

Saab and Aalto University

Further expanding successful research cooperation



SAAB

Webinar presentation for media

September 6th 2021

Agenda

Micael Johansson

President and CEO of Saab

Ilkka Niemelä

President, Aalto University

Q&A session with the speakers

Moderator Outi Toijala

Head of Corporate Relations, Aalto University



SAAB

Saab invest an additional 3 million euro to expand strategic collaboration with Aalto University

- **In 2017, Saab and Aalto University launched a substantial long-term research collaboration**
 - Ten year programme with a 20 million euro investment from Saab
 - Engaging 10 professors and over 20 researchers and PhD students
- **Since 2017, ten research projects have been on-going**
 - Within areas of antennas, micro-electronics, digital signal processing, AI, hydro acoustics and quantum technology
 - Resulting in dozens of scientific publications and several patent applications
 - The first Doctors of Science graduate from Saab-Aalto programme in 2021
- **The additional investment enable expansion into new areas; machine learning, AI and cognitive technologies**
 - The research will now also extend to post-doctoral level

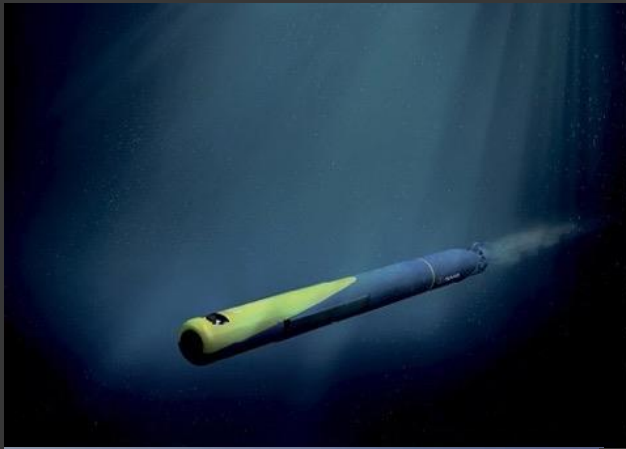


Saab and Aalto University further expand successful cooperation



Micael Johansson
President and CEO of Saab





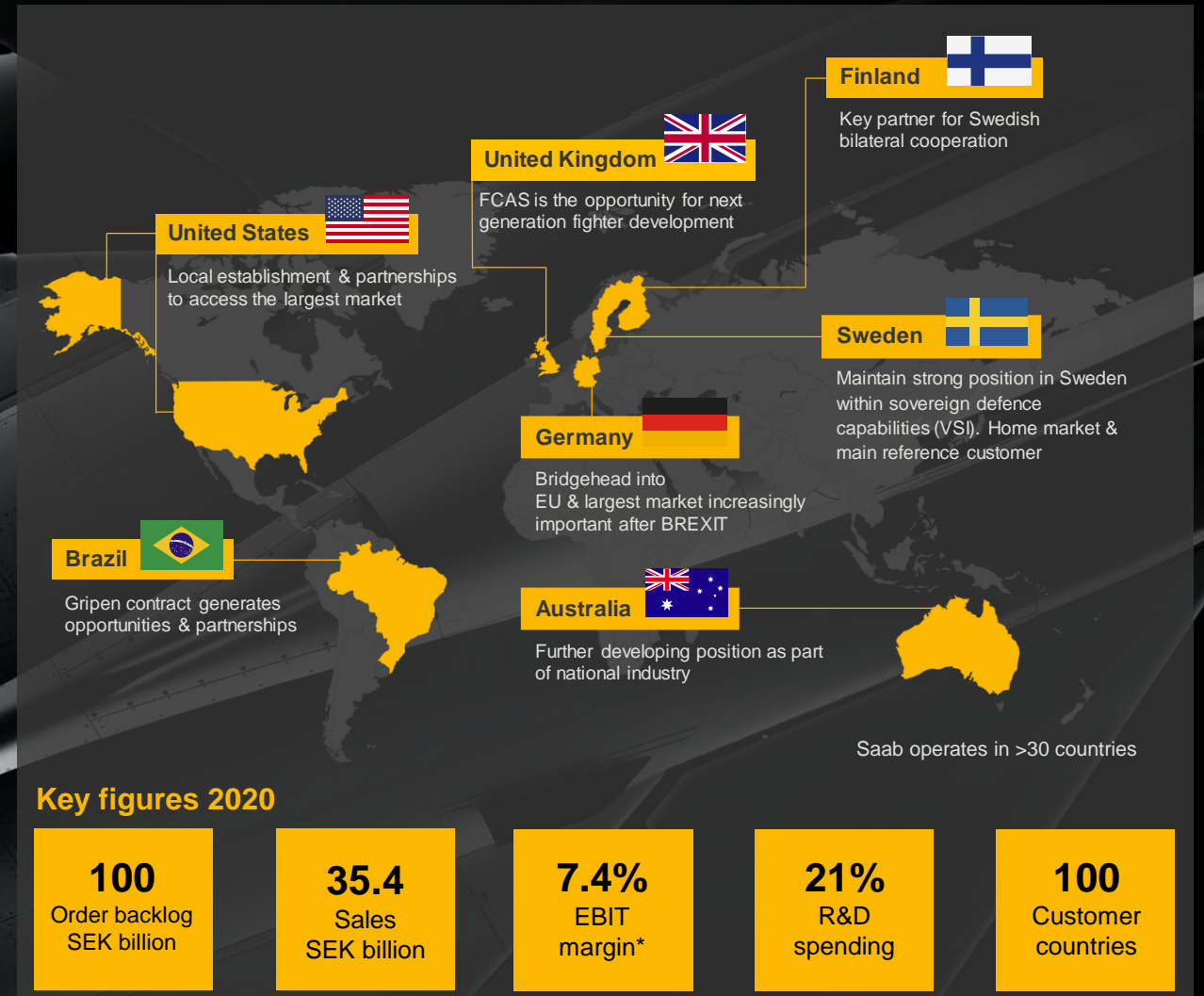
Saab
A Defence & Security company



