# WASP IMPACT

The first ten years of Sweden's largest research program



#### **Executive summary**

Since its inception in 2015, WASP has grown into Sweden's largest individual research program, uniting academia, industry, and society in a long-term commitment to building national excellence in Al, autonomous systems, and software. This shared effort reflects our deep belief in the power of research to drive societal progress and technological leadership.

Collaboration lies at the heart of WASP. Through our graduate school, industrial PhD and postdoc programs, research arenas, and strong international ties, the program has created a vibrant and forward-looking environment. With more than 740 PhD students admitted, 75 international faculty recruited, and a growing alumni network, we are collectively shaping the future of Sweden's knowledge economy.

Equally vital is the community that defines WASP. It is not just a research initiative — it is a shared platform for discovery, exchange, and growth. The program's emphasis on interdisciplinarity, physical meeting spaces, and world-class education cultivates a new generation of researchers ready to tackle the complex challenges of our time.

As we look to the future, our joint focus remains on enabling excellent and curiosity-driven research, enhancing Sweden's international standing, and ensuring that the program continues to make meaningful contributions to society. Together with the entire WASP community, we are excited to lead the next chapter of this important endeavor.

We are both honored to jointly represent a program that has become a cornerstone of Swedish research and innovation over the past decade.

> Amy Loutfi, Newly appointed Program Director January 2025 Anders Ynnerman, Newly appointed Chair of the Board and former Program Director 2021–2025

#### **EDITORIAL INFORMATION**

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#### WASP

Wallenberg AI, Autonomous Systems and Software Program (WASP) was initiated in 2015. It is Sweden's largest research program ever, and an important catalyst for collaboration between universities and companies in the areas of AI, autonomous systems and software.

WASP builds on the combined existing cutting-edge expertise at Sweden's five major Information and Communication Technology (ICT) universities: Chalmers University of Technology, KTH Royal Institute of Technology, Linköping University, Lund University and Umeå University, as well as leading research groups at Örebro University, Uppsala University and Luleå University of Technology.

#### A SNAPSHOT OF WASP:

- Budget: SEK 6.5 billion until 2031.
- Goal: to graduate 600 PhDs and recruit 80 world-leading researchers.
- Outcomes by April 2025:
  More than 740 PhD students have been admitted and more than 180 have graduated.
  - 75 top international researchers have been recruited.
  - 80 companies and authorities have committed to the initiative.

## **Early history**

### The challenge: need for a national competence boost

In the 2010s, the general development of computer technology and computing power began to rapidly open doors to artificial intelligence and self-learning systems, and thus to a variety of applications for these technologies. Progress before this time had been uneven and difficult.

Around the world, investments in autonomous systems and artificial intelligence research and development were increasing. For Sweden to stay competitive as a nation of knowledge and innovation, it was urgent to get in the race. Facing the risk of falling behind in competence and research for the major technological shift, a bold initiative was needed.

#### The answer: a research program

In May 2015, the Knut and Alice Wallenberg Foundation announced the founding of a research program within autonomous systems. The program would be national in scope and hosted by Linköping University. It would entail a national graduate school, recruiting top researchers internationally, and conducting foundational research with industrial relevance. With a budget of 1.8 billion SEK, it was a historic investment in research. This was the origin of what would become the Wallenberg AI, Autonomous Systems and Software Program (WASP), the largest research effort in Sweden — ever.

A research program of this size and ambition had never been executed in Sweden, posing new challenges. Several large technical universities in Sweden needed to cooperate with each other and with industry to create the necessary competence.

In this document, we describe how WASP faced these challenges, and the achievements accomplished after ten years of operation.

#### **Program design and launch**

To fulfill the mission of supporting excellent research that benefits Swedish industry and society long-term, the program organized around several core components:

- Ensuring dialogue between academia and industry.
- Gathering prominent researchers in Sweden with previous experience of coordinating large research collaborations.
- Building a national graduate school with a focus on excellent research and networking.
- Increasing the number of researchers in Sweden.
- Supporting international partnerships and networks.

#### **Program setup**

WASP's Board of Directors consists of top administration from the five partner universities together with representatives from Swedish industry. The chosen companies come from a variety of sectors and have extensive experience with academic collaboration.

Strong researchers from a variety of technological fields and with previous experience of building research collaborations filled the ranks of WASP management. Several of the researchers had experience working with the Swedish Research Council and had ongoing participation in European research networks. The team took on five areas within the program: a Graduate School, a Research Program, Recruitment, Research Arenas, and Internationalization.

Less than six months after the initial announcement, the first projects kicked off, followed by a call for PhD students. The WASP Graduate School offered each PhD student a tailored package with courses distributed over all partner universities, a summer school, international study visits, a generous travel budget, and the possibility to create special interest groups ("clusters") to meet peers in similar fields. To educate PhD students at a high technical level and develop strong networks, the curriculum emphasized in-person meetings and courses that offered both breadth and depth within the fields.

In parallel, the program began to recruit faculty. To attract top researchers at an international level, the positions included substantial funding and unique possibilities to collaborate with industry and across the Swedish universities. By recruiting the best talent from abroad to Sweden, WASP aimed to increase the number of research groups in Sweden, strengthen existing groups, create international networks, and support a longterm competence boost in academia.

Throughout the setup phase, WASP leadership made clear that the program is more than just a research funding agency. WASP looked beyond financing to serve also as a national meeting point by creating events and forums for collaboration and innovation.

It has been exciting to follow WASP over 10 eventful years. Much has been accomplished — a growing graduate school where almost one PhD student per week graduates, many research recruitments to Sweden, and powerful investments in strong research constellations and collaboration with other research programs.

Another thing to note is the donation from the Knut and Alice Wallenberg Foundation to acquire the supercomputer Berzelius, which was brought in to support research at WASP, but has also enabled other major investments in advanced computational resources.

WASP is a leading actor in the development of Al in Sweden and a catalyst for collaboration between academia, industry, and society. As the host university for WASP, we can state that it is a very successful initiative.

> Jan-Ingvar Jönsson, Vice-Chancellor, Linköping University

The program should be seen as an influx of talent and research ability, but one that needs maintenance and stamina, so that the national competence boost persists and continues.

> Lars Nielsen, WASP's first Program Director 2015–2020



## **Milestones**





## **Scientific** impact

## Excellence within the four strategic areas

When WASP started, all research in the program was within the category of autonomous systems. In 2018, the research was separated into the strategic areas Al, Autonomous Systems, and Software. Al was in turn divided into Al/ MLX and Al/Math.

Over the past decade, WASP has had a significant impact on research in Sweden within these four areas. Through comprehensive recruitment of highly ranked international faculty (see page 13) and admission of several hundred PhD students (see page 14), WASP has fostered substantial research contributions.

The greatest strength of WASP is its ability to bring together top researchers from different domains with industrial and societal organizations. This interdisciplinary approach has made WASP a leading force in the field, fostering a collaborative and innovative research culture that continues to push the boundaries of AI research in Sweden.

> Without WASP, Sweden would have missed the opportunity to be at the forefront of top-tier research. WASP has also enabled Sweden to sustain its technological transformation by providing a new generation of researchers with deep technical knowledge. Now, Sweden will need to continue to invest and make use of these outstanding research results.

> > Anders Ynnerman, Chair WASP Board of Directors, former Program Director

#### Strategic area: AI/MLX

The field of AI research in Sweden is dynamic and rapidly growing, thanks in large part to WASP. Over the next five to ten years, greater integration of AI into society and more breakthroughs in autonomous systems and machine learning are expected. Developing reliable, explainable, and interpretable systems is crucial as AI becomes more integrated into everyday environments. Multi-agent systems, including human-robot interaction, are anticipated to play a significant role in the future.

#### WASP FOCUS

Among the foundational questions addressed in WASP, substantial focus has been on improving the efficiency and safety of AI algorithms and integrating AI into various industrial processes. A key aspect has been deploying AI in real physical systems to enhance the reliability, safety, and effectiveness of autonomous systems.

#### IMPACT

There are three major reasons for the program's success in the AI field.

Firstly, WASP established numerous research groups dedicated to studying basic scientific questions in AI, which would not have been possible without the program's support.

Secondly, the program has recruited top talent, many of whom have been instrumental in advancing the field.

