

NordSEnt

Swedish results

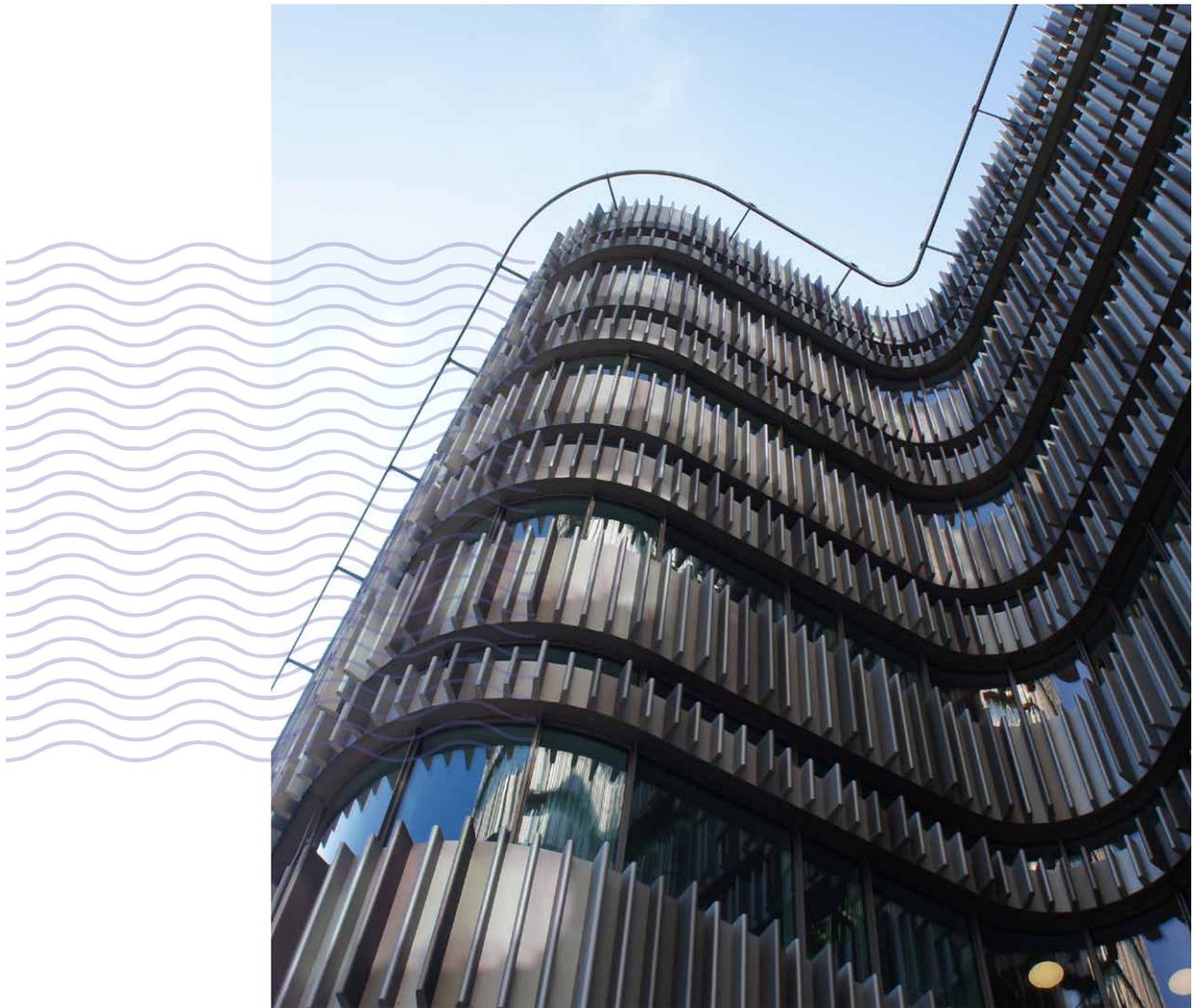
Mapping Swedish Higher Education Institutions' work on entrepreneurship and sustainability through the Nordic Sustainable Entrepreneurship Network



Royal Swedish Academy of
Engineering Sciences

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Introduction and background

SUMMARY

The results presented in this report are part of a Nordic-Baltic cooperation project, NordSEnt. The project was carried out from August 2021 to July 2022 with IVA's Entrepreneurship Academy as Swedish partner. The purpose of the project was to share information on how to support sustainable entrepreneurship education and hub activities at Higher Education Institutions and to increase the numbers of sustainable entrepreneurs at universities in the Nordic and Baltic countries.

The full result is available on NordSEnt's website: <https://nordsent.com/materials/>

Sweden's contribution to the report consists of interviews with key informants at six Swedish higher education institutions: Chalmers University of Technology, Karlstad University, Linköping University, Luleå University of Technology, Lund University and The Royal Institute of Technology (KTH).

Sustainable entrepreneurship is thriving in Sweden and this is in no small part thanks to the work of higher education institutions in the country. This had become apparent after interviewing a large number of representatives from six Swedish universities, including programme supervisors, vice-chancellors, incubator and holding company managers and others. This opinion is also shared by other interviewees from relevant government ministries, public agencies working with elementary or higher education, business leaders and others.

Development in this area is also driven to a large extent by the younger generation – today's students and tomorrow's researchers. By focusing on sustainable development and societal challenges, the universities stay relevant in the eyes of the students, who in turn become highly attractive in the job market once they have graduated. However, other parts of society are also making a strong contribution to increased sustainability, as discussed in further detail below.

Challenges do exist, however, including a traditional over-reliance on the big corporations of the past, a lack of institutional capital and to some extent a lack of coordination around entrepreneurship initiatives between different university departments.

The political level

The goal of Sweden's economic policy is to strengthen the country's competitiveness and create the right conditions for job creation and business growth. Sustainable entrepreneurship is a natural element of this policy. Sweden intends to implement Agenda 2030 for Sustainable Development in three dimensions – economic, social and environmental, through harmonised policies, nationally and internationally. In this regard, sustainable entrepreneurship is seen as an issue of strategic importance in industry, as is improving and enhancing knowledge, research and innovation to meet the challenge of reaching the Agenda 2030 goals.

Several government strategies are aligned with this intention, including the national electrification strategy, Sweden's climate policy framework with the 2045 goals and other key documents. In 2018, the government also decided to establish a circular economy delegation to support efforts to transform the whole of Sweden into a circular economy.

The National Agency for Public Procurement has also been assigned to support climate-neutral public procurement. Since this sector is valued at SEK 800 billion annually, it could have a huge impact in driving increased sustainability.

The entrepreneurship ecosystem is well developed in Sweden. The key actors include the Swedish Agency for Economic and Regional Growth (Tillväxtverket), the Swedish innovation agency Vinnova, Almi which is a network of regional business developer offices, incubators and science parks across the country and the organisation Drivhuset's network for students interested in entrepreneurship. Many more such actors exist, especially at the local level.

The higher education level and young people

Researchers and innovation managers representing various universities describe the well-functioning, innovative and relevant courses and programmes provided at their institutions. Sustainability as a subject is generally in very high demand among students, and within organisations in the university innovation ecosystem, such as incubators and holding companies. What may still need to be developed at some institutions is coordination at the faculty and university administration levels around entrepreneurship, as well as cooperation around these themes between different departments and projects. Also, according to some interviewees, the investor community does not always prioritise sustainability, which can be a problem.

Several university partnerships promoting entrepreneurship do exist, however, not least at the local level. Stockholm School of Entrepreneurship (SSES) is a platform for cross-disciplinary cooperation on entrepreneurship for several universities in the Stockholm region, the GoINN initiative aims to establish a coordinated innovation system in the west of Sweden and Öresundsuniversitetet (a consortium of Swedish and Danish universities) wants to increase cooperation for innovation in the south of the country and with neighbouring Denmark.

Sustainable entrepreneurship is a big deal among young people, driven by an ambition to contribute to the greater global good and by climate anxiety and various fears. This interest is channelled and catalysed to a large extent by the non-profit organisation Ung Företagsamhet – Junior Achievement Sweden, which works to promote entrepreneurship among Swedish upper secondary school students and to facilitate relationships between industry and the Swedish school system. The organisation has reported a significant increase in interest in sustainable entrepreneurship in recent years, in contrast to the traditional “buy and sell” type of business model.

It is, however, important that this student interest is not only channelled through Ung Företagsamhet, but is also

embraced in other avenues and tools in the school system. Greater agility is also required at relevant government agencies to increase the number of places at higher education institutions and to ensure the future supply of talent.

The business and industry level, and investors

Sweden has a sizeable heavy industry sector, which includes large plants for processing wood and pulp, and manufacturing steel, cars and trucks etc. This sector is now rapidly moving in a more sustainable direction and this will have big implications for all of society, including among the vast number of suppliers, subcontractors and other businesses in the value chain. Many new enterprises are, in turn, likely to spring up as a result of bigger companies shifting towards sustainable solutions.

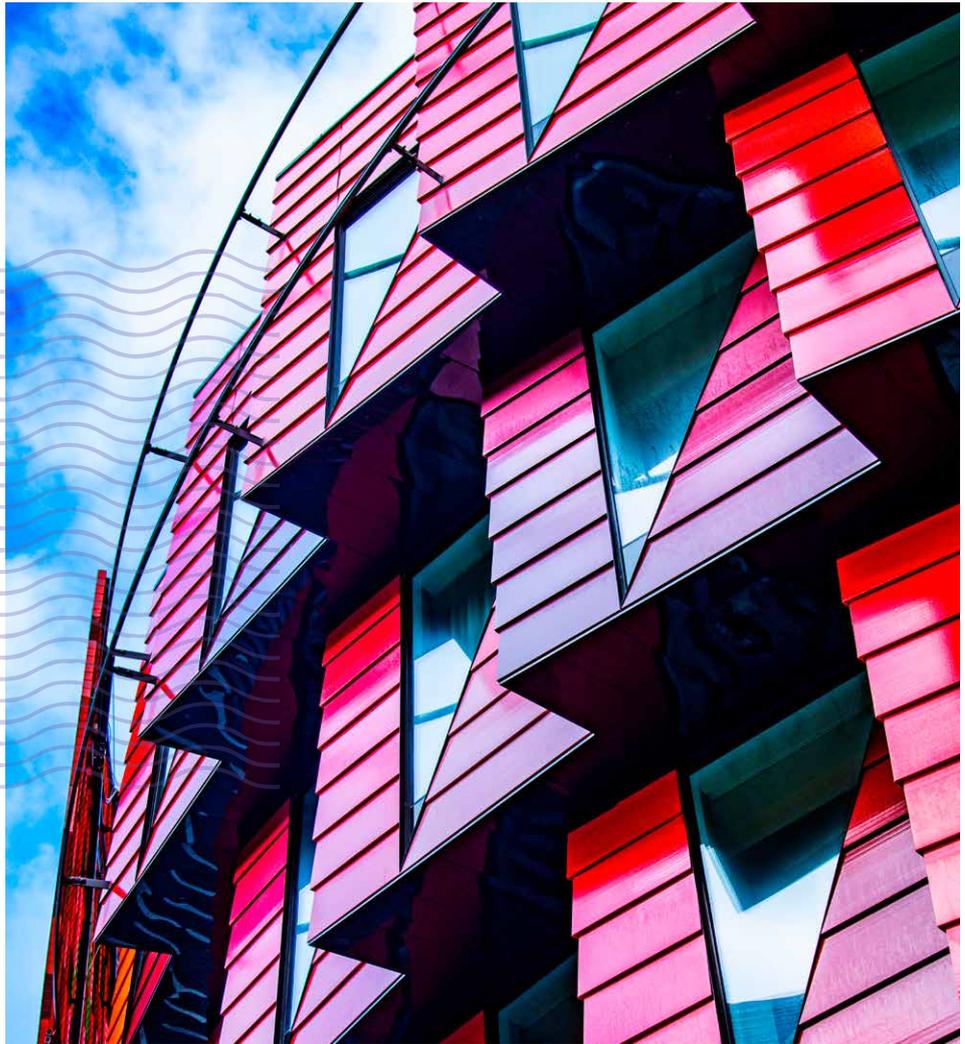
Examples of this transition include the steel company SS-AB's project Hybrit, which will start producing steel with hydrogen as a reducing agent instead of coal and coke, and Northvolt, which will set up huge plants to produce and recycle electric car batteries.

In recent years, the start-up scene in Sweden has become very hot, with companies such as Spotify, Klarna and King taking off and hitting the world stage. In fact, Sweden is second only to Silicon Valley in terms of “unicorns” (start-ups valued at more than USD 1 billion) per capita. Several private investors and family trusts have also started financing sustainable solutions, such as Hybrit challenger H2 Green Steel, the start-up hub Norrskan, the Wallenberg Initiative Material Science for Sustainability and others. Some investment funds are also focusing on green investments. The big pension funds are, however, considered to be lagging behind in supporting the green transition and in buying shares in promising new sustainable companies.

There are several financing tools available to start-up companies. Mature and growing companies with proofs of sales generally also have access to investors that specialise in specific sectors. The area in between – the “Valley of Death” – is however insufficiently funded. More institutional capital is needed to support growing sustainable companies.

Sweden has traditionally relied on a few old and big corporations, and needs to start growing upcoming businesses as well. This is happening today, but the pace is too slow according to some of those interviewed. Positive entrepreneurship cases should be highlighted to accelerate this transition.





Chalmers University of Technology

Chalmers University of Technology in Gothenburg conducts research and offers education in technology and natural sciences at a high international level. The university has 3,100 employees and 10,000 students, and offers education in engineering, science, architecture and maritime engineering. Based on scientific excellence, Chalmers promotes knowledge and technical solutions for a sustainable world. Through global commitment and entrepreneurship, the university fosters an innovative spirit in close cooperation with the wider community. The EU's biggest research initiative – the Graphene Flagship – is coordinated by Chalmers. The university is also leading the development of a Swedish quantum computer. Chalmers was founded in 1829 and has the same motto today as it had then: *Avancez – Forward*.

Chalmers has a vision for a sustainable future. Through this vision, the institution seeks to meet the need for ecological, social and economic sustainability in a committed, innovative and pioneering way.

