Annual report 2025

Strategic Environment Transformative Technologies

Mid Sweden University in partnership with

Knowledge Foundation

Annual report 2025 Strategic Environment Transformative Technologies
Dnr MIUN 2025/964
Photo: Sandra Lee Pettersson

Executive Summary

This report presents the results and status achieved by the end of 2024 in the Research Environment of Transformative Technologies (**TransTech**) at Mid Sweden University (MIUN). Last year marked the end of the three-year Strategic Environment program supported by the Knowledge Foundation. In this report, we will reflect on how well we met the strategic ambitions and goals of the Strategic Environment during 2022—2024 and outline how we will continue the development of **TransTech**.

Focusing on the three strategic ambitions, the outcome of this development period are as follows:

- <u>*A combination of stronger Research Profiles and high scientific impact*</u>: The number of Strategic Actions was reduced from four to three: **NIIT,** characterized by a strong research profile, scientific impact and international collaborations; **NeoPulp,** defined by a strong and unique research profile; and **AMP,** distinguished by highly effective scientific production. In terms of impact, our research is of high quality (H-index and Journal Impact Factor) and is gaining significant international traction through joint publications and funding from international sources. While the total publication volume did not increase, we expect this to change as international collaborations continue to grow.
- <u>*A broader industrial and regional relevance*</u>: Our research collaboration with industry remains strong, and the scope broadens. At the national level, we have joined new large-scale programs and are coordinating joint proposals. **DRIVEN,** a competence development program for professionals, has an increasing number of participants — over 400 to date from across the country. Each of the Strategic Actions has a regional innovation program, with over 200 companies participating in the activities. In the development of **AMP** research, we focused on a few industrially relevant fundamental areas, waiting for the industrial development in the region to clear up.
- <u>*A more dynamic Academic Environment*</u>: The interaction between **TransTech** researchers and international colleagues and students has increased, making the environment noticeably more dynamic. The number of international PhD students and postdocs has doubled, and on average, every researcher and PhD student goes to a research mission every third year. Also, the total number of PhD students has grown. We will move our recruitments even more from professors and associate professor to PhD students, aiming at twice as many PhD students per supervisor (the current average is 1.8). Another priority will be to recruit international MSc students. This together with student engagement in research, is expected to lead to a higher number of MSc degrees. Scientific publications and MSc degrees were the only two significant goals that we did not fully meet in this strategy period.

Our plan moving forward is to update the strategy of **TransTech** and further strengthen the research profile of the university in line with the regional vision *Transforming the Industrial Ecosystem (TIE Vision)*.

Contents

1. Introduction

Reported here are the results and status achieved by the end of 2024 in the Research Environment of Transformative Technologies (TransTech) at Mid Sweden University (MIUN). Last year was the last year in the 3-year program for a Strategic Environment that the Knowledge Foundation granted MIUN after the preceding 10-year program of Knowledge and Competence Centre. The aim of these programs is to continue to strengthen a research profile for the university in line with the regional vision *Transforming the Industrial Ecosystem (TIE Vision)*. The most important instrument in the Strategic Environment program were two Strategic Initiatives that we planned and started.

The plan for the current development phase of TransTech was presented in the Transformative Technologies Strategy 2022–2024 and implemented in continuous dialogue with the Knowledge Foundation. This report compares our achievements with the goals and ambitions of the strategy and outlines the development actions that we plan to undertake next. Chapter 2 concentrates on the strategically important development efforts during 2024 and the resulting fulfilment of the strategy. Chapter 3 reports the status reached in our quantitative progress indicators, and Chapter 4 the planned next steps of our development work. The organisation of TransTech and all progress indicators can be found in the Appendixes.

We develop our research program with the help of Strategic Actions. They define the focus of our research profile and our intentions for its strategic development. Since 2023, we have consolidated our research into three Strategic Actions, rather than the previous four:

- **NIIT:** Internet of Things enabling AI-models with sensor data
- **NeoPulp:** New technology for pulping and new cellulosic materials
- **AMP:** Advanced materials and processes

The first two Strategic Actions derive their acronyms from the Knowledge Foundation Research Profiles that form their core, and the third from the industrial needs for new competence that we want to match. Figure 1 shows the scientific composition and organisational position of the Strategic Actions.

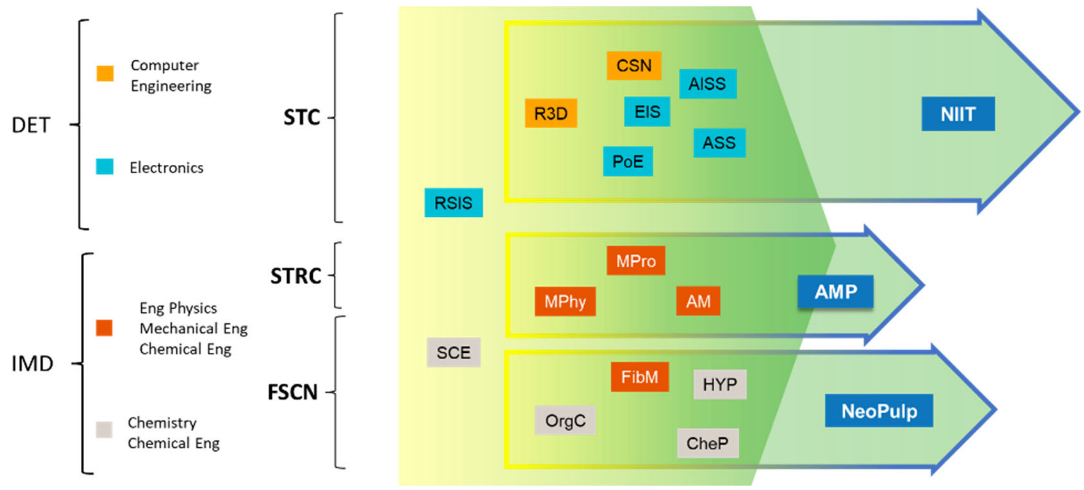


***Figure 1:** Each Strategic Action consists of several Research Groups, here represented by acronyms and colours for scientific disciplines, and belongs to one Research Centre (STC, STRC or FSCN), which in turn belong to one of two Departments, DET or IMD. The acronyms are defined in Fig. 2.*

Please note that for the purpose of clarity, we write the acronyms of Research Actions and Strategic Initiatives **in bold**, key concepts with Capital Initials, and goals with <u>*italics and underlining*</u>.

2. Implementation of Strategy

In this Chapter, we explain the development work carried out during 2024 in five development areas: Internationalization, National collaborations, Degree programs, the Academic Environment, and the Quality System. The main actions in 2024 followed the 6-point Action Plan in Appendix E.

Internationalisation

- Stage 1 of the Strategic Initiative **IRS TransTech** (Action #5 in Action Plan 2023—2024) started in 1 September 2023 with 8 students and Stage 2 is planned to start 1 April 2025 with another 8 students. The purpose is to deepen our interaction with selected international strategic partner universities through more activities and greater involvement from researchers on both sides. With Stage 2, **IRS TransTech** covers all our Strategic Actions **NIIT**, **NeoPulp** and **AMP**.
- The Strategic Initiative **TransTech2Horizon** (#1 in Action Plan) started in summer 2024. The purpose is to establish a repeatable process that supports the career development of researchers and results in new EU-project proposals. The first phase of **TransTech2Horizon** will result in three new EU-proposals in 2025–26.
- We submitted twenty-nine applications for international collaboration projects in 2024, a ten-fold increase from 2021 before the current strategy period started. The increase was primarily driven by **NIIT** and resulted in an increase of TransTech's international funding from approximately SEK 3 million in 2021 to almost SEK 16 million already secured for 2025.
- MIUN/**NeoPulp** organized the 2024 International Mechanical Pulping Conference (140 participants) and was granted the organization of the international Progress in Paper Physics Seminar in May 2025 (100 participants expected) and the Annual Conference of EPNOE (European Polysaccharide Network of Excellence) in August 2025 (400 participants expected).
- As a part of MIUN's goal to develop collaborations with India, **AMP** established contacts with MIT-World Peace University, Pune and Shivai University, Kolhapur.

National collaborations and position

Our strategic plan was to build more collaborations with universities, including those in Sweden, for a stronger academic position and production on one hand, and with more companies and RISE for further enhanced relevance of our research on the other. Equally important is that a robust funding base depends on broad national collaborations. During 2024, we coordinated or took part in the following national and regional initiatives:

- We have entered new areas of national collaboration. Emission-Free Pulping is a 5-year collaboration of six companies and eight universities from Sweden and Finland (including MIUN), and one company from Chile, aiming to transform chemical pulping. Mission 0 House to decarbonise automotive manufacturing is another 5-year national program where **NeoPulp** participates.
- The Additive Manufacturing Group of **AMP** has joined AM4Life, a 5-year competence centre with 37 national and international partners, hosted by Uppsala University. **AMP** continued also in the Chalmers-coordinated platform SIO Grafen and the partnership with Uppsala University in battery materials. **NeoPulp** continued to take part in the Forest Industry National Research Agenda, Treesearch and Wallenberg Wood Science Centre.

- **NIIT** and **NeoPulp** joined forces to coordinate a national proposal **Dig4CREW**[1] to Vinnova's program on Advanced Digitalisation which can lead to a 6-year, 120 MSEK program.
- TransTech's large regional innovation programs **DIGIT** and **HIPS** (SEK 70 million each, in **NIIT** and **NeoPulp**, respectively) continued to attract more industrial interest, bringing the total in **DIGIT** to a 27 formal project partners and 140 other companies participating in **DIGIT** activities. **HIPS** has 15 partner companies and 52 other companies participating in activities. **IMPHET**, a new regional project in **AMP** has 5.
- On the other hand, industrial investments in battery materials in our region and Sweden experienced some setbacks (Northvolt, PTL) while those in hydrogen-based synthetic fuels went forward. As a result, we slowed down the profiling of the **AMP** area (#2 in Action Plan) and instead identified a few scientific areas that can be of importance for the new industries in our region (Appendix G). Nevertheless, last year **AMP** won new projects worth of SEK 29 million in national funding, up from 0.9 million in 2023. Decision on a new Knowledge Foundation Synergy application is expected in May 2025.

Academic Environment

A more dynamic Academic Environment is one of the three ambitions in our Strategy, focusing on our personnel. We pursued this ambition by supporting the interaction and mobility of researchers and students in and out, supporting career development, and recruiting more graduate students. Among other things, last year this consisted of the following actions in accordance with our Action Plan 2022—2024 (Appendix E):

- Implementation of a systematic approach to the career development of early-career researchers (#6 in Action Plan)
- Promotion of one full professor and two associate professors
- Start of a seminar series in **TransTech2Horizon** (#1 in Action Plan) to help international careers
- Opening of the training program for early-career researchers in co-production to all areas of TransTech (#3 in Action Plan)
- Implementation of a process for efficient recruitment and entry of new researchers (#4 in Action Plan)
- Recruitment of two new international associate professors and twenty international graduate students, the latter in part a result of Stage 1 of **IRS TransTech** (# 5 in Action Plan).
- The total number of international students and postdocs increased to 60 last year, up from 23 in 2021.
- Eight of TransTech's researchers received funding from the faculty program for international mobility

During the strategy period, we simplified our organisation, making it more efficient. The positions of our Research Groups in the Strategic Actions, Research Centres and Departments are shown in Fig. 2. The changes also made our research more consolidated. The number of Strategic Actions went from four to three. Two groups (**RSIS** from STC and **SCE** from FSCN) have strong collaborations between Strategic Actions. In 2024, two **AMP** groups were merged into one, and one of **NIIT's** groups was dissolved as the group leader retired.

[1] Digital strategi för resurseffektivitet i kemikalie-, råvaru-, energi- och vattenflöden

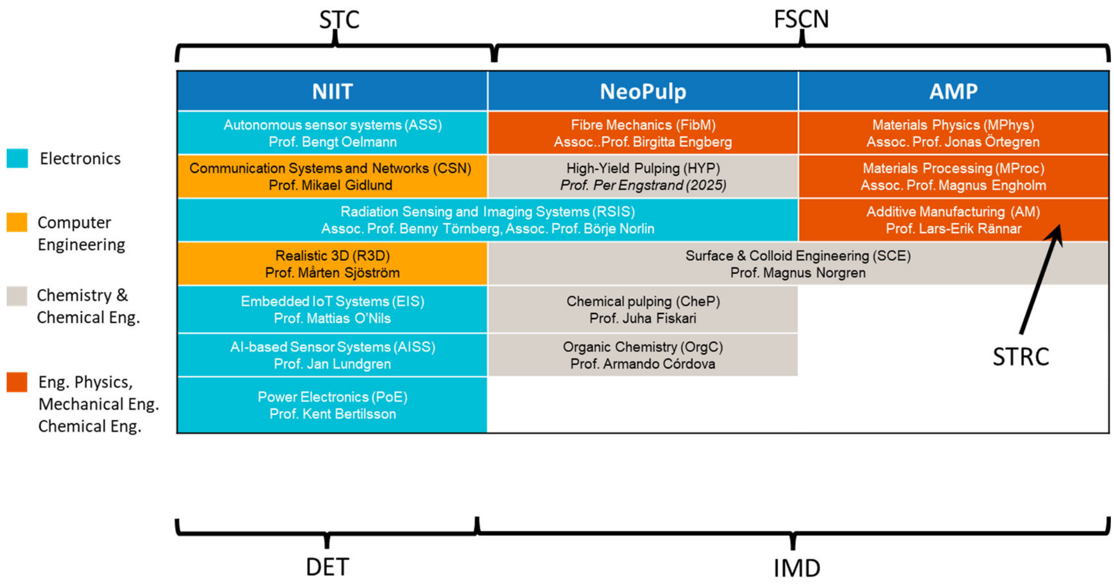


Figure 2: *TransTech's Research Groups in relation to the Strategic Actions (**NIIT, NeoPulp** and **AMP**), the Research Centres (STC, FSCN and STRC) and Departments (**DET** and **IMD**, explained above). Closely related scientific disciplines are indicated by the colour codes. One of the group leaders will retire in 2025.*

Degree programs

Degree programs account for half of the work done by TransTech's personnel and increasingly form a source for the recruitment of graduate students. The development of our second-cycle programs during the strategy period 2022—2024 is summarised in Table 1. It includes two new programs: the Erasmus Mundus Joint Master's program **EMJM in Imaging** and a Master's programme in Additive Manufacturing. We also have master-level courses in the project **Driven**.

