



Research for **innovation**

Goals and Strategy 2018–2021



Table of Content

1. Strategy, background and challenges 2018-2021	1
2. Goals 2018-2021	2
2.1. Development and positioning	2
2.2. Profiling	3
2.3. Quality and organization	5
2.4. Recruitment and career	6
2.5. Funding	6
2.6. Education	7
2.7. Relevance, co-production and innovation	8
2.8. Specified goals for each profile area	9

Research for innovation

Goals and strategy 2018-2021



1. Strategy, background and challenges 2018-2021

The Knowledge Foundation environment Research for Innovation is a long term program financed by the Knowledge Foundation and Halmstad University with support from Swedish industry. It is the Vice-Chancellor's main tool for strategic positioning and profiling of the University's strong research and education on advanced and PhD level. It is rooted in the University's Vision and Strategy for 2013-2020 (FUS).

Innovation builds on the ability to think and work across subjects. It requires close cooperation with stakeholders. It requires thinking about the human, the technical, and the business challenges in a cohesive way. Research for Innovation is designed to enable this.

The strategy for Research for Innovation is to develop the intersections between the three subject areas innovation sciences, health sciences, and information technology. This does not exclude maintaining and strengthening core strengths in the subject areas. It is in subject areas one can show a strong scientific position, but it is in the intersections between them that a unique scientific position can be achieved. The intersections between the three subject areas are developed via two overarching profile areas: Health innovation and Smart Cities and Communities. They are driven by the digitization of society, they are examples where research and education at Halmstad University can have a significant role, and they are areas where Swedish industries need to be competitive. Both are connected to Halmstad University's two Knowledge Foundation profiles: CERES and CAISR.

Based on the health technology alliance established in Halland about 17 years ago, the profile area Health Innovation (HI) was developed through a sequence of research projects, EU structural funds funded projects, strategic investments by the university and development of education. It has its base in the integration of health sciences and health technology, and today also includes innovation research. Similarly, Halmstad University's research on intelligent vehicles and very successful EU-supported research on energy, led to the formulation in 2016 of the profile area Smart Cities and Communities (SCC) to integrate these into an overarching profile area. The vice chancellor invests a total of 25 million sek in strategic funding during the period 2015-2021 specifically for the management and build-up of the two profile areas.

Halmstad University's goal with Research for Innovation is to profile the university. Metrics measuring Halmstad University's development of research, education and co-production capacity show increased performance for many important indicators during the program's initial five years. The volume of research, and number of active researchers, has increased by about 40%. PhD educations have been established in the three subject areas and today 2/3 of the PhD students at Halmstad University are enrolled in these PhD programs. Scientific output (publications) show a strong positive qualitative and quantitative development. The University's international standing has been strengthened by a number of international guest professors (IGP), which have contributed to international network building, partnership in EU grants, and outreach of education to other universities, as well as competence building at Halmstad University. Industrial collaboration and co-production has increased significantly in volume during the first period for Research for Innovation. It is safe to say that the ability to conduct close cooperation with industry partners is spread much wider within the University today than before Research for Innovation started. There is now a strong basis for co-producing research with industrial partners in all the three subject areas. The aim for the coming years is to build more strategic relationships in the cooperation with companies.

We have developed programs on advanced level to channel research to education in several ways. Today the university offers five international two-year master programs and three international one-year masters based

on research from the strongest research groups. Health innovation offers multidisciplinary courses on all three levels. Web based education is offered in different forms. A MOOC and a program for developing net based education were launched during 2016. Industry is supported with an industrial graduate school in embedded and intelligent systems as well as with expert competence education on master level and commissioned education in our core areas. Funding from the Knowledge Foundation is crucial for this development.

Recruitment and continued competence development remain a very important issue and a challenge. Leadership and management skills, not least in relation to co-production with external partners, need to be strengthened within Research for Innovation.

2. Goals 2018-2021

The overarching goal for the last four-year period for Research for Innovation is to further develop and strengthen the unique and strong position, nationally and internationally, of our profile areas Health Innovation and Smart Cities and Communities. To achieve this, we will focus our efforts on only a few core subareas in each of the profile areas. For Health Innovation these are Sustainable Youth and Aging and Self-Management. For Smart Cities and Communities we will primarily focus on Smart Mobility. We will in the last section further elaborate on the specific goals for each profile area.

Research for innovation has been fundamental for developing a strong and distinct profile not only in itself but also for the university as a whole. Therefore, the goals presented here are not only goals for the program as such, but also central for many of the University goals, which are expressed in the research and education strategy (FUS). The goals presented here are all in line with the university goals.

The profile areas will have program managers, budgets, and research and education agendas involving cooperation with academia, companies, the region and municipalities. We will invest in and make use of our innovation and cooperation arenas to do this (most of them have been established 2015-2017). A strong focus is placed on the vision of Complete Academic Environments; environments characterized by excellent research, acknowledged and attractive education on all levels, and well-established collaboration with public sector and industry in both research and education. All the university's schools have the mission to establish Complete Academic Environments. The School for Business, Engineering and Science has built up excellent skills in Graduate Professional Development Programs (AMPPI and GAIN) that we will transfer to the other schools.

Prioritizations of research activities will be defined by four aspects:

1. how they support the agendas of the profile areas;
2. how they strengthen the research competence in key areas (see more on this below);
3. that they involve the use and/or development of IT based tools (address digital transformation);
4. how they develop strategic industrial relationships.

