Redefining Semiconductor MES

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Pioneers of MES

How do you manage a semiconductor production facility? Most people in the chip industry would say: with semiconductor MES. With its complex processes and products that cannot be clearly seen with the naked human eye, the semiconductor industry began broadly adopting MES in the 1980s and 1990s.

Early systems such as Workstream and PROMIS emerged in the late 1970s. These products helped to define semiconductor MES. These were configurable workflow systems that helped to error-proof and ensure work was done in sequence. MES also eliminated the need for paper to record data that risked contaminating and damaging products from particulates.

By 1990, the term MES came into being. In 1992, I was the writer and non-aligned presenter for a MESA working group that developed the MESA model with 11 functional areas. We did a good job. We painted a vision with that model that has guided software developers and buyers.

New Definition of Semiconductor MES

The semiconductor business has changed radically in 30 or 40 years. The applications, products, processes, and equipment have all changed dramatically.[1] Fortunately, the MES business has also changed radically.

It's time to redefine semiconductor MES.

Error-proofing, track and trace, and data about the process are still central. However, today's semiconductor MES is broader, deeper, more usable, more configurable, and far better integrated than a decade ago. The best ones can keep up with the pace of change.

We see four dimensions in which to redefine semiconductor MES.

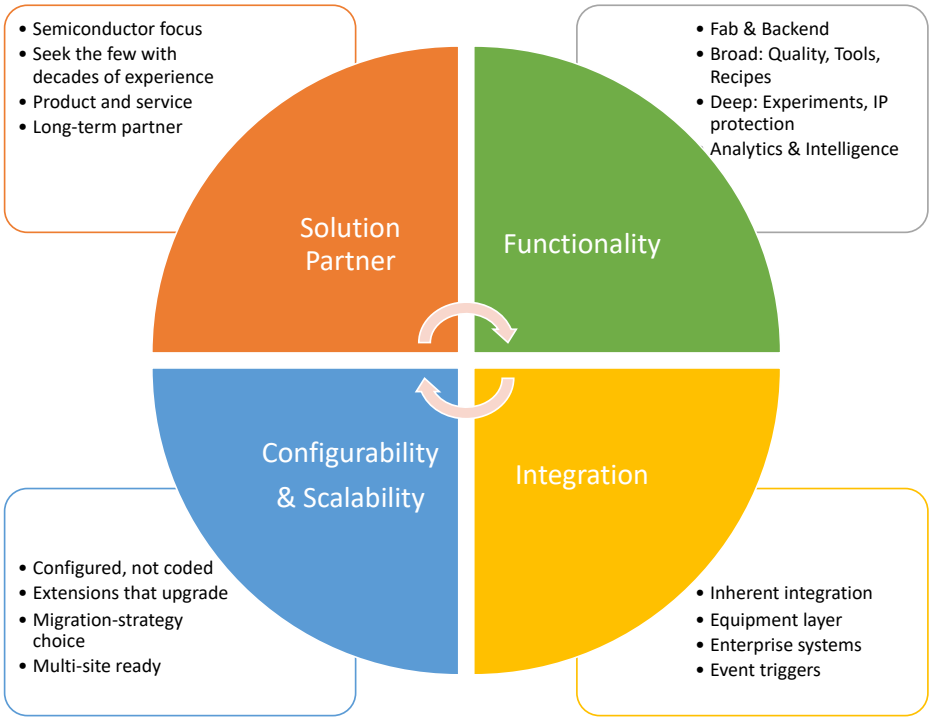
1. Functionality
2. Integration and data availability
3. Configuration and scalability
4. Solution partner experience

Functionality

With more complex products and processes over the years, semiconductor companies need advanced and expanded functionality. While early systems were workflow engines with a thin layer of track and trace and operator guidance, today's semiconductor MES has many functions and capabilities.

In the new definition, semiconductor MES is designed to support all aspects of fabrication, test, and assembly. While legacy systems tend to be good in the fab or the backend, but not both, some systems today support both. This enables a seamless handoff and greater IT and operations consistency.

Another function in the new definition of semiconductor MES is specialized support for experiments and NPI. Rather than running special lots outside the system, the MES should support engineers in defining the unique routes,



splits, merges, specifications, and reporting of these unique lots. These lots are controlled and recorded but run without interrupting lots going through standard processes.

Quality management is now an integrated part of semiconductor MES – this includes not only NCRs and support for 8D, but also SPC. As a process is ongoing, MES measures quality and details of where it is trending and triggers OCAPs and NCRs. Tool, equipment, reticle, and recipe management are also all part of the MES definition.

