STRATEGY 2024-2029

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

Aarhus University - June 2024

AARHUS
UNIVERSITY
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

CONTENT

Introduction and background 2

ECE's vision, ambition, and strategy house 3

ECE´s strategy: Why choose an impact-based strategy? 5

Our values 7

Strategic focal points 8

- Societal challenges
- Students
- Private and public organizations
- Diversity, equity and inclusion

From strategy to impact through ECE's "actions" 10

How will we realise our strategic goals? 15

Closing remarks 17

INTRODUCTION AND BACKGROUND

This document describes the strategy for the Department of Electrical and Computer Engineering (ECE) from 2024 to 2029. The introduction includes a brief background to allow the reader to familiarise themselves with ECE and its history.

ECE was officially "opened" as a new, independent department in January 2021, as a result of the comprehensive restructuring of the engineering area at the Faculty of Technical Sciences (TECH), at Aarhus University (AU). Since 2016, AU has invested intentionally and heavily in its engineering area, which has experienced rapid growth in both research activities, degree programmes, and number of students. To further consolidate and strengthen the area, the Aarhus School of Engineering and the Department of Engineering were closed and replaced by four new engineering departments, of which ECE is one.

Today (April 2024), ECE employs 223 staff (including 37 postdocs and 41 PhD students) and a total of 1285 enrolled students. Of these, 564 students were enrolled in 2023 and 315 are expected to graduate in 2024.

ECE'S VISION, AMBITION, AND STRATEGY "HOUSE"

ECE's vision is to be internationally recognised for outstanding research, education and innovation in electrical and computer engineering, creating a positive and visible impact on society and the environment through interdisciplinary collaboration, excellence and diversity. Our mission is to create a positive impact on societal challenges, our students as well as private and public organisations.

ECE's overarching ambition for the period 2024-2029 is to create impact through our core activities: research, education and collaboration. The ability to create impact is firmly rooted in our research excellence, both fundamental and applied, with the inherent ambition to achieve meaningful and, ultimately, tangible results, which we translate into strong educational programmes. Our graduates are trained to address and engage in real-life challenges, for which they are valued and highly sought-after by employers. Career and salary prospects are good and the current demand from industry exceeds supply. The combined outcome of our research efforts (including, scientific contributions, technology transfer to industry, technology-focused spin-offs) and our continued supply of competent graduates to society contributes to solving national and global societal challenges and to creating value for private and public organizations.

ECE's strategy for 2024-2029 is visualised by the ECE Strategy House (Figure 1), consisting of our vision and mission, tied together by overarching strategic focal points, our values and core activities: research, education and collaboration. For each strategic focal point we have identified specific actions to focus on during the strategy period in order to continue developing, growing and moving forward as an organisation. The list of actions is dynamic and additional actions may be added later.

The intention of the strategy is to:

- Utilise our academic and practical engineering skills and knowledge to address the most pressing societal challenges and create global and local impact.
- Align our activities with both the current and future needs of our stakeholders, by engaging in active dialogue with our partners and collaborators.
- Raise external awareness of ECE's competences to position ECE as an appealing partner for collaborative research, development and innovation initiatives.
- Offer high-quality education, establishing ECE as an attractive and reputable place to study.
- Strive to withhold and develop ECE as an outstanding place to work with on-going initiatives and focus on strengthening our working culture.
- Maintain the relevance and effectiveness of ECE's strategy, by evaluating and revising it on a yearly basis.

The ECE Strategy "House"

