# Andea GUIDE: MES IN COMPLEX ASSEMBLY

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# WITH GREATER GROSS MARGINS COMES GREATER RESPONSIBILITY.

Manufacturing complex, customizable products involves longer production cycle times, while production control remains the top priority to ensure efficiency and quality of the end product. For that reason, an increasing number of complex manufacturers are starting to realize their current systems are no longer sufficient to support their continually evolving production needs.

Implementation of a Manufacturing Execution System (MES) software can help streamline the production process, and it's quickly becoming the go-to solution for complex manufacturers. An MES solution such as Apriso tracks and reports production process data in real-time, enabling manufacturers to act upon it quickly and efficiently.

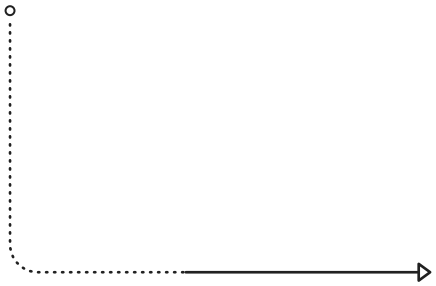
But enough of the theory - let's answer some of the most pressing questions regarding the use of MES in complex manufacturing environments.

# HOW DO YOU TYPICALLY HANDLE CHANGES TO THE PRODUCTION ORDERS AND ASSOCIATED WORK INSTRUCTIONS ONCE A PRODUCTION ORDER HAS BEEN STARTED IN APRISO?

When it comes to complex manufacturing and especially, Engineer to Order (ETO) type of business where we're dealing with low volume production in highly specialized manufacturing environments, executing a production system defined by Process Authors can be a challenge in itself. Firstly, there could be tens of operations involved, each with hundreds of underlying steps to follow in accordance with work instructions. Not to mention a significant amount of material lines with BIOS and data points that need to be collected during execution.

Furthermore, although the final process is submitted for review and approval prior to execution, errors can and do take place during production on the shop floor. On top of that, it's not uncommon for engineers to introduce last-minute but necessary design adjustments, which adds further complexity to the entire production process.

This is precisely where an MES software such as Apriso and its redlining functionality comes in. Some of you may still remember when the shop floor personnel used paperwork instructions and a red pen to mark required production or process changes - the original redlining process. MES redlining functionality works on a similar premise, except that the process is fully automated, seamlessly integrating all the information required to manage the order execution effectively.



The following operations characterize a typical redlining module:

1. **Identify production orders impacted by the change, usually done by a serial number, work instruction, or more commonly, the part-revision combination.**

2. **Mark and hold production orders (or, redline them) which makes the shop floor personnel aware of the upcoming changes to prevent the introduced changes from disrupting the production order or even overwriting the current production progress.**

3. **Implement the latest modifications to order production on the shop floor, including updating work instructions with activities such as steps, buy-offs, or control approval workflows. It's important to note that each change or modification must be validated and approved before orders are released back to production.**

# WHAT ARE SOME OF THE HIDDEN CHALLENGES THAT YOU HAVE EXPERIENCED THAT WERE SURPRISINGLY DIFFICULT WHEN DEPLOYING MES IN A COMPLEX ASSEMBLY ENVIRONMENT?

So far, we have experienced four main challenges while implementing MES in a complex manufacturing environment:

**Challenge #1**

What we tend to experience a lot is that while process authoring is usually managed by the Product Lifecycle Management (PLM) system, it's impossible to implement PLM right from the beginning of the execution stage. Therefore, MES/MOM is forced to act as a temporary replacement until implementing the PLM system is possible.

The DELMIA Apriso platform supports process authoring via the Process Builder tool; however, many complex manufacturers decide against using this tool and choose to build their own version of 'Planning Tools' instead, usually to include functionalities not supported by the standard Apriso tools.

As you may expect, these tools require great flexibility, and so the "Process Authoring" module is more than just a set of screens but rather an ecosystem where engineers can effortlessly configure the production processes according to their requirements.

Let's consider a typical complex production process with tens of operations, complex routings, multiple steps, buy-offs, work instructions, components, skills, and data collection aspect on top of this. All of a sudden, 'Process Authoring' becomes a large and very complex component of the MES implementation process that cannot function properly if the 'Process Planning' and the 'Execution' modules aren't aligned.

Building solutions that support both advanced "Process Authoring" and its execution is the source of the challenges in creating an appropriate design that fits nicely with the MES platform and its limitations. The exciting side of these challenges, though, is the satisfaction of making such solutions a reality.

