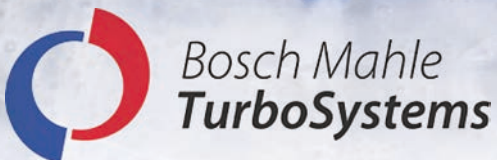


## Bosch Mahle Turbo Systems: exhaust gas turbocharger production for Industry 4.0



# *Bosch Mahle Turbo Systems GmbH & Co. KG*

Bosch Mahle Turbo Systems GmbH & Co. KG specializes in the development, production and sales of exhaust gas turbochargers. The company has now introduced the iTAC.MES.Suite Manufacturing Execution System since quality is the main priority throughout the entire value added chain.

This runs alongside the entire production process and is closely intermeshed with the material logistics and the so-called business level of the company. What makes this solution special is that the central system hosted in Stuttgart works on the basis of the multi-tenancy principle according to the principles



Bosch Mahle Turbo Systems GmbH & Co. KG, St. Michael

of Industry 4.0 as it is based on the private cloud infrastructure used by Bosch Mahle Turbo Systems GmbH & Co. KG. This enables the efficient, multiple-plant use of a central MES instance.



## *Central MES instance rolled out for multiple plants and implemented using a multi-tenancy architecture*

### **Initial situation**

Automotive manufacturers are having to exploit every conceivable technical approach in order to comply with future emissions standards. The downsizing concept which uses turbocharging to achieve vastly reduced fuel consumption levels without spoiling the driving experience plays a key role in this respect. As turbochargers are already used as standard in diesel engines, the automotive industry now welcomes their increasing popularity in petrol-engine cars.

Turbochargers are designed to increase the performance of engines by using the emissions as a source of energy.

The energy gained through this is used to transport fresh air at high pressure into the intake system and then into the engine's combustion chambers. This means that the engine does not have to draw in the air itself and can achieve the same performance as an engine with greater displacement.

The exhaust gas turbocharger is exposed to massive stresses during this process – it has to withstand temperatures of up to 1,050°C and reaches speeds of up to 300,000 revolutions per minute. But smooth operation

and zero leaks are just as important criteria for the customer as a long service life and failure rates close to zero. After all, there is nothing more harmful to sales and image in the automotive industry than a recall.

The stated aim of Bosch Mahle Turbo Systems is therefore to ensure the highest possible quality at all its sites, a target which can be achieved in particular by the use of a dedicated process control system. The MES solution from iTAC Software AG is one of the central components used to meet these requirements.

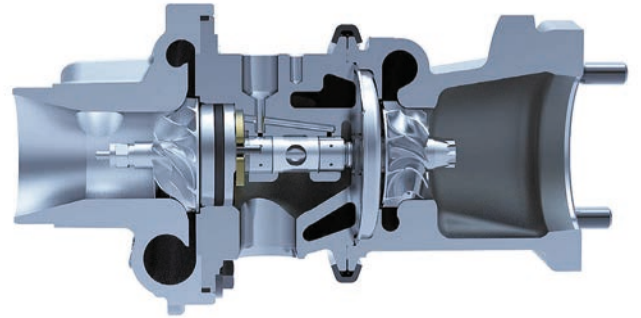
### **The requirement: zero parts per million (PPM)**

Bosch Mahle Turbo Systems' target is zero PPM production coupled with the ability to adjust to the increasingly bespoke requirements of its customers. One of the challenges in this respect is to manage a large range of variants within the production processes.

This requirement can be satisfied by using comprehensive quality assurance and technologies for process management and improvement. The aim is to plan and implement all processes in compliance with the specifications – even minor discrepancies must be identified and interpreted without delay.

*„The complete traceability of all components is a complex challenge since a turbocharger consists of up to 50 individual parts. We therefore require a solution which enables us to identify weaknesses at an early stage during the production process so as to prevent errors from the very outset“, says Peter Weratschnig, Head of Financials ERP and IT, St. Michael, at Bosch Mahle Turbo Systems.*

That means that the traceability of material batches and assemblies up to the end product must be guaranteed by recording measurement, process and error data at multiple production sites. Bidirectional SAP and PLC coupling with an integrated process locking function is a central requirement for this.



**The challenge:**

**Networking to meet the requirements of Industry 4.0**

The primary aim is complete digitization to ensure efficient and transparent processes at the three European and the one Chinese sites. For this a total of 400 users from the production, production planning, logistics and development units access the central MES via a private cloud infrastructure run internally by BMTS. The Chinese site has its own MES installation and communicates with the central MES instance in Stuttgart via iTAC's „SCT Service“ (Supply Chain Traceability) using Soffico Orchestra.

The multi-tenancy architecture ensures access to a standard software platform which serves the various clients.