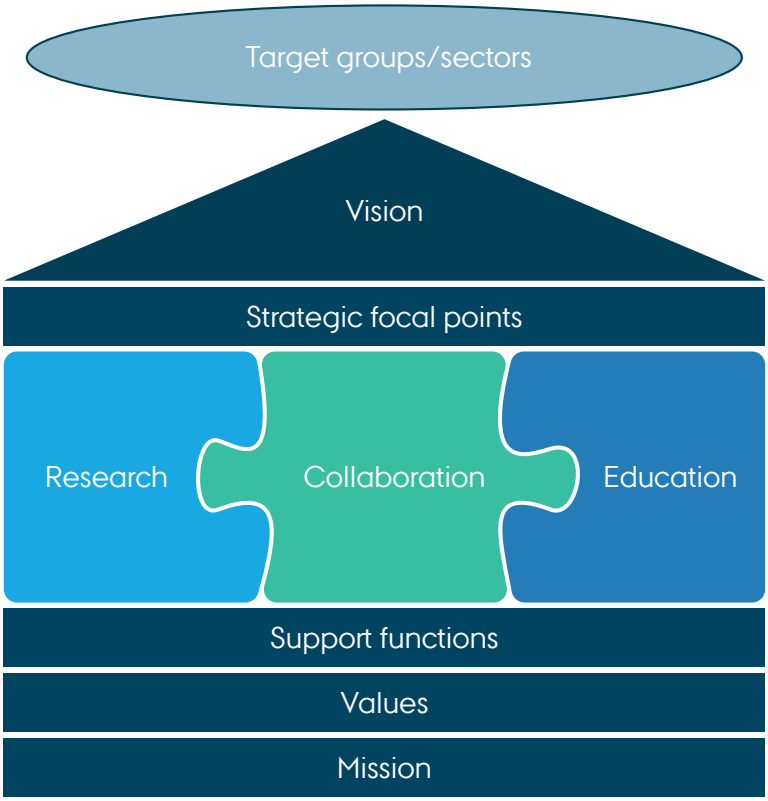


Figure 1: The ECE Strategy House

ECE'S STRATEGY: WHY CHOOSE AN IMPACT-BASED STRATEGY?

Interest is growing rapidly in the evaluation of non-academic benefits or "impact" of publicly funded universities. National and international political, private, and funding bodies are increasingly seeking evidence of the value of their investments and their impact on society as a whole. At the same time, society is facing major challenges that demand universities to contribute with sustained solutions through research, education and knowledgetransfer, as well as innovation, collaboration and consultancy.

This expectation is also evidenced in the increased focus by funding agencies and governments to support missiondriven research as well as research focused on pressing societal challenges (e.g., the green transition, digitalisation). Our approach to ECE's strategy for 2024-2029 is inspired in part by these trends.

Creating impact is not new to ECE. We have a strong track-record and experience with collaborative and solution-oriented research as well as strong educational programmes that prepare our students for the professional demands of private and public organisations or for carrying out future research for the benefit of our society. Thus, we are well-positioned to take on these new challenges. In fact, the increased focus on creating societal impact is an opportunity for ECE to further leverage its core activities to the benefit of society, our students, and the industries and organisations we collaborate with.

Impact has various definitions but in our strategy for 2024-2029 we define impact as the results, effects and influence of our core activities: research, education and collaboration. This includes academic impact, such as enhancing scientific quality, continually developing relevant undergraduate and graduate programmes and building critical expertise and facilities. It also includes societal impact, which is about the contribution of research, and the advantages of having well-educated engineering graduates, the benefits to society, to individuals and as a facilitator for creating value for private and public organisations. Impact is created in many ways, for example through publications and knowledge dissemination, by providing industry with skilled and well-trained engineering graduates and by engaging actively with collaborators, end-users and other stakeholders. Impact is created when our actions lead to the discovery, innovation or development of new products, processes, systems, or services. It can also be when our actions lead to changed policy, practices, shaping legislation and changing behaviour. Impact may occur quickly in some cases, but it typically takes time. Therefore, ECE acknowledges that impact can be over the short-term, medium-term and/or long-term.

