Version 3, February 2022

Mittuniversitetet
MID SWEDEN UNIVERSITY

Transforming the Industrial Ecosystem

A research, innovation, and education vision

Mid Sweden University in partnership with

Knowledge Foundation ><

Transforming the Industrial Ecosystem
– A research, education and innovation vision

Photo: Olle Melkerhed

Executive summary

Transforming the Industrial Ecosystem (TIE) describes a vision for renewal and growth in the Mid-Sweden region of Västernorrland and Jämtland-Härjedalen. It combines the industrial strengths of the region with the dynamic force that Mid Sweden University represents. The university attracts and educates young people to work in the region and sustain its industrial competitiveness. Through research and knowledge transfer to institutes and companies, the university facilitates renewal. When acting in symbiosis, the strong industrial core and a flora of new businesses form an effective ecosystem that continuously renews itself.

The Research Environment for Transformative Technologies (TransTech) defines the focus of the technology-oriented research of Mid Sweden University, conducted mainly within the research centres FSCN, STC and STRC. The research focuses on the renewal and digitalization of the process industrial and manufacturing sectors of the region. The interaction of the three centres, located in Sundsvall and Östersund, is an important source of dynamism in TransTech and gives a unique identity to the transformative efforts by Mid Sweden University. These efforts include education, research, and innovation programs together with surrounding strategic partners, such as cities, and divisions of the research institute RISE. External innovation support is provided by clusters such as Bron Innovation in Sundsvall and Peak Innovation in Östersund. Industrial partnerships with companies flourish in research projects and many collaboration platforms for the development education and competence programs.

The joint research program of TransTech consists of large Strategic Actions, each with the goal of making strong scientific and innovative impact. These include two long-term profile programs in collaboration with industry that aim for a nationally recognised position for the university in a specific research field, and others for the industrial renewal of the region. We believe that the combination of sharp focus and a broader scientific foundation is vital for our pursuit of a sustainable national position and the international attractiveness of TransTech and the university.

The TIE Vision is an initiative presented by Mid Sweden University to nurture continued industrial renewal and growth in the Mid Sweden region and the entire Norrland. It focuses on research but covers all the three tasks of the university and addresses the entire region. Therefore, the *TIE Vision* can be fulfilled only through systematic development of collaboration between all actors and parts of the region.

Contents

Version 3, 18 February 2022

Social and industrial challenges for regional development

For two hundred years, much of the economy in the Mid-Sweden region has relied on industrial manufacturing of goods from forest resources. Especially in Västernorrland, the dominant product for half a decade was paper in different forms, but now the focus is moving to biofuels, pulp and wood products. Supplier and service industries such as machine manufacturers, chemical suppliers, consulting companies and IT services have evolved with the local forest industry as a pilot customer. The significance of the service sector to the regional economy is comparable to that of the manufacturing industries. There are an increasing number of new high technology companies that utilize information and sensor technology first developed for process industry to innovate also in other areas such as security, living comfort and environmental monitoring.

Readily available hydropower has been another important foundation of industrialization that has enabled not only the forest industry, but also, e.g., the production of aluminium. Today, climate change and electrification together drive large investments in windmill power plants. Jämtland-Härjedalen is investing heavily in infrastructure for electricity-intensive industries in The Power Region[1] that attracts new manufacturing companies to the region.
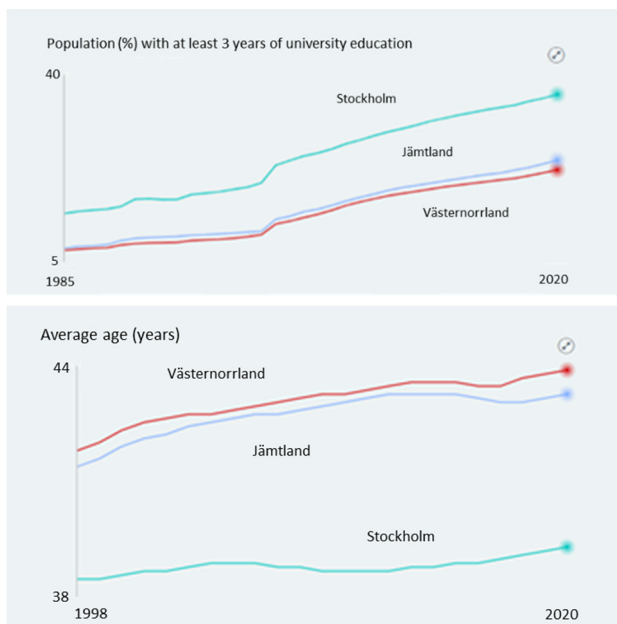