Thirdly, the program emphasized interdisciplinary research, combining AI with other technologies.

WASP has successfully placed its PhD students in prestigious institutions, demonstrating the program's impact on career development and the broader research community. This also includes successful industry collaborations, answering the recognized need for closer collaboration between academia and industry to bridge the gap between research and practical applications.

The visibility and impact of WASP researchers have increased, with publications in top venues where Swedish research was not previously very visible, indicating a positive shift in the research culture.

WASP has had a pivotal role in advancing AI research in Sweden.

WASP has established several national research groups that study basic scientific questions within AI. Getting people from mathematics and computer science working together — that would not have happened without WASP.

> Danica Kragic, Professor, Chair of Research Management Group AI/MLX 2018–2025

#### Strategic area: AI/Math

Mathematics is the language of Al. It provides deep understanding of various topics associated with Al and its applications. Recent success of deep learning has led to important collaboration between mathematicians and computer scientists. Using Al for mathematical reasoning is advancing faster than ever. This has been transformative for both mathematics and Al.

#### WASP FOCUS

Main contributions by the WASP AI/Math track:

- Methods from different areas of mathematics (like high-dimensional statistics, topology, numerical analysis, machine learning, and optimization) are used to create new domain adapted AI models that are more efficient and reliable.
- Researchers in WASP develop advanced mathematics to provide understanding of how AI works. This is essential for understanding which tasks can reliably be addressed with AI.
- Key algorithms in science and engineering are typically backed by rigorous mathematical understanding to ensure reliability, safety and trustworthiness.

#### IMPACT

A key shift in the mathematics area since WASP started has been towards understanding and improving deep neural networks. Another has been to use mathematics for adapting AI models to specific domains to improve reliability and reduce model size.

There has also been rapid development of methods to handle huge datasets and to answer complex questions, driven both by the explosive growth of the amount of available data, and in increased computational power.

WASP has significantly changed Swedish mathematics, shifted its focus and produced important results. AI is now at the center of attention and research in affiliated mathematics departments.

This is evident from the rapidly increasing research output from WASP mathematicians, and from the large number of PhD students, postdocs, and faculty, and from the increasing number of grants awarded from sources outside of WASP.

WASP is pioneering research on the mathematical foundations of AI and has received international recognition for this. WASP mathematics contributes, and will continue to contribute, to making AI more useful, reliable, and safe for science, industry, and society.

People are the greatest impact of WASP. Most important are the PhD students. They are the ones who will drive the future of AI in academia, industry, and society. The WASP assistant professors and senior researchers will also have a very important and long-term impact, both on universities and on industry.

Holger Rootzén, Professor, Chair of Research Management Group AI/Math

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#### Strategic area: Autonomous systems

A general trend in the field of autonomous systems (AS) has been an increasing focus on integrating classical approaches with machine learning. The emergence of generative AI and large language models has accelerated this shift.

#### WASP FOCUS

Autonomous systems research in WASP includes several research areas such as robotics, human-machine interaction, perception, control, information theory, wireless communication, visualization, computer vision, manufacturing and production, autonomous vehicles, and cloud and extended reality (XR). Each of these areas has its own foundational questions and are investigated in WASP.

In response to technological developments, WASP researchers are now exploring how to best combine new AI technologies with existing methods in their respective fields in AS. This integration will remain essential, particularly in areas involving interaction with the physical environment and with humans, and in large systems and networks.

#### IMPACT

One of the greatest strengths of WASP is its ability to bring together students and researchers from diverse backgrounds. Just as in WASP's other strategic areas, this interdisciplinary approach is crucial for addressing complex problems in autonomous systems. The success of this interdisciplinarity is visible in the large variety of conferences and journals that researchers within AS are now publishing.

With this approach, the program has advanced the field and prepared a new generation of experts to continue this progress.

The PhDs that graduate from WASP have a wide knowledge of autonomous systems, software and AI, deep expertise in a subfield, and a broad network. In this rapidly evolving field, they have all the tools needed to understand what's coming and to make use of it.

> Karl-Erik Årzén, Professor, Chair of Research Management Group Autonomous Systems

#### Strategic area: Software

The strategic area of Software covers a broad range of topics, but in particular deals with the major scientific shift induced by the inclusion of AI and machine-learning techniques in software development. Capabilities like automatic program repair and code synthesis have been dramatically enhanced by the new techniques, but there are still questions to be answered.

#### WASP FOCUS

Software research in WASP can be exemplified by five main aspects:

- Testing, validation and verification how can AI and autonomous systems be "cleared" for quality, safety, and reliability?
- Software development how can processes be improved? For example, there is need for new methods to develop hybrid systems combining AI and traditional software.
- Software performance how can statistical and AI methods, and dynamic modeling help optimize the trade-off between performance and power use of software systems?
- Security and privacy how can we protect user data and secure communication between interconnected devices, and establish security for cloud-assisted computing?
- Autonomous and self-managing systems how can we meet the challenges in performance evaluation and system management of autonomous systems, specifically with the widespread adoption of, for instance, microservices and serverless architectures?

#### IMPACT

WASP funding has, through the program's interdisciplinary nature and its role in advancing both foundational research and practical applications, brought more collaboration and exchange between different research areas than traditional governmental funding.

WASP research has provided significant contributions in using AI to improve software development, regarding both quality and efficiency, specifically within program repair, testing, and validation of autonomous systems.

Several PhD students have obtained prestigious postdoc positions abroad and returned to faculty positions in Sweden or at top institutions globally.

> We need to find new ways to develop software since the new AI technologies are very different from traditional software technologies. We need whole new ways to design these technologies, and we cannot simply evolve the methods we already have. In a sense there is a revolution needed. I hope and think that WASP can play a big part in this.

> > Robert Feldt, Professor, Chair of Research Management Group Software

#### **Graduate School**

WASP PhD students have made a great impact on the WASP partner universities. Through WASP, many departments have seen a massive increase in the number of PhD students, which in turn has affected their scientific publishing and impact.

The WASP PhD students are enrolled in the national WASP Graduate School. Through specialized courses, several joint trips in Sweden and abroad, and the possibility to engage in academia-industry collaboration, a strong community with unique skills and large professional network is built.

By ensuring that PhD students from different fields meet each other, and offering courses that enable both width and breadth, the WASP PhDs are both experts and generalists. These skill sets are prerequisites for solving complex challenges or working with professionals from various backgrounds — may it be in academia or in industry.

There are three types of PhD students in WASP: academic, industrial, and affiliated. The academic PhD students spend full time at a university, the industrial PhD students are employed at a company and split their time between the company and a university. The affiliated PhD students have funding from sources outside WASP but are enrolled in the WASP Graduate School and have the same opportunities in WASP as their WASP-funded peers.

#### WASP Industrial PhD Program

The WASP industrial PhD program is one of the major initiatives for collaboration between academia and industry, significantly boosting Swedish industry's innovation capacity. This program facilitates knowledge transfer and fosters increased innovation capacity by addressing real-world industrial needs through research.

Industrial PhD students, enrolled in the WASP Graduate School alongside academic PhD students, benefit from a vast network both in Sweden and internationally. The companies hosting industrial PhD students gain access to the latest research and a large pool of talent within the WASP network, which in turn raises in-house competence.

The program aims to graduate at least 150 industrial PhD students, many of whom highlight the advantage of experiencing "the best of two worlds." This unique blend of academic rigor and industrial application ensures that their research is not only cutting-edge but also highly relevant to industry needs, driving innovation and maintaining Sweden's competitive edge in the global market.

wasp-sweden.org/industrialcooperation/industrial-phd-inindustry/



#### Industrial Postdoc Program

Mobility between academia and industry is important for knowledge transfer and attractive career paths. WASP is always looking for novel ways to develop this in Sweden. One way has been to promote industrial postdocs, not often seen in Sweden before.

Providing challenging and stimulating work environments is crucial for retaining highly skilled individuals in Sweden. By promoting industrial postdocs, WASP facilitates knowledge transfer and offers attractive career paths that bridge the gap between academic research and industrial application.

Giving students the opportunity to access an attractive postdoc in Sweden also supports diversity and inclusion in academic career paths. For an early career professional with a family, it can be hard to move abroad for a couple of years, which is usually the case when pursuing a postdoc. This is more often an obstacle for women. It is also a WASP goal to retain talent in Sweden that has moved here from abroad. By adding new paths for career development, WASP seeks to increase diversity in academia and industry.