Going forward Chalmers plans to increase the focus on sustainable development in engineering. This means playing a key role in finding solutions to some of today's urgent and complex global environmental and resource challenges. Sustainable development is an urgent issue to include in all programmes, but in the programmes described below it is the primary profile.

Research

Researchers from Chalmers and the University of Gothenburg are focusing on environmental science and entrepreneurship: Backcasting¹ and life cycle analyses² are frequently applied by both universities and are highly effective tools. They allow the overall environmental impact of products that may be produced in the millions to be analysed and problematised.

Since 2019 Chalmers and IVL Swedish Environmental Research Institute have had a strategic partnership to work in an efficient and coordinated way to develop research to meet the needs presented in the UN Sustainable Development Goals (SDGs).

Strategy

Society is now facing several global challenges that are the most serious in our history. These challenges will require substantial and large-scale technological and social changes. Engineers in this field will develop innovative solutions that may be crucial for the transition towards a sustainable future. At Chalmers, an entrepreneurial approach is included as a key element in both research and education. This involves transparency, co-creation and flexibility, as well as tackling real-life problems, testing bold new ideas and making a difference in the world.

1 *Backcasting* is a method used in planning. It begins with outlining a desired goal or object in the future and then working backwards to identify programs and policies needed to connect that desired future back to the present.

2 *Life cycle analysis* is a method used to evaluate the environmental impact of a product through its life cycle from its raw materials to disposal or recycling.

The vision, *Chalmers for a sustainable future*, is a theme that runs through all the university's activities – from undergraduate education and doctoral programmes, research, innovation and collaboration, to campus development and the internal environment. For almost thirty years, all students have taken a course in environment and sustainable development and have had the opportunity to complete their studies with a sustainability profile.

The Chalmers Challenge Lab is a challenge-driven innovation and co-creation arena aimed at supporting the transition to a more sustainable society. Challenge Lab provides a space for students from different master's programmes to develop as leaders, collaborate with various stakeholders from all areas of society, and explore complex sustainability challenges from multiple perspectives.

Activities

Chalmers Entrepreneurship Society (CES) (<https://www.facebook.com/chalmersentrepreneurshipsociety/>) is an association that focuses on entrepreneurship. It shares some facilities with Chalmers Students for Sustainability (CSS), thus creating a natural collaboration hub around entrepreneurship and sustainability. CES always sets out to solve sustainability challenges from an entrepreneurial perspective. To do this, the society arranges workshops, networking events, case nights and competitions.

Chalmers E-village (<https://www.chalmers.se/en/evillage/Pages/default.aspx>) is a hub for innovation and entrepreneurship at Chalmers University of Technology. Located at Campus Johanneberg and at the heart of the university's creative environment, it is a place full of opportunities for students, researchers, entrepreneurs, start-ups, growth companies and others interested in collaborating, sharing ideas and exchanging knowledge.

Miljöbron (<https://miljobron.se/vast/>) is a sustainability-focused, member organisation that promotes commitment, provides resources and drives innovation for the future of entrepreneurship. It helps students to build sustainable organisations of the future, while simultaneously allowing them to develop their CVs, forge new contacts and gain experiences to kick-start their career.

Ecosystem

Chalmers Ventures (<https://www.chalmersventures.com/>) is one of Scandinavia's top university incubators. Chalmers

Ventures launches, develops and finances research- and knowledge-based companies. Since 1999, the company has worked with over 600 start-ups, invested in over 200 companies and completed 29 successful exits. Through its programmes and processes, around 80 companies are supported and coached each year. Of these, Chalmers Ventures invests in some 10–15 new potential growth companies.

Investments are made at the early stages with the possibility of following the enterprises over time, with the goal of developing and divesting companies in the portfolio. The funds for investment come from the Chalmers Foundation.

A separate holding company, Chalmers Ventures AB, has been set up to replace the previous innovation companies Chalmersinvest AB, the Chalmers Innovation Foundation and parts of the Chalmers Industry Technology Foundation. The company is owned by the university.

Education

Chalmers School of Entrepreneurship

(<https://www.chalmers.se/en/departments/tme/school-of-entrepreneurship/Pages/SchoolofEntrepreneurship.aspx>; see below for best practice deep dive) unites education and research through entrepreneurship to generate value for society by developing novel and innovative ideas. The students can choose between 2–3 tracks, where entrepreneurship and sustainability are two important components. This is an environment where entrepreneurship is experienced and not only taught in classrooms. Students work with real venture projects during their education and apply their knowledge, creativity and entrepreneurial skills in real settings.

All students must study 7.5 credits in environment and sustainable development during their education. Problem-solving is also emphasised and solutions for financing, for example, need to exist within the framework of student projects.

Business Development and Entrepreneurship

(<https://www.chalmers.se/sv/utbildning/program-pa-grundniva/Sidor/Affarsutveckling-och-entreprenorskap.aspx>) is based on both engineering and social sciences, and also incorporates sustainable development throughout the programme. Many courses in the programme are project-based. Group work and presentations are common, giving students an opportunity to improve their relationship-building skills. Several courses include elements of both business development and entrepreneurship. Students also run business development projects in cooperation with companies, giving them an insight into the business world.

Master of Sciences in Product Development (<https://www.chalmers.se/en/education/programs/masters-info/Pages/Product-Development.aspx>) focuses on *multidisciplinary product development while taking user needs and all phases of a product's life cycle into consideration*. Development work today is typically characterised by multidisciplinary, international teamwork, as well as efforts to consider multiple issues related to the product and its life cycle simultaneously. Product development is a core industrial activity that addresses all of these aspects; it is a multidisciplinary process of identifying and envisaging the needs of the user, company and society, and bringing those needs to life.

Best practice: Chalmers School of Entrepreneurship

Story

Chalmers School of Entrepreneurship was started in 1997, but plans for the initiative date back to the 1980s. Even before this, the Torkel Wallmark Centre for Innovation was set up in 1978–79, and chair in innovation technology was established, with Wallmark being the first professor in this subject ever in Sweden.

The School of Entrepreneurship was subsequently set up to offer an academic environment and resources around entrepreneurship. Academic companies were, in general, not seeing much growth at the time, but it was hoped that the new school would improve opportunities to set up and build growing companies.

Several incubators have used this model as an example, and ten years ago Chalmers's hub was the most successful one.

Chalmers School of Entrepreneurship focuses on sustainability. Without technology, it is hard to make sustainability work in practice, and without sustainability on the curriculum, the courses will, in general, not be as attractive to female students. Both research and entrepreneurial creativity are needed, but to find solutions, entrepreneurial creativity is essential. Sustainability and technology go hand in hand; for example, there are not many students working on petrol engines for Volvo these days.

Impact

Today, 40 percent of the students at the school are women. Chalmers alumni from 10–15 years ago are now working in various positions where they are contributing to sustainability. IKEA's CEO is a former Chalmers student and the company is extremely focused on sustainability.

Tools and methods

Among the tools that are frequently used are life-cycle analysis and backcasting. The university also participates in EU projects on e-creation, sustainability and innovation. Lean start-ups and design thinking are other methods that Chalmers School of Entrepreneurship uses a lot. However, many of the methods being used were not developed with a focus on sustainability and will therefore rely on potential customers actively caring about sustainability for them to really work as sustainability tools.

Special activities

All the projects at the school should have an entrepreneurial and sustainability focus. Some good examples of projects are [Viable Cities](#), Makerspace prototype creation projects and [Challenge Lab](#).

Educators who want to start project courses (7.5 ECT) can receive funding for this.

Framework

Students at Chalmers are passionate about Scandinavian entrepreneurship and management. Today's students are not willing to work for companies that have a negative impact on the environment; they want to contribute and feel proud of their work. Topics being discussed are areas where technology can intersect with values relating to the environmental and human rights. It is important for students to be engaged in a discussion about risk, such as when Facebook interferes with democracy.

Assessment

In addition to its standard evaluation of all courses, Chalmers School of Entrepreneurship has ongoing partnerships focusing on research and evaluation with similar programmes in Trondheim, Norway (NTNU) and Lund, Sweden (Lund University). The school's partnerships with large corporations and with the Chalmers Ventures Incubator, provide a built-in learning and assessment tool. The school also conducts interviews with "e-lumni" (former students of Chalmers School of Entrepreneurship) about what they are currently working on.

Success factors

The main success factors have been the ability to incorporate sustainability into all programmes and courses. It has also been valuable to involve all levels of the university in this effort – including administration and management, incubators etc.

Tips and strategies

We need to allow students to learn from other countries in Europe, and to some extent also Africa. It is necessary to have a committed faculty so that students have opportunities to carry out activities with their professors, and to work on projects outside the classroom. More and more professors and researchers want to work in a more project-based way with their students. There is a great potential here and it will be part of the strategy going forward.

The promotion system is also important. It should not just be about publishing. Other factors include gender equality and working in teams. Many female academics want to be part of a larger context. Today there is too much emphasis on the individual in academia – there needs to be more team activity.

Needs

“Dull and technical” is a communication challenge. Those who are not academics find it difficult to see the benefits of collaborating with a technical university. Meeting places like Entrepreneurship and Small Business Research Institute (Esbri) are needed, as well as better communication. The City of Gothenburg (where Chalmers is located) needs to show interest in collaboration with various actors, in Stockholm and elsewhere.

Scalability

Chalmers School of Entrepreneurship has several projects that work well to scale up. The school has written a paper intended to inspire other higher education institutions in Europe to work in the same way. Communication is important here, with the surrounding community as well as within the various layers of Chalmers University itself, since it is sometimes difficult for one hand to know what the other one is doing.

Links to relevant courses

Practical leadership and entrepreneurship

<https://student.portal.chalmers.se/en/search/Pages/default.aspx?q=tek700>

Creating technology-based ventures

<https://student.portal.chalmers.se/en/search/Pages/default.aspx?q=tek656>

Business development and entrepreneurship

<https://student.portal.chalmers.se/en/search/Pages/default.aspx?q=tek575>

Science, innovation and entrepreneurship

<https://student.portal.chalmers.se/en/search/Pages/default.aspx?q=tif181>

Technology-based entrepreneurship

<https://student.portal.chalmers.se/en/search/Pages/default.aspx?q=cip017>

Patents and innovation engineering

<https://student.portal.chalmers.se/en/search/Pages/default.aspx?q=cip061>

Innovation economics

<https://student.portal.chalmers.se/en/search/Pages/default.aspx?q=ioe012>

Management and organisation of innovation and R&D

<https://student.portal.chalmers.se/en/search/Pages/default.aspx?q=tek745>

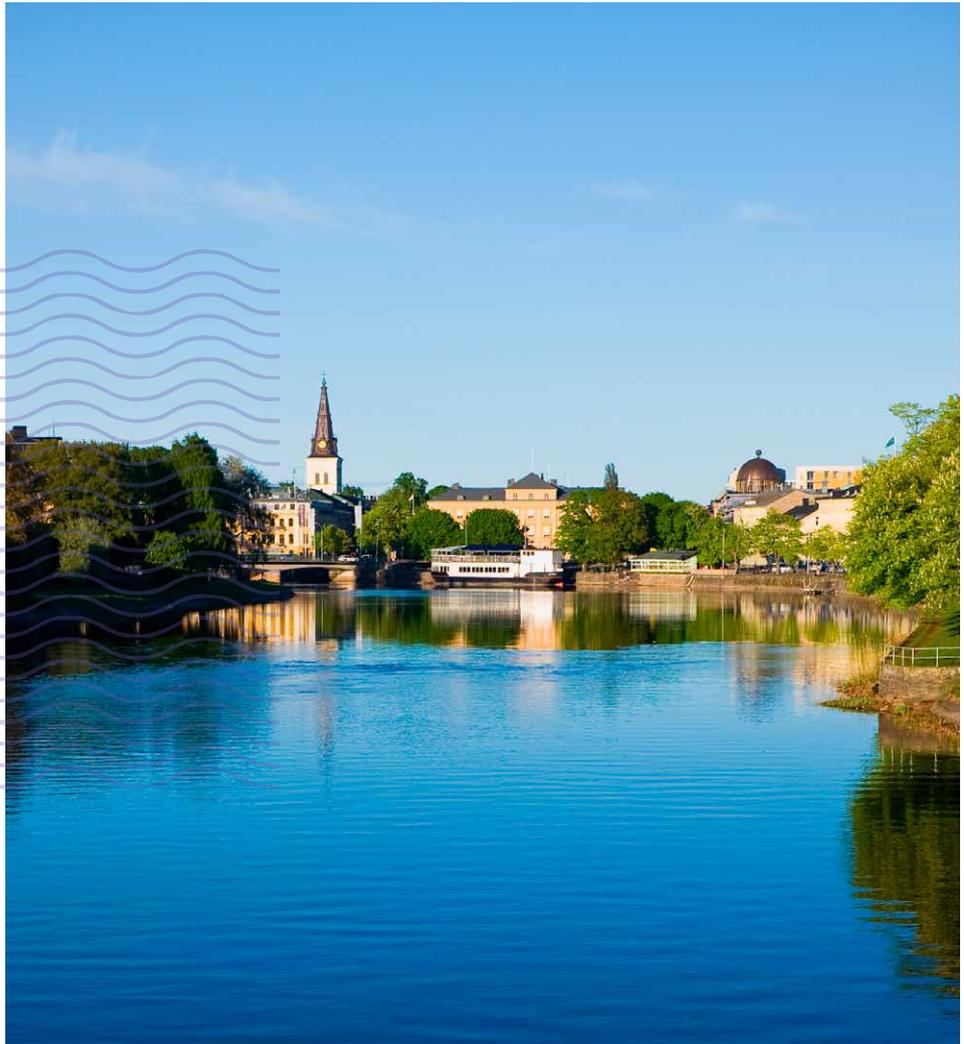
Circular economy

<https://student.portal.chalmers.se/en/search/Pages/default.aspx?q=tek680>

Managing stakeholders for sustainable development

https://student.portal.chalmers.se/en/chalmersstudies/courseinformation/Pages/SearchCourse.aspx?course_id=21783&parsergp=3





Karlstad University

Karlstad University became a university in 1999, but at that time Karlstad already had a long tradition of higher education. Teacher education has, for example, existed in Karlstad since 1843. In 2006, Karlstad University became Sweden's first ECTS accredited higher education institution. The European Credit Transfer and Accumulation System (ECTS) enhances the flexibility of education programmes for students. It also supports planning, delivery and evaluation of higher education programmes. Karlstad University has around 80 programmes and 700 courses. Some 16,000 students are enrolled in undergraduate education and there are between 230–250 registered doctoral students.