An innovative and growing international defence and security company with a strong Swedish base

Saab value drivers

- A strong Swedish base and heritage to grow from
- We invest in innovation and increased efficiency
- Accelerating our international expansion to fuel future growth, with a multi-domestic strategy (US, UK, Brazil, Australia, Finland, Germany)



* Adjusted for items affecting comparability

Saab's operations in Finland

Saab's operations in Finland started in 1946 and we are proud of a broad and fruitful cooperation with the Finnish Defence Forces.

✓ Growth from 70 to 160 employees since 2015 and constant recruitments ongoing

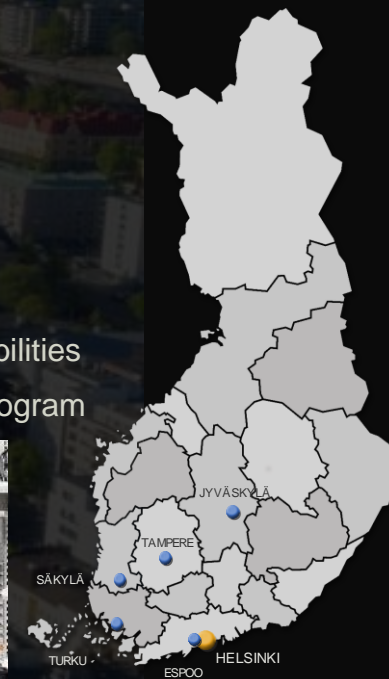
- Operations at six locations: Helsinki, Tampere, Espoo, Turku, Jyväskylä and Säkyä

✓ Large installed product base

- Navy, Army, Air Force and Civil services

✓ Technology Centre Tampere
– part of Saab's global R&D organization

- Centre for advanced Electronic Warfare capabilities
- C2 System Centre established for SQ2020 program



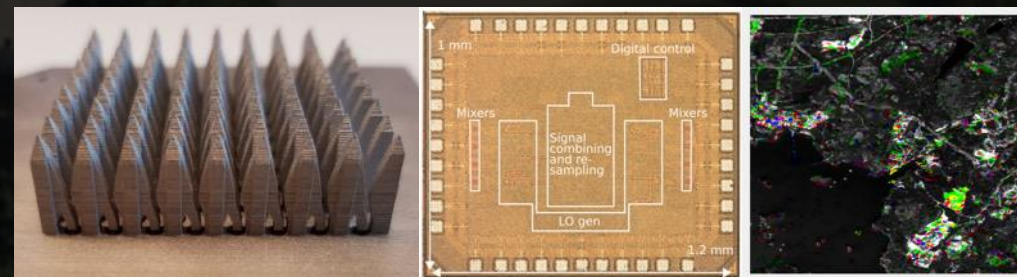
✓ Strategic research co-operation

- with Aalto university since 2017
(Advanced electronics, microwave technology, hydro-acoustics)
- with VTT since 2019
(Transceiver design, materiel technology, augmented reality)

Saab – Aalto University cooperation

A strategic cooperation supporting our continuous innovation and product development within key technology areas.

