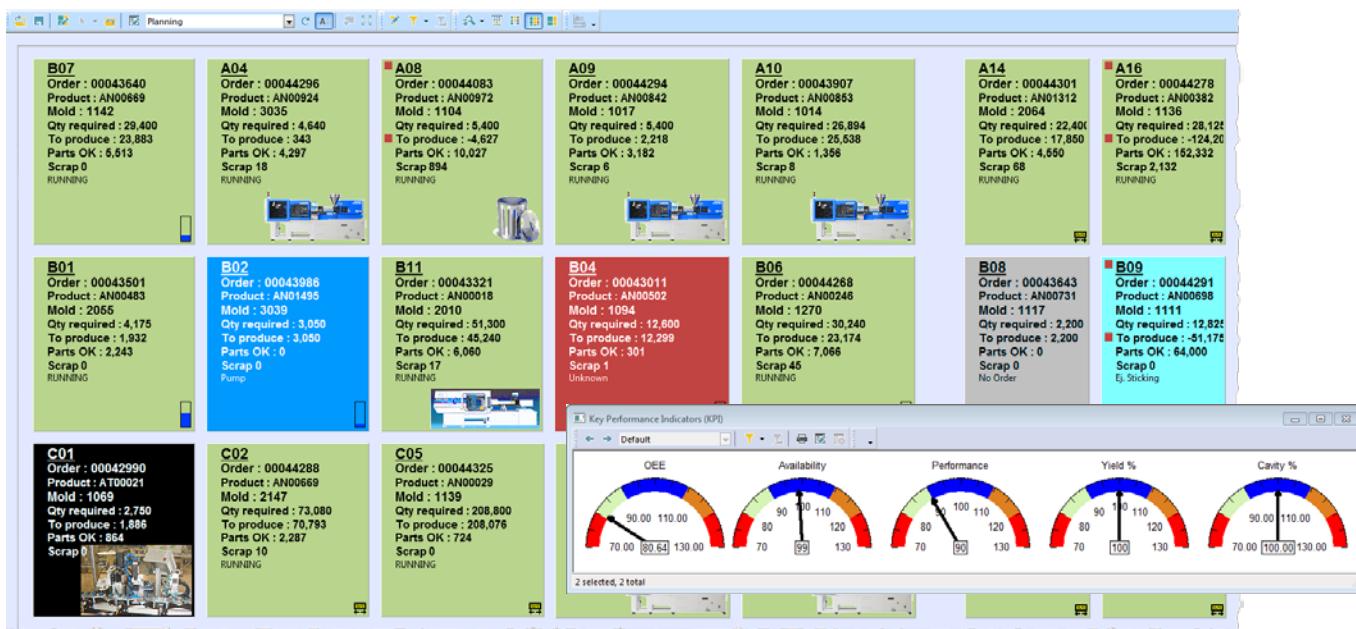
The **OPCCONNECTOR** is a user-friendly tool allowing easy and straightforward integration of any machine OPC server available on the network. It was developed to support the Euromap 77 interface for injection moulding machines but it can be configured to interface with any OPC UA server without the need for extensive programming thus reducing the total investment as well as the cost of ownership for the MES system.

## WEB-DU: HMI application for multiple machines

The **WEB-DU** application is used as HMI for a group of machines that are equipped either with **DU2P** or **DU7** headless devices for automatic data collection (production count, stops, ...) or that are connected via Ethernet. **WEB-DU** can be implemented on any browser enabled touch screen device such as PC, tablet and smartphone. BMSvision offers the **WEB-DU** including a Touch Panel PC with a 15.6" display.



## Real time production visibility for quick response



## Machine monitoring

**PLANTMASTER**'s most important real time analysis tool is the **PLANTVIEW**. In this color-coded layout of the plant, the machine color indicates the machine status or alarm condition.

The user can select the type of information to be displayed. User definable “filter sets” display only those machines which match a certain condition, for example all machines with OEE below 85%, machines producing too much waste, ...

