IW 2019 Final Report
Team #38

Week 1

In the beginning of the week we were assembled as a team for the first time – with different backgrounds and unique skills, which (as we found out later) comes in handy for a variety of reasons. At first, we had 3 completely different ideas of what our project should be: a self-heating container for food, a drug-sorting machine for the hospitals or a particle collector for a satellite engine (the last idea was suggested on the Project Fair by CDMM department). During the Speed Dating session, we described our ideas to several mentors and discussed our options with them. As a result, after weighting all the pros and cons, we have decided to go with the particle collector for ABEP satellites. It seemed like the most promising project, giving the fact that we had a space engineer, a specialist in 3D modelling, a wide-skilled physicist and programmers.

The first step was to really understand the project – by reviewing literature and discussing it with Anatoliy from CDMM department, who was the author of the original idea. After that we came to realize what will be the technical aspects of our prototype, how to assemble the circuit for it, and theoretical basis of orbital mechanics. We separated the roles in our newborn project and started to work.

Then a raw market analysis was performed. We contacted several people from industry and academia (Sputnix, TSAGI, Space Center at Skoltech) and arranged meetings with them for the next week. At the same time, the first work at Fablab has started. After the 3D models were done, the 3D printing started simultaneously. Also, the first coils were constructed by the end of the week.

Figure 1. Team #38 at "Quick Failure" Friday

At the "Quick Failure" Friday we presented our project for the first time – and weren't too successful with it (and we also had only one team member presenting our project). As we see it, we failed to describe our problem and solution properly, therefore most of the mentors couldn't understand our project and its value to space industry. Also, we had no chance to

create a prototype in such short time. But we had some really useful feedback and suggestions from mentors, so we knew how we can get better.

Week 2

The 2nd week started with discussing our project with assigned mentors, who all gave us useful advice – Stefano, who is in space industry, helped us with understanding the real value of our technology and potential market; Johannes helped us with our business model; Pavel, who was the head of our cohort, helped us to improve our problem statement and highlighted our weak spots, which eventually leaded us to get better.

At the 2nd week, we laid out the design of the prototype. The 3D modelling and printing continued, also we began to cut out some details with laser. The calculations for coils and circuit were performed, so the soldering began as well. Programming, which was needed for the coils, was also performed during Week 2.

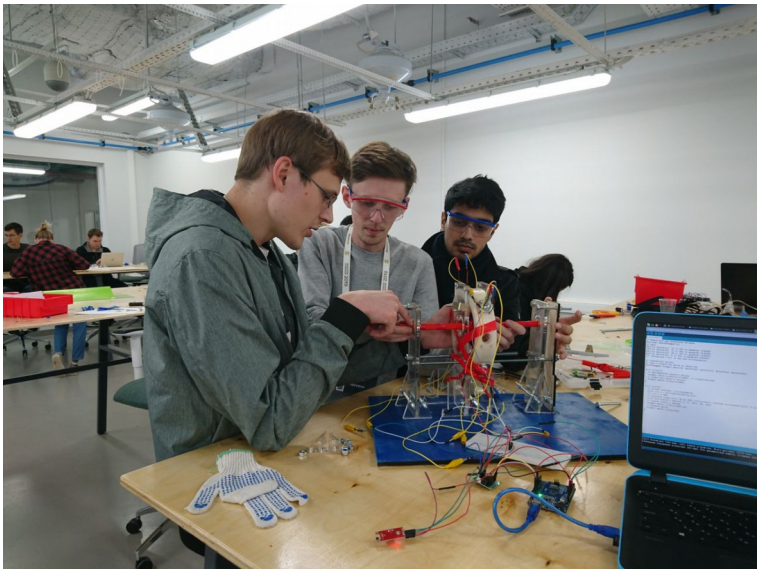


Figure 2. Assembling the prototype at Fablab

We met with Anatoliy, who is a Marketing Director at Sputnix. Not only was he positive in his feedback on our idea, he also suggested us using their launching platform, which meant that if we have a real working prototype, they can help us with sending it to space.

The next day we met Alexander, who is a Lead Researcher at TSAGI – one of the most famous Russian institutes for aerodynamics. He dedicated several years to studying the ABEP, however, focusing mainly on the passive intake. Our solution for active intake seemed great too him, because usually such technologies are too heavy and not feasible after all, but we managed to overcome this problem.