Figure 1. Academically educated fraction (top) and average age (bottom)
of population in Västernorrland and Jämtland, compared to Stockholm[2].

[1] https://powerregion.se/
[2] https://www.ekonomifakta.se/Fakta/Regional-statistik/Alla-lan/Vasternorrlands-lan/

In the last decade, globalised economy and digitalisation have changed the competitive advantages and business environment for both manufacturing and service sectors. To stay competitive, the efficiency of all business processes and use of resources must improve. Indeed, the refinement of manufacturing technologies and introduction of information technology have radically reduced the demand of traditional workforce irrespective of industry sector. In parallel with this, all industries and services have difficulties in the recruitment of engineers who can work with advanced information systems, improve operational quality, and engage in the development of new revenue streams. The demand for new IT solutions has stimulated new growth in the IT service sector everywhere, also in all parts of our region. At the same time, the rapid technology development challenges the capabilities of local IT service providers and increases the need for not only well-educated personnel but also for programs for life-long learning.

The distributed energy system of windmills also exemplifies the increasing need for modern information networks for monitoring and resource allocation, in this particular case smart grid solutions. In a region of large distances, even much of the energy use, the information networks of society, and supply chains of industry are sparsely distributed. The development of automation and remote control are natural steps to take in our industrial ecosystem.

The key regional challenge shared by the industry and the society is to attract young people, educate them for the evolving labour market, and offer them an engaging environment to build their lives in. We have a large potential to increase the education level in our region as it is below the national average and especially the capital region of Stockholm (Fig. 1). However, that is only part of the solution because the mean age continues to increase. Therefore, it is crucial that we can attract more young people to the region. We believe that this requires an open attitude that focuses on future opportunities and welcomes everyone who wants to contribute in her or his own way.

Opportunities for industrial growth

In the modern world, real opportunities exist only in the global perspective. To be the best within a region is not a sustainable position. The abundance of renewable raw material, renewable energy and pure water are real assets that offer global growth opportunities for the Mid-Sweden region. The region has a long tradition of using these assets industrially in a manner that gives answers to the first two of the Grand Challenges of mankind: global warming, tightening supplies of energy, water and food, ageing societies, public health, pandemics and security.[3] However, abundant resources are no longer enough. Societies increasingly expect that all industries can significantly reduce their direct environmental footprint and contribute to the other Sustainable Development Goals of UN (Fig. 2). Growth based on abundant resources will be possible only if we can become more efficient in the use of these resources.

Figure 2. Sustainable Development Goals of UN[4].

Even though many of the opportunities that arise from the Grand Challenges lie outside the traditional market segments of the region's industry, many initiatives are in progress to harness all of them. Biofuels, chemicals and medicines, food technology, and materials for the generation and storage of electricity are some examples that build on competences originally developed for the forest industry.

The second asset of the Mid-Sweden region is its vibrant consulting and ICT service industry. Information technology, especially the Internet of Things, is the key enabler of improvements in productivity and waste reduction. We believe that the interplay between industrial and consumer applications of information technology accelerates

---

[3] Lund Declaration, "Europe Must Focus on the Grand Challenges of our Time", Swedish EU Presidency, 8, July 2009, Lund, Sweden [Online]

[4] https://www.un.org/sustainabledevelopment/sustainable-development-goals/

evolution in both markets and will give answers to the challenges of ageing societies, public health and security. Thus, it is important to benefit from the growth potential of ICT in all sectors and leverage the attraction power that ICT has among young people who are interested in technology and the natural sciences.