By expanding the Industrial postdoc program, WASP aims to make industrial postdocs a more prevalent and recognized career option, ensuring that highly skilled professionals from diverse backgrounds can thrive in both academic and industrial settings.

wasp-sweden.org/industry-postdocprogram/



The WASP Graduate School offers an unparalleled PhD student experience, featuring a unique range of courses from entry-level to advanced, at the forefront of research, covering a broad range of highly relevant topics. PhD students benefit from generous national and international networking opportunities, as well as various social activities, fostering a strong foundation for their future careers and lifelong friendships.

Daniel Axehill, WASP Graduate School Director

#### Alumni of the Year

Through the Alumni of the Year award, WASP acknowledges individuals who have excelled within WASP by generating outstanding scientific impact as well as contributing through their engagement in the WASP community or to society by leveraging their WASP experience.



Olov Andersson was awarded WASP Alumnus of the year 2021. WASP recognized Olov's outstanding achievement as a part of the winning team Cerberus in the DARPA Subterrain Challenge, a prestigious global competition in Autonomous Systems.

Olov emphasizes the importance of WASP for his research career: "I would like to in particular highlight the WASP research arenas. It provides an interesting opportunity to talk to different people and companies about what their problems are, the solutions they need as well as possible techniques in practice."

Olov also emphasizes other networking possibilities within WASP, such as the summer schools and scholarships. He graduated in April 2020 with his thesis "Learning to make safe real-time decisions under uncertainty for autonomous robots" at Linköping University.

#### **REBEKKA WOHLRAB**

Rebekka Wohlrab, Assistant Professor at Chalmers University of Technology, was awarded WASP Alumna of the year 2023. She was admitted to the WASP Graduate School in the first batch of PhD students, and as a WASP Alumna, she leveraged a WASP international postdoc scholarship at Carnegie Mellon University in Pitts-

burgh to build upon her PhD work at Chalmers.

With competitive research output in top venues, a series of best paper awards, funding acquisition far beyond expectation, and — finally, through a pedagogical prize at University of Gothenburg, Rebekka Wohlrab has exhibited a model career as a WASP alum.

"I never thought that my CV would become such a WASP-CV, but here I am. And thanks to WASP, Sweden now has an additional citizen," says Rebekka.

#### LARS SVENSSON

Lars Svensson, CEO of Nordic Forestry Automation, was awarded WASP Alumnus of the Year 2024. In 2016, he started his position at KTH Royal Institute of Technology as part of the first batch of WASP PhD students. In his research work, Lars developed new algorithms for motion planning and control of autonomous cars and trucks in critical situations.

The PhD studies included an exchange period at Berkeley: "It had a big impact on my academic work as well as my entrepreneurial journey. I got into collaborations with some of the most prominent research groups in my field at Berkeley and Stanford," says Lars.

In 2021 Lars, together with two other WASP graduates, applied for a Wallenberg Launchpad (WALP) project, which was crucial in maturing the technology — and his thoughts of a business model — to a stage where he could raise venture capital. "The WALP funding gave us the opportunity, time and peace-of-mind to explore and work on our idea. I learned a lot during this time and met many senior and knowledgeable people. We received great advice, which

was crucial for building the company further," he says.



#### **Recruitment program**

Increasing the volume of researchers in both short and long term is one of the main priorities of WASP. Already from the start of the program, WASP focused on how to strategically form the recruitment program. The ambition is to make 80 recruitments before the end of 2031.

Within WASP's scientific scope, the global competition to hire the most reputable researchers is tough. To address this, attractive recruitment packages were assembled. A standard WASP recruitment package covers salary costs for four years, one or two PhD positions funded for four years, and two postdoc positions funded for two years each.

Over the years, WASP has recruited faculty at all seniority levels and across all the scientific fields within our scope, ranging from assistant professors to senior full professors.

Recruitment has been made through open calls. The scope of the calls has varied, sometimes choosing a top-down approach to the candidates' profiles and sometimes choosing a bottom-up strategy. This dynamic way of recruiting has enabled the WASP management to identify strategically important research areas to strengthen but also allow the universities to influence which areas they want to empower.

An emphasis on candidates' international experience has been prominent, either they spent all their academic career abroad or gained impactful international experience along the way. The goal is to attract new researchers to WASP, rather than to have researchers moving around in Sweden.

The recruitment of reputable researchers from all over the world has succeeded beyond all expectations. Through 2024, more than 70 researchers, ranging from assistant professors to full professors, have been recruited to Sweden to build up research groups across the country. In addition to the recruitments, several guest professors and guest researchers have been funded.

#### NESTs

Building on this massive influx of researchers to Sweden, WASP saw the opportunity to create cross-disciplinary research environments. In 2021, WASP launched NEST — a series of open calls characterized by Novelty, Excellence, Synergy and Team.

"The idea behind NEST is to try to address really hard, challenging research questions that require multidisciplinary efforts and thus have strong PIs join forces and form teams that are equipped to address these problems, which have potentially very high academic, industrial, and societal impact," says Anders Ynnerman, who started the initiative during his time as WASP Program Director. The NEST environments are expected to generate research of wider external impact, promoting synergy effects, and in turn paving the way to future developments in their respective areas.

In response to the first call for NEST projects in early 2021, 35 applications were submitted involving more than 100 individual researchers. After international peer review, nine proposals were awarded grants for five years. Each NEST involves four to six established researchers, including several WASP-recruited faculty.

"We are building the NESTs on an extremely robust platform, systematically created since the start of the WASP program," Ynnerman continues.

#### **RECRUITED FACULTY**



#### **EXPANDING THE NESTS**

In 2023, WASP held another call for NEST projects. This time within the topic of Cybersecurity. Five projects were granted funding.

As of the time of this report's publication, the next steps are underway for new calls to form NESTs between WASP and the Data Driven Life Science Program and the Wallenberg Initiative Materials Science for Sustainability.

## **Statistics and bibliometry**

ADMITTED ACADEMIC PHD STUDENTS PER UNIVERSITY



#### ADMITTED INDUSTRIAL PHD STUDENTS PER ENTERPRISE (TOP 7)





2018

2019

2020

2021

2022

2023

2024

#### **ALUMNI DESTINATIONS**



Carnegie Mellon U, ETH, Stanford, MIT, Berkeley, Oxford, UC London, Cambridge, Tübingen U, Max Planck Institute, Columbia U, UC San Diego, UPenn, U Amsterdam, Yale, Imperial College London, Harvard Medical School, U Catholique de Louvain, Grenoble, KAUST, Akershus U Hospital, Karolinska Institutet, U Zürich, U Luxembourg, Eindhoven U

> Japan Germany Sweden

#### BIBLIOMETRY

**2 242** Publications 2016-2023.

48% International 25% Industrial co-authoring.

AT least 20 Awards per year for best paper and similar.

Based on ORCID from PhD students, postdocs, and recruited researchers (while active in WASP) via Scopus and Web of Science, obtained by Linköping University Library. Publication types included are conference papers, journal articles, doctoral theses, and book chapters. Other types of publications are not included.

#### GRANTS

94

Number of significant grants to recruited researchers, WASP Faculty and management personnel, in addition to WASP funds.

> Includes grants from ERC, KAW, SSF, VR, during the period 2016–2024 while the individuals were engaged in WASP.

#### From the cutting edge

The following university perspectives show how WASP has influenced research environments across Sweden. These accounts demonstrate the program's role in strengthening institutional capacity, supporting strategic recruitment, and enabling new forms of collaboration — both within academia and with industry.

#### Data Science and AI — Chalmers University of Technology

A transformation from modest beginnings in machine learning to a robust, interdisciplinary powerhouse linking fields like medicine and the natural sciences while also establishing strong foundational research in Al and ML. That is how the Data Science and Al (DSAI) division within Chalmers University's Department of Computer Science and Engineering (CSE) describes the past decade. This evolution owes much to WASP, which has enabled DSAI's expansion through recruitment and project funding.

**"WASP has been invaluable,"** says Dave Sands, Vice Head of Department and Head of Research at CSE.

Associate Professor Fredrik Johansson adds:

"The WASP AI/MLX professorship enabled me to build a research group where PhD students learn collaboratively toward shared goals. Funding for student travel and international exchanges has allowed my students to connect with my collaborators and grow their own networks."