Research

Business research areas can be functionally divided into categories such as marketing, accounting, finance, financial management and organisation, or categorised according to a problem-oriented perspective, with areas such as entrepreneurship, internationalisation, logistics and service production. Many researchers are focusing on various aspects of service and value creation through the multidisciplinary research group CTF, Service Research Center. Their research explores service management, service innovation, customer behaviour, user involvement in the production of services, and new business models and organisational structures.

Strategy

Karlstad University works systematically towards socially, economically and environmentally sustainable development. The knowledge and skills of students and employ-

ees contributes to a sustainable society. The university is focusing on solving major sustainability challenges and identifying future needs for research and education. High-quality education and research in combination with active collaboration with the surrounding community are what characterise Karlstad University.

Karlstad Business School is AACSB-accredited (Association to Advance Collegiate Schools of Business) and the university supports entrepreneurship and sustainability in all education programmes. These aspects are to be included both horizontally and vertically, at basic levels as well as more advanced ones, and in professional development contexts.

The university's research and innovation strategy focuses on smart specialisation. Right now, there is a process under way to update the university's strategy for the next five years. Forest bioeconomy is one of the most important areas, where the aim is to transform forestry and pulp production into sustainability-based industries.

While Karlstad University has a global and national role, it also has a regional focus. The university is one of the most important actors promoting regional development, through its research and education programmes. It also shares a common strategy with Region Värmland, an organisation formed by Värmland county's municipalities, and various industrial clusters. These clusters bring companies in a particular industry together to drive development.

Activities

The Fyrklöver innovation office (<https://www.kau.se/en/research/collaboration-researchers/innovation-cooperation/innovation-office-fyrklovern>) arranges an informal

meeting via Zoom once a month to which many actors are invited, including researchers. Attendees discuss sustainability, often with a focus on the environment. An arena or conference on the theme of sustainability in Värmland is needed. Those interviewed in the region feel that Värmland is lagging behind in this area.

Karlstad Innovation Park (<https://karlstadinnovationpark.se/english/>) links businesses, academia and the public sector. It offers custom processes to both new entrepreneurs and established companies. The innovation park is home to companies and organisations that want to grow through collaboration with other companies, researchers and the community.

Ecosystem

The Grants and Innovation Office (GIO; <https://www.kau.se/en/research/research-support/support/grants-and-innovation-office>) acts as a university incubator and provides funding support. In addition to providing strategic support to the university and faculty administration, GIO staff members offer expert advice to researchers in connection with research applications, and with the purpose of utilising and commercialising products or ideas.

The GIO works directly with researchers. It also cooperates closely with faculty innovation coordinators and with project managers who are responsible for running overarching university projects within the GIO's area of responsibility.

Karlstad University Innovation AB (<https://www.kau.se/en/external-relations/research-and-innovation-collaboration/innovationssamverkan/karlstads>), established at the beginning of 2018, is a wholly owned subsidiary of Karlstad University Holding AB. This company acts on behalf of Karlstad University as needed in the surrounding innovation system – regionally, nationally and internationally.

To some extent, this holding company has the ability to influence education programmes and it offers a doctoral student course providing a number of credits. The research objective at the basic level is to become more focused on sustainability.

Karlstad University has chosen not to operate incubators under its holding company, but instead works in cooperation with external incubators and accelerators. These incubators work predominantly in forest bioeconomy, but are also active in areas such as digitalisation of welfare services. A focus on sustainability is steadily growing as a require-

ment among incubators. Without this focus, it is not possible to enter the incubators or seek funding.

Sting Bioeconomy (<https://stingbioeconomy.com/>) supports start-ups and business ideas in the field of bioeconomy, services or products that may, in one way or another, help us to preserve the earth's finite resources. This incubator offers guidance, paths to funding, recruitment, networking, marketing and communication, and office space. Its start-up programmes focus on innovation within bioeconomics, for example renewable raw materials from the forest, soil and sea to replace fossil fuels and other materials.

The Fyrklövern innovation office (mentioned above) promotes innovation and aims to raise awareness among case owners (researchers, students and employees). There is however no general strategy for its activities at the university. Fyrklövern's setup for cooperation between the private, public and non-profit sectors is effective and a good way to connect and work together on societal challenges, but it is not being promoted by the university. There is a sense that the university needs a unifying force to decide how to proceed and drive sustainable entrepreneurship, and not postpone activities to sometime in the future.

Funders are starting to ask how businesses will support the Global Goals, and this can have a positive or a negative effect on funding availability. More and more projects are being funded that incorporate the Global Goals (UN SDGs) in their applications, which in itself represents a success. Not many of the companies resulting from these projects have however integrated this perspective fully into their resulting business models. It may nevertheless be difficult to obtain funding for early circular business models and to use the available resources for the right efforts.

Education

Sustainable Business and Leadership (<https://www.kau.se/en/education/programs-and-courses/courses/FEAD47>; see below for best practice deep dive). This course deals with economic, social and ecological sustainability and the leadership and management required to achieve sustainable operations within organisations. The course provides a broad understanding of how ethics, core values, corporate social responsibility and sustainable development influence and create new scenarios for business development and leadership.

Business is also described from a management perspective in terms of sustainable leadership, with leadership and management of service enterprises, human resources, di-

versity issues and leadership styles (including authentic/ethical leadership) being areas of focus.

Master of Science in Industrial Engineering and Management (<https://www.kau.se/en/education/programs-and-courses/programs/TACIE>) offers a common core base and then invites students to choose between five exciting fields of study. The programme has courses in entrepreneurship and sustainability, including sustainable entrepreneurship. Students with an MSc in Industrial Engineering and Management will use their engineering knowledge and management skills to solve problems relating to management and governance of technology-based industries. They will serve as a bridge between technology specialists who lack knowledge of financial management and leadership, and business economists who lack technical knowledge.

Idea Management in the Front End of Innovation (<https://www.kau.se/en/education/programs-and-courses/courses/IEAD06>) is a course focusing on the idea development process linking an organisation's idea management to sustainability. The course is based on an idea development process and divides idea management into four sub-areas.

Business Ethics and Sustainable Business (<https://www.kau.se/en/education/programs-and-courses/courses/FEGB34>) is a course aimed at preparing students to achieve equality, corporate social responsibility and sustainability in their business activities. Achieving these objectives often involves an organisation going through an extensive process of adaptation in terms of business development and marketing communication. Many organisations lack basic knowledge of what is required to do this. Through this course, students develop a broad understanding of how this can be achieved. From a holistic perspective, students analyse, identify and formulate an ethical challenge relating to a current event or phenomenon with relevance to the course content.

Best practice: Sustainable Business and Leadership

Story

The course deals with economic, social and ecological sustainability and the leadership and management required for organisations to have sustainable operations. Achieving a sustainable business often involves extensive restructuring of an individual organisation. Many businesses today lack a basic knowledge of what is required. The course provides a broad understanding of how ethics, core values, corporate social responsibility and sustain-

able development influence and create new scenarios for business development and leadership. Corporate governance involves specifying the rights and obligations of members of an organisation or those who have influence over it, i.e. management, department heads, shareholders and other stakeholders. Corporate governance relies on a blend of expertise in financing, economics, accountancy, law, leadership and the corporate culture. From a management perspective, it also addresses sustainable leadership, managing service enterprises, human resources, diversity and leadership styles (including authentic/ethical leadership). Students are required to holistically analyse, identify and formulate a problem, or a current event or phenomenon related to course content.

Impact

Upon completion of the course, students should, among other things, be able to demonstrate insight into economic, social and environmental sustainability in a business enterprise. They should also demonstrate how business ethics is a critical component in an organisation's long-term potential to operate in a sustainable way, and to show a deeper understanding of an organisation's potential to operate in and for a sustainable society. Students should receive a greater understanding of various perspectives on corporate governance, with respect to value creation for shareholders and other stakeholders, and analyse matters relating to CSR, sustainable development and leadership.

The Service Research Center (CTF) at Karlstad University provides numerous advanced and short courses that focus on professional development, and many of the students/participants witness the importance of sustainability in their work roles. The environment, climate and Agenda 2030 are almost always in focus.

The course coordinators have also witnessed a remarkable difference between business students today and 20 years ago. Today's students envision totally different success factors and ideals than their predecessors. For instance, students today are far more concerned with being an entrepreneur in order to make a difference in the world. Work that involves striving for a greener planet also appears to be attractive from a student perspective.

Tools and methods

The university carries out interviews with companies and organises focus groups. There are groups providing strategic advice with representatives from companies and banks, and consultants with a focus on the climate. They also visit various companies, for example IKEA – a company that strongly emphasises sustainability.

Special activities

CTF successfully provides courses for professionals in both the private and the public sector. One public sector example is a division within the local municipality that is focusing on the transition towards a greener society. In the private sector, IKEA, Volvo Group and other companies are driving the same agenda.

Framework

Through a greater focus on sustainability, research is influencing education. The researchers determine their own education with a stronger emphasis on sustainability, creating a greater understanding and commitment to various areas of sustainability.

Assessment

The course coordinator receives feedback from companies and students who have completed the course.

Success factors

It is important to determine the wants and needs of the target group: students, companies, municipalities and, in some cases, non-profit organisations. It is also important to understand strategic areas with a five-year perspective, with a focus on sustainability.

Tips and strategies

The starting point is the situation at the university and at surrounding industries. Karlstad University, for instance, focuses on forest-based bioeconomy. It is also noteworthy how several of the university's initiatives around digitalisation are contributing to Agenda 2030 (i.e. inclusiveness, less travel, etc.).

Needs

More education and knowledge about sustainability is always needed. Academia is often organised in silos, with different reward systems for different specialisations. This makes it difficult to invite lecturers from other universities and other disciplines. Course coordinators would like to collaborate more with the energy sector.

Scalability

There is a need to find out what the strategic energy supply of the future will look like and to focus on topics related to this. In terms of courses for professionals, other universities could make an important contribution.

Links to relevant courses

Master Programme in Innovation and Service Development

<https://www.kau.se/en/education/programs-and-courses/programs/SAIND>

Innovation Management

<https://www.kau.se/en/education/programs-and-courses/courses/IEAD03>

Idea Management in the Front End of Innovation

<https://www.kau.se/en/education/programs-and-courses/courses/IEAD06>

Operations Management

<https://www.kau.se/en/education/programs-and-courses/courses/IEGB01>

Sustainable Product Development for Industrial Engineering

<https://www.kau.se/en/education/programs-and-courses/courses/MSAD20>

Entrepreneurship

<https://www.kau.se/en/education/programs-and-courses/courses/IEGC02>

Sustainable Business and Leadership

<https://www.kau.se/en/education/programs-and-courses/courses/FEAD47>

Sustainable Product Development

<https://www.kau.se/en/education/programs-and-courses/courses/MSAD19>

Facility Management from a Service Perspective

<https://www.kau.se/karlstads-universitets-uppdraags-ab/uppdraagsutbildningar/ledarskap-kommunikation-3>





Linköping University (LiU)

Linköping University conducts world-leading, cross-boundary research in fields including materials science, IT and hearing. This takes place in close collaboration with the business world and the public sector. In the same spirit, the university offers numerous innovative education programmes, many of which have a clear vocational focus, leading to qualification as, for example, a medical doctor, teacher, economist or engineer.

The university has 35,900 students and 4,300 employees across four campuses. International rankings consistently place LiU as a leading global university. It achieved university status in 1975 and claims that “innovation is LiU’s only tradition”.

Research

Linköping University promotes innovation and openness across subjects and departments. This in turn has led to several world-leading research environments. In addition to science-related issues, the university aims to address areas where benefits to all of society can be achieved. Entrepreneurship courses, for example, must incorporate theoretical knowledge grounded in research combined with practical knowledge.

Research funding is increasingly being aimed at sustainability, and students learn early on that they must make an impact towards the UN’s Sustainable Development Goals. Many of the research funders are now requiring a focus on gender and other aspects, in addition to the environment.

Strategy

Based on specific directions and instructions, the University is required to incorporate a sustainability approach. The push for increased sustainability has been happening for many years. Social entrepreneurship has shifted to working towards global sustainability. The guidelines around this are very clear.

Region Östergötland has a focus on structural “Smart Specialisation” in five areas, in accordance with Agenda 2030 and the UN’s Sustainable Development Goals (SDGs). One of the areas is *Environmental benefits as a business*. The companies in Östergötland, together with Linköping University and public actors, have been successful in turning models such as circular economy into sustainable solutions. There is also a partnership in place with the municipal energy company Tekniska verken.

Activities

Navitas (<https://www.navitas.se/>) is the largest student organisation with a focus on sustainable development at LiU. It brings students with a passion for sustainability together with other students and organisations to inspire each other. Examples of activities include prizes for entrepreneurs and lunch lectures with companies, to create sustainable innovation.

Circularis (<https://liu.se/en/article/circularis>) is a project that aims to develop innovative support for Swedish manufacturers who want increased resource efficiency and sus-

tainability in their products and services. The circular economy is stressed as a new economic model that addresses with recycling of products and materials through e.g. upgrading, maintenance, repair, reuse, sharing, remanufacturing and remodelling.

Engineers Without Borders (EWB) – The Reflective Engineer (<https://volunteer.ewb-swe.org/departments/the-reflective-engineer>) arranges seminars and activities highlighting current challenges in developing technology for a sustainable future. The goal is to highlight the role of engineers in contributing to a sustainable future.

