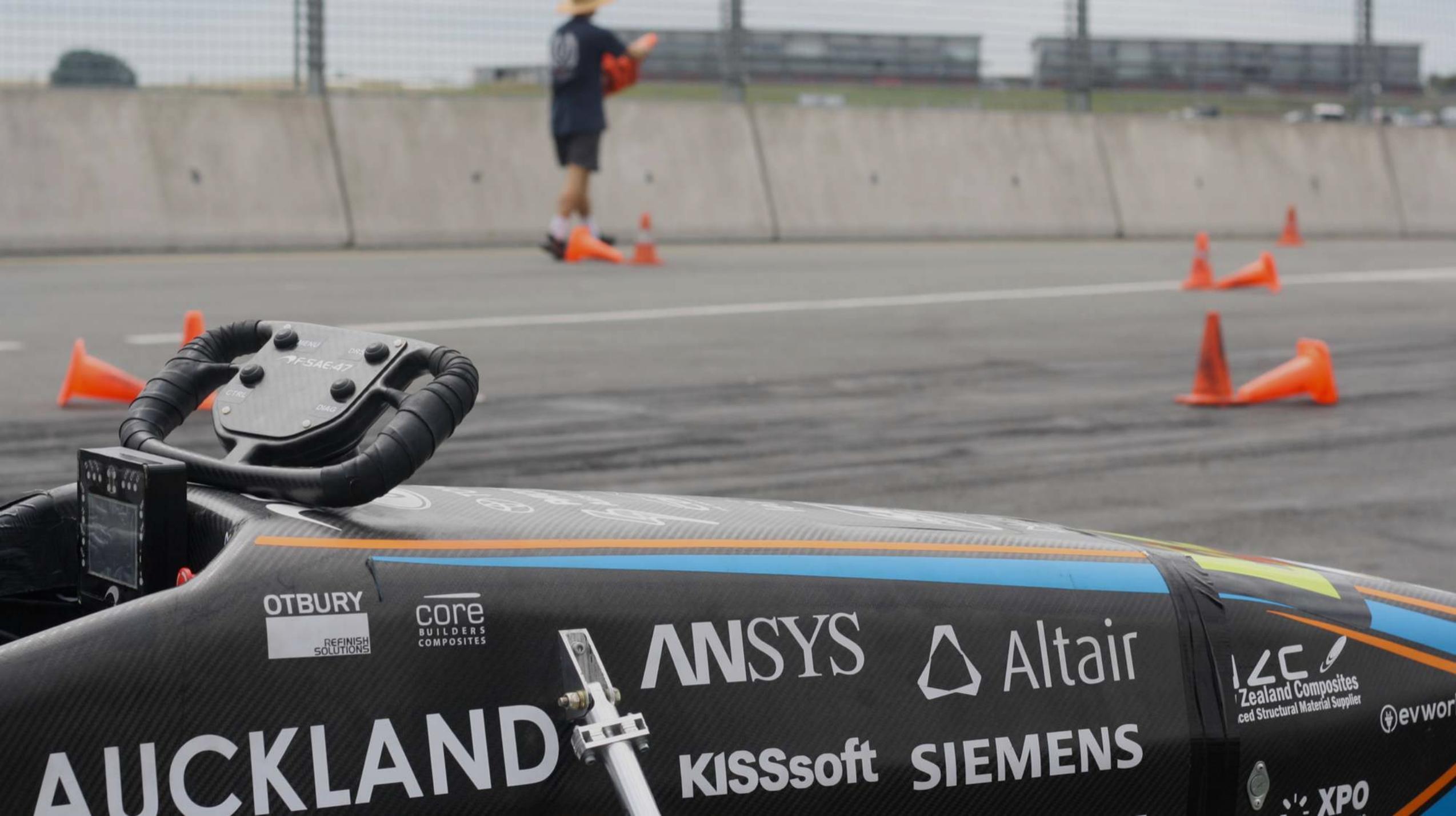




Team Newsletter

January 2021





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Team Leader Keith Anderson



A stylized, handwritten signature of Keith Anderson in white ink on a dark background. The signature is fluid and cursive, starting with a large 'K' and ending with a long horizontal stroke.