At the same time the other part of our team assembled our first prototype, which took a lot of time and effort. The successful separation of the roles led to a great piece of technology, both working and good-looking. Also, the additional market analysis was performed, we got the scientific and engineering validation for our project.

At the “Dry Run” Friday we performed much better – we improved our presentation (and all team members were presenting that time), we had a much better presentation and we succeeded in explaining our problem – however, still weren’t too good in explaining the

solution. But we had a great working prototype, which was one of the main reasons we were at Top-3 in our cohort that time.

Figure 3. Team # 38 and our mentor Johannes with the prototype at "Dry Run" Friday

Week 3

The final week of the IW again started with discussing our project with mentors – but this time different ones. Timothy helped us realize why we fail to explain perfectly our problem and solution; Rakshit helped us restructure the whole presentation and explained how the problem statement should look; Pavel gave us useful advice on almost every part of our presentation.

As a result, we completely changed the structure and the design of our presentation, making it not only clearer for understanding, but also much better looking. We focused more on the technical description, to make it more understandable for mentors.

At the same time the work on the prototype continued. The new coils were made and programmed, new shafts were printed out and tried on the prototype, some changes in design were made to make our prototype more aesthetic. This was the toughest week, during which our engineers and programmers had to stay for the night at Fablab, constantly improving our work. Of course, the other member of the team tried to help them out in any possible way. And a smaller version of prototype was assembled – to show to mentors that we really can scale our technology.

We also got feedback from Stefano, who was our mentor during 2nd week – he said that our technology “has unlimited potential to revolutionize the space industry. We also tried presenting our project at CDMM department to show them our progress and to improve our presentation.

At the “Final Cut” Friday we managed to present a great presentation and an even better prototype. We really did improve in all parts of our project, which led to a successful performance and fascinating piece of engineering. We applied most of our mentors’ advice and worked really hard, which helped us to finish in Top-3 in our cohort, which is an excellent result.

Finally, we think the main goal of IW was achieved – we see that a random team of skillful people can make almost any project in short time – of course, if they want to.