To keep a coherent frame with previous descriptions, we group our goals for 2018-2021 in a similar way as for the previous two periods: 1) development and positioning; 2) university profiling; 3) quality; 4) recruitment; 5) funding; 6) education; 7) relevance, co-production and innovation; and 8) specific goals for the profile areas.

2.1. Development and positioning

Goal: *To further position Research for Innovation scientifically with respect to impact and specialization, and with respect to applied and fundamental research. The aim is to have both high consideration of use and high contribution to understanding (the Pasteur position in Pasteur's quadrant). Furthermore, there should in each of the subject areas be research groups with high specialization and high scientific impact.*

The scientific position for Research for Innovation is on the overall level defined by the three subject areas Information Technology, Innovation Sciences and Health Sciences, combined within the profile areas Health Innovation and Smart Cities and Communities. Each subject area works within certain thematic areas, but these are not aligned with bibliometric key words and hence difficult to measure the impact of (when benchmarking against other research organizations). Bibliometric analyses performed by DAMVAD, as well as our own in-house analysis, point out subfields (defined by bibliometric content areas) where Halmstad University has and can strengthen a high specialization and impact, and where there is a strong history for cooperation with industry. The DAMVAD bibliometric analyses are summarized in Appendix A. The three content areas with the largest publication volumes in Scopus and highest specializations over the period 2006-2015 are “Computer Networks and Communications”, “Software”, and “Artificial Intelligence” (in order of decreasing publication volume). This is not surprising since they are results of our investments into the Knowledge Foundation profiles CERES and CAISR. The IT field was selected as a strong field at Halmstad University already before CERES started, and we are now transferring the success within this field to innovation and the multidisciplinary profile areas Health Innovation and Smart Cities and Communities.

A bibliometric position analysis will have to be based on bibliometric content areas¹, to enable benchmarking against other organizations. This is why they are mentioned in the above paragraph. We emphasize, to avoid misunderstandings, that strengthening these must be done to strengthen the profile areas. It is in the intersections between the subjects that uniqueness can be achieved.

The prominent subfields (see Appendix A) will be individually strengthened and combined in the profile areas Health Innovation, and Smart Cities and Communities. A goal for 2018-2021 is to have a strong scientific position in the two profile areas and to achieve this by significantly increasing the relative specialization and relative impact in these subfields compared to the period 2012-2016 and by specialization of research publications within the subjects Innovation Sciences and Health Sciences.

The success of this positioning will be measured by scientific positioning analysis (bibliometry) and by external peer review evaluations of the research at the end of the period.

To achieve this goal, we will:

- Develop the two profile areas. This includes having a program management for them, strategic plans, and external reference boards. The core subareas will be developed; within SCC we will direct the Knowledge Foundation efforts towards primarily Smart Mobility, within HI we will direct the Knowledge Foundation efforts towards Sustainable Youth and Aging and Self-Management.
- Promote Knowledge Foundation funded initiatives, in research and education on advanced level, in strong subfields. This includes Graduate Professional Development Programs and NU (Networked/distance based Education Programs). Commissioned education can go outside of these, in related fields.
- Establish at least one national competence center within one of the profile areas.
- Develop the profile areas through deeper collaboration in connecting subfields with strategic external partners. The activities in Research for Innovation will focus on projects involving industrial partners, but in both profile areas are public sector partners very important. It is therefore important that the Knowledge Foundation funded activities are complemented by other funding to also involve public sector partners.

¹ See https://service.elsevier.com/app/answers/detail/a_id/15181/supporthub/scopus/

2.2. Profiling

Goal: *The University profile – “The innovation driving University” – shall be well known and recognized regionally, nationally and internationally.*

This means to be perceived as the innovation driving University. Our activities in research and education should lead to tangible results in terms of improved or new products/services and entrepreneurship.

Halmstad University has been associated with innovation already since the beginning in 1983. Through the Knowledge Foundation funding of Research for Innovation the recognition of the University as innovation driving has substantially increased. In 2012-2013 the vice chancellor conducted a university wide inspiration process on the innovation driving university as our character, with internal workshops and seminars. The conclusions were summarized in the booklet “Perspektiv på innovation” vid Högskolan i Halmstad, where the characteristics of an innovation driving university are listed (they are all in this goal document).

Each year, the organization Företagsbarometern conducts a survey of Swedish students and what images the students associate with their universities. The students at Halmstad University associate innovation very much with their university: top 3 i 2014, top 3-4 in 2016, and top 5 in 2017. That it drops in the minds of our students indicates that we need to increase the focus on this aspect in our branding. A report in 2017 from the Royal Swedish Academy of Engineering Sciences stated that Halmstad University is very clear in its strategic documents on its desired position among universities: to be the innovation driving university. We were, however, only ranked in the second group on cooperation by Vinnova in the first pilot (which was used to allocate direct research funds in the latest government budget). In the second Vinnova pilot we came out better.

The success of the profiling will be evaluated by gauging the associated connections between the desired profile and the perceived profile. A concrete goal is to have innovation at top 3 as an associated characteristic for our university among our students. Similarly, we want the industry to associate us with innovation, also at top 3. A further goal is to be ranked in the top by the government in impact and cooperation.