Unfortunately we were not able to build a car, nor compete at competition over in Australia this year, which means our usual metrics for judging the success of a year are pretty much useless and we have to dig deeper to try and quantify the team's performance. Instead, I would argue, the best way to measure the teams performance would be against the high-level goal we had set of leaving the team in a better place for the following year. This means growing the teams abilities (via up-skilling, recruitment, and knowledge transfer), increasing the teams resources (sponsorship retention and acquisition), as well as making long-term investments and fostering team cohesion.

Going into the year we lost a large portion of our senior team members, many of whom completed their final year of University. This amplified the usual challenge of recruiting a diverse range of newbies who can each bring their own unique set of skills and experience into the team. In just a couple short years most of the teams senior team members will have graduated and the current batch of newbies will be running things, so newbies truly are the life-blood of our team.

Unfortunately things were quite stop-start on this front, with multiple set-backs and delays as we tried to work around the lockdowns and holiday periods to ensure that the process was fair and equitable. In the end, we were extremely excited to bring on a promising group of new recruits, albeit much later in the year than we had wanted to. Not building a car, and not having access to our workshop also meant we had to re-think our approach to up skilling and knowledge transfer. The team moved to an online-learning approach to this as team members studied key areas of their subgroups, led by our most senior team members. The success of this approach will only be seen in the coming years, though we are all quietly optimistic.

A year of isolation fostering team cohesion was a massive challenge. We fell well short of our goal to have one team bonding event per month over lockdown, and have only been able to get back up to pace in the past few months. We look forward to meeting and exceeding this goal in 2021.

One area that has had a special focus this year has been on making long-term investments in the team. On the workshop front we have been gearing up to make a number of tool and equipment purchases, while on the car front we have purchased a new set of cells and a BMS which will allow us to continue to work towards our long-term goal of having two electric drive-trains.

Of course, the money for all of these key strategic purchases has to come from somewhere. As always we have been blown away by the generosity of our sponsors, even in the midst of this global crisis and have been extremely proud to even bring on a small handful of new sponsors. To our sponsors: thank you - it is because of all of you that we all get to live and breathe FSAE.

Therefore, as we move into the new year I think it's fair to say that in spite of a challenging year we have left the team in a strong position, from which we can expect to perform well in the future both near and far.

2020 has undoubtedly been one of the most challenging years for all of us. Without access to our workshop for an extended period, simple collaboration tasks became much more challenging and less inspiring. Despite this, the team has not only managed to hold together, but also successfully implement a range of new process improvements, fix some legacy design issues and complete the higher-level design for the 2021 car! For all these accomplishments, I am extremely proud of the grit, determination and passion our team has shown. Further, we are grateful for the continued support that you, our sponsors and friends, have shown us through what I know has also been a difficult time for you.

Some of the process improvements our team has seen this year include: moving to Microsoft Teams as our primary method of communication, migrating our project management over to Microsoft Planner, switching to the Autodesk Inventor CAD package to integrate better with University courses, implementing Autodesk Vault for CAD management (thanks to help from CADPRO – a new platinum sponsor) and working by a new custom, higher-level stage-gated project management plan called the “Formula SAE Development Process” (FDP – see below for stages and overview). Along with FDP has come a set of new documentation templates which aim to aid robust knowledge transfer into the future.

As mentioned earlier, several issues on the M019 have been resolved. These have both allowed us to get the M019 up and running for the NZ competition, as well as prove that these issues are resolved for the M021 through testing. The two most notable of these issues are the leaking cooling jackets and the fatigue-failed gearbox spindles. One design issue with the powertrain remains due to additional pressure put on the system from the switch to 4WD. With regular testing back up and running in the M019, we hope to have this issue fully debugged and resolved soon.

