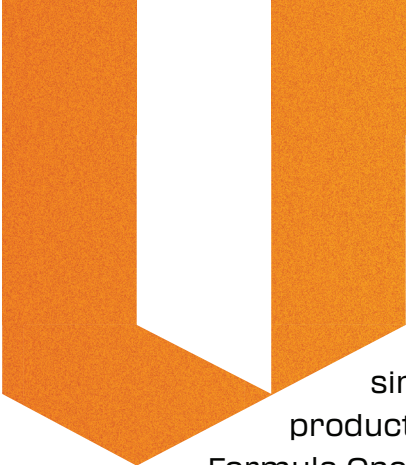


Mercedes-AMG PETRONAS Formula One Team

From old race car to new race car: VERICUT takes pole position



User Story



Long before a racing season concludes, the Mercedes-AMG PETRONAS Formula One Team is already thinking about improvements to the following year's car. This complex process sees the majority of car components redesigned. In production, they rely heavily on VERICUT verification, simulation and optimisation software from CGTech, a core production engineering resource at Mercedes-AMG PETRONAS Formula One Team for over two decades.

The process of new car development has evolved over time. Not so long ago, a Formula One car would undergo a complete redesign each year, with the exception of commodity parts like fasteners. With the introduction of the cost cap at the start of the 2021 season, all that changed. Non-performance components or parts already performing at the right level can be carried over to the following season. Today, Mercedes-AMG PETRONAS Formula One Team carries over a much larger quantity of machined car components each year, in comparison to pre- cost cap seasons.

Robert Brown, Machine Shop Manager at Mercedes-AMG PETRONAS Formula One Team, says: "It's changed the nature of how we work. Now, as soon as a decision is taken to carry over a component type, we can use some of our spare 'summer capacity' to manufacture the carry over, meaning we can focus on redesigned performance parts when they start arriving in time for the following season."

Cost counting

Close liaison between design engineering and production engineering has become more important since the cost cap implementation. Historically, designers would simply create the part they wanted without much consideration for machining costs.

"It's different today: we can point out a small design change that might reduce the machining cost by two-thirds, for example," says Mr Brown. "The voice we have in the design cycle is much louder than a few years ago."

James Peddle, Production Engineer at Mercedes-AMG PETRONAS Formula One Team, goes deeper into the process: "When we receive a redesigned performance part, we start by assessing how many operations the machining process will require to produce the component in the most efficient way possible. We then look at the fixture requirements and start programming."

Clear the air

This stage of the process also sees the creation of a routing and an

estimate of cycle time, which the team can use to approximate a cost. What follows is the beginning of the optimisation phase, where production engineers look to reduce the lead time even more. Here, the team relies on tools such as the VERICUT Air Cut Optimisation module, which can cut cycle times considerably.

“Air Cut Optimisation is a very safe optimisation to apply,” says Mr Peddle. “It doesn’t work the cutters any harder or affect part quality: it simply reduces the amount of time that cutters are not in contact with the component.”

“To ascertain the time required for the machining element of making a component, we simply use the output time calculated by VERICUT,” he adds. “The machine kinematics in VERICUT’s virtual environment are such that we’re confident the time reported will match the real run time.”

Safety first

Producing complex redesigned components economically and safely is seemingly unthinkable without the help of VERICUT.

“Primarily it would be unsafe and massively labour intensive,” states Mr Brown. “I think the days are gone when you can just read the X, Y, Z co-ordinates of the G and M codes on the screen - not with the complexity of parts today. At peak times, one operator will be responsible for multiple machines, running brand new CNC code. Ensuring the machines run safely without using VERICUT? Forget it.”

Adds Mr Peddle: “A lot of our programs have millions of lines of code. We don’t have enough people to run through that on a line-by-line basis without VERICUT. We would probably need to double our labour resources.”

A meeting of minds

Among the many beneficial features of the software is CGTech’s NX® Interface, which provides an easy and convenient way to verify NC programs directly from within NX, the CAM system in use at Mercedes-AMG PETRONAS Formula One Team.

The interface can verify individual CNC programs, a series of selected CNC programs or a complete sequence of operations. All CNC program and tooling information transfers automatically to VERICUT. Design, stock and fixture models also transfer automatically in their proper orientation. Notably, the VERICUT process runs external to NX so users can continue working in the CAM software while verifying the CNC program.

“The interface between NX and VERICUT is very impressive,” says Mr

Peddle. “We know with confidence that we’re simulating exactly the same scenario as intended in our CAM session. Moreover, VERICUT simulation is quick. Even with a complex part like an axle, which has a run time of around 45 hours, it doesn’t take long to check for collisions, gouges and excess material.”

Losing weight

Every year, the redesigned parts coming through at Mercedes-AMG PETRONAS Formula One Team seem more challenging. Weight reduction, without compromising functionality, is at the heart of many modifications.

“This always creates a challenge for production engineers who must keep the component stable during machining,” explains Mr Brown. “We might need to apply special tools or cutting strategies; get really creative about how we machine certain features such as very deep face grooves. The ability to simulate those operations and replicate custom tools in VERICUT is really useful and gives us so much confidence.”

He continues: “For example, a component may have a very thin wall thickness through the bore. There’s no way of using a conventional boring bar in the Z axis of a CNC turning centre due to the profile. We therefore use modified boring bars and machine the bore at various angles. It’s complex, but by applying VERICUT we knew it would be safe. Without the software it would require a skilled operator to be present at the machine, listening for things like a change in harmonics to try to understand what is happening in the cut area inside the bore.”

licence to be creative

Aside from the production engineering benefits, the use of VERICUT at Mercedes-AMG PETRONAS Formula One Team also provides designers with a notable boost

“We get quite a few requests from design engineers asking if a new component is machineable,” explains Mr Peddle. “Sometimes it’s an easy yes or no answer. But if not, we quickly develop some tool paths for the part and run it through VERICUT. The software provides us with the answer, and maybe even one or two ideas about how to make it easier to machine. This capability allows design engineers to make positive decisions at the concept stage.”

Mr Brown adds: “VERICUT gives our designers the confidence to be creative. Without simulation we would probably be asking them to reign in their creativity, potentially compromising performance. We know from experience that VERICUT not only has a hugely beneficial impact on production, but also on design.”