- ✓ 10-year Programme with 20 M€ investment
- ✓ Currently 10 doctoral level research projects
- ✓ Research community of ~30 people
 - Professors, industrial doctoral students, MSc students
- ✓ Research areas covered
 - Antennas for Active Electronically Scanned Arrays (AESA)
 - Radar receivers on nm-scale CMOS silicon chips
 - Cognitive radar signal processing
 - Emitter classification algorithms with deep learning AI
 - Localization in GNSS-free situations
 - Nano satellite-based signal intelligence
 - Hydro-acoustic Array Processing for underwater sensing
 - Quantum illumination for sensing



Mutual benefits of bi-lateral cooperation

The cooperation is boosting Finnish-Swedish research cooperation in general with extensive benefits for Saab as well as for Aalto University

✓ Strong boost to Saab capabilities

- Provides competent experts for Saab as **more than 20 Doctors of Science** will be educated at Aalto University
 - So far 9 Masters degrees
 - First doctors graduating this year
- **Strengthening excellence in critical technology areas** for Saab's R&D operations in Finland
- **Catalyzing innovative solutions** for Saab's product development globally
- So far 5 patent applications, covering
 - Reliable and cost-efficient production of antenna systems for different applications, e.g. fighter aircraft
 - New architectures for digital sensors enabling high performance in demanding environments

Mutual benefits of bi-lateral cooperation

The cooperation is boosting Finnish-Swedish research cooperation in general with extensive benefits for Saab as well as for Aalto University

✓ Broader benefits within Finland

- Boosting the academic excellence: so far approximately **30 publications** in scientific journals and conferences
- **Boosting the research ecosystem** in Finland, in particular for defense and security sectors
- Improving **Security of Supply** by strengthening the excellence within key areas
- **Extending the Finnish – Swedish research collaboration** – An opportunity for new European and global research

Finland – a country for further growth

Saab's operations in Finland are successful, contributing to our global business, and we are planning additional growth within several areas.



Strategic research cooperation with Aalto University to grow further



- Encouraged by the excellent results and as Aalto University recently joined WASP (Wallenberg Artificial Intelligence, Autonomous Systems and Software Program), **Saab is now increasing research funding to Aalto University by 3 million euro**
- Raising the total investment to 23 million euro, equivalent to a **40% increase on annual basis**
- This funding enables us to extend the cooperation into new fields of research:
 - Autonomous systems
 - Cognitive technologies
 - Artificial intelligence
- The funding extends the collaboration from the doctoral level research into Post-Doc research



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Saab Finland

Aalto University

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**Shaping a
sustainable future**