The third asset of the region is the education and research done by Mid Sweden University and the research and technology development done by RISE. For example, RISE Processum and the surrounding cluster in Örnsköldsvik is nationally leading in the development of forest-based biorefineries. For its part, Mid Sweden University has been developing the Research Environment for Transformative Technologies (TransTech) since 2012, to support the *TIE Vision* for industrial competitiveness and renewal.

TransTech drives the technology-oriented research, education, and competence development programs of Mid Sweden University within the research centres FSCN, STC and STRC. The additive manufacturing branch of STRC joined TransTech in 2021. The centres have well-established co-operation with the forest-based and allied industries in the region and nationally. They also have significant collaboration with other industrial segments such as industrial IT, measurement and process control, advanced materials and manufacturing technologies, and the production, storage, and distribution of electricity. STRC's mission in in TransTech is to help Swedish companies to industrialize additive manufacturing.

The cross-sectorial interaction of the three research centres, located in Sundsvall and Östersund, is an important source of dynamism and gives a unique identity to the transformative efforts by Mid Sweden University. Shared facilities and common research governance mean that the over 150 experts of TransTech can make a powerful contribution to regional renewal and industrial growth. The three research centres collaborate closely with RISE units in the region and nationally, and with different players in the innovation system, such as Bron Innovation, Peak Innovation, and Bizzmaker.

Our vision is that TransTech will form part of a symbiotic and dynamic industrial ecosystem through a gradual and sustainable transformation. There is a classical tension between core business and edges in industrial development, discussed by Hagel and Brown[5]. They conclude: "*In particular, we must regrind our lenses to monitor the periphery, that is, the edges, of our business. At these edges lie our richest opportunities for value creation and our strongest protection against value destruction.*" In such a transformation, existing industry can continuously improve its competitiveness in parallel with the development of new businesses. The first part relies on proven competence regarding existing industrial processes, the second part on creativity and entrepreneurial spirit.

---

[5] Hagel and Brown, The only sustainable edge; why business strategy depends on productive friction and dynamic specialization, Boston (Mass.): Harvard Business School, cop. 2005

Attracting talent

This is the key challenge for all parties, even for the research, education, and innovation environment of the university. The most important task of a university is to educate people who want to use their knowledge and skills to the benefit of society at large. Even in research the most characteristic "product" of an academic institution is a well-educated researcher or expert. One cannot develop academic research if one cannot attract talented students. Difficulties in this respect also affect Mid Sweden University.

The university wants to perform better in attracting undergraduate and graduate students to relevant areas such as chemical engineering, chemistry, electronics, engineering physics, mechanical engineering, and information technology. These are the key disciplines needed in our research and in the industrial ecosystem alike. We also develop continued education so that industry personnel can keep up with the technological revolution caused my information technology, especially the Industrial Internet of Things and Artificial Intelligence, and the changes it leads to in the workplace.

We believe that the university can become better still at attracting students, but this requires profiling the most *exciting* rather than the most *relevant* research and education opportunities. Our exciting opportunities include the ICT as a whole, advanced materials and technologies such as additive manufacturing and new bio-based products. Young generations are more attracted by meaningfulness and problem solving than by disciplinary excellence, and education must be arranged accordingly[6]. Finally, we believe social dynamics and an open spirit on the campus, in the cities and the region at large, is very important for young people.

Research opportunities

Success in the sustainable transformation and development of the industrial ecosystem relies on our ability to foster an open academic environment that goes beyond the old starting point of abundant raw materials, energy, and water. Today, the most important development goal in the existing, predominantly forest-based industrial value chain is to improve resource efficiency, both in terms of raw materials, energy, and water, but also in terms of environmental footprint. New solutions to these challenges require path-breaking research and new technologies that offer new opportunities for machine and service suppliers. Just think of the disruption that arises from the global fight against climate change and plastic pollution. The transition to a circular bio-based economy will also enable the creation of completely new industries, such as e.g., battery factories and textile fibres.

