aris

space to grow

ARIS Annual Report 2018/19

Summary of activities of the cycle from September 2018 to 2019

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Official Annual Report of ARIS for the fiscal year from September 2018 to September 2019

Issued by the ARIS association board on September 28, 2019

A year of growth

EXECUTIVE SUMMARY

A rocket project ranking overall 4th of 121 teams at the largest international rocket engineering competition, developing a hybrid rocket engine test facility, establishing a long-term strategy, improving the internal processes and IT, new partnerships, STEM events and keynotes with stellar speakers - thanks to the solid foundation from the previous team, ARIS grew in the academic year 2018/19.

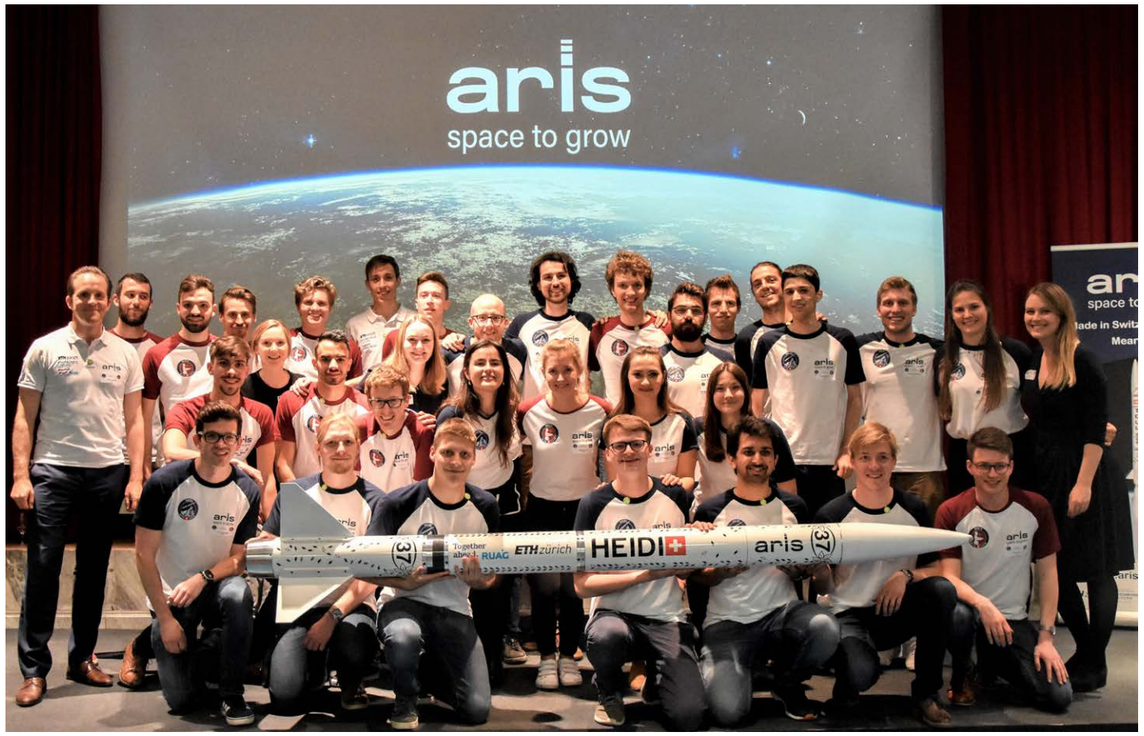
ARIS grew in almost every aspect. The lessons learned from the first cycle, combined with engaged members enabled to streamline the activities and define a mid- and long-term goal: to win the Spaceport America Cup with a sophisticated system in the highest category by 2024 and fly a system in orbit by 2029.
Reaching for the stars seems 2840 meters easier due to the succesful flight of HEIDI at the Spaceport America Cup 2019. With its phenominal 2nd rank in the category, the 4th rank overall, and an honourable mention for safety, project HEIDI encouraged to go further and address new challenges. One of them: the development of an own hybrid rocket engine and its testing facility in the project RHEA since September 2018. A first static firing is planned before the end of 2019.
ARIS is in good fiscal shape and has achieved all its financial goals. Project HEIDI came in under budget by approximately CHF 7,000 and was able to provision CHF 3,900 for the second project cycle. A small book profit is remaining to cover VAT reimbursement uncertainty. In the meantime, ARIS emergency reserves were increased to CHF 5,000.

In the next project cycle 2019/20 ARIS focuses on mastering new challenges: flying a supersonic sounding rocket to 30'000ft, developing and testing our high-end hybrid rocket engine and its facility with a Focus Project at ETH Zürich, implementing a Strategic Development team to streamline activities for the future, and standardizing our internal processes. We are looking forward to reach the next level together with our partners.

We are most grateful for the support that enables us to lift-off with our visions!

Zürich, Switzerland.

