# Homebrew Sienna: Toyota Engineers in Michigan Keep the 2021 Sienna Going Places Despite COVID Shut-Downs

June 29, 2020

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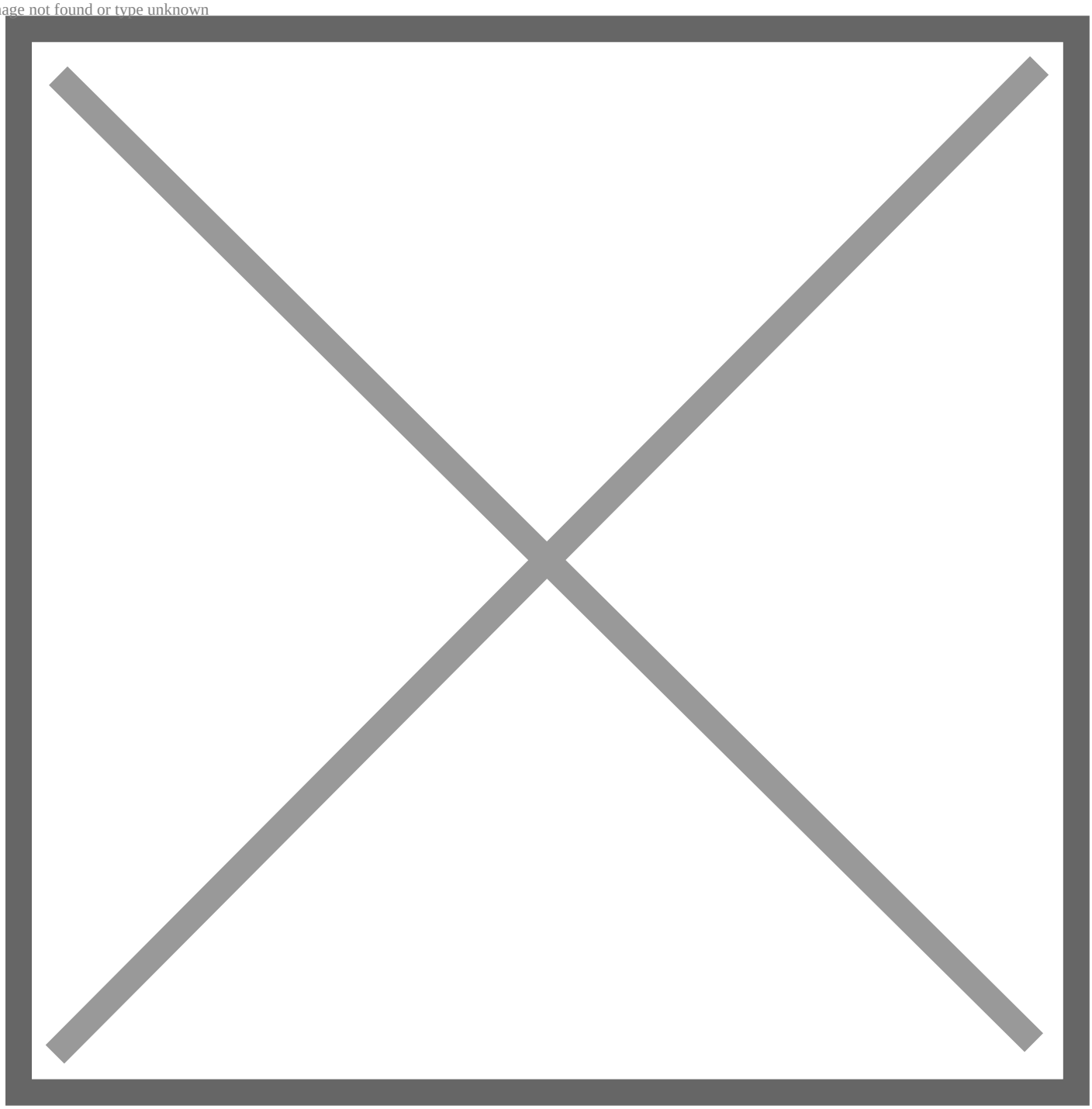


