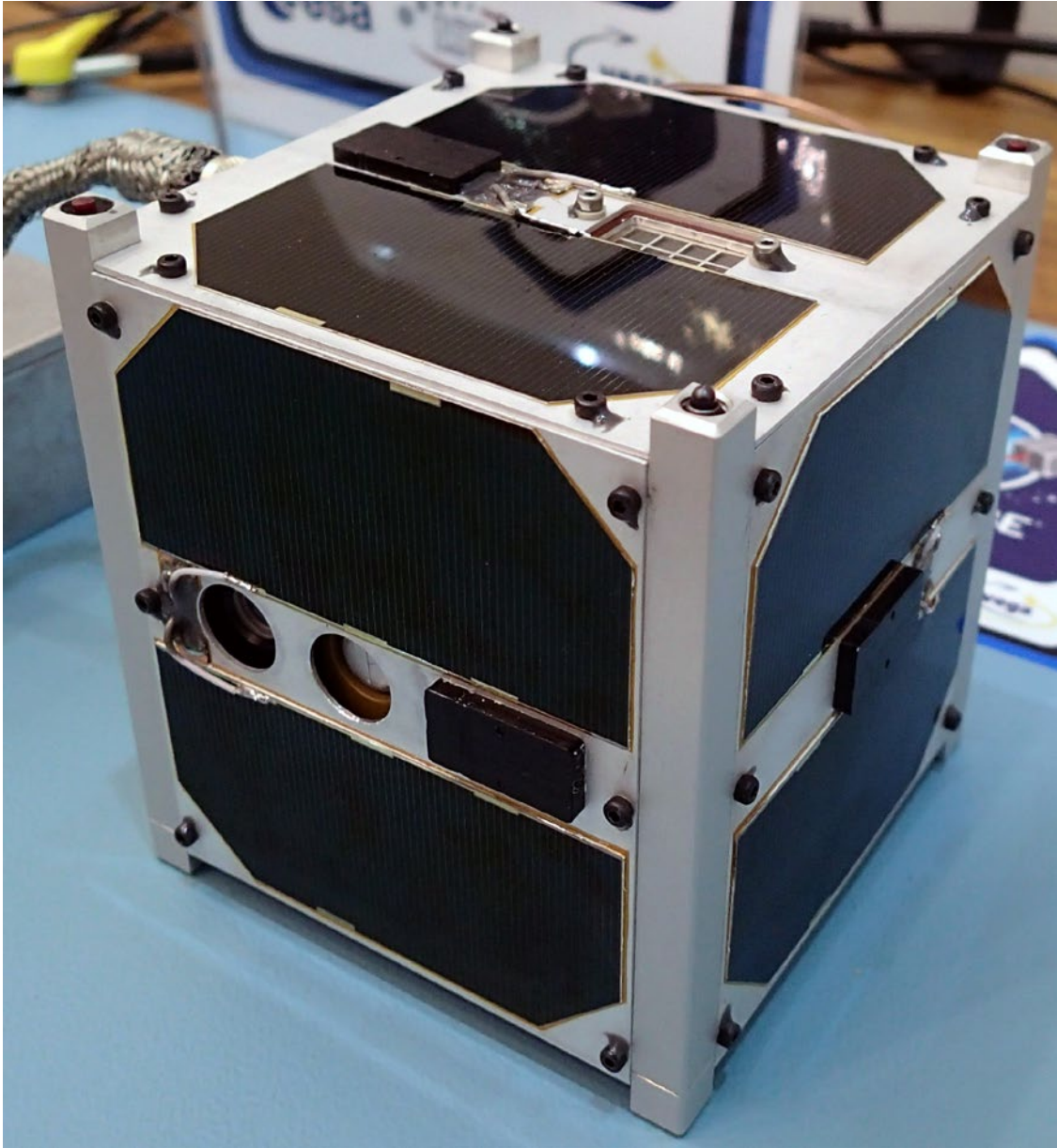# TALLINN UNIVERSITY OF TECHNOLOGY
LAUNCHING ESTONIA'S FIRST SATELLITE WITH SOLIDWORKS EDUCATION EDITION

With SOLIDWORKS Education Edition software, a team of students from Tallinn University of Technology, Tartu University, the Estonian Aviation Academy, and the University of Life Sciences designed and built the ESTCube-1, Estonia's first satellite, which will test deployment of an electric solar wind sail.

TALLINN UNIVERSITY OF TECHNOLOGY

Challenge:
Design, build, and launch Estonia's first satellite to conduct proof-of-concept testing of the electric solar wind sail, an innovative space propulsion system that leverages the solar wind.

Solution:
Utilize SOLIDWORKS Education Edition software to coordinate design and production of the satellite among engineering students and scientific research and manufacturing partners.

Results:
- Created first launched Estonian satellite
- Improved coordination with student, research, and manufacturing partners
- Streamlined exchange of part/assembly models for production
- Facilitated communication with eDrawings and photorealistic renderings

When the ESTCube-1 satellite blasted into space atop a European Space Agency (ESA) Vega rocket on May 7, 2013, it was the first Estonian-built satellite to enter Earth's orbit. The tiny 10 centimeter by 10 centimeter by 10 centimeter, 1.05 kilogram satellite was built as part of the Estonian Student Satellite Program to perform proof-of-concept testing of the electric solar wind sail.