1. ARIS Report of Activities in 2018/19

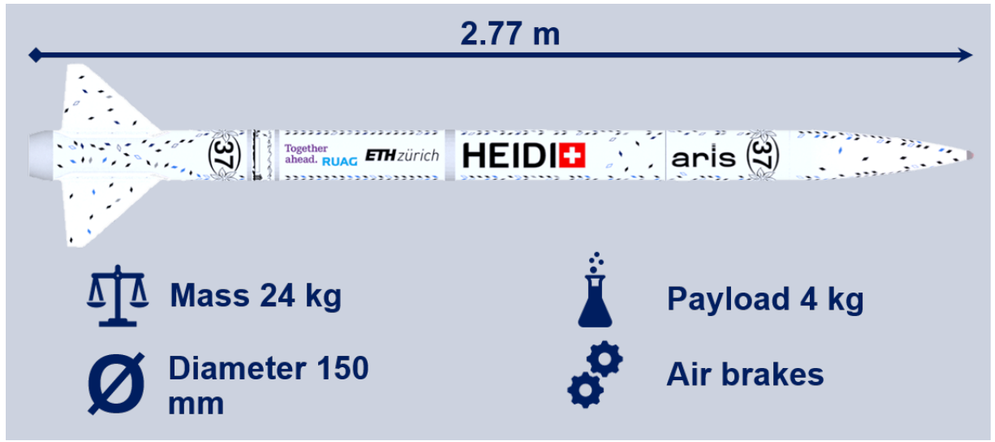


In 2018/19 ARIS streched the boundary of what we believed to be possible. This fiscal year created a momentum of fascination on the solid foundation of project TELL: 80 ARIStronauts developed a high-ranking sounding rocket and a sophisticated engine test facility, attracted top-of-the world space explorers, and carried their passion and courage into the World.

Today we can proudly say that ARIS won two prices in two years, ranked second on an international platform with its second project cylce and strives surely towards the first firing of ARIS' own engine. All these achievements result from combining students and initiative partners that are active beyond the ordinary. Thank you all for achieving these big steps together!

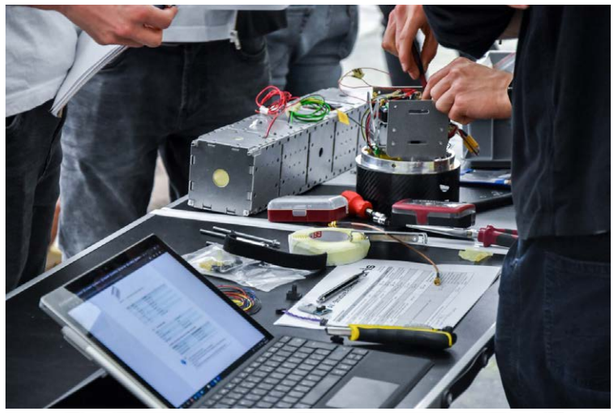
1.1 Project HEIDI ranks 2nd at the Spaceport America Cup 2019

In September 2018 the second sounding rocket project of ARIS, Project HEIDI, launched its journey towards Spaceport America Cup 2019. Together, 30 students from ETH Zürich, HSLU and ZHAW built a launch vehicle that can reach exactly 10'000 ft while carrying a payload of 4 kg. Additionally, a highly reliable recovery system should guarantee reusability.

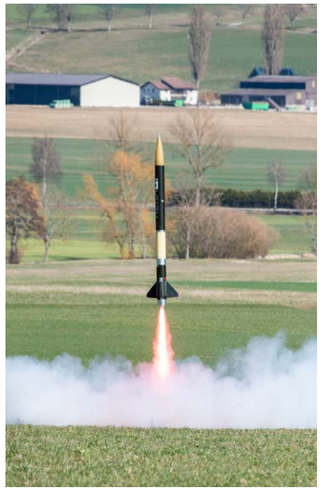


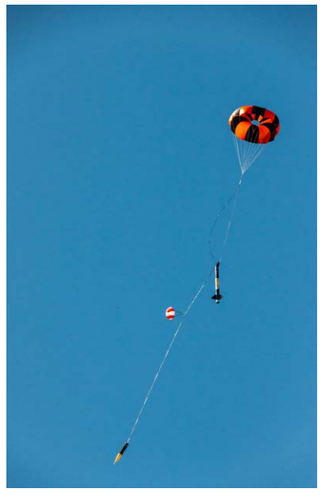
In the first phase of the project the team combining ten different nationalities and eight fields of study, concentrated on finding the most promising concepts and designing the system. With the help of a review board of experts from academia and industry, the best concepts were evaluated in a preliminary design review (PDR) in October 2018 and design input was gathered in a critical design review (CDR) in November 2018. Both reviews were conducted in cooperation with the EPFL Rocket Team.

The second phase of the project started with the manufacturing of all the parts and peaked at the wind tunnel test where the team validated its simulations. This raised the confidence to go for HEIDI's maiden flight in Val de Ruz (CH) in end of March.



At this test launch, HEIDI reached approximately 1'100 m above ground with peak accelerations of 6 g and a safe recovery of the system. This event marked a huge milestone for ARIS as it was the first successful launch of its student developed sounding rocket. The launch revealed minor design flaws which had to be solved in only a few weeks. This was also deeply investigated in the readiness review together with the EPFL Rocket Team in Lausanne.





Eventually, nine months of challenges, hard work and night shifts were about to peak at the Spaceport America Cup 2019 in New Mexico, USA. The competition started with the poster and podium session in the convention center of Las Cruces, New Mexico. The HEIDI booth was crowded with students of universities from all over the world, judges from the competition and sponsors of the event. The Podium session describing HEIDI's highly integrated avionic system was fully booked.

Eventually, the rocket was prepared in the vertical launch area of Spaceport America in the desert of New Mexico under extreme outside temperature and wind conditions. With the whole team waiting anxiously, the rocket was installed on the launch pad and the launch button was pressed on Thursday 20. June 2019.