[6] Popper, K. R. Conjectures and Refutations: The Growth of Scientific Knowledge. New York: Routledge and Kegan Paul, 1963, p. 88.
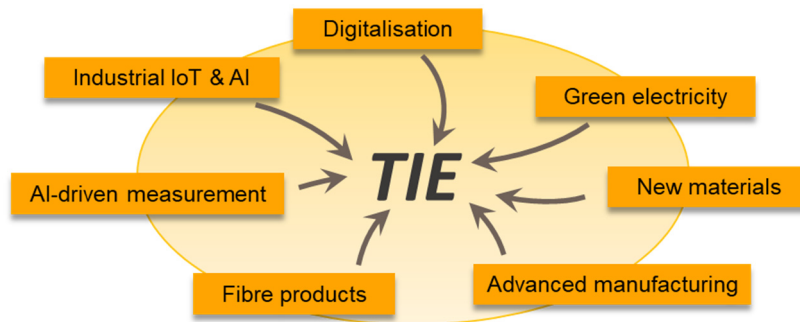
Figure 3. Some of the industrial and technological opportunities addressed in the Research Program of TransTech.

The research centres FSCN, STC and STRC of TransTech conduct research on industrial and technological opportunities that either are or can become important for the region, see Fig. 3. Improved efficiency is the main industrial motivation in the areas of Fibre products and Industrial IoT, as we have two long-term profile programs in collaboration with industry and aim for a nationally recognised position of the university in the respective research field. However, even these two as well as all the others aim at industrial renewal opportunities for the region. The combination of programs with a sharp focus and programs with a broader scientific foundation is vital for the pursuit of a recognised national position and international attractiveness.

When selecting research topics to the Strategic Actions, we apply the following six guidelines that summarise the analysis presented above:

1. Exploit the competitive advantages of the Mid-Sweden region
2. Choose opportunities of global importance
3. Use information technology as a key enabler
4. Respond to the changing needs of society
5. Supply relevant competence and skills to industry
6. Build on the most exciting research opportunities

Long-term goals for Mid Sweden University

Mid Sweden University contributes through its research, education and innovation environment to the sustainable transformation and development of the regional industrial ecosystem. Success is shown by the ability to attract young people to the educational programs and stimulate them to continue to research, new business creation or established industry of the region. The future ecosystem is characterized by symbiotic dynamics between different kinds of enterprises, including the major manufacturing companies that today operate in the region. The university can play a strong role in the ecosystem with its students, personnel, and collaboration partners.
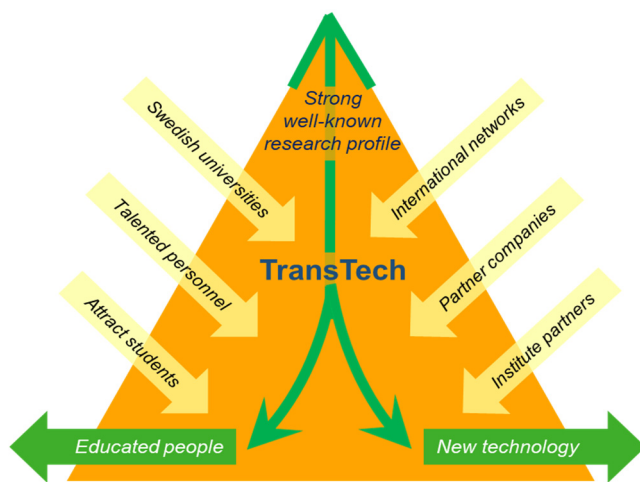

Figure 4. Well-known research profile makes it possible for Mid-Sweden University to educate people and deliver new technology to society.

With TransTech, Mid Sweden University is working strategically to raise its profile in research and education with the ambition to become a *global university with regional commitment*. In the first phase, from 2012 to 2020, TransTech was created by consolidating the research centres FSCN and STC. As the additive manufacturing branch of STRC now joins, and TransTech will cover all technology-oriented research of the university. The interaction of the three centres, located in Sundsvall and Östersund, is an important source of dynamism and gives a unique identity to the transformative efforts by Mid Sweden University. Later on, yet broader engagement of the university is predicted.

The university can offer many contributions to the implementation of the *TIE Vision*. These include the ability to acquire research and innovation funding that also benefits the private and public companies of the region. The university is intensively involved in the regional research and innovation agenda including competence delivery. The

following table gives the long-term organisational, scientific, collaborative, and innovative goals of the university for the development of TransTech.