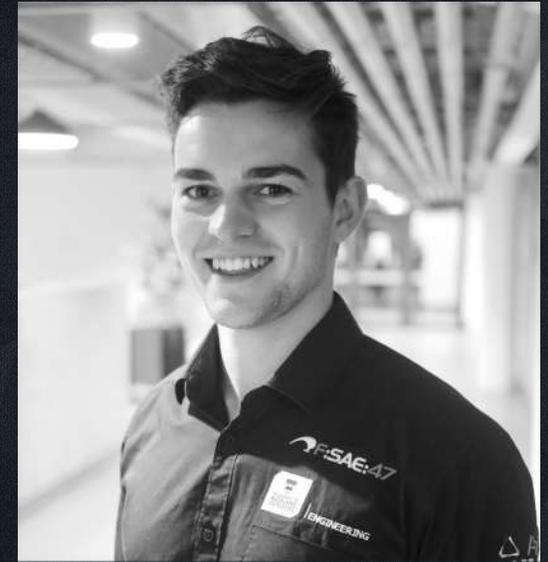
One of the greatest achievements of the 2020 team was the completion of the M021 design. With all but the lower-level design of some specific components completed, the design team have a design earlier than ever before. This is extraordinary given that this design was completed almost entirely remotely. Being a first for the team, this was a huge challenge from a personal, communication, and integration point of view. Without the extreme patience of the design leaders and the new systems we implemented, this would have been impossible.

The M021 is what the design team considers to be the perfect balance of ambition and guaranteed reliability. With very few changes to the powertrain and electronics, testing on the M019 will be directly applicable to the M021. This should allow us to identify and resolve powertrain issues well before competition; one of our weaknesses in the past. The suspension and aerodynamics packages have seen significant upgrades with changes from the chassis to accommodate these. These changes will allow us to make better use of our increased testing time, and exceed our design goals.

Thanks to an immense effort from the team, we have now begun manufacture of the M021 car. The new summer manufacture period has its own challenges but will give us the increased testing time that we need to push ourselves to the next level. The team is excited to be back in the workshop and it is awesome to see such amazing progress far earlier than is traditional for our campaigns.

We look forward to working with you, our sponsors, over this period to produce the next chapter in our story. All the best and for those whom we have not contacted recently, we look forward to catching up and involving you in this exciting time.

Chief Engineer Harvey Merton



2021 Management



Team Leader
Keith Anderson

Bachelor of Engineering
(Hons) – 3rd Year Compsys



Deputy Team Leader
Emily Steiner

Bachelor of Engineering
(Hons) – 3rd Year Mechatronics



Chief Engineer
Harvey Merton

Bachelor of Engineering
(Hons) – 4th Year Mechatronics



Race Engineer
Justin Vasiljevic

Bachelor of Engineering
(Hons) – 4th Year Mechanical



Marketing Manager
Priya Prasad

Bachelor of Biomedical Sciences
(Hons) – 3rd Year



**Electronics
Leader**
Brandon Pais

Bachelor of Engineering
(Hons) - 4th Year Electrical



**Chassis
Leader**
Liam van
Mechelen

Bachelor of Engineering
(Hons) – 4th Year Mechanical



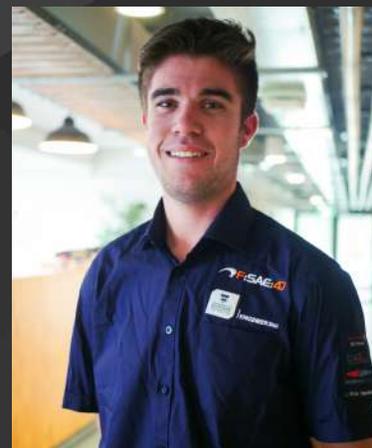
**Aerodynamics
Leader**
Jordan Williams

Bachelor of Engineering
(Hons) – 3rd Year Mechatronics



**Research &
Development
Leader**
Joshua Schoeman

Bachelor of Engineering
(Hons) – 3rd Year Mechanical



**Suspension Leader &
Workshop Foreman**
Alex Faulconbridge

Bachelor of Engineering
(Hons) – 4th Year Mechanical



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WORKS

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MEG

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Subgroup Progress

Electrical

The electrons have been hard at work modifying many of the PCBs (printed circuit boards) that run our cars. During testing sessions and design reviews, the team will often discover a way in which we can improve the electrical systems, typically to improve functionality or enhance safety. All our electrical CAD is done in the highly powerful Altium Designer. Once they are finalised, we will send out the PCB designs to be manufactured.