A nominal flight

It was a stunningly beautiful flight: Upon lift-off, HEIDI flew on an unperturbed, straight path to apogee, separated and the drogue parachute deployed. Close to the ground the main parachute deployed as expected and the rocket could be recovered without any damage. The on-board flight computer registered an apogee of 9298 ft or 2834 m. This shortcoming compared to the target apogee of 10'000 ft was a combination of mass added to the rocket for increased safety and an underperforming motor burn.

2nd Place in the category and an honourable mention for safety -

- Rank 4 at the largest international Rocket Engineering Competition

The hard work paid off. Project HEIDI reached 1010 points out of 1000 (bonus points for early launch and payload formfactor), scored second out of 46 teams in its category and fourth place out of 121 competing teams overall. Additionally, Team HEIDI's effort to put safety in the middle of their operations was recognized with an honorable mention for safety.

The closure of the project cycle took the form of a Wrap-Up event for team, industry and academic partners and the interested public. With the start of the new ARIS projects for 2019/20 in September ARIS is looking into a very promising future!

Abhimanyu Bhadauria
Andreas Walker
Bogdan Danciu
Deia Melchior
Eashan Saikia
Ertekin Sarper Melik
Fabian Wiesemüller
Felix Dannert
Jérôme de Viragh
Julian Haug
Luca Somm
Lukas Rother
Manuel Gerold
Marco Torredimare
Marko Lovrinovic

Mirela Minkova
Muriel Scherer
Nikola Radevic
Nikolaus Vertovec
Otso Gächter
Pascal Steinmann
Pascal Sommer
Paul Prantl
Petar Jokic
Roland Schwan
Sam Bodry
Severin Kiefer
Sven Kiefer
Timo Laaksonlaita
Tom Kuchler

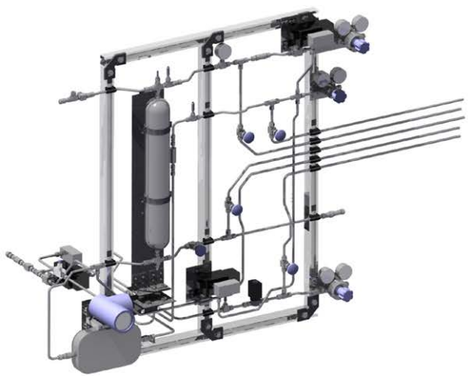
1.2 Project RHEA paves the way for ARIS rocket engines

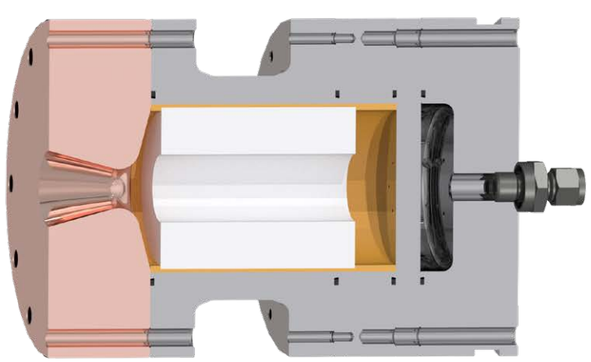
Team RHEA, named after the greek godess, is developing a first generation hybrid rocket engine and a test facility in parallel since September 2018 to lay the foundation for future engine development projects.

Two shipping containers are used as an enclosure in which the whole test equipment is integrated. The containers are divided into three compartments:

- **Engine compartement:** contains a test bench on which the engine is mounted and the thrust generated by the engine can be measured.
- **Fluid Supply System:** stores and transports the oxidizer into the combustion chamber of the engine located in the engine compartment.
- **Data Acquisition and Control System:** contains all electronic modules to receives the sensor signals and to control the Fluid Supply System and the ignition.

In order to validate the test infrastructure, a small scale hybrid rocket engine with a peak thrust of approximately 500 N and a burn time of 10 s was designed and manufactured. This first generation engine will help to understand the hybrid engines' working principles by allowing to study grain regression rates, the effect of injector geometries and of the pre- and post-combustion chamber.





The knowledge gained will be used to design a second generation engine delivering a thrust of approximately 5 kN over 10 seconds, which is needed to propel a rocket up to 30'000 feet.

The project successfully passed the Preliminary Design Review in front of professors and industry partners in December 2018 and the second part of the project started in February 2019 with the focus on finalizing the design and validating the concept through simulations and calculations. After the Critical Design Review in April 2019, manufacturing and organization of the infrastructure started. On top of this came an inspiring visit and exchange with ArianeGroup and DLR (Deutsches Zentrum für Luft- und Raumfahrt) in Lampoldshausen, Germany, where the team experienced a full Vulcain 2.1 (Ariane 6 main engine) test.

During June and July, the system was assembled. First, the shielding plates, which separate the engine and FSS compartment, and the testbench were integrated, followed by the FSS system and cable trays. In parallel, the electronics boxes were assembled.

The last steps towards ARIS' first firing of a own developed engine

The system assembly is being finalized in and the facility will be moved to Ochsenboden for the testing campaign in November 2019. After completing the dry test and a cold flow test, the rocket engine will finally have its first hot fire in the end of 2019.

RHEA Team is building a high-level test infrastructure which sets the foundation of the new ETH Focus Project IRIDE. IRIDE will be able to focus on the development of a 5 kN lightweight engine as preparation for ARIS' first attempt to participate at the SPAC (2021) with a student researched and developed hybrid rocket engine.

