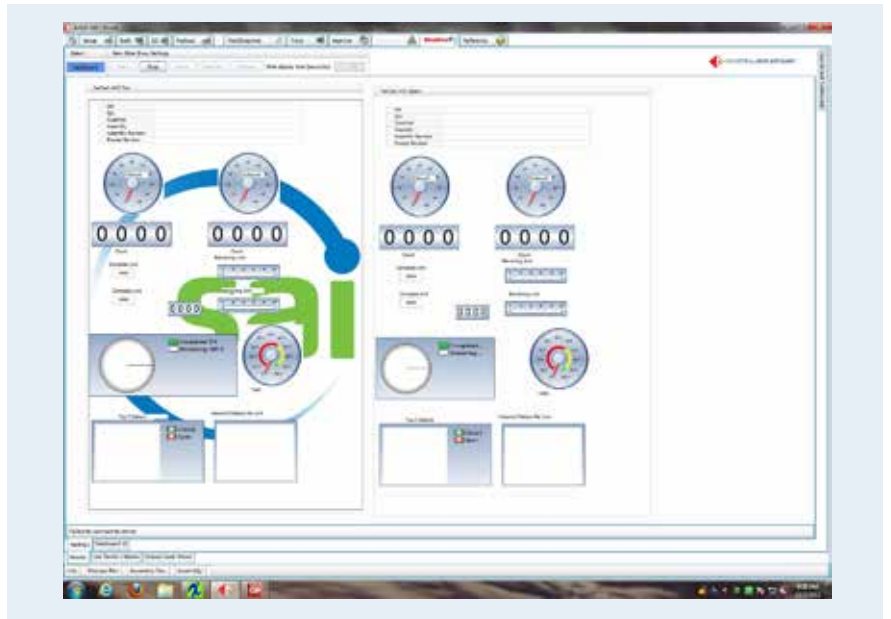


# The Paperless Factory: Using technology to improve efficiency in high mix and CTO production

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Regional EMS provider Spectrum Assembly, Inc. (SAI) uses a combination of manufacturing execution system (MES) software and interconnected production equipment to speed project launch and line changeovers and efficiently manage a wide range of product configurations. This article discusses the areas their team saw as critical in the automation strategy, and the lessons learned and benefits gained in migrating to a paperless factory.



Offering a competitive U.S. manufacturing solution requires more than simply being able to build quality product at a competitive price. It also requires creative solutions that eliminate hidden costs and inefficiency. SAI considered that issue carefully in deciding to migrate to a paperless factory.

Most of the contractor's projects are low-to-medium volume and higher mix. Some have variable or seasonal demand. Projects include printed circuit board assemblies (PCBAs), cables and harnesses, and box build. Some products are highly regulated and the contractor is certified to ISO 9001, ISO 13485 and AS9100.

There were several goals in the system selection strategy:

- Reduce machine programming time
- Enhance process consistency
- Reduce line changeover time and documentation integrity
- Support traceability and device history recordkeeping requirements
- Enhance quality data collection and reporting capability.

The contractor opted to use Aegis Manufacturing Operations Software in conjunction with MYDATA manufacturing equipment. The Aegis installation includes the Iview, Itrac and IQ modules. In addition, to standardizing on MYDATA placement equipment, the contractor uses the MYlabel system and humidity-controlled component storage towers which link to the MRP system.

## Programming support

The system allows offline machine programming, which frees up production resources. Programming that used to take 3-5 hours on the floor using production staff now takes the engineering team less than an hour.

It also shortens project launch time as pick and place and AOI programming can be driven through the same data import, and makes engineering change order (ECO) implementation faster. In addition to cutting time and resources, it also eliminates the human error that can occur when an operator is interpreting engineering drawings and bills of materials (BOMs).



of the time it takes and the potential for mix-ups in revision levels if paper versions aren't carefully controlled. In the current system, when Engineering releases a document through Aegis it goes to all computers able to access that document. When an engineering change order (ECO) is implemented all documentation is immediately updated and the revision history is annotated.

The contractor has added touch-screen LCD monitors at each workstation to support the conversion to a paperless environment. In addition to enhancing documentation control, it also speeds line changeover between products, since work instructions can be changed in seconds.

Additionally, process instructions are much more detailed. The digital visual aid is completely interactive. Operators can quickly reference and validate questions on-the-fly or enlarge the drawing by touching the screen displaying work instructions.

Every work order released has the relevant standards and customer instructions attached to the file. This allows easy lookup of product details at all levels of production. This has created a little culture shock on the production floor. In paper-driven production environments, it isn't unusual for some operators or lead people to become experts on certain products or processes, and as a result they become the advice-givers to those with questions. In this system, the

**Process consistency**

Contract manufacturers tend to be very service oriented and sometimes that "can-do" attitude results in operators or supervisors willing to bend or break rules to meet scheduling goals.