On May 18, 2020, Toyota pulled the cover off the all-new 2021 Sienna. Reimagined for its fourth generation, Toyota's newest minivan was engineered and designed in Michigan and is assembled in Indiana. This new generation of Sienna redefines the conventional suburban minivan with bold styling, a segment first standard hybrid powertrain with class-leading 33 MPG, optional all-wheel drive and a host of amenities for all lifestyles.

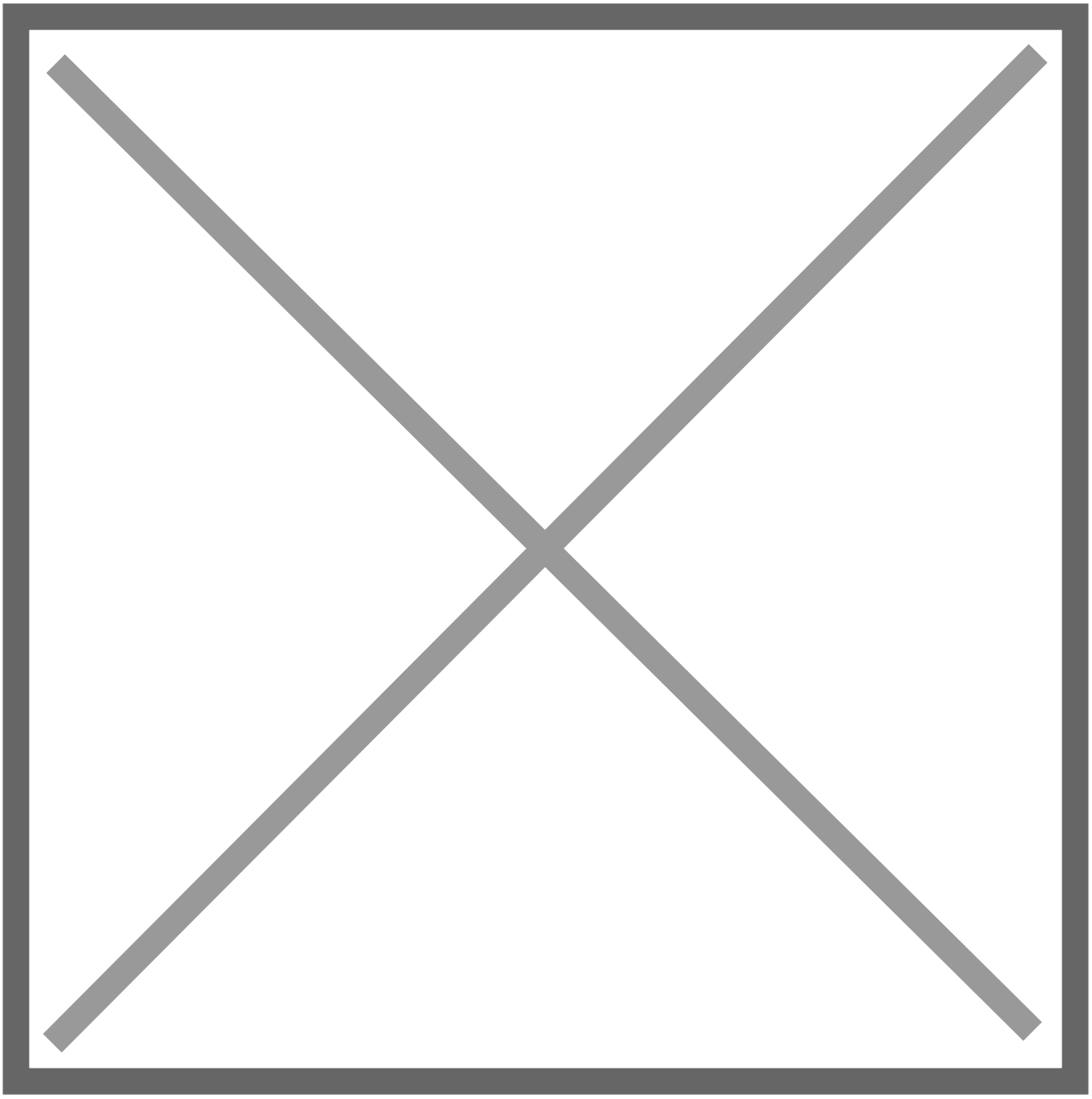
The new Sienna's final phases of engineering, however, were anything but ordinary. Set to be completed in March 2020, this crucial prototyping phase fell at the onset of a global pandemic. This meant that the Research and Development team in Ann Arbor, Mich., had to make major adjustments as mandatory shutdowns and shelter in place orders began to roll out across the country.