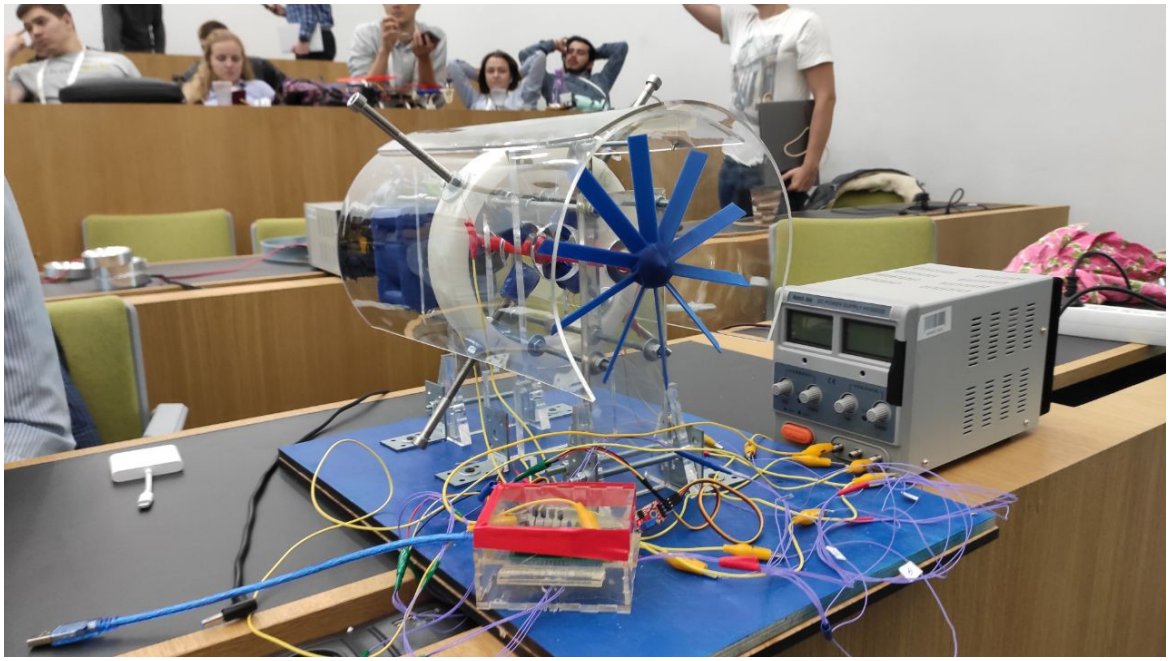


Figure 4. The final prototype

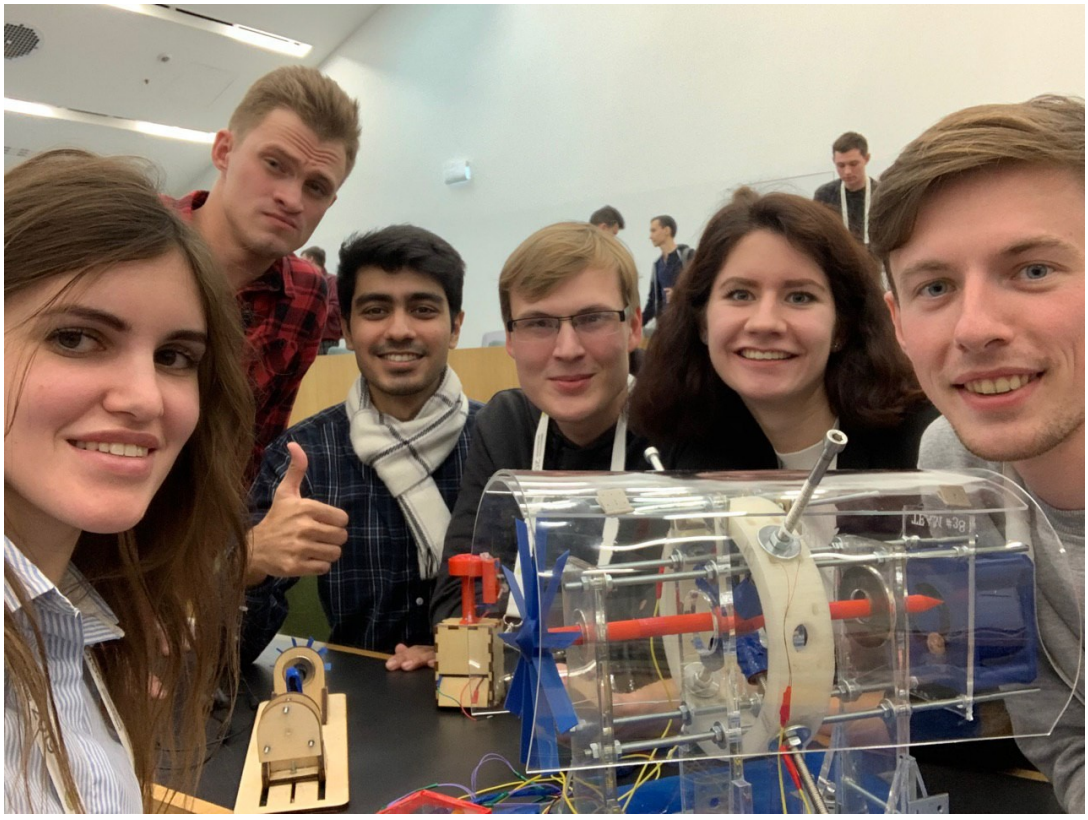