Many of the activities related to achieving this goal, operationalization of the innovation driving university, are described under Section 2.7. Here we list specific activities that are related to increasing the perception of us as the innovation driving university:

- Appoint a deputy vice chancellor with specific responsibility to develop the University’s collaboration and innovation (done in late 2017).
- Put emphasis on “the innovation driving University” in our marketing - especially for education and research within Research for Innovation.
- Increase internal communication on what it means to be innovation driving.
- Introduce a prize to Halmstad University staff for outstanding innovation and cooperation work, to be awarded at the University annual academic ceremony (done in late 2017).
- Build up a database over impact cases from research at Halmstad University.
- Establish the university and the region as an international innovation arena in Health Innovation through the Vinnväxt program.
- Offer courses within our common core directed towards innovation.
- Initiate a research program on the topic of research in collaboration and co-production related to achieving innovation, to build a scientific knowledge base in this field and establish a state-of-the-art position at Halmstad University. This includes developing models and frameworks for organizing and managing societal cooperation in universities, as well as indicators for measuring collaboration and knowledge assets, such as co-production quality.

2.3. Quality and organization

Goal: *Further enhance the high quality in research and education, for students, for faculty and staff.*

This includes increased quality in co-production of research, and in commissioned education courses directed at, and developed together with, external partners.

Halmstad University has developed very well over the last years in research quality as measured by bibliometric indicators. This is evident in material from the Swedish Research Council (based on Web of Science) and The Royal Swedish Academy of Engineering Sciences (based on Scopus). The halftime review by DAMVAD, commissioned by the Knowledge Foundation, shows that this is also the case for Research for Innovation. DAMVAD comments that Research for Innovation as a whole has a higher scientific impact than any previously evaluated Knowledge Foundation Profile.

Halmstad University was evaluated to be at the highest level in its education quality system in 2009, but our programs came out poorly in the latest round of education evaluations (2012–2016) by the Swedish Higher Education Authority (UKÄ). This started an extensive quality improvement process, which involved closing many programs and strengthening those that remained. All our programs have now been awarded high quality. We have a new quality follow-up and development program that involves self-reviews and reviews by external experts, plus program advisory boards with external partners and alumni. This work is organized by the Research and Education Board (FUN) and the vice chancellor's quality advisory group.

The researchers in Research for Innovation are good at running co-production research. The DAMVAD review indicates that although Research for Innovation is the broadest (in terms of subjects) of the current Swedish Knowledge Foundation environments, we perform very well when it comes to involving industry partners in strategic development of research and education. There is room for improvement; the concept of an industrial long-term strategic partner is not spread widely enough in the environment, and we will develop this.

Research quality will be measured according to established indicators. Education quality will be evaluated through Halmstad University's new quality assessment system for education. A concrete goal is to increase the bibliometric impact from papers within Research for Innovation 10-20% for 2018-2021 compared to 2013-2016. Another concrete goal is that all education programs and courses within the subjects in Research for Innovation shall show improving quality (as measured by our own quality assessment system) during 2018-2021. A third concrete goal until 2021 is that we have defined (formalized), identified and established at least twenty long-term strategic partnerships with external partners, covering all parts of Research for Innovation. We have long-term relations with companies that correspond to strategic partnerships but they have not been formalized, and (above all) we have not formalized within the university what such strategic relationships entail.

The steps for achieving this are drawn up in biannual dialogues between the vice chancellor and the schools, where the ambitions for each year are set and followed up. It is also discussed and followed up in and by the leading group for Research for Innovation.

To achieve this goal, we will:

- Promote publication strategies in the subject areas that increase the visibility and impact of the scientific output. Here we need to take into account that different subareas have the need of different strategies.
- Improve recruitment strategies, with an increased focus on recruiting persons with a mindset for cooperation and potential for high quality research output.
- Promote networking (EU projects, international visiting researchers and professors, etc.) that lead to stronger networks and projects in high quality settings.
- Develop the culture and skills for best practices of industry-academy cooperation.
- Define "long-term strategic partner" and establish more such partnerships.

- Make further use of advisory boards / reference groups with international members for the profile areas and the thematic areas to sharpen the strategies for increasing impact and international visibility.
- Further strengthen scientific agendas for the profile areas and the subject areas.
- Improve the continuous project support (budget status, ERP and HR support etc.). This includes better monitoring of project progress and supporting project managers with continuous project status.
- Support researchers in writing industry agreements, managing IPR and confidentiality, intellectual asset management etc.

2.4. Recruitment and career

Goal: *Make and keep Halmstad University, and specifically research for Innovation, an attractive academic workplace.*

For Research for Innovation the specific task is to shape Halmstad University into a highly attractive academic workplace, in our key scientific areas, for research, education and innovation in collaboration with Swedish industry.

The number of researchers in Research for Innovation has increased by 41% from 2011 to 2016, which is one indicator for increased attractiveness. The number of international visiting professors has increased from zero in 2011 to 13 in 2016.

It is our opinion that Research for Innovation has made Halmstad University a more attractive academic work place. Young researchers appreciate the interaction with visiting professors. The openness between the research environments has increased the PhD student and postdoc interaction between the subjects. We have over the period 2014-2016 had on average 5-6 applicants per professor or senior lecturer position in Research for Innovation. In general, there are more applicants to positions within Information Technology than to the other two subject areas. Furthermore, junior career recruitments like postdoctoral and associate senior lecturer (biträdande lektor) positions have essentially only been used for Information Technology. It is a goal to increase the number of junior career recruitments in the subject areas Innovation Sciences and Health Sciences.