Ecosystem

LEAD Incubator (<https://www.lead.se/>) is a business incubator linked to Linköping University aimed at growing companies that will benefit society. There is no separate track for sustainability, but all incubator companies in general incorporate economic and social sustainability aspects. The aim is to integrate sustainability throughout the companies, but also to realise and explore sustainable market opportunities.

LiU Holding (<https://liu.se/en/organisation/liu/lhg>) is owned by Linköping University. The holding company participates in educational initiatives inside the university and informs students how the holding company and the incubator work. Research funding is increasingly focused on sustainability, and students learn early on that they must aim to make an impact towards the UN's SDGs.

The holding company has various subsidiaries that with a variety of operations. It is involved in the early stages of a company's formation. Once a company is part of the holding company, it enters the LEAD incubator. LEAD's programmes focus on companies in all dimensions of a *growth* scale. Business advisors at LEAD all have the same objective – to advance companies higher up the scale. The company also invests in start-ups that have already received training and have a Societal Readiness Level (SRL) that makes them interesting. The objective is to then make the business model even more sustainable.

The scale has been used for the past three years with an emphasis on working towards sustainability goals in general, and over time more specifically towards the different levels of the scale. There has been a sharp increase in companies based on these directives.

Linköping Innovation (LiU Innovation; <https://liu.se/en/article/liu-innovation>) supports students, researchers and staff

at Linköping University to develop ideas from early concept to finished products or services. LiU Innovation has two tracks with a focus on sustainability – LiU Changemakers and LiU Impact Factory. Both programmes aim to accelerate solutions linked to Agenda 2030.

Vreta Kluster (<https://www.vretakluster.se/in-english>) is a business park, a meetingplace and an arena of development agriculture, forestry, animal husbandry, food, renewable energy, aquaculture and horticulture.

Linköping Science Park (<https://linkopingsciencepark.se/>) is a company owned by the municipality. It works to ensure that the 350 companies with 6,500 employees grow and develop in the best possible way. Its strategy of having an open environment with proximity to international large companies, launching small start-ups and focusing on world-leading research leads to exciting collaborations and projects.

Education

Linköping University has several courses in entrepreneurship, innovation and sustainability. Some courses combine these subjects. Below are some examples.

InGenious Cross-Disciplinary Project (<https://liu.se/en/education/course/799g52>; see below for best practice deep dive). The InGenious project course follows the challenge-based learning approach and serves as a bridge between business and the public sector in the region and students who choose to take the course. The business community submits real-life challenges to the project course. The students – working together in cross-disciplinary groups – develop ideas and find a sustainable solution to the challenge they have taken on from an external challenge provider. The course is student-driven and the method used is challenge-based learning (CBL). This course is intended for students who want to work on real challenges, in a cross-disciplinary way and with the goal of finding solutions to problems clearly linked to Agenda 2030. In addition to the idea development process, there is an emphasis on the group process and pitching techniques.

Innovative entrepreneurship, TEIO06 (<https://studieinfo.liu.se/en/kurs/teio06/vt-2021>) is aimed at enabling students to acquire knowledge and skills in entrepreneurship, with a particular focus on idea feasibility analysis and business planning for new, innovative ventures. A CBL approach is used in this course. This is defined as “an experiential learning approach that starts out with wicked, open and sustainability-related real-life challenges that students, in multidis-

ciplinary teams, tackle in their own way and develop into innovative and creative solutions which are presented in open forums”.

Environmentally Driven Business Development, TKMJ49 (<https://studieinfo.liu.se/en/kurs/TKMJ49>) is a course that aims to develop the students’ ability to develop and plan a business solution to address an environmental problem. It also focuses on entrepreneurship, innovation and business activities in general and in the context of environmental technology more specifically. The course is run in close cooperation with Tekniska verken, incorporating a circular economy framework. Over the years, the course has also partners with other environmentally focused tech firms. Students combine knowledge of the environment and environmental technology with innovation and entrepreneurship.

Best practice: InGenious

Story

In collaboration with the international development platform InGenious and ECIU (European Consortium of Innovative Universities), Linköping University is arranging an interdisciplinary project course that is unique in the Swedish education system.

The course provides opportunities for collaboration with students from all faculties in interdisciplinary project groups, to tackle business innovation projects and societal challenges. The course is based on challenge-driven learning, which means that the groups work on real challenges provided by external actors.

Interdisciplinary communication is an important part of the course and takes place in group assignments and through “pitches” – presentations within the course and to external companies or organisations.

The course provides an opportunity to create networks and develop personal and professional skills – all in an international environment characterised by creativity and entrepreneurship.

Entrepreneurial idea creation and innovation development are core elements in the course. Students develop cases within the framework of sustainable development, with a

triple bottom line: social, economic and environmental.

Impact

Students are engaged in the initiative. Many students are working on a challenge to improve agriculture. One example is students using drones to combat bark beetles and next year they will launch a start-up based on this product.

Tools and methods

The course is not an entrepreneurship course as such, but one that strengthens entrepreneurial skills. Students develop their solutions based on the NABC model³ (Need, Approach, Benefit, Competition). To initiate the creative ideation process and to get the groups started in team-building, they use “Shitty Prototyping” as a tool, where groups of students and their “challenge provider” visualize their challenge and, in a limited timeframe, build a prototype with simple mock-ups. This stimulates creative thinking and gives the project group a clearer picture of the project they will be working on.

Through the Value Creation Forum (VCF) the students (and the challenge providers) are encouraged to give each other feedback and constructive criticism. This helps project groups to develop their pitches, but VCF also helps them to develop the idea and the actual solution. As a result, individual students grow, become more confident in public speaking and more aware of what makes a presentation effective and interesting.

As mentioned above, the approach used is challenge-based learning (CBL), which originated in previous courses in 2003. The students work with real cases – to find an opportunity to launch a venture and to get financing. Entrepreneurship theory is used in the entrepreneurial process and then the theories become tools. Students are meant to assume the mantle of an entrepreneur and learn from real-life situations.

In challenge-based learning, students work with external partners or companies/public agencies, and thereby gain a broad range of experience. If the partners like the idea, they can buy it from the university or hire the student. If the partners do not proceed with the students’ idea, the group can still continue to develop it with support from [LiU Student Innovation](#) and other actors within the regional support system (such as [ESBR, East Sweden Business Region](#)).

3 The NABC model was originally developed by Stanford Research Institute and is used to frame the development and communication of innovative solutions based on user needs and value creation.

Special activities

The combination of theory and practice puts students in the shoes of an entrepreneur. The courses need to be as real as possible and also adapted to the target groups. The university arranges sizeable courses with 150 students in each class. These large student groups do not study an excessive amount of theory, but instead obtain their own cases and work on projects in groups of eight people. They also need to think about how they can commercialise the products they are working on.

The course coordinators also want the students to go the extra mile. As mentioned above, one student invented a solution to combat bark beetles, which has attracted a lot of interest among numerous external companies and parties.

The courses are for different types of students, including physicians etc., and should be adapted to their target groups. An internship can be combined with a theoretical component or a theoretical course with an internship.

Framework

The university works in a multidisciplinary way, with courses made up of different types of students. The InGenious course gathers students from four different faculties to avoid having all the technology students in the same groups. It also works in cooperation with the regional public energy provider, Tekniska verken, and offers an international course with cases and student ideas. There is also a sustainable social development component and problems are approached from different perspectives.

Assessment

It is difficult to measure the effects of education. If we look at what graduates are contributing to the business sphere, we see companies that are still small but successful, including in terms of sustainability. Some of the companies may experience growth a decade later, making the results even more difficult to measure.

Success factors

One success factor is ensuring that students actively apply for the InGenious course, as it is an independent course and an elective for anyone with at least 90 credits. The students can then propose projects and motivate and rank their proposals. Projects are then put together based on an assessment of the proposals and of a personal letter from the student. This makes it possible to create the right conditions for dynamic, interdisciplinary teams.

Facilitators are continually in contact with the project groups allowing them to work more actively on group processes and prevent possible exclusion or conflict. Challenge providers have highlighted the benefits of participating in a project where students have actively chosen to work on their particular project as it guarantees commitment and curiosity among group members.

Another success factor is the importance of students not regarding themselves as consultants for their challenge provider. This approach has definitely resulted in more creative solutions. In addition, students have been encouraged to take a more entrepreneurial approach during the course – their solution may be interesting to many stakeholders and have value for many more actors than the just their challenge provider. This has resulted in the student groups seeing themselves as start-ups/enterprises that need to pitch their solution to sell it in a market. It has also resulted in one or more solutions being purchased each semester. Also, it is not uncommon for a student group – all or part of it – to want to continue working on their solution. There are examples of students who have been offered co-ownership of a company or fixed-term employment to implement the project group's solution. Students develop professional skills and can add these to their CV, and companies get help with their challenges and new thinking around sustainability.

Tips and strategies

Live as you learn. Continuously improve, test and try different methods. Keep what works and get rid of what doesn't. Also, credibility is key – it is important to show that you are a true entrepreneur in a practice situation. Educators also need to allow students to question what they are telling them.

Some students have reported that they wish they had known earlier on how much focus would be on the entrepreneurial aspect and pitching techniques. It is therefore important to be clear about why these elements are emphasised and significant – that a solution must have value in order to be useful, that pitching training enables everyone to become more self-confident in their presentations, and that they need find out what gets a solution noticed in the market.

The teachers are not only educators but are also active in business to a large extent. They have various connections to the business community, which gives them credibility – they know what they are talking about. The business programme is also a source of knowledge for the regionally active business development company Almi, and examines applications for innovation financing.

Needs

Courses like this one are extremely demanding to provide as the process of creating challenges requires a lot of work. On the other hand, they provide the 21st century skills that many future employers are looking for.

A comprehensive, mandatory entrepreneurship course for all engineers would be very beneficial, but challenging to provide because it would require significant resources and many teachers, and would be dependent on available funding.

More short films presenting various concepts and areas of study would be helpful to increase student awareness of aspects such as a circular economy, entrepreneurship, design thinking, Susan Wheelan's group process etc.⁴ This could also help in spark interest and willingness among students to expand their knowledge by looking for courses in a related area.

Students have also reported that they would like to know more about hands-on entrepreneurship and how to launch a start-up. Voluntary seminars with speakers from business development organisations could be a potential way to address this.

Scalability

Courses need resources. If a new course is established, another course will need to be removed. Linköping University has some substantial and successful courses in, for example, engineering that need to remain in place. However, a mandatory entrepreneurship course for all engineering students would be a great addition.

It would be interesting to try to scale the course up to a bigger project course of, for example, 15 credits to provide enough time for implementation – perhaps an InGenious course 2.0?

This type of course could be provided within a specific faculty, but this would probably not provide many different perspectives for a specific challenge. It is important for students to be able to encounter other professional areas and disciplines, so that they can prepare projects with others that have a very different educational background. This would promote mutual respect and understanding of the importance of everyone's collective skills and knowledge.

Links to relevant courses

Master of Science in Energy – Environment – Management

(<https://studieinfo.liu.se/en/program/6cemm/4194>)

Master's Programme in Sustainability Engineering and Management

<https://liu.se/en/education/program/6msus>

Sustainable Business – an ecological perspective

<https://liu.se/en/education/course/723g51>

Innovation Management

<https://studieinfo.liu.se/en/kurs/teio90/ht-2018>

Corporate Social Responsibility

<https://studieinfo.liu.se/en/kurs/teio41/vt-2017>

Project course – advanced: Sustainable Business Development

<https://studieinfo.liu.se/en/kurs/tmpi04/ht-2020>

Bachelor Thesis – Energy and Environment Engineering

<https://studieinfo.liu.se/en/kurs/tkmj41/vt-2018>

Innovative Entrepreneurship

<https://studieinfo.liu.se/kurs/TEIO06/vt-2022>

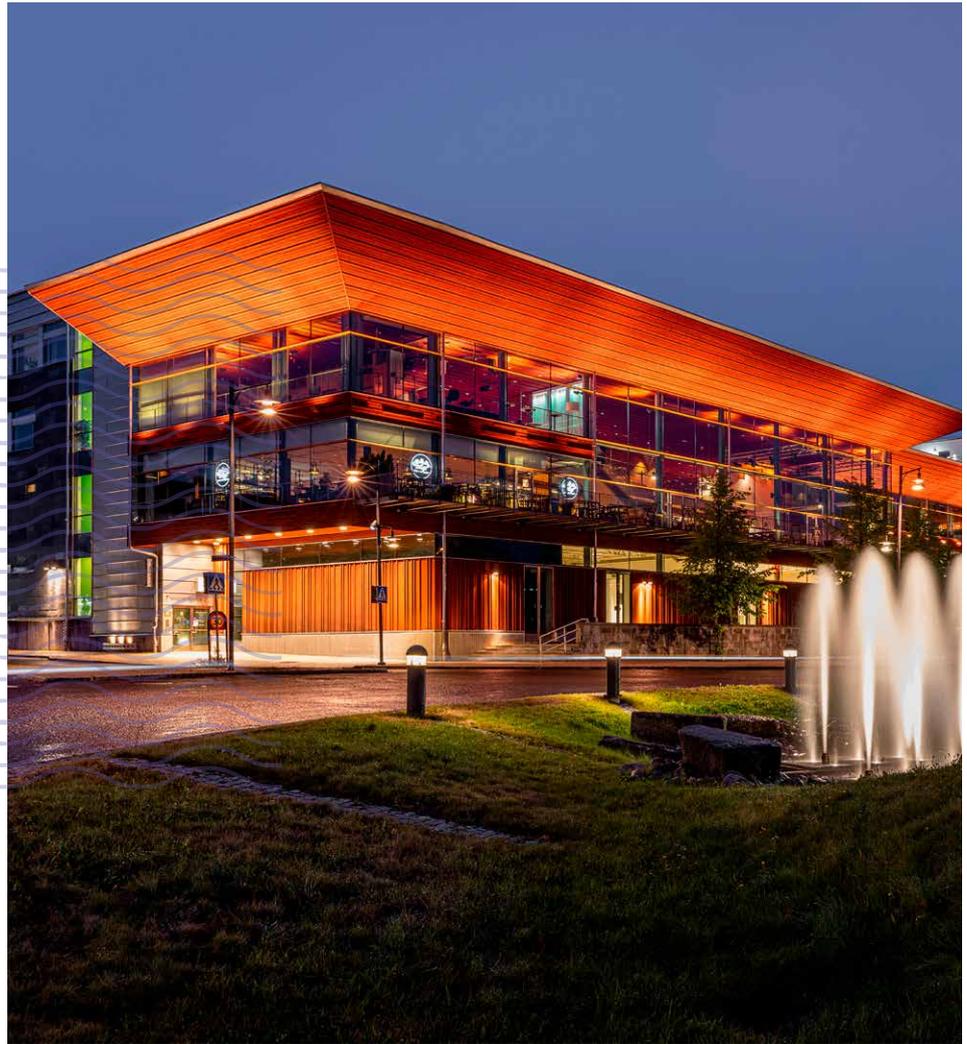
Environmentally Driven Business Development

<https://studieinfo.liu.se/en/kurs/TKMJ49/ht-2022>

InGenious – Cross Disciplinary Project

<https://liu.se/en/education/course/799g52>

⁴ Susan Wheelan's *Integrated Model of Group Development (IMGD)* is a model that can help leaders understand group dynamics.