This issue has never been much of a problem in the PCBA processes because quality issues become immediately apparent if the process isn't followed, but it can be an issue in secondary processes and system assembly. The new system doesn't allow on-the-fly changes to any part of the process, which creates an efficient, yet disciplined process flow. Process configuration and shop floor layout is locked down by engineers. Work-in-process (WIP) can't be moved out-of-order. WIP must travel by process configuration and be released by each station. If a prior stage hasn't been satisfied, the next station is locked out.

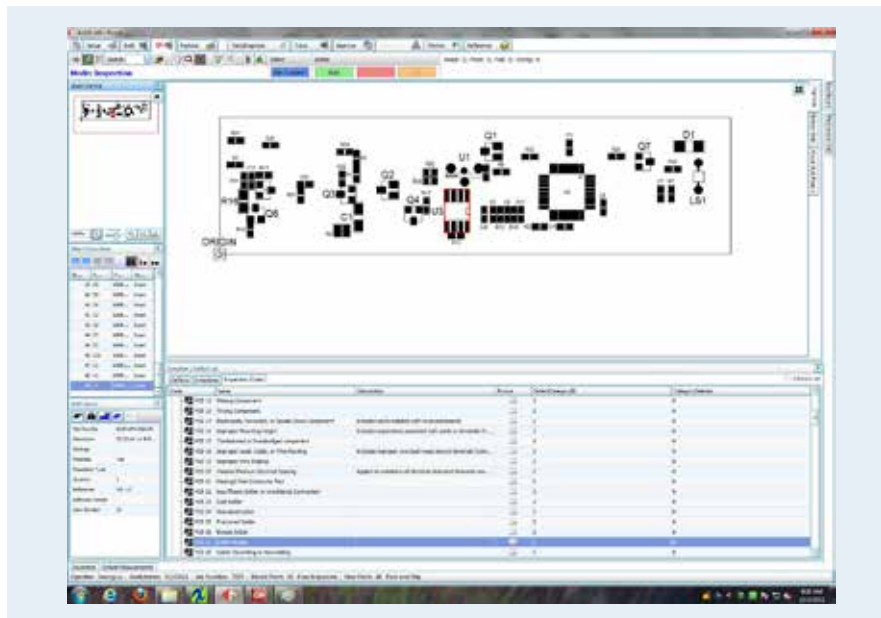
In addition to the quality benefits inherent in minimized variation that come with consistent processes, this additional check and balance supports ISO 13485 and AS9100 requirements.

The engineering team at SAI has also discovered that while Aegis tools were designed for PCBA manufacturing, with slight adaptations they can also be used to support work instruction and process development for cable assembly and box build.

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**Reduced changeover time/ documentation integrity**

In a paper-driven factory, work instructions are distributed and collected as each product is built. In a high mix environment this is an inefficient process because





*“In the TransferAssist model, the contractor’s team identifies gaps in the documentation and works with the customer to construct the needed documentation.”*

entire team associated with a product has access to all the information needed. This eliminates the potential for misinformation that can come when information is disseminated by a few expert operators.

However, this added level of detail does come with a tradeoff. Projects must start with a good documentation package. The incoming package needs to include digital drawings, a complete and accurate BOM and clean instructions on the secondary operations or the system flags deficiencies. Not all customer packages meet these requirements, particularly when a customer is new to outsourcing. The contractor addresses this issue with a service package known as SAI TransferAssist. In the TransferAssist model, the contractor’s team identifies gaps in the documentation and works with the customer to construct the needed documentation.

MYDATA component storage towers are used in the SMT lines for point-of-use stocking. The towers are humidity-controlled. This enables partial reels or

open packages to be stored near point-of-use in a controlled environment. The towers are computer-controlled which also helps eliminate potential “pick” errors which can be possible in manual kitting from a warehouse. Operators request the parts from computer files and load machine feeders as the tower releases them.

### **Traceability/device history recordkeeping**

Highly regulated products require detailed recordkeeping. ISO 13485 and AS9100 have requirements in this area. The controls on process flow also track the work order through production. Each operator has a user name and password to login to the system. At a work order level, the system tracks the individual products produced, the inventory associated with the product, the processes completed and the operators associated with producing the product. The data is stored for future reference.

### **Quality data collection**

The paperless approach has several advantages from a quality data collection standpoint.

With the Aegis iQ module an operator with a touch screen can tap any component on the board and access and/or print all recorded defects associated with that part. The operator can also enter new defects in database as they are identified. Defects can be assigned to the pin, the component or the board. Engineering can set alarm points that trigger if a certain number of defects are entered and emails are sent to a designated distribution list such as the lead quality engineer associated with that product.

Traceability and device history record-keeping are also supported. The system can be configured to track down to the component level, if required. Since processes are tracked at the work order level, quality can review defect trends associated with a specific machine. This can be valuable in Six Sigma projects.

As shown above, the benefits of a paperless factory go far beyond faster programming or line changeover. A well thought out paperless factory structure supports workforce job enlargement, continuous improvement initiatives, robust data collection and process control. Today’s tools offer contract manufacturers the ability to cut time, better utilize existing personnel resources and improve quality. The extent to which that occurs depends on the creativity of the deployment strategy.

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