Attractiveness will be measured both quantitatively, by number and academic level of applicants to announced positions, and qualitatively by interviews with existing faculty and other stakeholders.

To achieve this goal, we will:

- Recruit researchers based on strong discipline competence and specialization in and ability to contribute to developing both subject areas and profile areas in cooperation with external partners.
- Support researchers' academic careers, building or developing their industrial networks and ability to conduct high quality co-production research projects.
- Increase junior career recruitments (postdocs and associate senior lecturers) in the subject areas Innovation Sciences and Health Sciences.

2.5. Funding

Goal: *Continue the transformation of the University from a largely educational institution to a more research characterized organization.*

Research for Innovation is certainly a locomotive in this process; the last years increase in research volume at Halmstad University comes to a large extent from increased volume in Research for Innovation. The University goal is that staff devote at least 40% work time to research (including PhD education). In Research for Innovation the goal is higher: to be at 50%. The original goal, stated in 2011, for total research volume in

Research for Innovation was to have 195 million by 2020, of which 67% would be external competitive grants. This is still an ambitious goal but reachable and we therefore keep it. We are confident that we will have more than 165 million in research volume within Research for Innovation by 2020. The external grants should have a mix that reflects our profile of co-production, innovation and high quality research: 40-50% of the grants should come from the Knowledge Foundation, 15-20% from Vinnova, 10% of the grants from EU, 10% from Swedish Science Councils (VR, Forte, Formas), and the remaining 20% from various other regional and national funding agencies. A significant majority of the funding shall be for projects that are done in close collaboration with external partners. We were very close to this situation (in our mix of funders) in both 2016 and 2017.

To achieve this goal, we will:

- Support competence development among staff for writing applications and manage research projects. In 2018, an education in managing and administering research projects will be started
- Continue to recruit staff with strong research competence and networks.
- Establish and maintain strategic relationships with key funding organizations (e.g. the Knowledge Foundation, Vinnova SIPs, Forte, EU calls in profile areas).
- Establish new and maintain old strategic relationships with industrial partners that are involved in national and international research initiatives.
- Further strengthen the university's research support organization. The vice chancellor initiated a project 2016 with docents and professors from the academies that runs 2016-2018. The project, the Halmstad University strategic research team (forskningsstaben), has the specific purpose to propose an improved research support organization from January 1, 2019.

2.6. Education

Goal: *Halmstad University has attractive and relevant education programs with regional, national and international students on all academic levels. The University also has a wide offering of attractive and relevant courses to external parts for continued education. Research for Innovation is a driving force behind this.*

Research for Innovation education programs will develop the profile areas, support industry and public sector with competence development in our expert areas, and profile the University regionally, nationally and internationally. This shall be achieved within the framework of Complete Academic Environments with strong connections between education, research and co-production. We will increase our offer on competence development for the industry and public sector and strengthen the international impact of education.

Halmstad University has a good history of offering relevant education with strong links to external partners. All education programs are required to have a reference board with external members. We have been highlighted by Svenskt Näringsliv for offering a lot of practical cooperation in our education programs, compared to other universities. Many of our education programs have elements of practical placement in them, i.e. when the student spends some time in e.g. a company or a public authority as a part of a course. This is by government requirement built into some professional programs but is also common in the engineering programs in Halmstad. A concrete goal is to expand this aspect to all programs within Research for Innovation, and market this much more than what has been done before. Another goal is to strengthen industrial connections for international students. A third goal is to establish an alumni network (this exists today by private initiatives in some programs) for all programs within Research for Innovation, to better use our alumni students to show the value of our education to our current students and external partners.

Fulfillment of this goal is indicated by increased competitiveness of our education, measured in number of students, national and international, that apply our programs and courses. Also, the attractiveness of commissioned education and distance based education will be included in the evaluation. Fulfillment of this

goal is also indicated by good careers for our students after graduation, and how external partners perceive our educations.

To achieve this goal, we will:

- Continue to offer programs and courses on master and PhD levels that build the subject and profile areas. These shall attract international students.
- Offer attractive learning spaces by utilizing the innovation/cooperation arenas.
- Develop web-based education in profile areas to increase international outreach. At least five net based courses will be developed and implemented.
- Increase the offer of commissioned education in the profile areas. At least two courses per research environment. Support lifelong learning and develop relevant pedagogical models to reach out to new groups of students among professionals.
- Increase the placement aspects in the education programs, including the international students, and market these more.
- Establish an alumni activity, and use the alumni to market the quality of our educations, both internally and externally.

2.7. Relevance, co-production and innovation

Goal: *Halmstad University, and specifically Research for Innovation, has a very strong role as a strategically important partner for industry and public-sector organizations to maintain and develop their quality and regional, national and international competitiveness.*

When Research for Innovation started there were many years of experience from working with industry in research projects, but mostly within the engineering sciences. Furthermore, some were more strategic in this work than others, again mostly in the engineering sciences. All this is quite evident from the ARC13 report (the Assessment of Research and Coproduction 2013). We have invested in spreading this knowledge within Research for Innovation. The university has also invested 2015-2017 in building up innovation/collaboration arenas that can serve as platforms for “matchmaking” partners, spur creativity, and even run projects.