A “mouse click” on a specific machine or group of machines opens a window with detailed information for the selected machine(s).

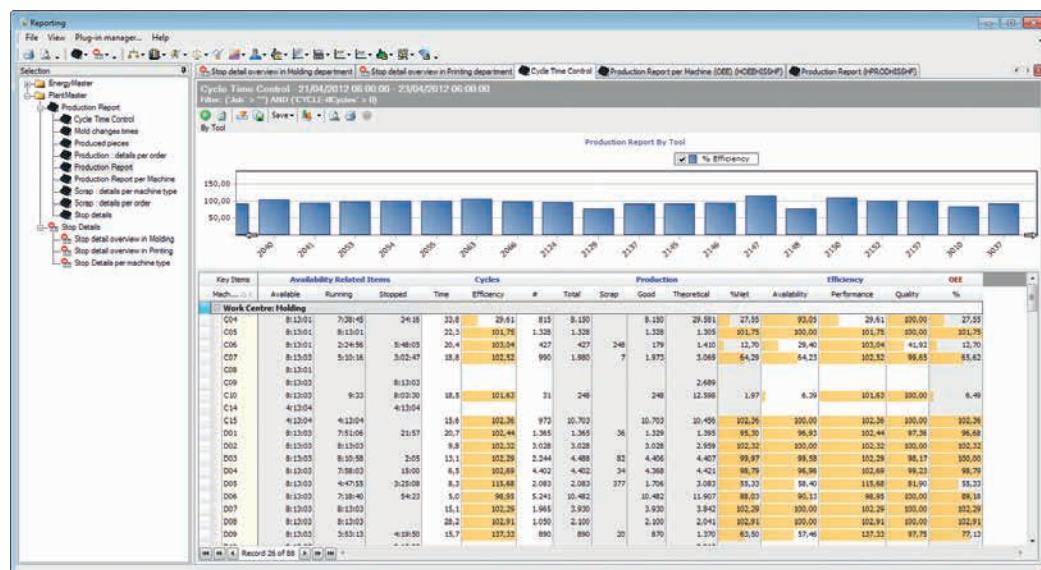
## Reporting

All data is stored in an Oracle or SQL relational database. By means of a powerful report and formula generator, featuring interactive reports and charts with multiple period selection, ad hoc filtering, ad hoc highlighting, users can define and configure their own calculations and reports.

For every report item selected from the database, upper and lower warning and alarm limits can be defined resulting in color coded exceptions in the report. Once a report has been defined, the user can select it for a variety of selection keys such as by machine type, by operator, by style, ... and for any time period such as shift, day, week, month or year.

With the reporting scheduling feature, reports are generated at fixed times, after shift end, etc. and be transferred to different outputs, e.g. printer, file folder, e-mail, HTML page.

Integrated graphics allow managers to build their own personalized “dashboards” for a quick and transparent analysis and evaluation of all Key Performance Indicators (KPI).



# Data analysis for continuous improvement

The Management Dashboard interface includes:

- Machine: 01 - Machine Efficiency**: Shows a gauge at 67.08% and a table of machine status.
- Machine: 02 - Machine Efficiency**: Shows a gauge at 61.88% and a table of machine status.
- Stop detail**: A line graph showing Stop Time over time and a bar chart of Stop Groups.
- Stop rate**: A stacked bar chart of stops per hour.
- A sidebar with a table of stops categorized by plant and code.
- A hand holding a tablet displaying the same dashboard interface.

## Management Dashboard

This module allows the combined presentation of any data available in different BMSvision software modules into a single web based report.

With this tool, each user can create his own dashboard showing all important KPI's at a glance. As such, the manager can have all important information regarding efficiencies, quality and energy consumption displayed in real time on one single screen. Zooming functions allow him to drill down further in detail if required.

