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Seamless Data Integration:

# Unlocking The Hidden Capacity Of Process Plants

Much has been made of the benefits of open and interoperable fieldbuses, but not enough attention has been paid to data structures.

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In an ideal world, all communication and record keeping in a plant, from production floor to boardroom, would be seamless, immediate and error-free. A good start towards this end is embodied in ISA-95 (formerly known as SP95), the international standard for the integration of enterprise and control systems, although, this has not yet spread to all companies or solved all problems.

ISA-95 divides plant activities into four levels (five, if you include Level 0, the physical production equipment itself). Starting at the highest (enterprise) level, these are:

- Level 4 — This is the ERP level. It is concerned with business logistics management, including plant production scheduling, shipping, receiving, inventory and so on. The interface between Level 4 and Level 3 is handled by the business process information network. Information exchanged includes production capability information, product definition information, productions scheduling and production performance.
- Level 3 — This is the MES level. It is concerned with manufacturing

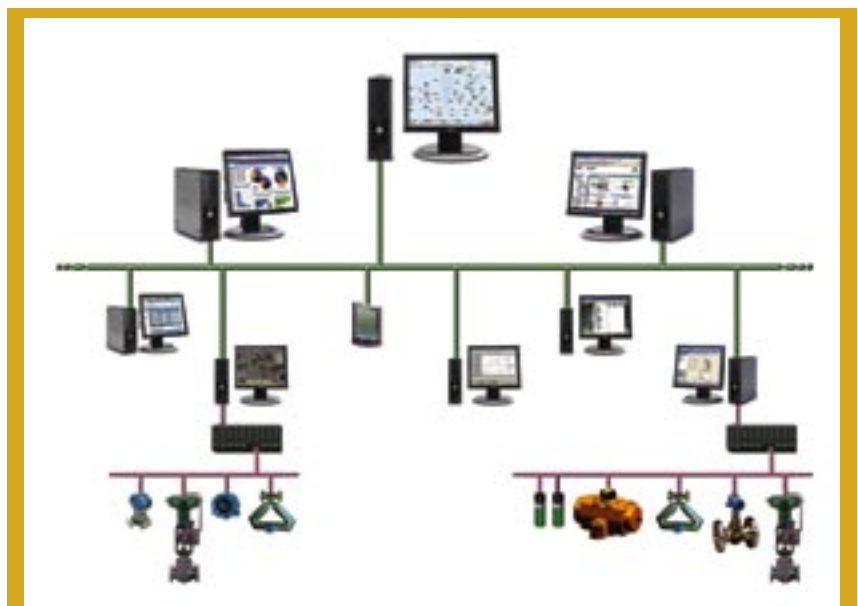
operations management: dispatching, detailed production scheduling, production tracking and so on. Major activities at this level include maintenance operations, inventory operations, production operations, quality operations, management of documentation, management of security, management of configuration, and management of compliance. Equipment status maintained/validated by MES also includes other systems such as LIMS, WMS and CMMS. Level 3 connects to Level 2 via the operations information network.

- Level 2 — This level is concerned with the actual manufacturing process, be it batch control, continuous process or discrete control, and in some ways can

be considered as two levels. The upper part includes equipment managed/monitored/controlled by HMI, SCADA and batch systems, which connect via the automation networks to the equipment below it that provides operational control: PLCs, DCSs and packaged systems. Level 2 interfaces to the level below it via a number of discrete and process device communication networks.

- Level 1 — This level consists of the physical interfaces between the control equipment and the physical machinery. Equipment includes I/O, actuators and sensors.

With such an orderly arrangement, and with the appropriate networks in place, one would think that information would flow smoothly from level to level. At levels 1 and 2 much of it does, or plants would not be able to operate at all, but there are still significant difficulties, particularly between levels 2 and 3, and even within level 3. Each requires information from a separate source – typically in a different form. Some information is found in databases, some in paper records. The databases tend to be disparate, and paper



Level 1-4: Device to Enterprise

Emerson



*Linking databases can be a challenge*

records are notoriously subject to human errors and omissions. This is a long way from the goal of tying together process control and equipment management, and then integrating that into manufacturing operations, like recipe execution, materials management, asset management, and so on.

### Linking Databases

There have been attempts to link individual systems, like LIMS with batch systems, by simply doing database queries. Unfortunately this method always poses a great challenge as the individual system does not necessarily provide information like the context of a batch, and even when the link is successfully developed and working such one-off, site-specific solutions are not transportable from one company to another or even from one site to another, within the same company.

One example was a pharmaceutical plant that had built up about 250 different spreadsheets, databases and other software tools to meet their record keeping needs. As one can imagine, trying to maintain 250 different applications, connect them together and ensure that the batch record context was consistent was

a major headache. It simply didn't work.

