

# Dalarna University - School of Information and Engineering (IIT)

## External Committee - Research Evaluation Report

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## Preface

We evaluated the School of Information and Engineering at Dalarna University for the period 2018 to 2022. The evaluation is based on a comprehensive self-evaluation report and an online interview with junior and senior staff from the three departments and with the school management. The committee wishes to express its thanks for the open and constructive dialogue at all levels during the interview.

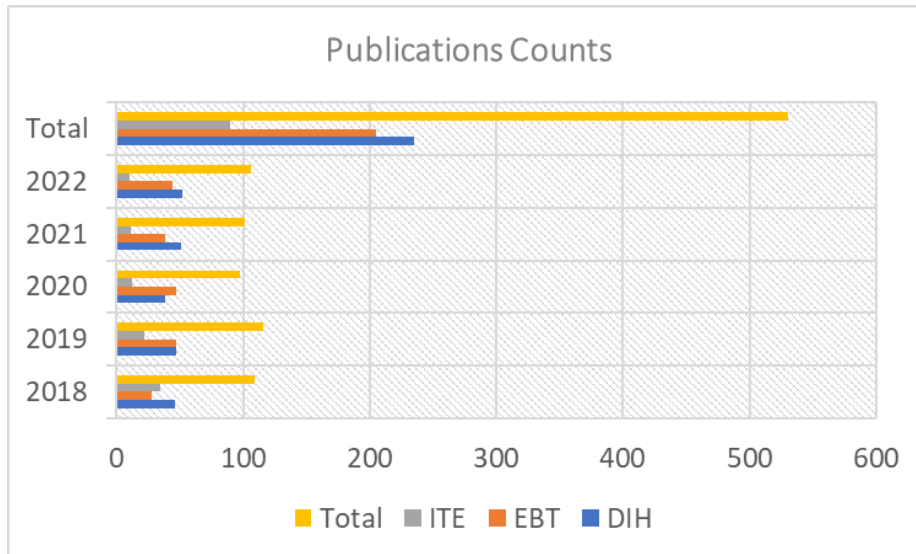
## Summary

- Despite the organization's restructuring, the research has continued, and we notice continuity in the scientific publishing activity. The re-organization appears successful, although interviews with senior staff indicated dissatisfaction with management access and long decision-making paths.
- We noticed the international collaborations of authors in the publications of level 2. Therefore, we advise increasing international collaboration to increase this standard.
- Given that external funding is essential for the sustainability of research, the school might consider recruiting grant writer(s) to help in attracting more external funding, but also to ease the administrative burden of research staff. Additional external support in preparing EU applications might be of help.
- One way to boost DU research could be to actively expand international collaboration within Scandinavia and at a European level. Targeted efforts to be (or remain) strong at an international level within selected research topics would consolidate DU's position and allow

for increased external funding through international consortia, e.g., in EU-funded research projects.

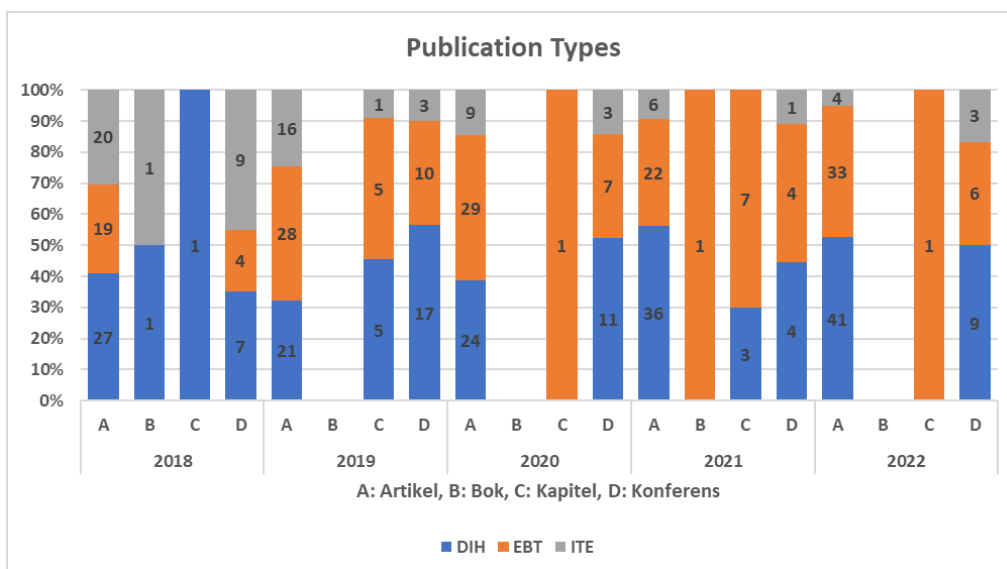
- Even though the gender imbalance is evident and well-known in engineering departments, no strategies appear to be in place to address this imbalance.
- The school and departments would also benefit from having an advisory board, including members from both regional industry and academia and international experts, to advise the management level regularly and assist with formulating research strategies.
- Compared to other Schools at DU, IIT is successful in attracting external funding, although the desire to expand research calls for a higher influx of external funding.
- We noticed the absence of teaching-related research and non-teaching-related activities in the professional development components for the academic staff.
- The current average ratio of publications to researchers is rather low, given that the school has a trendy profile such as the **MDA**. It can be improved by developing a profile strategy in addition to the school research strategies. For example, the thesis and bachelor projects might be used to develop conference papers, book chapters, and journal papers.
- We noticed the absence of edited book publications. Only one **DIH** and one **ITE** published one book in 2018. The publications count can be increased by having more collaborations within the school but also with other universities locally and internationally. Having public and regular seminars will help a lot in increasing the collaboration in research.
- Despite **DIH** having more publications than other departments, the number of citations in both databases for **EBT** is the highest among the three departments. A strategy to increase the number of citations can be exposing research publications on academic and social media. A citation map can also help with this strategy.
- **MDA** also has widened the focus of the research to include new topics that conventionally would be anchored in **REBM**, such as energy use and building materials. This indicates that the university's ambition of promoting coherent and interactive research environments has been successful, at least within these two departments.
- At **MDA**, restructuring some administrative tasks and redistributing the responsibilities might increase the time allocated for research.
- Though the research outcome of **REBM** is satisfactory and backed up by skilled staff and senior-level researchers, it should be noted that several key senior staff members are close to retirement. The recommended strategy efforts and infrastructure updates should naturally be carefully aligned with recruiting new senior staff.
- The **IE** department needs to identify common research goals and define future research plans and strategies. The school's management should, therefore, dedicate resources to assist with this process to strengthen the field where research and education are in demand from the local, regional, and national industries.
- **IE** is under critical mass in personnel, and one of the most experienced and productive senior professors is only working 10% full-time (post-retirement position). **IE** has no Ph.D. students in Materials Technology at the moment, few doctoral students related to Entrepreneurship and Industrial Engineering and Management, and there is a risk that **IE** may fade away. The success of the new educational program is vital in its own right and to attract students to DU.
- We have concerns about the stability and sustainability of the **IE** research profile. However, we recognize strengths in the collaborations between the unit and Tallinn University of Technology, Estonia, and the University of Gävle, Sweden.