Simon Olsson, associate professor, says, "WASP support allowed me to take bold research directions, such as developing efficient surrogate models for simulating stochastic dynamics — a new subfield in Al4Science."

The growth of the DSAI division showcases the potent impact of WASP, underscoring the division's role as a dynamic and influential part of Chalmers' CSE department.

#### Computer Vision Laboratory — Linköping University

The Computer Vision Laboratory (CVL) develops theory and methods for computer vision, for application in fields where technical systems are supposed to coexist with — and therefore predict actions of humans.

Research and development at CVL are mainly based on machine learning, signal processing, and applied mathematics — all of which are areas supported by WASP.

"The Knut and Alice Wallenberg Foundation early understood the importance to support AI research in Sweden. WASP and its AI extension enabled ramping up AI research in Sweden, with major impact to existing groups such as CVL," says Michael Felsberg, Head of CVL.

CVL's vision has always been to rely on data-driven models, guided by specific knowledge from computer vision. In 2015, Felsberg participated in discussions about starting the WASP initiative:

"At that time, I could not know that this research program would accelerate our research by an order of magnitude. Since then, CVL has brought 9 WASP PhD students to their degree, recruited one assistant professor, and conducted several collaborative projects with other institutions in Sweden and abroad," says Felsberg.

"Our research during this period has been awarded five paper awards, achieved several top ranks in international challenges on tracking, SLAM (Simultaneous Localization and Mapping), and topological machine learning, and attracted more than 30,000 citations," Felsberg continues. "In 2024 alone, we published more than 10 papers in top-tier conferences such as CVPR, NeurIPS, ICML, ECCV, and AAAI."



#### Intelligent Systems - KTH Royal Institute of Technology

WASP is playing a crucial role in revitalizing research at KTH's application of AI and Machine Learning within Autonomous Systems, engaging young assistant professors in KTH's world-class research environments, and enabling them to make the next significant steps both in research and teaching.

The Department of Intelligent Systems at KTH serves as a good example. The department conducts research and education in the general area of intelligent systems, with research activities ranging from basic and theoretical to applications in autonomous systems, robotics, AI and machine learning, media processing, sensors, micro and nanosystems, and communications.

"The WASP starting grants provide an excellent foundation for independent research, allowing the young professors to venture into new areas," says Bo Wahlberg, Professor in Automatic Control at KTH and representative for WASP activities at KTH. "Al and autonomous systems are expected to usher in a fourth industrial revolution. The WASP program is an initiative to promote intensive research in these two fields."

#### Cross-fertilization of human-centered AI research – Umeå University

Human-centered AI (HCAI) has been a major research area among AI researchers at the Department of Computing Science at Umeå University for decades. Since 2017, the research environment within HCAI has gained critical mass, covering new important topics such as privacy, security, and responsible AI. This increase is primarily, but not exclusively, an effect of WASP funding and recruitment.

"We see a lot of cross-fertilization across old and new research groups, new collaborations within and across departments," says Helena Lindgren, Professor at the Department of Computing Science. "Many interdisciplinary projects have emerged, partly thanks to the university's generous effort on interdisciplinary AI, and partly due to matching funds to manage the increased staffing cost at our department."

She continues: "WASP has made a profound impact on our research environment and given researchers the platform to advance to next levels in their research careers. I am especially happy that WASP provides the opportunity for young researchers to return to Umeå University after doing their postdoc abroad. This allows for developing a sustainable research environment with devoted research leaders who further develop the environment, contributing to excellence and nurturing the UmU spirit of closeness, openness, and cross-disciplinary research."



For Uppsala University, specifically the Department of Mathematics and Department of Information Technology, the impact of WASP can be seen in three different aspects. Firstly, the program has significantly boosted the basic research activities within Machine Learning and AI. Secondly, WASP has increased the interaction with industry via WASP industrial PhD students, and, thirdly, the funding from WASP has increased the group's contributions to the top venues in Machine Learning and AI — which, importantly, is also true at the senior level, where more researchers view these venues as the most desirable publication targets.

Jens Sjölund, WASP Fellow, says: "The generous recruitment package meant that I could immediately establish my own research group and through it produce research that was the basis for later grants."

Sjölund adds: "I have benefited greatly from the network within WASP, which has led to several joint doctoral projects with WASP researchers at other universities. This illustrates one way — of many in which WASP has helped connecting nationally within the area, which is very important for the long run."

On a larger scale, for the past five years, Uppsala University's project Al4Research has focused on the development and use of AI within research across all scientific disciplines of the university. WASP has been useful in this context in providing a natural forum for AI research at the national level.

#### Multi-department support — Lund University

At Lund University, most of the WASP funding has been used by four departments: Automatic Control, Computer Science (CS), Electrical and Information Technology (EIT), and Mathematical Sciences. The funding has had a strong impact by significantly increasing the basic research in AI, Autonomous Systems, and Software, and increased collaboration with industry through industrial PhD students and WARA Ops.

Some concrete examples are the Lund Robot Lab, co-owned by Computer Science and Automatic Control, with 16 current or past WASP PhD students and a private 5G network from Ericsson; the Computer Vision and Machine Learning group at Mathematical Sciences with 11 current or past WASP PhD students, including many industrial ones; and the Large-Scale Systems and Learning group at Automatic Control with 12 current or past WASP PhD students.

"WASP's strategic investment in key departments has significantly advanced research capabilities, strengthened industry collaboration, and facilitated the recruitment of exceptional talent," says Karl-Erik Årzén, Head of Department and Professor of Automatic Control. "This multifaceted support has solidified Lund University's position as a leading hub for innovation in AI, Autonomous Systems, and Software Development."

#### Thriving Robotics and AI Research — Örebro University

Örebro University has been at the forefront of research at the intersection of AI and robotics since the late 1990s. Our pioneering work began with fundamental research in autonomous systems, mobile robotics, and AI-driven decision-making. Over the decades, we have built a strong foundation in perception, planning, and learning, establishing ourselves as one of Sweden's leading institutions in intelligent systems research.

The research has contributed significantly to theoretical advancements in machine learning, sensor fusion, and real-time autonomy, while also addressing critical societal challenges, such as environmental sustainability, digital security, and the automation of complex industrial processes.

"Thanks to our affiliation in WASP, the robotics and AI research thrives within a strong ecosystem that includes academic partnerships, industrial collaborations, and national research programs," says Amy Loutfi, WASP Program Director and first University Representative at Örebro University. Specifically for the affiliated groups, the ability to recruit top-tier talent, especially guest professors, has injected renewal into our research environment, fostering new groups and directions that ensure long-term sustainability. Areas to mention are neurosymbolic AI, social AI, multi-agent systems, and most recently cybersecurity.

As a large group with a highly specialized focus, the mutual gains from WASP have been transformative — elevating not just Örebro University but the entire Swedish research landscape. This synergy has reinforced the impact of the research, ensuring that Örebro's contributions continue to shape the future of AI and robotics both nationally and globally.

The affiliated research groups are proud to be a large and highly specialized group with a distinctive research focus, continually evolving to meet emerging scientific and industrial challenges. WASP has enabled this group of excellence to not only maintain its high standing but also take the next stage in its development.



#### **Board members from the universities**

The recruitment of internationally renowned researchers through WASP has significantly enhanced LiU's research environment. They have strengthened already existing strong groups and established new ones. Many recruits have integrated well into the Swedish academic system and contributes to LiU, engaging in under- and post-graduate education, in advanced research education and lifelong learning. They have also played key roles in strategic university initiatives.

Johan Ölvander, Dean at the Faculty of Science and Engineering, Linköping University

WASP has contributed to the development of several of our departments spanning over a broad range of topics and brought about new collaborations between their faculty members. It has been instrumental to lifting the scientific excellence of our activities in the AI/MLX area.

Anders Palmqvist, Vice President, Research and sustainable development, Chalmers University of Technology WASP is very important in strengthening KTH's position in research and education in autonomous systems related to AI and machine learning. The program creates the conditions for both groundbreaking research and outstanding education, particularly by providing opportunities to recruit young researchers to tackle new and innovative areas.