In the light of these considerations, we can describe ECE's ambition more concretely as creating a meaningful and positive impact on societal challenges, enhance students' development and learning experience and create value for private and public organisations. We will achieve this by:

- Having a specific focus on societal challenges
- Continually strengthening our engineering degree programmes
- Being internationally recognised for our research
- Supporting private and public organisations in developing new or improved solutions, products, processes, systems, and services
- Ensuring that relevant stakeholders have access to up-to-date research-based knowledge as part of our public consultancy activities
- Creating an innovative and entrepreneurial environment
- Supporting start-ups to turn ideas into business
- Prioritizing diversity and equality
- Ensuring a good working environment
- Being the collaborating department




OUR VALUES

We believe that to achieve our department's potential, we need to create an environment for our staff and students, where they can reflect, think deeply, develop, exchange ideas, and ultimately, thrive. Therefore, we will strive to offer a diverse, equal and inclusive environment that can attract a wide spectrum of researchers, educators, support staff and students and that also make us an attractive partner for external stakeholders to work with.

Our values include:

- **Innovativeness**
  We are curious by nature, often driven by a strong desire to know more, e.g. about a problem and its possible solution. We are open to explore new ideas and to challenge the norm.
- **Professionalism**
  We are familiar with and follow the standards, codes of conduct and other qualities that define the best practices within our professional fields.
- **Excellence**
  We aim for the highest quality in everything we do, and we take pride in our work. We actively search for new opportunities to develop our knowledge and skills.
- **Integrity**
  We act honestly and demonstrate strong moral and ethical principles.
- **Responsibility**
  We are accountable for our actions and strive to make the right choices under any circumstances to the best of our abilities.
- **Collaboration**
  We have a proven track-record for successfully working together and with others to reach a common goal. We are recognised for our collaborative approach, and we will continue to develop our relationships with existing partners and/or to build relationships with new partners.
- **Interdisciplinarity**
  We are aware that complex problems often require an interdisciplinary approach and have wide experience with working with other disciplines, ranging from other engineering disciplines to clinicians, chemists, physicists or business experts etc. We are comfortable leading interdisciplinary activities.
- **Inclusiveness**
  To create an inclusive environment, we value the need to respect individual boundaries, to maintain respectful communication, and to be aware of the biases that surround us in our daily lives. Creating a work environment that is inclusive and equitable is essential to the success of ECE's strategy. We are all a part of creating and ensuring a good and safe work environment.

STRATEGIC FOCAL POINTS

ECE's strategic focal points are linked to our ability to create a positive impact on societal challenges, students, private and public organisations and to strengthen ECE's internal processes and support functions. ECE's deep technical skills, practical knowledge and ability to understand industry's needs position us uniquely to carry out research and innovation and develop novel approaches and solutions to global challenges.

Therefore, our strategic focal points are:

- Societal challenges
- Students
- Private and public organisations
- Diversity, equity, and inclusion

For each overarching focal point, specific actions that are linked to our ability to create impact have been identified and will be addressed during the strategy period. These acions are dynamic by nature and additional actions may be included during revisions of the strategy. Successfully addressing the specific actions for each focal point will not only allow us to move forward but will contribute to our brand, making us more attractive to external stakeholders, including potential new employees, companies, other universities, international partners and potential new students. It will also bolster our on-going internal initiatives aimed at cultivating ECE into an outstanding place to work, retaining, developing and advancing our current staff members whilst strengthening our visibility and reputation towards the outside world.

Societal challenges

Societal challenges address major global problems that potentially impact a vast number of people and call for innovative solutions, where competences within electrical and computer engineering often play an important role. Examples are sustainability (including climate change, the green transition, water), security, health and quality-of-life.

ECE will contribute to solving some of these major global societal challenges by leveraging our expertise in electrical and computer technologies. The specific actions that have been identified are aligned with the department's fields of expertise, addressing both the societal and technological aspects of these challenges.

Students

ECE focuses on creating a positive impact on the individual student's education. Students are introduced to the latest knowledge and technologies that are the necessary tools they will need to address societal challenges. They engage in project-oriented coursework in selected emerging research topics and in projects that address real-life problems that are experienced by private and public organisations facing these challenges. We encourage an entrepreneurial mind-set and provide facilities for student start-ups.

This focal point addresses our ability to enhance our students' development and learning experience and how we inspire, encourage and support our students, preparing them for the future and ensuring employability.