*„Robust data connections were essential as a result of the decision in favor of a central MES instance on a scalable cluster basis which works for multiple plants. The solution was highly available from the very outset as the entire network provided a high performance, redundant design during the implementation and start-up phases“, says Ata Güteryüz, IT Manager at Bosch Mahle Turbo Systems, and continues, „Another benefit, which is also a major reason behind the success of the system, is the MES’s high level of functional standardization.“*

This means that all added value processes in mechanical production whose value stream extends from ERP via MES to the system controller or production process can be industrialized and digitized.



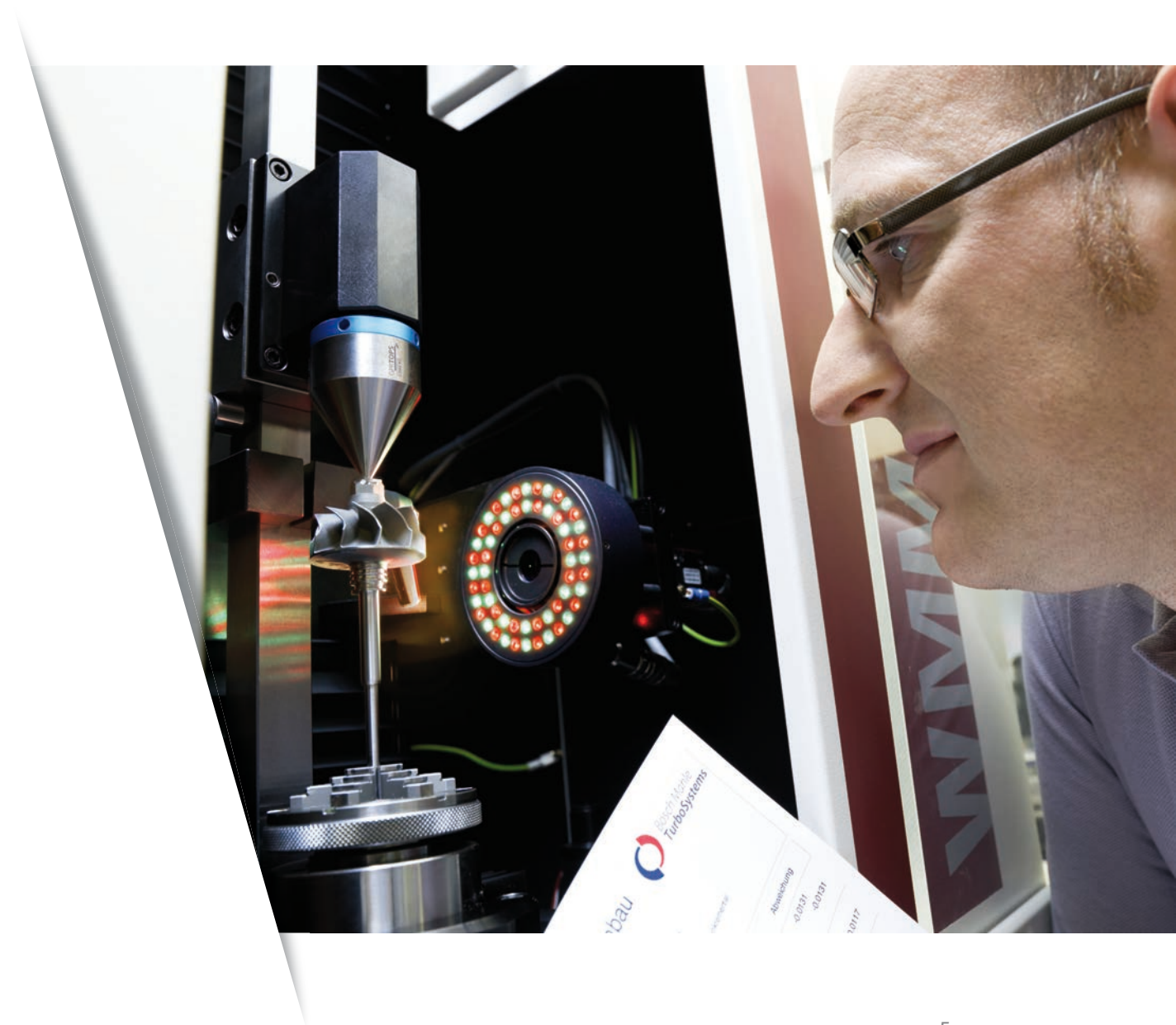
### The technological basis

SAP is the leading system for master and inventory data at Bosch Mahle Turbo Systems. It is used in all commercial and logistical business processes. SAP and the iTAC.MES.Suite can also be coupled using the centrally provided Soffico Orchestra middleware architecture.

The standardized platform-independent MES from iTAC is responsible for controlling and documenting the production process. It also assures traceability including process locking functions in the event of error messages. In addition to its active traceability, the main points in favor of the iTAC.MES.Suite by comparison with rival systems include its bidirectional system

integration, SAP integration and its centralized approach and future-based technological features to meet future requirements.