Ilkka Niemelä, President

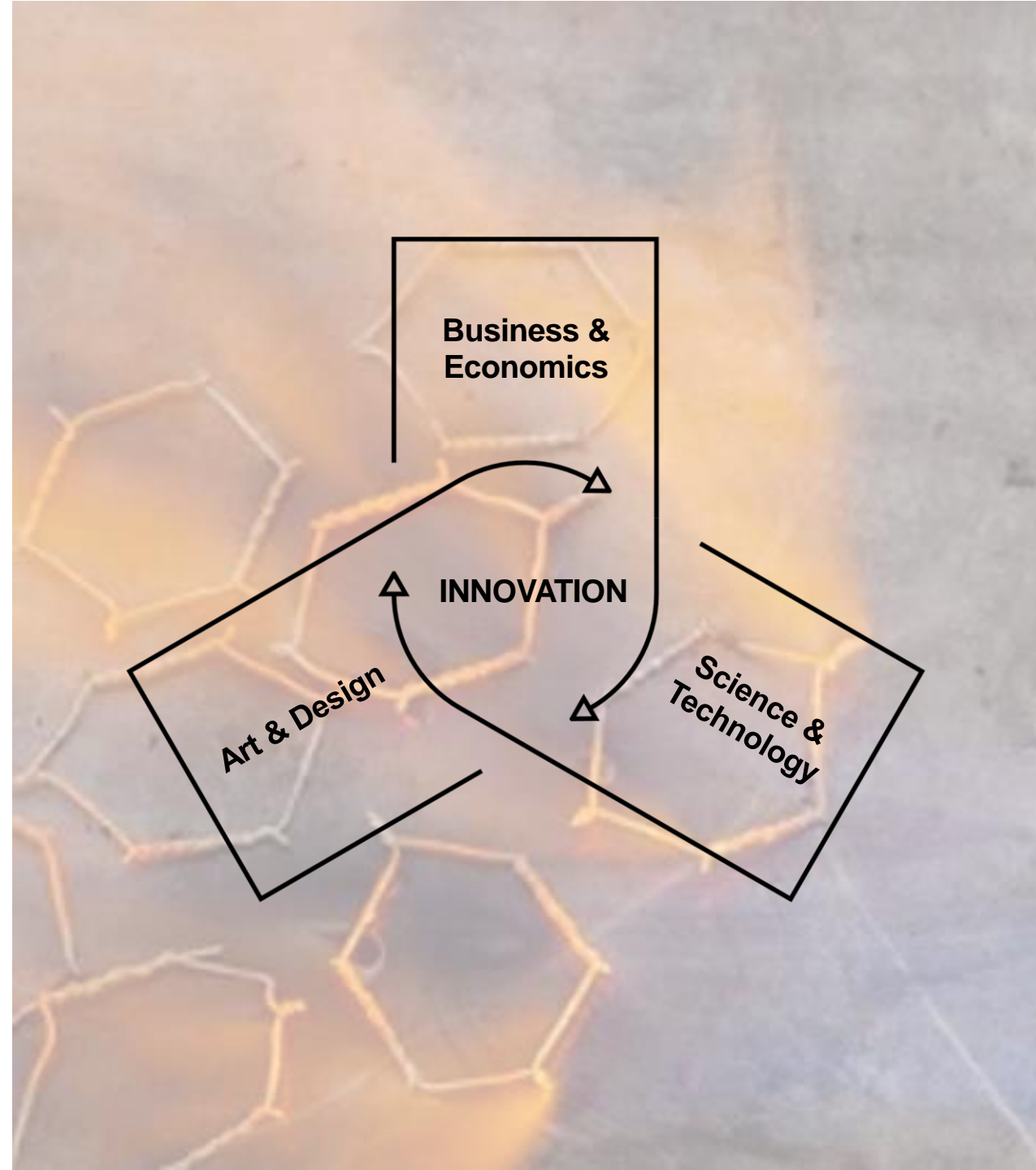
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Aalto-yliopisto
Aalto-universitetet
Aalto University