Private and public organizations

Collaboration is part of our DNA and ECE creates impact through, and in collaboration with, all types and sizes of private and public organisations in our ecosystem creating value for private and public organisations alike. We are recognised for our collaborative approach and we foster collaborative partnerships and knowledge exchange and we offer public and private consultancy services. We draw on unique skills, strengths and experiences within applied research and solution-oriented work, supported by a wide range of laboratories and experimental facilities.

Diversity, equity and inclusion

We attract talent from around the globe and one of our strengths arises from this diverse community where everyone is openly invited to contribute with their own perspectives. We will continue to invest in people, strengthen our internal processes and support functions and strive to foster and promote an inclusive culture.

In 2023 ECE completed a process of analysing the needs and mapping key recommendations on Diversity, Equity, and Inclusion (DEI), resulting in the internal report "Strengthening (gender) equality at ECE. A report on the situation & how to move forward". In the strategy period 2024-2029 we will implement these recommendations and undertake new initiatives to create a positive impact by actively promoting and working with DEI principles. We will create an even more inclusive and supportive environment, ultimately contributing to a diverse and equitable future in the field of electrical and computer engineering.

DEI efforts not only benefit the individuals directly involved but also contribute to a richer and more innovative academic community.

FROM STRATEGY TO IMPACT THROUGH ECE'S "ACTIONS"

The focal points call for concrete actions that will drive the strategy towards creating actual impact. ECE has completed an internal process within the management group, inviting short descriptions of concrete actions. The descriptions are written into standard templates and each action indicates which focal point(s) the action addresses. Looking forward, this will be an on-going process, where new actions can be taken up at later stages, i.e. during the annual review of the strategy. The individual actions have subsequently been collected into three groups, "digital transformation", "education" and "support services and facilities". The groups and their associated actions are shown in table 1.

Action Group	**Specific action** (with shortened title – se below for the full version)
Digital Transformation	**Digital X:** Targeting new digital transformation initiatives in key markets
	Digital Twins: Providing easily accessible digital services
	Cyber Security: Countering the growing threat of cybercrime
	Chip Design: Intelligent Semiconductor chips driving future industries
	Digital Energy: Advancing the Green Agenda with digital technologies
	Healthcare: Increased support for a pressurised healthcare system
	Increased awareness of research outcomes: Targeting stakeholders
Education	**Digital competences for students:** Keeping afront of digital developments
	Cybersecurity competences for students: Navigating the digital world
	Sustainability competences for students: Preparing a sustainable future
	Future-proofing ECE students: Employability in an uncertain future
Support Services and Facilities	**Working environment and culture:** Making ECE an outstanding place
	Green Campus: Sustainability starts here

Table 1: Overview of actions

Actions addressing the digital transformation

A short summary (in non-prioritised order) of each action is presented below.

Digital X: Targeting new digitalisation initiatives in key vertical markets

ECE is already actively involved in several exciting digitalisation initiatives, e.g. digital twins, edge intelligence and Artificial Intelligence/Machine Learning. Attractive opportunities also exist in digital transformation verticals such as Digital-Water, Digital-Energy, Digital-Health, Digital-Space, Digital-Defence, Digital-Brain and Applied Quantum Com-puting technologies. This action will address these verticals, that demand a unified effort, particularly for critical infrastructures, where breaking of internal silos enabling cross-discipline collaboration is key to attracting and securing large, long-term external funding and resources.

Digital Twins: Providing easily accessible digital services on top of physical products

The digital transition is challenging but necessary for the public and private sector alike. An important, and challenging, part of any digital journey is to consider the digital services that can be offered on top of a physical product and not just how to produce a cheaper product. One of the possible solutions to this is establishing digital twins providing additional services on top of physical products. ECE has key competences and a successful track-record within digital twins and the ambition of this action is to develop technical solutions that make it easier and more cost-efficient for companies, in particular SMEs, and the public sector to get started with digital twins and embark on their digital transition.