Research and Design

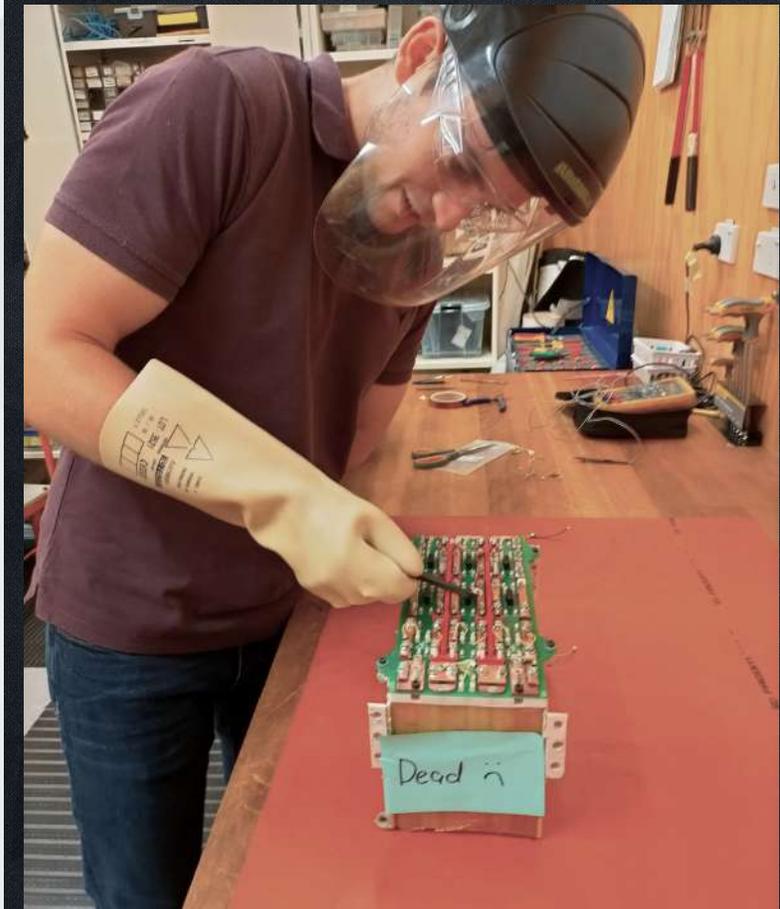
Over the course of 2020 we've taken all the spare time created by lockdown to carry out some major research. We have been looking at the possibility of moving to a new powertrain based around motors designed by Fischer. Fischer assemble the motor internals into a housing which must be designed and provided by the customer. This gives us a lot of design freedom, and would allow the motors to be customized to suit our application. The new motors would provide substantially higher efficiency and let us better integrate our cooling system. The change would also necessitate moving to a new inverter package, so the options available are currently being investigated. A motor housing has been fully designed, and if the new system provides enough potential performance gains to justify the cost and effort, it is possible they will be on the 2022 car.

Aerodynamics

The design team for the 2021 has been hard at work producing a new aerodynamics package for the M021 car. Despite most of our efforts in Composites Team being aimed at beginning production of our chassis, we have still been making some solid ground at getting our new package ready for next year's car. Our wing elements are a great place to introduce our newbies to manufacturing with composite materials so we have begun making our 2D wing elements which are plentiful in our new design. They have been putting in an enormous amount of effort and I am super pleased with the progress they are making, the talent pool we are working with going into composite manufacture this and next year is incredible and I can't wait to take on some of the more challenging aspects of the package such as our completely redesigned undertray and sidewings.

We expect to have a much larger period of time to conduct testing on the M021 and as such will be able to delve into much more in depth methods of validating our package on track. The data we gain from this testing will be invaluable to proving our concept can be taken from its design to the actual car and will allow us to gain a better understanding of how our designs translate into real world performance.