Working with relevance, co-production and innovation corresponds to being and acting as the innovation driving university. This will be done in (e.g.) projects, through industrial graduate schools, through strategic mobility activities, and through innovation arenas built on our core research areas and industry networks. A concrete goal is to have at least 15 individuals that do strategic mobility (i.e. academics spending time in industry, or industrial people spending time in academy) during 2018-2021.

To achieve this goal, we will:

- Appoint a deputy vice chancellor with specific responsibility to develop the University’s collaboration and innovation (done in late 2017).
- Continue to, and emphasize more to, recruit and develop staff with a strong ability to conduct research projects in collaboration with external partners.
- Increase the number of external boundary spanners, i.e. academics who spend time at companies and public sector and organizations that we collaborate with, or external staff who spend time in our academic environments.
- Increase the number of internal boundary spanners, i.e. researchers and teachers from different subject areas that are active in the profile areas.
- Include more innovation aspects in the education programs, to develop the innovation abilities. This will be done e.g. through our new common core.
- Offer more education programs/courses with innovation aspects directed at continued professional education (an example is AMPI, which will be expanded).
- Continue to have a large fraction of industrial PhD students.
- Develop and modernize the Development Engineer program.

- Offer education for our personnel in innovation and value creation.
- Build new and maintain old long-term strategic collaboration with companies, the municipality, the region, organizations and interest groups to develop common agendas for Research for innovation.
- Increase the role of our innovation and cooperation arenas – Electronics Center Halmstad (ECH), Health Technology Center Halland (HCH), Halmstad School of Innovation (HSI), FabLab, Digital Laborative Center (DLC) and Health Lab – for developing strong connections to local and regional industry and public sector actors, to integrate co-production and education. Link the subject areas and the profile areas with the innovation arenas.
- Establish, together with Region Halland, a Vinnväxt effort in HI centered in Halmstad.

2.8. Specified goals for each profile area

The decision to use university spanning profile areas to build the intersections between subjects is a direct result from Research for Innovation. It was first discussed with, and supported by, the Research for Innovation external reference group in a workshop in April 2013. Health Innovation (HI) was the first identified, in 2014, followed by Smart Cities and Communities (SCC) in 2016. The work with HI has formed the model for how to work with SCC.

HI has a program manager, a steering group, and an external advisory group (with international members). HI is established in Region Halland's growth strategy since 2014. Within HI have two core subareas been proposed, which can make Halmstad University stand out in this profile area; international visiting professors funded within Research for Innovation were important in this work. Our priority during 2018-2021 is to further strengthen these areas considerably. The first subarea, Sustainable Youth, focuses on health promoting digital service innovation in relation to health and wellbeing of children and young people. It received strategic financial support from the vice chancellor in 2014 and has received extensive external funding of subprojects and recruitments. The second subarea, Aging and Self-Management, focuses on technical smart solutions to support elderly in the home environment, specifically with drug administration. Both projects are part of the proposed Synergy for 2018: User participation in co-production of health innovation.

During 2016-2017 the vice chancellor financed the development of a strategic agenda for SCC. SCC builds upon some very successful research since many years at Halmstad University; some supported by the Knowledge Foundation and some by the Swedish Energy Agency and EU. Within SCC we have identified at least one subarea that we will focus on and strengthen during 2018-2021: Smart Mobility (which is in our Knowledge Foundation Profile application for 2018). Another subarea that we have identified as possible to further strengthen is Smart Energy. This latter area does not have the same priority within SCC to receive funding from the Knowledge Foundation; the intention is to strengthen it with resources from other funding agencies.

Both profile areas will be managed by program managers, and with external reference/advisory board with national and international representation.

The Health Innovation profile area shall:

- Focus the Knowledge Foundation resources on two subareas: *Sustainable Youth* and *Aging and Self-Management* and within core subareas strengthen and further develop research and collaboration with strategic partners in industry and in the public sector. In particular, the strategic partners should include large multi-national companies.
- Increase the research environment and volume through more and more diverse external funding. This applies especially to areas that have comparatively low external funding from other sources than the Knowledge Foundation.
- Recruit key senior researchers with a track record of international high visibility and external funding.
- Increase international publication and, in particular, publication channels with high impact.

- Further develop the education offers on all levels (basic, advanced and research). Specifically, to use research from the core subareas to offer courses for national profiling.
- Establish a research school, with support from both public authorities and private industry, within the HI area.
- Develop and strengthen the network of Halmstad University and external partners within HI. This should include both public and industrial members.
- Make Halmstad University an active and important member in the relevant Vinnova funded Strategic Innovation Programs (SIPs).
- Further increase the volume of EU-funded projects at Halmstad University in HI with national and international participation. Participate in at least one European Framework Programme where Halmstad University is a prominent member.
- Establish the university and the region as a strong innovation arena in HI through the Vinnväxt program.
- Brand HI at Halmstad University on the national and international arena. This means being present and active in national and international fora.