Cyber Security: Countering the growing threat of cybercrime and misinformation

Increasingly digitalised societies with ever-growing numbers of interconnected devices and systems implies a growing threat from cybercrime. The availability of cybersecurity experts is limited, whilst demand is growing rapidly. Security as a requirement in software development projects is now the norm, however our software engineering graduates lack the necessary technical knowledge. This action will establish a research group on cyber-security in embedded systems collaborating across sections and with the Department of Computer Science. Courses and electives will be designed for BEng and M.Sc. undergraduates.

Chip Design: Intelligent Semiconductor chips driving the industry of the future

The importance of having national and European strongholds within chip design is clearly emphasized in the recent EU Chip Act and many other on-going activities globally. ECE has a strong, well-established research group working on chips and, in particular, on chip design and we are uniquely positioned in both Denmark and the EU. Strategically we should seize all current opportunities to expand our existing strengths and firmly place ECE on the map as Denmark's leading university department and centre for chip design and associated activities.

Digital Energy: Advancing the Green Agenda with digital technologies and tools

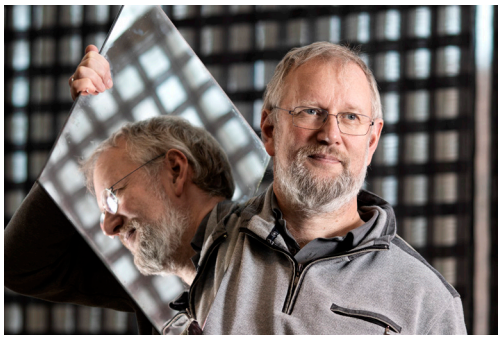
Europe's (and Denmark's) journey towards climate neutrality calls for massive investments in renewable energy sources and energy infrastructure. Digital technologies and tools are critical enablers for ensuring the success of the green transition, for example in new, GW-scale energy parks. One of the major issues facing these gigantic energy parks is integrating electrical energy solutions at all levels, across all sectors and scale. ECE has solid competences within this area and this action will establish ECE as a leading researchbased department within energy system transition.

Healthcare: Increased support for an increasingly pressurised healthcare system

Healthcare systems are coming under increasing pressure to provide preventive measures and deliver adequate and timely services to citizens with diseases or disabilities. There are promising opportunities within the biomedical engineering field for ECE to expand activities and address exciting emerging technological areas to support the healthcare system and healthcare industry. Examples are improved disease prevention, diagnosis, treatment, monitoring, and rehabilitation of patients and citizens with acute and chronic diseases or disabilities.

Increased awareness of research outcomes: Raising stakeholder awareness

ECE's rapid growth has resulted in a growing need to increase awareness of what we can offer towards external and internal stakeholders. More specifically, how can they adopt and implement our research outcomes into viable products, services or methods in the short, medium and long-term. One way of doing this is to develop explicit communication and stakeholder engagement plans supplemented by outreach material translated from scientific or technical language into a direct and understandable language easily understood by our key stakeholders.



Actions addressing education

Digital competences for students: Keeping in front of digital developments

Digital competences are essential for understanding and using technology for learning, working and our everyday life and practically every job offered to our graduates today requires digital competences. We will increase the level of digital competences across our study programmes, enabling students to master different levels of digital skills. At Bachelor level the student will be able to solve complex problems with limited resources, to integrate solutions in their chosen profession and to guide others. At Master level the student will be able to formulate and solve complex problems with numerous interacting factors and propose new ideas and processes within their chosen field(s) of research. Examples of digital competences include digitalisation of the energy sector, digital twins and simulation for EET programmes and for E, EE, SW, CE and ST it could include a stronger focus on relevant software development targeting embedded, high-level, simulation-software.

Cybersecurity competences for students: Navigating securely in the digital world

The necessity of understanding cyber security is important now more than ever and the trend is that its significance will continue to grow. While our students study with us and afterwards, in the careers they choose to follow, it will be vital to be able to recognise cyber threats that could impact their personal, academic or professional life. We will increase the level of cyber security competences across our study programmes, with compulsory sub-jects ensuring basic levels of understanding and electives at advanced level. Compulsory subjects will address basic principles and concepts of cyber security, cyber threats, vulnerabilities, risk assessment and management and introduce the student to the concept of continuous learning to keep updated. Examples of electives are threat intelligence, cryptography, cyber security frameworks, security architecture and design, digital forensics and non-hackable electronics. This action will be aligned with the action “Cyber Security”.