In lieu of completing the vehicle's final engineering changes at the company's R&D facilities with their traditional equipment, the Sienna engineering team instead had to make do while working from home. Likewise, rather than being unveiled on stage at the New York International Auto Show under the lights of the Javits Center as originally planned, the 2021 Sienna instead debuted within a digital broadcast. In just a few short days, the vehicle's timeline had been turned on its head.

**Crucial Data Gathering**

In early March, the initial Sienna manufacturing trials began on the line at Toyota Motor Manufacturing Indiana (TMMI) – timing that would prove to be fortuitous, as the team entered the Early Detection Early Resolution phase of engineering (EDER).

"While we got a bit lucky with the timing, it was clear to us that the pandemic situation was getting worse as countries around the world began to shut down. We took the opportunity to get as much hands-on time with the vehicle as possible in early March," says Chief Engineer, Monte Kaehr.



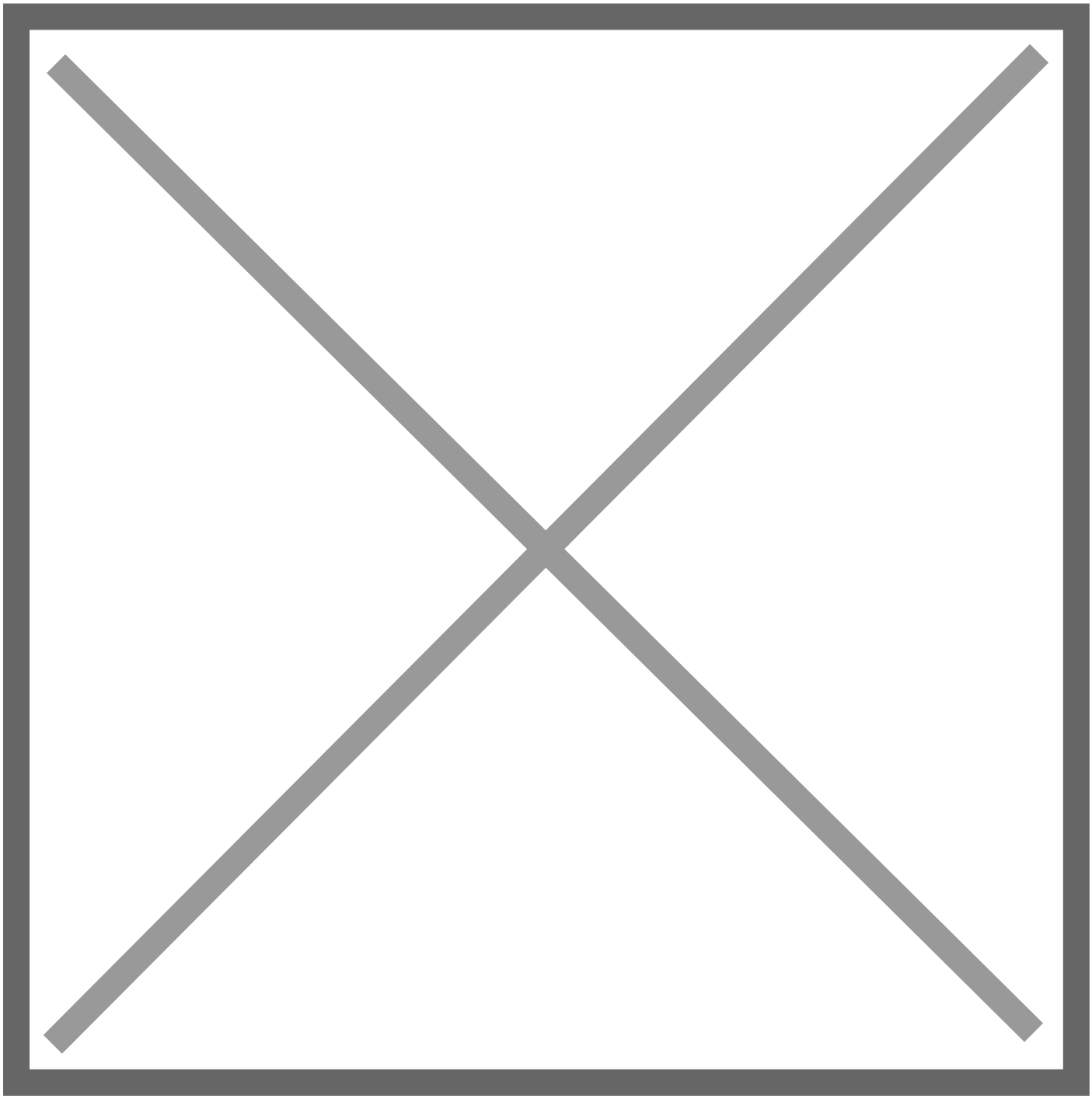
This ended up working in the team's favor. On March 19, an all-hands engineering review session was held in order to identify any final changes needed before engineering cutoff. On March 23, the state of Michigan announced its shutdown, and the R&D team was transferred to working from home the next day.

"This is the phase where we focus on refinement, and despite the change in our working environment, we did not skimp on any details," explains Kaehr. "A core philosophy within Toyota is *Genchi Genbutsu*, which means 'go and see' and emphasizes hands-on engineering. While we went home with all of the necessary data to complete EDER, we needed to completely rethink how we would go about accomplishing *Genchi Genbutsu*."

