

The hybrid approach

Namur and VDI have both issued guidelines on the required functions of MES systems in relation to process technology and manufacturing technology. Both sets of guidelines exhibit weaknesses in relation to hybrid systems, but these weaknesses can be overcome by merging the two sets of guidelines.

Namur (an interest group for automation technology and process technology) developed its working paper NA 94 and the VDI (German engineers' society) its VDI guideline 5600 to form practical guides based on existing norms and standards to support users in an introduction to MES. Establishing ISA95 plays a defining role in both sets of guidelines (see inset) and can be differentiated in its control hierarchy (levels 2, 1 and 0) between three process categories:

- Batch processes
- Conti processes
- Discrete manufacturing

Both organizations come to the conclusion that there must also be differentiations in relation to the MES level (level 3). Even if the MES functions as such are identical, there are differences in specification and priority depending on the process category. Whilst Namur focuses on the requirements of the process industry in its working paper NA94 and associated documents such as Namur's recommendation NE59 for batch processes, VDI defines companies with an emphasis on discrete manufacturing as its target group for its VDI guideline 5600.

The classical understanding of MES is based on the perspective of discrete manufacturing processes. In comparison with the structures of the process industry, a large number of sometimes highly specialized manufacturing levels with local operator guidance function largely self-sufficiently and are linked together via transport systems. The recording and processing of production data across aggregates and plants down to real-time derivation of consequences for the manufacturing process can therefore only be implemented by means of an additional infrastructure – the Manufacturing Execution System. MES acts as a link between the individual manufacturing levels and the ERP level.

However, process technology dependencies of process levels in the process industry (for example mixing systems, fermentation or drying) inevitably necessitate a significantly higher degree of integration. This leads to a low number of process levels, but the communication between these is however fundamentally more complex. As a result, MES functions generally need to be integrated to some extent directly into the process control level.

Mesa model

- the origin of every MES-guideline

At the end of the 90s, Mesa defined a total of eleven MES function groups together with the company IT areas interacting with these such as SCM (Supply Chain Management) or ERP (Enterprise Resource Planning).

Mesa (the Manufacturing Enterprise Solution Association) had already posited at that time that MES comprised a combination of functions, the selection, degree of utilization and priority of which should be defined according to the application.

The ISA (Instrumentation, Systems and Automation Society) discusses the Mesa model in its ISA95 norm, building on it with a detailed data model and defining the individual functions and their interfaces to one another.

Norms: tough for users

Norms such as ISA95 form an established theoretical basis and are therefore of primary interest to system providers. They have no significant practical significance for users who wish to implement MES functions or improve functions that have already been implemented. It is material that no differentiation between Mesa and ISA is required, because there is significant concurrence in relation to functions. The level 3 functions defined in the ISA functional enterprise control model accord with the eleven MES function groups defined by Mesa:

- Resource management*
- Detailed production planning and job disposition*
- Materials management*
- Document management*
- Data acquisition*
- Job management*
- Quality management*
- Process management*
- Maintenance management*
- Product tracking*
- Performance analysis*

The Namur working paper NA94 contemplates seven MES functions from these function groups whereas the VDI guidelines derive eight MES tasks.

Hybrid overall processes

In reality, a large proportion of the production processes cannot be unambiguously assigned to one of the three categories, as they consist of many sub-processes, which when individually considered are batch processes, conti processes or discrete manufacturing processes. Therefore, MES implementation should not be oriented exclusively in accordance with Namur working paper NA94 or VDI guidelines 5600. Moreover, there is the opportunity to combine the two perspectives. This enables a more comprehensive understanding of MES requirements and thus effective collaboration with system suppliers in the definition and implementation of an MES solution.

In a working paper (*Computer&AUTOMATION* 2006, Vol. 9, p. 86) Namur confirms the view that MES functions need to be integrated to a significant extent in the process control level. Namur expressly refers thereby to the process categories defined by ISA, but also takes into account that there is an almost infinite number of forms combining conti and batch processes.

Depending on the type of operations (mainly conti, batch or discrete processes) various combinations of systems are suggested (for example PCS and LIMS). In this way, Namur clarifies that an MES system is not necessarily required in order to realize MES functions. Working paper NA94 describes seven MES functions with their sub-functions and the information flows between these functions. In addition, Namur provides insights in handling MES projects and technical system requirements necessary for MES solutions.

In its guidelines (*Computer&AUTOMATION* 2006, Vol. 8, p. 22ff.) VDI brings a fundamental aspect to the forefront – the tasks of an MES. For this purpose, the individual MES functions are compared with the various business processes in a matrix. Even if the VDI guidelines focus on discrete manufacturing processes, the methods for all types of manufacturing are likewise of interest. The comparison enables rapid and reliable answers to core questions when implementing an MES solution:

- How many MES solutions are required?
- Where is the optimal starting point?
- How can I target the best ratio of outlay to benefit?
- How quickly will I see a positive development?

