

# Harvest moonshine



Ideas generated at Commercial Airplanes' annual Lean+ competition drive efficiency and safety improvements in the workplace

By Dan Ivanis

**K**eith Zanghi wasn't expecting a lot when he turned to the Commercial Airplanes Moonshine War competition for possible solutions to an ongoing ergonomic issue in his work area.

"I really thought we would get back a variation of the process we already had in place, and that would have been fine—anything would have helped," said Zanghi, a production manager in Boeing Fabrication's Skin and Spar operation in Frederickson, Wash. "Instead, I was completely blown away. They came up with a solution that we never would have. It's been a real success story."

For Zanghi, "they" was a team of employees from Boeing Portland, in Gresham, Ore., approximately 120 miles (193 kilometers) south of Frederickson. Despite being new to the Moonshine War—an intense, week-plus annual competition—and having never been to Frederickson, the Boeing Portland team developed a solution that had the Frederickson team

**PHOTO:** Keith Chigbrow, a mechanic in Boeing Fabrication's Interiors Responsibility Center in Everett, Wash., uses a tool developed during the 2008 Moonshine War that eases loading of pilots' chairs into 777 overhead rest modules. GAIL HANUSA/BOEING

talking: an automated, 34-pound (15-kilogram) tool that could replace a repetitive, hands-on process involving a 600-pound (272-kilogram) tool.

"Everyone in our shop is really excited about this. The automatic operation could make people's jobs much simpler and much safer," Zanghi said. "The basic concept has the potential to be applied in other parts of our operation and at other locations."

Based on a now-defunct cable television show called "Junkyard Wars," the annual Moonshine War competition, sponsored by Commercial Airplanes' Lean Enterprise Office, pits teams of Boeing employees against one another in a contest to develop the best solutions to actual workplace efficiency and safety issues. (From a Lean perspective, "moonshine" is the

“I was forced to think in new ways. I had a lot of questions as we went along. And by asking those questions, I forced our engineers to think in different ways.”

– Joy Koppes, estimating and pricing specialist,  
Finance



practice of resolving issues by creating mock-ups and performing simulations with inexpensive, available resources.)

Prizes are awarded to winning teams, including the grand prize: a trip to Japan for a week of intense Lean training. However, the real winners often are the organizations that capitalize on the ideas generated at the competition to improve efficiency and safety in their work areas.

### FIRST, INVESTIGATE

Since the event's birth in 2002, both the Moonshine War and the challenges it addresses have evolved. Focused on efficiency in the early years, in 2009 the Environment, Health and Safety organization became involved in the Moonshine War and safety and ergonomic solutions were given priority in judging. That reflects Boeing's new, companywide workplace safety effort—Safety Now—and five-year targets for improving workplace safety.

During the Moonshine War, teams of five or six use the Production Preparation Process (3P) to investigate problems, dream up ideas and build mock-ups to demonstrate their solutions (see the sidebar at right). Each team receives a budget of \$1,000 for materials, although few use it all. But most do spend every available hour, and then some, to solve the challenge.

“It was a very intense week, with a lot of late nights and long hours,” said Andy Mott, a Propulsion Systems engineer and two-time participant. “It is an exhausting experience, but it's also invigorating and rewarding. You learn all-new ways of thinking, and it gives you a chance to go out and work with your hands, which I don't get to do often.”

A unique characteristic of the Moonshine War is that teams are not allowed to work on issues from their own work areas. Although teams usually are made up of members from the same geographic areas, their experience and expertise vary.

For instance, one member of the Boeing Portland team that designed the tool and process for Frederickson was Joy Koppes, an estimating and pricing specialist in Finance, who was less than a year out of college and had no factory experience.

“We had a very diverse team with one person from the factory, two engineers and two people from support organizations,” said Koppes, who has since joined the 787 Dreamliner team in Everett, Wash. “Our diversity forced each of us to think outside the box. I certainly had a different

## Production Preparation Process (3P) is one Lean technique used during the Moonshine War

### Purpose

Improve the flow of a production process by developing effective designs and processes that focus on transformational steps.

### Benefits

- Right-sized assets
- High-quality products
- Standard, reliable methods
- Dramatic reductions in cost, inventory and lead time

### Key deliverables

- A simulation of the improved process
- An implementation plan
- An equipment development plan
- Resource requirements
- Timeline
- A right-sized flowing production system

For more information, visit the Lean+ Web site on the Boeing intranet (<http://leo.web.boeing.com>).