## Challenge #2

Another example of a surprisingly complex challenge we encountered was actually that of work instructions. While not a common occurrence for the Andea team, this particular set of work instructions left us stunned due to its size, complexity, and the fact the instructions changed frequently, and those changes had to be reflected in the production immediately. To make the matter even more challenging, operators also had the ability to modify and include additional information in the work instructions. One thing for sure, after what we've experienced with this particular project, we won't be surprised again by the complexity of any given work instructions...

## Challenge #3

Serialization and adding a serial number to the produced part can also prove extremely difficult, especially when dealing with small-scale parts such as electrical or circuit boards that leave very little or no room to add the barcode. Moreover, the serial number isn't always known during the first operation, and we also have to be conscious that the part goes through complex and often destructive actions, such as heat-treatment, which could damage the barcode.

Customer serializations are also one of the requirements we're often met with, but in some instances, the end customer remains unknown to us, or their requirements for the sequential serial numbers may differ. In our experience, all multi-serial production orders create many additional tasks as each serial equals a separate execution, together with all the data collections, completions, verifications, installations that need to be done at a serial level and not the order level.

## Challenge #4

The final challenge we often stumble upon when implementing our Apriso platform is adding new features and functionalities in conjunction with the existing Work In Progress (WIP). There are two issues with it: first, updating the process plans and second, updating the production orders which tend to be pretty archaic and not in the best shape.

# HOW DO YOU HANDLE 'FIRST ARTICLE' PARTS IN PRODUCTION?

What we've discovered pretty quickly is that every single part released and worked on the floor must be treated as the first article. Contrary to general consensus, the first article is often not the first part released to the floor and usually is a serial number X or Z rather than number #1. It's natural and expected in a dynamic manufacturing environment; we need to be able to factor in all necessary non-conformance and engineering changes into the flow. The last step of dealing with the first article parts is verification (or First Article Inspection, FAI) of the engineering and quality bodies.

Once the verification process is complete, all further quality checks and current work can be 'removed' from the flow, significantly impacting the flow's complexity as there's no framework to follow per se; instead, we approach each production individually. For instance, removing data specific to the first article from both, production process and WIP (such as operations, steps, parts, or data collection) can be extremely time-consuming, so any mass updates in the process plans and redlining systems can save hundreds of hours. It's worth noting that redlining can also be fully automated, making canceling these first-article checks relatively straightforward.

# IN YOUR EXPERIENCE - WHAT WAS THE MOST CHALLENGING PROJECT YOU HAVE DONE AND WHY? WHAT WERE THE MAJOR LESSONS YOU LEARNED ALONG THE WAY?

Project #1

One of the most challenging projects we've ever dealt with comes from the automotive industry, where one of the outcomes we were tasked with was reducing the takt time of the main assembly line by a couple of seconds. To achieve this outcome, we first had to ensure the main operator screen refreshed the screen every 1 second. You're probably wondering why this particular task proved so challenging - let us tell you.

To begin with, all the production lines were working based on the takt time signal; meaning that when the assembled parts were moving from one station to another, all the 60+ (just on the main line) Operator Console screens were refreshing at the same time, creating a significant peak that impacted the refresh time. Another factor that made this project so challenging was the wireless network's low stability in some parts of the line causing the screens to lose critical signals and not refresh at all.

We're referring to this project as a challenge for the purpose of this guide, but in reality, we consider it a valuable learning moment for everyone at Andea. As a result of an innovative idea of spreading the data's load from the servers to all clients over time, we reduced the refresh time to less than 300 milliseconds.

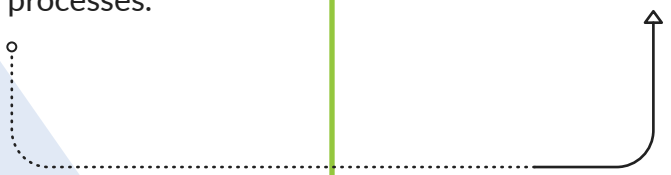
The key lessons we learned from this project:

- **No system is ever too fast, but many can be too slow. Design and develop with the performance in mind, and don't hesitate to seek custom solutions whenever it makes sense and can be justified.**
- **Avoid wireless connection at all costs. It may significantly impact critical system functions.**
- **Don't be afraid to spend money on building custom tools that can simplify or automate the testing process - you'll see a much higher return on investment long-term.**

Project #2

In numerous cases, some challenges we encounter have nothing to do with the MES system itself but rather with geographical restrictions and communication barriers caused by different time zones. While these difficulties can result in friction and a certain level of frustration, these things happen, and we believe they are also worth mentioning.