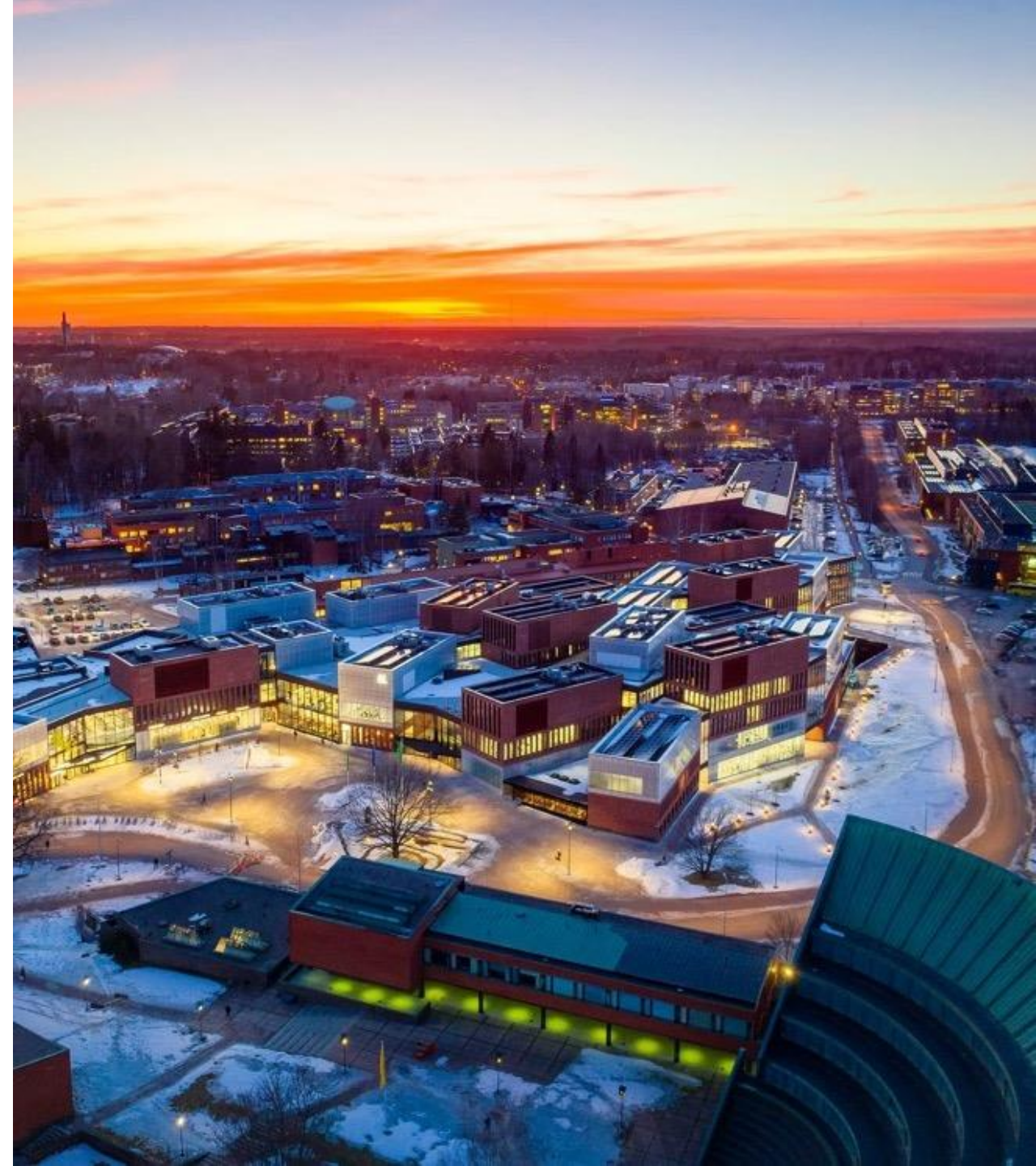
Aalto University

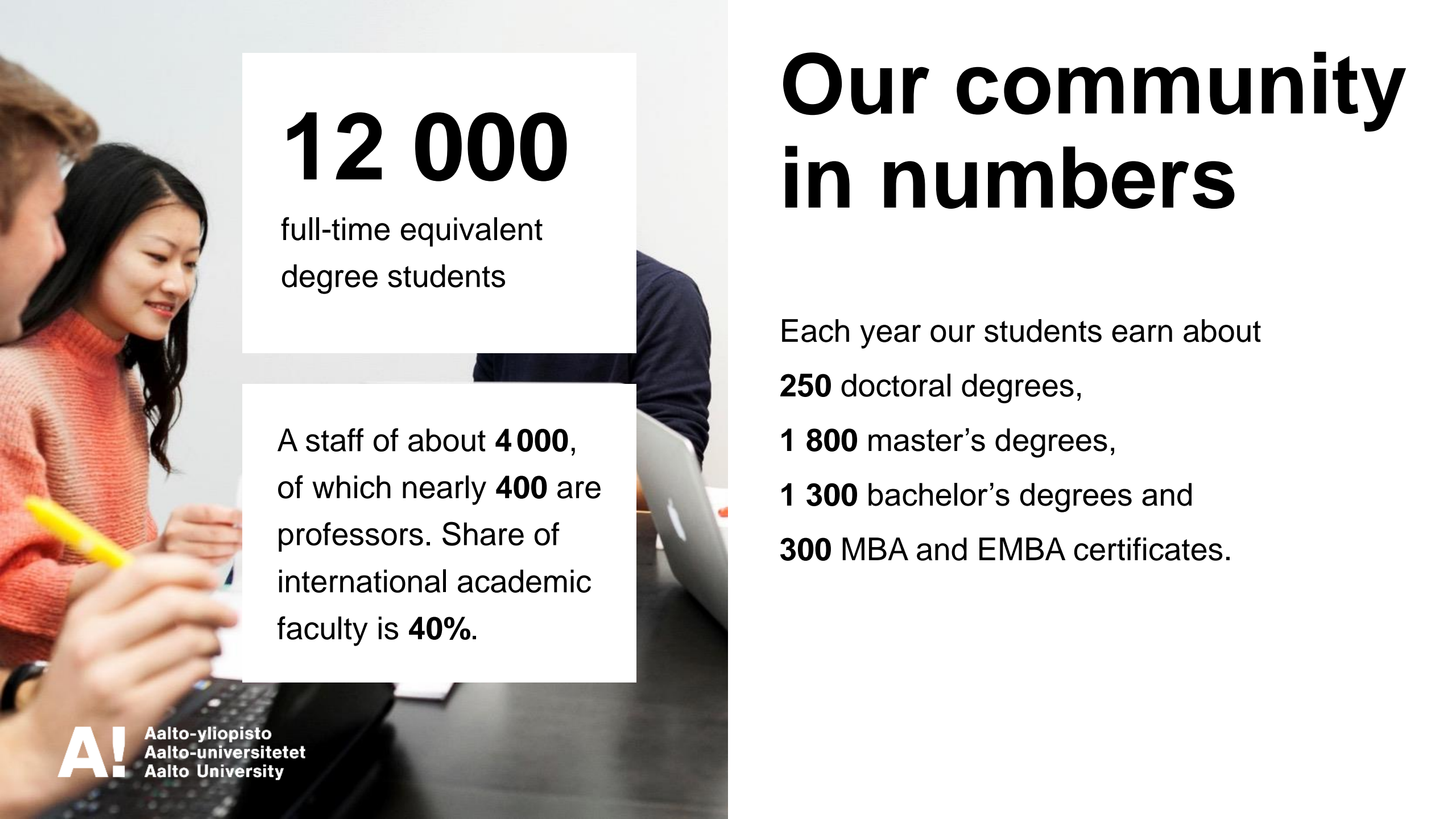
- By merging three leading universities in 2010, Aalto was founded to work as a societally embedded and innovative research university for a better world.
- Aalto has a national mission to strengthen Finland's innovative capacity through first-class research and education.
- Our Purpose: shaping a sustainable future.



