How Applying the ISA88 Standard Today Will Prepare You for a Transition to MES Tomorrow

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ABSTRACT

Manufacturing Execution Systems (MES) have the ability to provide obvious value for manufacturers, and many manufacturers are spending millions evaluating the different technology options available. The ANSI/ISA-95 (S95) standard has been adopted by many of those MES vendors, making messaging between the business layer and the control layer easier to understand and to manage. But standards at the control layer have been less defined and many manufacturers have not invested in adapting to the ANSI/ISA-88 (S88) approach, on which the ANSI/ISA95 terminology and foundation are built. Is the adoption of S88 a prerequisite to successfully adopting S95 standards and subsequent MES solutions built on that standard? If you have built your control systems without consistency or standards, how much will you need to reinvest in order to make MES a reality? How do you implement MES if your current automation and batch management controls have been built without a consistent standard?

WHY MES IS NECESSARY

Manufacturers face huge challenges in today's marketplace. Margins are squeezed from every angle, food safety and regulatory concerns push the limits of quality departments, and "Powerful Retailers" are constantly redefining the term "Everyday Low Price." In this new world, efficiency, product genealogy, and cost saving challenges are critical to the overall viability and success of manufacturers. As manufacturers wrestle with these challenges, often the first question asked is "Where do I begin?" The key to solving the manufacturing efficiency challenge can be found by gaining the ability to accurately envision what is happening on the factory floor.

This visualization capability can be achieved through the implementation of the selected facets of a Manufacturing Execution System (MES). MES provides the ability to understand the relationships and potential for efficiency savings in areas such as scheduling, inventory control, product traceability, downtime, uptime, product specification management, and key performance tracking.

THE SUCCESS FACTORS

Often the largest hurdle to conquer in the implementation of MES is mining all of the relevant and available data from the factory floor. The data can come from a myriad of sources:

- Automated batching/processing systems
- Human entry
- Scanning of barcodes or RFID tags
- SCADA/HMI applications
- Process instruments
- OEM equipment

The implementation of MES requires careful thought and planning to overcome specific process and cultural issues that each manufacturer faces. These challenges are not barriers to implementation but rather the items that map the path to a successful deployment. Ignoring these real world facts and specific issues is a recipe for failure.

As the analyst and industry gurus continue to forecast exponential growth in the use of Manufacturing Execution Systems, the practical world continues to search for a definition of just what is MES. Every vendor has their description and we will not try to continue that debate here. The practical approach is that most manufacturers will enter into their own MES initiatives based on their own priorities and under their own terms. For some that will mean a focus on information visibility or regulatory compliance. For others it will be about material handling, production scheduling, or one of the other core function sets of MES.

INVESTING IN ISA88 FOR A FUTURE VISION OF MES

The one thing we can all agree on is that MES is about completing the link between the factory floor (S95 Level 1 and 2) and the Enterprise Resource Planning System (S95 Level 4). MES normally has two primary objectives:

1. To provide the business functionality that you do not get from the control, SCADA, or ERP systems.

2. To enable communication between the factory automation system and the ERP.

While the S95 standard has provided a template for how these two objectives can be achieved, it has not solved every problem. As an analogy, think of the ERP layer as a traveler that speaks German, which is appropriate since the German company SAP dominates that world. Next think of factory automation as a local resident of Spain that speaks Spanish. To enable interaction and meaningful communication between the traveler and the local resident, you need to provide an interpreter. This is the job of MES.

Following the same analogy, here lies the real problem. The truth is that on Monday the traveler is in Portugal and needs to speak Portuguese, on Tuesday it is off to China to speak Chinese, on Wednesday Swahili, Thursday Japanese, and so on.

This problem is not really the ERPs fault. The control system is 50 years old and learned to speak "ladder locic" from birth. As the control system grew up, different teachers were brought in to teach and modify it. But every teacher had a different dialect approached things differently, and left their own mark of influence. It is not uncommon to see the control system littered with various OEM PLCs, different communication protocols, and various approaches to the software code that make it all work.

The truth is that this approach has worked for the past 30 years because we have not been overly concerned about the ability for one system to communicate with the other. The function of the control layer has been to maximize production efficiency, and it has done a fantastic job of accomplishing that function. Historically people were relied upon to fill the communication role with paper and processes. Now that the manufacturer has to evolve their business and make it work within a tighter financial model of fixed pricing and squeezed margins, the only way to succeed in this business climate is to achieve a huge improvement in efficiency. This improvement in efficiency is only going to occur by identifying and managing waste and inefficiency.