Andrea Schorn
Andreas Stankowski
Anushka Gaikwad
Christoph Germann
Clément Stoquet
David Martinez de la Cruz
Davide Frey
Filip Lolland

Kujtesa Q Kryeziu
Lukas Hauser
Marco Trentini
Maximilian Leeb
Nicolas Streit
Richard Wadsworth
Shady Elshater
Sotiris Catsoulis

1.3 Other Activities

ARIS encourages students to define a vision and realize it. To enable this, ARIS is active in many ways. In this cycle, ARIS achieved this not only through its successful hands-on engineering projects, but also through a series of events and achievements with and for the local and international community.

1.3.1 Infrastructure: A real space to grow

For one year, students can enjoy the ARIS Hub at ETH Hönggerberg to work on the projects. With the help of a few angels and a huge picture from tpc Switzerland AG, it became a really inspiring workspace. Currently, ARIS is working on properly equipping the workspace with tools for designing, assembling and integrating our systems. Many thanks to ETH Zürich for providing ARIS this room - an invaluable support.

In July 2020, ARIS will potentially move to Innovation Park Dübendorf together with AMZ, Swissloop and many other laboratories of ETH Zürich.

1.3.2 Academic projects

Nine students conducted the academic projects listed below at ETH Zürich and HSLU, including ARIS' first scientific paper. Most of the projects were conducted independently from the ARIS project and might find implementation in future endeavours. For the next cycle, ARIS aims to simplify and standardize the possibility for bachelor, semester and master theses.

„Chance-Constrained Optimal Altitude Control of a Rocket", Presentation at the 8th European Conference for Aeronautics and Aerospace Sciences (EUCASS) in Madrid, Thomas Lew, Fabian Lyck and GianAndrea Müller, ETH Zürich

„Airbrake control for a sounding rocket", Group Work, Nikolaus Vertovec and Roland Schwan with Prof. Florian Dörfler, ETH Zürich

„Modeling of a liquid N_2O and paraffin based hybrid rocket engine", Bachelor Thesis, Christoph Germann with Prof. Lino Guzzella, ETH Zürich

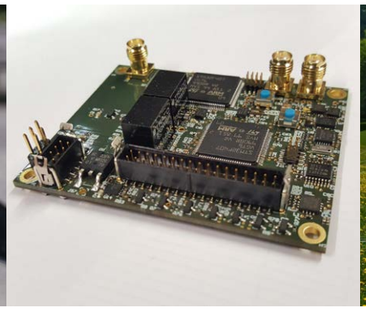
„Design, analysis and manufacturing of a connection component for a sounding rocket", Industry Project, Deia Melchior with Prof. Gerhard Székely, HLSU

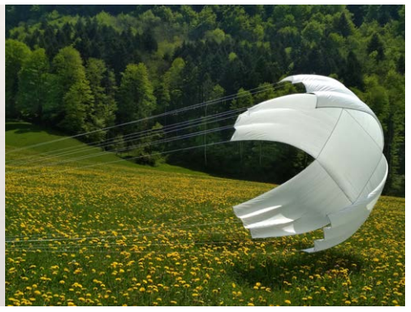
„Development of a parachute landing system for research rockets", Bachelor Thesis, André Trochsler with Prof. Gerhard Székely, HLSU

„Development of a fly-away rail guide for sounding rockets", Bachelor Thesis, Patrick Traxel with with Dejan Romancuk, HLSU

„Design of a launch pad for a sounding rocket", Bachelor Thesis, Raffael Balzarini with Prof. Gerhard Székely, HLSU

„Concept development of a balancing tool for a sounding rocket", Industry Project, Manuel Müller with Prof. Ralf Baumann, HLSU