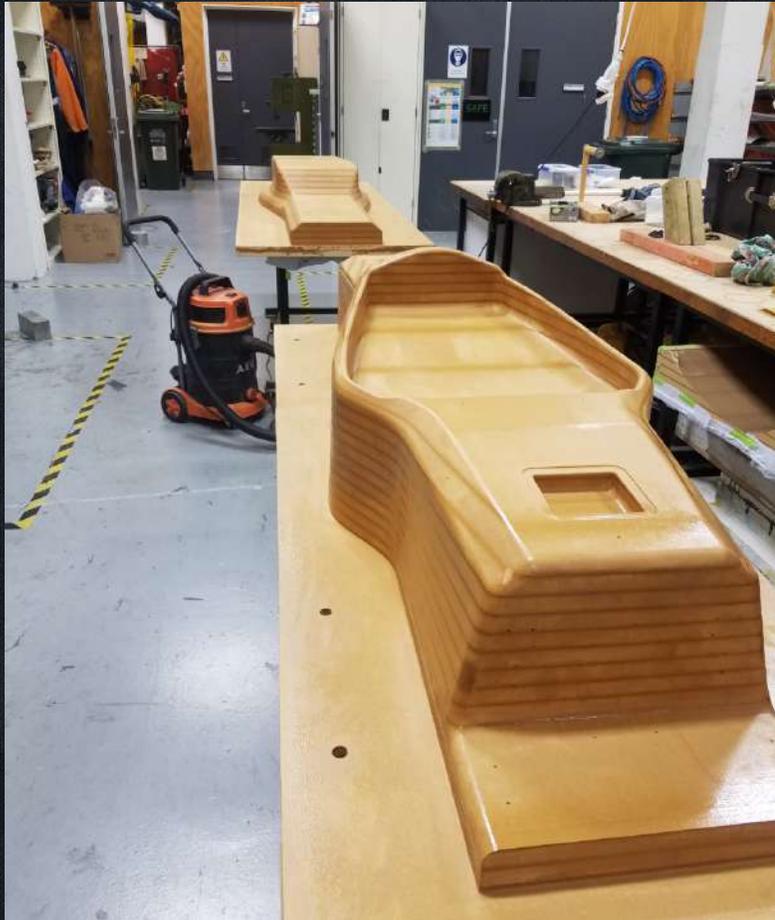
Overall, we have super exciting plans for our new package and I can't thank all of the team members and sponsors that make this possible enough, I hope to have something amazing to show to you all very soon!





Chassis

The Composites Team have definitely hit the ground running these summer holidays. Looking to make the most out of the shifted design cycle, the chassis production is in full swing after receiving our freshly CNC machined plugs from Jackson Industries-Electrical. Plug preparation continues with a good sanding and sealing treatment, providing inspiration into what the end product will look like. With a fresh batch of keen team members, we're continuing to provide the unparalleled learning experience the team is all about. We're well on our way towards mould production in the early new year whilst our design team works hard to deliver the laminate design that will once again bring about a visually stunning, strong and lightweight carbon fibre monocoque!



Suspension

With the team's summer manufacture period now well underway, the suspension team is getting into a range of projects and tasks to ensure the success of the M021 car. The primary focus of the subgroup during this period has been to teach new team members how to use the team's machinery and begin with the manufacture of simple elements required for the car. In addition to manufacturing tasks, senior suspension members have been hard at work finalising the mechanical design of the suspension and steering systems on the car and working with new team members to show them the ropes. Newbies have also been working through supporting design tasks to develop their skills and give them a taste of how the teams larger design and manufacture cycles work.



Events

Tech Night 2020

This year's tech night was hosted on the 23rd of November. Being one of the only significant events of this year, it was a bit of a scramble and challenge organizing the night. Despite the difficulties organizing tech night and the NZ competition commencing three days later in the South Island, the night was a huge success. Here we would like to acknowledge team member Emily Steiner for her many hours of hard work putting tech night together. The event would most likely not have gone ahead if it were not for her efforts.

The evening kicked off with the team mingling with guests, which ranged from family friends to the team's sponsors' representatives. Our newbies had their first chance to formally represent the team and meet the many sponsors who do so much for us. The knowledge gained for the newbies from this event was an essential step to becoming a fully-fledged team member.