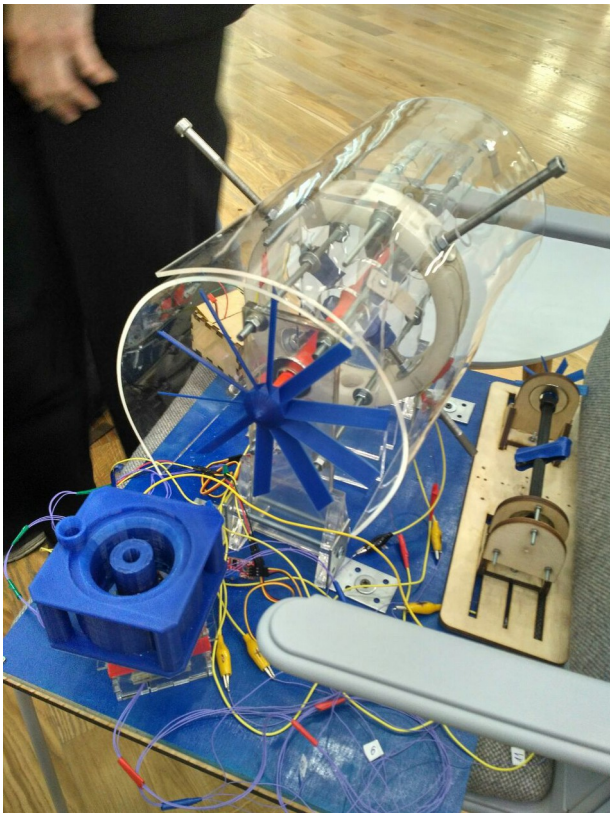
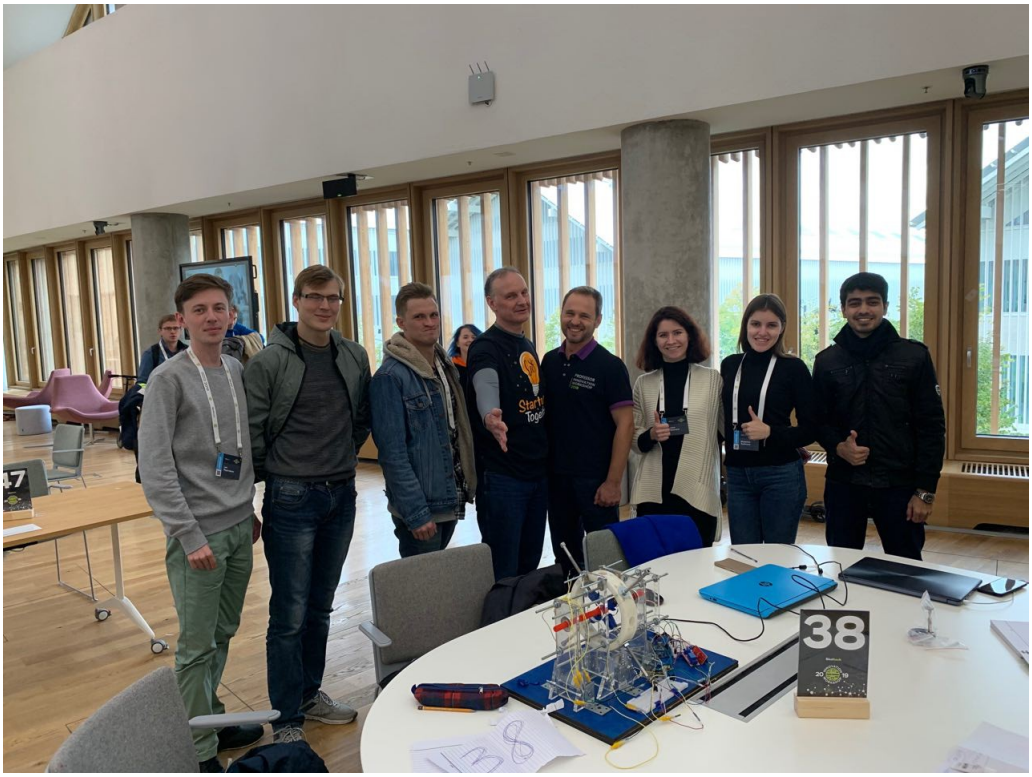