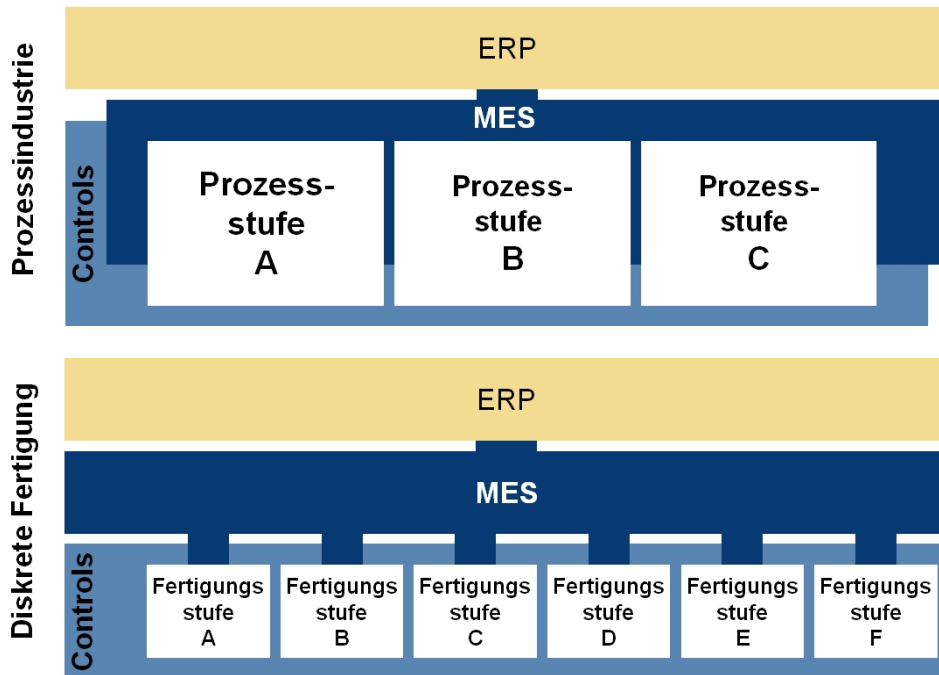


Positioning of norms and guidelines from ISA, Mesa, Namur and VDI in the ISA control hierarchy.

There is an entry in the VDI matrix for each MES function and every business process as to whether a particular MES task is relevant to a particular sub-process, resulting in the following:

- A list of relevant business processes ranked by the significance of MES to their processing; and
- A ranking of the MES task according to its significance in relation to all business processes.

The results reflect the specific requirements of the relevant application in relation to the deployment of MES functionalities. For further clarification, the relevance of the MES task can be weighted via a points system (for example 0 to 3). Such a tabular representation also highlights the differences between applications from the process industry or manufacturing industry, as the same MES function can have a completely different relevance to individual business process from the overall process.



VDI guideline 5600 looks at discrete processes with many self-sufficient manufacturing levels and superimposed MES (below) whilst Namur's working paper NA94 starts with few process levels with integrated MES.

Business processes are often pre-defined

The business processes to be examined generally already exist within the framework of quality management (TQM documentation) and are thus already individual in nature. This must be taken into consideration when implementing the VDI process. In addition, the selection of business processes should be wide, despite the fact that this may seem to entail additional outlay, for only in this way is it possible to log and take into consideration the hidden influences of business processes on production and manufacturing management.

		MES-functions / -tasks											
		(z.B. data acquisition, product conception & -tracking)											
step 1	Geschäftsprozesse (z.B. Arbeitsvorbereitung, Produktion, Optimierung)	→											
		primary process 1											
		sub-process 1.0	•		•	•		•	•	•	•		•
		sub-process 1.1	•	•	•	•	•	•	•			•	•
		sub-process 1.2	•		•	•				•	•		•
		sub-process 1.n	•	•	•	•	•	•			•	•	•
		primary process 2											
		sub-process 2.1	•	•	•				•	•	•	•	•
		sub-process 2.2	•		•				•	•	•	•	•
		sub-process 2.3			•	•			•		•		•
		sub-process 2.4		•								•	•
		sub-process 2.5			•	•	•		•	•			•
		sub-process 2.6		•	•	•	•		•	•		•	•
		primary process 3											
		sub-process 3.1					•	•	•				•
		sub-process 3.2	•			•	•	•	•	•	•	•	•
sub-process 3.3			•	•	•	•	•			•	•		
primary process 4													
sub-process 4.1		•		•			•	•		•	•		
step 2	primary process 1	4	2	4	4	2	3	3	2	3	2	4	
	primary process 2	2	3	5	3	2	0	4	4	3	4	6	
	primary process 3	1	0	2	1	2	3	3	1	1	1	2	
	primary process 4	0	1	0	1	0	0	1	1	0	1	0	
	MES-Ranking	50%	43%	79%	64%	43%	43%	79%	57%	50%	57%	86%	

The matrix of business processes and MES functions logs their relevance for individual business processes and where necessary their sub-processes.

The evaluation is based on the eleven MES functions of Mesa as VDI and Namur's perspective of MES tasks/functions that is oriented towards target groups does not always adequately address the requirements of varying production and manufacturing processes. Some examples follow:

- Namur does not consider Personal Management to be an MES function
- Data acquisition is identified by Mesa as an elementary MES function, but is viewed by Namur as a sub-function of production documentation. In turn, VDI sees data acquisition as an MES task in itself.
- Batch tracking is identified by Mesa as an MES function, perceived by VDI to be a business process and viewed by Namur as a sub-function of quality management.

Namur's working paper NA94 and VDI guideline 5600 both provide fundamental support in the evaluation of individual MES requirements. Despite the fact that both documents are oriented towards target groups, it is recommended that both documents be considered. Namur takes the coexistence of various process categories in the relevant process into consideration and gives valuable pointers for the technical implementation of an MES solution. The VDI approach of comparing the business processes of a set of MES tasks and evaluating them in relation to their relevance to sub-processes enables efficient definition of requirements that also takes hybrid processes into appropriate consideration when using the eleven MES functions defined by Mesa.

Further information:

www.proleit.de
www.vdi.de
www.mesa.org
www.isa.org