**Figure 2: Publications counts of the school between 2018-2022.**

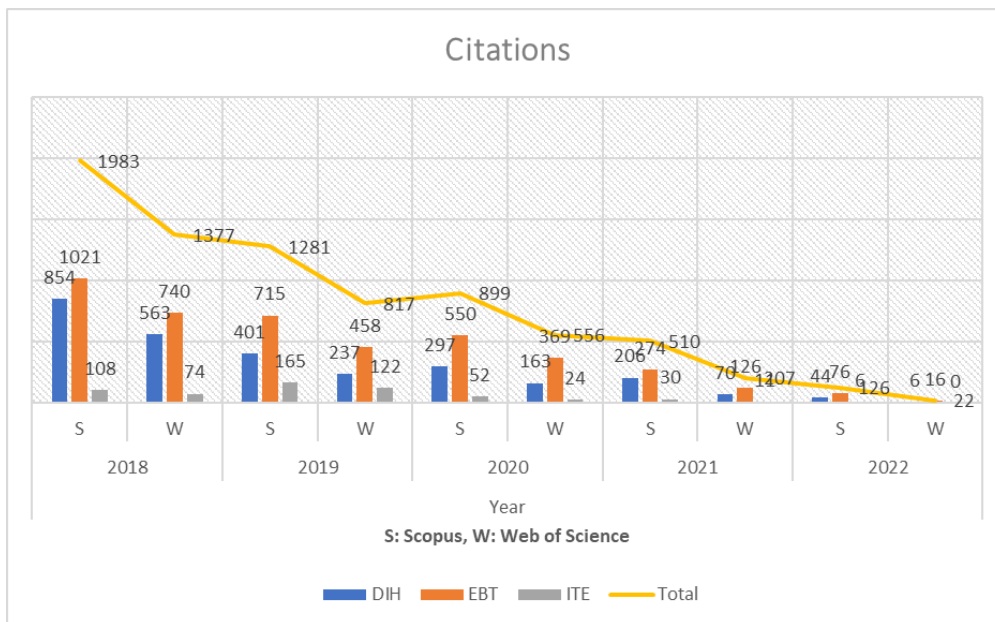
We noticed in Figure 3 that the DIH department is more productive in publications, which is expected given the broad and diverse research topics, history, number of published researchers for the time period (34 out of 65 in total at IIT), and staff size at the departments (app. 50 at DIH, 40 at EBT, 20 at ITE).. The number of conference papers and book chapters could be higher. A focus might be on international conference papers, and flagship conferences will enhance the quality and progress in the researcher’s field. The number of publications of book chapters can be increased by converting some of the senior projects, MS theses, and part of Ph.D. theses into book chapters. We noticed the absence of edited book publications. Only one book from DIH (2018), one from ITE (2018), and one from EBT (2021). The publications count can be increased by having more collaborations within the school but also with other universities locally and internationally. Having public and regular seminars will help a lot in increasing the collaboration in research.



**Figure 3: Publication counts by type of the school between 2018-2022.**

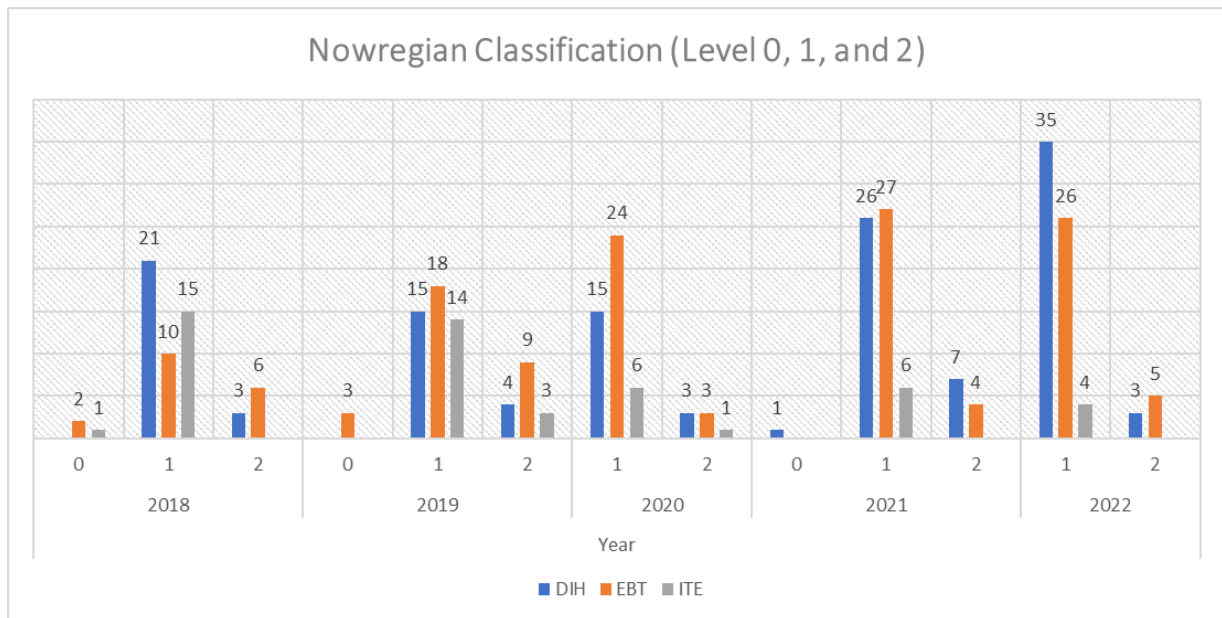
Qualitatively speaking, the school has many citations in both databases, Scopus, and Web of Science

(see Figure 4). In general, the citation count will increase with time. School citations in Scopus are higher than in Web of Science, and that is expected due to the higher number of resources indexed in Scopus. Despite DIH having more publications than other departments, the number of citations in both databases for EBT is the highest among the three departments. A strategy to increase the number of citations can be exposing research publications on academic and social media, like Researchgate and others. A citation map can also help with this strategy. A Citation Map is a graphical representation that shows the citation relationships (cited references and citing articles) between a paper and other papers using various visualization tools and techniques. Using citation mapping, you can analyze which researchers cite your papers ([see link](#)).