Luleå University of Technology (LTU)

Luleå University of Technology is a public university and has four campuses located in the Arctic region in the cities of Luleå, Kiruna, Skellefteå and Piteå. Luleå University College was originally established in 1971. In 1997, the institution was granted university status by the Swedish government and was then renamed Luleå University of Technology. It has close to 300 partner universities in over 50 countries around the globe. The university is famous for its groundbreaking collaboration with companies such as LKAB, Ericsson, Boliden, ABB and Epiroc.

Luleå University of Technology has a total turnover of SEK 1.8 billion per year, and currently has 1,770 employees and 17,200 students.

Entrepreneurial creation, innovation and sustainability are all high up on the agenda. Some courses include modules such as business model development, including circular business models. E-learning and business planning courses include elements where students write a business plan based on their own ideas. More and more students are focusing on sustainable business models.

Research

The university is enjoying strong growth and has world-leading expertise in several areas of research. Research at the university is conducted in close cooperation with industries such as LKAB, Ericsson, Boliden, ABB and Epiroc as well

as leading international universities. A research background is a significant advantage, and educators bring their own research into the classroom when teaching classes within courses. There are close links to the business community in both research and teaching. Companies have a major impact because most of projects are run in cooperation with companies.

Strategy

Luleå University of Technology aims to contribute to a more attractive and sustainable society through research, education and collaboration with the surrounding community. Many of the university's research topics cover various aspects of sustainable development, such as recycling, management of natural resources, sustainable urban development and waste management. Sustainability is also integrated into efforts to develop the student environment. Luleå University of Technology has programmes where sustainability and the environment are common threads in all courses. All students should feel that they have the necessary skills to create sustainable businesses when they graduate.

The university recently celebrated its 50th anniversary. The idea from the start has been to work in close cooperation with companies. This is in part due to the fact that local businesses already wanted a university in the region before it was established.

Activities

Innovation Day 2021 (<https://www.ltu.se/ltu/Samverkan/Hallbarhet-och-smarta-losningar-pa-Innovationsdagen-2021-1.213689?l=en>) brought together innovators and entrepreneurs who presented a wealth of exciting ideas. The aim was to offer information and inspiration, and to encourage more people to become engineers. The green transition is opening up fantastic opportunities for new innovation. Sustainable food production and non-toxic flame retardants were two of the highlighted topics at the event.

The Universities of the future – impact of the pandemics (<https://www.ltu.se/ltu/calendar/Konferenser/Framtidens-larosaten-pandemins-paverkan-1.205492?l=en>) was a conference focusing on how the pandemic has been a catalyst for change in the higher education system. The event included a discussion on how to create an innovative undergraduate programme that is flexible, choice-based, dynamic, authentic, multidisciplinary, geared towards difficult sustainability challenges, and which involves integrated, student-owned assessments.

LTU Business Summer (<https://ltubusiness.com/services/ltu-business-summer/>) offers summer work as an idea and business developer working on real-life cases from exciting industries and in a team of passionate peers. The students have the opportunity to work for nine weeks with other students and experienced coaches on idea and business development for real cases.

Ecosystem

LTU Business (<https://ltubusiness.com/>) is a business development company owned by Luleå University of Technology through LTU Holding. It offers free consultation services for students and researchers. There is also a summer school to support students (see under Activities above). This company is a great source of support for anyone who wants to work on idea generation. It is also sometimes involved in courses by, for example, offering feedback.

LTU Business provides consultants who also work with the university itself, as well as on specific projects.

Arctic Business (<https://www.abi.se/>) has built over 170 tech start-ups with offices on every continent and is constantly hosting innovators from all over the globe. Together with its partners, Arctic Business offers the perfect environment for ideators, creatives and entrepreneurs. This incubator has a strategy focused on sustainability and its start-ups have completed a programme with this focus.

LTU Holding AB (<https://www.ltu.se/org/LTU-Holding?l=en>) only scales up two or three companies each year following a thorough selection process where those selected are considered to have the greatest growth potential. This holding company has its own equity firm (Lunova) which finances the companies. All of the companies – which include deep tech enterprises – are required to incorporate a sustainability perspective.

Education

Master Programme in Industrial and Management Engineering (<https://www.ltu.se/edu/program/TCIEA/TCIEA-Civilingenjor-Industriell-ekonomi-1.76864?l=en>; see below for best practice deep dive). This is a five-year programme with three different specialisations that include various types of educational models. Sustainability is specifically highlighted through the programme's first course. All students then take a course in sustainable development. The programme offers a combination of engineering, entrepreneurship and sustainability. Students are trained in structured problem-solving, which is an essential skill in order to handle the challenges that engineers are facing today.

Master Programme in Engineering, Sustainable Production (<https://www.ltu.se/edu/program/TCHPA/TCHPA-Civilingenjor-Hallbar-produktion-1.212012?l=en>). The new Master of Science in Sustainable Production is one of the few master's programmes in Sweden with a focus on the transition to sustainable production in industry. Each module takes a holistic approach to sustainability, incorporating analysis of ecological, economic and social sustainability. Anyone studying a Master of Science in Sustainable Production will gain broad knowledge and expertise and will be able to secure a key position in industry. Students acquire knowledge and tools to shape technology, organisational structures and systems for sustainable development of the future.

Sustainable Business (<https://www.ltu.se/edu/course/G70/G7002N/G7002N-Hallbart-foretagande-1.214883?l=en>). This course addresses the work companies are doing on current sustainability challenges. It is divided into three modules. One of them aims to provide an overview of current sustainability challenges and progress on sustainability in the private sector, with a focus on how companies and organisations implement, manage, report and communicate sustainability. Another module focuses on current research on sustainable business linked to various business practices and how different research perspectives can facilitate an examination and analysis of companies' sustainability work. The third module focuses on identifying and analysing

ing companies and/or business operations that are aiming to integrate sustainability into their core processes.

Best practice: Master's Programme in Industrial and Management Engineering

Story

After completing this programme, the students can, for example, work as project managers, as technology, management or IT consultants, as products or logistics managers, as sustainability managers or as strategic procurement officers. Some start their careers as trainees, often in larger companies, while others work in the service industry or start their own businesses.

The programme began 20 years ago. A major transformation is under way and the first semester with the new concept will be autumn 2021. The programme's primary sustainability focus is based on the Sustainable Development Goals (SDGs): Industry, Innovation and Infrastructure, Responsible Consumption and Production and Climate Action.

Impact

More and more students are seeing the opportunities of becoming entrepreneurs after graduating and many have side projects under way. These projects may involve working on a start-up or launching their own business. Students are more interested in sustainability than before, as is the case in the whole of society. Three avenues are common among students completing the course: technology or management consultants, working for big corporations and setting up their own business. There are, however, relatively few students opting for the third avenue.

Talent supply in the region is an important factor – many companies are recruiting students for summer jobs or alongside their education. Many students gain strong networks and qualifications, and feel more confident in their working roles based on their previous experience working for companies.

Tools and methods

The programme runs for five years, has different specialisations and uses different types of educational models. Sustainability is specifically highlighted in the first course. After that, all students take a course in sustainable development. They also study law for engineers to learn about regulatory

aspects. They can choose a technical profile in sustainability in year 3 (with four courses in total), and a specialisation in years 4–5 in sustainable industrial business, consisting of 6–7 courses in total.

The university arranges workshops for idea creation and produces templates that the students can use if they want to start a business. The regional business development company Almi has budget templates that make it easier to create a business plan. Overall, Sweden has good infrastructure for those who want to start a business.

Special activities

This is the only Swedish master's programme in industrial engineering and management that has a sustainability focus and where entrepreneurship is consistent throughout the programme.

Partnerships are established with local companies with the goal of developing projects together with the companies. Students can work in similar ways within an incubator and with NorrlandsNavet (a centre for business development in northern Sweden). Use of available resources is discussed and students are encouraged to write their master's thesis together. Many Swedish companies participate by providing guest lecturers, offering case studies and taking part in the programme council.

Framework

Locality is important for students at this university in the far north of Sweden. Companies in the area have pointed out that they started their business in the region and can explain to the students how this works in real life and what effects it has on sustainability. The companies are often active in mining, forest industries and natural resources. Real knowledge is emphasised throughout the programme and not only with respect to sustainability.

Assessment

Standard methods are used and the number of students that start a sustainable business after graduation is monitored.

Success factors

One important success factor is that the students are to a large extent getting involved with local businesses and NorrlandsNavet. These form role models for the students, including in the area of sustainability.

Tips and strategies

The university has a focus on entrepreneurship, although this is not always reflected in the various courses that it offers. It is important to analyse the business models of larger companies with a sustainability perspective. This is a way to get more students to focus on sustainability.

Needs

It is important to highlight how to develop as a student and/or a business based on a variety of perspectives. Students need to understand the basis for the assignments included in their course. It is a good idea to take advantage of the tools being used by other individuals and universities, for example those relating to management in innovation environments.

Scalability

It is possible to scale up courses by partnering with companies, but they need to be adapted to the regional environment. The university offers an online course in entrepreneurship and business planning, and it would be beneficial to make this available to more students. Last year 1,000 students applied for the course but only 90 were admitted. In order to grow the course, however, more funding is needed, especially for faculty recruitment. It is also important to continue to ensure good student outcomes.

The knowledge that the university and the lecturers have of entrepreneurship is a valuable asset and is often brought into the courses. Businesses also have a strong impact, since many of the projects that the university wants to fund are co-funded with companies and therefore need to be relevant to them. Research and education are both closed aligned with the businesses.

Although scaling up works well in general, the master's thesis process can be a challenge.

Links to relevant courses

Master Programme in Industrial and Management Engineering

<https://www.ltu.se/edu/program/TCIEA/TCIEA-Civilingenjor-Industriell-ekonomi-1.76864?l=en>

Master Programme in Industrial Design Engineering

<https://www.ltu.se/edu/program/TCTDA/TCTDA-Civilingenjor-Teknisk-design-1.76880?l=en>

Master Programme in Applied Artificial Intelligence

<https://www.ltu.se/edu/program/TCAIA/TCAIA-Civilingenjor-Tillampad-artificiell-intelligens-1.201990?l=en>

Master Programme in Sustainable Process and Chemical Engineering

<https://www.ltu.se/edu/program/TCKPA/TCKPA-Civilingenjor-Hallbar-process-och-kemiteknik-1.168844?l=en>

Arctic Mineral Resources

<https://www.ltu.se/edu/program/TMAMA/TMAMA-Arktiskamineralresurser-1.201984?l=en>

Master Programme in Architectural Engineering

<https://www.ltu.se/edu/program/TCARA/TCARA-Civilingenjor-Arkitektur-1.76852?l=en>

Master Programme in Green Networking and Cloud Computing

<https://www.ltu.se/edu/program/TMHMA/TMHMA-Hallbar-datorkommunikation-och-molnbaserad-databehandling-master-1.191663?l=en>

Master Programme in Climate Physics Engineering

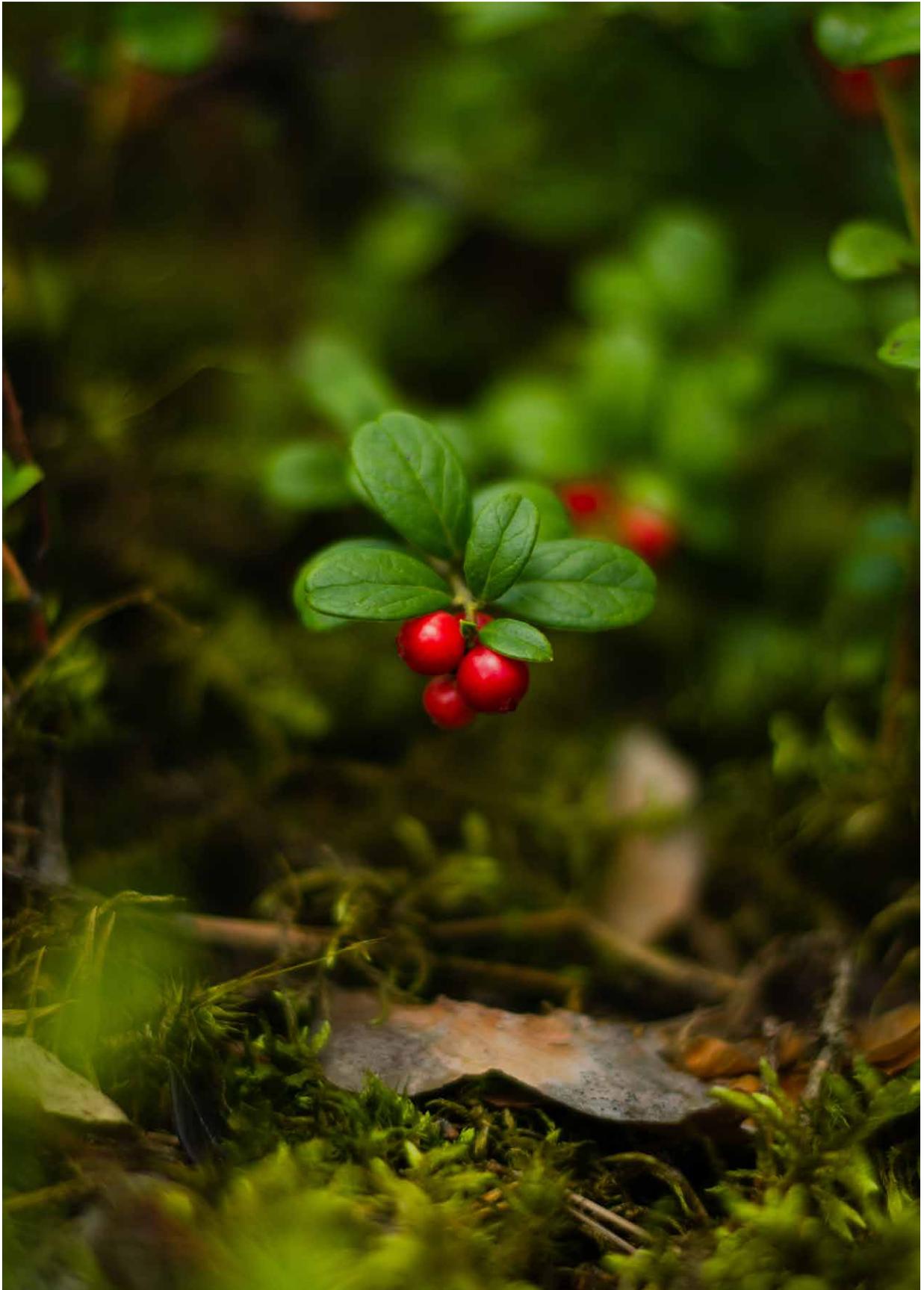
Master Program in Climate Physics Engineering, Program, – Luleå University of Technology (ltu.se)