**Building a Car from the Kitchen Table**

As the team settled in at home – be it in a garage, basement, patio or at the kitchen table – and began to dig into the technical changes that needed to be made, the Sienna engineering team established new routines.

Remote access to terminals at Toyota's Ann Arbor R&D facility was possible, but due to initial data limitations the team found it had to work in shifts. Team members remoted into Computer Aided Design (CAD) stations as early as 4:00 a.m. and turned their bandwidth over to colleagues in the afternoon.



Timelines shifted from weeks to single days in order to ensure milestones were achieved, and regular check-ins were encouraged between team members to share progress. With a bit of ingenuity, video conferences made it possible to review drawings, walk through sketches and even demo physical mock-ups from separate homes. In some cases, team members literally had to work with what they had around the house.

Engineer Kyle Steinkamp had a design change to make on the vehicle's rear brake hose housing in order to ensure proper clearance from moving suspension components. Without the sophisticated tools typically available to evaluate components, Steinkamp took to the garage to innovate, using his bench vise as a common point of reference to validate the final design change. Similarly, Senior Engineering Manager David Burke took advantage of his hobbyist 3D printer to ultimately mock-up and finalize the design of the flexible fabric shroud which covers the Sienna's adjustable steering column.

None of these changes, however, would have been possible to implement without a critical digital tool that had been years in the making. Known as the Paperless Approval System (PAS), its implementation came just in time and was crucial to moving the engineering process forward while team members worked remotely.