**Figure 4: Citations counts of the school, as of January 2023, between 2018-2022.**

In Norwegian journal classifications, level 2, for journals of high standing, publishing at most a total of 20 percent of all publications within their fields. The school published some papers in Level 2 (see Figure 5). While checking those papers, we noticed the international collaborations of authors in these publications. Therefore, we advised increasing international collaborations to keep this standard.



**Figure 5: Citations counts of the school according to Norwegian classification between 2018-2022.**

In summary, on average, the research performance is acceptable, but it varies between departments, of which some are approaching a challenging low number of staff. This problem needs to be addressed. The school has a long research practice, resulting in research contributing to a larger share of the core activities (education and research) than the university. Two of the environments have succeeded in growing and become academically mature enough to attain doctoral programs. The environments have grown independently of each other from the start, developing more interdisciplinary collaboration in the past five years. There is collaboration between the three environments and other environments within the university. One collaboration that has evolved over time and is now a research group with two senior researchers (one each from **MDA** and **REBM**, respectively) and a few doctoral students is in energy systems modeling. The collaboration between researchers from **MDA** and **REBM** is remarkable. Given that the grant is essential for the sustainability of research, the school might need to hire someone strong in writing a research proposal to increase the chance of getting funds from outside the university. For **IE**, the number of publications decreased to 30% in 2022 compared to 2018. *Materials technology*: Today's group has one professor, one senior professor (10 %), two associate professors, and a research engineer. *Mechanical Engineering*: Research is conducted by one assistant professor. *Industrial Engineering and Management*: One associate professor and PhD student conduct the research. *Entrepreneurship*: One assistant professor and one PhD student conduct the research. **IE** altogether: eight researchers, including one professor, three associate professors, two assistant professors, and two PhD students. Groups seem slightly fragmented and below critical mass (as mentioned in the self-evaluation), and an effort should be made to formulate a joint strategy for the department. With new staff, future directions for the research may be formulated. This should be prioritized. Currently, one researcher is equal to one research direction, so collaboration on certain topics gives Industrial Engineering a stronger profile with which it can be recognized. Publications in author lists for the School indicate collaboration with both national and international partners. This indicates that ongoing research activities go beyond DU. Still, one way to boost DU research is to actively seek to expand international collaboration in Scandinavia and at a European level. Targeted efforts to be (or remain) strong at an international level within selected research topics would consolidate DU's position and allow for increased external funding through international consortia, e.g., in EU-funded research projects.

## 2. Preconditions: organization and resources in the school



After the reorganization, the school is a new unit at the university and as such must adhere to university rules and regulations, as well as its ambitions but also develop its own profile. Given the overall research profile of the school (digitalization, resource efficiency), the school has great potential to contribute to the areas described by the university as its prioritized societal challenges.

At the university level, goals are expressed in terms of ‘growing’ – by increasing the number of teachers, associate professors, and professors by external and internal recruitment and by increasing external research funding overall. These are goals that apply also to the school. At the same time, as it is important to achieve both goals for the school to grow on a solid resource basis, the goals are (as yet) very general, and clear strategies appear (as yet) to be lacking. The three departments have put forward proposals (although fairly general) for the future. Still, it would benefit the departments and the school if these goals could be developed, possibly quantified, along a timeline, together with strategies on how to work towards achieving the goals. These activities should align with developing the proposed research strategy.

That said, at the university level, it is clearly stated that one wants to achieve coherent academic environments. The formation of the schools has been an important step towards creating these environments in that the earlier three schools and six research profiles have become five schools divided into departments. One intention has been that such an environment, i.e., School, will be able to use the available internal basic funding in a way that will secure critical mass and apply for the right to award master as well as doctoral degrees. Such coherent academic environments with research and education at all levels (from bachelor to Ph.D.) provide a good basis for the further development of research as well as education. The school is now responsible for several bachelor, master, and recently also two Ph.D. programs, which have been one of the clearly stated goals – At the same time, further growth in the number of master and Ph.D. programs will require substantial resources (in terms of staff, infrastructure, etc.). Such an ambition emphasizes further the importance of considering the above-mentioned goals and strategies.

Furthermore, in 2022, the university changed the principles for internal basic funding, which has led to a slight increase in internal basic funding and new, more transparent principles for how the funding is divided between Schools - which has been positively received by staff. More basic funding and transparent principles for dividing resources will probably positively affect the school. Nevertheless, it is also essential that the new quantitative parameters comply with and lead to the desired goals for the school and the departments. For example, considering the trend for one of the departments (**IE**) in terms of the number of publications and external funding, the consequence could be an ever-decreasing internal basic funding, which could lead to less resources being assigned to, for example, writing research applications, etc.

The introduction of Schools also meant a change in roles and responsibilities. Now, the Head of School has, together with the Deputy Head of School, the Department Directors, and the School Steering Council (IL), the overall responsibility for education, research, and collaboration. In contrast, the responsibility of each Department Director per se is limited to the allocation of resources within his/her department. Each department has a Research Coordinator to coordinate and assist with staff planning, etc. Other roles are Director for the doctoral program and Head of the doctoral subject. The organization, different roles, responsibilities, and rules for delegation are in place and accessible in

different official documents. From this perspective, the re-organization appears to have been successful, although interviews with senior staff indicated dissatisfaction with management access and long decision-making paths. This is at least in part interpreted as though the organization is still new and that not all routines have come into place. Still, the School is encouraged to openly discuss these and other issues that could result from the reorganization.

Regarding the possibility for the junior and senior staff to influence decisions, the university and/or School has several fora - informal and formal - which, according to the interviews with senior staff, are appreciated information and communication channels. (For example, the staff representatives decided how to distribute internal funding to the three departments.) Hence, the School should not have any problem being able to address any dissatisfaction that may exist or arise. These fora also provide good opportunities for the school and the departments to initiate and arrange more strategic discussions addressing the issues discussed earlier.

At the same time as the opportunities to take part in discussions and influence decisions on a departmental and/or School level must be maintained, it is also important to consider the time that has to be allocated by the staff – in addition to the different tasks (e.g., Department Director) and responsibilities that members of staff have (e.g., teaching, applying for research funding, writing papers, etc.). In some cases, the respective documents specify how much of a full-time position each position/role is allocated regarding resources - between 5% and 15%. In addition, according to the self-evaluation, each staff member with a Ph.D. has 5% of their full-time post for participating in research meetings/seminars and 5% for writing applications. To specify and be transparent regarding how much of a full-time position each position/role is allocated is positive - but it is also important to follow up and assess the work situation, particularly for teachers and researchers with multiple responsibilities.