Annika Borgenstam, Vice President, KTH Royal Institute of Technology

It is hard not to overestimate the impact of WASP at Lund University. Through the program, different units across the university have developed together. This positive effect is further enhanced by the collaboration with WASP-HS, WISE and the DDLS programs. Our partnership in WASP additionally creates close ties between researchers all over Sweden. This will have a massive effect on our young researchers and their future careers.

Viktor Öwall, Pro Vice-Chancellor, Lund University

WASP has significantly strengthened and expanded the research environment in AI. autonomous systems, and software at Umeå University through highquality recruitments, an excellent national network, many new doctoral students, and various other funding opportunities. The research environment has also fostered new interdisciplinary and transdisciplinary research activities at Umeå University, including the establishment of the transdisciplinary AI centre TAIGA, a new AI policy lab, and activities within WASP-HS, which Umeå University coordinates.

Sara Sjöstedt de Luna, Deputy Dean at the Faculty of Science and Technology, Umeå University

## **Societal** impact

#### **Gender balance**

WASP has made significant strides in promoting diversity and inclusion within its community. The Diversity and Inclusion Group (DIG), established in 2021, has played a central role in these efforts, bringing together both internal members and external experts to create awareness and implement effective strategies. The group — itself diverse across gender, cultural background, career stages, and scientific topical categories — has focused on actions that were data-driven and scientifically validated, guided by research on discrimination and privilege in scientific and academic settings. This approach has led to several tangible outcomes.

#### ACTIVITIES AND OUTCOMES

One of the notable achievements has been the increased participation and representation of underrepresented researchers through directed calls. An example is the strategic recruitment of professorships within Al/MLX which has led to a significantly improved gender balance. Before DIG was initiated, 7 (17%) out of 41 recruitments were of underrepresented gender.

During 2022–2025, the numbers have improved. Out of 34 recruitments, 9 (26%) were of underrepresented gender. Evidence shows that faculty of underrepresented gender are more disposed to recruiting PhD students and junior faculty of underrepresented gender, without sacrificing equity. Thus, these recruitments are expected to have both direct and indirect positive impact on gender balance.

Another example is the recently added incentive of "two PhD student package", if at least one of the candidates is of the underrepresented gender. WASP has established a brave recruitment goal that at least 40% of the PhD students are of underrepresented gender. This aims to improve the diversity of the research school, but is also a long-term

strategic goal, intended to supply a diverse pool of candidates for future faculty recruitments.

Other examples include directed activities within WASP's events and the encouragement of initiatives led by students and faculty members of the WASP community. For instance, on-site workshops and online seminars along different themes of diversity and inclusion have successfully attracted participants at various career stages, fostering an environment where individuals could connect, learn, and gain inspiration from one another.

These workshops have included talks from prominent female researchers and

industry leaders, along with hands-on tutorials and discussion panels. Feedback from participants has indicated that the workshops have helped not only to address gender disparities but also to encourage younger researchers to pursue careers, marking a positive shift in WASP's gender balance and diversity.

#### FOUNDATIONAL VALUES

The foundation for the WASP culture of respect and appreciation for diversity is documented in the WASP Code of Conduct as a distinct statement of the community values. The driving force for the efforts is not only that equity and inclusiveness are desirable values per se, but a strong belief that the values contribute significantly to the research quality and outcomes.

As a clear sign of the commitment to these values, the DIG chairperson is appointed member of the executive committee to ensure that these perspectives are considered in all significant operational decisions.

By addressing systemic barriers and promoting inclusive practices, WASP has demonstrated its commitment to creating an equitable and supportive scientific environment, yielding significant progress toward its long-term diversity and inclusion goals.



#### Impact on humanity and society — WASP-HS

The Wallenberg Al, Autonomous Systems and Software Program — Humanity and Society (WASP-HS) is a separate research program, but one with close ties to WASP. WASP-HS enables cutting-edge research, expertise, and competence building in the humanities and social sciences and contributes to the development of innovative humane technologies and their transformative interaction with society.

Focus is on fostering novel interdisciplinary knowledge in the humanities and social sciences about AI and autonomous systems and their impact on human and social development. WASP-HS connects funded projects across Sweden and across disciplines. It further combines project funding with recruitment packages, a graduate school, and internationalization activities.

The program thereby aims to contribute to the development of humanities and social sciences research on Al into a research field of the highest international quality. All this benefits science, society, and industry, and helps Sweden take a leading role in this field of research. WASP and WASP-HS have several collaborations. For example, the programs have co-coordinated conferences and summer schools to support cross-disciplinary exchanges. The two programs also share one PhD course about the ethical, legal and societal aspects of AI. This is the only course in WASP's curricula that is mandatory for every WASP PhD student.

#### Impact on education - WASP-ED

The need for Al-competence ranges from the experts developing the technology to a much broader range of professions and disciplines. Hence, Al must be introduced in education beyond the specialized education programs for technical experts. To succeed, there is a great need for a "unifying force" within all disciplines, subjects, and courses connected to the scope of WASP, and of a common entrance to Sweden's universities, eliminating the very frequent obstacle of finding the right person at each university.

The answer to this need is WASP-ED, which is the Wallenberg AI and Transformative Technologies Education Development Program. Its purpose is to significantly increase the capability and capacity of Swedish universities in providing timely, relevant, and scalable education in Al and other transformative technologies. WASP-ED is designed to be the educational counterpart to the WASP and WASP-HS research programs and builds upon the competence and knowledge developed in these programs.

WASP researchers currently run most of the WASP-relevant courses at our institutions of higher learning. The researchers are also involved in creating new profiles, which ensures the highest relevance possible in the development of the field. WASP-ED has developed new course concepts enabling the scaling of courses within and between higher-education institutions, and the program is continuously expanding to include more education.



WASP-ED has been invited to contribute to SAPEA's report AI in Science, as well as to KVA's report on the research connection in education. WASP-ED is included in the Swedish AI commission's report as a strong foundation, and the same report suggests that AI should be included in all education. On the international level, WASP-ED is very well aligned with the increasing activities in Europe and elsewhere related to the need for upskilling and reskilling.

wasp-ed.org/overview/



**Enabling technologies** 

Through excellent foundational research and interdisciplinary collaboration, WASP contributes to a future where technology advances as well as supports a sustainable and secure society.

Al, autonomous systems, and advanced software solutions are essential technologies for solving the many challenges our society is experiencing today and for the generations to come. There are several examples in the subfields of WASP:

#### AUTONOMOUS SYSTEMS

Resource optimization, task automation, and effective planning are some of the topics covered in WASP that aid society and the people living in them. These research areas are important when developing efficient and sustainable methods in, for example, forestry and farming, leading to safer work environments by removing dangerous tasks, and reducing our carbon footprint from transport by making them more effective.

#### ARTIFICIAL INTELLIGENCE

Al drives significant technological advancements by optimizing resource use, increasing our understanding of complex data, improving efficiency, and more. While Al is often seen as a horizontal technology impacting various fields, WASP focuses on developing Al as a vertical technology that specifically addresses sustainability challenges.

WASP supports research aimed at improving weather forecasting and increasing our understanding of how weather systems work. We develop technology to aid people involved in accidents in difficult environments more quickly and safely. Several researchers investigate challenges related to human-machine interaction and collaboration. By collaborating with researchers in other fields, such as medicine and material sciences, WASP contributes to faster drug discovery and more efficient diagnostic tools in healthcare, as well as quicker ways of discovering new and more sustainable materials.

Understanding the foundational mathematics of Al is an important part of the WASP research portfolio. This deep understanding is crucial for making Al tools safe and verifiable.

#### SOFTWARE

Software systems have become increasingly complex, both because we want them to do more and with the introduction of new technologies such as Al. New software engineering methodologies are being developed in WASP, ensuring that software systems are secure, robust and trustworthy.

WASP emphasizes the importance of securing digital infrastructure. We have therefore deepened our commitment to cybersecurity, in relation to both Al, autonomous systems, and software. WASP has allocated considerable funding for attracting and nurturing cybersecurity talent and initiated several cybersecurity projects.

It is advantageous to build on what has been done within WASP-ED. For example, a new curriculum has been developed for the new broader AI subject, research and development has been conducted to introduce AI into all higher education programs, and technical higher education in AI has been scaled up.