In order to realize the benefits of MES, the information must be collected from the PLC and SCADA systems already in place. The questions are:

- "Have they been engineered with that in mind?"
- "Do they collect data?"
- "Is the information from one line, system, and plant consistent with another?"

STANDARDS

The moral of the story is that the control system layer, for most manufacturers, has been developed without the use of standards. It has been built with the creative influence of dozens of operators, vendors, and engineers. It is not unusual to find PLCs from multiple vendors executing software code written by multiple people over many years.
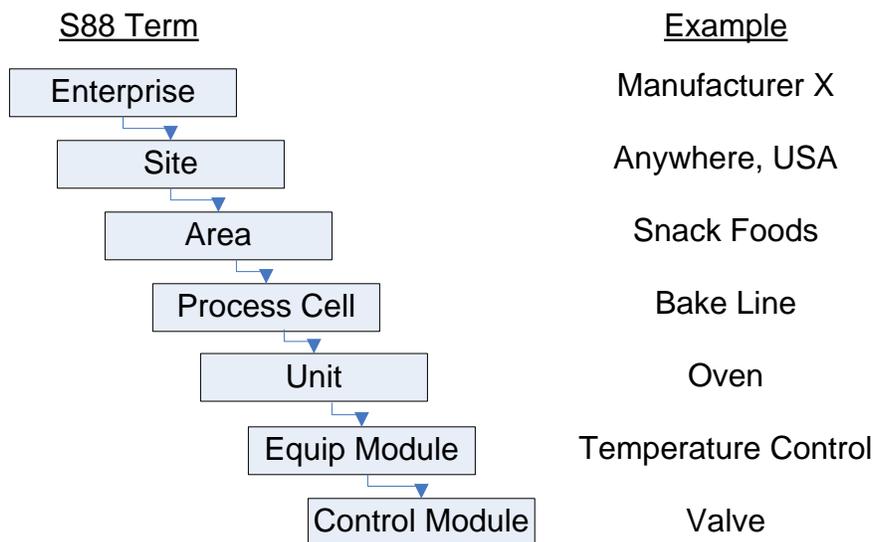
Aside from S95, most MES systems that are designed to support batch processing have structured their design around a functional approach to the batch process. For many, this approach was built on the predefined methodology of the S88 physical model. But even if it is not, applying the S88 standard is a natural application of standards for how your control systems are structured. Since S88 is based upon a universal physical model, the standard applies equally to discrete, continuous process, and to batch processing alike.

MAPPING THE PHYSICAL PROCESS TO THE BUSINESS PROCESS

If one of the objectives of MES is to allow communication between the ERP system and the control system, then a logical first step to making MES a reality will be the mapping from one system to the next. Before you even talk about mapping information, you must start your mapping at a higher business function level. You also need to consider that MES offers the opportunity for the integration of many different manufacturing plants into a single corporate ERP and supply chain management system. Therefore, logically breaking down your manufacturing operations into a common physical designation is critical to accurately mapping the business process and planning MES into your future.
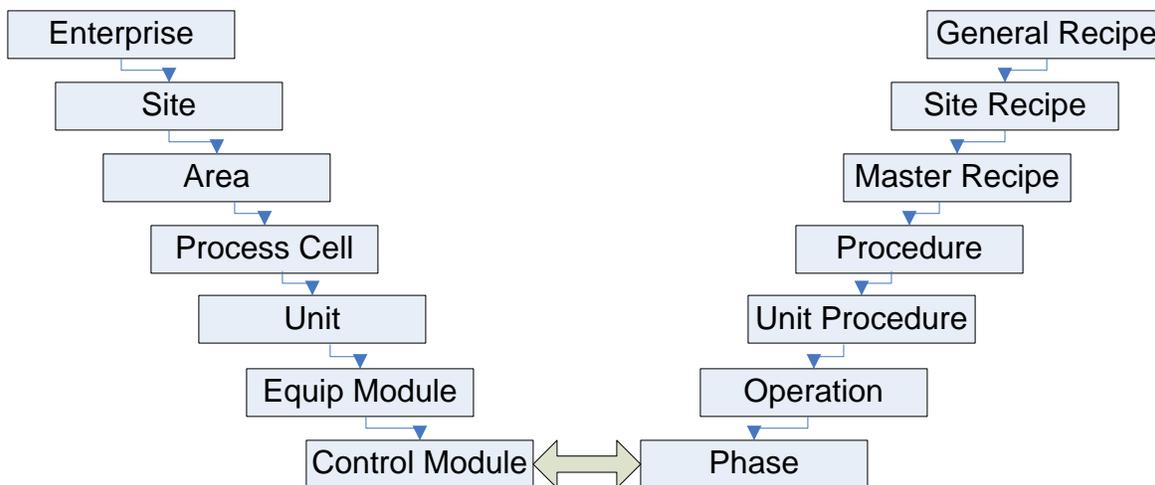
No standard is better to break down your physical manufacturing layout than the published S88 standard "Physical" model. It appears so simple that it is hard to understand why everyone is not doing it. By using the S88 physical model, you can take every production line and break it down for easy identification to the component level. Doesn't it make sense that using a standard to physically designate your production capabilities is a natural progression to allow the data to communicate in the future? The S88 physical model coupled with the S88 procedural model allows and enables the flow of complete data exposure. These standards allow the consistent mapping of systems and information across the corporate global enterprise.