**PHOTO:** Chuck Duncan, a mechanic at Boeing Fabrication's Skin and Spar operation in Frederickson, Wash., attaches a prototype automated shot peening machine to a wing panel. The device will replace a manual process that involves a 600-pound machine. **ED TURNER/BOEING**

perspective, given my background in finance, and I was forced to think in new ways. I had a lot of questions as we went along. And by asking those questions, I forced our engineers to think in different ways.”

Teams from Canada and Australia also have taken part in the Moonshine War, communicating electronically with the competition going on in Seattle.



## The 3P Creative Process used during the Moonshine War stimulates creative thinking

1. Define the function, theme and scope
2. Use keywords to define the function
3. Find examples of the keywords in nature
4. Examine what's happened; sketch and post examples
5. Sketch the background and conditions
6. Combine ideas and create sketches of them; think of at least seven ways
7. Select the best proposals
8. Construct prototypes; continue "moonshining," or innovating
9. Conduct simulations
10. Gather and evaluate data; keep moonshining
11. Review the process with the customer to select the top design

**PHOTO:** Moonshine War participants present to judges and observers at the 2009 event in Seattle. **JIM ANDERSON/BOEING**

### SHOT PEENING MADE EASIER

The challenge the Boeing Portland team addressed had to do with the repetitive nature of the shot peening process in Frederickson, where huge sheets of raw aluminum are transformed into meticulously formed wing panels for 737, 747, 767 and 777 airplanes.

Shot peening is used to finish the surface of a part. The surface is hit with shot—miniscule round particles—that act as tiny ball peen hammers. The process enhances structural fatigue performance by imparting a compressive stress layer at the surface of the part. Shot peening machines vacuum up the particles immediately as they hit the surface.

Throughout the manufacturing process, wing panels are transported between stations by overhead cranes, which hook into

tabs that protrude from each panel edge. Just before the panels are shipped to their respective assembly plants, the tabs must be cut off and the raw, exposed areas must be shot peened before being treated and painted.

To shot peen these areas, mechanics must wheel 600-pound (272-kilogram) Vacu-Blast machines along the length of the panel, stopping to run the heavy shot peen head over the exposed area 50 to 60 times before moving on.

"We have some mechanics here who weigh less than 125 pounds (57 kilograms), and they have to fight this machine up and down the length of a 777 wing panel," Zanghi said. "The repetitive nature of the work also is a stress on arms, shoulders and necks."

The Portland team's solution is a self-contained, 34-pound (15.4-kilogram) shot peening machine that clamps onto the edge of the wing panel and does the back-and-forth work automatically. Skin and Spar employees are studying ways to reduce the weight even more. A 6-pound (approximately 3-kilogram) derivative also is being studied for other uses in Skin and Spar.

The shot peening process is just one of many solutions that have emerged from the Moonshine War and have been implemented as is, or with minor modifications, since the competition began in 2002.

### MOVING CHAIRS

At Boeing Fabrication's Interiors Responsibility Center in Everett, manager Howard Hampton and mechanic Keith Chigbrow are benefiting from a solution developed during the 2008 Moonshine War.

As part of their work statement, Hampton and Chigbrow load special, but bulky, pilots' chairs into a small module that is part of the overhead crew rest areas on some 777s. The chairs, which weigh approximately 80 pounds (36 kilograms) each, are the last items to be loaded before the module is shipped.

Before the Moonshine War solution was implemented late last year, loading the chairs was awkward at best. It took two employees to physically lift each chair about four feet (1.3 meters) off the ground and balance it on the lip of the module's rear opening. While one employee held the chair in place, the other would crawl in from the other side and, from his knees, lift the chair again before lowering it into position.

In addition to the obvious ergonomic issues, Hampton also faced scheduling problems. "If I had only one person on second shift, they couldn't do the job," he said. "We always had to schedule around the fact that it took two people."

Thanks to the "Propulsion Fuelers," a Moonshine War team made up of propulsion installation and fuel system engineers from Everett, now one person can do the job.

The Propulsion Fuelers solution is a lightweight, wheeled tool that features a lift mechanism, run by a battery-powered drill motor, and a manual arm extension mechanism. To load the chairs now, Chigbrow attaches the tool to the back of the chair, uses the lift to raise the chair, wheels the chair to the module opening and then uses the arm extension mechanism to move the chair gently into place.

"This is a lot safer than the way we used to do it," Chigbrow said. "We would have to jiggle it back and forth to get it in its tracks. Now it just drops right in. I'd just like to thank the people who designed it."

“You pick up part of an idea here, and another part there and you think, ‘We could do something like that back where I work.’ ”

– Darren Melhart, four-time Moonshine War participant

## MIRACLE TOOL

At Integrated AeroStructures in Boeing Fabrication’s Auburn, Wash., facility, process engineers Rich Alexander and Mike Milby turned to the Moonshine War when they were looking for a solution to eliminate a workplace safety concern and relieve a production bottleneck at the facility. Within its million square feet (93,000 square meters), Integrated AeroStructures produces aluminum sheet metal, aluminum extrusion and assembly commodities.