Together, we have come far

- We have successfully brought together science, art, technology, and business to become a forerunner in our key areas.
- Our campus has rapidly grown into a world-class collaboration hub.
- We have transformed into one of Europe's most international universities.





12 000

full-time equivalent
degree students

A staff of about **4 000**,
of which nearly **400** are
professors. Share of
international academic
faculty is **40%**.

Our community in numbers

Each year our students earn about

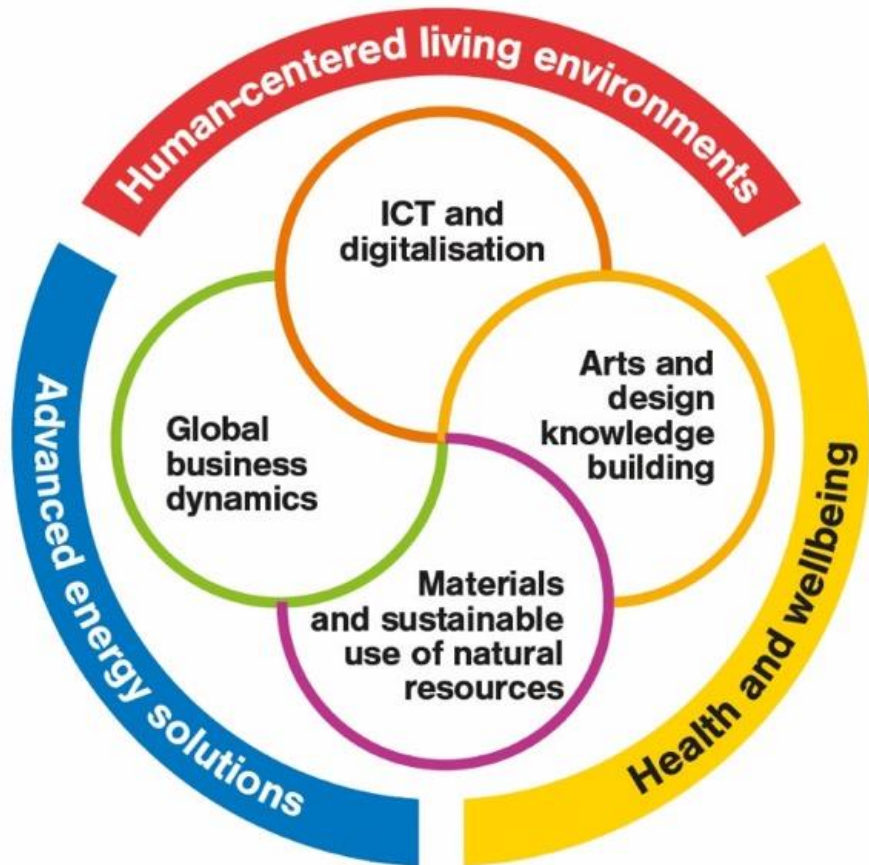
250 doctoral degrees,

1 800 master's degrees,

1 300 bachelor's degrees and

300 MBA and EMBA certificates.

Excellence in all key research areas



ICT and digitalisation

ShanghaiRanking: Telecommunication Engineering 34
US News: Computer science 33

Global business dynamics

ShanghaiRanking: Management 27
Business administration 24

Advanced energy solutions

ShanghaiRanking: Electrical & electronic engineering 76–100

Human-centred living environments

QS: Architecture/Built environment 41

Arts and design knowledge building

QS: Art & design 6

Health and wellbeing

ShanghaiRanking: Medical technology 101–150

Materials and sustainable use of natural resources

ShanghaiRanking: Mining and mineral engineering 76–100
Marine/Ocean engineering 35