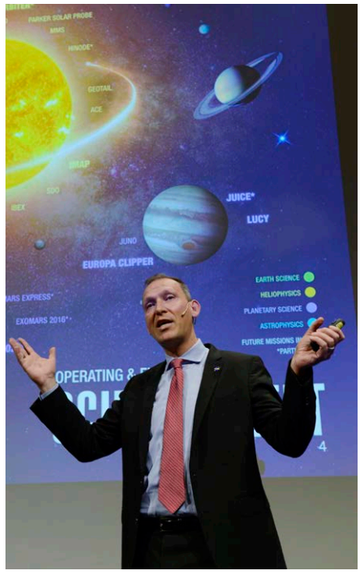


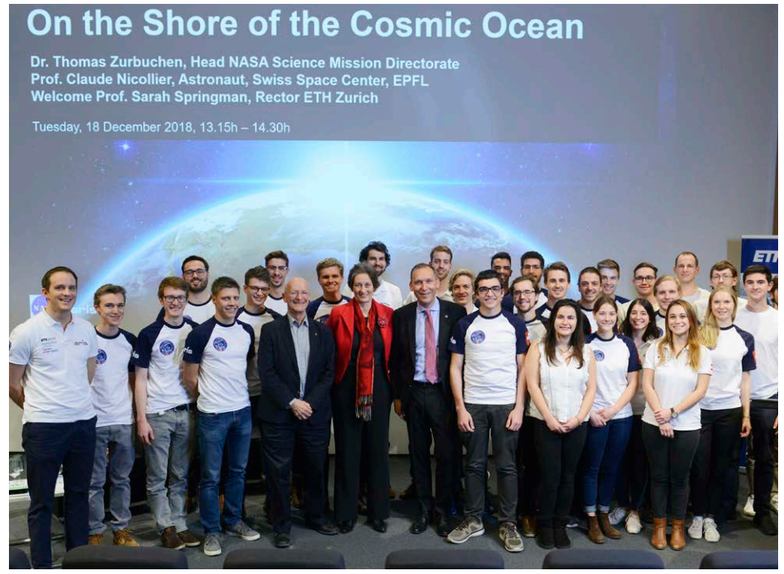
1.3.3 Community and network

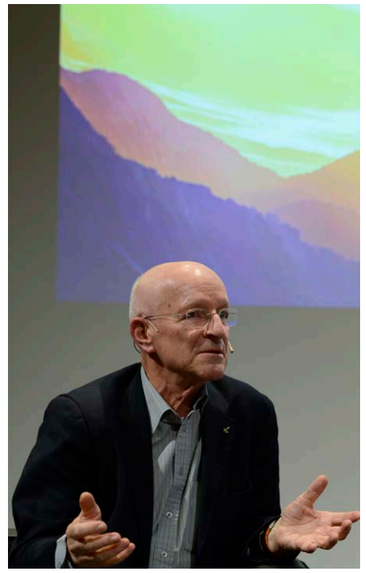
2018/19 was intense and filled with events to inspire, get inspired and strengthen the community and network: ARIS was honoured with visits from top-of-the-World scientists and astronauts and was invited to present at various events.

- **Be a Star in ESA's Universe - 8. Nov 2018:** As a student organization for space enthusiast, the Swiss Space Center and ESA invited ARIS to talk about the opportunities to use the studies as a springboard for a space career.
- **Annual Assembly of the Swiss Space Center - 6. Dec 2018:** a few ARIS members were invited to network at the annual assembly of SSC at ETH Zürich
- **Prof. Thomas Zurbuchen & Prof. Claude Nicollier - 18. Dec 2018:** Upon meeting at a congress, the Head of the Science Mission Directorate of NASA decided to inspire ARIS and ETH Zürich about the cosmic ocean - and the only Swiss astronaut joined in. What a stellar event! Many thanks to ETH Global and Prof. Sarah Springman, Rector of ETH Zürich, for immidiately supporting us and organizing the event.
- **GE Girls Camp:** Through the Swiss Space Center, ARIS was able to inspire a group of young ladies from Kantonsschule Baden, brought together by GE. Many thanks!
- **ARIS Roll-out @Kunsthaus Zürich - 15. May 2019:** ARIS presented its projects HEIDI and RHEA in the middle of Kunsthaus Zürich's exhibition „Fly me to the moon" to ARIS' academic and industry partnes as a private event.
- **Family Day @Kunsthaus Zürich - 26. May 2019:** Launching paper rockets with children at Kunsthaus Zürich on behalf of the 50th anniversary of the moon landing.
- **General Assembly of the Swiss Aerospace Cluster - 4. Jun 2019:** Presenting ARIS to a network of academia and industry at ETH Zürich
- **GNSS conference - 5. Sept 2019:** Invited by the organizer Prof. Markus Rothacher, ARIS presented its project to international scientists and experts on GNSS in Zürich.
- **Astronaut & Prof. Jeff Hoffman - 25. Sept 2019:** The former Space Shuttle Astronaut and Professor of MIT came Switzerland in September 2019. He did not only inspire ARIS and other students at ETH Zürich about the future of Mars exploration, he took 1.5 hours to visit ARIS. Many thanks to the Embassy of the United States, ETH Global and the Swiss Space Center for the great collaboration.
- **Space Lectures @RUAG Space - 3. Oct 2019:** Project HEIDI was invited to present to the real rocket engineers at RUAG Space in Zürich.

ARIS was furthemore present at open doors events of HSLU, the Student Project House and ETH Zürich, as well as at fairs from industry partners (e.g. Swagelok).







1.3.4 Honourable mentions

The establishment of ARIS as an association and its successes resulted in several unexpected opportunities: ARIS was invited to feature the cover of the Annual report of ETH Zürich and played a leading role with secondary actors in ETH Zürich's Master video. Thanks to the Swiss Space Center, two students could accompany astronauts and cosmonauts, including a moon walker, during the STARMUS festival. Moreover, a video made and shared by ETH Zürich of HEIDI winning the second place in the category at the Spaceport America Cup had more than 24'000 views.

1.3.5 Team events

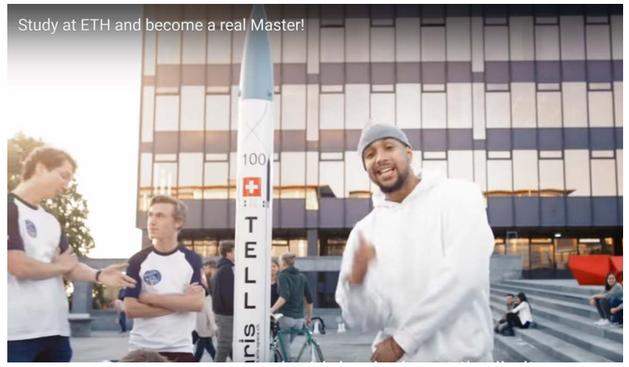
Besides the many community and networking events, ARIS found more and more time to live its team spirit: Christmas dinner, several barbeque events and participation at the SOLA Stafette in Zürich were some of them. The team came together during five design reviews, a Roll-out and a Wrap-up event with external partners. An information event for the Focus Project IRIDE was visited by over 50 interested students - a good fraction of which is part of ARIS today.

