Cutting cost with cutting tools

How Boeing Information Technology worked with a cross-functional team to trim aluminum—and expense—from airplane parts

By Ron Glowen and Robin McBride

Boeing Information Technology is helping save time and production cost in the shop-floor fabrication of wing parts for Commercial Airplanes.

At manufacturing facilities in Frederickson and Auburn, Wash., arrays of computer-controlled cutting and drilling tools the size of coffee cans are loaded into customized machines. They are used to remove excess metal from thick aluminum slabs to shape the panels, spars, stringers and other components for airplane wing structures.

This automated choreography at Boeing Fabrication Skin & Spar is a state-of-the-art process for creating precision wing parts that can be up to 100 feet (30.5 meters) in length. Yet everything depends on the high-performance cutter assembly tools performing the right task in the right place to exacting tolerances.

In the mid 1990s, the Auburn Skin & Spar team asked the factory's Information Technology (IT) systems group to find a way to reduce machine setup time and ensure the correct cutters were being used. Thus began a continuous improvement process culminating in a technology-based tool management solution now in use on 13 spar mills and seven skin mills in the Frederickson fabrication building.

The Boeing-designed Tool ID (short for Tool Identification) system is yielding significant savings in several areas. Tool ID combines software and the latest radio frequency identification (RFID) technology with computer numerically controlled (CNC) machining to manage cutting tools.

"Our IT team went out to the shop floor to observe and talk to the machine operators and tool-crib operators, looking for process improvement opportunities," said Rick Morrow, IT Manufacturing & Quality Systems manager for factory automation. "We also talked to vendors for the RFID device, and CNC technology needed to develop the tools and processes. Our job was to bring it all together as a standard user interface with standard processes that can be replicated at each milling machine."

The skin and spar mills are CNC machines with two cutting heads, each with a spindle turning at high speed. Cutting assemblies are inserted into these spindles. The motion of the heads and the left or right rotation of the spindles perform the milling operations.

As a milling job progresses, the computer-based part program prompts the machine operator to manually replace and load the cutters with the appropriate tool for the part feature being milled, a step known as a tool-change operation. Before the use of Tool ID, this step could result in the operator inserting either the wrong tool or selecting the incorrect tool orientation, resulting in a scrapped part or costly rework.

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– Nancy Bailey, vice president Boeing IT Product Systems

With Tool ID, each cutter is embedded with an RFID chip—a component about the size of a fingernail—to eliminate the possibility of a tool being placed incorrectly during tool change operation. Tool ID prompts the user to scan data from this chip using a hand-held sensor or wand. The system compares the data from the chip to what is required by the part program. The tool change process is inhibited unless the correct tool is scanned by the hand-held wand.

Eliminating tool mismatch has resulted in significantly increased machine utilization, keeping pace with higher airplane production rates and reducing rework. The Tool ID system also collects and maintains information on how long a cutter has been in use. This gives tool-crib personnel data to better estimate cutter life, monitor tool wear and manage inventory.

Key to developing a standard solution was creating workable interfaces with different CNC programs, machines and software vendors. A cross-functional team of equipment engineers, manufacturing engineers, industrial engineers, computing specialists, numerical control programmers, CNC machine control vendors, maintenance and tool-crib operators developed the retrofit specifications. In a Material and Process Technology lab, M&PT and IT teams developed productivity and process improvements for interoperability between the Auburn and Fredrickson Skin & Spar shops.

"The implementation of the Tool ID system is the culmination of many years of hard work by the IT, M&PT and factory teams to reduce production costs, including material, transportation, machine wear and manual work due to mismatch," said John Donohue, Extrusion shop manager. Philip Leith, senior manager in Skin & Spar, said, "This will be installed on many new milling machines and is becoming a company standard process."

"These teams have demonstrated a strong commitment to technical excellence by using Lean+ thinking and have achieved tremendous success in attaining greater factory productivity, higher quality and lower operating cost," said Nancy Bailey, vice president of Boeing IT Product Systems. ■

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Photos:

Left: Mike Kegley (from left) and Raam Mahadevan are shown inside the operator console with Ray Hervey, Frederickson Skin & Spar machine operator. Kegley, Mahadevan and Tom Grant (not shown) developed the Tool ID computing interfaces that match cutter selections with computer-controlled part-milling programs.

Right: Al Reeves Jr. (left) and Ralph Warren Jr. calibrate the precise tool parameters needed for milling operations at the Tool Presetting and Measuring station. Automating this process means each tool is preset with the same settings to perform a specific task.

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