MES should also have mechanisms to protect the IP of the products and processes it handles. Whether it is your IP or a customer's or partners, look to protect it with cybersecurity capabilities. With legacy MES, getting data out of the system isn't easy once it is collected. Today, MES data should be easy to access and available as reports, for analytics, and real-time status and performance dashboards.

testing processes. They can capture enormous amounts of tag data from equipment, controls, or sensors. A value of X ohms ACR or ACZ (Alternating Current Resistance/Impedance) may be good at one point in the battery assembly process but bad at another point in the process. Only an actual MES can provide the process-flow context to make sense of the data a simple historian or integration system may be logging. In addition, MES is designed to help prevent errors or guide each aspect of the production process.

MES can use data from a historian to manage the entire process, including steps where data is manually entered or reviewed.

Integration

Historically, one of the most significant challenges for MES implementations, deployments, and maintenance is integration. Our research shows that most companies spend substantial resources integrating and maintaining integration between MES, quality, maintenance, scheduling, IIoT, and equipment data. With broader functionality in the MES, much of what needed integration in the past is now all in a single application architecture. Some semiconductor companies have replaced dozens of legacy systems with a single MES.

Even when you still use disparate systems, the MES should have a way to integrate with those systems effectively. When the other systems are in the fab or backend, the speed of data flow can be crucial, so event-based integration schemes can work well.

Equipment integration is crucial for full benefits from MES. The semiconductor industry has long had an equipment layer separate from MES. Yet the new definition of MES includes that integration layer as well. Ideally, it is a low-code or no-code process to configure integration with not only SECS/GEM but any other equipment protocols a facility might use.

Integration to enterprise applications such as ERP is ideally just as straightforward as to machines, with low- or no-code approaches that the team can configure to ensure data flows as needed. MES that is ready to integrate into other enterprise applications such as PLM and CRM, can also support semiconductor companies' innovation and customer-facing operations.

Yet, the real-time data from MES moves quickly. Integration based on event triggers enables better visibility into production and more timely reporting and understanding throughout the company. Integration is a crucial foundation for MES to deliver long-term benefits and should be a central consideration in selection.

Configurable and Scalable

As early MES adopters, semiconductor companies have suffered. They had to heavily customize those MES because they were incomplete. The result often was that they could not upgrade and keep on current versions or technologies. It is common for legacy semiconductor MES to be written in languages and run on operating systems and hardware that are no longer supported.

In the new definition of semiconductor MES, the system is configured with business logic. No coding or skilled IT developers should be necessary to set up the system and keep it current. This typically is called a low- or no-code approach.

Another element of the definition needs to be a way to prevent getting stuck on any version of the software. Configuration that does not entail customized code is fundamental to a system you can successfully upgrade. While some solution providers have made certain products obsolete, other MES providers have consistently upgraded their systems over the years, ensuring customer continuity.

In the new definition of semiconductor MES, it is also possible to run multiple sites from the same MES. Having one instance and configuring it for each site should be possible. This supports IT efficiencies and mergers and acquisitions or shifting products into and out of foundries or contract partners.

Experienced Partner

One aspect that has remained the same is that the semiconductor industry has specialized products, equipment, requirements, terminology, and recursive processes. Only deeply experienced MES solution providers are likely to have the capability to ensure customers succeed.

Semiconductor MES is specific and more complex than MES for many other industries. Only a few current providers of MES have deep experience in the semiconductor industry. These few semiconductor MES suppliers who keep their products moving forward can deliver significant benefits.

Look for both product and consulting or service expertise. We can't necessarily define consulting as part of the new semiconductor MES. However, having skilled and experienced consultants who understand the MES and your specific industry issues may well be a vital enabler of both short-term value in migration and long-term profitability and innovation.

MES for the Next 30 Years of Semiconductor Progress

Those old enough to remember those very basic early green-screen MES may also remember how exciting they were back then. Yet we need to be sure we're moving with the times.

Define semiconductor MES as something more like the original vision of MES. This is much broader, deeper, more fully integrated, and easier to integrate, configure, and scale than early semiconductor MES. By this new definition, MES will serve your fabs, backends, and enterprise well for years… and maybe decades.

About the Author

Julie Fraser joined Tech-Clarity in 2020 and has over 35 years of experience in the manufacturing software industry. She is an enthusiastic researcher, author, and speaker. She has a passion for manufacturing progress and performance gains through Industry 4.0 strategies and supporting software technology.

Julie is actively researching the impact of digital transformation and technology convergence in the manufacturing industries, with a focus on supply chain and plant floor and how to use manufacturing data in conjunction with data from offices, labs, and the ecosystem.

About Tech-Clarity

Tech-Clarity is an independent research firm dedicated to making the business value of technology clear. We analyze how companies improve innovation, product development, design, engineering, manufacturing, and service performance through the use of digital transformation, best practices, software technology, industrial automation, and IT services.