Sustainability competences for students: Preparing for a sustainable future

Coming generations will be faced with interconnected challenges such as climate change, loss of biodiversity and the unsustainable use of natural resources. For our students to be able to address these future challenges in a qualified way, it is important that they are well-equipped with relevant knowledge and the necessary competences. We will increase the level of sustainability competences across our study programmes, with compulsory subjects ensuring basic levels of understanding and electives at advanced level. Compulsory subjects will introduce UN world goals, circular economy, energy flows and data centres. Examples of electives are Life-Cycle-Analysis, P2X, change management, the environmental impact of materials/products and strategies for sustainable development.

Future-proofing ECE students: Ensuring employability in an uncertain future

Graduates from ECE are currently sought after by employers in a market that is characterised by higher demand than supply. This situation may change in the future but whatever the marked situation we will stive to give our students the best qualifications possible so that they graduate with a high level of technical competences and other essential skills to be attractive for employers. Our goal is that all our graduates have an offer of employment after completing their degrees. This action will address how to engage and develop our undergraduates throughout their study time at ECE so that they learn how to learn and appreciate that learning is a life-long experience. As a side effect it may counteract drop-out and/or give inspiration to further education programmes for ECE's graduate engineers, where there currently is little incentive for graduates to embark on further education.

Actions addressing support services and facilities

Working environment and culture: Making ECE an outstanding place to work and study

We are already committed to on-going efforts for improving working and studying conditions and strengthening gender-equality and inclusion aspects at ECE. Our ambitions include creating a good working and studying environment and making ECE an outstanding place to work and study, for everyone and at all levels. This action will not only implement the recommendations from the work carried out in 2023 but will build on and expand these efforts with renewed focus selected focus areas, e.g. on-boarding, staff-retention, communication, nudging and constructive dialogue. Similarly specific actions will be made to the overall study environment for our students such as improved facilities and dedicated areas for students to meet and socialise or study together or alone.

Green Campus: Sustainability starts here

ECE is already well-established at the Katrinebjerg Campus and the continued growth of the department places increasing demands on our buildings and how/when the staff and students use them. We are also lagging behind with regard to separating and sorting our waste into the fractions that can easily be sent to recycling (paper, plastics, glass, metal etc.) We believe that there are potential savings to be made by using our building spaces more intelligently, by separating and sorting waste and by altering behaviour to reduce consumption of resources such as electricity, heating and water. This also applies to potentially empty offices and/or unused rooms/classrooms/labs/-other spaces. This action will investigate how we currently use our building spaces, possible ways of using them more intelligently and ways to save or recycle resources.

HOW WILL WE REALISE OUR STRATEGIC GOALS?

ECE's strategy maps into AU's and TECH's overall strategy and strategic goals. AU's strategy focusses on research, education and collaboration as does ECE's. TECH's strategy shows how activities in the individual departments feed into the faculty's strategy, which in turn supports AU's strategy. This is illustrated in Figure 2.

