- Quality management
- Information management

1.4.3 The ideal MES

When we consider the tasks we have so far described, tasks which an MES should perform within the context of different control strategies and different kinds of manufacturing types, the question arises as to what the ideal MES is. Is there an ideal MES anyway?

Throughout all manufacturing industries, "yes" will certainly not be the answer to this question. Nevertheless an attempt should still be made to sketch out the functionalities an MES should ideally have for the environment of discrete manufacturing or even of batch-oriented manufacturing. The "working area" of an MES will, of course, extend from interfacing with corporate management applications as far as the deepest depths of data acquisition, communication with industrial systems and the provision of data for machine controllers or influencing the machine controllers directly. This extensive operational area, which not only includes a comprehensive range of different topics but which must also cover different time levels, ranging from days and weeks down to seconds, also calls for a tiered examination of the individual functionalities. This examination can thus be subdivided into the following areas:

- The functionalities of an MES itself
- Communication with corporate management applications
- Communication with the manufacturing environment

As a rule a PPS covers three function groups: production, quality and personnel. Within these function groups powerful modules are available which can be activated and used depending on requirements. A basic system ensures that all modules are linked together in real time and furthermore provides intermodular functionalities. Another important function is acting as the information hub.

In an analogous manner to these function groups in the PPS/ERP system, an MES can also be divided into three function groups. These are primarily the functionalities for production, the functionalities for quality and the functionalities for personnel allocation. To prevent these functions from appearing rather too abstract, we shall use the descriptions and in some cases the designations used in the classic definitions of the modules from which the MES developed.
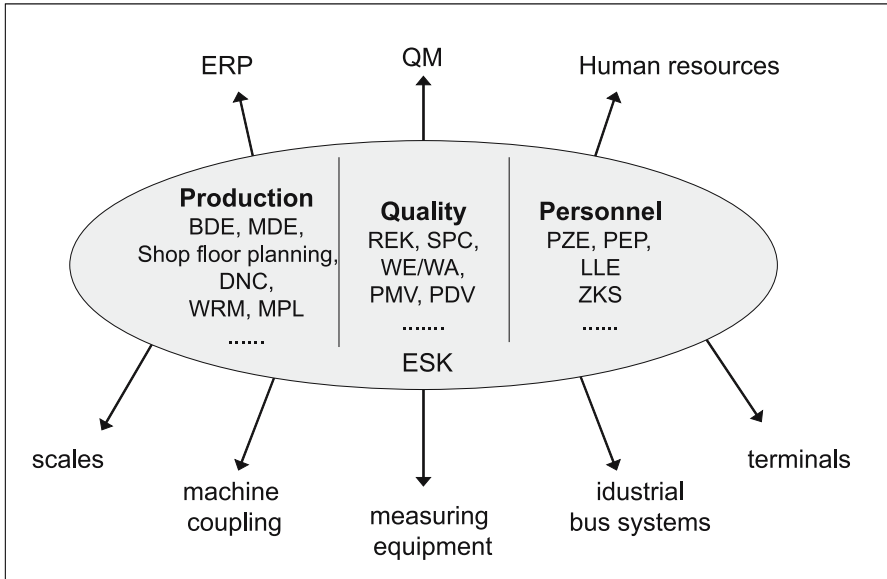
Fig. 1.10. MES function groups

Function group: production

The function group "production" can include the following modules:

− PDA: production data acquisition
  Here order- and person-related times and quantities are recorded. In the quantities a distinction is drawn between conforming items and scrap and also scrap categories. It is also possible to directly record material consumption and wear and tear on operating resources or process materials and associate them with the corresponding orders. The data which have accumulated over shifts, days or weeks are prepared correspondingly and then made available to corporate management applications. Detailed, real-time displays and analyses can be prepared in parallel with this for organizational functions in production.
− MDC: machine data collection
  Machines or other operational resources are managed in this group. Status data can be acquired manually and automatically via comprehensive systematics and subsequently be assigned to resources or resource groups. The data can then be supplied here not only by conventional terminals but also by industrial bus systems. Automated registration of quantities via counters, via balances, scales and comparable equipment should also be supported. The data so acquired can then be supplied in a condensed form to corporate management as a basis for effectiveness

statements but also, in their detailed form, permit analysis of points of weakness within production.

− Control station, planning table

These functionalities are the subject of vigorous discussion. On one hand, ERP systems via their APS functions offer planning possibilities within a shift. In the case of the control station and planning table modules in an MES system the emphasis is even more on preparing technologically feasible plans whereby the feasibility should also be assessed on the basis of a current situation. It is a waste of time making plans whose likelihood of being put into action is relatively low. From this it follows that the more detail and precision are required for planning, the more the plan must be related to current situations. Here the detailed planning modules of an MES should not only allow manual interventions which are simple from the operator's point of view but also offer support for fully-automated loading as well as simulation and optimization.