## BI Connect

With this optional extension, all data is put available for use in standard business analysis tools such as PowerBI. With these tools, the user can freely search and explore across all data, instantly pivoting his analysis when new ideas surface. Innovative visualizations put all data in the right context allowing fast and smart decisions.

## OEE (Overall Equipment Effectiveness)

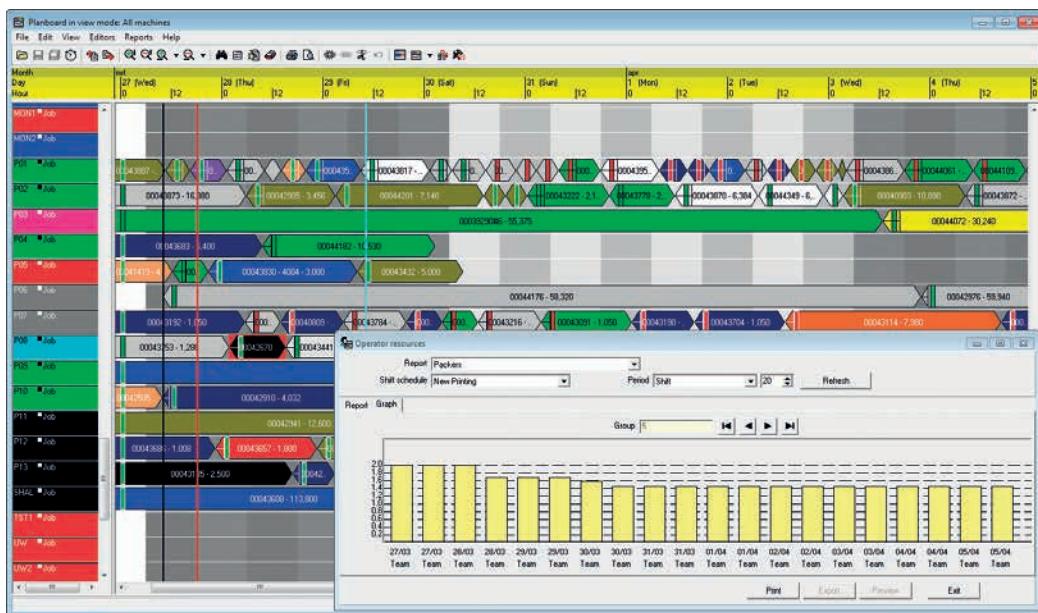
**PLANTMASTER** includes all elements required for OEE reporting: equipment availability, performance and production quality (rejects) is collected automatically from the machines. Analysis of these important KPI's drives efficiency improvements resulting in considerable cost savings.

With the “multi-site consolidation” module, managers can compare KPI's between sites allowing operations to learn from the best performers (benchmarking).



$$A \times P \times Q = \text{OEE}$$

# Managing job schedules



## Real time job schedule

PLANTMASTER's **PLANBOARD** lets you know within seconds whether you can meet customer's requested delivery dates. Orders can be entered directly into the system or downloaded from the ERP system.

Based on the actual situation in the plant, technical restrictions stored in the database, maintenance schedules, the system helps the planner in finding the optimum job sequence. Jobs can be rescheduled by simple "drag and drop" operations on the **PLANBOARD**. Jobs which are too late are automatically highlighted allowing the planner to take the necessary actions to get the situation under control again.

## Kan Ban support

More and more manufacturers have switched from traditional order based planning (push) to Kan Ban planning (pull). **PLANTMASTER** supports this Kan Ban functionality.