The AI Commission's roadmap for Sweden (SOU 2025:12)

### Bridging the gap between academia and industry

Throughout its ten years, WASP has actively worked to bridge the gap between academia and industry and to lower the thresholds for collaboration. With a pragmatic and dynamic approach, WASP is continuously improving its programs and initiatives, maximizing impact on the Swedish climate of innovation.

By fostering a collaborative environment, driving an extensive industrial PhD program, and facilitating real-world testing through initiatives like WASP Research Arenas and the Wallenberg Launchpad, WASP ensures that innovative ideas can be effectively developed and eventually brought to market.

#### Impact on Swedish industry

Swedish industry demands competence in disruptive technologies, and they are dependent on access to state-of-the-art technology. The graduation of at least 600 PhDs and the possibility to collaborate with academia through one strong organization is appreciated.

A majority of the PhDs produced in WASP continue their career in industry. They are well suited to take on leading positions within technological development. The PhDs are also a valuable source to extend the Swedish startup community with new startups. Several WASP alumni have founded startups, even making it onto prestigious lists of promising startups.

Most WASP alumni stay in Sweden, enriching the Swedish job market. For those leaving Sweden, we see several examples where they get employed by attractive employers such as Apple, Microsoft, Toyota Research Labs, DJI, Amazon Robotics and more.

## Ecosystemic impact

I believe that one of the essential foundations for innovation is networking and collaboration. I think that's completely key. The larger community is one of the most significant contributions WASP has made to Sweden's innovation climate.

For the industry, perhaps the most important contribution has been that by supervising doctoral students and cooperating with the universities, they have been able to increase their own innovative power, both in terms of their own competence and ability to collaborate. Moreover, thanks to the fact that the program had a very strong connection to the industry's needs right from the start, the threshold has been low for the industry to support the program and give its positive response.

For the academy, the program, its funding and its networking resources add new approaches for research and provide access to new data and new infrastructure, which in turn warrants relevance and, in the end, boosted academic capability. Moreover, the combination of network collaboration and scientific weight offered by the program means that the academy's goal of scientific publication can coexist with industry's, and Swedish innovation's, goal of research results being passed on to industrial development and products on the market.

Salla Franzén, Investment Manager, Navigare Ventures

For Saab, the collaboration within WASP is crucial for driving technological development in AI and autonomous systems — with a focus on Swedish security and competitiveness. It is of utmost importance that this research takes place in Sweden, as it strengthens our national innovation capability, ensures technological sovereignty, and creates conditions for us to remain at the forefront of defence technology.

Petter Bedoire, Chief Technology Officer, Saab

WASP is essential for building competence and knowledge in AI, autonomous systems, and software, ensuring Swedish industry remains competitive and stays in the lead. For Ericsson, it supports knowledge building, the application of relevant research results, and the creation of a broad recruitment base of top talent in these fields. Magnus Frodigh, Vice President and Head of Ericsson Research

At H&M Group, we see great value in bridging the gap between the Al industry and academia – and in Sweden, WASP is a leading research programme driving that connection. By working together through initiatives like industrial PhD programmes and hosting workshop sessions comprised of academia and industry, we gain access to cutting-edge knowledge and fresh perspectives that complement our own work. For companies like ours, where the focus is often on delivering immediate value to our customers, partnerships with trusted programmes such as WASP are essential. They help us stay curious, push boundaries, and build solutions for the long term. Charlotte Werger, Head of Al, Analytics & Data, H&M Group King makes iconic mobile games like Candy Crush Saga and we're always exploring new ways to make our games more fun. But real innovation takes more than existing tools. That's why we partner with brilliant Industrial PhD students whose research in areas like reinforcement learning and generative models helps push boundaries. Initiatives like WASP show how we bring academic research in AI and real-world game development together to Make the World Playful.

Eric Bowman, Chief Technology Officer, King

Having industrial PhD students aligns perfectly with our mission to dramatically reduce traffic-related fatalities and injuries. Their contributions have advanced our Advanced Driver Assistance Systems (ADAS) and Autonomous Driving (AD) technologies. We are currently integrating methods originating from PhD work into our closed-loop simulation environments, enhancing the sensor realism, cost-effectiveness, and safety of our software testing. Other insights have influenced our development of cutting-edge AI technologies, increasing the robustness, accuracy, and scalability of our software solutions.

The support from WASP has been key in enabling these advancements. WASP's support not only accelerates our research but also fosters a collaborative environment where industry and academia can work together to solve complex problems and drive technological progress.

Erik Coelingh, Chief Technology Officer, Zenseact

#### WASP Research Arenas (WARA)

A key initiative for academia-industry collaboration in WASP are the WASP Research Arenas (WARA). They are organizational units in WASP, typically led by a company, which gathers other companies and academics to share resources and conduct joint projects. The intent is to increase the value and relevance of research by strengthening and promoting cross-institutional collaboration.

The WARAs provide platforms and resources where researchers can test and refine their research in real-world scenarios. Vibrant communities of researchers, industry professionals, and startups have been built around the arenas, making it easy to connect and collaborate.

During recent years, four arenas within different fields have been and are still active. However, the discussion about further areas of interest is always ongoing, providing a continuous possibility to initiate additional arenas in new domains.

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#### WARA MEDIA AND LANGUAGE (M&L)

is a horizontal arena, viewing Media Al as both an area for research and as an enabling technology. Its mission is to build a multidisciplinary ecosystem around Media AI, connecting scientific fields and a diversity of industrial segments. It addresses research topics related to the generation and analysis of media data, as well as its extrinsic effects. WARA M&L provides data management and benchmarking, together with engineering support and legal consultation on IP matters.

The arena supports internationally recognized benchmarks such as the visual object-tracking challenge and the GENEA, a gesture generation challenges, stimulating world-class foundational research and generating dozens of scientific publications each year. Together with NVIDIA, RISE, and AI Sweden, the arena trained GPT-SW3, the first LLM for the Nordic languages. This effort is now being continued together with partners at Ericsson, with a stronger focus on application-specific modelling.

WARA M&L arranged a summer school in 2024 for the WASP PhD students to increase knowledge about generative AI. The summer school was offered together with WARA Robotics, Unite, and WASP-HS, attracting close to 100 PhD students from diverse fields of study.

Currently the arena is establishing a distributed lab environment to promote remote collaboration between WASP partners and showcase project results. In addition, WARA M&L brings together benchmarking and inference services into a joint digital portal for easy access and control.

Number of researchers connected Estimated number of PhDs involved Number of companies/ organizations connected

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WARA ROBOTICS offers a rich set of research problems in an environment that enables robots to navigate and perform manufacturing-relevant manipulation tasks. Under realistic deployment conditions, robots are required to autonomously understand the world around them, to build knowledge incrementally, learn new skills, perform them safely and reliably, and adapt to changes in the environment and in human behavior.

At ABB Research in Västerås, WARA Robotics has built a completely new physical lab space, with industrygraded collaborative and industrial robots and a unique mobile manipulator as research platform. The physical lab is complemented with a virtual lab that has all the prerequisites of the physical site. There, the same layout of the lab is reproduced, and it is possible to import a precise model of the mobile manipulator that shares the same control interfaces as the in-person one.

This setup lets researchers easily switch between the virtual and the physical lab. The result is that the threshold to test a project idea or a hypothesis is low, and it reduces travel time and costs for the researchers.

Robotics research is needed in several industries. WARA Robotics has, for example, collaborated with AstraZeneca on a challenge to the academic community to solve a complicated mobile manipulation use-case. Another collaboration project with the Children's Heart Center of the Skåne University Hospital tasks a robot to assist a surgeon during complicated heart-surgical procedures.

Number of researchers

connected Estimated number of PhDs involved

Number of companies/ organizations connected



#### WARA OPERATIONAL DATA (OPS)

seeks to bring together Swedish industry and academia to solve stateof-the-art challenges in data-driven operational research. It develops an advanced data storage and processing infrastructure, enabling users to interactively store, annotate, process, and visualize large operational datasets. Importantly, it provides a collaborative environment allowing users to interact, share data and results, setting challenges and research questions.

In 2017, the predecessor of WARA Ops, WARA Common, connected to Sweden's first 5G networks deployed at the AstaZero test environment outside Borås. This allowed WASP researchers unique access to cutting-edge telecommunication technology. Large-scale cloud services from the WARA Common cloud were closely integrated with virtualized edge computing capabilities close to the radio network, providing both low latency and high computing capabilities.