Table 1. *Development of our second-cycle programs arranged by scientific discipline.*

Scientific discipline and Department	Programs running 2024	Start of research connection	Start of new programs since 2021
Computer Engineering, **DET**	5-year engineering degree program Master by Research Two 2-year Master programs **Driven, EMJM in Imaging**	With **NIIT** before TransTech	**Driven** courses 2022—2026 **EMJM in Imaging** 2024 New track for **EMJM** 2025
Electrical Engineering, **DET**	5-year engineering degree program Master by Research 2-year Master program **Driven**		**Driven** courses 2022—2026
Engineering Chemistry, **IMD**	5-year engineering degree program Master by Research 2-year Master program **Driven**	With **NeoPulp** 2015	Joint degree program with KTH 2021 **Driven** courses 2022—2026 Student exchange with NTNU 2024 International Master 2026
Engineering Physics, **IMD**	5-year engineering degree program Master by Research	With **AMP** 2018	International Master 2025
Mechanical Engineering, **IMD**	5-year engineering degree program Two alternatives of Master in Additive Manufacturing	With **NeoPulp** 2021, with **AMP** 2023	Master in Additive Manuf. 2023

Synergies between the Research Profile **NeoPulp** and the 5-year programs in Engineering Chemistry and Technical Design increased last year with more student projects in **NeoPulp**. The one-year Master programs in Additive Manufacturing, including one for working professionals have significant synergies with the Engineering Physics program and help in the consolidation of **AMP** research. An international Master's program in Engineering Physics is being prepared to launch in 2025.

The programs in Computer Engineering and Electrical Engineering were running prior to the establishment of TransTech but were updated during its course. Both the 5-year Master's and Master's program in Computer Engineering have two profiles, *Intelligent Systems and Networks* and *Visual AI,* which are closely linked to the research groups. Similarly, the Master's program in Electrical Engineering offers profiles in *Autonomous Sensors, Power Electronics, Smart Cameras, Detector and Measurement Systems*, and *Intelligent systems*. The new Erasmus Mundus Joint Master's Program **EMJM in Imaging** was launched last year with Politecnico Milano, and Tampere University will offer a second track starting in the autumn of 2025.

To increase the share of students taking the exam, we continued to invest in new laboratory instrumentation that can be used both in the Mechanical Engineering and Engineering Chemistry programs and research. In Engineering Chemistry, we agreed with NTNU that we will both market our programs to local students and accept transferring students both ways.

In the Expert Competence program **Driven** the goal is to support industrial competence in IoT and AI (from **NIIT**) in bio-based industrial processes (from **NeoPulp**). So far 23 **Driven** courses have been given to 442 participants.

Quality System and Management

In accordance with the agreement with the Knowledge Foundation, TransTech's management structure has been formally established through a decision by the Vice-Chancellor of Mid Sweden University. Hans-Erik Nilsson has been appointed as Project Manager for TransTech by the Vice-Chancellor. This role encompasses 20% of a full-time position and is funded by the Faculty of Science, Technology, and Media. The current assignment is in effect until June 30, 2026, as per the Dean's decision.

TransTech's management structure consists of three components: an operational Management Group, a scientific and industrial Reference Group, and a Steering Group. The purpose of this structure is to ensure that the strategic development of the research environment continues in line with the objectives set out in the long-term Strategic Initiatives (**IRS TransTech** and **TransTech2Horizon**) approved by the Knowledge Foundation.

Since the start of the Knowledge Foundation environment in 2012, Mid Sweden University has maintained a Vice-Chancellor decision mandating external peer review of applications submitted to the Knowledge Foundation. Although the Knowledge Foundation environment formally ended on December 31, 2021, the decision was extended to cover the entire period of the Strategic Environment, until December 31, 2024. The original aim—to ensure the scientific quality of applications and to strengthen their alignment with the funder's strategic goals—remains a key priority for the faculty. A new decision regarding the continued external review of Knowledge Foundation applications is currently being prepared. The quality assurance process with external review of applications and final reports for major research projects will continue as before.

Changes and deviations in ongoing projects

Most changes in ongoing Knowledge Foundation-funded projects during 2024 were minor in nature and did not affect the objectives or deliverables agreed with the Knowledge Foundation. Typical adjustments include the reallocation of funds between budget items. They are made by the project managers in direct communication with the Knowledge Foundation.

The only significant change concerned an extension of recruitment project **MechEx — Professor i Maskinteknik med inriktning mot experimentell mekanik** (KKS 20210053). The project requested an extension by two years which was granted by the Knowledge Foundation. The new project end date is July 31, 2028.

3. Quantitative results

This section reports on and discusses the results reached during 2024. The values of all our indicators can be found in Appendix C. In the next Chapter 4, we compare the results we achieved to the goals and ambitions of our Strategy 2022—2024.

Significant research results achieved in 2024

Since we want to improve our scientific impact and production, we also want to give credit to important research results. Here are some highlights from last year:

- First known demonstration of electron beam powder bed fusion (PBF-EB) processing of functionalized ceramic Al_2O_3 powder, paving the way for the manufacturing of pure ceramic parts using PBF-EB.[2]
- A demonstration of how laser processing can improve graphite anode material to significantly enhance the storage capacity in Li-ion batteries.[3]
- Ultrapure Aluminum and Aluminum containing 1wt% iron show negligible differences in electrochemical plating/stripping behavior, thus indicating that an aluminum-iron alloy could serve as an efficient and cheap alternative as anode in aluminum batteries.[4]
- Cellulose II's crystallographic, triboelectric, and micro-mechanical properties could be systematically controlled by changing the hydrophobicity in the coagulation bath.[5]
- The combination of lignin microparticles and retention aids, together with hot-pressing, was evaluated for chemi-thermomechanical pulp (CTMP) as a potential application in packaging materials.[6]
- Transparent, plastic-like cellulose materials suitable for 3D-shaping could be manufactured by stacking regenerated cellulose sheets that were self-gluing under heat and pressure.[7]
- Correlations between paper properties and fibre curl were identified, enabling enhanced testing routines for hand sheet paper.[8]

[2] Sjöström W, Botero C, Jiménez-Piqué E. Melting ceramic Al2O3 powder by electron beam powder bed fusion. Springer; . Progress in Additive Manufacturing. 2024;9:1523-1535.
3 Bond, L., Andersson, H., Hummelgård, M., & Engholm, M. (2024). Laser-formed nanoporous graphite anodes for enhanced lithium-ion battery performance. Applied Physics Letters, 125(18).
4 Razaz, G., Weißensteiner, I., Örtegren, J., Trink, B., Pogatscher,S., & Arshadi Rastabi, S. (2024). Impact of Surface Microstructure and Properties of Aluminum Electrodes on the Plating/Stripping Behavior of Aluminum-Based Batteries Using Imidazolium-Based Electrolyte. ACS Applied Materials and Interfaces, 16(47), 65725-65736.
5 Dahlström, C., Eivazi, A., Nejström, M., Zhang, R., Pettersson, T., Iftikhar, H., Rojas, O., Medronho, B., & Norgren, M. (2024). Regenerated cellulose properties tailored for optimized triboelectric output and the effect of counter-tribolayers. Cellulose, 31(4), 2047-2061.
6 Sanchez-Salvador, J. L., Pettersson, G., Mattsson, A., Blanco, A., Engstrand, P., & Negro, C. (2024). Extending the limits of using chemithermomechanical pulp by combining lignin microparticles and hot-pressing technology. Cellulose, 31(15), 9335-9348.
7 Dahlström, C., Duan, R., Eivazi, A., Magalhães, S., Alves, L., Engholm, M., Svanedal, I., Edlund, H., Medronho, B., & Norgren, M. (2024). Stacking self-gluing cellulose II films: A facile strategy for the formation of novel all-cellulose laminates. Carbohydrate Polymers, 344, 122523.
8 Ferritsius, R., Sandberg, C., Rundlöf, M., Ferritsius, O., Daniel, G., Engberg, B. A. & Nilsson, F. (2024). Development of fibre properties in mill scale: High-and low consistency refining of thermomechanical pulp (part 2) - Importance of fibre curl. Nordic Pulp & Paper Research Journal, 39(4), 575-585.

- Machine learning techniques were applied to enhance image analysis software for optical fibre analysers, designed to evaluate fibre distributions in pulp samples.[9]
- The first use of betulin for functionalization and hydrophobization of paper and cellulosic materials in water.[10]
- Sub-ppb H_2S detection using a screen-printed ZnO/SnO_2 sensor with an optimized SnO_2/ZnO (3:4) composition achieving a 0.14 ppb detection limit at 325 °C, offering high precision for environmental and industrial applications.[11]
- New methods for integrating cellulose nanofibers with sustainable polyesters through reactive extrusion.[12]
- Comprehensive review, classification and synthesis of deep learning-based data fusion methods, covering various architectures, applications, and challenges across domains such as industry, IoT, and autonomous systems.[13]
- Development of a high-sensitivity, wide-bandwidth spectral imaging system for multiple K-edge imaging, enabling improved material characterization with potential applications in medical and industrial X-ray imaging.[14]
- BASICS: A broad quality assessment framework for static point clouds in compression scenarios. The work provides insights into perceptual quality degradation caused by compression, supporting better design of future point cloud codecs.[15]
- Design and demonstration of a circularly polarized, dual-band, wearable screen-printed MIMO antenna integrated with an artificial magnetic conductor (AMC) for Wireless Body Area Networks (WBAN). The antenna improves signal quality and supports wearable communication systems.[16]
- Introduction of a contextual knowledge-informed deep domain generalization method for bearing fault diagnosis. The method enhances model robustness to unseen operational conditions by incorporating domain knowledge into deep learning.[17]
- Further study of 6G communication techniques, specifically analyzing statistical channel distribution and effective capacity of STAR-RIS-assisted BAC-NOMA systems, confirming energy-efficiency and capacity improvements under various network conditions.[18]
- Automated design methodology for ortho-planar spring structures for vibration energy harvesting. The proposed method improves the design of energy harvesters for self-powered sensors, especially in industrial environments.[19]

[9] Lindström, S. B., Persson, J., Ferritsius, R., Ferritsius, O., & Engberg, B. A. (2024). Multivariate lognormal mixture for pulp particle characterization. Cellulose, 31(3), 1843-1854.
[10] Rafi, A. A., Deiana, L., Alimohammadzadeh, R., Engstrand, P., Granfeldt, T., Nyström, S. K., & Cordova, A. (2024). Birch-Bark-Inspired Synergistic Fabrication of High-Performance Cellulosic Materials. ACS Sustainable Resource Management, 1(12), 2554-2563.
[11] Akbari-Saatlu, M., Heidari, M., Mattsson, C., Zhang, R., & Thungström, G. (2024). Sub-ppb H_2S Sensing with Screen-Printed Porous ZnO/SnO_2 Nanocomposite. Nanomaterials, 14(21), 1725.
[12] Avella, A., Rafi, A. A., Deiana, L., Mincheva, R., Córdova, A., & Lo Re, G. (2024). Organo-Mediated Ring-Opening Polymerization of Ethylene Brassylate from Cellulose Nanofibrils in Reactive Extrusion. ACS Sustainable Chemistry & Engineering, 12(29), 10727-10738.
[13] Hussain, M. , O'Nils, M. , Lundgren, J. & Seyed Jalaleddin, M. (2024). A Comprehensive Review On Deep Learning-Based Data Fusion. IEEE Access, vol. 12, pp. 180093-180124.
[14] Perion, P. , Brombal, L. , Delogu, P. , di Trapani, V. , Menk, R. H. , Oliva, P. & Arfelli, F. (2024). A high sensitivity wide bandwidth spectral system for multiple K-edge imaging. Journal of Physics D, vol. 57: 35
[15] Ak, A. , Zerman, E. , Quach, M. , Chetouani, A. , Smolic, A. , Valenzise, G. & Le Callet, P. (2024). BASICS: Broad Quality Assessment of Static Point Clouds in a Compression Scenario. IEEE transactions on multimedia, vol. 26, pp. 6730-6742.
[16] Arulmurugan, S. , Kumar, S. T. R. , Sidén, J. & Alex, Z. C. (2024). Circular Polarized Dual-Band Wearable Screen-Printed MIMO Antenna Integrated With AMC for WBAN Communications. IEEE Open Journal of Antennas and Propagation, vol. 5: 6, pp. 1805-1814.
[17] Lundström, A., O'Nils, M. & Qureshi, F. Z. (2024). Contextual knowledge-informed deep domain generalization for bearing fault diagnosis. IEEE Access, vol. 12, pp. 196842-196854.
[18] Basharat, S. , Hassan, S. A. , Jung, H. , Mahmood, A. , Ding, Z. & Gidlund, M. (2024). On the Statistical Channel Distribution and Effective Capacity Analysis of STAR-RIS-Assisted BAC-NOMA Systems. IEEE Transactions on Wireless Communications, vol. 23: 5, pp. 4675-4690.
[19] Phan, T. , Xu, Y. , Kanoun, O. , Oelmann, B. & Bader, S. (2024). Automated Ortho- Planar Spring Design for Vibration Energy Harvesters. In 2024 Proceedings of the IEEE Sensors Applications Symposium, SAS 2024 -.