Even if the internal funding has increased, the school must attract more external funding if its research portfolio is to expand (and involve more Ph.D. students, increased number of publications, ...). Increased external research funding relies on more (approved) applications. There is support from the school in that an applicant can get some funding for writing the application (5% of basic funding). The school also has a process in place for the approval of applications. Before writing the application, the Research Coordinator must be informed, but the approval of research applications is formally made by the Head of School or higher (depending on budget size, etc.); more specifically, the application is approved at a decision meeting where the proposal is presented to the Head of School and the Research coordinator and the Department Director are also present to confirm that resources are available. Hence, there are several decision gates with a focus on available resources (which is evidently an essential prerequisite), but it appears as though the university/ School offers less support before (in planning, setting up) and/or during writing - apart from the 5% basic funding which is essential but maybe not enough. Such an additional support (cf. consultants in EU applications) could be a way forward along with discussions within the school and/or the department of whether the application 'fits' the overall research agenda and which partners to involve (strategically), etc.

The documents received from the University state that teachers should also be involved in research and that teachers without a Ph.D. should have the opportunity to achieve one. However, the obtained information does not provide much information on how or to what degree this is (to be) achieved. The principles for basic funding should (in principle) encourage this (i.e., more Ph.D., more funding) at the school and departmental level - but the question is if there is a correspondence between what is gained (1 Ph.D.) and what is lost (teaching hrs., etc.)? Another question is whether there are any incentives on an individual/personal level. As the salary of a Ph.D. student is considerably lower than that of a lecturer, it would appear as though this is not really the case. If the School wants to



encourage teachers without a Ph.D. to achieve one, it is recommended that alternative incentives are discussed.

Recruitment strategies are in place to recruit lecturers and assistant professors or professors. Recruitments are international, and the staff at the school have different nationalities and varying educational backgrounds. This has had positive effects, providing a basis for a widespread international research network. However, there are also acknowledged challenges in terms of new researchers facing challenges in acquiring external research funding. Still, a solution is to offer them a larger share of internal funding for their first years. Something that also is done by the School. Nevertheless, the internal basic funding is limited. The proposed support for writing applications could play an important role for new researchers overall, particularly for someone unfamiliar with the Swedish system. Regarding gender balance, only 1/11 of professors are female, and according to the self-evaluation, female applicants are in the minority, whereas the ratio is almost 50/50 for the assistant professors. Even though the gender imbalance is not unknown in departments with an engineering focus, no strategies appear to be in place to address the former imbalance.

### 3. Research: conduct, results, impact, and professional relevance



#### 3.1 Conduct of research

*3.1.a. How the School works to promote and maintain both the quality of research and good research practice*

##### [General]

Each department at the school has a research coordinator who helps with the research management. The coordinators also take care of cross-departmental networking and information exchange through regular coordination meetings, which have been found useful. If the upper-level research management seems to be adequately resourced, the help on proposals, proposal writing, and practical project management is, however, found inadequate, putting much burden on the research-carrying part of the organization. Professional grant writer assistance would be a welcomed resource, releasing senior-level resources to research and supervision. Some kind of professional R&D management resource would have the same effect. If these resources were available, they could help increase the external funding level, recruit more Ph.D. students, etc., with positive outcomes on research output and impact.

The interviews and discussions with the management and senior staff indicated the need to strengthen the research strategy. The research in the school is rather broad, considering the number of senior staff and the available time for research duties now split between teaching and research. Also, the status of the research infrastructure, important to both undertaking projects and attracting new projects, varies among the units, but mostly, it would need rather urgent renewal and modernization. The R&D infrastructure is the responsibility of the departments, putting a significant financial burden on these. Therefore, creating a more coherent research strategy for the school is recommended, in which the division of responsibilities between the school and departments should be reviewed and updated, e.g., strengthening the support across the whole School. Such an update could also include focusing the research effort on fewer, stronger strategic topics, building stronger synergies across the departments, R&D infrastructure, and R&D management support (grant writing,

project management) from the school level. The school and departments would also benefit from having an advisory board, including members from both regional industry and academia and international experts, to advise the management level regularly and assist with formulating research strategies.

### **[MDA]**

Publication authorship is commonly shared within **MDA** staff, with staff from other school departments, and external research partners. **MDA** also has widened the focus of the research to include new topics that conventionally would be anchored in **REBM**, such as energy use and building materials. This indicates that the university's ambition of promoting coherent and interactive research environments has been successful, at least within these two departments. Senior researchers act as hubs for the department's younger researchers and research activities, which may promote good quality research practice and is well aligned with the university strategy. Nevertheless, it should be assured that early career researchers could play a role in the definition and conduct of the research.

Although this may be a partially formalized component of the department's conduct, Ph.D. students are offered assistance when beginning to write articles themselves. This good practice contributes to continuing a culture that encourages publishing high-quality articles. In addition, the practice may help raise the scientific impact and reach the goal of publishing in the highest-impact journals. With the topics traditionally covered by the department (computer science, statistics), **MDA** should be able to function as an attractive partner for both researchers within other fields and for industry. Already, there is a collaboration with scientific associations. The department has plans to strengthen cooperation through joint publications and partnerships with researchers at other institutions. The school could use different incentives to enhance such productive partnerships, e.g., through financial support or other rewards. Non-financial awarding could include stronger recognition of active individuals, teams, or major achievements.

### **[REBM]**

The research at **REBM** is interdisciplinary, mainly, and partly conducted with other departments, schools, and local industries. The research agenda is clearly formulated, and the department has acted visionary by teaming up with partners that contribute with expertise in topics not naturally anchored in **REBM**, e.g., modern analysis techniques (**MDA**) and the social sciences. The research agenda documents the outlook, and the department seems willing to take appropriate risks by complementing conventional research approaches by introducing new ones. However, although it looks like a well-thought-out plan to not deal with resource efficiency for buildings, it is a topic that currently draws attention from many sides within the research community, in policymaking, and in the building profession (e.g., circular built environment). Nevertheless, the department clearly defines themes to prioritize in the future, which naturally will have consequences for some themes considered more peripheral. **REBM** is a strong department and carries out research that addresses global issues related to climate change but on a local scale. The department is in an excellent position to combine urban planning/social science/energy and building renovation that could facilitate the transition to a greener community. The research infrastructure necessary to undertake the extensive experimental research seems at least partly to be soon outdated. It would benefit from new investments in which the school could play a stronger role, e.g., through co-funding or taking more responsibility for the research infrastructure, which could benefit other research directions in the school or even at the University level. Though the research outcome is satisfactory and backed up by skilled staff and senior-level researchers, it should be noted that several key senior staff members are close to retirement. The recommended strategy efforts and infrastructure updates should naturally

be carefully aligned with recruiting new senior staff. More broadly, these need also be better linked to School and department-level strategies on future research priorities and directions.