A unique collaboration hub

Meilahti
Health
Campus

University of
Helsinki

Maria 01
Startups

Ruoholahti
Business
District

Aalto
University

Keilaniemi
Business Park

Corporate collaboration

We increase the societal impact of our research and education through corporate collaboration.

Continuous dialogue and knowledge sharing with our corporate partners offers us valuable opportunities to:

- better understand future trends and challenges;
- identify relevant research questions;
- share interesting data and experiences;
- transfer research findings to innovations and products.

Among the **25**
best universities in multidisciplinary
collaboration internationally.

World University Research Rankings 2020

Over **2500**
corporate collaboration partners.

About **70%**
Of Master's theses are done in
collaboration with companies.

ABB

NESTE

NOKIA



SAAB

Strategic corporate partners

With our strategic corporate partners, we strive for a sustainable future by building capacity and investing in mutually beneficial, long-term collaboration.

Collaboration with Saab: Research results

Collaboration with Saab is a prime example of how universities and companies together can create impact.

	2018	2019	2020	2021
Projects	6	8	10	10
Industrial doctoral candidates	2	3	5	6
Scientific articles	3	4	11	6
Doctoral degrees	0	0	0	2
Master's degrees	1	4	3	1
Patent applications	0	0	4	2

Dual-Polarized Ka-band Vivaldi Antenna Array

Henri Kähkönen, Juha Ala-Laurinaho and Ville Viikari, *Senior Member, IEEE*

Abstract—This paper presents a high-performance fully metallic dual-polarized wideband Vivaldi array for the Ka band (26–40 GHz), which is going to be used, for example, in 5G millimeter wave (mmWave) communication networks. Antenna-array elements are fed straight from a single printed circuit board (PCB) that allows integrating active components in the immediate proximity of antenna elements. A whole array can be placed on a PCB as a through-hole or surface-mount technology component. The antenna is simulated in a unit cell with periodic boundary conditions and in an 8×8 array configuration. The simulations show that the active reflection coefficient is below −10 dB across the entire Ka band and throughout most of the beam-steering angles up to ±60°. Lower than 3 dB scan loss is achieved in approximately ±60° range in the elementary planes and ±50° in the diagonal planes. The reflection coefficient and gain of each of the four elements in different parts of the manufactured dual-polarized 8×8 array were measured and simulated with the remaining elements terminated with a 50-Ω load. The measured results follow closely the full-wave finite array simulation results; the reflection coefficient is low and the element pattern is wide over the entire frequency range.

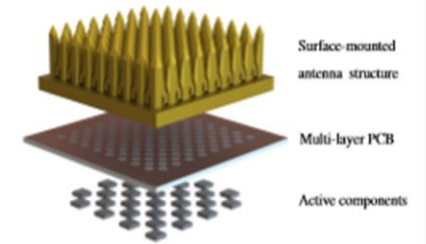


Fig. 1. Exploded view of the proposed integrated structure comprising three distinctive layers: the antenna structure, the multilayer PCB including the RF- and control signal paths, and the integrated electronics feeding the antennas.

Stationary Activations for Uncertainty Calibration in Deep Learning

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Abstract

We introduce a new family of non-linear neural network activation functions that mimic the properties induced by the widely-used Matérn family of kernels in Gaussian process (GP) models. This class spans a range of locally stationary models of various degrees of mean-square differentiability. We show an explicit link to the corresponding GP models in the case that the network consists of one infinitely wide hidden layer. In the limit of infinite smoothness the Matérn family results in the RBF kernel, and in this case we recover RBF activations. Matérn activation functions result in similar appealing properties to their counterparts in GP models, and we demonstrate that the local stationarity property together with limited mean-square differentiability shows both good performance and uncertainty calibration in Bayesian deep learning tasks. In particular, local stationarity helps calibrate out-of-distribution (OOD) uncertainty. We demonstrate these properties on classification and regression benchmarks and a radar emitter classification task.

Wide scope of collaboration



Joint communication campaigns and tech talks, annual Saab Aalto Research Day.