Scientific impact and production (Indicators 2a, 2b)

We have set targets for the impact and production volume of our research (cf. Appendix B). For the impact, we follow the mean impact factor of the journals where we published and the 5-year H-index of our publications (this time for 2020–2024). The earlier strong progress (Fig. 3a) levelled off but the values, Impact Factor = 5.42 and H-index 39 still meet the goals set for 2024, 5.5 and 33, respectively. Although journal impact factors have generally increased, our analysis shows that the biggest increase was between 2013–19, i.e. before the growth at TransTech started. The most likely explanation for the drop in our Impact Factor last year is the increase of the share of conference publications from 31—32% in 2022 and 2023 to 38% last year. Appendix A lists the 39 most cited publications. Of these, **AMP** and **NIIT**, accounted for ca. 40% each and **NeoPulp** for 8%.

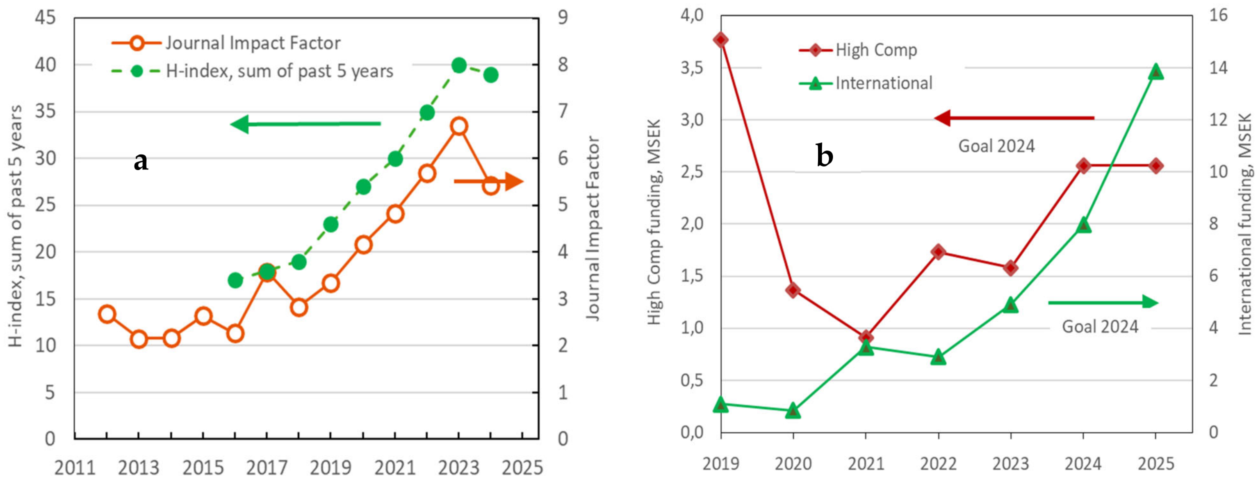


Figure 3(a): *Journal Impact Factor and H-index of TransTech's publications.* ***(b):*** *funding (in million SEK) granted by high-competition and international sources. For each year, the H-index comes from our publications in the five years ending in that period and the journal impact from our publications the previous year. Arrows indicate our goals for 2024.*

Appendix A gives our most cited publications of 2020—2024 that gave the H-index = 39 last year. Of these, **AMP** and **NIIT**, accounted for 40% each and **NeoPulp** for 8%. The mean value of person-years used in research (= FTE) during 2022—2024 gives a rough estimate of the corresponding resources: 48 for **NIIT**, 22.4 for **AMP** and 24.5 for **NeoPulp**. The relative differences are at least in part connected to global publication volumes in the respective focus areas of research, from Internet of Things and new materials in **NIIT** and **AMP**, to pulp fibres in **NeoPulp**.

Our progress in scientific quality is also evident in MIUN's comparisons with other Swedish universities, Fig. 4. Since TransTech includes all engineering research at MIUN, this comparison implies that TransTech had the same share of high-impact publications as KTH and Chalmers.

Figure 4. *Ranking of Swedish universities in the share of highly-cited engineering publications where TransTech represents MIUN. Diagram prepared at MIUN from Research Barometer 2023 (Forskningsbarometern 2023) of the Swedish Science Foundation.*

We also measure scientific impact indirectly through the funding granted by high-competition sources such as Swedish research councils (Fig. 3b). The volume has increased almost monotonically since 2021 and the volume 2.6 MSEK in 2024 was close to our target of 3 MSEK/a. International funding offers another positive perspective on how our peers assess our potential to make an impact. The improvement has been strong, much because of our systematic efforts to increase international collaborations.

The volume of our scientific production is shown in Fig. 5 (total publication volume and academic degrees), and Fig. 6 (publications per Strategic Action). Our total publication volume has grown in 2023 and 2024 but still has not exceeded the initial level of 150 publications we had in 2011—12. The goal in our strategy was 200 publications in 2024. A partial explanation for the difference is that we have emphasized quality (Fig. 3a) instead of quantity (Fig. 5). The significant improvement of the impact factor shows that we are submitting papers to more prestigious journals than before. Another contributing factor is that we examined only one doctoral degree and two licentiate degrees last year. These numbers are bound to start increasing again since many new graduate students have started and will start in **IRS TransTech** and MIUN's own funding program. We had a total of 50 MIUN and industry employed doctoral students in 2021, and 62 in 2024 (Figs. 8 and 12 below). In MSc degrees, we managed to stop the decline but were not able to reverse the trend.

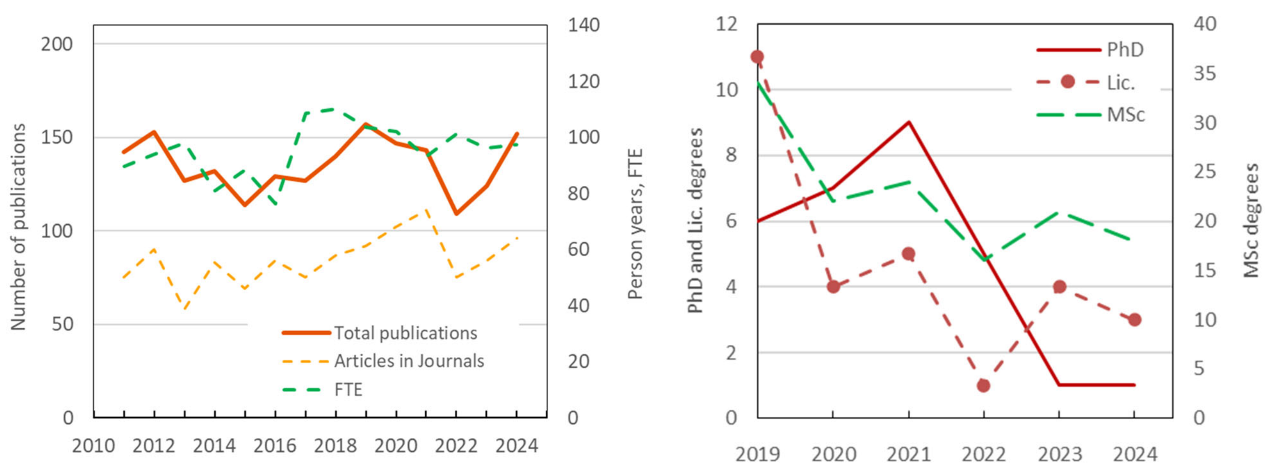


Figure 5. *On the left, the number of peer-reviewed publications from TransTech and person-years used in research (= FTE). On the right, the number of doctoral, licentiate and master's degrees awarded.*

The publication volumes of Strategic Actions are shown in Fig. 6. The corresponding productivities of **NIIT**, **NeoPulp** and **AMP** relative to the time spent in research one year earlier are similar, as shown by the dashed green lines that give 1.5 x FTE. Thus, we have not yet seen the expected improvement of productivity that should follow from the increase of international collaborations, reported next.

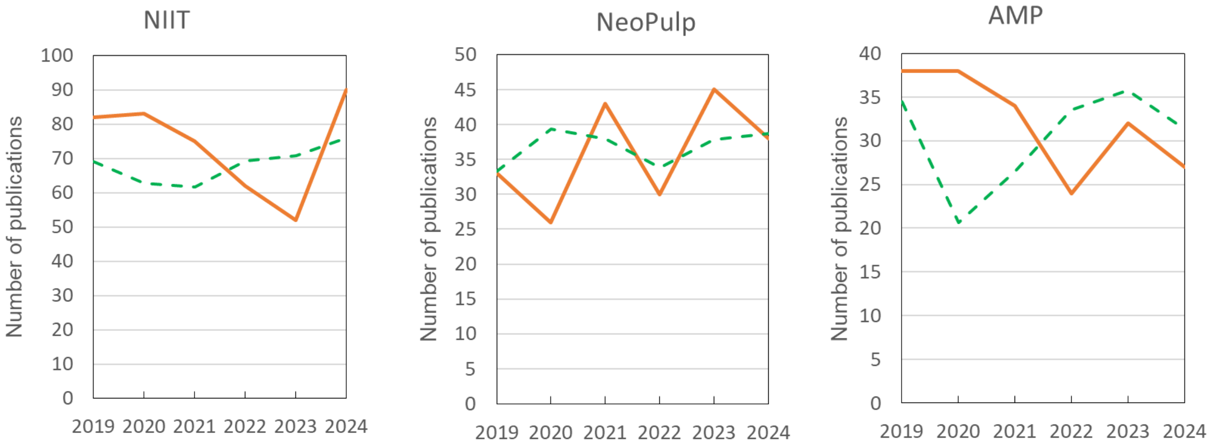


Figure 6*. Publication volumes (peer-reviewed only) in the Strategic Actions, solid red lines. The green dashed lines show the expected mean level of 1.5 publications per FTE that roughly agrees with TransTech's total publication volume in Fig. 5.*

International collaborations (Indicator 4a)

Figure 7a shows three aspects of our international collaborations that complement the rapid growth of international funding in Fig. 3b. The number of joint publications with international partners grew last year to 106, i.e. above our goal of 90. Thus, already two-thirds of our publications come from international collaborations. At the same time, the number of joint projects and guest researchers decreased, the latter only slightly. The contrast reflects a shift in the projects from networking activities to collaborative research – a positive change despite the deviation from our strategy. This is also seen in the volume of projects that received funding from international sources, shown in Fig. 7b. In all three Strategic Actions the mean funding per year of such projects increased clearly after 2022, to SEK 1 million. During the entire strategy period 2022—2024, **NIIT** accounted for two-thirds of TransTech's international projects, both those with international funding (6 out of 9 projects in 2024) and those with international partners (15 out of 22).

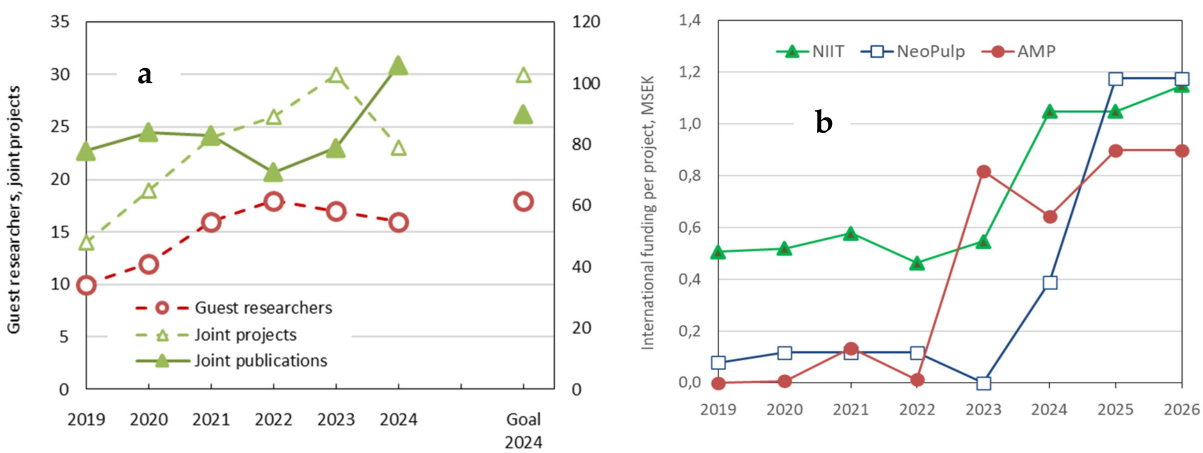


Figure 7. (a) *International collaborations: on the left axis, the number of joint projects and guest researchers (professors and others with a PhD degree); on the right axis, the number of publications with international co-authors.* ***IRS TransTech*** *is counted as one project.* ***(b)*** *International funding as the average per project in* ***NIIT, NeoPulp*** *and* ***AMP.***

The number of international missions in 2024 was 12 inward and 16 outward missions (Appendix C, Indicator 4). Although well below our goal of 60 – and the pre-pandemic number 51 in 2019 – the result is reasonably good. On average, it corresponds to each PhD student and researcher (not professor or associate professor) going on a mission every third year. We also observe that our international publications (Fig. 7a) and, especially, funding (Fig. 3b) have grown significantly since 2019, despite the drop in international missions. Clearly, research missions are not critical for the development of our scientific production. The same is true for international guest researchers (also in Indicator 4), whose numbers have been almost constant at 16—18 during the same period.