Figure 5. Team # 38 and our prototype at "Final Cut" Friday

Appendix



Two final prototypes



Team #38 with Dmitriy and Pavel – cool people and awesome mentors

Altitude: 206 km (dm=0.194 mg/s);
GSR = 100 cm;

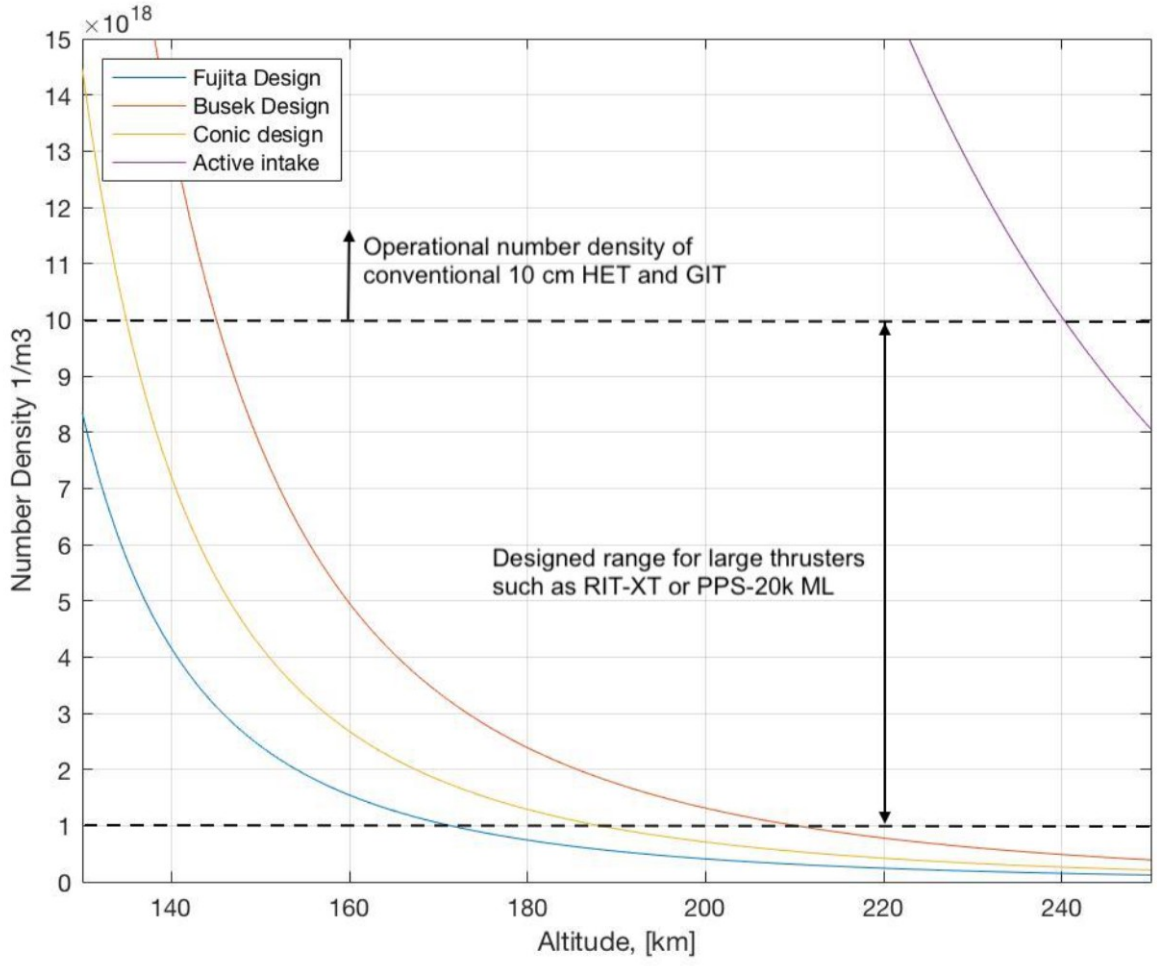
Geometry:
Diameter: 0.5m
Length: 1.46 m
Solar arrays area: 1.9m²

Body Drag = 3.77 mN (Cd = 2.87)
Panels Drag = 1.65 mN (Cd = 19.1)
Overall Drag: 5.42 mN
Available thrust: 6.9 mN

Calculations

	Physical Parameters	Model Predictions			Examples	
					Quickbird	GeoEye-2
1	Orbital Altitude (km)	200	400	800	482	681
2	Resolution (m)	0.5	0.5	0.5	0.65	0.32
3	Payload Aperture Diameter (m)	0.22	0.44	0.88	0.60	1.10
4	Spacecraft Dry Mass (kg)	24.4	194.8	1,558.6	995.0	2,086.0

Table for Very Low Earth Orbit



Active intake solution feasibility

Team #38 with Anatoliy from CDMM department