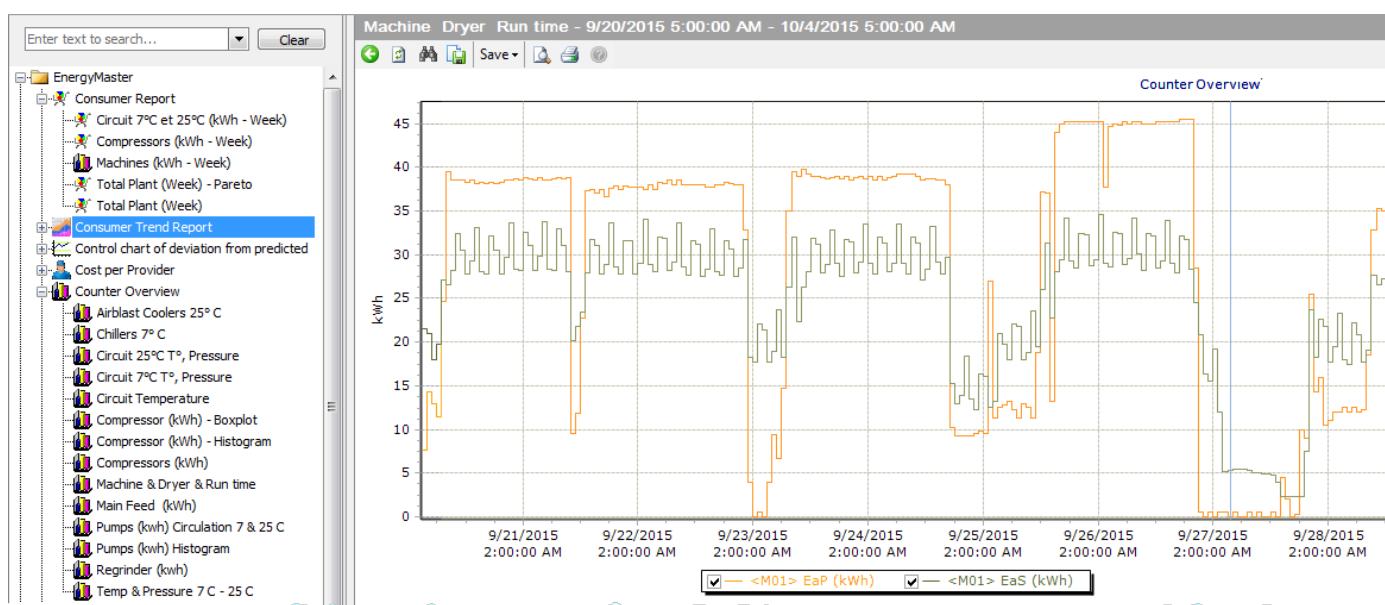
In the Kan Ban philosophy, material or component requirements are triggered by the process that consumes this component. A "Kan Ban Card" is sent to the workcenter that produces this component. This bar coded card contains the product code, tool and quantity required. Scanning this card at the machine automatically generates a "production job" in the **PLANTMASTER** database.

## Label printing and logistics

**PLANTMASTER** also supports the registration of logistics data for the produced packaging or pallets. The correct labels are printed in real-time and the production data are automatically reported back to ERP.