One takeaway for the next strategy would be to focus the indicators of internationalisation on funding and production (joint publications and examinations). Guest researchers and research missions are important for the academic environment and career development of researchers, and it is appropriate to consider them in that context.

National partnerships and co-production (Indicators 3 b–d)

Industrial collaborations have always been the strongest side of our national partnerships. As Fig. 8 shows, we are now very close to our goal of 100 partner companies in our projects, as targeted in our strategy, and main 20–30 MSEK in-kind funding. When compiling this report, we realised that we had likely missed part of our partners of 2023. The number of industrial graduate students grew by almost a half in the five-year period of 2019–2024 but further growth is unlikely for a while since the industrial graduate school **FORIC** ended, and **SMART** will end 2026. Instead of an industrial graduate school, we have put our efforts into the international graduate school **IRS TransTech** where companies are involved but do not have their employees as students.

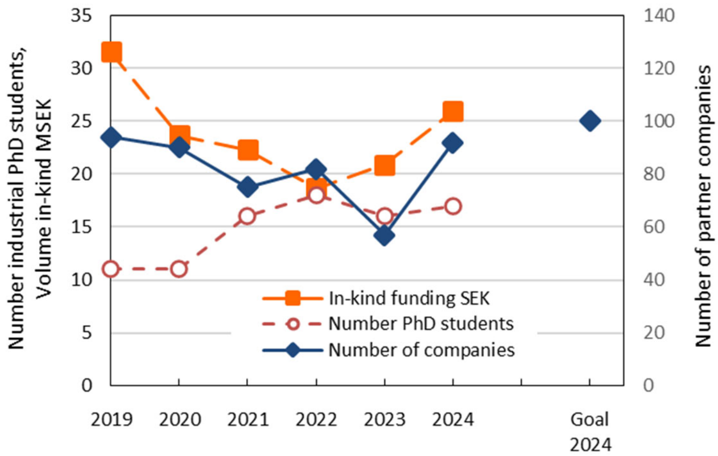


Figure 8: *Industry collaborations: number of partner companies (on the right axis); industrial doctoral students and in-kind funding from the companies (on the left axis). From Indicator 3b.*

Despite our goals and efforts for more collaboration with Swedish institutes and universities, the numbers of joint projects showed little improvement (Fig. 9a). Our interpretation is that universities and institutes lack incentives for joint projects except when such are specifically targeted in funding calls to nationally important areas. Examples of this are Advanced Digitalisation and Mission 0 House, both of which we participate in or have submitted applications to. Furthermore, just as for international collaborations, the number of national collaborations is not crucial. The annual volume of the projects with Swedish universities and institutes has been quite stable since 2022 (Fig. 9b). In other words, the larger volume of the projects has compensated their smaller numbers. Similar change occurred in the projects in which industry participates. From 2023 to 2024, the mean size of projects grew by 22%, while the number of projects decreased by 28%.

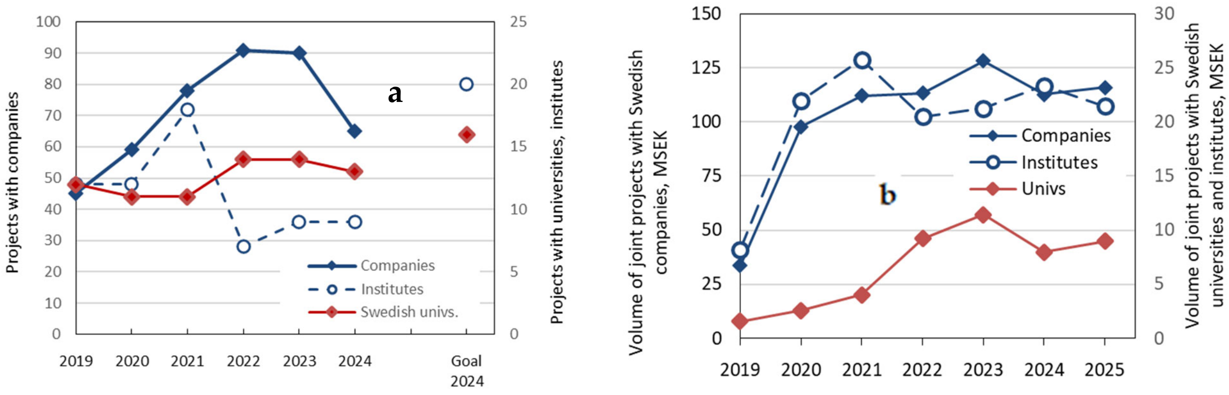


Figure 9. ***(a)*** *Number of projects with national partners; companies on the left axis, institutes and Swedish universities on the right axis. From Indicator 3c.* ***(b)*** *Total volume of projects with companies, institutes and universities*

Finally, Fig. 10 compares academic and other national collaborations (institutes, industry etc.) in terms of joint publications. The earlier declining trend continued in academic joint publications. With 7 such publications last year we fell far below our goal of 20 publications per year. We had six times as many publications with other national partners (43, cf. Fig. 10) and fifteen times as many with international partners (106, Fig. 7a).

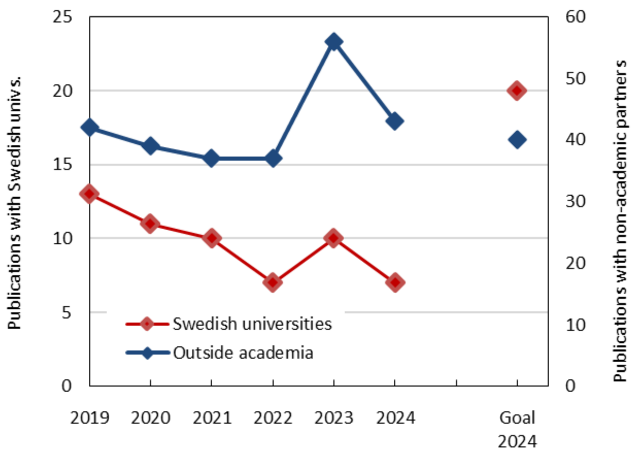


Figure 10: *Comparison of partners in publications: number of publications with co-authors from Swedish universities (on the left axis) and outside academia (on the right axis). From Indicator 3d.*

Industry accounted for most of our publications with Swedish partners, and in summary, industry is our most important research partner in Sweden. The development of industry collaborations was generally positive in 2022—2024 and met the goals set in our strategy (Figs. 8 and 10).

Partnerships in Strategic Actions

The balance between industrial, national academic and international collaboration projects of each Strategic Action during 2024 is shown in Fig. 11. Institute projects were not included in this follow-up. There are clear differences between the Strategic Actions with regards to the relative significance of international and industrial collaborations.

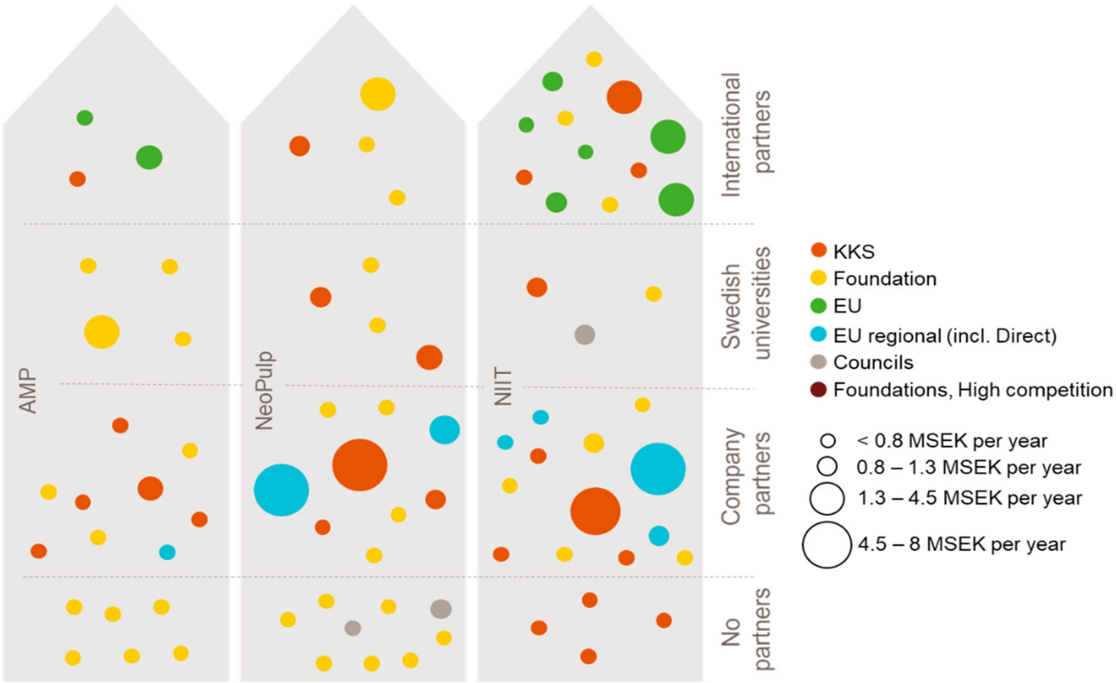


Figure 11: *Externally funded projects in 2024 for each Strategic Action, divided into four groups so that projects with international partners are at the top, followed by projects with Swedish universities, Swedish companies but no universities, and at the bottom projects without partners. Colours correspond to different financiers and symbol sizes to annual project volume.*

Personnel (Indicators 1a, 1b, 2c)

Figure 12 shows how the different categories of our personnel have developed. It does not include industrial PhD students or external co-supervisors in **IRS TransTech**. One new professor and two new associate professors were promoted last year. As a result, the number of professors has increased by nearly half, from 23 in 2021 to 33 in 2024. Our focus in recruitments was on PhD students and their number reached 43, slightly above our goal of 40. Including the 17 industrial PhD students (Fig. 8) gives an average of 60/33 = 1.8 graduate students for each professor and assistant professor to supervise. The recommendation of TransTech's Reference Group was two or three PhD students per professor.

At the end of 2024, we were close to our goal 18 guest researchers, but we were unable to double the number of adjunct and affiliated researchers to 20. This is because concrete collaborations with RISE did not grow as we had targeted, and companies were not enthusiastic about formal affiliation arrangements. However, we believe that our personnel resources developed positively. The fewer-than-targeted appointments of affiliated researchers and guest researchers did not cause problems for our research. Again, it seems appropriate in the next phase to consider affiliate and guest researchers in the context of developing our academic environment and researcher careers rather than in the context of personnel resources.

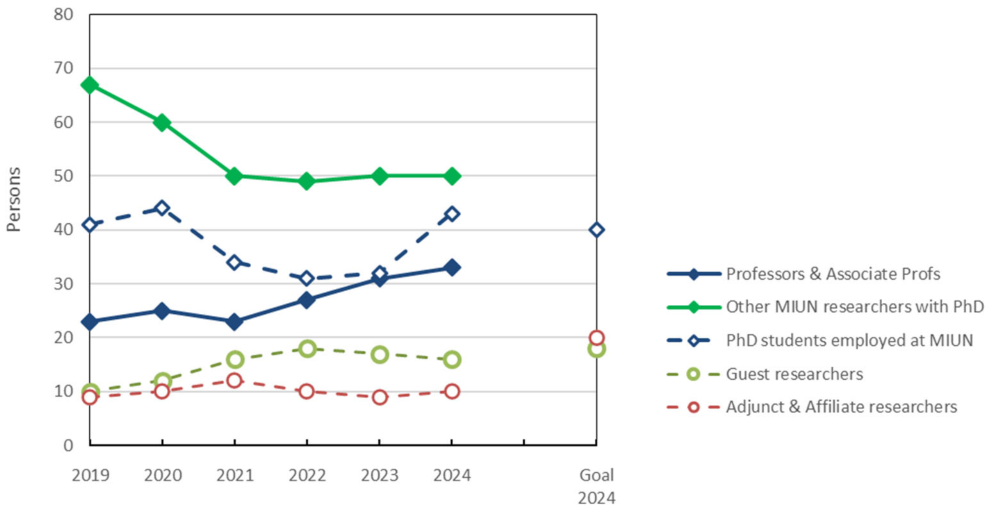


Figure 12: *TransTech research personnel in different categories. The green line (Other researchers) refers to those with a PhD who are not professors or associate professors. From Indicator 1a and 1b.*

Synergies of education and research (Indicators 1c, 1d)

Figure 13 compares the development of MSc degrees (already shown in Fig. 6) with the number of students enrolled in the second-cycle programs connected to our research. The increase of students in 2021 was in part a result of the Research Profile **NeoPulp**, which opened a new connection to an already existing program in Mechanical Engineering. We did not reach the goal of 50 MSc degrees in 2024, but a large share of our MSc students is now involved in all Strategic Actions – unlike in 2021 when this was true only for **NIIT**. We now have at least one second-cycle program connected to each of the Strategic Actions, which was also one of our goals. We will continue this work with new international Master's programs. In an effort to increase the production of degrees and even the number of students, we have added new programs, pathway options, and stronger connections to exciting research. In addition, we launched two new programs (Master's programme in Additive Manufacturing and Erasmus Mundus Joint Master's Programme in Imaging) in 2022–24, a reasonable number as our goal was four. However, these efforts did not yet yield results. We will update our goals for the MSc programmes in TransTech's new strategy 2025—2027.