In 2018, then TMNA CEO Jim Lentz issued a challenge to departments across Toyota to pitch where costs could be saved. This ignited the initial feasibility studies as to how the team could make a paperless technical package solution a reality.

Toyota has long been a champion of flexible work schedules, including working remotely, but the paper-heavy engineering process was a hurdle. Approvals needed to be signed on drawings by hand and physical packages then needed to be issued. For team members who travel frequently, this created a bottleneck – not to mention all of the associated printing and administrative costs.

The Digital Solutions team had long been chasing the idea of digitizing the paper-heavy engineering process and took the opportunity of Lentz's challenge to elevate their idea within the organization. The savings were clear, and they were given the greenlight to start developing the system that would ultimately become PAS.

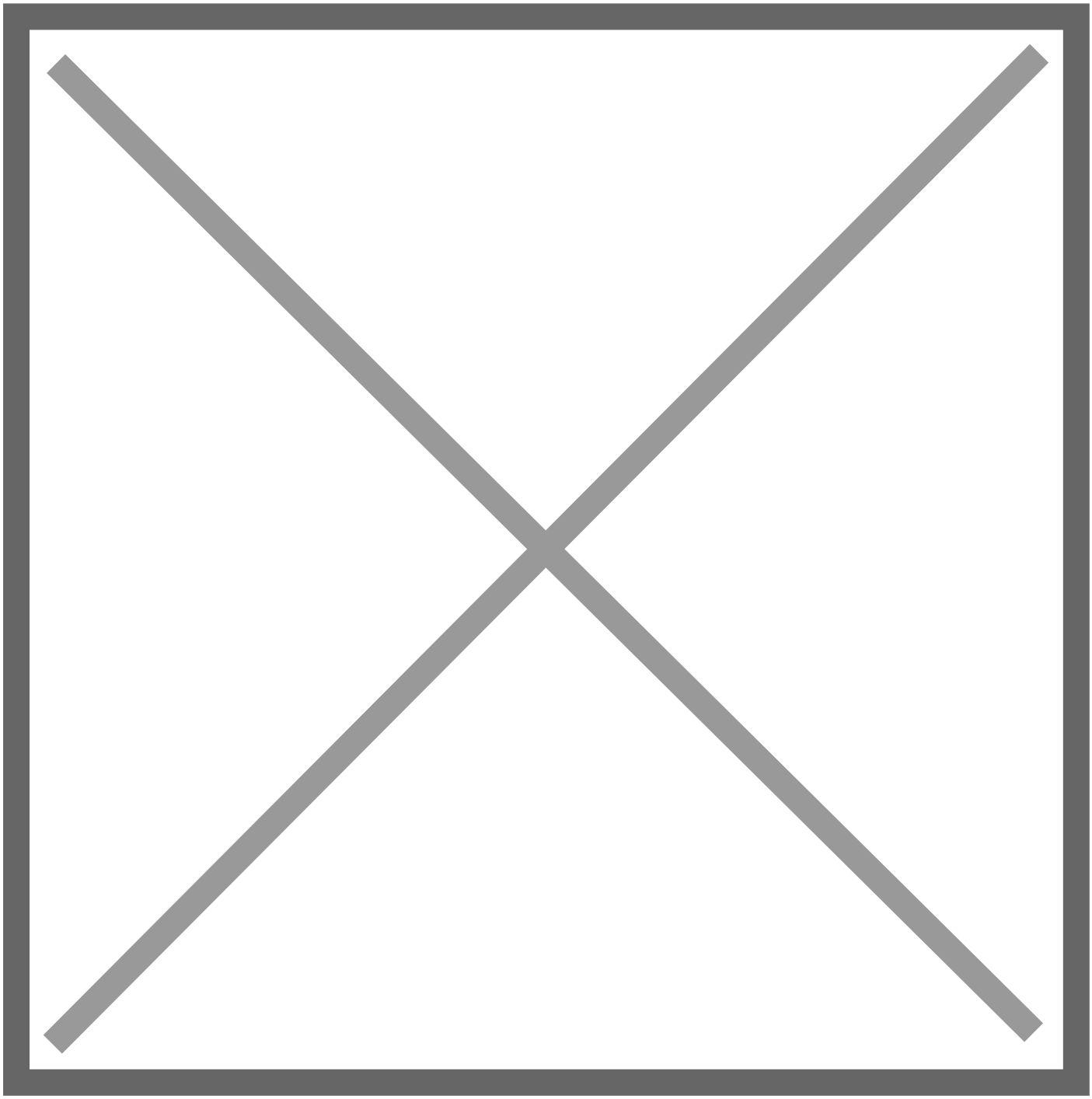
The system has been in active use within TMNA in an evolving form, and the Digital Solutions team has been consistently adding new features. The last feature needed to make the process entirely paperless – paperless drawings – was scheduled to be rolled out in early summer 2020. By February, however, it became clear that COVID-19 related closures were looming. Working around the clock with the Toyota IT department, the needed changes were implemented, and by the end of March the paperless process was in place, keeping the Sienna and other vehicle programs on schedule.

