

Quarterly Report, Q1

KTH Formula Student

March 2020



1 Introduction

This report aims to represent the progress and to summarise the operations made by KTH Formula Student during the first fiscal quarter of 2020, from January 1 to March 31.

KTH Formula Student is a nonprofit project where we design, manufacture, test and compete with an autonomous electric racing car in Formula Student competitions across the world. The project is all about learning to work as a team and produce a high-quality product together. The experiences gained from the yearlong project gives the team members a head start in the transit between academic studies and future workplace.

Every organisation has its purpose, during this quarter it is clearer than ever before, our goal is to empower students to engineer the future of e-mobility and autonomous drive. This has been done with the help from our partners, workshops, lectures and visits has provided us and other students at KTH with invaluable knowledge. These resources provided through partners and the team members are accumulated in order to bring value to all of our stakeholders.

2 Comments from the Project Lead

The first quarter of 2020 has been interesting to say the least. We started the year by focusing on the qualifications for the competitions, as we do every year. In the end, the effort payed off and we qualified first for FS East within DV and for FS Germany (FSG) with a good margin, I was so proud of the team and the team was so exited to have qualified for FSG ones again. However end of March FSG officially announced that there will be no competition 2020 with the purpose of not pushing teams to try and finish a car in the current situation.

After qualification we put more focus towards the development of DeV17, pushing for the next deadline, first detailed design that was coming up in April. However, March 15th, the management had a meeting about the development of COVID-19 and the new regulations put in by the government. On that day we decided to minimise all meetings and "cancel" the physical

team-meeting every week, instead we are having digital meetings. Shortly after we decided this KTH revoked all access to the garage and KTH.

COVID-19 has affected the whole world and we know people have effected more than we, so there is no reason not too stay positive. Since we had planned a 2-year project, we do have time to delay the project, and instead focus on a deeper development of each subsystem meanwhile still having more time for testing than previous years. So in the end I do believe that we will be able to create a great car, maybe even a better car with the extra time put into the development.

3 Economy

3.1 Financial Results

Income (SEK)	
Income from sales	0
Sponsor contributions	29953.06
Total income	29953.06

Costs (SEK)	
Office supplies	61.88
Operational costs for events	0
Depreciation costs	0
Acquisition of components	21025.04
Travel/freight expenses	7585
Administration costs	1175.826
Other	0
Total costs	28671.92

Profit (SEK)	1281.134
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3.1.1 Notes

Several purchases were made during this quarter, including the main motor and other parts, with their respective depreciation estimates listed below.

Sponsor contributions is not directly deposited to us, but instead goes through KTH. It also refers to the debt collected from KTH from accrued compensation from Q3 and Q4.

3.1.2 Depreciation estimates

Lifespan (Years)	
Machinery and components	3
Some office supplies	5
Consumables	0.25

3.2 Balance Sheet

Assets (SEK)	
Current assets	
Cash	0
Inventories	140625
Accounts receivable	0
Total current assets	140625

Fixed assets	
Equipment	140625
Total fixed assets	140625

Total assets	281250
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Equity and liabilities (SEK)	
Current liabilities	
Accrued expenses	227661
Accrued compensation	19443.21
Total current liabilities	247104.59

Long term liabilities	0
Equity	34145.41
Total equity and liabilities	281250

3.2.1 Notes

Notable in the balance sheet, cash is 0, and accrued expenses is relatively high at 227 661 SEK. This is a result of the current pandemic, leaving a lot of our partners in a tough situation, something we are in complete understanding of. Looking after their own responsibilities and company, several partners have chosen to terminate their current partnership agreements, leaving us with no partnership incomes (accounts receivable) and therefore a lower than expected cash position. As mentioned above, no partner is at fault, as this is an understandable decision.

At the time of writing, the possibility for partners to offer monetary compensation are at an all time low. This however, does not necessarily mean that partnerships have to end. Several partners have chosen to offer mentorship programs and assists the projects in other ways, something we value tremendously and are very thankful for. Due to the nature of the situation, any aid to the project is greatly appreciated, especially knowledge and experience.

4 Summary of Q1

Q1 started well with all new projects going off with speed. However, when the pandemic struck and the Swedish government put regulations up regarding big gatherings and keeping smaller gatherings to a minimum, we in KTH Formula Student took the decision of starting to work digitally. One week later, in the middle of March KTH Royal Institute of Technology decided to close the entire school locking us out of the garage. Since then all projects meetings, workshops and team building events have been held online. The plan right now is to adapt to the situation, we do not know when we can start manufacturing parts yet. Therefore we are cautious of making plans to far ahead, and try to get trough this one week at a time. Trying to make the best of the situation and utilising this time to prefect our designs and document everything properly on the teams newly created Wiki page.