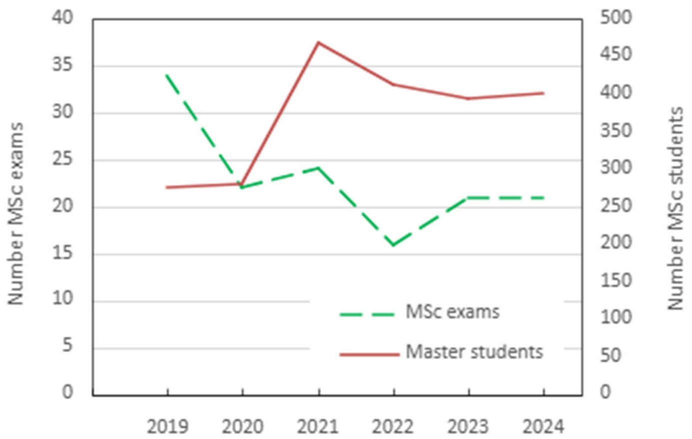


Figure 13: *The number of MSc degrees and students in the second-cycle programs connected to TransTech.*

Funding (Indicators 2d, 2e)

There was a small downturn last year in TransTech's generally positive funding development, from a total of 150 MSEK in 2023 to 145 MSEK in 2024 (excluding in-kind, Fig. 14). Nevertheless, last year's value exceeded our goal of 130 MSEK and the outlook is positive as the funding already granted for 2025 is 151 MSEK. International funding (Fig. 3b) increased to 8 MSEK last year and has already reached 14 MSEK for 2025, clearly exceeding our goal of 5 MSEK. National non-Knowledge Foundation funding was 17 MSEK, which is below our goal of 20 MSEK. The funding diagrams of the Strategic Actions can be found in Fig. 15, demonstrating some differences. The research program and industry networks of **AMP** continue to strengthen, while the industry support for **NIIT** and **NeoPulp** is already extensive. **NIIT** has an especially large share of international funding, and the other two Strategic Actions should follow **NIIT's** lead. We have made good progress in large national programs and are well-positioned to expand our large regional projects, **DIGIT** 40 MSEK, **HIPS** 34 MSEK and **IMPHET** 9 MSEK in external funding, should more funding be made available from the European Regional Development Program.

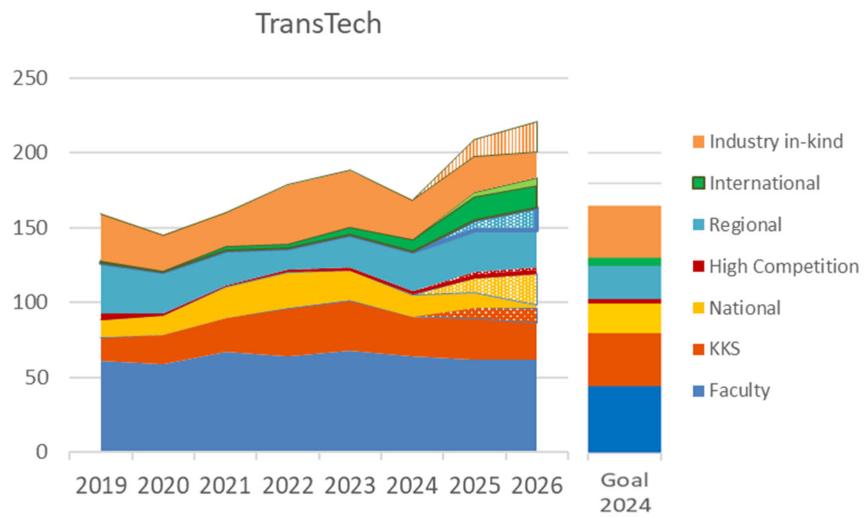
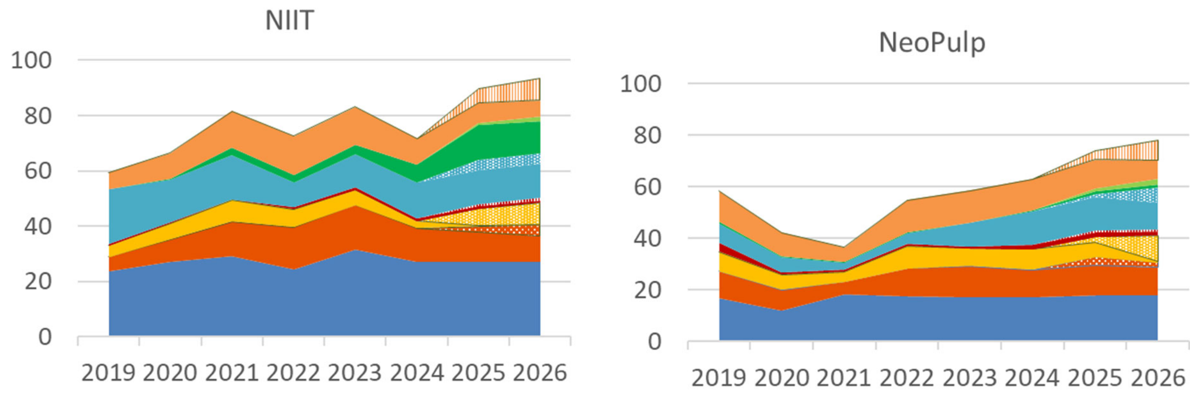


***Figure 14.** Funding (MSEK) of Transformative Technologies according to project budgets (solid colours = approved projects, half-tone = planned projects).*

The funding profiles of the Strategic Actions (Fig. 15) show some differences. In **AMP**, a new generation of research leaders has started at the same time when the development of new industry has suffered some setbacks in our region. However, now **AMP** funding is growing back; 29 MSEK of new funding was granted last year. The industry support and funding to **NIIT** and **NeoPulp** is already extensive. **NIIT** has an especially large share of international funding, and the other two Strategic Actions should be able to follow **NIIT's** lead.



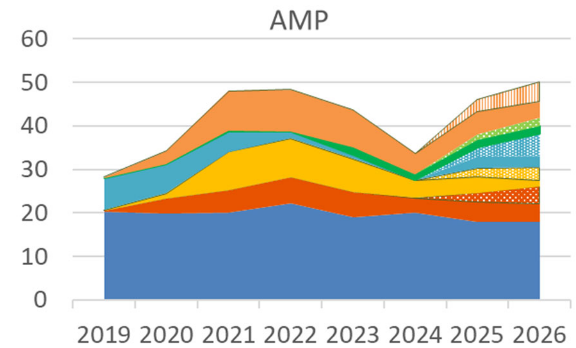


Figure 15. *Funding (MSEK) in each of the Strategic Actions according to project budgets. Same colours as in Fig. 12 for funding sources.*

Figure 16a shows how much of our external funding (excluding in-kind, the scale on the left) came from the Knowledge Foundation (one third, the scale on the right) and national funding sources (one fifth). The funding values for 2025 include only granted funding and are therefore likely to increase throughout the year. Last year saw the lowest success rate of applications since 2019. One reason for this was submitting 29 applications to international programs, a big increase from the 8 submitted in 2023. Although 8 of the international applications were approved last year and 3 in 2023, the success rate last year (28%) was lower than in 2023 (38%).

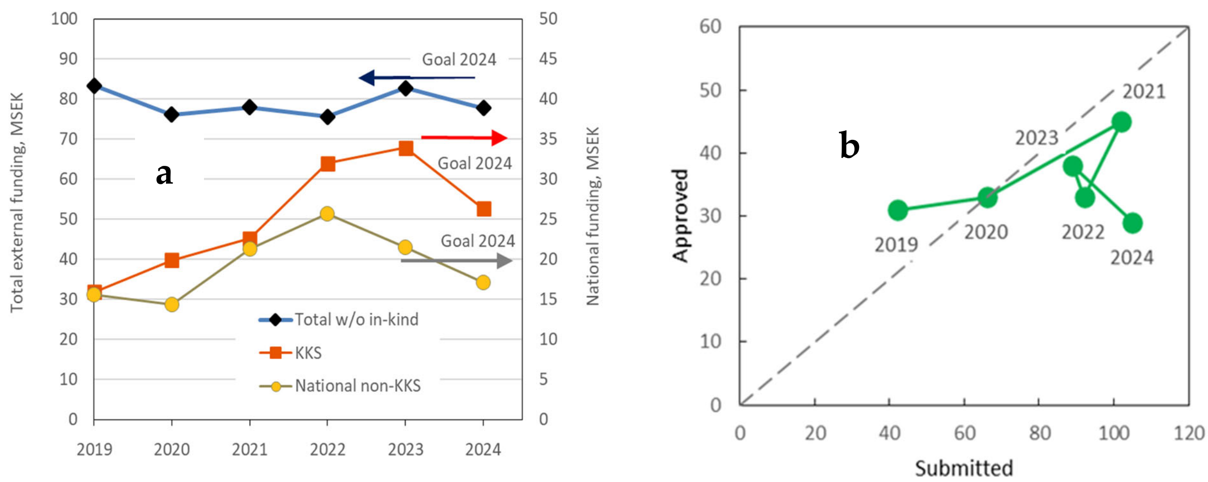


Figure 16. (a) *Total granted external funding (blue, left axis), funding from Knowledge Foundation and funding from other national sources (right axis), all in million SEK.* ***(b)*** *Approved vs. submitted funding applications, with a 50% success rate indicated by the dashed line.*

4. Fulfilment of Strategy

Here, we summarize the efforts and results reported above by evaluating how well we achieved the main Ambitions and Goals of our Strategy, executed the planned main Actions, and strengthened our Capabilities.

Ambitions

We had three main ambitions in our Strategy 2022—2024:

- *A combination of stronger Research Profiles and high scientific impact*,
- *A broader industrial and regional relevance* and
- *A more dynamic Academic Environment.*

Our position after the three-year period is clearly better in all these respects. This is most evident in our scientific impact, as demonstrated in Figs. 3 and 4. In addition, the profiling of our research is clearly stronger than in 2021. Instead of four Strategic Actions, we now have two strong Knowledge Foundation Research Profiles, **NIIT** and **NeoPulp** and a third Strategic Action **AMP,** which is in the Knowledge Foundation Synergy stage. **NIIT** combines a strong research profile, scientific impact and international collaborations. A strong and unique research profile is characteristic of **NeoPulp**, while **AMP** is known for its very effective scientific production.

We continue to maintain solid industrial and regional relevance. Industrial companies continue to be very important partners in our research, with a high funding volume and increasing number of industrial PhD students, Fig. 9. We have entered two large national industry programs in **NeoPulp**'s area and **NIIT** and **NeoPulp** coordinate a large consortium proposal to Vinnova's program for Advanced digitalisation. Another indication of our industrial relevance is the strong and growing participation from industry in our programs – particularly **DIGIT** and **HIPS** at the regional level and **DRIVEN** at the national level. The expertise in graphite/graphene production and applications (e.g. spin-off companies 2D Fab and Granode) in **AMP** is highly relevant for a possible national graphite/graphene initiative. It is very valuable for the development of our research that MIUN is active in the industrial development of our region and across Sweden.

Finally, the structure of our academic environment, shown in Fig. 2, is much simpler and thus more effective than in 2021. Several processes and programs have been initiated that support research careers and international collaboration, particularly **TransTech2Horizon** and **IRS TransTech**. International missions are at a good level, with roughly one mission every third year for all our PhD students and researchers. The number of international PhD students and postdocs is more than twice the number of 2021, and we will prepare a training program to recruit more MSc students from abroad. Also, the total number of PhD students (on-campus and industrial) is higher than in 2021 and will continue to increase with the Strategic Initiatives. Unlike in 2021, MSc students are now involved in research in all three Strategic Actions. This should motivate more MSc students to complete their studies at MIUN. The increased interaction of **TransTech** researchers with international colleagues and MSc students have clearly made the academic environment more dynamic than in 2021 and this development is bound to continue.

Goals and Actions

In terms of our results for goals and actions, they were generally good, even if we did not reach some of the quantitative goals. Appendix B tabulates the outcome of the nine development areas in **TransTech**'s Strategy 2022–24 and Appendix C all the values of our Indicators. The indicators were predominantly positive in four areas: *Scientific impact*, *Research profiles*, *International collaborations* and *Funding*. Publication volume was the only clearly negative in this area, partly a result of our emphasis on publishing in high-impact journals. We expect that the strong growth in international collaborations will also lead to an increase in our production volume.

In the other five areas, our progress fell short of the numerical targets. The shortfall in MSc students and degrees awarded (in *Synergy of education and research*) was discussed above. Some of the indicators, particularly the number of collaboration projects, turned out to be misleading as the volume (financing) of joint projects either went up or stayed constant at levels clearly higher than in 2019 despite decreasing project numbers. In other words, smaller projects were replaced with larger projects – a positive change. In retrospect, achieving collaboration with Swedish universities depends on funding instruments explicitly supports such projects – such as the programs we have recently applied to and joined. Without these, universities remain primarily competitors. In our new strategy, we will reconsider our targets for national collaboration.

