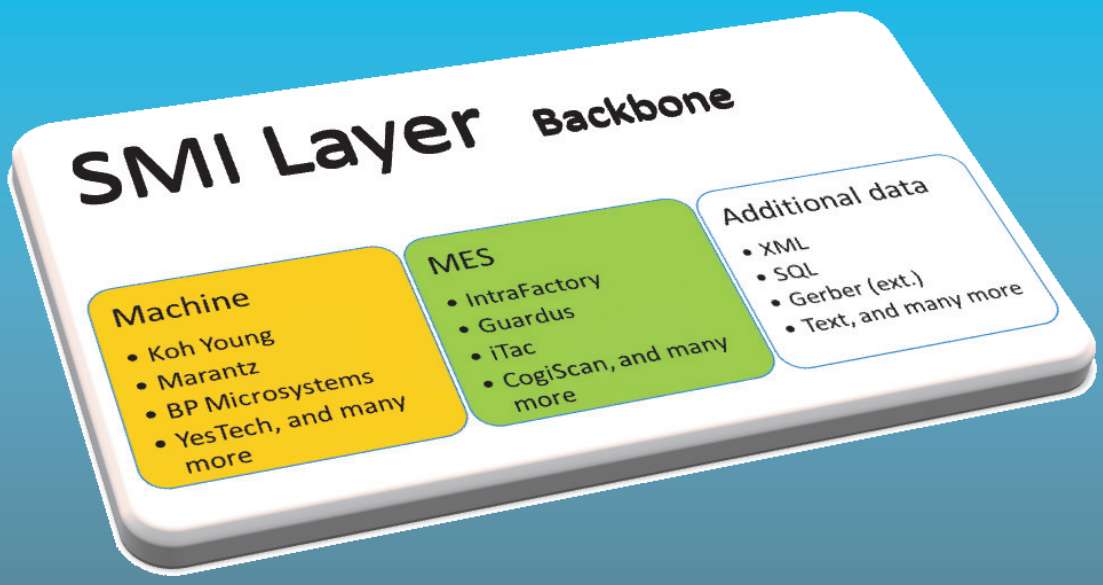
Smart **M**achine **I**ntegration Layer

The right connection as a basis for success

Production data acquisition in electronic manufacturing using a KohYoung SPI as an example



Increasing globalisation of the markets is leading to continual growth in competitive pressure. The orientation of ones own production structures and processes towards the needs of the customer, as well as quality assurance are taking on ever more importance. In order to counteract rising costs, optimisation potential is increasingly being utilised through sustainable process improvements and early recognition and elimination of any potential faults in the production process. Catchwords such as Traceability, Production Management or Quality Data are ubiquitous.

Thus, it is an absolute must for manufacturing companies to rely more heavily on process related Manufacturing Execution Systems (MES). These systems should be placed within the software architecture below the ERP systems and above the automation levels (see illustration 1). Whilst the ERP system has the entire company in focus and is therefore able to optimise logistics across several locations, the MES system is focused on the individual production lines of one factory .

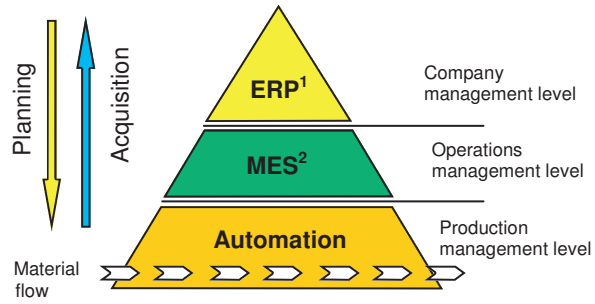


Illustration 1: Automation pyramid

In an optimum situation, the MES system continually collects all production data that arises along the material flow of this production line and makes it available to the overriding ERP system. That way, complete traceability of products, components or batches can be ensured. Furthermore, the basis of the documentation product development is set in this way, with special regard paid to liability law. However, both optimisation potential and process improvements can only be recognised and utilised directly through this production data. They are the basis of all decisions and thus, fundamentally important.

[1]ERP Enterprise Ressource Planning
[2]MES Manufactoring Execution System

Order data acquisition using a SPI system from the Koh Young Company as an example

The variety of available machines on the market, however, leads to dissimilar environments for machine integration. Not only the machine interfaces, but also their tasks within the production processes require different connections. This can be illustrated quite clearly using a Solder-Paste-Inspection (SPI) machine from the KohYoung Company. The Korean manufacturer KohYoung Technology has made itself a worldwide name within the area of 3D Solder-Paste-Inspection, and has advanced to become the de facto standard.
The usual approach to controlling a SPI machine requires the creation of the circuit board by using a CAD program. Using the extended Gerber format, the layout data for the circuit board is subsequently exchanged between the CAD program and the SPI machine. The SPI software then generates a job data file in which all essential information regarding the inspection solder paste points (pads) is included. This job data file then becomes the basis for the specific solder-paste-inspection (See illustration 2).