"The paperless approval system was absolutely critical to our success in being able to make engineering changes remote," explains Kaehr. "Relying on paper drawings would have significantly slowed down the remote working process, if not halted it. The PAS system is a backbone of the digital culture shift within the organization, and it has reduced lead time which has led to the engineering team achieving technical targets with higher volumes."

While final changes were being made to the vehicle design by R&D, the production engineering team was also sorting out what changes needed to be made on the production line – a task that is already extremely complex when they had full access to the line, and now needed to be done entirely remotely.

A team of engineers at Toyota's Production Engineering and Manufacturing Center (PEMC) in Kentucky collaborated extensively with the R&D team in Michigan during the shutdown, and also had access to the data collected during the benchmarking phase. They were able to leverage this data in order to keep the production engineering process on schedule. The 2021 Sienna features an aluminum sliding door – a global first for Toyota – and the team was still making fitment accuracy adjustments prior to the shutdown. Using the data supplied by R&D, they were able to prepare the CAD files remotely so that they would be ready to implement when they

returned to the production line. The PEMC team also pioneered some of the COVID-19 safety procedures that would soon be protecting team members at Toyota's North American facilities once manufacturing resumed.



**The Digital Auto Show Unveil**

On March 10, it was announced that the New York International Auto Show would not be taking place in April – the original planned event for the unveiling of the 2021 Sienna. By early March it had become apparent within TMNA that the show would likely be postponed or cancelled, but the R&D team already had three cars built and

designated for auto show use. Following the vehicle's final engineering review on March 19, the team made the quick decision to ship one of the cars to TMNA headquarters in Plano, Texas – just in case they needed it.

The move came just in time, only days before the work from home process began. With the show vehicles in hand, the team in Plano was able to pivot from the traditional auto show reveal into what became Toyota's first all-digital unveil on May 18. This event drew over 15,000 streaming views, showcasing two new hybrid-only vehicles, the 2021 Sienna as well as the 2021 Venza two-row crossover.

**Returning to a New Normal**

TMMI officially reopened for production on May 18, after nearly two full months of closure. Today, the Sienna team is moving forward with the process of finalizing changes needed prior to full production, which is set to begin in Fall 2020.

While the process of finalizing engineering changes on the Sienna was unconventional, the end result is the same – a vehicle that matches up to Toyota's reputation for quality and reliability. The team also took away from the process lessons that are certain to benefit the organization in the future.

"We had to maximize both efficiency and ingenuity during our time working from home, and I think this will lead to greater flexibility and productivity in the future," says Kaehr. "*Kaizen*, or the process of continuous improvement, is synonymous with the Toyota brand, and I think we learned a lot during the last few months that can be used to improve processes across the entire organization."