The arena also provides unique data on the enormous power consumption of data centers, which may require up to 18% of global electricity by 2030. Research to improve operational efficiencies is crucial and has high impact outcomes in academia, industry, and ultimately society. However, up-to-date data center operational data is very difficult for academic researchers to find; by continuously monitoring and archiving data from the Ericsson Research Data Centre (ERDC), WARA Ops portal now hosts the largest source of publicly available real-time operational data center metrics and logs in the world. This gives a huge advantage to WASP researchers who wish to work on data center research including energy-efficiency, security, and behavioral prediction.

16 Number of researchers connected
Estimated number of PhDs involved
Number of companies/ organizations connected 

#### WARA PUBLIC SAFETY (PS) focuses

on heterogeneous system-of-systems in joint operation to handle complex scenarios around public safety. This includes unique autonomous vehicles and sensors in true multi-domain: in air and space, on ground, on water and underwater. Collaboration between experienced engineers, researchers and real users ensures important use cases for industry and society as well as challenging research to be tested in real environment.

Perhaps the arena's biggest impact on Swedish innovation has been in its role as a demonstration and collaboration facility, increasing collaboration between academy and industry.

Collaborators have access to an available and flexible platform — a core system — to test and integrate their results. The well-functioning core system is a launch pad for projects to quickly go from ideas to action. The arena has also highlighted the need to involve humans in systems and increase the focus on collaborative systems.

In its unique role as a national facility for demonstration and collaboration, WARA PS has grown a community and attracted lots of new organizations to WASP, including SMEs, government agencies such as FMV (Swedish Defense Material Administration), LFV (Swedish air traffic control), Swedish Maritime Administration (Sjöfartsverket) and Rescue Services in Sweden, and other partners from academy, industry and government. Over 80 different organizations normally show up to WARA PS events.

Number of researchers connected
Estimated number of PhDs involved
Number of companies/ organizations connected The arena has been referred to as a role model and inspiration for research arenas. WARA PS has been described, nationally and internationally, as a strong example of how a research arena should work.

> Jesper Tordenlid, Project Manager, WARA PS

### Wallenberg Launch Pad (WALP) and startups

Many research results have the possibility to improve products and services on the commercial market or to introduce completely new concepts. To take the research out of the labs and create value in society are important tasks for the universities.

WALP was created to address an identified gap in support for early research validation. Through the Wallenberg Launch Pad (WALP), researchers in WASP are offered support to explore and validate if their research findings could form the basis of a commercially viable product or service.

The WALP program has two phases. The first phase aims to explore, clarify, describe, define and verify an idea through personalized coaching. The goal is to present a pitch and if successfully presented, the researchers enter the second phase. In phase two, they can apply for the KAW proof-of-concept grant which gives an opportunity to develop their discoveries towards validated methods, products or processes and prepare for innovation and commercialization.

All support in WALP and the KAW proof-of-concept grant is a non-conditional innovation support aiming to make it easy for researchers to explore if their results can make an impact outside of academia and to prepare them for the next step on the innovation journey.

Here are a few descriptions of successful WALP startups.

#### SUCCESS STORY - MOTORICA

Motorica creates virtual motion-capture actors for the games industry and has set itself out as the leader in the space of character motion synthesis. Conventional 3D motion capture is expensive and slow. In big productions, time is money; with Motorica's web app or their Unreal plugin, the customer can generate the motion they need, in the style they need. The company is the only provider that currently meets the rigorous standards for high-profile AAA productions out of the box.

The company has had a lot of interest from angel investors in its first two funding rounds — more than Motorica could fit in on the initial ticket. The company was also selected for a MegaGrant from Epic Games, which provided recognition of early successes and momentum.

There is a lot of buzz around Motorica in the 3D industry: most game and VFX studios already know about the company, and animators have given positive response to working with and using its product demo.

Motorica is a direct commercialization of research Gustav Eje Henter did as part of his WASP Assistant Professorship starting grant. WASP has both financed the underlying research and — through the Wallenberg Launchpad (WALP) — the development of the initial prototype of what now is the Motorica product. Several people from the WASP orbit have provided valuable advice, introductions, and collaborations.

The company retains its connections to WASP and is affiliated with the WARA M&L arena.

Without WASP research, there truly would be no Motorica.

Gustav Eje Henter, CEO, Motorica

#### SUCCESS STORY - RIACT

Programming of industrial robots is generally a complicated and expensive task, which prevents more widespread use of robots in SMEs. RiACT, founded in 2019 and based in Copenhagen, Denmark, provides a universal operating system for industrial robots, featuring an intuitive dragand-drop interface and ready-made application templates, thereby reducing engineering time, facilitating rapid reconfiguration, and empowering users without prior robotics experience to operate robots efficiently.

RiACT's overarching goal is to make robotic automation more accessible and flexible, thereby enhancing productivity across various manufacturing sectors. RiACT seeks to make robot programming knowhow a commodity.

RiACT is led by Volker Krueger, WASP-recruited Professor, and is run together with WASP PhD students. Research results from WASP are directly used in their product. Exploited research results include AI, computer vision, and robot control. In addition, the affiliation to WASP helped the company to hire top candidates.

Presently, measures of success are sales and market penetration; manufacturing has traditionally been very conservative. For SMEs, to automate manual tasks with robots is considered a big change, full of costs and uncertainty. Companies generally prefer well explored paths, e.g., well-known software and well-known hardware. Right now, the biggest challenge is to convince companies to test a novel path.

RiACT was the first-ever WALP project. Our hope is that when RiACT is successful it will also shine back on WASP by confirming credibility of the research results.

Volker Krueger, CEO, RiACT

#### SUCCESS STORY - FLEETMO

FleetMQ, short for "Fleet Message Queue," provides resilient, high-performance, minimum-latency data-streaming software tailored for customers in transportation, robotics-as-a-service, and other industrial automation sectors where low latency and high reliability are essential. The platform leverages AI and automation to enable seamless communication within and between vehicles. The key challenges met by FleetMQ concern enhanced safety, reduced downtime, and improved operational efficiency.

FleetMQ was founded in 2021 by Frank Jiang and Elisa Bins and has deep roots in research, originating from a WASP PhD project. The prototype preceding FleetMQ's product was utilized in multiple WASP PhD papers, in a WASP PhD project course, a WASP NEST project (DIS-COWER), and validated in WARA PS.

While still pre-product launch, FleetMQ measures success through external investments and the value generated in pilot projects. FleetMQ has secured funding from KTH Holding and demonstrated significant impact through pilot projects involving teleoperation of road vehicles, rovers, boats, and space robots.

Outside of pure financing, WASP has offered FleetMQ important access to a network of leading research and industry collaborators across Sweden. This network has been instrumental in validating the company's technology and shaping its product from the research prototype predecessor. Additionally, WASP has given the company a valuable platform to disseminate their technology and connect with an audience that can directly benefit from their solutions.

It's both scary and exciting, we are going to enter the market. If it wasn't for WASP, I'm sure I wouldn't have stayed in Sweden and there would not be a FleetMQ.

Frank Jiang, CEO, FleetMQ

## International impact



#### **Globe-spanning research**

Internationalization is an inherent part of WASP. The community consists of researchers, PhD students and postdocs from around 70 countries, and almost half of their publications have international co-authorship.

There are also several initiatives to further promote internationalization. The program was early to sign Memorandums of Understanding (MoUs) with leading universities abroad. Soon after, a postdoctoral scholarship program was established together with the Knut and Alice Wallenberg Foundation. Moreover, the recruitment of researchers with a significant international profile supports international networks.

All WASP PhD students are offered two international study trips to visit universities and companies abroad. They can also apply for funding for self-organized international study trips. In addition, PhD students within WASP are eligible to apply for research stints abroad and spend up to six months with a hosting group abroad.

The international trips are often highlighted as one of the most appreciated activities during the PhD students' time in WASP. Trips have been made to Singapore, London, Québec area in Canada, California, Tokyo and elsewhere. The hosts have been some of the most prestigious universities in the world and enabled exclusive possibilities for the PhD students to create a professional network and get an international outlook.