The Smart Cities & Communities profile area shall:

- Focus the Knowledge Foundation efforts primarily towards Smart Mobility, and within core subareas strengthen and further develop research and collaboration with strategic partners primarily in industry but also with the public sector.
- Increase the impact of scientific articles and exceed the OECD citation average.
- Increase the research environment and volume through more and more diverse external funding. This applies especially to areas that have comparatively low external funding from other sources than the KK Foundation.
- Recruit key senior researchers with a track record of international high visibility and external funding.
- Further develop the education offers on all levels (basic, advanced and research). Specifically, use research from the core subareas to offer courses for national profiling.
- Establish an industrially supported research school within the SCC area.
- Develop and strengthen the strong industrial network for Halmstad University within SCC. In particular, the number of large multinational companies should increase. It should also include important public authorities.
- Establish strong strategic links with industrial Swedish research institutes and other academic institutions in Sweden.
- Further strengthen Halmstad University's position as an active and important member in the Vinnova funded FFI (Fordonstrategisk Forskning) program and establish Halmstad University within the relevant Vinnova funded Strategic Innovation Programs (SIPs).
- Further increase the volume of EU-funded projects at Halmstad University in SCC with international participation.
- Prepare for, and ideally establish or be a key member of, a national competence center in SCC.
- Brand SCC at Halmstad University on the national and international arena. This means being present and active in national and international fora.

Appendix A - Summary of DAMVAD's bibliometric analyses

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Introduction

DAMVAD has performed two bibliometric analyses that are relevant for Halmstad University and for Research for Innovation. The first analysis was commissioned by the Knowledge Foundation, and looks specifically at Research for Innovation. Here the focus is on scientific impact. The second analysis was commissioned by Region Halland, which looks at Halland and a scientific positioning for Halland (and not just Halmstad University). Here the focus is on scientific specialization and impact.

We have, with DAMVAD's help, reproduced some of the latter analysis with a specific focus on Halmstad University.

DAMVAD impact analysis of Research for Innovation

DAMVAD did an analysis focusing only on Research for Innovation, which looked at the development over the six years 2011-2016.

FIGUR 2.10
Impact för producerad forskning vid Forskning för Innovation under perioden 2011-2016.

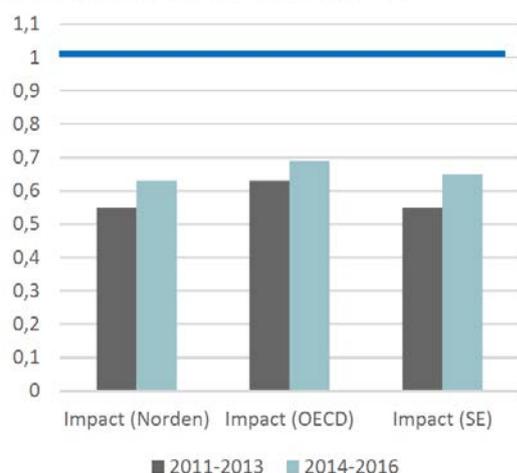


Figure 1: Average impact for papers from Research for Innovation, compared to Nordic countries, OECD countries, and Sweden. Based on Scopus data.

FIGUR 2.11
Impact per delmiljö under perioden 2011-2016.

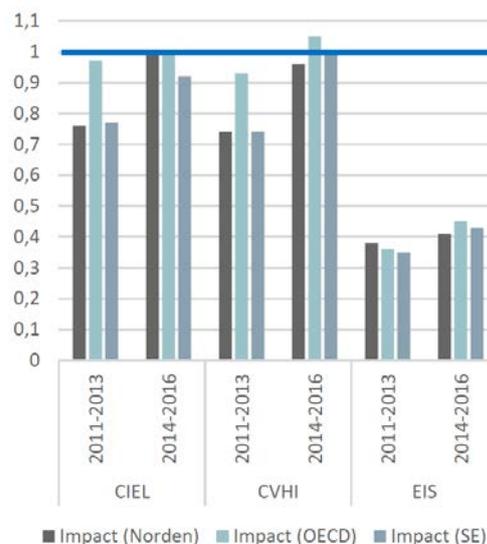


Figure 2: Average impact for the three environments that form Research for Innovation, compared to Nordic countries, OECD countries, and Sweden. Based on Scopus data.

The results (Figure 1 and Figure 2) show that all three environments in Research for Innovation have improved their scientific impact from the period 2011-2013 to 2014-2016. The results also show that the average impact in Information Technology (EIS) is quite low. This is surprising given another comment in the DAMVAD review: that EIS produces a very high fraction of their papers in the top journals. In the DAMVAD review they therefore also show the impact measured with two other bibliometric metrics: Source Normalized Impact per Paper (SNIP) and SCImago Journal Rank (SJR).

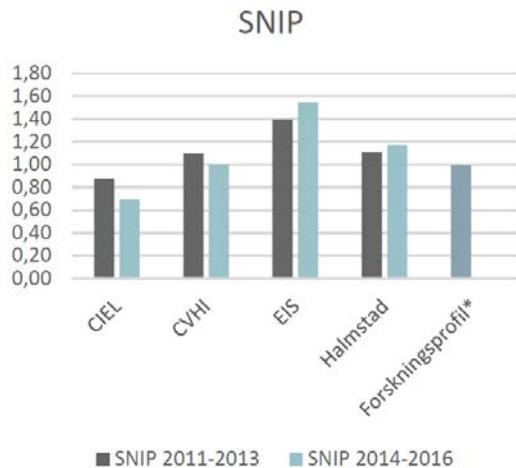


Figure 3: Average Source Normalized Impact per Paper (SNIP) for publications from the environments in Research for Innovation. Based on Scopus data.