*„Multiple connections for the production systems and the separate ongoing development of so-called custom functions which are encapsulated on the MES server site in API-based form, underpin the technological strengths of the MES solution. This gives us the scope we need“, explains Peter Weratschnig.*



**The solution:**

**MES controls and documents at multiple sites**

The MES server/database system is installed at the central location in Stuttgart. The production sites at Blaichach and St. Michael and the logistics centers are connected to this. The MES is based on SOA-compliant web services and therefore on an internet-capable 3-tier architecture. The various production sites are therefore linked to each other using MPLS networks, which makes it possible to use a standard data management system in a central database.

**Traceability:**

**Cutting out errors**

One of the main drivers of success for Bosch Mahle Turbo Systems en route to zero errors production in Industry 4.0 is the possibility of ensuring perfect traceability and consistent process locking functions to prevent errors. Because high product variance can quickly result in non-compliant production.

Traceability makes research work in the event of anomalies or supplier errors drastically easier whilst the locking functions prevent assembly errors. The iTAC.MES.Suite enables anomalies in the production process to be identified in real-time and their causes to be analyzed and evaluated providing the perfect platform for a continuous improvement process.



**MES function in detail**

Process data specifications	Process locking functions	Process data recording	Traceability
<ul style="list-style-type: none"> <li>❑ Test, process and machine parameters</li> <li>❑ Work instructions</li> <li>❑ Documents (test instructions and test records, etc.)</li> <li>❑ NC / CNC linking of program versions</li> </ul>	<ul style="list-style-type: none"> <li>❑ Process flow control</li> <li>❑ Parts list installation versions at serial number level</li> <li>❑ Process and test parameter control</li> <li>❑ OK / Not OK verification</li> <li>❑ Removal if Not OK</li> <li>❑ Tooling verification</li> </ul>	<ul style="list-style-type: none"> <li>❑ Recording test, process and machine parameters</li> <li>❑ Online monitoring and analysis of test, process and machine parameters</li> <li>❑ Message recording</li> </ul>	<ul style="list-style-type: none"> <li>❑ Unique resolution of order batch</li> <li>❑ Part-based monitoring of assemblies with ID numbers</li> <li>❑ Unique item installation log</li> <li>❑ Integration of logistic batches / HUs</li> <li>❑ Serial number delivery</li> </ul>
Paperless production	Process performance evaluation	Logistics integration	Set formation
<ul style="list-style-type: none"> <li>❑ Online display of work instructions, test instructions, etc</li> <li>❑ Documentation integration</li> <li>❑ Online recording of error data</li> </ul>	<ul style="list-style-type: none"> <li>❑ OEE Reporting</li> <li>❑ Alarm system in the event of faults</li> <li>❑ Cp/Cpk</li> </ul>	<ul style="list-style-type: none"> <li>❑ Supplier batches</li> <li>❑ Supplier process data</li> <li>❑ HU formation for delivery</li> <li>❑ Serialisation</li> <li>❑ Automated registration of goods received, order response, etc.</li> </ul>	<ul style="list-style-type: none"> <li>❑ Recording and verification of the components</li> <li>❑ Preparation of a set</li> <li>❑ Joining the components to the set number</li> </ul>

### The benefits at a glance

- Intermeshing the MES with the company's business functions
- Consistent control and traceability of the entire production process
- Unique serial number for every exhaust gas turbocharger
- Formation and documentation of assembly sets of individual components
- Batch traceability of internal and external material batches and inventories
- Recording of process data, such as bolting data, at the various production stations
- Process locking functions in the event of incorrect identification and incorrect measurements or differences from specifications

### Result and future outlet: Industry 4.0 global

By using the iTAC Manufacturing Execution System, Bosch Mahle Turbo Systems has secured its stated aim of manufacturing at consistently high quality and efficiency according to the principles of Industry 4.0.

The MES makes it possible to achieve complete documentation and traceability as well as transparency for the production process down to the internal and external supply chain. The main results of this include a reduction in documentation costs, error prevention, satisfying the compliance requirements of OEMs, management of the range of versions and a standard key performance figure system for production.

The global roll-out has already started and the installation work in China has been completed. Since the system has a future-safe, scalable design, the next step is to roll out the existing range of functions. In addition there are plans to expand the machine/operating data acquisition section and for alerts in the event of faults. Bosch Mahle Turbo Systems is prepared for the future requirements of the fourth industrial revolution.

Since it first opened for business in 1988, iTAC Software AG (Internet Technologies and Consulting) has specialized in supplying internet-based technologies for the manufacturing industry. As a producer of standard software and products for intercompany IT applications, it is a leading system and solution supplier of the Manufacturing Execution System (MES) which goes beyond a single supply chain.

The company develops, integrates and maintains its cloud-based iTAC.MES.Suite for manufacturing enterprises around the globe. The company is a specialist in highly available, scalable and sustainable infrastructure solutions (based on the Java EE technology platform) and aims to establish standards and guarantee reliable IT-based business processes.



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