S88 Physical Model

S88 Term	Example
Enterprise	Manufacturer X
Site	Anywhere, USA
Area	Snack Foods
Process Cell	Bake Line
Unit	Oven
Equip Module	Temperature Control
Control Module	Valve

The S88 Physical Model provides the structure and standards to leverage the data imbedded within the Procedural component of S88. This Procedural Model tightly integrates with S95 MES standards.

S88 Physical and Procedural Model

Physical	Procedural
Enterprise	General Recipe
Site	Site Recipe
Area	Master Recipe
Process Cell	Procedure
Unit	Unit Procedure
Equip Module	Operation
Control Module ⟷ Phase	

The data imbedded in the procedural phases includes many of the components of MES. Information such as Start times, End times, Ingredient usage, Tolerances, Source lots, Batch numbers, and Equipment trains are all typically included as phase parameters and subsequently information enabled. These points are the building blocks for relevant MES data.

THE REAL WORLD

As a manufacturing systems integrator, we are constantly amazed at the number of manufacturers who will ignore the use of an S88 batch approach for a new or upgraded production system. The purpose of this paper is not to argue the values of S88 from a batch control and recipe management system. The World Batch Forum successfully defines those values in everything that they do. If a manufacturer can successfully argue not to change their existing approach to S88 for those business reasons, can anyone justify that a lack of standards is going to make forward progress expensive, if not impossible?

CHOOSING AN MES STRATEGY

The use of the S88 physical model is defined here to establish a basis for choosing and implementing an MES strategy. You can summarize this philosophy into a basic "best practice" approach that expands further on that foundation. This foundation includes a six phase approach to achieving operational efficiency through the implementation of MES based on standards of S88 and S95.

> **Step 1** - Define the factory business requirements in terms of data and business objectives from a corporate standpoint.
>
> **Step 2** – Map the business process from one system to another and complete an assessment of the difficulty in achieving the data and the ability to act on the data you will ultimately collect. (Have the systems been developed with standards that can be leveraged? Are there legacy systems which must be replaced? Is the existing system documented and supportable?)
>
> **Step 3** – Establish priorities and identify areas where a rapid implementation can provide an immediate business return on investment.
>
> **Step 4** – Implement technology that will enable the collection of critical data from various points across your production line. (If the plant has a modern automated production line, then this is normally a simple matter of collecting data from the existing control systems. If not, data can be collected by installing a series of sensors or other data collection devices.)
>
> **Step 5** – Provide the data to the different factory managers in a format that empowers them to achieve their business goals. This can be as simple as a printed report, an interactive web based computer interface, a more robust manufacturing management application, or a complete MES system.
>
> **Step 6** – Utilize the requirements gathered from Step 1 and the data gathered from the subsequent steps to create and implement a longer term strategy.

The six phase MES approach above is the simplest and most cost-effective way to begin collecting data about an active production line and to eventually maximize the management of manufacturing systems. Even if the plant manager is waiting for corporate to decide on a long term MES implementation, the approach practically guarantees that the solution will be reusable in the enterprise long term.

Advanced Automation

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