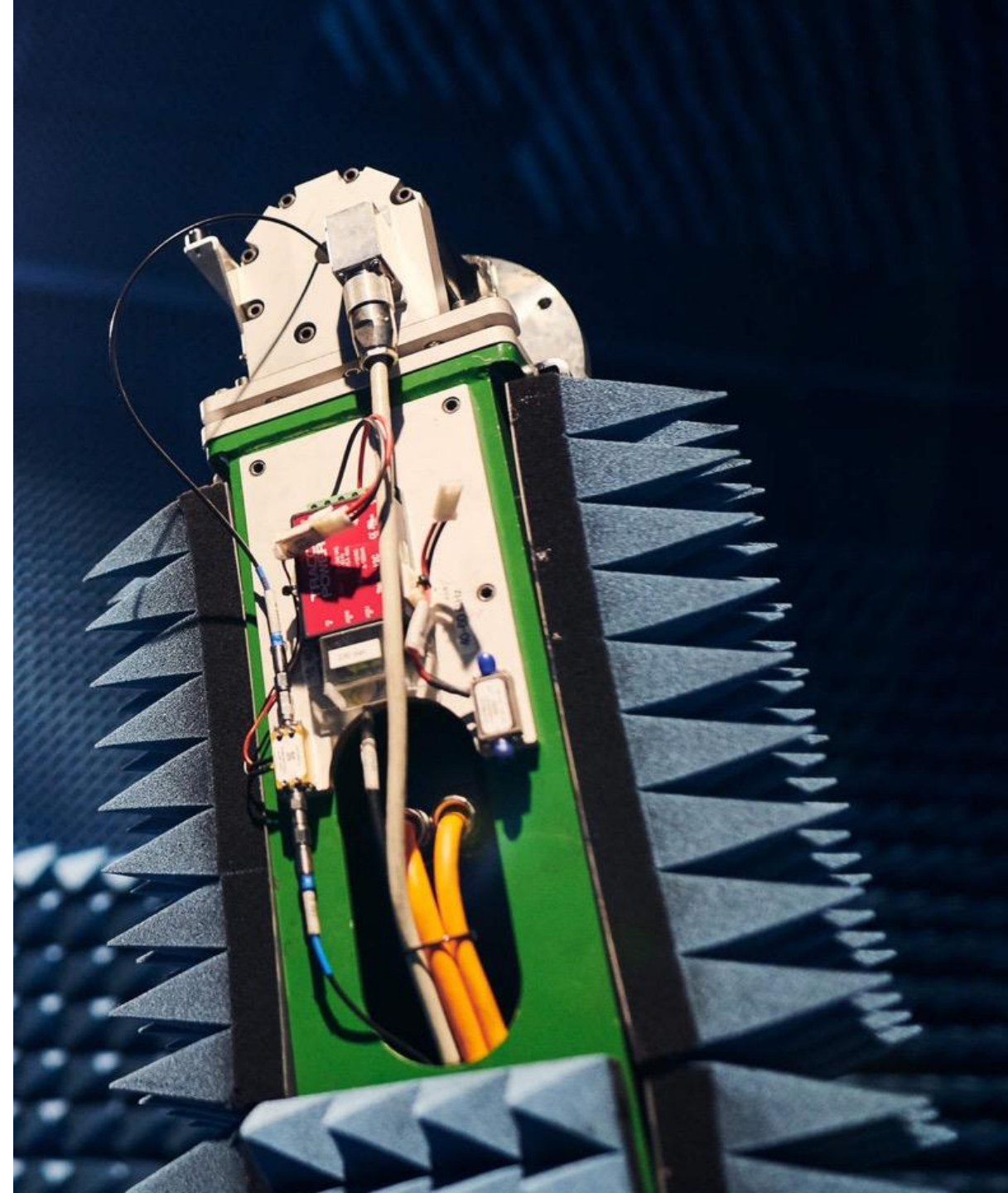
Saab sponsored student projects and courses.



Joint research collaboration projects in Finland and Europe.

Future collaboration with Saab

- Expanding to new areas of machine learning, artificial intelligence and cognitive technologies.
- Doctoral research will be extended to the post-doc level.
- AI is one of Aalto's key competence areas, and we are a founding member of FCAI (Finnish Centre for Artificial Intelligence).
- Aalto has recently also joined WASP (Wallenberg Artificial Intelligence, Autonomous Systems and Software Program), involving 5 Swedish universities and 40 Swedish companies.



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