



Solar Turbines Integrates Process Planning and Production Execution

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Solar Turbines manufactures industrial gas turbines that are used for electric power generation, gas compression, and pumping. They produce from a couple hundred to 350 units a year, but these units are extremely complex and customized to their specific use, and must be extremely reliable. They often operate in remote locations, like drilling platforms in the middle of the ocean.

Time to market is important to their customers, so they must design, build, test, and deliver a complex custom device in six to 18 months.

The goal: the paperless shop floor

Currently, they take the engineering bill of materials (the eBOM, which defines the turbine as designed, including all items, parts, components, sub-assemblies and assemblies) and turn it a manufacturing bill of materials (mBOM, which includes details of how the product is put together, including things used in the assembly process but not part of the final product), with an increasing amount of process planning.

Because of the complexity of their products, they have automated the allocation of the mBOM parts to the process plan in [PTC Windchill MPMLink](#). Each of their products is unique, so they can only use each process plan once—in another business it might be used repeatedly.

Despite its one-time-use nature, the process plan still gives a lot of value because of the up-front definition. When it comes time to service the turbine, perhaps ten years later, the process plan will allow for complete knowledge of that particular turbine. Field service can create and take the necessary custom part to a remote location, saving an immense amount of work and time.

The goal is “design anywhere, build anywhere”, so that the most cost-effective facility can be chosen for each manufacturing operation, and engineering can also be located anywhere.

Someone unaccustomed to a modern production facility may not appreciate how big a role paper plays in keeping things organized. For example, a simple bracket will have a stack of sheets with the operations on them, and the ERP routing means that the paper is associated with that part. If there are five brackets, there are five stacks, each one including the specific customer order—and giving that paper up creates a risk of installing the bracket into the wrong order. But, Solar is exploring ways to get paper out of the shop floor by delivering 2D, 3D, and augmented reality work instructions to operators.

Moving toward MRP

Soon Solar will be using process planning to run their manufacturing resource planning (MRP), which will automatically create the customer orders. Further out is the adoption of [augmented reality](#) (AR) and a manufacturing execution system (MES).

Today, the [Windchill](#) instructions are on a flat screen at each work station as they put the parts together, with an image of the component, the assembly instructions, and all the parts. They can click through to examine each of the constituents.

Eventually Solar wants to have a part list by operation, so they can get the necessary parts to the shop floor just in time. In response to the shop floor's needs, they will send the operation label as part of the mBOM, so it is clear which part is associated with which operation.

Transition to augmented reality

Solar is testing an interim form of augmented reality, from Light Guide Systems. Two Digital Light Processing (DLP) projectors mounted over workstations shine locations of parts and assembly instructions. For example, it shows the stack of washers on a bolt in the correct order, because who can always remember whether the smooth, the locking, or the star washer goes next?

This allows for an easy entry to augmented reality and its use on the shop floor. They are also using AR displays on tablets showing the eBOM, the mBOM, and the process plan in detail, and will eventually move to fixed flat screen displays at each station.

Further changes: MES and factory redesign

Solar used to do process planning and manufacturing execution in Excel. Over the next couple of years they are moving to an integrated manufacturing execution system (MES), with [Solumina](#), which integrates with Windchill and their current ERP. This new MES will allow for paperless documentation, a complete definition for the operator, fully illustrated work instructions, and control over operational flow.

Even after years of operation, there can still be problems with the way work flows through the physical factory. The products are so big that there can be trouble moving a turbine of unique design completely through without partially disassembling it to clear plumbing, a new piece of equipment, or a structural element. They intend to scan the shop weekly with a laser scanner and completely incorporate each measurement before commencing assembly of a given design.

The benefits of long-term planning

Solar Turbines works continually to optimize, streamline, and improve their operations to provide a quality product more quickly, cheaply, and safely. Their shop floor has a strong voice, and will need to feel secure with a paperless process before it is implemented fully.

Images courtesy of [Solar Turbines](#)