Our Team Leader Keith, Chief Engineer Harvey, Marketing Manager Priya and Race Engineer Justin then gave speeches, outlining our progress

in making the M021 and plans for next year. We also took the chance to acknowledge and thank Eva Håkansson, one of our previous faculty advisors who has since left the university, for her contributions to the team. The team greatly benefited from the advice and experience she brought to us, and we are very grateful for her efforts to help steer us in the right direction. To wrap up the evening, Alex our Workshop Foreman, drove the M019 around the carpark to showcase some of the capabilities of our previous electric race car, which mirrors some of the capabilities of our next car (albeit the next car will be even better!).

The team would like to thank all of those who came to our 2020 tech night. It was a fantastic and informative evening where much knowledge was exchanged between guests and team members. We hope to see you again at our next tech night, where more exciting updates from the team awaits!





New Zealand Competition

M014

I was very lucky to be able to drive our combustion car, the M014. I'd like to say a thank you to the former team members that worked on the M014, it's a big statement that it's still competitive. The M014 ran well all throughout the competition. On Thursday morning I took part in the Acceleration event and Josh in the skid pad event. Unfortunately we were limited for time in the morning so we only got to compete in one event each.

In the afternoon both Josh and I put in a great effort for the Autocross event, with us both setting clean laps. It was very exhilarating trying to set a fast lap on an unfamiliar track with cold tyres!

On Friday morning some showers came through, making the track wet. This made for a very slippery Endurance for which we put on our wet tires. One of my favourites moments was when the M019 joined the track in front of me and I followed for two laps. I was stoked to hear there were some good photos taken of that! That moment made me feel very proud for what the team has achieved and I'm sure the other team members were feeling the same