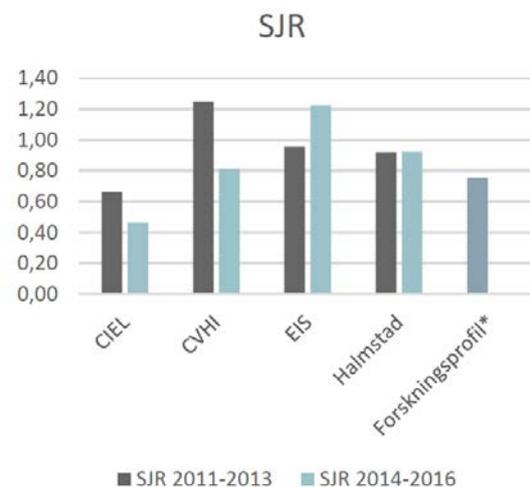


Figure 4: Average SCImago Journal Rank (SJR) for publications from the environments in Research for Innovation. Based on Scopus data.

Figure 3 and Figure 4 above show these two impact measures.

Source Normalized Impact per Paper (SNIP) measures citation impact by weighting citations based on the total number of citations in a subject field. The impact of a single citation is given higher value in subject areas where citations are less likely, and vice versa.

SCImago Journal Rank (SJR) is a metric based on the idea that “all citations are not created equal.” With SJR, the subject field, quality and reputation of the journal has a direct effect on the value of a citation. It builds on the Google Page Rank algorithm.

With these two metrics it appears that Information Technology has a high impact, which is more in line with publishing in top ranked journals. It illustrates (at least) that there are many intricate details in bibliometrics.

DAMVAD positioning analysis of Halland

DAMVAD did a scientific positioning analysis based on Scopus data 2006-2015. This is illustrated in a positioning analysis graph, where relative specialization is shown against relative impact factor.

Relative specialization is an indicator of the intensity of research of a given geographic or organizational entity in a given research area (domain, field) relative to the intensity of the reference entity (e.g., similar universities) in the same research area.

Average relative impact factor is a proxy for the quality of the journals in which an entity publishes. Each journal has an impact factor (IF), which is calculated (annually) by Scopus based on the number of citations it receives relative to the number of papers it publishes. The IF of papers is calculated by ascribing to them the IF of the journals in which they are published. In order to account for different citation patterns across fields and subfields of science (e.g., there are more citations in biomedical research than mathematics), each paper’s IF is then divided by the average IF of the papers in its particular subfield in

order to obtain a Relative Impact Factor (RIF). The average relative impact factor of a given entity is computed using the average RIF of papers belonging to it. When the ARIF is above 1, it means that an entity scores better than the reference group average; when it is below 1, an entity publishes in journals that are not cited as often as the reference group average.

All Journals, conference proceedings etc. in Scopus are classified into content areas, which can be done on different levels. The figures below show the result at the level with 300+ content areas. Every Journal, conference proceeding etc. can have several content areas assigned to it so the result must be interpreted with some caution: it is not necessarily so that the content area classification in the analysis of an individual article agrees with the actual content of the article (i.e. the content that the authors think it should be labelled with). Furthermore, it also means that an article can (and will) appear in more than one content area in the analysis.

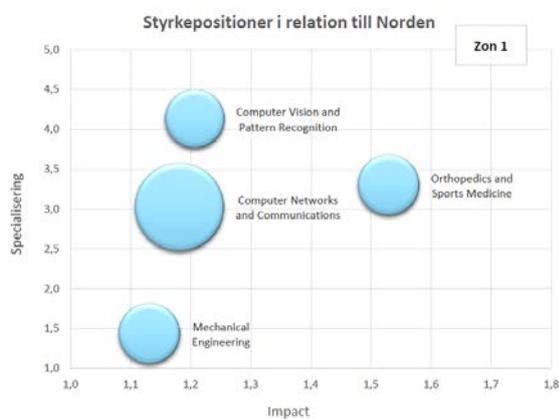


Figure 5: Positioning analysis graph for Halland cf. Nordic countries. The graph shows the quadrant for “high specialization” and “high impact” and for the subject areas with more than 45 papers in Scopus between 2006 and 2015. The sizes of the circles reflect the number of papers.

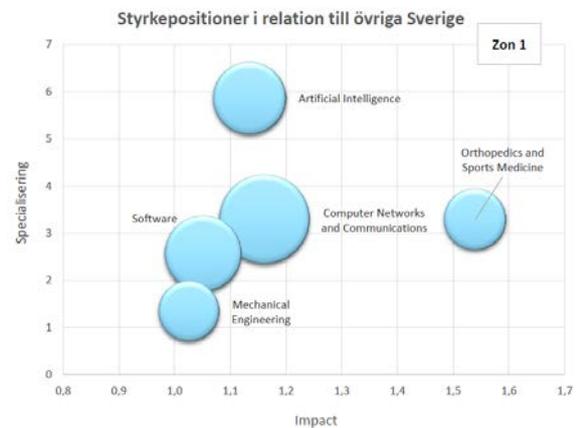


Figure 6: Positioning analysis graph for Halland cf. Sweden. The graph shows the quadrant for “high specialization” and “high impact” and for subject areas with more than 45 papers in Scopus between 2006 and 2015. The sizes of the circles reflect the number of papers.