1.3.6 Rocket Launches in Switzerland

ARIS was present at three ARGOS rocket launch days in Kaltbrunn and in Val de Ruz, one of which was the successful HEIDI maiden launch. Many thanks to Jürg Thüring for this unique opportunity in Europe, basically on our doorstep.

1.3.6 House of Switzerland

ARIS represented Switzerland on a global scale by bringing Swiss souvenirs to the Spaceport America Cup. Chocolate, post cards, goodies from Zürich and ARIS stickers made their way into the hands of the future space generation.



2. ARIS Financial Close Report 2018/19

2.1 Financial Report Executive Summary

ARIS is in good fiscal shape and has achieved all its financial goals. The total cash expenses for 2018/19 amount to CHF 70’903, approximately CHF 19’000 less than in 2017/18. Project HEIDI closes with CHF 44’473 excluding value-in-kind sponsoring and came in under budget by roughly CHF 29’000. Project RHEA currently stands at CHF 12’109 with expected upcoming expenses of approximately CHF 8’000 which is CHF 15’000 less than budgeted, again without value-in-kind sponsoring. The significant difference between budgeted and actual cash expenses comes from the extraordinary effort of several team members in closing numerous value-in-kind sponsoring deals. The next financial year starts at CHF 6’305 provisioned for the next teams, and CHF 5,000 in emergency funds. All commitment fees have been successfully reimbursed.

The following activites come up on the horizon:

- Keep increasing the emergency provisions fund. The goal for the end of the financial cycle is to reach CHF 15,000 in emergency provisions. The long-term goal is to set aside about CHF 30,000-50‘000 which relates to 20-25% of the annual budget.
- Plan budgets for 2019/20 cycle more accurately by using the actual expenses from 2018/19 as a benchmark. Furthermore, the financial team should work closely with the engineering members to calculate the whole value of the association including value-in-kind sponsoring and other assets.
- Communicate with Ernst & Young to arrange external audit of ARIS’ financial book.

2.2 Overview

2.2.1 The ARIS Finance Unit

The finance unit of ARIS aims to make cash-flows smooth, simple and clear for ARIS and external reviewers. Members of both the finance unit and the association board oversee the finances to ensure that the basic principles are fulfilled.

Functions		Principles
• Tracking financial resources • Managing Cash Flow & Liquidity • Determining Financial Needs • Executing Transactions • Reporting	⟷	• Transparency • Accuracy • Completeness • Consistency • Stability

2.2.2 Processes and Oversight

The ARIS Board and internal auditors provide financial oversight through 3 key cycles:

- Monthly financial report, approval by the association board
- Quarterly budget, approval by the association board
- Yearly book closing, approval by two internal auditors selected by the general assembly

2.3 Financial Statements

ARIS is fiscally healthy and has achieved all its financial goals.

These goals include the reimbursement of the Spaceport America Cup member commitment fees, a book profit to cover potential VAT expenses, provisions for the coming cycle, and an increase of the emergency funds. In the cycle 2018/19 ARIS conducted two engineering projects in parallel, both casescoming in under budget thanks to the extraordinary effort of the project teams to close additional material sponsoring deals.

2.3.1 Statement of Financial Position

ASSETS		
Bank account CHF	CHF	49,501.56
Cash on hand CHF	CHF	125.00
Cash on hand USD	USD	364.06
Receivables	CHF	419.40
TOTAL ASSETS		**50,410.02**

LIABILITIES		
Payables	CHF	18,073.20
Credit Card Debt	CHF	
Reimbursements Due	CHF	
VAT according to VAT report	CHF	(3,257.22)
Short-term capital		**14,815.98**
Cycle Provisions	CHF	26,300.70
Emergency Provisions	CHF	5,000.00
Long-term capital		**31,300.70**
Profit (Loss) carried forward	CHF	1,391.45
Profit/Loss for the period		***2,901.89***
Net Assets		**4,293.34**
TOTAL LIABILITIES		**50,410.02**

2.3.3 Profit and Loss Statement

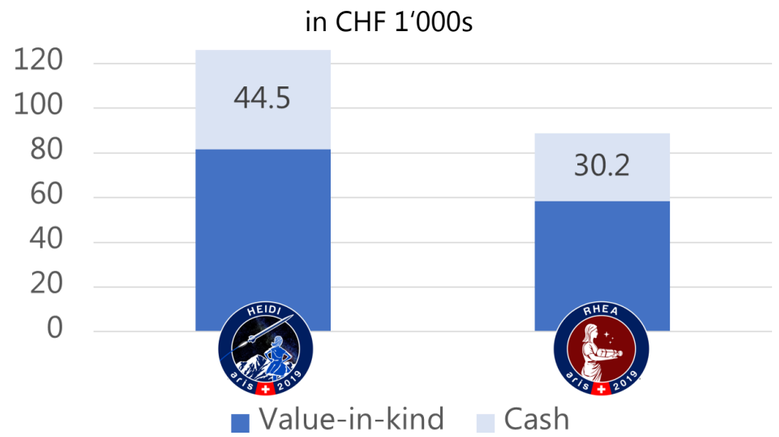
REVENUE		
Membership & commitment fees	CHF	
Other revenue	CHF	4,925.72
Donations	CHF	20,100.75
Cash sponsoring	CHF	96,073.20
Cash Revenue		**121,099.67**
TOTAL REVENUE		**121,099.67**