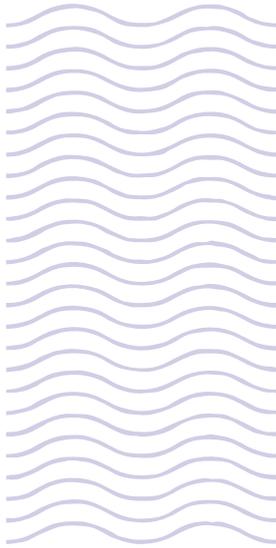
Master Programme in Business and Economics

<https://www.ltu.se/edu/program/FYCEA/FYCEA-Civilekonom-1.76760?l=en>

Sustainable Business, course

<https://www.ltu.se/edu/course/G70/G7002N/G7002N-Hallbart-foretagande-1.214883?l=en>





Lund University

Lund University is a public research university in Sweden and one of northern Europe's oldest universities. The university was officially founded in 1666 next to Lund Cathedral. Lund University has nine faculties with additional campuses in the cities of Malmö and Helsingborg. It has around 44,000 students in 270 different programmes and 1,400 courses. The university has 640 partner universities in nearly 70 countries and is consistently ranked among the world's top 100 universities.

Research

Lund University is involved in 11 national research areas of strategic importance for Sweden, many of which relate to sustainability. The strategic research areas are key for the realisation of Lund University's vision to understand, explain and improve our world and the human condition, so that scientific and artistic knowledge can contribute significantly to achieving sustainable development.

The Centre for Environmental and Climate Science manages the strategic research area Biodiversity and Ecosystem services in a Changing Climate (BECC) together with the University of Gothenburg. The research combines empirical studies with social science methodology and economic and ecological modelling to understand how land use and anthropogenic climate change impact biodiversity and ecosystem services at the local, regional, national and global levels.

Through MERGE (Modelling the Regional and Global Earth system), models are developed that enable the climate to be studied from a systemic perspective, encompassing the interaction between the atmosphere and Earth's biosphere.

The International Institute for Industrial Environmental Economics (IIIEE) is a unique centre and node for interdisciplinary research and education within Lund University. It con-

ducts interdisciplinary and collaborative research focused on advancing sustainable solutions.

With a focus on industry needs and processes, Lund University also carries out industrial sustainability research through the Sustainable Production Initiative (SPI). The initiative involves close collaboration with companies and aims to enable the manufacturing industry to become more competitive and sustainable over the long term.

Innovation and entrepreneurship are at the very heart of Lund University. The artificial kidney, ultrasound technology and Bluetooth are examples of inventions that originated here and that went on to be used by millions of people all over the world.

The Sten K. Johnson Centre for Entrepreneurship develops knowledge in the area of entrepreneurship and conveys this through courses and other activities. The courses – many of which are open to students and doctoral candidates from all faculties – apply action-oriented teaching methods aimed at creating better entrepreneurs. A large network of entrepreneurs support students in courses and activities.

At the Centre for Innovation Research (CIRCLE) the aim is to understand and explain how innovation can contribute to a good society and tackle societal challenges such as economic crises, climate change or increased globalisation of economic activities.

Strategy

At Lund University, world-leading research is conducted to impact society and improve our world. The university wants to be part of the solution and has therefore established a graduate school with a focus on societal challenges, sustainability and Agenda 2030.

The vision for the Agenda 2030 Graduate School is to be “a multidisciplinary and innovative world-class graduate school for world-leading researchers who can meet the many challenges expressed in the UN Sustainable Development Goals (SDGs) and who can help to promote sustainability research and knowledge of Agenda 2030 for Sustainable Development”.

Activities

Teknologkåren (<https://en.tlth.se/>) has two projects: Innovation Week and Sustainability Week. At Innovation Week, students have the opportunity to interact with start-ups in a trade fair forum and through lunch lectures. Sustainability Week is a week of lunch lectures, panel discussions and other interactive events focusing on sustainability. During the week, companies are invited to talk about their sustainability work and students have the opportunity to present their ideas and provide input.

Sustainable Future Hub (<https://www.lusem.lu.se/collaborate/sustainable-future-hub>) is a collaboration hub for students, researchers and external actors focusing on economic and social sustainability. Sustainable Future Hub catalyses projects and collaborations where different actors can work together to drive development in the area of sustainability.

Within the Master’s Programme in Entrepreneurship and Innovation (see below), and as part of several other entrepreneurship courses, many guest lectures take place with a focus on the circular economy and circular business models. The Sustainable Business Model Canvas is also used in several courses and programmes, and the SDGs are integrated into assignments in various courses. A number of the mentors also work within the area of sustainability.

Ecosystem

LU Innovation (<https://www.innovation.lu.se/en/>) is the University’s hub for innovation and constitutes a place where students and researchers can convert business ideas and research results into innovations. LU Innovation is part of FSI, Lund University’s research, collaboration and innovation division, and is tasked with supporting innovation. It helps researchers and – via VentureLab – students, to develop their research results and ideas and to fund innovation projects, and provides expertise on intellectual property protection and legal issues.

LU Innovation manages a range of projects and programmes in collaboration with other stakeholders. One example is *Innovationskontor Syd*, the joint innovation office for all the universities in southern Sweden. Another example is *SWElife*, a strategic innovation programme coordinated by LU Innovation and funded by the Swedish public innovation agency Vinnova.

Venture Lab (<https://www.venturelab.lu.se/home>) is a part of Lund University and aims to inspire students and new graduates to try out entrepreneurship and innovation. They do this through inspiring events, programmes, an incubator, a large network and a supportive community.

Investments are managed by **LU Holding AB** (<https://www.innovation.lu.se/en/index.php/lu-holding>) which is owned by the Swedish state but managed by Lund University. LU Holding’s mission is to create new businesses from ideas and research results from Lund University that will contribute to growth and create jobs in Sweden.

LU Holding invests in innovative companies that have substantial growth potential and a committed team. Over the past two years, it has increased the focus on sustainability in the new companies. A consultant has developed models for how to work on sustainability. Sustainable production processes and transport are among the key focus areas. LU Holding has noticed that companies today are thinking more about sustainability before scaling up. Researchers should also be made more aware of the need for sustainable research solutions and innovation.

Ideon Innovation (<https://www.ideoninnovation.se/>) evaluates around 200 ideas annually. Of these, 10–15 are admitted to the incubator process. The reason an enterprise is not accepted is often that it is in a very early phase and needs to work more on developing its team, offering and customer verification methods. For these entrepreneurs, Ideon Innovation offers an incubator preparation programme, where they get the opportunity to build further on their idea and will hopefully have the opportunity to enter the incubator process after six months.

Smile (<https://www.smileincubator.life/>) is a non-profit business incubator for life science start-ups with a vision of creating a future of better health by nurturing a community of passionate life science innovators. The incubator does this by offering advanced coaching programmes, well-equipped labs with state-of-the-art equipment, a large international network of industry partners and investors, and a community of world-class life science innovators.

Education

Master's Programme in Entrepreneurship and Innovation (<https://www.lusem.lu.se/staff-pages/media/studies/msc/curriculum/eagei.pdf>; see below for best practice deep dive). The programme focuses on new venture creation, but also provides knowledge on entrepreneurial processes within existing businesses. The balance of economic, social and environmental sustainability is also given attention throughout the programme. The programme is based on the belief that entrepreneurship cannot be taught by relying on traditional forms of instruction alone, but has to be incorporated through real-life experience and experiential learning.

ENTN10 Business Model Development (<https://www.lusem.lu.se/staff-pages/media/studies/msc/curriculum/eagei.pdf>) is a course within the Master's Programme in Entrepreneurship and Innovation. In this course the students learn about various types of business models. They also gain an understanding of what business model development involves and are provided with the skills they need to develop, iterate and test business models. The course includes a Live Case assignment with IKEA Circular to design a circular/pay-per-use furniture business model for households and workspaces.

Master's Programme in Environmental Management and Policy (<https://www.iiiee.lu.se/education/masters-program-environmental-management-and-policy-emp>). The courses in this programme cover environmental science, business management, economics and technical systems. From the second semester, the courses focus on various challenges and the application of knowledge gained. This involves projects in cooperation with external organisations as well as individual research.

Best practice: Master's programme in Entrepreneurship and Innovation

Story

In the master's programme students learn how to create, develop and exploit business opportunities by starting up and managing new ventures. The programme offers an opportunity to be fully involved as an entrepreneur in the start-up process – from idea selection and team composition to venture formation. This enables students to gain real experience in starting up a new business. In addition, students take part in a mentorship programme where they are matched with an experienced mentor.

Impact

Interest has grown and today 80 percent of start-up projects have a social or sustainability focus. A number of the mentors also work in the area of sustainability.

Tools and methods

Idea creation and student projects are the starting points for much of the instruction provided. In addition to gaining knowledge and experience in the programme, students can use the knowledge and skills that they bring with them from their previous education and activities. Students from various disciplines are accepted to the programme.

The Lund University collaboration with International Institute for Industrial Environmental Economics (IIIEE) is a win-win partnership. Students from the master's programme in entrepreneurship and innovation are working together with students from the IIIEE master's programme, sharing knowledge from their respective fields.

Special activities

The master's programme was launched in 2007, and right from the start there were elements of sustainability integrated into the curriculum. The master's programme in entrepreneurship and innovation has collaborated with the master's programme run by the IIIEE.

Business model development includes environmental aspects.

Guest lectures form an important part of the programme – experts working in various areas of entrepreneurship and innovation are regularly invited to share their expertise and hold workshops.

The programme works in cooperation with Lund University's VentureLab student incubator and graduates of the programme can enjoy a fast-track application process to join the Incubator.

The programme also offers students the opportunity to participate in the [Dragons at the University](#) pitching competition, in [Venture Cup](#), to attend the Trendspotting at Lund University seminar series, and also to go on various field trips and study visits to companies in the surrounding area.

Framework

To ensure a mixed profile of knowledge and skills, Swedish and international students with various backgrounds are invited to take part in the master's programme. Topics

covered by lecturers include what students should think about to ensure that business models incorporate more sustainability aspects. Much of the work in the programme is quite hands-on; through practical experience, students learn to become entrepreneurs.

Evaluation

The course has no specific assessment models or criteria for the sustainability content. For the most part standard course evaluations are made, supplemented by individual assessments in order to develop courses and programmes. There is also a focus on the career paths of the students. The goal is for sustainability thinking to be integrated into students' work, rather than having students working directly on sustainability.

Success factors

In the master's programme the students come into contact with other students who are involved in sustainability in various ways, and they continue to stay in touch after concluding the programme. Most of the students are aware of the importance of sustainability, which in itself is often enough to inspire them to use the tools for learning and action that the course provides.

Tips and strategies

In the words of a [programme alum turned beauty entrepreneur](#): "Identifying the 'gaps in the market' and finding ways to make money is one thing, but understanding the hard work behind successful entrepreneurship is another. Just focusing on finding the gaps won't bring fortune, it's important to find one's inner power and ambition."

Needs

It is important that sustainability becomes a part of the whole – always integrated into the education package as a part of the learning plan to bring the necessary skills to the students. Educators provide knowledge and students pursue practical tasks and work on their projects.

Scalability

Business models are discussed and problematised from a sustainability perspective. Models for this exist and can be scaled up. The collaboration with IIIIEE will require a similar organisation/department offering a master's programme in sustainability.