## [IE]

The scope of the **IE** department's activities seems very wide compared to the number of staff, which means that some groups within the department fall below the critical mass for a stimulating research environment. Also, research is conducted only within a few of the subjects hosted in the department, and the coherence between the topics currently is relatively weak. The research infrastructure or equipment seems outdated and may need to be renewed to maintain deep enough research. The department needs to identify common research goals and define future research plans and strategies. The school management should, therefore, dedicate resources to assist with this process to strengthen this field where research and education are in demand from the local, regional, and national industries. To a large degree, the research in **REBM** and **IE** is experimental, and in **REBM**, experimental work coupled with modeling and simulation is a scientifically valid approach. Due to the nature of the research, experimental facilities are less relevant for **MDA**, who may benefit more from strong computing facilities. The research infrastructure has been built up for many years and supplemented with new facilities as opportunities have appeared or as defined by industry needs. The Dalarna Villa is a noteworthy initiative designed by students and funded and constructed by local companies. Also, the facilities anchored in the Materials Technology group address the needs of the industry by providing opportunities for careful testing of material properties. Overall, the experimental activities are a strength for the school, and their use underlines the societal relevance of the research. The experimental infrastructure already seems well developed, but upgrading and further development could increase collaboration with industry and the opportunities to attract external funding.

*3.1.b. How the School's structural organization supports this work. - participation in, for example, networks, academic positions of trust, international partnerships and exchanges along with other contributions to the wider research community, as well as the ability researchers have to be part of such activities.*

University research benefits from strong doctoral education as doctoral thesis work is part of the academic research pursued. The organization's present structure needs to fully benefit from doctoral education for research, which has remained rather modest. The share of senior staff to doctoral students is high (>1), which indicates that there would be enough supervising capacity to increase the number of doctoral students in the future. Moreover, the organization of doctoral education may be better, as it is left to each department to organize, leading each case to an almost subcritical size. Over time, a common Ph.D. school could increase the number of Ph.D. students and cross-fertilize the research across the departments and strengthen the methodological teaching of doctoral students. The university and the school have multidisciplinary profiles that could be strengthened through such a [multidisciplinary] doctoral education [unit] in which the departments can provide the deepening special training complemented by shared more general education to all. Through a stronger organizational structure and profile, doctoral education could also better attract talents from outside the University. The recruitment of the students could also be more systematic, and the school, when acting as a unit, could more easily provide back-up funding to ensure prompt graduation in case of financing bottlenecks on the departmental level. Administrative (non-university) hurdles might exist in recruiting non-EU Ph.D. students that affect the pool of potential Ph.D. candidates in the future. The involvement in external activities such as associate editorships, editorial board memberships, evaluation of research proposals, or memberships of conference organizing committees is concentrated on relatively few senior staff members, who, on the other hand, are committed to several

such tasks. Participation in such activities creates visibility and strengthens international networking, but it is often initiated by invitation. If Schools took the initiative to coordinate some of these activities, junior staff could be more involved, which would help them build networks. Experience shows that participation in committees, etc., is appreciated by management. Still, sometimes, it is also seen as a burden that should be limited due to its use of resources. Compared to other Schools at DU, IIT is successful in attracting external funding, although the desire to expand research calls for a higher influx of external funding. The interviews revealed a strong wish for more administrative support to prepare research proposals. Management should focus on building up such a support function. Also, a further developed experimental infrastructure could increase the school's attractiveness as a partner in international research projects and collaboration with industry.

### **[Summary]**

The school generally documents good research practices and conduct. In two departments (MDA and REBM), activities with reviewing the research strategies are well underway, even though a short time has passed since the reorganization of the University, and the COVID-19 pandemic also caused challenges during that period. Clear visions for the research will support practices and conduct by shifting focus to how to translate the strategy into practice. The strategy formulation also helps to fulfill the overall university strategy of strengthening the research environments and their coherence. **MDA** and **REBM** have adapted their research strategies to meet current trends, although at the expense of a circular built environment that receives considerable focus at other institutions in Scandinavia and abroad. **IE** needs assistance from management to define a viable research strategy that can create coherence between groups within the department and between the departments at the school. This is also important because of the infrastructure needs and the necessary renewal of equipment. This should be prioritized.

## **3.2 Results**

### *3.2a Dissemination*

In general, the school has seen an increasing academic output, but in **IE**, a negative trend must be turned around.

### **[MDA]**

The department has seen an increase in the number of publications, particularly in the number of articles in scientific journals. This supports the idea that the activities in the department are of sufficient quality to be published in peer-reviewed journals. The topics the department covers are on the interface between engineering and economics/social sciences, which implies that some fields need to be more visible in the databases used to generate the statistics. However, the majority of articles received citations. H-indices among senior researchers' range between 6 and 19, which is low on an international scale. The department has the aim of publishing higher-ranking journals.

### **[REBM]**

The department has seen a very positive development in the number of publications, particularly articles published in scientific journals. The department has benefitted from active researchers and an ambitious publication strategy that resulted in many articles in high-ranking peer-reviewed journals, which have been cited well.

## [IE]

Overall, the publication activity of the department fell considerably during the evaluation period. One group delivered the majority of the publications.

IE is under critical mass in personnel, and one of the most experienced and productive senior professors is only working 10% full-time (post-retirement position). IE has no Ph.D. students in Materials Technology at the moment, few doctoral students related to Entrepreneurship and Industrial Engineering and Management, and there is a risk that IE may fade away. The success of the new educational program is vital in its own right and to attract students to DU.

*3.2.b Ongoing research, including current and planned projects, and completed projects that are of continued significance for the school's profile and future aims should be considered.*

## [MDA]

The department participates in research projects with other departments at the school and researchers from different national and international institutions. The seminars held in the department are valuable and essential for the direction of research. Ongoing research aligns well with current trends in developing analysis methods for large data sets. Also, the department has been able to do research in new domains due to recruiting new staff. It is unclear if the school has a strategy for the research direction or if new opportunities are seized when they appear. The department has been able to attract external funding for the research, although the amount and therefore the share of external-to-internal funding varies between years.. Junior staff are involved in preparing proposals that are developed together with senior staff. This supports the continuity of the research and stimulates an inclusive work process. However, the research direction is driven by funding opportunities. This approach is common, but it does not facilitate research strategy.