Expenses		
Total ARIS Operations Costs		**1,533.02**
Total ARIS Marketing Costs		**3,873.22**
Strategic Developmet		**2,030.12**
Total ARIS Events Costs		**6,889.07**
SPAC Rocket Team Costs		
IREC & SPAC 2019 Expenses	CHF	35,308.54
Structures	CHF	895.54
Simulations	CHF	47.40
Recovery	CHF	3,190.46
Avionics	CHF	3,118.03
Payload	CHF	652.84
Tripoli Certification	CHF	62.28
Testing	CHF	882.75
Management	CHF	315.50
Other	CHF	
Total SPAC Rocket Team Costs		**44,473.34**
HRE Development Team Costs		
Hybrid Engine R&D	CHF	28,929.19
Hybrid Engine Testing	CHF	
Other	CHF	1,253.41
Total HRE Development Team Costs		**30,182.60**
Total Costs	**CHF**	**88,981.37**

2.3.1 Financial Breakdown

The total cash expenses of project HEIDI amount to CHF 44‘473, whereof CHF 35‘308 (77%) were spend on activities related to Spaceport America Cup. At the same time HEIDI received roughly CHF 81‘500 in value-in-kind sponsoring.

Project RHEA has cash expenses of CHF 30‘182 and received roughly CHF 58‘500 of value-in-kind sponsoring. Project RHEA is still ongoing until the end of 2019.



2.4 Outlook

2.4.1 Key Learnings

To further improve on the accounting and budgeting, four key learnings are derived:

- A standard expense procedure, i.e. sending a bi-weekly team report has streamlined the reimbursement process significantly and should be continued
- ARIS members should follow these procedures strictly
- Stay strict with receipts tracking (VAT numbers/breakdown), zero missing receipts
- Continuous communication between the Finance Unit and the teams is crucial

2.4.2 Emergency Provisions

ARIS plans to establish an emergency reserve fund to cover unexpected necessary spending. The long-term goal is to set aside CHF 30‘000 to 50‘000 and ARIS aims to increase this fund to CHF 15‘000 by the end of 2020. This decision was taken to count for the uncertainties or (safety) risks ARIS might encounter in future rocket building.

2.4.3 Budgeting and Tracking

The new budgeting period is to be completed until 15. November 2020, using the data from 2018/19 as a benchmark. An increase of up to 30% is expected in the cost of the new rocket due to its larger dimensions and supersonic speed.

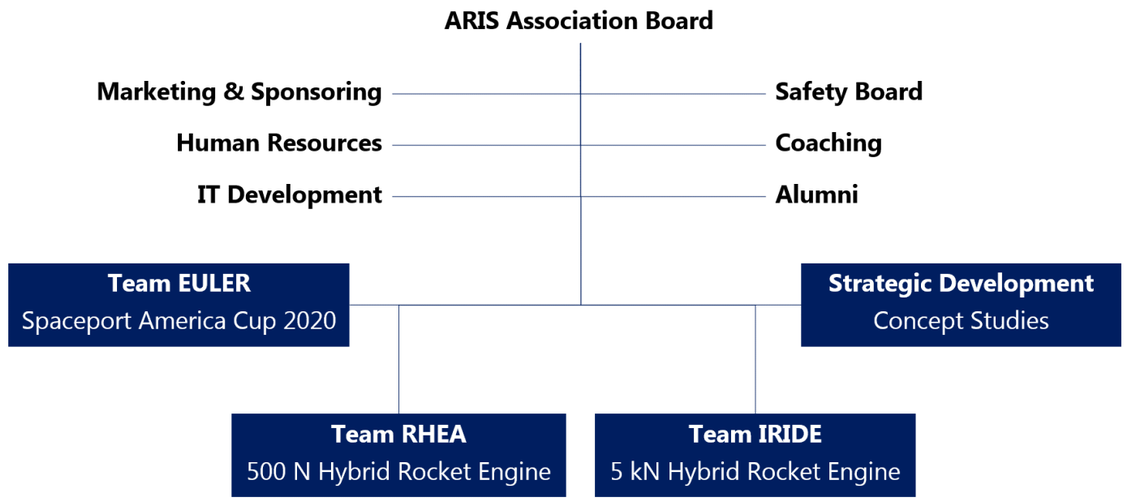
2.4.4 Tax Status

An external Audit by Ernst & Young is to be arranged until the start of 2020.

3. ARIS Organizational Changes

ARIS stabilized and further established itself as an organization:

- A **vision and strategy** has been developed: to fly a student built system in orbit by 2029. As a cornerstone ARIS develops a sophisticated and completely student-built sounding rocket by 2024. This vision and roadmap will be further updated and detailed along the next cycles.
- The **partner network** was strengthened, new partners from industry and academia enabled ARIS to advance to completely new levels and more conrete collaborations were established with previous partners.
- The **number of active members in ARIS stabilized** around 60. Thanks to more and more effective recruiting processes, our teams act more efficient.
- **Four projects** were conducted in parallel: Two engineering projects, an IT project and in future a Strategic Development Group collaborate to advance on ARIS' long-term objective
- The **knowledge transfer and coaching routines** have been streamlined. Student coaches ensure strong team dynamics and a rapid transfer of knowledge from the previous teams to the new. A new IT infrastructure with an efficient documentation structure (Wiki & Cloud) has been introduced.
- The **tasks ARIS association board** were clearer defined so that the board is not only covering the strategic, but also executive lead of the association.
- Addressing the **overarching management tasks** separate proved to be inefficient. For the next cycles the marketing, sponsoring and operations teams will be integrated into the engineering teams while ensuring regular streamlining of activities.