Long term goal – 10 years perspective	Strategic funding partner
Competent people: TransTech attracts and retains competent researchers, supports their development, and fosters strong teams. (TIE 1, organisational)	Knowledge Foundation, EU, Cities, Regional development organisations, Swedish Agency for Economic and Regional Growth
Well-known research profile: TransTech has a nationally recognized position in research and innovation. Its research makes clear impact in the important international science communities and industrial networks, evidenced by well-cited publications and memberships in program committees and editorial boards. (TIE 2, scientific)	Vinnova, VR, SSF, Swedish Agency for Economic and Regional Growth, Sundsvalls kommun, Industrial companies (national and international), Knowledge Foundation, Horizon Europe
New technologies: Research results of TransTech are implemented in the industrial ecosystem together with research institutes, companies, and start-ups. (TIE 3, collaboration and innovation)	Innovationsbron, Vinnova, Business angels and venture capital, industrial contracts
Attractive education: Education programs of TransTech attract talented students from Sweden and abroad to meet the needs of both companies and our own research. (TIE 4, organisational and collaborative)	Partner industries and industrial networks, partner universities (e.g., KTH, SLU, Umeå University)
International networks: TransTech has good international networks for research and education collaboration and exchange of researchers and students with leading academic institutions (TIE 5, scientific and collaborative)	Horizon Europe, Vinnova, STINT, EU Interreg

Internal leadership and regional co-operation

In this development, Mid Sweden University will work strategically to form long-term alliances with external partners such as funding organisations, industrial networks and research partners in academia and institutes. In the following table we list strategic funding partners and their role in the long-term development of the environment. In particular, the Knowledge Foundation has supported strategic

development at MIUN, first through the program Knowledge and Competence Centres and now through the program Strategic Environments.

Organisation	Contribution and support
The Knowledge Foundation	Support for research excellence in collaboration with industrial partners. Knowledge development and competence exchange and training.
Vinnova	Support for innovative research, verification of innovations, funding for innovation coaching and innovation networks, research program supporting path-breaking and disruptive initiatives.
Bron Innovation, Peak Innovation, Bizzmaker, RISE, Samling näringsliv?	Innovation systems that connect us with industrial networks of small and large companies and enable our support to the creation of new businesses.
VR, SSF, Formas	Support for path-breaking academic research.
The Swedish Agency for Economic and Regional Growth (ERUF)	Development and innovation funding for regional development. Research and development with focus on regional growth.
Cities, Regional development organisations	Collaboration and funding to establish important research infrastructure, strategic recruitment of key competences, and innovation support and branding.
EU (Horizon Europe)	Funding for international exchange, networking, and strategic partnership.

Achieving the vision requires a combination of internal and external leadership and co-operation. At the university, TransTech has a well-established management structure and quality system. TransTech systematically develops external collaboration in research, education and innovation with important industry networks and RISE. The development of internal synergies and collaborations with public organisations are coordinated at the university level across faculty boundaries. These efforts include education, research, and innovation programs together with surrounding strategic partners, such as cities, and divisions of the research institute RISE. External innovation support is provided by clusters such as Bron Innovation in Sundsvall and Peak Innovation in Östersund. Industrial partnerships with companies flourish in research projects and many collaboration platforms for the development education and competence programs.

Mid Sweden region – a new industrial landscape

The *TIE Vision* is an initiative presented by Mid Sweden University to nurture continued industrial renewal and growth in the Mid Sweden region. It focuses on research but covers all three tasks of the university and addresses the entire region (Fig. 5). The research, education and competence development programs of the Research Environment for Transformative Technologies are also an important part of the accelerating industrial renewal and growth of entire Norrland. They complement other initiatives such as the biorefinery cluster in Örnsköldsvik and battery factory in Skellefteå. There are also many other new, still incipient industrial areas, such as fine biochemicals, medicines, food technology and environmental remediation that may one day be important parts of TransTech and the industrial landscape of the Mid Sweden region.

Figure 5. Some of the foreseen contributions from TransTech to a new industrial landscape of the Mid Sweden region.

Mittuniversitetet
MID SWEDEN UNIVERSITY