Moving onto a more specific project scope-related challenge, we recall one where the client required that operators work on mobile devices but perform all the activities during production without connecting to the server. Instead, operators were to synchronize and upload a new set of data every so often. But when you take into account that different operators might have worked on the same sets of data, the synchronization suddenly became a challenge. And if this wasn't enough, any issues registered by the operators during production could affect other orders or even processes.

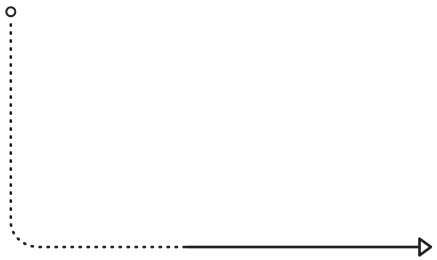


The key lessons we learned from this project:

- **We know the cliche advice is to "Go Big Or Go Home", but in this case, go small first. Take a simple case, make sure that you understand it, and expand it with more complex issues later. Don't try to cover too much at once.**
- **Always have one person responsible for dealing with a project, no matter how many time zones or geographical locations. Large meetings with multiple project participants are brilliant for brainstorming ideas, but from a practical point of view, there should be at least one decision-maker present at all times.**

# HOW DO YOU HANDLE LINKING AN MES UP TO AN ADVANCED PLANNING AND SCHEDULING SYSTEM?

When managing integration between the APS and the MES, a crucial component to keep in mind is ERP - there always has to be one place of truth, and that place is usually the ERP. Therefore, we encourage our clients to consider a model where there is no direct exchange between the APS and MES while all the information goes through the ERP. In this approach, any scheduled changes should be first reflected in ERP and then propagated into the MES; equally, any changes in the production that may influence the schedule should be transferred to ERP first. These changes may include simple status changes of the operations, issues registered during production, unplanned downtimes, unexpected operators' availability, and even some minor schedule fine-tuning done in the MES. In some cases, alterations resulting in design changes could even be transferred to PLM software and then to APS through ERP as it also may impact the scheduling.



# HOW DO YOU HANDLE COMPLEX BOMS WITH CHANGING ENGINEERING REQUIREMENTS AND DESIGNS?

To be completely honest, there is no easy way to handle complex BOMs and changing requirements. Significant engineering changes generally have an enormous impact on the up and down the tree-based form, fit or function changes and potentially require adjusting hundreds of parts. For this reason, an effective and stable change management process is required; however, we highly recommend PLM integration to automate as many aspects of the process as possible.

Another technique we found to produce promising results was introducing peer engineering reviews of changes to see if they are genuinely needed and try to moderate the number of engineering changes taking place.

Although this method may be impossible to avoid in some instances, try to break up the complex BOMs into the corresponding operations to predict for which stage of the production the parts are required and clearly show what is necessary to complete the work.

Some of the production orders we come across are enormous, with hundreds, sometimes thousands of operations. A good practice to follow is to create intermediate parts that exist only in the built, controlling the production's scope and what needs to be approved.

Long story short, complex BOMs aren't easy to contain and control and while they require input from many people in different positions, handling them isn’t unachievable.

# FINAL THOUGHTS

We realize that the complex manufacturing world is never black and white, and so we approach each project with utmost attention to every detail and work relentlessly to find a solution that benefits our clients the most. More importantly, however, we are not afraid to encounter challenges and treat each as teachable moments that allow us to improve our solutions continuously.

We hope we sufficiently answered all your questions and clarified your queries. We encourage you to watch the webinar recording for a more in-depth overview of some of the challenges we've experienced implementing the DELMIA AprisoMES system. Should you have any further questions or would like to discuss the subject further, please do not hesitate to contact us via contact forms on our website or email us directly at **info@andea.com**

# ABOUT ANDEA

Andea specializes in delivering MES services and solutions, from conducting technical assessments and implementing strategic manufacturing systems to managing global MES rollouts. Our employees are process experts in production and logistics, quality management, and production data analysis. We have successfully delivered hundreds of global manufacturing system implementations in various industries, including Automotive, Aerospace & Defense, Packaging, Medical Devices, FMCG, and Industrial Machinery & Equipment.

In 2020 Andea decided to expand its portfolio with APS (Advanced Planning and Scheduling) solutions by signing a partnership agreement with Dassault Systèmes as the only authorized DELMIA Ortems vendor in the Polish market. Since then, Andea has been distributing the product on their home market and providing implementation services worldwide. With this expanded product portfolio, Andea provides its customers with solutions that support a more comprehensive range of manufacturing processes.

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