# EnergyMaster: Energy management



## Monitoring energy consumption

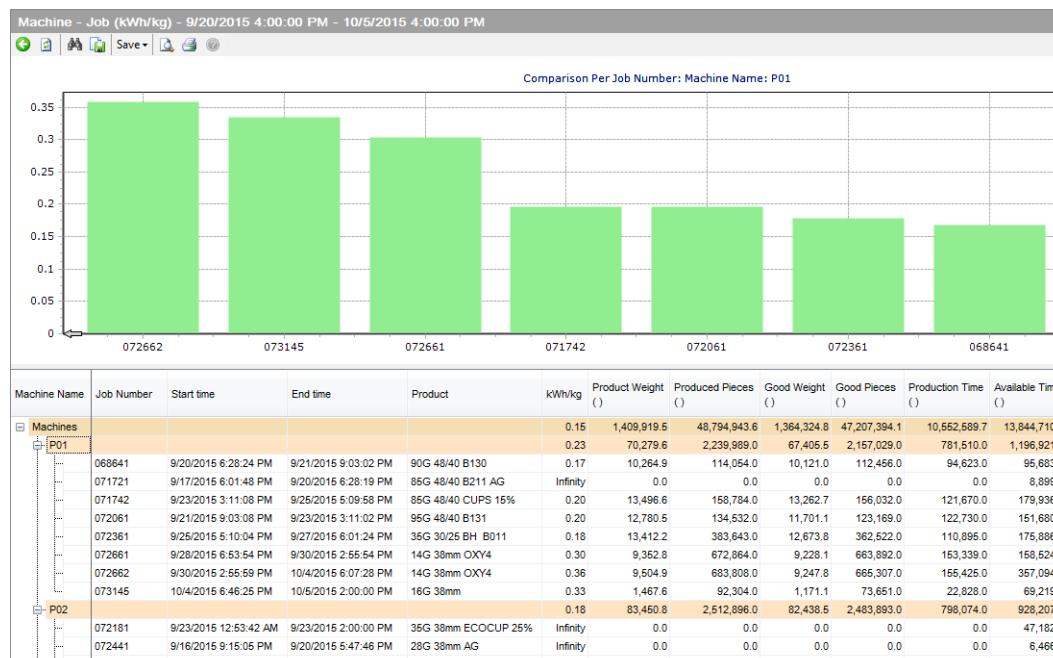
With the **ENERGYMASTER** module, the **PLANTMASTER** MES system is extended with a powerful tool to optimize the use of energy in the plant. Following the principle of Monitoring & Targeting, it maps the various energy consumptions (electricity, gas, compressed air, water, steam) for full analysis and optimization.

Energy meters can be connected to the Data Units on the machines and energy data is passed on to the server using the MES data collection network. As such, no additional investment in data collection infrastructure is required.

## Reporting consumptions

**ENERGYMASTER** integrates seamlessly with the **PLANTMASTER** monitoring and scheduling module. Combining production data with information about energy consumption is a powerful feature that allows evaluating the energy component in the overall production cost of each order and product.

By defining an Energy Efficiency Plan with clear objectives, significant energy savings can be realized. **ENERGYMASTER** is the right software package to provide analysis and decision support for quick energy saving actions while ensuring a short pay-back time.



## Communication in the plant



### Digital signage

**PLANTMASTER** can be extended with a DID (Digital Information Display) for quick and effective communication of actual performance (OEE), outputs/rejects, alarm conditions, etc. in the plant. The DID driver software allows flexible configuration of the displays, such as:

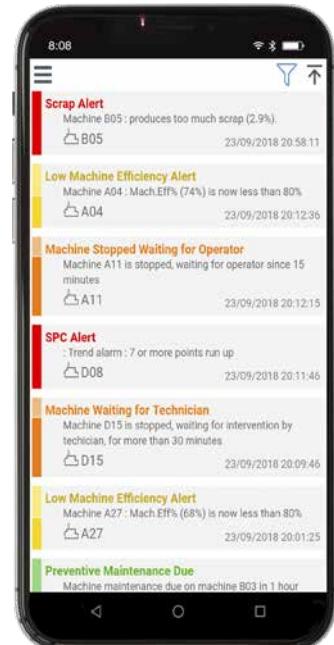
- Data to be displayed  
(selectable from the BMSvision **PLANTVIEW** data items).
- Text font/size/color.
- Machine filter.
- Update interval.

### Alarm handling & messaging

The Events & Alerts module continuously compares selected parameters or KPI's with predefined exception limits.

As soon as an “alarm condition” is detected, the software triggers one or more actions, such as sending a message to the **MyMES** app on a smartphone or to the **SMART BRACELET**, transmitting an alarm message to the machine’s Data Unit, where a lamp can be activated and a message displayed on the Data Unit screen.

“Escalation scenario’s” can be defined, for example if one person does not react to a message within a certain amount of time, a message will be sent to another person.