## [REBM]

The department has clearly defined core themes and areas that will receive particular focus in the future. Also, it embraces emerging topics and aims to discontinue other topics to rationalize resources. Overall, the research strategy for the department is laid out well. The department faces a generation shift but is attentive to the need to let incoming staff have a say in the definition of future research. The department has a clear vision for the research and is inclusive in stimulating the involvement of Ph.D. students in the formulation of research. It is also worth noting that the department is part of a Swedish Center of Excellence, which is positive for the unit's profile and prospects. The department has successfully acquired research funding from external sources, and the success rate is unusually high. The department has seen a positive development regarding external funding and increased submitted proposals. The informal procedure for requesting input to proposals from staff in the department works well.

## [IE]

Ongoing and recently completed projects are mostly anchored in the Materials Technology and Entrepreneurship groups, while the Industrial Engineering and Management groups contributed to projects coordinated by other groups. Since the education program is discontinued and there are no Ph.D. students in Materials Technology (since 2019), the research is done by seniors.. Previous work was mainly experimental and concerned steel forming and surface engineering. These topics were well-anchored in the surrounding industry. A new research strategy has to be developed in

collaboration with the surrounding industry partners. The share of external research funding has decreased from >60% in 2018 to 21% in 2022, which is a concern.

### 3.3 Impact and Professional Relevance

Research impact, as measured by citations of publications, is still moderate but moving in a favorable direction. Some publications reviewed have high international standing, and in some fields, the research is well-known internationally. The school has widespread collaboration with local and regional industries, including industrial PhD students, and receives funding from regional sources. Outreach activities are well-established and involve local, regional, and national institutions and associations. Outreach activities are valuable and support the university's positioning in the community and businesses. The research has achieved societal impact through these channels. The school is also encouraged to better track its social impacts through more systematic metrics, which could strengthen the school's profile.

One of DU's achievements is its strong anchoring in the region, which should be continued despite the explicit aim of increasing international activities to boost external funding. Yet, the school has a relatively vast international network.

## 4. Relationship between research and teaching, including doctoral education



[General]

There have been various attempts to incorporate research into the teaching process since teaching and research are considered core academic activities. It has been demonstrated in the literature that research and teaching contribute to improving students' subject knowledge, critical thinking skills, and problem-solving abilities. Studies have shown that integrating research elements into course teaching promotes students' beliefs about academic research. Educators, academic managers, and policymakers are encouraged to use the results from this literature to strengthen the relationship between academic research and teaching. We noticed that some education programs didn't define their program educational objectives. Program educational objectives are broad statements that describe what graduates are expected to attain within a few years after graduation. Program educational objectives are based on the needs of the program's constituencies and must be consistent with the institution's mission. We noticed the absence of teaching-related research and non-teaching-related activities in the professional development components for the academic staff. In addition to the usual research of the academic staff in their fields, research related to teaching and/or attending a workshop or conference related to teaching, like the IEEE EDUCON conference, will enhance this component. Creating IEEE and other student chapters related to the three profiles will improve the students' research skills through the activities these institutions support. Adding a research component to the bachelor projects might increase the number of publications, book chapters, or conference papers. Master theses must lead to publications. An invited speaker from industry or academia to give a specialized talk at any level will enhance the student's knowledge and research skills.

The School offers 11 educational programs for the academic year 2023-2024: 4 two-year (120 credits), 4 bachelor's, 2 bachelor engineering, 2 one-year master's, 2 two-year master's and 2 doctoral

programs. There is a clear correlation between the courses in the master's and doctoral programs and the titles/keywords of the research outcomes. However, this might be strengthened by the below recommendations.

### [MDA]

The research time allocated for this profile is low. The professors spent an average of 38% of their time on research, junior researchers spent 21%, and Ph.D. students spent 60%. Restructuring some administrative tasks and redistributing the responsibilities might increase the time allocated for research. Several educational programs fostered by the **MDA** department have an **MDA** researcher as a program manager. An essential task of this manager is to keep track of the research components' progress among the students at all levels.

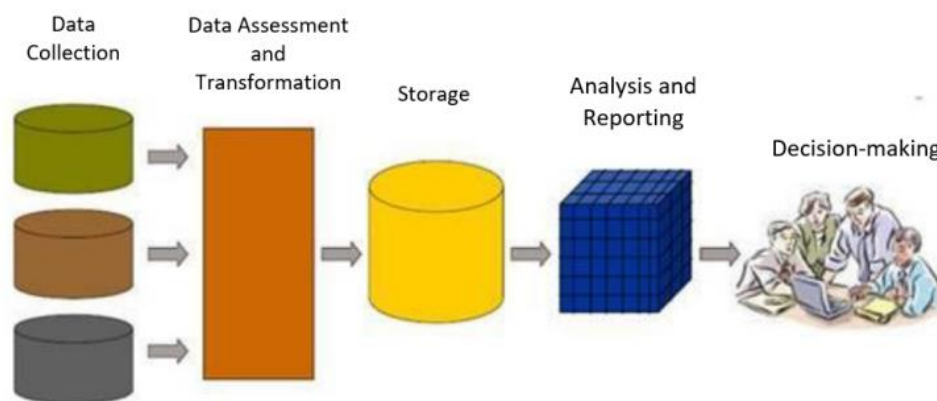


Figure 6: Process of research at MDA

Given that the **MDA** profile defines the research process to follow, as shown in Figure 6, and that it is consistent with the curriculum, we noticed some topics/courses could be added. Hence, more possible research outcomes include NLP, Cloud Computing and Big Data, and Generative AI. Departments can subscribe to AWS Academy for free, so instructors and students can have free access to many courses and cloud computing equipment. We noticed that the profile didn't publish its own created datasets. Such datasets will get many citations.

### [REBM]

Among the features of the **REBM** profile is the opportunity for students to participate in research projects, such as lab tests, model development, IEA tasks, and cost action. Several students have also presented papers at international conferences with their supervisors and attended international conferences. By expanding their thesis work, some students have even published high-quality journal papers with **REBM** colleagues.

### [IE]

We are worrying about the stability and sustainability of this profile. The program develops a promising future plan over the coming five years in the undergraduate, master's, and Ph.D. programs. It is too early to evaluate the outcome of this plan. We see strength in the collaborations between the profile and Tallinn University of Technology, Estonia, and the University of Gävle, Sweden. A prompt plan could be creating a collaboration between the profile and these universities on the other level, maybe a dual program and exchange students using the Erasmus+ program.