*Claude Griffith
M014 Driver at NZ Competition*

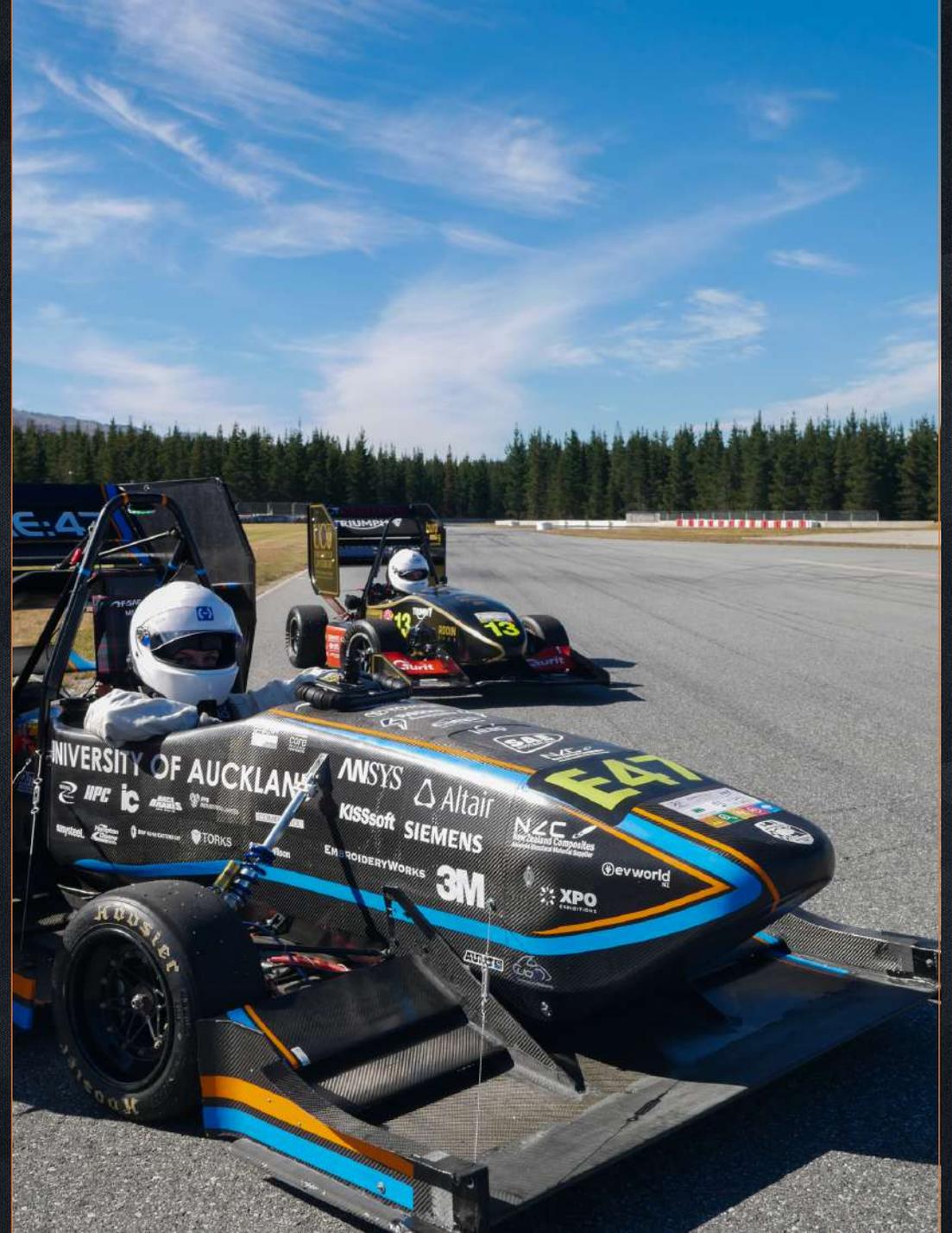




In the M014 was our only previous competition driver, Claude Griffith, and team veteran Josh Hares. Multiple lockdowns and a general lack of time meant that new drivers were not readily available to train this year, so I had to look to experience to fill the seat. Josh had driven both the M04 and M014 before in a casual setting and is a senior team member. Having been both the Chassis Design Leader and Research and Development Leader for the 2019 campaign, Josh has made significant contributions to the team, all while completing a PhD in Mechanical Engineering. I believed all these factors would make him a perfect fit, and it was also one way the team could express some gratitude to Josh and all the hard work he has given to the team.



M019





The M019, on the other hand, was seated with young talent. I put one of our newbies, Alex Barbarich-Bacher, in the driver's seat. I heard about Alex's previous experience in karting in the past, which explained the stellar performance at the Hampton Downs go-karting session we did as team bonding months prior. Having only been in the car before briefly, Alex quickly adapted to the new environment of instant torque and a light and nimble car. While times weren't the focus of the event as a whole, and I only heard whispers of which cars were fastest at which event. From what I was told, Alex in the M019 had the fastest time of all four cars (Canterbury brought the 2018 combustion and 2019 electric cars).

There wasn't much time to rest, with Skidpad directly after Acceleration. While doing the Accel event isn't easy, Skidpad presents a bit more complexity, especially for someone who had never seen the event before, neither in person nor in a simulator. Alex drove cautiously at first, but on only his second lap, he began pushing and trying to find the car's limits. By his last lap, he was flat out the whole way, the data putting him only 2 km/h slower than our time in Melbourne last year, which got us 2nd place in the event. Alex was more than impressive in the morning, and I felt comfortable keeping him in the car to gain more experience for both the Autocross and Endurance events.

Claude and Josh in the M014 had similar performances. Only being able to make use of second gear, the M014 topped out just before the end of the 75-meter acceleration run but still put-up respectable times. However, in the Skidpad, Josh set the fastest time of the day in by far the oldest car. It is a testament to those now alumni who designed and built the M014 that it still runs and performs to a high level to this day.

Before Autocross in the afternoon, it was organized to have a pseudo design presentation where newbies were to make a very short presentation about a particular part of the car. With only the night before to prepare, they did a fantastic job, learning about unfamiliar subsystems then being asked questions by alumni.