Recruitment goals (in *Individuals and teams*) are another area where we want to revise our targets and change the focus from professor recruitments to promotions, especially in **AMP**, and to PhD students. We should move up from the current level of less than two PhD students towards three or four which can be considered a competitive number in academia. Our currently low levels in this respect followed from the earlier priorities of the Knowledge Foundation.

In our Strategy, we assigned Development Actions to the Research Leaders of each Strategic Action and Department Heads. These plans were also fully completed, see Table 2. We believe that maintaining the structure of Department Heads, Research Leaders of Strategic Actions and Leaders of Research Groups (Fig. 2) is a good way to keep track and plan renewal in our research management.

Finally, when the program for a Strategic Environment started, we also made another Action Plan 2023—2024 (Appendix E) for the Strategic Initiatives that the program enabled. Those initiatives progress as planned.

Table 2. *Plan for development actions in the Strategic Actions and Departments, as shown in Table 5 of the TransTech Strategy 2022–24, and status at the end of 2024.*

Development Action	Scheduled goals and results	Responsible
NIIT:	• 3 new Horizon applications by 2023: **DONE** • New large national project by 2024: **DONE** • 10 new partner companies by 2024: **DONE**	Mattias O'Nils Sebastian Bader
NeoPulp: Academic collaborations	• 3 new guest researcher-**TransTech** pairs working 2022: **DONE** • 2 new projects funded by 2024: **DONE**	Kaarlo Niskanen Birgitta Engberg
KM2 --> AMP: Upgraded agenda	• **AM** group included in the **KM2**-planning process 2022: **DONE** • Agenda for scientific and innovation effects 2023: **DONE** • Horizon or other internationally funded project 2024: **DONE**	Jonas Örtegren Lars-Erik Rännar Claes Mattsson
XGeMS: New role for research groups	• New positions ready in 2022, research groups' role in other Strategic Actions by 2023: **DONE** • 5 new partner companies by 2024: Not applicable	Mattias O'Nils, Kaarlo Niskanen
Collaboration between TransTech and Departments	• New Departments/**TransTech** interface in operation 2023: **DONE** • Collaboration with other universities for early-career researchers & graduate students in operation 2024: **IRS TransTech** for students • 4 new second-cycle programs by 2024: **Three** launched • Demonstrated benefits of **AM** included in **TransTech** by 2024: **YES**	Claes Mattsson, Patrik Österberg & **TransTech** Management Group

Capabilities

Table 3 summarises our assessment of the Capabilities of **TransTech** at the end of 2024. Compared to the status in 2021 (see Appendix 3 in **TransTech** Strategy 2022—2024), we have made the most improvement in our Capability to *Secure resources*, moving from level 2 to level 3. This is evident in the progress of our funding portfolio (cf. Figs. 3b, 14 and 16) and recruitments (Fig 12). Regarding the ability to *Build scientific profile*, it remains for us to demonstrate that we can build a strong research profile in **AMP** and effectively *Integrate research and education* to reach good enrolment levels. Remaining improvement needs are minor.

Table 3: *Development level of TransTech in the Capabilities agreed with the Knowledge Foundation. Improvement needs and steady progress are in lighter green, good level in darker green. Capability values are the same as in 2021 in all areas except Resourcing.*

Capability, the level achieved (1-4; 4= best)	Main strengths	Improvement needs	External risks and opportunities
Can develop and implement strategy: 4	Good and legitimate process to plan, implement and evaluate strategy from vision to plans and follow-up in all **TransTech**		
Can build scientific Profile: 3	Iterative process to define and implement renewed research profiles. Clear national position for **NIIT** and **NeoPulp**.		Opportunity: Growth of **AMP** research in parallel with new industries.
Can co-produce: 4	Can interact on all time scales with a few large companies, and on project level with almost one hundred	Extend industry collaborations in **AMP** and secure continuity in resources (see below)	Risk and Opportunity: Investments in new industries in Sweden
Can integrate research and education: 3	Can build complete Academic Environments in all areas. Good industrial relevance of our degree programs.	Attract more students for a better balance between income and expected deliveries.	Opportunity: Education combined with research co-production Risk: Smaller government funding to education and research
Can secure quality: 4	Strong academic environment with good processes from strategic level to individual projects. High scientific impact.		Opportunity: Guest professors co-supervise doctoral students and work with early career researchers
Can build organisation: 4 (*concerns faculty level*)	Good leadership and simple efficient organisation with well-established research centres and strong departments		
Can secure resources: 3 Starting level 2021: 2	Can balance funding and attract strong international guest professors and postdocs.		Opportunity: More researchers become strong in co-production.

5. Preliminary plan for 2025–2027

This chapter outlines a preliminary plan for the Strategic Initiatives, as shown in Figure 17. In order to increase our production and counteract the anticipated decline in national funding, we will continue expanding our international collaborations and funding. Another priority will be to recruit more international MSc students. To achieve this, we aim to adapt our Master's programs and support processes through the International Trainee initiative. It would facilitate a seamless transition from our selected partner universities to our MSc programs while ensuring added value for our partner companies.

Alongside the **IRS TransTech** and **TransTech2Horizon** initiatives, this strategy will further strengthen our international profile. As a part of the internationalization efforts, we will propose a new **Horizon Synergy** action for the Knowledge Foundation. The goal would be to build a national and regional program with our partner companies connected to the Horizon project(s) that should result from the **TransTech2Horizon** actions. The **Horizon Synergy** initiative would reinforce collaboration between academia and industry, enhancing innovation and knowledge transfer.

At the national level, we are preparing for continued research following the conclusion of **NIIT** in 2027, while also strengthening the research profile of **AMP**. Finally, we plan to propose a national research school in Transformative Technologies, inviting other universities to collaborate and thereby further strengthen our national position and academic collaborations.

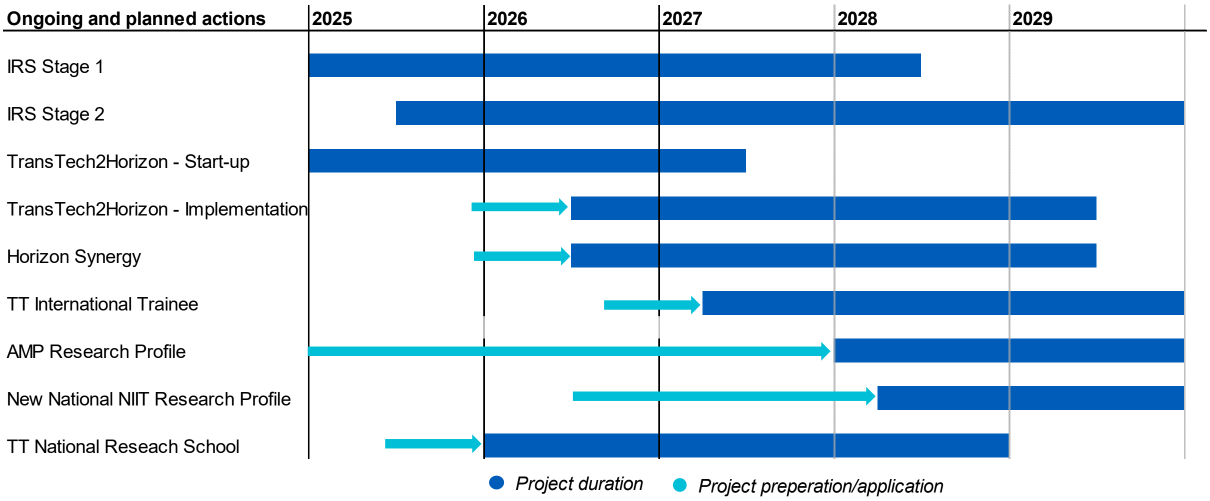


Figure 17: *Preliminary diagram of present and planned new Strategic Actions of TransTech from 2025 forward.*

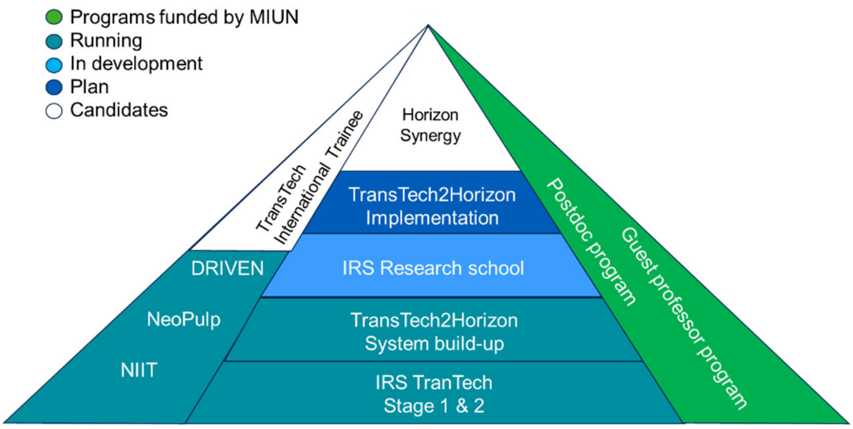


Figure 18: *Our vision of a strong international program in the Research Environment for Transformative Technologies at Mid Sweden University.*

Some additions and changes to these plans will arise when we prepare the new **TransTech** Strategy 2025–2027 during spring 2025. The corresponding Action Plan 2025–2026, new indicators and goals will be defined in the strategy process.

Appendixes

Appendix A: Articles in 2020–24 that gave H-index = 39 in 2024

	Number of citations	Strategic Action
Butun I, Österberg P, Song H. Security of the Internet of Things: Vulnerabilities, Attacks, and Countermeasures. IEEE Communications Surveys and Tutorials. 2020;22(1):616-644. :8897627.	369	**NIIT**
Zhang R, Olin H. Material choices for triboelectric nanogenerators: A critical review. . ECOMAT. 2020;2(4):e12062.	283	**AMP**
Wang N, Luo X, Han L, Zhang Z, Zhang R, Olin H, et al. Structure, Performance, and Application of BiFeO3 Nanomaterials. Nano-Micro Letters. 2020;12(1):81.	164	**AMP**
Basharat S, Ali Hassan S A, Pervaiz H, Mahmood A, Ding Z, Gidlund M. Reconfigurable Intelligent Surfaces: Potentials, Applications, and Challenges for 6G Wireless Networks. Institute of Electrical and Electronics Engineers Inc.; IEEE wireless communications. 2021;	144	**NIIT**
Zhang R, Dahlström C, Zou H, Jonzon J, Hummelgård M, Örtegren J, et al. Cellulose-Based Fully Green Triboelectric Nanogenerators with Output Power Density of 300 W m−2. Advanced Materials. 2020;32(38):2002824.	142	**AMP**
Mahmood A, Beltramelli L, Abedin S, Zeb S, Mowla N I, Hassan S A, et al. Industrial IoT in 5G-and-Beyond Networks: Vision, Architecture, and Design Trends. IEEE Transactions on Industrial Informatics. 2022;18(6):4122-4137.	124	**NIIT**
Radamson H H, Zhu H, Wu Z, He X, Lin H, Liu J, et al. State of the Art and Future Perspectives in Advanced CMOS Technology. Nanomaterials. 2020;10(8):1555.	122	**AMP**
Song Y, Wang N, Wang Y, Zhang R, Olin H, Yang Y. Direct Current Triboelectric Nanogenerators. Advanced Energy Materials. 2020;10(45):2002756.	117	**AMP**
Akbari-Saatlu M, Procek M, Mattsson C, Thungström G, Nilsson H, Xiong W, et al. Silicon Nanowires for Gas Sensing: A Review. Nanomaterials. 2020;10(11):2215.	100	**AMP**
Aboelwafa M, Seddik K G, Eldefrawy M, Gadallah Y, Gidlund M. A Machine Learning-Based Technique for False Data Injection Attacks Detection in Industrial IoT. IEEE Internet of Things Journal. 2020;7(9):8462-8471.	95	**NIIT**
Li Y, Wang G, Akbari-Saatlu M, Procek M, Radamson H H. Si and SiGe Nanowire for Micro-Thermoelectric Generator: A Review of the Current State of the Art. Frontiers in Materials. 2021; 8:611078.	80	**AMP**
Waqar N, Hassan S A, Mahmood A, Dev K, Do D, Gidlund M. Computation Offloading and Resource Allocation in MEC-Enabled Integrated Aerial-Terrestrial Vehicular Networks: A Reinforcement Learning Approach. IEEE transactions on intelligent transportation systems (Print). 2022;23(11):21478-21491.	80	**NIIT**
Beltramelli L, Mahmood A, Österberg P, Gidlund M. LoRa beyond ALOHA: An Investigation of Alternative Random-Access Protocols. IEEE Transactions on Industrial Informatics. 2021;17(5):3544-3554.	79	**NIIT**
Melro E, Filipe A, Sousa D, Medronho B, Romano A. Revisiting lignin: a tour through its structural features, characterization methods and applications. New Journal of Chemistry. 2021;45(16):6986-7013.	79	**NeoPulp**
Popov V V, Grilli M L, Koptyug A, Jaworska L, Katz-Demyanetz A, Klobčar D, et al. Powder bed fusion additive manufacturing using critical raw materials: A review. Materials. 2021;14(4):909.	77	**AMP**
Fernandes C, Melro E, Magalhães S, Alves L, Craveiro R, Filipe A, et al. New deep eutectic solvent assisted extraction of highly pure lignin from maritime pine sawdust (Pinus pinaster Ait.). International Journal of Biological Macromolecules. 2021; 177:294-305.	75	**NeoPulp**
Abedin S, Munir M S, Tran N H, Han Z, Hong C S. Data Freshness and Energy-Efficient UAV Navigation Optimization: A Deep Reinforcement Learning Approach. IEEE transactions on intelligent transportation systems (Print). 2021;22(9):5994-6006.	74	**NIIT**