Due to covid-19 Formula student Germany has made the decision that no competition will be held during the summer of 2020, which have led to termination of all projects regarding our car dV16. All our team members are now focusing on the development of our upcoming car DeV17, that is going to be our flagship car for 2021.

4.1 Subgroup summaries

The next section will include summaries from the different subgroups of the team, what states they are in and the progress that is being made. The situation around covid-19 has affected us all differently, and some are even affected by the virus themselves. We are a team with people from all over the world, away from their families. Therefore we are trying to make everyone feel like they have a place here at KTH Formula Student, and there are

people that care about them. A big priority right now is the physical- and mental-health of our team members.

4.1.1 Aerodynamics and composites

We had a strong start to the year, encouraged by plenty of useful feedback received at the end of the Conceptual Design phase. Some projects were clearly on the right track, others had been a little too ambitious and therefore needed readjusting, but the group was confident and eager to continue. In January we finally received our licences for Star CCM+, which was a fundamental step, granting us the opportunity to validate our designs. In the following weeks, however, we encountered some difficulties, most of which were related to the necessity to integrate the aero package with the rest of the car in a harmonious manner. The onset of covid-19 also slowed the progress, as working from a distance and the inevitable delay of the manufacturing have harmed the enthusiasm and reduced communications between members.

The silver lining is that we now have the whole summer to conduct more iterations of our designs, which has positively reduced the pressure on the members, as well as to plan manufacturing in more detail.

4.1.2 Powertrain & Electronics

The powertrain group has been working with the battery design, motors, and motor controllers. We participated in a 2-day training session in Stuttgart hosted by AMK, the supplier of the inverter and motor package. The training session covered an introduction around the motor kit as well as a tutorial on configuring and tuning inverter parameters. The battery group has focused on finalising the energy simulation to establish the physical and electrical dimensions of the battery and the integration with the enclosure design. Finally, focus has also been put into the thermal simulations for the powertrain to help decide the requirements for the cooling system.

For electronics group the main focus has been to progress with the design of the different systems, including, but not limited to, data acquisition, controls, safety systems, etc. The development of the different software's that will accompany the electronic systems has also started. In collaboration with Business and Marketing the team has also secured the sponsorship of

a Swedish PCB manufacturer: NCAB, as part of a collaboration with the team. The agreement includes both support and mentorship around the PCB design and manufacturing for the boards designed by KTH Formula Student

4.1.3 Vehicle Dynamics

The VD group started this quarter with finalising the concepts for our designs. The analysis for our new tyres was completed and model files were made to be used by other projects. They were also used in the overall vehicle analysis along with tools like MMM diagrams. The suspension group decided to go with a decoupled suspension with three dampers, two for roll and one for heave. They started with the placement of hardpoints. This took a long time as many compromises had to be made between packaging constraints and performance. Steering design started with a simple 2D model which was later extended to a 3D one and integrated with the suspension. Currently both suspension and steering are doing kinematic analysis of their designs in ADAMS. Brakes group focused mostly on packaging of calipers in the smaller rims and an efficient way of implementing regen logic in the master cylinders, some compromises had to be made here too. The controls group started by modifying the existing controllers for the four wheel drive concept for next year. Specifically, they have been working to integrate traction control, torque vectoring and regenerative braking control with each other. By the summer we aim to complete our designs and continue our analysis on our designs. Validation of different parameters and testing would also be planned during the summer.

4.1.4 Mechanical Design

Q1 started of good for MD. The concept deadline is now behind us and most of us worked with developing detailed designs based on our concepts and the feedback we have received. In the meantime we are all working with improving our documentation using our brand new wiki page. This will make it easier for everyone to have an insight in other projects, and for the future it will make it easier to navigate our documentation.

Now we have our eyes on our designs and how we can optimise them. By doing so we are using different kinds of CAE tools that our partners and our school has provided. With the current situation around covid-19 we are

postponing the manufacturing phase, this will allow us to make sure that all of our parts and designs are as good as they can be. The goals for this summer is to continue the design phase and improve them even more. We hope that the situation around covid-19 will improve so that we can return to school and start working on the manufacturing, and eventually start to assemble our new car in the upcoming future.