With Autocross a couple of hours away, the M019's updated cooling system had its finishing touches. However, Autocross ended as quickly as it began. A technical issue caused a fuse to blow before even one lap was completed, which caused the entire car to go dark. It was an unfortunate end to what was a successful day. It did take some time to figure out what the issue was after returning to our accommodation. Even after the previous night's efforts, Brandon, De Mel, Ray, and Shaun stayed up past midnight to solve the issue. The electronics team has always had a very significant role in the car's operations at competition since 2016 when we switched to an EV. I remember very distinctly last year arriving in Australia and seeing the electronics team for almost 10 hours straight debugging and working on the car, only for them to leave Melbourne after midnight and drive over 2.5 hours to our accommodation in Benalla.



Overnight there were some showers, so we woke up to a wet track! We made sure to pack wet tyres for both cars, but only 2 of the M019 wets were on rims, and we only had 6 in total. This meant that we couldn't swap between the sets as we pleased, so we had to make a call about what we wanted to do. With the local Carter's Tyre Service being occupied by UCM trying to put their wets on some rims and the sun shining, which meant that the track was drying, we decided to send the car out on slicks once the track was dry enough.

Returning to the track, I was amazed to see only a handful of team members in the pits. Everyone else was either marshalling, timekeeping, or looking after the M014. That moment left an impression on me as I was genuinely grateful that everyone was keen to help in some way, which allowed the endurance to run smoothly. The M014 looked striking out on the track, the blue and grey paint scheme looking (I can only imagine) just as beautiful as it did in 2014. I saw a few hairy moments in the tricky conditions, but Josh and Claude exceeded expectations. The M019 rolled out on track soon after, with the worn, slick tires combined with the damp conditions proving to be no match for Alex's calculated speed. After seeing both Monash's combustion and electric cars on track at the same time at Winton in 2019, I remember thinking how cool it was that they essentially had two of their own cars' racing' each other. I definitely felt a similar sense of pride seeing our cars together on Friday morning.

The rest of the day consisted of go-karting, museum tours, and some more testing after Canterbury did some filming. Keep your eyes peeled on their social media for the footage!

We were also lucky enough to visit both Track Tec Racing and Paddon Rallysport Group (PRG). After watching Hayden Paddon compete in the World Rally Championship (WRC) on TV in the last couple of years, it was quite surreal to meet and talk to him in person. Seeing a group of kiwis leading the world by making one of the first-ever electric rally cars is very impressive. The car looked just like any other WRC car from the outside, with a full aerodynamics package with livery, the car definitely looked the part. It reminded me how Bruce McLaren had taken on the world of Formula One over 60 years ago in 1958.

Inspiring kiwis like Bruce and Hayden and his team are paving the way for young engineers like myself and so many others around the country to show that we too can achieve remarkable things if we work hard. I would also like to mention that the electric car PRG has made is unequivocally one of the coolest things I have ever seen. Seeing a driver like Hayden drifting around the circuit was a thing of beauty. It really showed the power of electric vehicles.



Damon Leitch, the Track Operations Manager and kiwi racing driver, let us stay late to finish off testing the M019 and getting some much-needed data. He also waited for us to finish packing the trailer in the pit lane, which we didn't finish until around 9 pm. It's hard to tell the time in Cromwell as darkness hits so late that far south. I am so grateful for his and everyone else's hospitality at Highlands. Deals on go-karting, opening and closing the track an hour either side of their usual times and their confidence and trust in a bunch of students to manage themselves at their racing circuit. Their time and effort allowed us to have this wonderful experience which would have not come to fruition without them. I'd also like to single out Jared Parker from UCM. Jared put a significant effort into making sure the event happened, with weeks of planning and liaising between the track and myself. Without him, I am sure the event would not have gone ahead.

Of course, I cannot end this without saying a massive thank you to all the team members, family, friends, sponsors, supporters, and university staff that made this happen. From Neil Allport Motorsport supplying us with a discount on their last racing harness with half a day's notice, to the Murray family for their everlasting support and patience for the team and everyone on it. We are all learning, and we seemingly without fail, make mistakes along the way. But your unwavering support and confidence to allow us to do what we do is exceptionally humbling. I think about how grateful I am to have the opportunity to do something I love with a pretty awesome bunch of people every day.

If anyone has any questions, comments, or stories to share, I'd love to hear it. You can email me at justin.vasiljevic@fsae.co.nz, or you can stop by our workshop; we'd love to have you!





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