Several of the former PhD students that have pursued a postdoc met their hosting group during an international trip with the graduate school, or while doing a research stint.

## International visibility and repositioning

The program has, through its impressive size and funding volume, left a significant mark in research and innovation in Sweden, as well as globally.

The level and scope of the program's recruitment has also improved the standing of the program internationally. An ever-growing number of world-leading researchers are, or have been, linked to the program, a fact which drives international visibility.

Beyond the sheer quantity of research produced, the quality of research is making itself visible on the international When talking to international researchers and attending leading AI conferences it is clear that WASP is having a global impact. Many are impressed by the quality and size of the program. Through WASP, Sweden has gained a global reputation as a strong AI research nation.

Fredrik Heintz, WASP Co-director for Collaboration

stage. The scientific publications from the program create a strong impact, and as more and more WASP researchers publish these results at leading Al conferences, further international visibility is created.

International research initiatives seek collaboration with WASP, which is both proof of improved visibility and a tool to accelerate further collaboration. For example, a Nordic collaboration between WASP, Pioneer Center in Denmark, FCAI in Finland, NORA in Norway, and CADIA in Iceland was signed in the beginning of 2025. The collaboration, named Nordic AI Research, Education, and Innovation Partnership (NordicAIR), includes the strongest AI-research organizations in the five Nordic countries.

Through WASP, Sweden has taken a more active role in the EU. Today, WASP researchers are coordinating several large EU projects, serving as chair for European Al conferences, and are regularly invited to give keynotes at major conferences including NeurIPS. WASP researchers are also actively involved in shaping EU policy through organizations such as Adra, which is the private part in the EU public-private-partnership on AI, data and robotics, and by providing input to important policies around AI and AI for Science.

#### International postdocs

For those who wish to pursue an academic career, an attractive postdoctoral position is the first step after the PhD. Since 2020 when the first full batch of PhDs graduated, 28 WASP alums have received a postdoctoral scholarship through WASP and Knut and Alice Wallenberg Foundation, and several others have received postdoctoral support from other funding sources.

It is notable that WASP PhD graduates get postdoc positions at top universities abroad. The largest concentration has been employed at the big technological universities in the U.S, such as MIT, Stanford, and Berkeley. ETH in Zurich stands out on the European list.

To support the retention of talent, WASP offers an opportunity for repa-

triation funding if a WASP alum wishes to continue their career in Swedish academia after their postdoc period. Up to now, two researchers have returned using repatriation grants for a limited time before being awarded competitive grants. They are now building new research groups in Sweden, educating the next generation of researchers.

#### International MoUs

The MoUs include prestigious postdoctoral programs for academic exchanges, and express support for activities to foster knowledge-sharing across borders. In some cases, funding for joint projects has been agreed and executed. Having appointed contacts to coordinate exchanges lowers the threshold for collaboration.

The international partners are: Stanford University, California;

- Nanyang Technological University, Singapore;
- University of California Berkeley;
- Aalto University, Espoo and Helsinki;
- Massachusetts Institute of Technology (MIT), Boston;
- California Institute of Technology (Caltech), California;
- ETH Zurich;
- Mila Quebec Artificial Intelligence Institute, Montreal;
- Imperial College, London.

#### Driving societal progress

As we conclude this overview of the Wallenberg Al, Autonomous Systems and Software Program (WASP), it is essential to reflect on the remarkable journey and achievements over the past decade. Since its inception in 2015, WASP has grown into Sweden's largest individual research program, uniting academia, industry, and society in a long-term commitment to building national excellence in Al, autonomous systems, and software. This shared effort reflects our deep belief in the power of research to drive societal progress and technological leadership.

## Innovation

Reflecting on a Decade of

The program's success is evident in its impressive milestones: more than 740 PhD students admitted, 75 top international researchers recruited, and a growing alumni network that collectively shapes the future of Sweden's knowledge economy. WASP has fostered a vibrant and forward-looking environment through its graduate school, industrial PhD and postdoc programs, research arenas, and strong international ties. This collaborative spirit has been crucial in creating a platform for discovery, exchange, and growth.

However, the journey has not been without its challenges. One significant challenge has been the need to continuously adapt to the rapidly evolving fields of Al and autonomous systems. The pace of technological advancement requires constant updates to research methodologies and educational curricula to ensure relevance and excellence. Additionally, recruiting top international talent in a highly competitive global market has posed challenges, necessitating the offer of attractive recruitment packages and strategic efforts to highlight Sweden's strengths as a research destination.

The program management, limited in scope but well-composed and with a clear mandate from the foundation, was able to make quick decisions crucial to the success of recruitment and other important parts of the program.

The credibility of the program has increased as these challenges have been addressed. The program's interdisciplinary approach has enabled groundbreaking research in Al and other areas, fostering innovation across various domains.

## Wrap-up

#### Looking Ahead: Sustaining Excellence and Impact

As we look to the future, our joint focus remains on enabling excellent, curiosity-driven research, enhancing Sweden's international standing, and ensuring that the program continues to make meaningful contributions to society. The next chapter of WASP will build on the solid foundation established over the past ten years, with continued emphasis on interdisciplinarity, physical meeting spaces, and world-class education.

The program's impact extends beyond academia, influencing industry and society at large. WASP's initiatives, such as the WASP Research Arenas (WARA), the Wallenberg Launch Pad (WALP), and the industrial PhD program, have significantly bridged the gap between academia and industry, fostering innovation and collaboration. These efforts have not only advanced technological development but also ensured that research findings translate into practical applications that benefit society.

Looking ahead, WASP faces the challenge of maintaining its momentum and adapting to emerging trends in Al and autonomous systems. The quick-moving technological environment presents both opportunities and challenges. Ensuring the reliability, safety, and ethical use of new technologies will be crucial.

In conclusion, WASP has succeeded in establishing itself as a cornerstone of Swedish research and innovation. The program's achievements over the past decade are a testament to the dedication and collaborative efforts of the entire WASP community. As we move forward, we remain committed to sustaining this excellence and continuing to drive impactful research that shapes the future of Al, autonomous systems, and software in Sweden and beyond. The challenges and opportunities ahead will require innovative approaches and a steadfast commitment to excellence, but with the strong foundation built over the past ten years, WASP is well-positioned to navigate and thrive in the evolving landscape of research and innovation.

#### THE AI COMMISSION'S ROADMAP FOR SWEDEN

Sweden has long held its own in research, innovation, and technology, but with the pace of change and development in the fields of AI, now is the time for deep and focused research support, according to Sweden's AI Commission. The commission was founded in 2023, with the aim of guiding the development of AI within Sweden.

"The pace and changes are such that it is not possible to stand aside and wait for total and complete knowledge," the commission noted within its 2024 Roadmap for Sweden. "Al becomes a threat if we stand aside and passively observe technological and societal change without acting and linking it to our overall aspirations in Sweden for a better life for all."

The AI Commission holds that for Sweden to remain on the cutting edge of research and leadership within AI, competency development is key. WASP is playing a vital and significant role in this development, according to the Roadmap for Sweden.

"In order not to fall behind and to continue to participate in the development of AI, nationally focused large-scale investments must be made in both the short and long term," says the Roadmap for Sweden, calling WASP the "most significant" research development program in the nation.

"We must therefore recruit leading AI researchers from other countries, while also taking advantage of younger talent," wrote the AI Commission. "In the long term, new researchers, through investments such as WASP, can become an important addition to the overall cutting-edge competence around AI in the country."

The AI Commission seeks a robust research environment within Sweden. The goal should be to have excellent research at the world's forefront in AI itself, while investing in subject-specific AI expertise in broad scientific fields, such as natural and technical sciences, medicine and health, and humanities and social sciences.





The greatest strength of WASP lies in our ability to bring together top researchers from various scientific communities and provide them with the necessary resources to drive excellence. Paired with an openness towards collaboration across institutional borders we are the Swedish initiative driving world class research in Al, autonomous systems and software.

Amy Loutfi, WASP Program Director

The Wallenberg AI, Autonomous Systems and Software Program (WASP) is a major national initiative for strategically motivated basic research, education and faculty recruitment in artificial intelligence, autonomous systems and software development. WASP was initiated in 2015 and its mandate extends to 2031. WASP is mainly funded by the Knut and Alice Wallenberg foundation.

Knut and Alice Wallenberg Foundation



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