Lindman B, Medronho B, Alves L, Norgren M, Nordenskiöld L. Hydrophobic interactions control the self-assembly of DNA and cellulose. Quarterly reviews of biophysics (Print). 2021;54: e3.	71	**NeoPulp**
Sarić R, Jokić D, Beganovic N, Pokvić L G, Badnjević A. FPGA-based real-time epileptic seizure classification using Artificial Neural Network. Biomedical Signal Processing and Control. 2020; 62:102106.	71	**NIIT**
Gebremichael T, Ledwapa L P, Eldefrawy M, Hancke G P, Pereira N, Gidlund M, et al. Security and Privacy in the Industrial Internet of Things: Current Standards and Future Challenges. IEEE Access. 2020; 8:152351-152366.	68	**NIIT**
Melro E, Filipe A, Sousa D, Valente A J, Romano A, Antunes F E, et al. Dissolution of kraft lignin in alkaline solutions. International Journal of Biological Macromolecules. 2020; 148:688-695.	68	**NeoPulp**
Kolahdouz M, Xu B, Nasiri A F, Fathollahzadeh M, Manian M, Aghababa H, et al. Carbon-Related Materials: Graphene and Carbon Nanotubes in Semiconductor Applications and Design. Micromachines. 2022;13(8):1257.	65	**AMP**
Du Y, Xu B, Wang G, Miao Y, Li B, Kong Z, et al. Review of Highly Mismatched III-V Heteroepitaxy Growth on (001) Silicon. Nanomaterials. 2022;12(5):741.	62	**AMP**
Liu J, Guomundsson A, Bäckvall J. Efficient Aerobic Oxidation of Organic Molecules by Multistep Electron Transfer. Angewandte Chemie International Edition. 2021;60(29):15686-15704.	60	**NeoPulp**
Zeb S, Mahmood A, Hassan S A, Piran M J, Gidlund M, Guizani M. Industrial digital twins at the nexus of NextG wireless networks and computational intelligence: A survey. Journal of Network and Computer Applications. 2022; 200:103309.	58	**NIIT**
Zelenika S, Hadas Z, Bader S, Becker T, Gljušćić P, Hlinka J, et al. Energy harvesting technologies for structural health monitoring of airplane components—a review. Sensors. 2020;20(22):6685.	50	**AMP**
Aslam M S, Khan A, Atif A, Hassan S A, Mahmood A, Qureshi H K, et al. Exploring Multi-Hop LoRa for Green Smart Cities. IEEE Communications Society; IEEE Network. 2020;34(2):225-231.	48	**NIIT**
Brunnström K, Dima E, Qureshi T, Johanson M, Andersson M, Sjöström M. Latency impact on Quality of Experience in a virtual reality simulator for remote control of machines. Elsevier; . Signal processing: Image communication. 2020;89(Nov):116005.	48	**NIIT**
Lopes M, Pierrepont C, Duarte C M, Filipe A, Medronho B, Sousa I. Legume beverages from chickpea and lupin, as new milk alternatives. Foods. 2020;9(10):1458.	48	**NeoPulp**
Li M, Bäckvall J. Efficient Heterogeneous Palladium Catalysts in Oxidative Cascade Reactions. Accounts of Chemical Research. 2021;54(9):2275-2286.	46	**NeoPulp**
Tran T, Lundgren J. Drill Fault Diagnosis Based on the Scalogram and Mel Spectrogram of Sound Signals Using Artificial Intelligence. IEEE Access. 2020; 8:203655-203666.	46	**NIIT**
Zhang R, Hummelgård M, Örtegren J, Olsen M, Andersson H, Yang Y, et al. The triboelectricity of the human body. Nano Energy. 2021; 86:106041.	45	**AMP**
Knall J, Vigneron P, Engholm M, Dragic P D, Yu N, Ballato J, et al. Laser cooling in a silica optical fiber at atmospheric pressure. Optics Letters. 2020;45(5):1092-1095.	44	**AMP**
Rondón R, Mahmood A, Grimaldi S, Gidlund M. Understanding the Performance of Bluetooth Mesh: Reliability, Delay and Scalability Analysis. IEEE Internet of Things Journal. 2020;7(3):2089-2101.	44	**NIIT**
Surmeneva M A, Khrapov D, Prosolov K, Kozadayeva M, Koptyug A, Volkova A, et al. The influence of chemical etching on porous structure and mechanical properties of the Ti6AL4V Functionally Graded Porous Scaffolds fabricated by EBM. Materials Chemistry and Physics. 2022; 275:125217.	43	**AMP**
Zhang W, Yang D, Xu Y, Huang X, Zhang J, Gidlund M. DeepHealth : A Self-Attention Based Method for Instant Intelligent Predictive Maintenance in Industrial Internet of Things. IEEE Transactions on Industrial Informatics. 2021;17(8):5461-5473.	42	**NIIT**
Akbari-Saatlu M, Procek M, Mattsson C, Thungström G, Törndahl T, Li B, et al. Nanometer-Thick ZnO/SnO2Heterostructures Grown on Alumina for H2S Sensing. ACS Applied Nano Materials. 2022;5(5):6954-6963.	41	**AMP**

Surmeneva M A, Koptyug A, Khrapov D, Ivanov Y F, Mishurova T, Evsevleev S, et al. In situ synthesis of a binary Ti–10at% Nb alloy by electron beam melting using a mixture of elemental niobium and titanium powders. Journal of Materials Processing Technology. 2020; 282:116646.	41	**AMP**
Posevins D, Bermejo-López A, Bäckvall J. Iron-Catalyzed Cross-Coupling of Propargyl Ethers with Grignard Reagents for the Synthesis of Functionalized Allenes and Allenols. Angewandte Chemie International Edition. 2021;60(41):22178-22183.	39	**NeoPulp**

Appendix B: Indicator values in 2024 relative to **TransTech** Goals for 2024

Table B: *Goals for TransTech to reach by 2024 in each of our nine development areas, the starting values in 2021 (excluding the AM-group) and final values in 2024. Indicator numbers and values refer to Appendix C, with green indicating the goals we achieved, black indicating those we did not achieve despite improvements from 2021 and red indicating those with a negative change from 2021.*

Goals to be reached in 2024	Indicators		
	No.	**Value 2021**	**Value 2024**
Scientific impact			
- Journal Impact Factor = 5.5	2b	4.83	5.42
- H-index = 33	2b	30	39
- Production 200 publications	2b	143	152
- High-competition funding 3 MSEK	2d	1.1	2.56
Research profiles	NA		
- **NIIT** & **NeoPulp** known in Sweden		No	Yes
- New agenda for **KM2** + AM group		No	Yes
- New role for **XGeMS** researchers		No	Yes
National academic partners			
- 16 joint projects in progress	3b	11	8
- 20 joint publications	3c	10	7
International collaborations			
- 18 guest professors & researchers	1b	15	16
- 30 joint projects in progress	3b	18	22
- 90 joint publications	3c	83	106
Industry networks and co-production			
- 100 companies in on-going projects	3b	69	92
Institute & society collaboration			
- 20 adjunct and affiliate researchers	1b	12	10
- 20 projects with RISE in progress	3c	18	6
- 40 joint publications	3d	37	43
Individuals & teams			
- 6 new external prof / associate prof	1a	0	1
- 40 on-campus doctoral students	1a	34	41
- 60 international missions in + out	4a	51*	28
Synergy of education and research			
- 50 MSc degrees	2a	24	21
- MSc program for each Strat. Action	N/A	Not for KM2	Yes
- Expert Competence Stage 2 running	N/A	Planned	Yes
Funding (granted for each year)			
- Total research funding 130 MSEK	2d	105	145
- National non-KKS funding 20 MSEK	2d	17.6	17
- International funding 5 MSEK	2d	1.8	8.0

**Pre-Covid-19 value from 2019*

Appendix C: Indicators

Table 1a. Doctoral students, postdocs and research assistants

Year	2019		2020		2021		2022		2023		2024	
Gender	**M**	**W**	**M**	**W**	**M**	**W**	**M**	**W**	**M**	**W**	**M**	**W**
PhD students*	29	12	34	10	22	12	22	9	20	12	29	14
FTE	24,45	9,06	24,13	7,16	16,25	10,84	19,24	7,07	16,16	9,94	21,1	8,88
Postdocs and research assistants**	28	9	26	7	21	5	10	8	10	1	14	2
FTE	13,37	4,71	15,36	3,45	12,54	3,68	7,48	6,1	8,97	1	8,7	1,3

* Not including industrial doctoral students
** Postdocs and temporary employment, PhD

Table 1b. Assistant professors, associate professors, professors, adjunct researchers, guest professors, supporting staff

Year	2019		2020		2021		2022		2023		2024	
Gender	**M**	**W**	**M**	**W**	**M**	**W**	**M**	**W**	**M**	**W**	**M**	**W**
Assistant professors	25	5	23	4	21	3	25	6	25	14	21	13
FTE	14,08	2,88	11,99	2,75	11,34	1,51	15,16	3,71	13,01	9,14	10	8,5
Associate professors	5	1	7	1	5	2	9	2	13	2	13	3
FTE	3,71	0,68	4,18	0,75	2,99	1,36	6,42	1,63	7,56	1,62	7,3	2
Professor, permanent	16	1	16	1	15	1	15	1	15	1	16	1
FTE	10,05	0,57	7,74	0,27	8	0,46	7,03	0,74	10,55	0,86	10,9	0,7
Adjunct researchers*	8	1	8	2	9	3	7	3	6	3	7	3
FTE	2,02	0,2	1,4	0,2	1,7	0,35	1,12	0,35	1,1	0,5	9,8	0,5
Guest professors	6	1	10	1	12	3	16	2	14	3	13	3
FTE	0,86	0,1	1,73	0,1	2,36	0,48	2,15	0,3	1,93	0,4	1,40	0,3
Supporting staff **	11	4	14	6	10	7	5	7	7	5	6	7
FTE	7,99	3,4	9,29	4,9	4,45	4,9	3,77	4,3	5,02	4,1	4	4,3

* Includes both professors and lecturers
** Administrative project managers, project leaders, technicians, communicators

Table 1c. Number of students in education on advanced level

Year	2019		2020		2021	2022	2023	2024
Gender	**M**	**W**	**M**	**W**	**M/W**	**M/W**	**M/W**	**M/W**
Master students	221	55	224	57	416	413	395	402

Table 1d. List of active programs and specialisations

Name	Level	Hp
Automationsingenjör	First cycle	180
Elkraftingenjör	"	180
Energiingenjör ~~- Hållbara fastigheter~~	"	180
Datateknik	"	180
Additiv tillverkning - högskoleingenjör maskinteknik	"	180
Nätverksdrift	"	120
Webbutveckling	"	120
Civilingenjör i datateknik	Second cycle	300
Civilingenjör i elektroteknik	"	300
Civilingenjör i teknisk design	"	300
Civilingenjör i teknisk fysik	"	300
Civilingenjör i teknisk kemi	"	300
Civilingenjörsutbildning i teknisk kemi Mittuniversitetet-KTH	"	300
Internationellt masterprogram i datateknik	"	120
Master by research i datateknik	"	120
Master by research i elektro**teknik**	"	120
Master by research i kemi	"	120
Master by research i kemiteknik	"	120
Master by research i teknisk fysik	"	120
Masterprogram i elektroteknik	"	120
Magisterprogram i additiv tillverkning	"	60
Masterprogram i teknisk yt- och kolloidkemi	"	120

Table 2a. Number of doctoral, licentiate and master degrees

Year	2019		2020		2021		2022		2023		2024	
Gender	M	W	M	W	M	W	M	W	M	W	M	W
No. Doctoral degrees	4	2	7	0	6	3	2	3	1	0	1	0
No. Licentiate degrees	8	3	1	3	2	3	1	0	3	1	2	1
No. Masters degree	28	6	18	4	13	11	14	2	19	2	10	8

Table 2b. Number of scientific publications *

Year	2019	2020	2021	2022	2023	2024
Articles in Journals	92	102	111	75	84	96
Conference Articles	65	45	32	34	40	56
H-index			30	35	40	39
Journal impact factor	3,35	4,16	4,83	5,7	6,7	5,4

* only affiliated publications

Table 2c. Promotions

Year	2019		2020		2021		2022		2023		2024	
Gender	M	W	M	W	M	W	M	W	M	W	M	W
No. Associate professors (docent)	2	0	1	0	1	1	5	0	2	2	1	1
No. Professors	3	0	0	0	0	0	1	0	1	0	1	0

Table 2d Funding granted, million SEK

Financiers	2019	2020	2021	2022	2023	2024
Faculty funding (MIUN)	66,42	53,20	59,95	59,19	64,90	67,15
National high competition	3,77	1,37	0,91	1,73	1,58	2,56
Swedish Foundations	11,86	12,98	19,46	23,44	19,95	14,60
KK-stiftelsen	15,95	19,92	22,63	32,02	33,95	26,31
Regional funds	34,58	27,74	23,33	14,49	22,37	26,33
International funds	1,09	0,84	4,24	3,48	4,91	7,96
Direct funding industry *	0,38	0,70	2,15	4,60	3,41	N/A
Total Funding	**133,68**	**116,05**	**130,52**	**134,35**	**147,66**	**144,92**

* Direct funding industry is included in Swedish Foundations and is therefore not included in the total.