4.1.5 Driverless

In general, our focus in this first quarter has been to finish setting up our pipeline and move on to testing with the racing car. Some important developments have been the integration of our cone detection neural network on our ROS pipeline and the integration of our communication interfaces (CAN) with the car sensors (SBG IMU, wheel encoders, steering actuator). From a development perspective, we started using 3rd party cloud providers, but then we switched to Qarnot, one of our sponsors, which has enabled us to train complex models on the cloud. We did some tests with the car without High Voltage (basically testing algorithms while pushing the car), but then we had to stop because of the corona crisis. This has impacted our testing phase, so in the meantime we are improving the systems that we managed to test, as well as documenting on our new wiki server. Another challenge we had testing on campus was that the GPS signal was affected by the surroundings (mainly buildings nearby), so that made it difficult to test. Finally, we are also working on simulations and looking for ways in which we can automate the evaluation of our algorithms

4.1.6 Business & Marketing

First and foremost we would like to thank all our sponsors for standing by the team even during these hard times we are facing. The primary focus for Business and Marketing this season is to further collaborate with the industry, and to keep looking for experienced mentors that are willing to assist the team within different projects. At the time of writing, the BM group is getting a head start on the static events for the Formula Student competition in preparation for the competition season 2020/2021, this includes a business plan presentation and a cost and design report. The coming quarter of Q2 and Q3 we will see the exciting implementation of KTH Formula Student rebranding which has been worked on during the previous quarters.

4.2 Improvement Group

This quarter, the Improvement Group has actively focused on finding ways of improving the overall workflow of the team. The work has resulted in the creation of an online documentation platform that is being used for efficient knowledge transfer. The documentation system, that is based on the MediaWiki platform, was developed by the Improvement Group with some key factors in mind. Due to the nature of a Formula Student team, the team consists of full-time students that are normally spending two to three years in the organisation. Because of a high student turnover rate and time being a precious resource, the organisation must work efficiently and smart to be able to stay competitive. In the past, knowledge transfer has been one of the biggest problems facing the team. The wiki system is therefore designed to end this problem once and for all. Listed below are the main goals of the documentation system from a technical perspective:

- Simplify the process of acquiring information about any system that has been developed in the past.
- Having a common and user-friendly place for documentation.
- The documentation is standardised with agreed-upon guidelines.
- Documentation also includes discarded design concepts and further development suggestions to save time for future design engineers.
- Having a system that guarantees up-to-date system information.

The document system has already proven to be successful. As of the end of the quarter, 90 content pages have been created since the system was set up and circa 1100 page edits have been performed. This number is expected to only increase with time and will be an essential part of future engineering success in the team.

5 Upcoming quarter

This quarter will be a special one due to Covid-19. Currently, there is no sign that we'll come back to the garage before the summer and manufacturing will most likely start during the summer or the autumn. We will still be working

with all the designs and do the best we can for the upcoming deadlines. The plan now is to re-evaluate all decisions we've taken and try to re-define our goals to match the time and money that we have. We are doing the best we can to make the most out of the situation we're in right now. Since there is no focus on dV-16 anymore, we're shifting our attention to make a lot of testing for this autumn. Especially for driver-less this could be a huge advantage, and they will take this opportunity to test as much as they can to be fully prepared for the season 2021.

For manufacturing, there is no signs of KTH opening soon again. So our full focus are on design. With some luck, manufacturing will start during the summer and have a car ready late 2020 to be fully ready for the fall 2021.

6 Covid-19

As with the entire market, covid-19 has presented a hurdle for us, not only on how the project is worked on, from not being able to directly work on the car itself to not being able to attend in-person meetings. But additionally, as a non-profit such as ourselves, one is heavily dependant and the relationship one has with its partners are crucial to the operations and project itself. The latest project DeV-17 has had its financial issued in the form of funding and components, an issue that is further magnified due to the situation. Furthermore, some of the mentorship-programs established last season has also been put on hold. In the meanwhile, we are receiving frequent updates from KTH and following the recommendations given by The Public Health Agency of Sweden.

The team has completely gone to online communications, successfully integrating all team meetings and workshops into online platforms. During this time of isolation the health and well being of each individual team member is of the highest priority, where various leisure activities are hosted online to make the team members remain connected and feel less isolated. As previously mentioned in section 3.2.1, we would like to emphasize that we are very grateful for all the sponsors who have been continuously supporting us even in their time of crisis.