## 5. External collaboration and other outreach activities



### 5.1. Collaboration

#### [MDA]

Collaboration is visible in the publications. Typical publications of **MDA** have 3-4 authors. They can be from **MDA**, but about 40 % of the publications are in collaboration with researchers from other Swedish institutions (mainly Uppsala University, Örebro University, University of Gothenburg, and HUI Research). There is also international collaboration, visible by about 44 % of the publications having co-authors from outside Sweden. The aim is to publish with researchers from other institutions and in high-ranking journals. Interestingly, there is the opinion that it is difficult to achieve high scientific impact when the research is transdisciplinary rather than with a certain traditional subject area.

#### [REBM]

Both, **Energy systems in the built environment** and **Energy efficiency in the built environment** are collaborating in their research internally, e.g., with the Department of Data and Information Management, the social and economic research groups, Political Science and Social Anthropology, and the Industrial Engineering and Management group. Additionally, there is collaboration with local industries. Using a developed road map, **REBM** has also shown the ambition to strengthen collaboration with the municipality energy companies.

Topics and scope of collaboration are reflected in Figure 7 from the report.

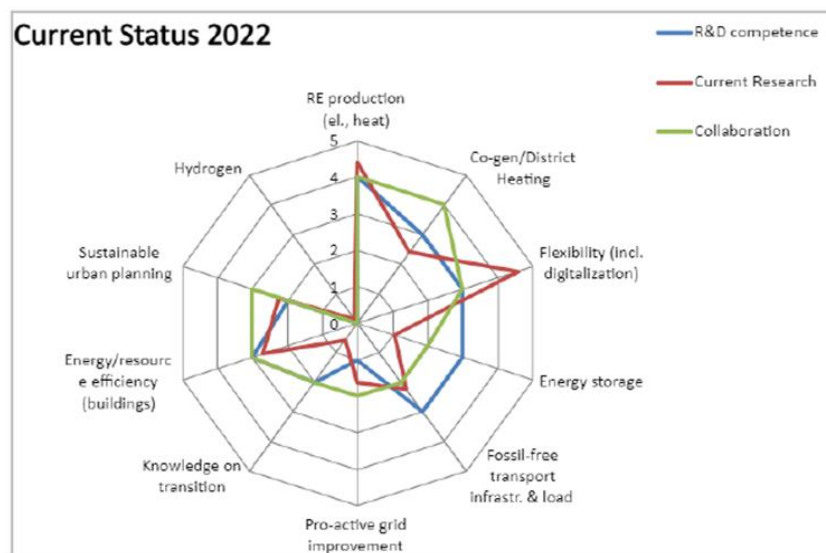


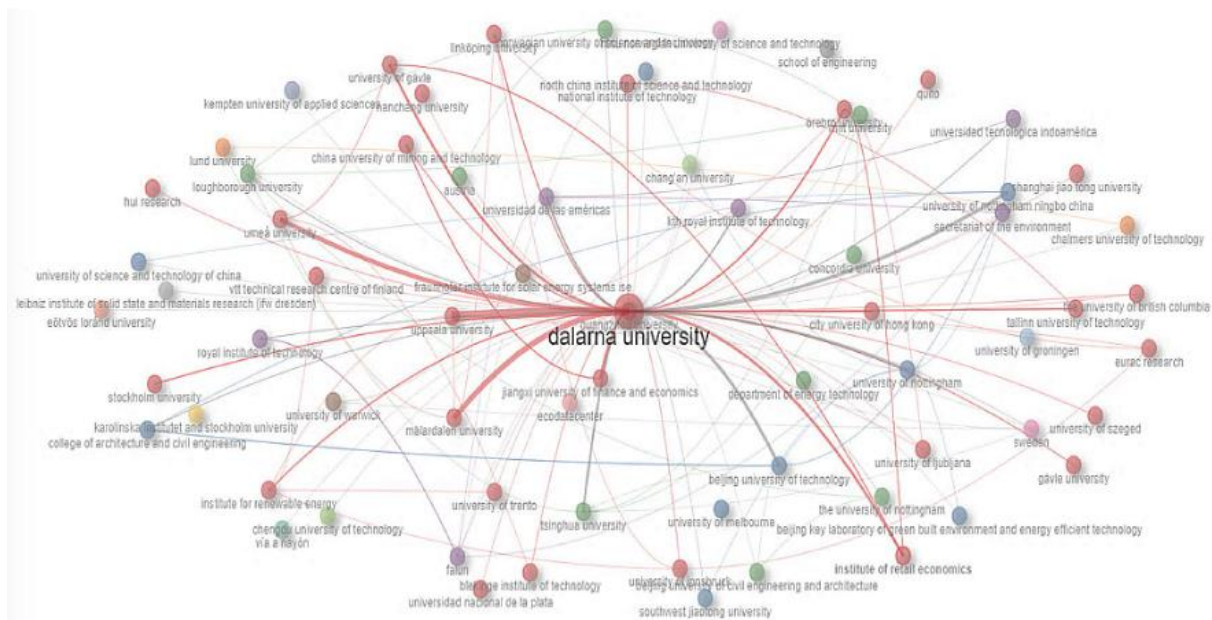
Figure 7: Topics and scope of collaboration at REBM

#### [IE]

Research in **Materials Technology** is traditionally carried out in close cooperation with Swedish manufacturing and steel industries. The topic of **Mechanical Engineering** is covered by only one assistant professor (subcritical). It is then important that the person is well connected in the industry



to attract respective funding and establish collaboration. **Industrial Engineering and Management** (subcritical) has internal collaboration with **REBM**. There is a collaboration with the University in Gävle (PhD project). **Entrepreneurship** (subcritical) should collaborate with local entrepreneurs. However, there is no collaboration mentioned. Cooperation with the other groups within **IE** does not occur due to a lack of common goals. **IE** has many sub-areas which are sub-critical in personnel (only 1 researcher). Collaboration with industry and other research groups depends on personal contacts rather than research competence. Most applications are made in collaboration with researchers from other universities and partners from industry or other organizations. External research collaboration is claimed to play a vital role for the School (Figure 8), the strongest connections are established to Uppsala University, followed by Mälardalen University and Umeå University. There is also a part-time engagement of one researcher at SLU.



**Figure 8 Collaboration network for co-authoring with academic institutions 2018 – 2022 for the whole School of Information and Engineering. (Source DiVA).**

**[Summary]**

Most of the internal collaborations concern mainly the areas of **MDA** and **REBM**. This is also reflected in Fig. 8 of the self-evaluation report. There is collaboration with Swedish industry and other universities (national and international), but this is mainly a matter of personal contact and needs to be strengthened further. With an attractive research profile and the necessary competence in the area (strategy to be developed), researchers at ITE would be recognized. They could get involved in larger national and international research projects/programs.