# QMaster: Statistical Process and Quality Control (SPC/SQC)

The screenshot shows two main windows of the QMaster software. On the left, the 'Inspection plans' window displays details for 'Record 7 of 50' of an inspection plan named 'K-20'. It includes fields for Name (K-20), Description (Inspection plan), Inspection process (Characteristic by characteristic), Status (Version 2, Approved, Valid from 10/17/2016 12:00:00 AM), and a tabs section for Characteristics, Sampling strategy, Creation rules, Documentation, Inspection station, Actions, and Other. On the right, the 'Inspections - inspection' window shows an inspection order for job number 115. It lists four characteristics: Weight (1 part), Length, Width, and Height, each measured by Mitutoyo. Below this is a photograph of a digital caliper measuring a part, with a value chart overlay showing a red dashed line at 71.78 mm and green dashed lines at 71.76 and 71.80 mm.

## Inspection plan and inspection order

The **PLANTMASTER** SPC/SQC module **QMASTER** keeps your process within the specifications required for optimum product quality and generates the documentation your customers demand for their quality assurance programs.

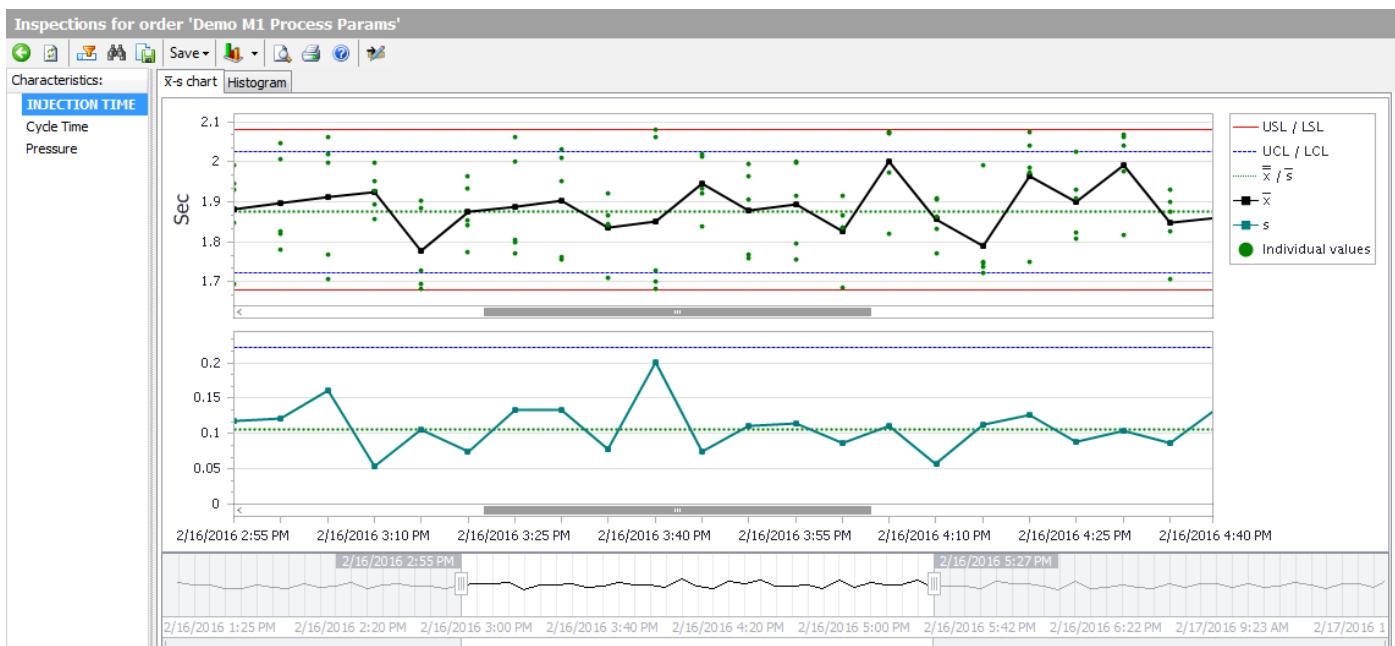
For every product, the quality manager defines the quality and process control plan including the parameters to be monitored, the sampling strategy as well as the calculations to be used.