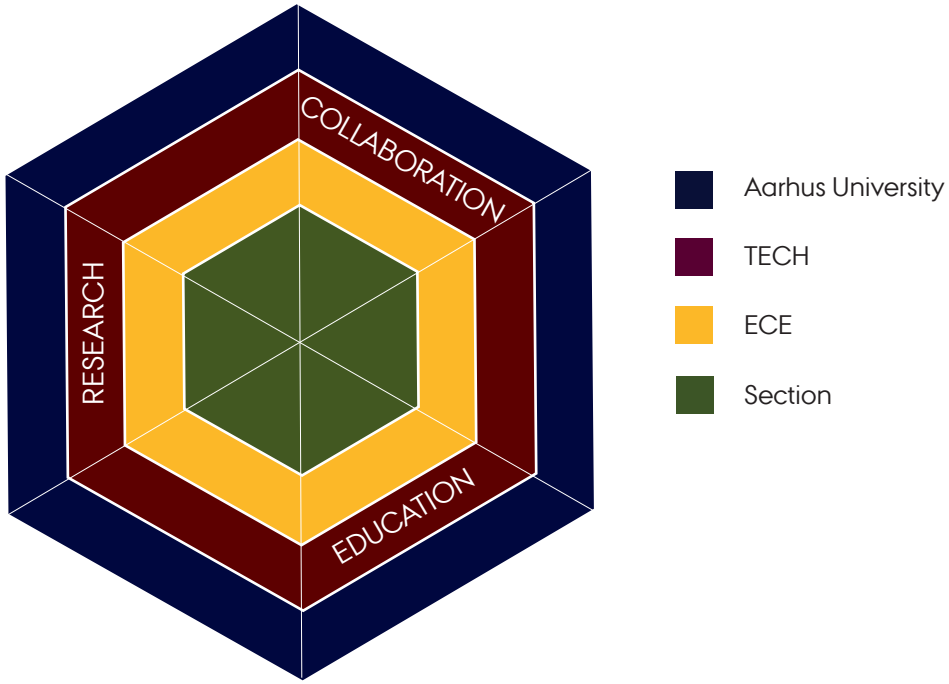


Figure 2: Relationship between AU's, TECH's and ECE's strategies

On a daily basis, ECE's research, education and collaboration activities are carried out in our six sections, each representing a core, but broad research field in electrical and computer engineering. The technical knowledge and skills necessary to run our degree programmes are provided by staff from the different sections. This allows us to build strong and robust programmes based on solid technical and scientific knowledge, incl. insights into the latest technologies, as well as providing flexibility and robustness by having multiple potential lecturers for each subject. The principle of this is illustrated by the matrix structure in Figure 3.