Table 2e. External funding: applied/approved

	2019	2020	2021	2022	2023	2024
Financiers	**success rate***	**success rate***	**success rate***	**success rate***	**success rate***	**success rate***
National high competition	0 / 2	0 / 6	1 / 14	2 / 11	1/7	0/8
Swedish foundations	13 / 18	15 / 36	24 / 61	19 / 54	19/47	10/47
KK-stiftelsen	10 / 10	8 / 9	11 / 15	4 / 10	3/10	4/10
Regional funds	3 / 4	6 / 7	5 / 6	4 / 5	7/8	4/8
International funds	2 / 4	0 / 2	2 / 3	2 / 10	3/8	8/29
Direct external funding from industry	3 / 3	4 / 4	1 / 1	2 / 2	2/6	-
Other	0 / 0	1 / 1	0 / 0	0 / 0	3/3	3/3
Total	31 / 42	33 / 66	45 / 102	33 / 92	38/89	29/105

* Number of approved / applied projects. The latter includes pending applications.

Table 3a. Indirect funding received from industry and non-industrial organisations

Year	2019	2020	2021	2022	2023	2024
Indirect funding (in kind) in SEK	31 558 453	23 659 953	22 319 717	18 646 581	20 909 101	25 932 235

** STC + FSCN + STRC*

Table 3b. Number of collaborative doctoral students

Year	2019	2020	2021	2022	2023	2024
No. of collaborative doctoral students	11	11	16	18	16	17

Table 3c. Collaborative Organizations

Year	2019	2020	2021	2022	2023	2024
Partners from industry (SME)	51	48	39	45	30	52
Partners from industry (non SME)	43	42	36	37	27	40
National partners from society excl. industry and academia	24	24	20	20	14	15
International projects	14	19	24	23	30	23
Projects with national academic partners	12	11	11	10	14	13
Projects with national institutes	12	12	18	11	9	9

* Final data for 2021 not yet available.

Table 3d. Collaboration in publishing*

Year	2019	2020	2021	2022	2023	2024
Number of scientific publications with representatives from society (not academia)	42	39	37	37	56	43
Number of scientific publications with national academic co-authors	13	11	10	7	10	7
Number of scientific publications with international co-authors	78	84	83	71	79	106
Number of scientific publications with representatives from both academia and society	24	31	23	24	43	31

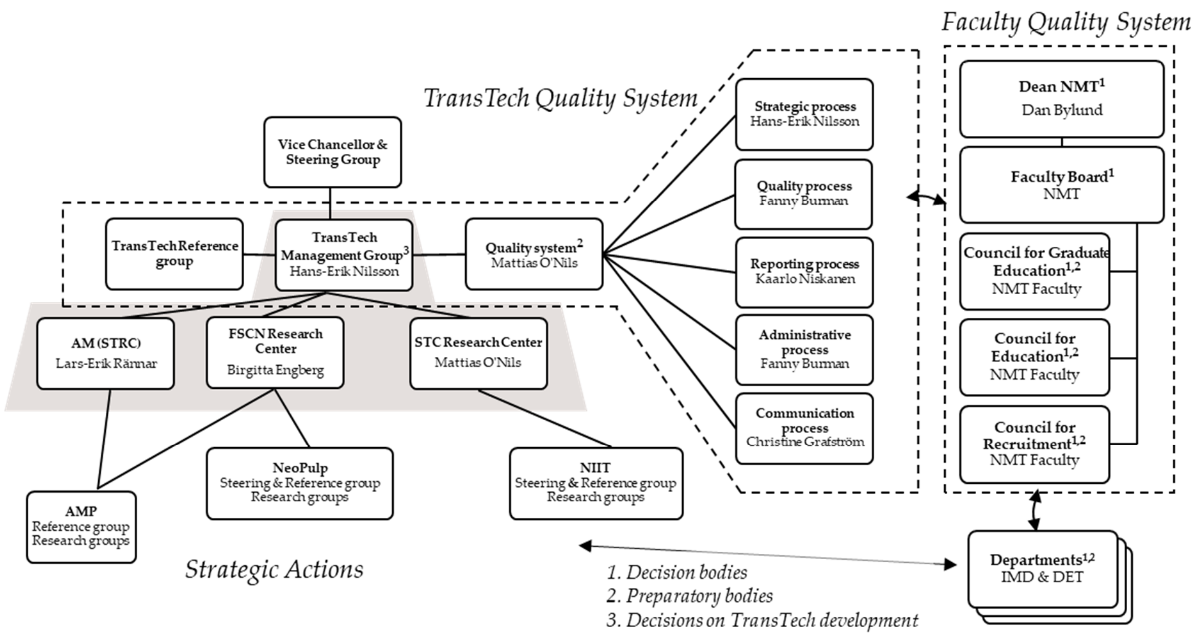
* Only affiliated publications

Table 4. International Exchange

Year	2019	2020	2021	2022	2023	2024
Number of international guest researchers	10	12	16	18	17	16
FTE	1,47	1,31	2,72	2,45	2,33	1,7
Number of international PhDs and postdocs*	22	24	23	20	41	60
FTE	13,35	11,61	12,76	13,73	35,59	41,2
Number of international research missions - In	21	6	5	14	19	12
Number of international research missions - Out	30	11	0	34	20	16
International projects, million SEK**	3,34	5,20	9,73	10,84	21,36	25,84
Number of publicatios with internatl co-authors***	78	84	83	71	79	106

* PhDs enrolled in Sweden but with foreign domicile, postdocs with PhD from a country other than Sweden
**All projects that contribute to internationalization, for example International guest professors
*** Only affiliated publications

Appendix D: Organisation 1 April 2024



Appendix E: Action Plan 2023–2024

Åtgärdsplan 2023-24 för hur TransTech ska uppnå målen i Strategy 2022-24

Aktivitetsbeskrivningar med ansvariga personer, tidsplaner och status

Main Action and Goal	Deadline	Responsible for activities	Planned activities and time plan	Status
1. TransTech2Horizon **Goal**: Start of the project within the KK program Strategic Environment Responsible: Hans-Erik Nilsson Team: Sebastian Bader, Carlos Botero and Alireza Eivazi	**Jun. 24**	*Hans-Erik Nilsson* *Hans-Erik Nilsson* *All team members* *Hans-Erik Nilsson* *All team members*	External process support started Dec. 2023 Project plan ready by beginning of April 2024 Work on action learning sub-projects Deadline for submission to KKS: last of April 2024 Project start September 2024	Running according to plan. Currently defining research focus for proposal and establishing industrial partners and networks. Have started work on the project plan.
2. Research program for Advanced Materials and Processing (AMP) **Goal**: Initial research program defined and organized Responsible: Hans-Erik Nilsson	**Jun. 24**	*Claes Mattsson* *Birgitta Engberg* *Birgitta Engberg* *Claes Mattsson and Patrik Österberg*	Main areas of AMP research identified, ~~Nov. 2023~~ April 2024 Research groups restructured, ~~Jan.~~ April 2024. Research program defined, ~~June~~ Sept 2024 Reviewed line organisation of TransTech, Nov. 2023	Running according to plan. Currently establishing teams to explore research opportunities and industrial partners. Work in progress with structuring of research groups.
3. Training program in coproduction for young researchers **Goal**: Start the program Responsible: Mattias O'Nils	**Dec. 24**	*Mattias O'Nils* *Mattias O'Nils* *Mattias O'Nils*	Training content (workshops, mentoring, coaching) Nov. 2023 1st group of participating researchers Nov. 2023 1st group of company cases launched Feb. 2024	According to plan
4. Support process for the recruitment and relocation of international researchers **Goal**: The process is running 2024 and refined by 2026 Responsible: Anna-Maria Selvehed	**Dec. 24**	*Maria Torstensson* *Caroline Cato* *Caroline Cato*	Process leader recruited, started Dec. 2023 Identification of different personas Feb. 2024 Development of processes for each persona May 2024	Running according to plan. Process leader recruited. Financing secured. Templates for handling incoming are being produced. Parallel processes should speed up the handling of new employees.
5. Development of IRS TransTech **Goal**: Funding application for Stage 2 is submitted to KKS Responsible: Mattias O'Nils	**Oct. 24**	*Mattias O'Nils* *Mattias O'Nils* *Mattias O'Nils* *Mattias O'Nils* *Mattias O'Nils / Birgitta Engberg*	The call for Stage 2 opened Jan. 2024 2nd group of PhD supervisors (MIUN+external partners) Jun. 2024 2nd group of partner companies June 2024 External analysis report Oct 2024 Stage 2 proposal to KKS Oct. 2024	Stage 1 is running. (External analysis of progress, goal fulfillment and development needs: ongoing follow-up research is carried out in the project)
6. Continuous development processes of personnel **Objective**: Create a more dynamic academic environment Responsible: Prefects Claes Mattsson and Patrik Österberg	**Dec. 24**	*Claes Mattsson* *Patrik Österberg*	Compile and implement a 4-year recruitment plan, including: - tenure track program (program för lärares forskningsmeritering) - recruitment of senior staff members - adjunct/guest professor recruitments. Ready April 24 Support from faculty funded programs* Activities connected to action 1 and 3.	Mentoring program linked to visiting professors is ongoing using faculty resources. A first version of a tenure track program is running but refinements is needed. Recruitments of high quality senior staff has succeeded in some cases but failed in others. The combination between tenure track and head hunting solutions is needed.

** Program for competence provision and competence development; points 1 and 2 below (SEK 4 million per year)*

1. Teacher's research qualification - lecturer, docent or professor (fo medel). Merit investment from the faculty. Individuals within TransTech who have been granted funds:

- Alireza Eivazi (lecturer to docent) - received project from Formas in the category 'early-career researcher', 2023, - Carlos Botero (lecturer to docent), - Renyun Zhang (docent to professor), - Börje Norlin (docent to professor), - Sebastian Bader (associate professor to professor), - Jonas Örtegren (associate professor to professor)

2. Strategic recruitment - funds for salary up to 750 kSEK (1 year). The faculty's program for strategic recruitment is used in synergy with recruitment efforts funded by KKS. Ongoing initiatives funded with faculty funds linked to TransTech:

- Computer technology: 3 assistant lecturers, 1 more ready as applied to become associate professor, - Electronics: 1 assistant lecturer, - Chemical engineering: 2 assistant lecturers, - Technical physics: 1 assistant lecturer

3. Mentor program (guest professor linked to younger researchers) SEK 10 million over 4 years.

The faculty's program is used in synergy with the KK foundation's instruments. Ongoing initiatives funded with faculty funds linked to TransTech:

- Emilio Jimenez Piqué, Universitat Politècnica de Catalunya, Barcelona., - Jukka Ketoja, VTT, Finland., - Professor Orlando Rojas, The University of British Columbia, Canada., - Docent Mohamed Wissem Naouar, Ecole Nationale d'Ingénieurs de Tunis, Tunisia.

Ongoing contract negotiations regarding guest professor in advanced materials and processes.

Appendix G: Development of research in Advanced Materials and Processes **AMP**

Scope of our research

The purpose of **TransTech**'s research in Advanced Materials and Processing (**AMP**) is to create solutions and technologies for emerging new industry sectors in our region. By emphasizing fundamental advancements in materials and process technologies, the research groups maintain flexibility to adapt to evolving application areas. We have three current application areas: energy storage solutions, such as batteries and advanced charge storage systems, advanced materials integrated into innovative sensor systems, and additive manufacturing technologies with focus on scalability and industrial applicability. We have competence in specialized coating techniques, exfoliation, and laser-assisted processing that enable novel functionalities in biomaterials, photonic materials, and nanomaterials. Our facilities for additive manufacturing and cleanroom processing enable research on new technologies that is both industrially and scientifically relevant.

Organisation

The research groups in **AMP** belong to the research centres FSCN in Sundsvall and STRC in Östersund. An external review by Pro&Pro in 2023 concluded that this organization is good but should be reevaluated as the industrial clustering relevant for **AMP** proceeds. The structure of research groups has been simplified. After a recent retirement, we have only one professor in this area but several researchers on track to be promoted to professor.

New industries

Several large investments in new industries related **AMP** research have been planned in our region. As a part of battery manufacturing in Sweden, the Chinese battery material supplier PTL was planning a factory and a research centre for anode materials. Other companies also announced interest to establish production of battery materials here. However, these plans are sensitive to the current economic and political turbulence in the world. In our region, the development slowed down when the Swedish government did not grant PTL the permission to build the factory, and Northvolt in Skellefteå encountered difficulties. Other possible directions of industrial development are the planned investments in hydrogen-based biofuel and synthetic fuel refineries that have been announced in Timrå, Ånge and Östersund, as well as hydrogen-based steel production. A national program on graphene would also be of interest for us, as the sector includes both an established company (Superior Graphite) in our region and two start-ups from our research, one here and one in Uppsala.

At this development status of new industries, it is important that the research program of **AMP** covers several areas that enable us to adjust as the industrial development unfolds. We believe that additive manufacturing technologies and battery manufacturing will continue to grow in Sweden and our research in **AMP** will grow along with it. Our focus on a few fundamental technologies helps us build national and international collaborations that increase our visibility, help recruit talent, and secure funding — all of which makes **AMP** a strong research profile.

Contact

Phone +46 (0)10-142 80 00
E-mail kontakt@miun.se
Website www.miun.se

Campus

Östersund Kunskapens väg 8, 831 25 Östersund
Sundsvall Holmgatan 10, 851 70 Sundsvall

Mittuniversitetet
MID SWEDEN UNIVERSITY