**5.2. Outreach**

The school is taking part in several outreach activities on a local level (Forskarfredag, Dalarna 24 hr Innovation Challenge 2023). At the department level, **MDA** is disseminating its research via external partners such as industries, the public sector, other universities, and regional organizations. **MDA** has contacts with a wide range of organizations. **REBM** has many local non-academic partners (Dalarna region). Energiinnovation and Energiinnovation 2.0 projects have been major outreach activities in the form of consultancy and in assisting in starting up companies. About 100 companies have

participated in their energy seminars and energy cafes (for industrial partners). This seems to be a major success. Other outreach activities and seminars are also organized and directed toward special interest groups. IE is a member of the Swedish Arena for Additive Manufacturing of Metals and, in that way, is reaching out and collaborating with national universities and companies working with additive manufacturing. Some researchers are engaged in the Academic Industry Meeting (AIM) Day organized by Uppsala University, the Corrosion Awareness Day, and the Swedish Iron and Steel Producers' Association, Jernkontoret. These activities are important as they help to make research/researcher at DU known to academia and industry for establishing contacts for future research activities. In addition, the Materials Technology group collaborates with regional and national companies to offer commissioned training and research.

### [Summary]

Outreach activities are widespread in all three departments. This is an excellent opportunity to strengthen research funding and should be very helpful for acquiring new projects.

### 5.3. Potential for future contract research

All three departments have the potential to do commissioned research. It should be in the interest of the school and the departments to connect to companies and other organizations by providing research expertise. Contract research is partly already done, e.g., by IE.

## 6. Summarizing recommendations and final comments

### 6.1 Summary and Recommendations

- Despite the changes, the research has continued, as documented by the number and quality of the publications and the amount of external funding. We notice the stability of publications output after the new organization of the university.
- The current average ratio (researchers to publications) is low, given that the school has a trendy profile, i.e., **MDA**. It can be improved by developing a profile strategy in addition to the school research strategies. For example, the thesis and bachelor projects might be used to develop conference papers, book chapters, and journal papers.
- We noticed the international collaborations of authors in the publications of level 2. Therefore, we advised increasing international collaborations to keep this standard.
- The reorganization appears to have been successful in that the new organization, with different roles and responsibilities, as well as rules for delegation, etc., are now in place. Nevertheless, we recommend the school to initiate an open discussion with the staff regarding the aftermath of the reorganization (responsibilities, decision paths, etc.).
- The university and/or School has several information and discussion fora - informal and formal. These provide an important platform for the school and the departments to maintain an open dialogue between management and staff as well as between members of staff.
- *Regarding the implementation of research goals and strategies, there is a clear generation shift ongoing at the School, which requires more careful strategic consideration to find a proper balance between renewal and continuity of research.*
- We also note that the *grand vision of the school* is not clearly articulated, which may be explained by the transition and restructuring of the school in recent years. However, it is strongly encouraged to clarify the vision, which will also benefit the whole research

community under the school.

- We recommend seriously considering the *department's research infrastructure* as much of it is outdated, and its maintenance is often a financial burden to the departments and individual groups. This calls for establishing a long-term research infrastructure strategy, including financing, and managing the RI and aligning these efforts with recruiting senior staff and future research directions.
- The school and its departments would benefit from having an *advisory board*, including members from both regional industry and academia and international experts, to advise the management level regularly and assist with formulating research strategies.
- The school has plans to strengthen cooperation through joint publications and partnerships with researchers at other institutions. The school could use different *incentives to enhance such productive partnerships*, e.g., through financial support or other rewards. Non-financial awarding could include stronger recognition of active individuals, teams, or of major achievements.
- More *basic funding* and more transparent principles for dividing resources will positively affect the school. It is recommended, though, that the consequences of the new principles are evaluated to assess whether they lead to the desired goals for the school and the departments.
- There is a *collaboration with Swedish industry and other universities* (national and internationally), but there is still plenty of room to strengthen it further.
- *Outreach activities* are widespread in the departments. This is an excellent opportunity to strengthen research funding and is considered helpful for acquiring new projects.
- All departments have the potential to do commissioned research, and it should be in the interest of the school and the departments to connect to companies and other organizations by providing research expertise. These R&D efforts would benefit considerably from School-level support on grant writing and project management, considering the limited senior research staff pool available.
- Documents specify how much of a full-time position different positions/roles are allocated. This transparency is recommended, but it is equally important to follow up and assess the work situation, particularly for teachers and researchers with multiple responsibilities.
- The staff have different nationalities and varying educational backgrounds with positive effects in terms of, e.g., a widespread international research network.
- Recruitment strategies are in place to recruit lecturers and assistant professors or professors. We recommend that the school develop recruitment strategies also to address gender balance issues (among professors in particular).
- The school has ambitions to grow in terms of researchers through external but also internal recruitment. In relation to the latter, we recommend the school (and the university) to find stronger incentives to encourage teachers without a Ph.D. to achieve one.

## 6.2 SWOT

To guide further the strategic elaborations at School and Department levels based on the evaluation assessment done, the external evaluation committee found it useful to sketch a SWOT-type of matrix with relevant questions for consideration once starting the implementation of evaluation recommendations. The evaluation committee has given its insight to several of these questions shown below in this report. However, from a strategic point of view we found it also useful to turn our key observations into question form as well, also considering the in-house efforts needed in implementing our strategic advice, which needs additional elements which this SWOT-matrix supports.

### Strength:

- What is done well?
- What's unique about the education/research at DU? (What should stay and be supported?)
- Which collaborations can be built on?

**Weakness:**

- What could be improved?
- Is the right/necessary personnel available?
- What resources are needed to improve performance?
- How to increase the attractiveness of education/research (for students; for industry/other research organizations (to increase collaboration)? Many areas are under critical mass in personnel; there is an insufficient number of students.

**Opportunities:**

- What is missing (strategy)?
- What are the goals for the near future and overall vision in the long run?

**Threats:**

- Are there new developments/research directions that must be considered?
- Is the necessary infrastructure (equipment) available? (Diversification vs. research profile; can all research directions be supported?)
- Is the research of interest for (and supported by) local industry and other organizations?
- Low scientific competence among many decision-makers

Committee members' signatures

The image shows five handwritten signatures in blue ink. The first row contains three signatures: 'Seifedine Kadry', a stylized signature that appears to be 'Tun', and 'Jean O. H. H.'. The second row contains two signatures: 'Ab. Alkhoum' and 'Hassan M. H. H.'. The signatures are written in a cursive, flowing style.