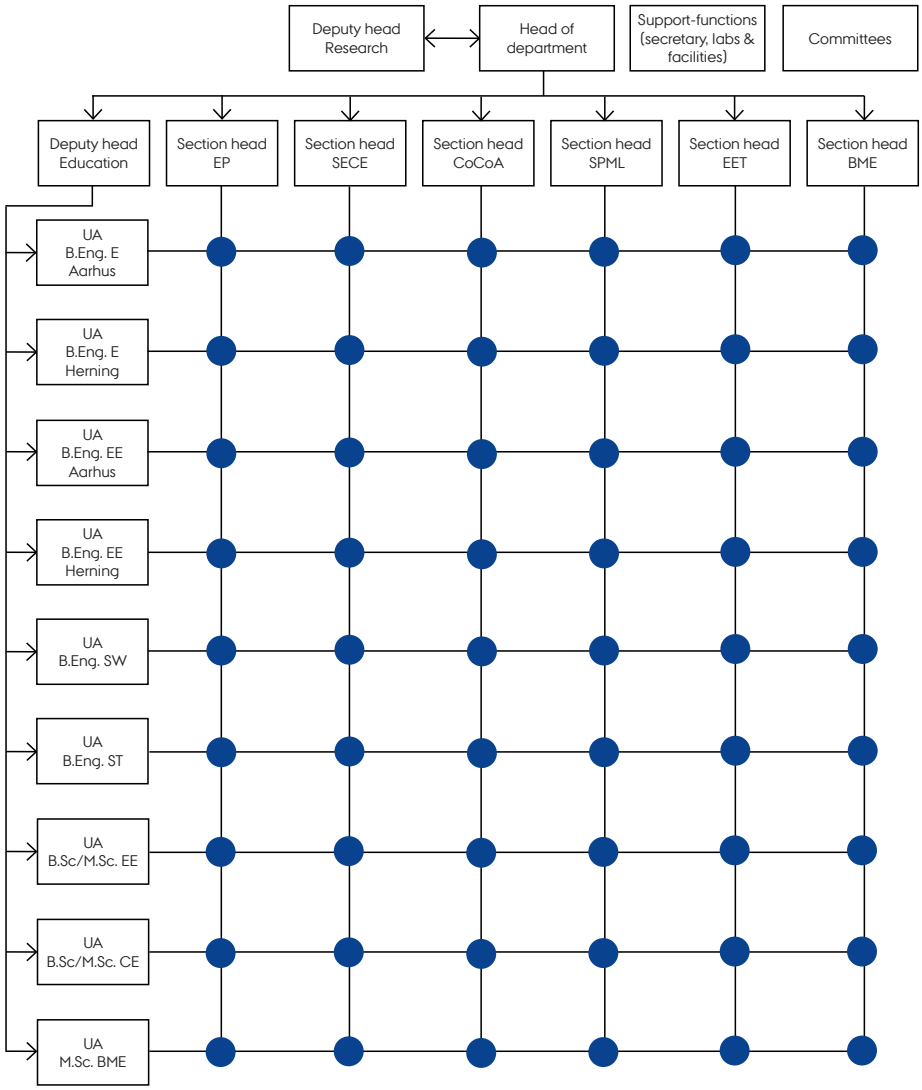


Figure 3: ECE sections provide a mix of expertise and skills to the engineering degree programmes

As Figure 3 also shows, the sections, along with the management group, are supported by – and highly dependent on – a comprehensive range of well-functioning and professional internal support services. These shared services include administrative tasks, support for staff and students, workshops and labs, communication, project support, industry collaboration, business development.

Figure 4 illustrates the interplay between our core activities, internal support functions and ability to create impact on, and in collaboration with, our key stakeholders.

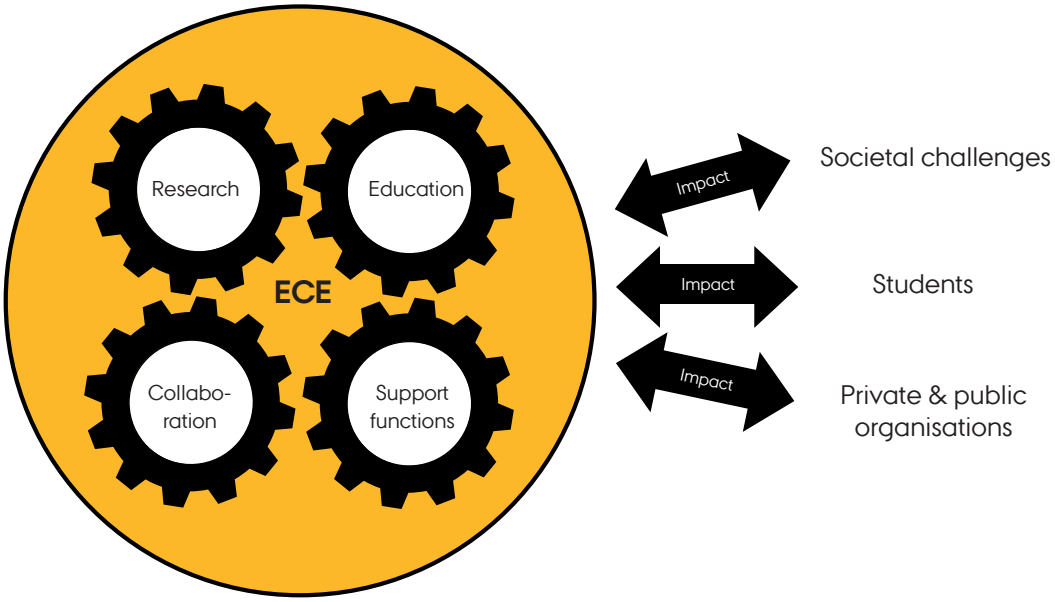


Figure 4: The interplay between our core activities and internal support services

CLOSING REMARKS

At the start of the strategi period 2024-2029, ECE is in a good position for further growth and development and with the ability to continue creating impact. The strategi identifies specific focal points and a number of actions with potential to turn strategy into impact within selected areas. Each action will be assigned an "owner" who will be responsible for driving the initiative. Progress will be followed by the management team and reviewed annually. New actions can be suggested and selected during the reviews.