A link with the **PLANTMASTER** scheduling software assures an automatic generation of inspection orders at the start of each production order. Production orders for which the quality checks are overdue are automatically highlighted by the system.

## Real time data input processing and reporting

Process parameters are collected automatically using the Data Units at the machines (serial or Ethernet interface with the machine controller or analog inputs) while part related data is sampled directly from measurement devices such as scales and calipers or entered manually through an input program on a PC or a mobile device, such as a tablet or smartphone.

The **QMASTER** SPC/SQC module offers an extensive set of reporting tools: control charts for variables and attributes, histograms and process capability calculations. For variables, the user can select from X-R, X-S and individual values charts. P, NP as well as pareto charts are available for attributes. The system automatically calculates alarm and warning limits.



# Tracing from raw material to finished product

The screenshot displays two windows side-by-side. The left window, titled 'Edit Process Routes', shows a form with fields for 'Process Route' (Flexo Pkg), 'Version' (1), 'Short Description' (Flexo Packaging), 'Status' (Released), 'Product Family' (Cartons), and 'Long Description' (Flexo Packaging). Below this is a grid titled 'Process Steps' containing 12 rows of data. The right window, titled 'Edit Process Steps', shows a form for 'FL Laminating' with fields for 'Process Step' (FL Laminating), 'Version' (1), 'Short Description' (FL Laminating), 'Link with PlantMaster' (checkbox), 'Type' (Assembly), 'Status' (Released), 'Sequence' (3), and 'Long Description' (FL Laminating). It also includes tabs for 'Instructions', 'Additional', 'Checks', and 'Results'.

## Process routing

In the “process routing” module, the user defines a routing for each product or product group. This routing describes all product steps necessary to manufacture the product. For each process step in the routing, the machine or workstation is defined as well as all data to be collected.

Typical traceability data includes operators, lot and component numbers and process and quality parameters to be documented.

During the production process, the system checks in real time whether all data is collected and generates an alarm (for example activate a lamp) in case certain data is forgotten or is falsely entered.

## Traceability reports

A powerful reporting module offers reports for forward and backward tracking per product, component and raw material and the search for causes in case of customer complaints.

For each individual product shipped, the system stores and reports raw materials and components used in each production step, process parameters, results of quality checks and operators that manufactured the product.

Information can be retrieved for as long as ten years in the past.

The screenshot shows two windows. The left window, 'Trace Back for Assembly', has a sidebar with selection types (Resin Lot, Master Batch, Material Lot, Part Number, Assembly, Carton, Container, Job, Tool, Archive data) and a main grid titled 'Trace Back for Container: PDBRL-004061190'. The grid lists components and their assembly history. The right window, 'Summary for PORT-RL PFFA1085ZL000068', shows a car part image and detailed information: Product (PORT.RL), Start (18/08/2017 11:52:42), Last (18/08/2017 14:16:43), Status (Good). It also shows 'Process Steps' (PT02 to PT05) and 'Materials' (BAR.PORT.X56, MAT.PLAST.N, PEAU.THF.POR.X56, PUR.SR.MDI, VIS.10x3).

# Operator tracking



**Edit Operators**

Record 5 of 1,322

Operator: 903 Short Description: R491

General Advanced Machines

Name:	Tianna Smothers	User Values
Clock Number:	30702BAB41	1:
Operator Type:	PACKERS . Packers	2:
Department:	PDS	3:
Workcentre:	MLD . Molding Germany	
Shift Schedule:	3. New Injection	
Shift Code:		
Maximum Machines:	2	
Maximum Load:	120	
Long Description:	6901015067088	
Remarks:	208040340289	

## Logon/logout

Operator tracking allows both direct and indirect operators to log on/off at a machine via the BMSvision Data Unit. This can be done in a number of ways:

- The operator simply types in a number (operator ID)
- RFID proximity device (tag reader)
- Barcode slot reader
- CCD scanner

Operators can be categorized into those that only need to log on at the machine (automatically logged off at the end of a shift) and those such as supervisors, quality operators and maintenance people who need to both log on and log off.