A team of students from Tallinn University of Technology, Tartu University, the Estonian Aviation Academy, and the University of Life Sciences undertook the challenge of designing and building a small satellite to carry a payload to test electric solar wind sail deployment. Invented at the Finnish Meteorological Institute in Finland by Pekka Janhunen, the electric solar wind sail uses a system of electrically charged wires that act as tethers when deployed to form a sail. Given a negative charge by an electron gun, the tethers are repelled by the positively charged protons in the solar wind, propelling spacecraft at speeds of up to 30 meters per second. The system has the potential for the development of faster, less fuel-intensive space propulsion systems.

According to ESTCube Structure and Mechanics Subsystem Manager Paul Liias, a mechanical engineering master's degree student at Tallinn University of Technology, the team needed an effective 3D design platform for developing the satellite and collaborating with manufacturing and payload partners. Prior to joining the ESTCube project in 2008, Liias had a choice of using SOLIDWORKS® Education Edition or Solid Edge® software for his Tallinn University of Technology product development courses.

"Growing up, I always had an interest in aerospace, which is why I was eager to join the ESTCube project," Liias recalls. "I knew SOLIDWORKS software came from Dassault Systèmes, developer of CATIA® software, which is the best-known design tool for aerospace development. I also wanted to start with a CAD program with a good interface that is easy to use, so I chose SOLIDWORKS.

"When we needed a CAD platform for the ESTCube project, SOLIDWORKS was the obvious choice," Liias adds. "Not only was SOLIDWORKS my preferred design solution, it was also what the students at Tartu University used. We did a lot of collaborating on this project, and SOLIDWORKS provided important advantages."

DEVELOPING SATELLITE ASSEMBLY
Using SOLIDWORKS Education Edition software, the student team developed all the CAD models and production drawings for the ESTCube-1 satellite. "SOLIDWORKS was the right choice for this project because in many ways we were learning while doing," Liias explains. "Since we were learning how to design, manufacture, and assemble a satellite to carry the electric solar wind sail payload, we needed a development platform that was easy to learn and use, and that wouldn't impede our progress.

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>
> — Paul Liias,
> ESTCube Structure and Mechanics Subsystem Manager

"With the entire student team working in SOLIDWORKS, we developed individual part files as part of smaller assemblies, and then combined them to complete the whole assembly," Liias continues. "SOLIDWORKS helped us streamline the exchange of part and assembly models within the student team, as well as with payload and manufacturing partners."
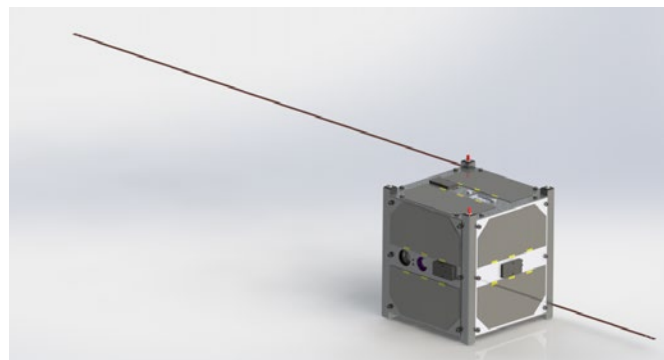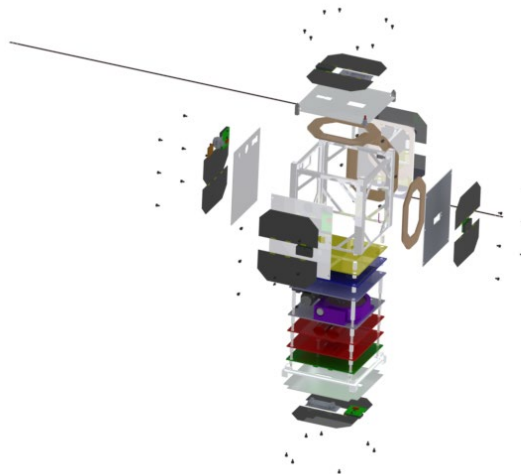
COLLABORATING WITH PARTNERS

While the satellite was designed as part of the Estonian Student Satellite Program, the Finnish Meteorological Institute and the German Aerospace Center developed the satellite's payload. The student team also leveraged the production resources of Protolab in the Tartu Science Park and other manufacturing partners. In this highly collaborative project, communication was a critical requirement.

"SOLIDWORKS software made it easier to communicate within the team and with project partners," Liias stresses. "We used the software to create photorealistic renderings to demonstrate our concepts and eDrawings® files to share information on specific CAD models. We also took advantage of Skype to conduct online meetings and share our screens to show certain things in SOLIDWORKS."

CATCHING THE SOLAR WIND

In addition to working on the student team, Liias worked with engineers at the German Aerospace Center to refine the deployment mechanism for the electric solar wind sail, which uses a reel system to unwind the wire tethers. Due to anticipated high vibration, the team needed to design a wheel lock to account for the end mass during tether deployment. Liias used SOLIDWORKS software for that purpose.

"The ESTCube-1 satellite was a great project and the first real engineering experience for many of the students on the team," Liias notes. "We are all proud to have been involved in Estonia's first launched satellite. Using SOLIDWORKS helped us complete the project successfully."

SOLIDWORKS design communication and visualization tools facilitated collaboration between the Estonian Student Satellite Program and the satellite payload developers: the Finnish Meteorological Institute and the German Aerospace Center.

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