3.1 ARIS Association Board 2018/19

ARIS is a non-profit association and a board is legally required. It consists of six members which are overseeing all association activities by leading the association executively and strategically. Since September 2018, several mutations took place at an Exceptional General Assembly on 1. May 2019:

- Anna Kiener, System Engineer of project TELL and Vice President, left the board and Manuel Gerold, Project Manager of HEIDI, was elected as new Vice President.
- Nicholas Eyring, Head of Operations in TELL and Treasurer, left the board and Aleksandar Totev, previously ARIS Financial Manager, was elected new Treasurer.
- Q Kujtesa Kryeziu, RHEA Operations Manager, was elected for Academic Relations

Oliver Kirchhoff
President

Manuel Gerold
Vice President

Aleksandar Totev
Treasurer

Nils Bircher
Industry Relations

Q Kujtesa Kryeziu
Academic Relations

Amir Mikail
Legal / Admin

3.2 ARIS Safety Board, Coaching Team and Leadership Coaching

To ensure risks in handling the high energy densities applied in rocket science, Safety Officers are installed both within the project teams and on the association side, forming an internal review loop.

A coaching team mainly consisting of ARIS alumni was installed in order to sustainably transfer knowledge from one team to the next, guide the teams and team members in their personal growth and ensure stable team dynamics. Furthermore, regular leadership workshops enable the teamleaders to maximize the experience in ARIS.

3.3 Initiated Student Projects for 2019/20

ARIS long-term goal with sounding rockets is to fly and land more accurately and is therefore conducting the following three projects since September 2019:

Sounding Rocket Project EULER

Together, the new, interdisciplinary team of bachelor and master students they bring ARIS to the next level by mastering the challenge of flying a sounding rocket with a commercial off-the-shelf solid motor to 30'000 ft through the supersonic regime and land it safely. The team started on 16. September 2019, aims for a full system test launch in April 2020 in Europe and for the Spaceport America Cup 2020.

RHEA - 500 N Hybrid Rocket Engine and Test Facility

Flying more accurately by better controlling the thrust is one of the objectives of ARIS. For this, an engine test facility and a first generation 500 N hybrid rocket engine with an N_2O liquid oxidizer and Paraffin solid propellant are designed for a static horizontal test firing and currently being realized. The project aims for a firing in November and will be closed in December 2019.

Focus Project IRIDE - 5 kN Hybrid Rocket Engine

To reduce the technology gap for ARIS' own propulsion system, a team of 8 bachelor students in mechanical engineering is working almost full time to develop ARIS's second generation hybrid rocket engine with a thrust of 5 kN for a static firing until June 2020. The project is under supervision of Prof. Lino Guzzella from the Institute of Dynamic Systems and Control (IDSC) of ETH Zürich.

3.3.1 Strategic Development

To streamline ARIS current technological activities in the right direction, a small think-tank team will be set-up in end October. Its main task is to coordinate or conduct concept studies of technologies for future ARIS rockets through small side-projects or academic bachelor, semester and master theses.

3.3.2 IT Development

Since March 2019 a small team of informatic students is and will further be developing ARIS's internal documentation and information system.

3.3 Strategy Development - beyond the Spaceport America Cup

ARIS wants to go high, ARIS wants to set a mark in the exploration of space by realizing sophisticated and meaningful space systems. On the way there, we want to encourage students to take charge of the future and realize their visions.

2018/19 can be seen as the first cycle where ARIS had time to think about the long-term vision. Efforts will be needed in the next cycles to further investigate the field of space exploration, define a strong vision and a clear roadmap.

Currently, the objectives are clear:

- To fly student-built space hardware in orbit by 2029 to mark ARIS' and Switzerlands exploration potential. Whether this system is a rocket, satellite, rover, ISRU technology demonstrator or any other is not defined yet.
- To build a sophisticated, fully student-built sounding rocket flying to altitudes beyond 10km and featuring an own developed hybrid rocket engine, a guided recovery system, and eventually being able to eject payloads at apogee.

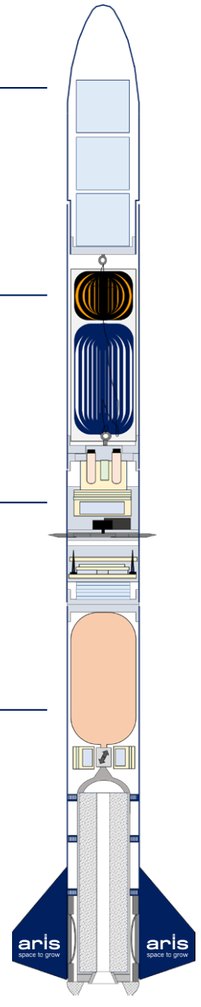
2024 Ejectable payload

2023 Guided recovery

2022 Self-made recovery

2021 Hybrid rocket engine

2020 Supersonic 30'000 ft



aris
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