## Operator based reports

The operator tracking software stores all recorded information by operator code. Reports can be generated showing production, scrap, downtime and efficiencies by operator. Both direct and indirect labor component can thus be reported for each production order allowing accurate allocation of labor cost to orders and products.

Operator Tracking detail - 5/9/2015 6:00:00 AM - 5/10/2015 6:00:00 PM																		
Key Items		Times					Cycles				Production							
Record Start	△ 1	Record End	Available	Running	Stopped	M-Stop Time	M-Operator	Time	Efficiency	#	Total	Scrap	Good	Theoretical	%Net	Availability		
<b>Operator Name: Adamina Prechtl</b>																		
Machine: C01																		
5/9/2015 8:40:27 AM		5/9/2015 8:54:10 AM	13:43	13:43				13:43	19.1	106.12	43	43	43	41	106.12	100.00		
5/9/2015 9:12:01 AM		5/9/2015 2:32:51 PM	5:20:51	5:09:11	9:51		9:44	5:09:18	19.7	103.35	944	944	20	924	942	98.04	99.96	
5/9/2015 2:54:57 PM		5/9/2015 4:23:05 PM	1:28:09	1:14:14	6:23		6:04	1:14:33	17.8	114.00	250	250	9	241	238	101.19	92.06	
5/9/2015 4:23:05 PM		5/9/2015 5:51:40 PM	1:28:35	1:27:08	1:27		1:27	1:27:08	19.8	102.56	264	264	264	262	100.88	98.68		
			8:31:18	8:04:16	17:41		17:15	8:04:42	19.4	104.92	1,501	1,501	29	1,472	1,483	99.27	98.44	
			8:31:18	8:04:16	17:41		17:15	8:04:42	19.4	104.92	1,501	1,501	29	1,472	1,483	99.27	98.44	
<b>Operator Name: Aislin Bicknell</b>																		
Machine: A04																		
5/9/2015 6:00:35 AM		5/9/2015 8:06:03 AM	2:05:28	1:51:53	13:35		10:31	1:54:57	56.4	79.77	119	119		119	167	71.13	97.33	
5/9/2015 8:21:08 AM		5/9/2015 8:36:49 AM	1:00:15:43	14:43				14:43	55.2	81.54	16	16	16	20	81.54	100.00		
5/9/2015 8:39:17 AM		5/9/2015 11:53:17 AM	3:14:00	2:39:42	34:18			3:14:00	55.7	80.78	172	172		172	259	66.49	82.32	
5/9/2015 12:25:06 PM		5/9/2015 5:53:29 PM	5:32:34	3:41:40	1:41:36			5:23:16	41.0	109.62	324	324	92	232	431	53.83	68.57	
			1 11:07:45	8:27:58	2:29:29		10:31	10:46:56	48.3	93.17	631	631	92	539	877	61.49	78.52	
			1 11:07:45	8:27:58	2:29:29		10:31	10:46:56	48.3	93.17	631	631	92	539	877	61.49	78.52	
<b>Operator Name: Alec Wallick</b>																		
Machine: A14																		
5/9/2015 5:51:21 PM		5/9/2015 6:00:00 PM	8:39	8:39				8:39	10.4	115.61	50	50		50	43	115.61	100.00	
			8:39	8:39				8:39	10.4	115.61	50	50		50	43	115.61	100.00	
			8:39	8:39				8:39	10.4	115.61	50	50		50	43	115.61	100.00	
<b>Operator Name: Alyx Gronko</b>																		

## References



## PlantMaster modular concept