The positioning analysis graphs (Figure 1 and Figure 2) show that *Orthopedics and Sports Medicine*, *Computer Networks and Communications*, *Artificial Intelligence*, *Computer Vision and Pattern Recognition*, *Software* and *Mechanical Engineering* are potential content areas where there is a substantial output volume, an above average impact, and where Halland’s relative specialization is higher than one. These are thus also potential areas of strength (in bibliometric terms) for Halmstad University.

A comparison with output volumes and position analysis at other universities in Southern Sweden is shown in Figure 3. It shows (unsurprisingly) that the publication volumes in Halland’s most prominent content areas are still small in comparison to the universities in Lund, Gothenburg and Linköping.

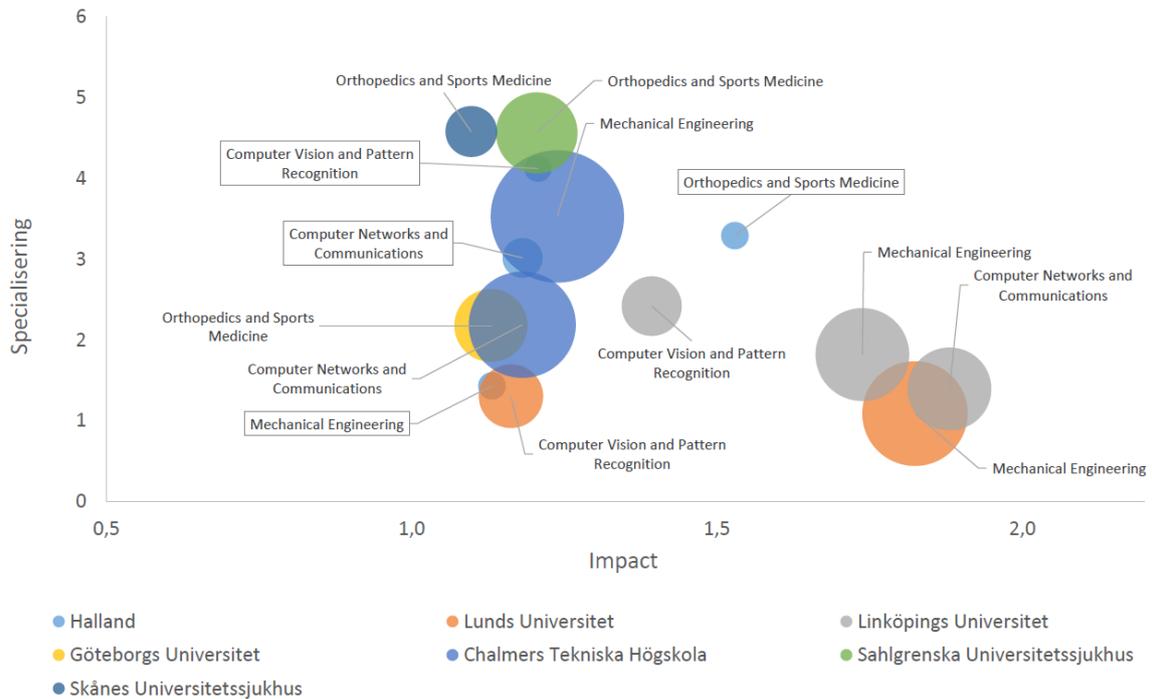


Figure 7: Comparison between Halland and universities in Southern Sweden. The positioning is cf. Nordic countries. The graph shows the subject areas with more than 50 papers in Scopus between 2006 and 2015 (for all universities) and with relative impact above one (cf. Nordic countries). The sizes of the circles reflect the number of papers.

The positioning analysis for Halmstad University

We repeated DAMVAD’s searches in Scopus but only for Halmstad University as address for the publication, to see how the numbers of papers change (for Scopus 2006-2015). The top result are shown in Table 1, which shows that *Orthopedics and Sports Medicine* papers to a large extent come from sources outside Halmstad University.

Table 1: Comparison of number of papers in Scopus 2006-2015 from Halland and from Halmstad University. The table shows the content areas where there were at least 40 papers in Scopus over the period 2006-2015.

Content area	Halland (DAMVAD)	Halmstad University
Computer Networks and Communications	118	115
Software	85	86
Artificial Intelligence	78	79
Orthopedics and Sports Medicine	56	27
Mechanical Engineering	54	48
Computer Vision and Pattern Recognition	48	48
Education	43	44

We also performed the same search in Scopus for papers between 2011-2017, to see how the volumes have changed. This time period (almost 7 years) corresponds to 68% of the time period 2006-2015. The results, in Table 2, show that all content areas seem to have increased their production except *Artificial Intelligence* and *Computer Vision and Pattern Recognition*, which remain at the same production rate.

Table 2: Comparison of number of papers in Scopus 2006-2015 and 2011-2017 (October) from Halmstad University. The table shows the same content areas as Table 1.

Content area	Halmstad U 2006-2015	Halmstad U 2011-2017
Computer Networks and Communications	115	114 (99%)
Software	86	74 (86%)
Artificial Intelligence	79	53 (67%)
Orthopedics and Sports Medicine	27	24 (88%)
Mechanical Engineering	48	39 (81%)
Computer Vision and Pattern Recognition	48	35 (72%)
Education	44	49 (111%)



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