Links to relevant courses

Entrepreneurship and Project Management

<https://kursplaner.lu.se/pdf/kurs/sv/ENTA70>

Master's Programme in Entrepreneurship and Innovation

<https://www.lusem.lu.se/staff-pages/media/studies/msc/curriculum/eagei.pdf>

The International Institute for Industrial Environmental Economics – Master's Programme in Environmental Management and Policy (EMP)

<https://www.iiiee.lu.se/education/masters-program-environmental-management-and-policy-emp>

Environmental Management and Policy – Master's Programme

<https://www.lunduniversity.lu.se/lubas/i-uoh-lu-XAMIS>

Innovation and Global Sustainable Development – Master's Programme

<https://www.lunduniversity.lu.se/lubas/i-uoh-lu-EAIGH>

Sustainable Energy Engineering – Master's Programme

<https://www.lunduniversity.lu.se/lubas/i-uoh-lu-TAHET>

Agenda 2030 – Knowing, Measuring and Leading

<https://kursplaner.lu.se/pdf/kurs/sv/MESCO2>

Industrial Environmental Management

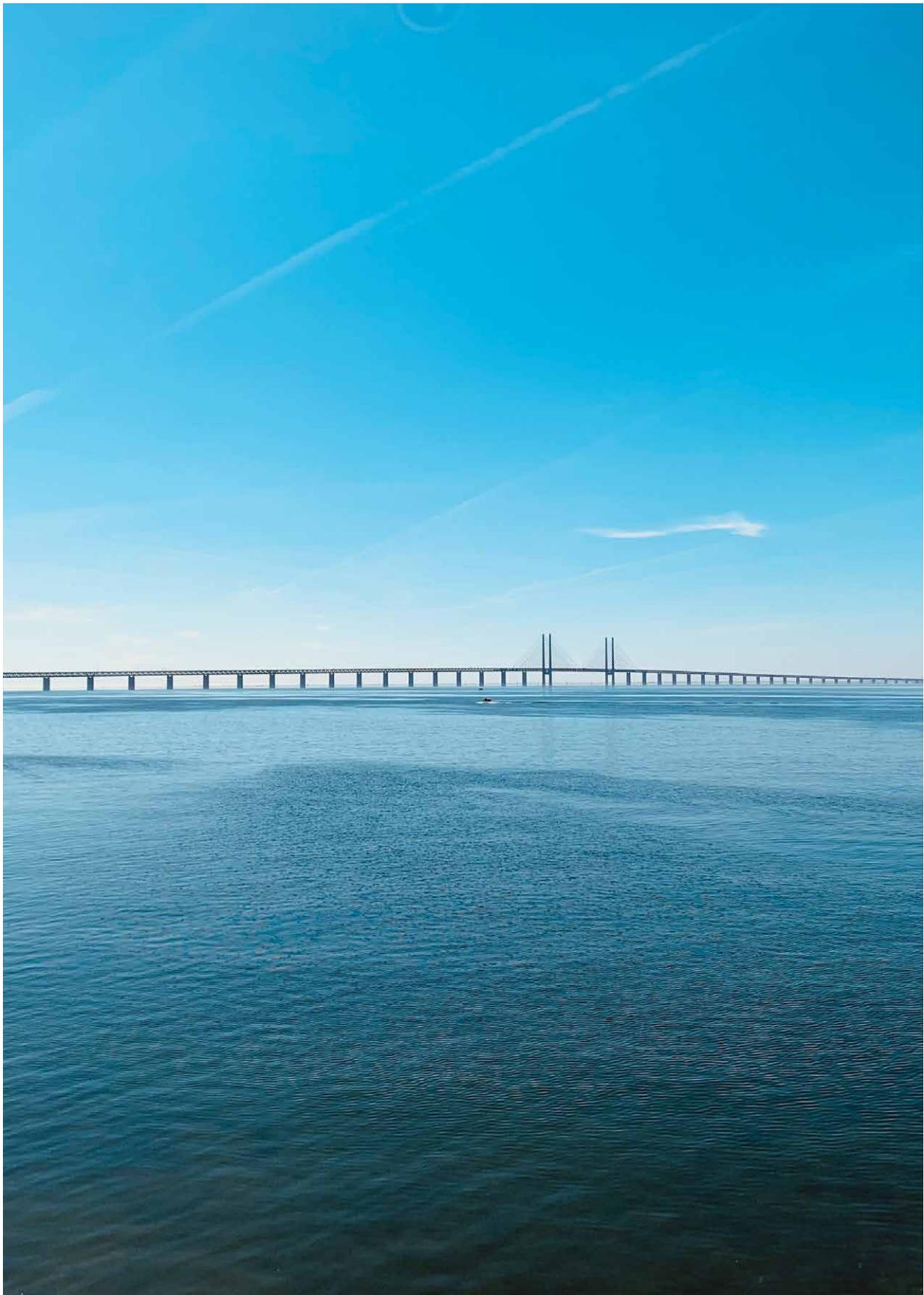
https://kurser.lth.se/kursplaner/21_22/KIIF01.html

Innovation Management

https://kurser.lth.se/kursplaner/21_22/INNN15.html

Business Model Development

<https://kursplaner.lu.se/pdf/kurs/sv/ENTN10>





Royal Institute of Technology (KTH)

Since its founding in 1827, the Royal Institute of Technology (KTH) in Stockholm has grown to become one of Europe's leading technical and engineering universities, as well as a key centre of intellectual talent and innovation. It is Sweden's largest technical research and learning institution and home to students, researchers and faculty from around the world who are dedicated to advancing knowledge.

KTH is working with the public and private sectors in pursuit of sustainable solutions to some of humanity's greatest challenges: climate change, future energy supply, urbanisation and quality of life for the rapidly growing elderly population.

Basic research and applied research are performed side by side at KTH and interdisciplinary research is conducted in parallel with work in specific fields. This approach encourages versatile solutions and the innovative climate creates many opportunities to realise great ideas. The educational programmes are fostering a new generation of engineers, architects, teachers and undergraduate engineers.

KTH embraces cooperation between academia and the public and private sectors. The university is part of extensive international research collaborations and participates in numerous educational exchange or joint programmes with universities in Europe, the US, Australia, Asia and Africa.

It has been a challenge to recruit students to KTH's campus in Södertälje. The university has therefore merged education with industrial production for a new approach. In general, KTH has a strong focus on sustainability, including in doctoral projects, but it needs more education programmes at the Master's level with a sustainability focus.

KTH is a part of five consortia of the prestigious EU collaboration, European Institute of Innovation & Technology

(EIT), which aims to make Europe a global leader in innovation within strategic areas. Entrepreneurship and sustainability are also included in all programmes at EIT, such as in energy and materials, energy for smart cities, renewable energy, transport & mobility and innovation, and smart electric systems.

Research

Around 50 research groups at KTH have environment and sustainable development either as a central focus area or as an important component in their research. In addition, KTH runs or is involved in about 30 centres focused on the environment and sustainable development. Research at these centres is primarily in new areas and is often carried out in collaboration with the public and private sectors.

Strategy

In 2011 KTH initiated a new investment in the environment and sustainable development. Based on these two aspects, the university has decided that entrepreneurship and sustainability should be integrated in all education – in both courses and programmes. KTH also offers degree programmes that focus specifically on the environment and sustainable development – including the Master of Science in Energy and Environment programme.

A basic course in entrepreneurship for all students would have a big impact, according to interviewees on the topic. KTH also has successful incubators, although there is a sense that these are unnecessarily fragmented at the university.

Activities

KTH Executive School (<https://kthexecutiveschool.se/courses-2/>) specialises in helping leaders manage disruptive business landscapes. Through a short but intense course in Sustainable Digital Innovation, students get tools to drive sustainable innovation across businesses.

In **KTH Innovation's pre-incubator program** (<https://www.kth.se/en/om/innovation/program-extra-stod/forinkubator-program/kth-innovations-forinkubatorprogram-1.414438>) students have office space on campus to be part of a supportive work environment. They also receive extra support to develop their ideas together with other teams in the programme.

Drop-in Sustainability (<https://www.kth.se/en/student/kalender/hallbarhetsevent/drop-in-hallbarhet-1.1114779>) is organised by KTH Students for Sustainability. The purpose is to bring people together, educate KTH students on sustainability and create an environment of collaboration between sustainability and entrepreneurship initiatives.

Ecosystem

KTH Innovation (<https://www.kth.se/en/om/innovation>) supports students, researchers and employees at KTH who want to develop new ideas or who want their research to have an impact through commercialisation. There is close cooperation with regional and international partners aimed at enabling more technology and knowledge from KTH to have an impact in society.

KTH Innovation works together with students, giving them an opportunity to work on fictitious projects and write business plans. Students with an idea can take a course to help turn it into reality. Within the framework of their course of study, many of the students can try to commercialise their business ideas through summer internships or can work on their Master's degree project within the incubator.

Since 2013, KTH Innovation has had its own framework, KTH Innovation Readiness Level™, as a basis for its support activities. Recently, sustainability has been integrated at all levels in the model. The model has also attracted a lot of international interest. So far, over 500 organisations all around the world have signed up to access this concept.

KTH Holding AB (<https://www.holding.kth.se/>) is a state-owned company managed by KTH's university board. The company invests in promising start-ups based on KTH research or education programmes, with the aim of support-

ing the commercialisation process and making it easier for new science to benefit society. The company also focuses on sustainable entrepreneurship, and aims to channel 75 percent of its investments towards sustainability, with an emphasis on the UN Sustainable Development Goals (SDGs). Students with projects without a clear sustainability connection are encouraged to think more along these lines early on in the process.

Some investors are still focused on high profitability and not necessarily on creating real change. The company may support cases that are not entirely sustainable.

Education

Master of Science in Industrial Engineering and Management (<https://www.kth.se/utbildning/civilingenjor/industriell-ekonomi/industriell-ekonomi-civilingenjor-300-hp-1.4891> – only in Swedish; see below for best practice deep dive). The Master of Science in Industrial Engineering and Management provides competence which is in high demand in industry and business development. The technical knowledge gained gives the students an edge in understanding how sustainable innovations come about.

Master of Science in Integrated Product Design (Innovation Management and Product Development track) (<https://www.kth.se/en/studies/master/integrated-product-design/msc-integrated-product-design-1.70435>; see below for best practice deep dive). The MSc in Integrated Product Design teaches students to create sustainable products, services, systems and business models. In one of two distinct specialisations, students explore management of innovation and product development processes. Graduates gain the skills they need for careers in a wide range of industrial and business sectors.

Master's Programme in Entrepreneurship and Innovation Management (<https://www.kth.se/student/kurser/program/TEILM/20212/arskurs1?l=en>) was launched in the fall 2021. The programme aims to provide deep knowledge of established and newer theories and models within the field of innovation and entrepreneurship, as a complement to and an extension of previously acquired technical and scientific knowledge. It also provides a thorough understanding of scientific and practical methods for assessing, developing and running creative and innovative projects, in either existing companies or new enterprises.

Master of Science in ICT Innovation (<https://www.kth.se/en/studies/master/ict-innovation/>). The main subjects are computer science and electrical engineering. The

programme combines advanced technical education in information and communication technology with business-oriented courses focusing on innovation and entrepreneurship, preparing future ICT engineers to exercise an entrepreneurial mindset to contribute to digital transformation. The courses focusing on innovation and entrepreneurship emphasise sustainability and are taken by all students in the programme.

Master of Science in Transport, Mobility and Innovation (EIT Urban Mobility) (<https://www.kth.se/en/studies/master/transport-mobility-innovation>) integrates traditional engineering disciplines with innovation and entrepreneurship. New technology and business models are transforming the world's cities and the way we move around. This transformation requires engineers who can construct urban environments that consume fewer resources, are more sustainable and support more liveable communities and workplaces.

Best practice 1: Master of Science in Industrial Engineering and Management

Story

The Master of Science in Industrial Management also provides business development skills. In their technical education, students gain an understanding of how to develop sustainable innovations. While studying industrial engineering, students learn about the interaction between technology, people and the market. The ability to understand the connection between technology, business strategy and the surrounding community enables students to evaluate the economic, social and environmental consequences of new technological solutions. The five-year Industrial Engineering and Management programme is divided into a Bachelor's degree (first three years) and a Master's degree (final two years). For the first three years, all students are study the same Bachelor's programme. Throughout the programme students take courses in business and management alongside their courses in mathematics, science and a specialisation in one field (applied mathematics, computer science, energy systems or product and production development).

The goal of the MSc in Industrial Management is to train engineers to understand several fields, industry as well as management-related ones. Students build teams, work with actual cases and analyse cases from different perspectives. An example of a case is one focusing on road electrification. How does it work and what effects does it have on the environment? Another example is based on the recent dis-

ussion in Sweden about cement production. What options are available etc.? Students need to have real examples to relate to as this increases their understanding of how to integrate sustainability.

Impact

The programme has traditionally had a stronger emphasis on large industries rather than start-ups, but a focus on smaller enterprises has been gradually introduced, as well as entrepreneurship, the public sector and other fields. Students often start their own businesses, and through the skills they gain in their education, they are well equipped to do this. Many students want to make a difference in the world. They are driving development and want to work on a sustainable transition and towards the UN SDGs.

When developing their own innovations, they need to include sustainability as an area of focus. Young people experience more stress today as they witness the changing threats to society.

Tools and methods

The entire content of the programme has recently been redesigned – from learning about sustainability to training engineers for sustainability. When teaching about sustainability a lecturer can be invited to describe what it is all about. But when teaching for sustainability, the concept must be integrated throughout the programme. This enables students to understand how their actions and choices affect their own work and career, and can lead to a more sustainable world. The aim is to give students the tools to act in a sustainable world. They can, for example, reflect from different perspectives on the consequences when choosing between aluminium and steel. It is much better to integrate sustainability into all programmes than to have a separate course on sustainability.

To do this, engaged teachers are needed, as well as professional development resources. More complex targets and more discussion around e.g. profit maximisation are also needed. The focus needs to be shifted more towards long-term sustainable development.

Special activities

Uniqueness was built into the programme from the beginning through a combined focus on management and technology. Having these two perspectives has made it easier to incorporate sustainability into the programme. There is a culture among the students where they want to understand both technology and society, and it is crucial to understand the role of technology in a sustainable transition.

The programme integrates societal perspectives and a sustainable transition. Teachers with different areas of expertise work in teams, which strengthens and increases credibility in the classroom. This way of working makes it easier to integrate sustainability in various areas of the programme.

Framework

As mentioned above, it is crucial to focus on teaching for instead of about sustainability. This in turn increases the students' understanding of how they can work for a sustainable world.

Assessment

When courses contain objectives related to the UN SDGs, KTH has its own processes to measure outcomes. There is no formal evaluation, but rather a programme analysis. It has not been a priority to measure outcomes with respect to sustainability and entrepreneurship, but teachers have a discussion with students at the end of the programme to get their view of how they have navigated these aspects. This provides teachers with valuable knowledge of what the students have taken away with them from the programme.