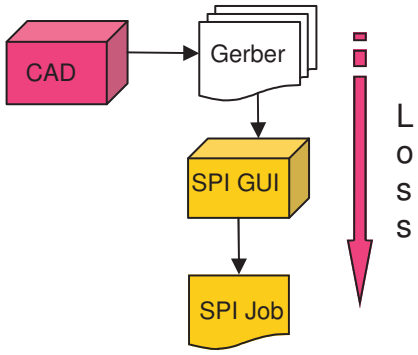


Illustration 2: Information loss during SPI job creation

However, during the process of job data creation, such information that is largely of no importance to the specific SPI process gets lost. This mainly includes information about the manufacturer of the electronic components, the type of housing used, the library classification, and much more. In case such information is required for analysis reasons later on, then it must be incorporated retrospectively .
As a permanent feature of a production line, the SPI receives the circuit board to be inspected from the material process, and then carries out the Solder-Paste-Inspection with the help of the previously created job data file. The results of this inspection are then saved for each individual pad in a local database (see illustration 3).

The extent of the data created for each circuit board is directly related to the number of pads to be inspected, and generally very extensive. Should any pads not meet the specified tolerances, then additional photographic material is stored for subsequent manual evaluation, which leads to an increase in the amount of data.
Thus, the task of the Smart Machine Integration Layers (SMI Layer) is to make all the requested data available by the MES system inspection process. This data is extracted from the results

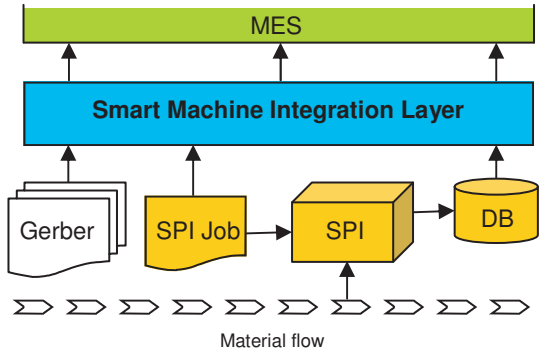


Illustration 3: Results preparation in the SML Layer

database as well as from the job data file. However, due to the immense volume of data that is created for each circuit board, extensive analysis must already be carried out in the SMI Layer in order to reduce the amount of data to tolerable levels for the tasks at the MES software level. This results preparation is naturally dependant upon the requirements of the MES layer. The situation may arise when information that was lost during the creation of the SPI job data is now required by the MES system in association with the results data. Should this prove to be the case, then the joining of the Gerber data with the results data must already have been carried out in the SMI Layer.

The Smart Machine Integration Layer

The loss of information which happens during the creation of the SPI job data, and the immense volume of data that is created for each circuit board, requires an intelligent interface to the overriding MES system. This interface must be contrived in a modular fashion in order to fulfil the requirements of differing MES systems (see illustration 4).
Due to the MES branch being a comparatively young software branch, the customer frequently uses proprietary systems which are commonly the result of their own development. Often, and specifically due to the absence of interfaces, it is necessary to integrate further data during the results

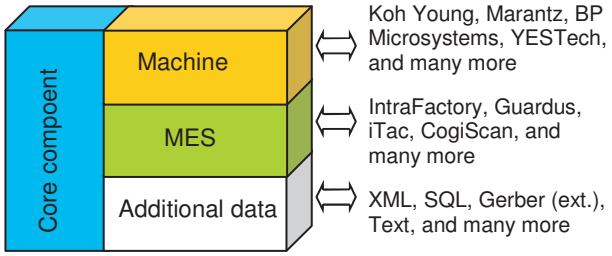


Illustration 4: Modularisierung des SMI-Layers

preparation after the SPI process.
However, even the aims mentioned earlier such as the traceability of components or production management require some specialisation within the connection software when connecting to the overriding systems. Only by the ERP system issuing a unique reference number for every system component can complete documentation during the manufacturing process be guaranteed. As these reference numbers are irrelevant for the specific CAD or SPI processes, they must be reunited with the results data from the SPI machines as early as possible. In this case, the modular concept supports the integration of the additional data from the various connection software of the ERP providers.
The variety of new and older machines has led to dissimilar integration environments which cannot be covered by just a few interfaces. Often the interfaces are specific to a particular device and far from industry standards, making the modulisation of machine connection extremely urgent.

Outlook

The continually increasing volumes of data, the permeation of the system levels with additional information and the customer's dissimilar software and hardware environments require a modularised connection of the machines and the overriding systems.
Such a modular connection has been available for quite some time now and has proven to be highly valued in production. Even the connection to the Koh Young SPI machine which was used as an example many times ran in the context of many varying MES systems. Trouble-free customer specific expansion is also possible through the modular concept, so that this connection can also be utilised as a stand-alone application without the need for overriding MES and ERP systems.

Thus, the right connection becomes the basis for our customer's success.

SMI-Layer

The consistent modularized software interface is the ideal link between the production management level and the operations management level, and connects the following systems to each other for example:

- ✓ **MES-Systems:**
  - ♦ **Standard:** **Guardus, iTac, IntraFactory, CogiScan, and many more**
  - ♦ **Proprietär:** **PDB (Continental), Scout (Siemens), and many more**
- ✓ **Machine:** **KohYoung (SPI), Marantz (AOI), YESTech (AXI), BPM (Bauteilprogrammierung), and many more**
- ✓ **Additional data:** **XML, SQL, Gerber (ext.), Text, and many more**

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