− TRM, DNC (tool and resource management and transmission of machine settings)

An MES should be able to manage tools and other auxiliary materials and equipment on a technically oriented basis. It is less a matter here of managing inventory (as is necessary and normal in the field of corporate management) but much more a matter of the technical state of operating resources, of current availabilities, of managing compatibilities with machines and the qualitative evaluation of these auxiliary resources. From the direct proximity to machine data collection, possibilities also emerge for preventive maintenance and thus for being an effective means of being able to reduce the occurrence of unforeseen downtimes.

− MPL: material and production logistics

A particularly important point in production is those materials which are in circulation or being held in interim storage facilities. Here a material and production logistics (MPL) module helps to keep an overview and to initiate transportation activities at the right time. A function of this kind should not be confused with a warehouse management function. Instead it is exclusively concerned with WIP (work in progress) – in other words, the materials which are circulating outside the classic storage facility. MPL supplies information about the quantities which are currently in circulation.

Function group: quality

The quality function group in the sense of an operative quality assurance should not be confused with the kind of quality management offered by,

for example, the major ERP systems and which is to be understood as a company-wide quality management system which plans and administers.

− SPC: statistical process control. SPC is concerned with connecting up measuring equipment to allow the specific acquisition of measured values, online comparison of the measured values against a set-point value, and the immediate output of warnings should the two values differ by earlier specified levels of tolerance. Naturally, SPC saves these random samples and permits tracking of certain trends. These trends can also be displayed directly online in the production facility and thus identify and prevent any production which might have malfunctions.

− NCM: non-conformance management. Here products which are the subject of complaints are traced back on the basis of technical aspects, manufacturing conditions, and input materials. Countermeasures are introduced and tracked via a response measures system.

− Incoming goods. In this context, the incoming and outgoing goods function is less the rating of suppliers as is normal in QM but rather the specific registration of delivered goods or of dispatched goods, the verification of batch numbering, and an online alarm facility if certain values are out of tolerance.

− Inspection equipment management is directly comparable with TRM from the function group "production". Here inspection, measuring and test equipment is managed and it is ensured that they meet the required standards and that they can also be used for the corresponding tests and inspections. This information must, of course, be available with immediate access during the inspection and testing procedures.

− PDP. An unusual feature in this context is the process data processing module. This implements the proposition that quality is not simply a property of the product but that quality also depends on the circumstances of production. For example, the pressures and temperatures used in the production process are of decisive importance to quality and for this reason an MES should also have the capability of acquiring process values directly, verifying them against tolerance or intervention limits, and in the event of errors recommending countermeasures.

Function group: Human Resources

− Staff work time logging. Throughout its history the human resources function group has always been very closely attached to corporate management. A series of elegant simplifications emerges for personnel allocation and personnel management in production when production-related personnel handling is mapped into the MES system. The staff

work time logging module covers clocking-in/clocking-out data as well as absence times and can also keep month-based time accounts where this would be useful. This approach would be particularly ideal when labor capacities in production facilities play an important role (as is very often the case) and these labor capacities have to be scheduled in a timely and efficient manner.

− Incentive wages. Staff work time logging in the MES deploys its strengths when bonus systems need to be implemented. Due to its direct proximity to production data acquisition, the incentive wages calculation module can very effectively create the connection between absence times and work order times and thus greatly simplify calculation of performance levels.

− Short-term manpower planning. With the short-term manpower planning module it is possible, in a similar manner to the planning table in the production function group, to obtain an overview of active personnel and to prepare the corresponding personnel schedules in an elegant manner or even with the aid of automatic functions, these schedules taking into account the loading situations on a departmental, company or plant level. Once again it is true to say that plans to be implemented at short notice can only be effectively drawn up on the basis of an up-to-date image of production.

− Access control. If staff work time logging has been integrated into the MES, one simple side-effect of this is that access control in the production facility can also be implemented via the access control module.

− Escalation management. Other mechanisms can be incorporated in the overall concept of an MES to make prompt reaction possible and, should limit values (what is meant here in the broadest sense is qualities, utilization ratios, downtimes, and so on) be violated, to make it possible to automatically implement the corresponding escalations or alarms and thus bring about a considerable reduction in how long faulty operational states last. An escalation management capability provides support here for production controlling and the operative level.

1.4.4 Technical requirements

Data storage

In an MES, data storage should always be right up to date technically and use standardized databases. One especially important point is the adaptability of an MES. Production systems are structured in various ways. Processes in different production systems cover a very wide range. A standard solution can scarcely be powerful enough for it to be possible to make all conceivable modifications via parameters. In addition, the complexity of