Success factors

The most important thing is to integrate sustainability throughout the programme and not just in one course. Students can then see sustainability in their own context and realise how innovation, products and choices are connected to real change and sustainable transition.

Tips and strategies

It is very important to work in teaching teams at universities so that teachers have colleagues to ask or to switch with when teaching difficult subjects. This resembles the process of writing research articles. If there is more than one person in the process, it becomes easier and everyone benefits from having different skills in a team.

Needs

The programme is in the midst of a transformation where it will be reorganised to incorporate more teaching teams. In the past, teachers generally held their own courses. Having a variety of teaching teams in the programme makes it possible to take advantage of different skills and knowledge, and to explain complex topics in depth.

A strategic approach from management is needed to bring this way of working into all entire education programmes.

Scalability

Teachers have typically created their own courses, but there is a lot to gain from teachers working in teams. This programme has 110 compulsory courses within various departments. This makes it difficult to create general teaching teams. Instead, the idea is to create teams for the courses that are common to all students.

Best practice 2: Master of Science in Integrated Product Design (Innovation Management and Product Development track)

Story

In today's fast-changing global market, engineers need advanced knowledge and highly developed skills in how to create competitive and sustainable products, services and business models. The MSc in Integrated Product Design offers two specialisation tracks: Industrial Design Engineering, and Innovation Management and Product Development. During the programme, students have contacts with industry and projects are often conducted in co-operation with companies or organisations, providing students with valuable practical experience.

In the final degree project, students delve deep into a problem from the public or private sector or academic research, aligned with their selected specialisation. The degree project is supervised by an experienced researcher and can take place in an industrial setting or an academic environment.

The Innovation Management and Product Development track focuses on managing innovation and product development processes. Students study and work on innovation in three ways: developing new products, services and business models, organising and managing innovation processes from both a development project perspective and an organisational structure perspective and, finally, working on innovation strategies in new business development. Cutting-edge research in innovation management and product development is an important element, as is strong collaboration with industry.

In the programme, students become familiar and well-equipped with tools that will help them systematically organise, lead and manage various types of product development projects and the challenges associated with them. They also gain knowledge and skills identified as being crucial for organisations to survive and prosper and to meet the great challenges facing our society.

Impact

When students develop their own innovations a focus on sustainability is almost always necessary, regardless of which area they are focusing on. Young people are, however, experiencing more stress today as they witness the rapidly changing threat scenarios.

Unfortunately, not everyone has the ability to start a business, nor does everyone want to. But many aspiring engineers see their role in terms of solving problems. They are more focused on results than what they are actually working on. Young people are not, for example, choosing to work in the defence industry. They are driven to create a more sustainable enterprise where their entrepreneurship can have a positive impact.

Tools and methods

As sustainable development is an integral part of all programmes at KTH, graduates have the knowledge and tools to move society in a more sustainable direction. Three key SDGs are addressed by the programme: Goal 9 – Industry, Innovation and Infrastructure; Goal 11 – Sustainable Cities and Communities; and Goal 12 – Responsible Consumption and Production.

It is of utmost important to tackle the challenge of transforming industry into a fully sustainable system. In the programme this is tackled on at least three levels:

- On a system level the programme pushes a circular approach, including moving into a service paradigm with business models based on providing shared functionality rather than just pushing stuff to the market.
- On a product level, where products need to be designed for use, repair, refurbishment and reuse, while also taking the choice of materials and production methods into close consideration.
- Finally, KTH research points to the need to also be innovative in the areas of management, organisational structures and business models in order to change the present linear paradigm into a circular one.

Tools have been introduced and are used in the programme to help students systematically organise, lead and manage different types of product development projects and the challenges related to them. Students acquire knowledge and skills that have been identified as being crucial for organisations to survive and prosper, and to meet the great challenges facing our society.

Special activities

Students take an initial course and they are then invited to develop their ideas into products.

Many of the researchers at the department have recently become engaged in the challenge of sustainable mobility in cities. One focus area is accessibility, i.e. providing more of the services people need at walking distance from their homes. Another focus area is providing mobility as a service (MaaS) as a way of breaking dependency on car ownership.

The Green Leap research team addresses sustainability challenges using design methods, often in partnership with companies, organisations and design practitioners. A Living Lab method is often used to gain useful insights into people's behaviour and their willingness to change in a sustainable direction.

Framework

Although the university is stuck in an old structure, there are some local initiatives. Global Hub, with innovation projects focused on urban environments, is one example. There are also some activities in partnership with Stockholm University, and collaboration between engineers and medical students. Students from some African universities also come to Sweden as part of their study programmes.

Assessment

Formal evaluations are carried out using KTH's models and processes.

Success factors

While many local initiatives have been successful, they remain local and are difficult to scale up. A review is needed of what should be included in an engineering degree.

Tips and strategies

At the larger universities of technology it is fairly easy to incorporate sustainability and innovation (which is often connected to entrepreneurship), but this is arguably more difficult at traditional universities.

Needs

The university needs a vice-chancellor who emphasises innovation and entrepreneurship. KTH is very large and fragmented. People typically work on their own, which means that few common educational initiatives are cre-

ated. This needs to be addressed at the vice-chancellor level. Sustainability is on the agenda but entrepreneurship is not as yet.

A basic course in entrepreneurship would give so many more students an opportunity to see a career as an entrepreneur and in business as an option.

Scalability

In order for students to develop their ideas they should be given opportunities to do so without risk in a protected environment. This is absolutely essential. Having courses where students can start developing their ideas and building prototypes will give them an opportunity to then test their idea in an incubator. KTH does not have this process today and it needs to be implemented.

A very important aspect for anyone studying management and engineering would be to develop awareness of what entrepreneurship can look like for engineers.

Innovation and Entrepreneurship in Electric Power Engineering

<https://www.kth.se/student/kurser/kurs/EI2600>

Product Innovation

<https://www.kth.se/student/kurser/kurs/MF2046>

Innovation and Product Development Processes

<https://www.kth.se/student/kurser/kurs/MF2085>

Energy Systems, Business and Management

<https://www.kth.se/student/kurser/kurs/MJ2146>

Challenge Driven Innovation for Sustainable Development

<https://www.kth.se/student/kurser/kurs/MF2089>

Innovation and Entrepreneurship in Sustainable Energy Technology

<https://www.kth.se/student/kurser/kurs/MJ2496>

Links to relevant courses

Master of Science in Industrial Engineering and Management

<https://www.kth.se/utbildning/civilingenjor/industriell-ekonomi/industriell-ekonomi-civilingenjor-300-hp-1.4891>
(only in Swedish)

Master of Science in Integrated Product Design

<https://www.kth.se/en/studies/master/integrated-product-design/msc-integrated-product-design-1.70435>

Entrepreneurship in Technology and Health

<https://www.kth.se/student/kurser/kurs/CM2008>

Innovation and Entrepreneurship in Sustainable Energy Technology

<https://www.kth.se/student/kurser/kurs/MJ2496>

Business Economics and Entrepreneurship

<https://www.kth.se/student/kurser/kurs/HE1201>

Entrepreneurship in Developing Countries

<https://www.kth.se/student/kurser/kurs/ME2828>

Innovations for Sustainable Development on a Local or Global Level

<https://www.kth.se/student/kurser/kurs/AE1707>





Key learnings from the cases and recommendations

Sustainable entrepreneurship is thriving in Sweden and this is in no small part thanks to the efforts of higher education institutions in the country. This became apparent in interviews we conducted with numerous representatives from six Swedish universities with various areas of focus and in different regions around the country. The universities we chose to include in the study are Chalmers University of Technology, Karlstad University, Linköping University, Luleå University of Technology, Lund University and Royal Institute of Technology (KTH). To gain a comprehensive picture of the situation in Sweden, we also interviewed representatives from the university's ecosystems, and set up meetings with various officials from the government, government agencies, non-profit organisations and the private sector.

At the universities, we held digital meetings with researchers, educators, vice-chancellors, incubators and holding companies. This provided us with valuable information about how entrepreneurship with a focus on sustainability can be promoted and integrated at the various universities. Sustainability as a subject is generally in very high demand among students and within organisations in the university innovation ecosystem, such as incubators and holding companies. These days, most of the universities also have a sustainability strategy.

Sweden has historically relied heavily on large corporations and industries. Universities have also traditionally educated students to prepare them to work for these. But there has been a distinct shift and today entrepreneurship is, to a far greater extent than in the past, regarded as a career path for students. By highlighting successful companies that have a sustainability focus, we can create role models that can further accelerate this transition.

In general, greater flexibility is required from government agencies to increase the number of places at higher education institutions and to ensure the future supply of talent.

Integrate sustainability into programmes

One theme running through the interviews we conducted is that it is not enough to have separate sustainability courses within education programmes. Instead it is vital to integrate sustainability throughout the programmes. The optimal approach is for sustainability to be a focus in all of a university's activities and to become a natural aspect of research and education. Research funders today are requiring that sustainability be a clear element in research projects. Researchers often design course content based on the research being carried out at the university, and when there is a greater emphasis on sustainability in research, students gain a better understanding for and become more engaged in issues around sustainability.

Giving educators the opportunity to work in teaching teams provides opportunities to take better advantage of the variety of skills and knowledge in those teams, and for complex topics to be explained in depth.

Partnering with the private sector

Interviewees emphasised the value of initiating partnerships with local industries and businesses, and aligning activities at universities with local conditions and needs. Below are a few examples of what such partnerships can look like.

One example is Luleå University of Technology. The region has large forestry and mining industries, and the university has developed close partnerships with local companies in these industries. By forming a reference group with the companies, the university can gain insights into which skills and expertise the region needs and can then adapt its programmes accordingly.

Karlstad University has a major focus on the forest bioeconomy. The university considers this to be one of the most important areas in transforming the forest and pulp industries into sustainability-based industries. When fossil fuels and waste materials are removed from production, sustainability increases throughout the manufacturing chain. Through interviews, strategic councils and focus groups with representatives from companies in the region, the university is gathering valuable information to inform the development of its education programmes.

Linköping University is working in cooperation with Tekniska Verken AB, a regional group of companies owned by the municipality whose main areas are energy, water and waste management, with a particular focus on efficient energy solutions. Through partnerships like this, students have the opportunity to run projects involving clearly defined, relevant case studies, and they also have access to mentors outside of academia.

Learning by doing

A method that all of the academics interviewed emphasised as important in student education is learning by *doing*. It is not enough to learn about what sustainability and entrepreneurship are; students need to work on practical assignments in projects or on case studies on these themes. Being able to test their ideas in a protected environment is essential in order for students to be unafraid to try out entrepreneurship. At a later stage, students can use what they learn to develop their original business concepts or other ideas. If they gain the tools they need to pursue entrepreneurship and sustainability, they can start a business with this focus later on in their career, even if they chose to initially take a job after graduating.

Students today are in general very aware of the issues and often have climate anxiety. The majority of them are therefore looking to include sustainability in their course selections. Also, more and more students see entrepreneurship as a way to make a difference and they will bring their sustainability focus with them into their future careers. Few students today are, for example, actively choosing to pursue studies or work in fields involving fossil energy sources.

Common theme

IVA's Entrepreneurship Academy is developing a strategy proposal to bring entrepreneurship into schools, from el-

ementary up to the upper secondary level. The vision for this initiative is as follows: "Entrepreneurship will be a common theme throughout the education system, supporting individuals and the development of society, business and industry." The proposal is being developed in cooperation with a work group that incorporates the various skills of teachers, school authorities, entrepreneurs, researchers and government representatives. Discussions include the importance of students learning about, through and in preparation for entrepreneurship. A key theme throughout the education system should therefore be an emphasis on various ways of doing and testing. Integrating entrepreneurship in school education is proving to have positive effects on the students' results in other subjects as well.

The importance of a focus on sustainability and the UN's Global Goals (SDGs) is also a recurring theme in the discussions. School students often worry about the environment, and this has negative consequences for their mental health. When they realise that they themselves can make a contribution and help find solutions, this has a positive impact on how they feel.

Scalable best practice

The interviews carried out show that *Chalmers School of Entrepreneurship* is highly suited for scaling up and is a concept that can be introduced at other universities. The programme started in 1997 and has been focusing on sustainable entrepreneurship for a long time. It offers a Master's degree through Chalmers University of Technology and the University of Gothenburg School of Business, Economics and Law. All students and projects at Chalmers School of Entrepreneurship are specifically required to include a focus on both entrepreneurship and sustainability, and the School stresses that without technology it is hard for sustainability aspects to be applied in practice.

One of the Master's programme's main success factors has been integrating sustainability in all of its courses and projects. A commitment all the way up to the university administration level is necessary for this to be possible. Support for this approach at all levels is very valuable, as is involving administration and management, incubators and other parts of the university ecosystem.

It is also important to have committed faculty members so that students can work on their activities and projects with educators outside the classroom. More and more educators and researchers want to work in a more project-based way with students and this approach has great potential. In general we see a strong focus on individual activity in

academia, but there is significant value in shifting teaching towards a more team-based approach.

Among the tools that are being used are *lifecycle analysis* and *backcasting*, taking into account the impact of products and services throughout the manufacturing process and user phase. *Lean start-ups* and *design thinking* are also concepts that are being widely used. Around 40 percent of the students are women and, according to Mats Lundqvist, Professor and Vice President of Utilisation at Chalmers, this is largely thanks to sustainability being one of the cornerstones in education programmes.

The Chalmers model is not only suitable for ideas in engineering and technology, it can be applied in all types of ideas with the potential to have a positive impact in terms of societal, customer and commercial benefits. Sometimes

a promising idea stems from a technical possibility; sometimes a new concept comes from understanding a need.

Many alumni of Chalmers School of Entrepreneurship are currently working in positions where they are helping to create sustainable solutions in the private and public sectors. There is plenty of experience here for other universities to benefit from as well.

The School also produced a report in 2016 to provide inspiration for similar initiatives in Europe – *Sustainable Business Development: Frameworks for Idea Evaluation and Cases of Realized Ideas*, by Sverker Alänge and Mats Lundqvist – which could also be useful to other Swedish universities. Contact mats.lundqvist@chalmers.se if you want to read the report.

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