### Paperless

One of the biggest steps forward would be to get away from paper. The paper system fosters missing data, errors, inaccuracies and wasted time. Even the physical amount of paper can be a problem. A recent conference on MES issues included a presentation from a company that produces pharmaceuticals based on the genetic makeup of each individual patient. The company tracks each person and the drugs made for that particular person through its manufacturing process.

The analysis has to flow



*Paperless record keeping*

through the system as the drugs are manufactured in order to prove efficacy and comply with multiple regulations, but in doing so the company creates about 1.5 to 2 ft of paper per person per product – all of which must be managed. The company hopes to grow to the point that it processes drugs for perhaps 1000 people every two weeks. It would have to go paperless, if for no other reason than that it will not be able to buy enough warehouse space just to manage the paper.

While not every company is faced with 1.5 ft of paper per production lot, it still generates a great deal of paper involving materials management, laboratory information, training records that have to be checked or maintained, equipment logs, process control system logs and things of that nature. The systems that generate them are typically provided by different vendors because nobody really has an integrated or total solution. Any realistic solution must somehow encompass all those disparate systems or islands of automation.

One of the issues, particularly in regulated industries, is the time required for a review of paper batch records. It can exceed the manufacturing process time by two, three or more times. A 14-day manufacturing process might require two months to review the paper batch record before the product can be released. Meanwhile the product sits in a warehouse unsold while the clock on expiration starts ticking.

### Error Rate

Another major problem with paper records is the error rate. It has been estimated that around 95 percent of paper records have errors of some kind before being reviewed and corrected by the manufacturing people and moving on to the quality department. We did a study in which we found that a large percentage – 60 percent or more, probably – of these errors were omissions and transpositions.

All companies have processes in

place to catch errors, so when the product goes out the door all of those things have been addressed, but such correction takes supervisor time and operator time – anywhere from four hours to a day or more – that could be spent better on producing output. A right-first-time rate in the single digits is unacceptable.

If the errors cannot be corrected, or the missing data cannot be found, the product must be dumped, although no company is likely to reveal how often that happens.

### Value Of Real-Time

The best answer would be to have all needed data in real time, and to be able to verify things proactively using electronic work instructions that prevent human error and streamline production. This is to avoid problems instead of reacting once they've happened.

An example is verification of training. Before an operator in a regulated industry can carry out a process, that person has to be trained on it; if not, then technically there is a deviation.

Yet today, because of the overhead and manual effort involved those checks are often treated as a deviation or an audit after the fact, and it is assumed that those records are maintained and that all needed training has been done. With modern paperless systems it is possible to check those in real time before the action is taken, before the activity is performed. That is seldom feasible in a paper world.

Applying the same methods to a LIMS, the automation system should take over management in real time, handling the submission of requests, tracking which ones are still outstanding, and incorporating the results into the record so that everything is available for the review process with no missing information and no missing reports.

### Unlocking Hidden Capacity

As an example of the timesavings possible with proper information handling, we are familiar with a

company that uses a fermentation process to produce an intermediate material that is considered as internal or mini inventory and must be analysed before being used.

Currently this takes one or two weeks, but the company plans to go to zero review time. The automation process will allow the company to take the risk and do the review process after release. If there is a problem they will catch it later on, but the odds of that happening are so low that they don't expect it to be an issue. They're saving one to two weeks per production cycle in the manufacturing process.


As a general rule, comparing normal cycle time to best-case cycle time, consider a product that, under normal conditions, takes 120 days to go from receipt of order to delivery. Given a sufficiently urgent rush order, that time might be cut to perhaps 35 or 40 days. By adopting paperless methods it should be possible to bring the average cycle time down close to the rush-job cycle time; in general it means at least a 50 percent improvement in release cycle time.

On the manufacturing side there may be a 15 or 20 percent reduction in work effort, simply by the reduction in the cost of quality. And similar savings occur in maintenance.

Because of the way the automation systems can track productivity or equipment utilisation it's often possible to extend maintenance times to close to the theoretical maximum; for example, if equipment calibrations are good for one year, the ability to track and monitor makes it possible to move from the usual six-month or nine-month cycle to close to the one-year.

### Single Source

When going for such improvements it is a good idea to stick to integrated systems provided by one vendor instead of many vendors and trying to integrate them together. This will minimise the number of interfaces to maintain and the change control needed as those different solutions migrate or upgrade.

Working with different vendors requires significant time and effort to resolve conflicts, overlaps and holes. Choosing a single source makes it possible to put all that burden on the vendor, which lowers your risk, makes it easier for you to operate, and lets you focus on the things that you care about – how your plant runs versus how well your systems talk to each other. 

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*Unlocking the hidden capacity in the plant*