The issues were the time, effort, and safety and ergonomic concerns involved in deburring—or finishing off—thousands of tiny holes in outboard stow-bin rails destined for 777s. The rails, which are part of the support structure for stow bins, have holes at 1-inch (2.5-centimeter) intervals and run throughout the airplane. For example, a typical 777-300ER (Extended Range) has approximately 11,300 stow-bin holes.

Before the Integrated AeroStructures team implemented the moonshine solution, mechanics had to debur the holes with hand-held power tools, which led to fatigue and was a prime environment for repetitive stress injuries. The prototype solution, developed by a team from Everett that represented both the Emergent Operations Facility and Right-Sized Equipment, is an automated tool that travels along the rails, deburring the holes as it goes. Mechanics simply attach the tool and let it do the work, freeing them to do other tasks.

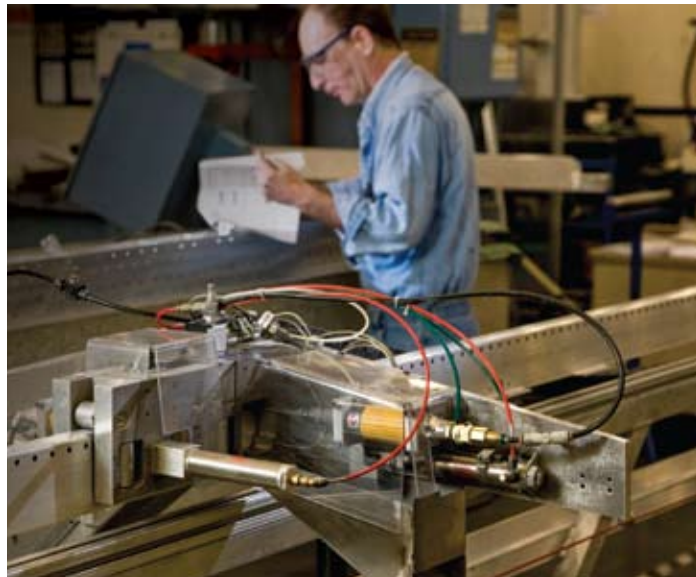
The tool has relieved both the bottleneck in the factory and the workplace safety concerns.

“An added benefit is that our quality has improved from the manual process,” Alexander said. “We no longer have elongated holes caused by hand-held tools going in at an angle.”

Alexander and Milby have made some changes to the original tool. “Their concept was right along the lines of what we had envisioned,” Milby said. “Having a working prototype is very helpful. You can quickly see what works and what can be improved. Overall, it shortens development time and leads to a better product.”

Darren Melhart, a mechanic at the time, was a member of the team that designed the deburring machine. Now a member of the Commercial Airplanes Lean Enterprise Office, Melhart has participated in four Moonshine Wars.

“I live for that kind of competition,” Melhart said. “One of the best parts of the Moonshine War for me is the report-out. Everyone in the room is studying everyone else’s ideas very



**PHOTO:**The automated deburring machine (foreground), developed during the 2007 Moonshine War, has increased safety and quality at Boeing Fabrication’s Integrated AeroStructures operation in Auburn, Wash. **ED TURNER/BOEING**

closely, and they are all taking mental notes. You pick up part of an idea here, and another part there and you think, ‘We could do something like that back where I work.’ ”

## BRIGHT IDEAS

Billy Roeseler, an Associate Technical Fellow supporting Advanced Concepts and Commercial Airplanes’ TheConceptCenter, in Everett, is a big fan of the Moonshine War and the kind of thinking it inspires.

After participating in two of the early competitions, Roeseler, then working on the 787 Dreamliner, submitted an issue regarding the join of the 787 wing and its raked wingtip. Although none of the solutions that emerged from the Moonshine War was implemented, the ideas inspired the 787 team to look at the issue in a different way and develop innovative solutions of its own.

“Some of the out-of-the-box thinking that I saw at the three Moonshine Wars I was involved in was really world-class,” he said. “The fact that the Moonshine Wars bring in nonexperts to work on these issues can be a big advantage. Experts have a habit of getting tunnel vision. People from outside are not constrained by preconceived notions.

“The Moonshine War is so important because it brings in the manufacturing function,” he continued. “You actually have to build and demonstrate the technologies. It is not just sitting at a computer and dreaming up bright ideas, but actually working with your hands and putting them into reality.”

And then putting them to work in the workplace. ■

*daniel.j.ivanis@boeing.com*