WORK PLAN 2015-2017

FOR THE KK RESEARCH ENVIRONMENT AT MID SWEDEN UNIVERSITY

Sensible Things that Communicate

PART OF MID SWEDEN UNIVERSITY

FSCN

PART OF MID SWEDEN UNIVERSITY

WORK PLAN 2015-2017

Photo: Tina Stafrén
Feature: Processing of silicon detectors in the clean room,
STC Research Centre, Mid Sweden University
Production: Division of Communications, Mid Sweden University 2014
Print: Print Office, Mid Sweden University 2014

Work Plan 2015 - 2017

Executive Summary

Mid Sweden University is working to systematically increase its national and international profile in the research that is driven in two research centres FSCN and STC. The target in this work is to make a powerful contribution to the regional renewal and growth in accordance with the vision *Transforming the Industrial Ecosystem – TIE*. Since 2011, the Knowledge Foundation has been supporting this development through the program KK Miljö.

In this Work Plan we have selected and quality assured five HÖG projects and one Synergy project that best implements our ambitions described in our TIE Vision. The selection has been verified by the Research Environment's reference group to implement our strategic ambitions.

We have also developed a second Synergy project of strategic importance for the development of our Research Environment. The scientific core of the project was rated as excellent in ARC13 and this was verified in the scientific evaluation of the initial research plan. Unfortunately the industrial consortium has not been completed and we therefore request that the proposal will be handled in according to the time plan for the ordinary call Synergy 14.

This is the Work Plan for the years 2015-2017. It has been formulated in dialogue with external partners and the Knowledge Foundation, including the evaluations and recommendations of the Expert Group and Ad Hoc Group. Following overriding development themes transpire the entire Work Plan:

Strategic development that supports industrial transformation: This requires deeper collaboration with new companies that are outside the core of our research, and stronger strategic process that engages our researchers. Better communication and alignment with the innovation systems support this strategic development.

Development of personnel resources in order to empower developing research areas and to prepare in time for coming generation change in important areas. Engagement of new companies through adjunct professors is vital for broader co-production.

Increased national and international collaboration in order to make reality of the goal of a strong research profile.

Further development and implementation of the quality system: The quality control processes need to be developed so that learning from the finished KK Research Actions is strengthened. We will apply these processes also on project applications send to other major funding sources to ensure that those projects also support our strategic development.

Content

About our terminology

This is a short summary of the most important terms used in this document.

Research Action	Structured research project, program etc that has specified goals, implementation plan and schedule.
Strategic Action	Strategically important Research Action. Currently we have five Strategic Actions; **e2mp**, **FLEX**, **FORIC**, **EISS** and **KM2.**
Research Area	Definition of a research direction that depends on the context and can change with the evolution of science and technology. Thus Research Areas can overlap and do not correspond to the organisational structures. Currently we have two internationally recognised strong Research Areas, High-yield Pulping and Embedded Sensors, and one area, Nanomaterials Systems, for which our goal is to reach such a status.
Research Group	Organisational unit that has a group leader. Currently 18 research groups make up our Research Environment. Each of the strong Research Areas is driven by one strong Research Group and supported by others.
Research Environment	In our case, this means the environment formed by the two research centres STC and FSCN. This Work Plan concerns the development of the environment into one strong and coherent entity. The Knowledge Foundation supports this development with their funding program KK Miljö (KK Environment).
Core and Edge	Core refers to the fact that that we are strong in certain areas of research (the Core of our research) and the related partner companies (the Core of our industrial network). Edge refers to new areas of research and co-production that are needed in in order to drive industrial transformation.

Please note our notation: Research Actions are marked with **bold font**, key concepts with Capital Initials, and strategic goals with *italics and underlining*.

1. Introduction

Mid Sweden University is working to systematically increase its national and international profile in the research that is driven in two research centres FSCN and STC. The target in this work is to make a powerful contribution to the regional renewal and growth in accordance with the vision *Transforming the Industrial Ecosystem – TIE*. Our development of a strong research environment is especially supported by the Knowledge Foundation through its program KK Miljö.

The *TIE* vision builds on the rich natural resources that our region has in the renewable forest resources, sustainable energy and pure water. Another important starting point is that over time our region has also accumulated remarkable competence in the processes of forest industry, in information technology and in digital services. In addition to these areas, Mid Sweden University also has strong research in new materials and strong programs in design education. By developing research that includes renewable raw materials, information and communications technology, and new materials, Mid Sweden University will make a strong contribution to the regional renewal and growth within forest industry, Information and communication technologies (ICT) and other related industrial sectors.

Within the university, this development of the research program and organisation of the research environment is going to create a powerful and coherent identity and profile for the research driven by Mid Sweden University both nationally and internationally. The two research centres STC and FSCN that are currently included constitute the largest research entity of the university (29% by volume of research funding in 2013). Today the relevant research is divided into two separate profile areas of the university, *Forest as a resource* and *Industrial information technology and digital services*. When successful, the development supported by KK Foundation will replace them with one profile that is centred on the research that we now drive and develop in line with the vision *Transforming the Industrial Ecosystem – TIE*.

This document describes the research and development work that we have planned for the coming three years, with emphasis on the plans for 2015. We have formulated this Work Plan in dialogue with external partners and the Knowledge Foundation, including the evaluations and recommendations of the Expert Group and Ad Hoc Group. The Work Plan reports our progress and future plans at three time scales. In the strategic level, 10-years forward, we will build strong identity for our research environment and maximize our impact on the industrial transformation. We want to let the identity grow through large concrete research actions that we call Strategic Actions. This is our way to ensure the engagement of researchers in the development, and to allow new groups to enter in order to further enforce the implementation of the *TIE* vision. The Strategic Actions are selected and motivated in 3-year plans, currently for the period of 2015-2017, and implemented in annual Work Plans. The Work Plans also include smaller projects that deal with important special questions and promising new research directions related to the Strategic Actions. This is our way to keep the project portfolio dynamic but at the same time focused since for every project a connection to one or more Strategic Actions is required

In Chapter 2 we report the progress made during the first half of 2014 and Chapter 3 describes new plans for our research project portfolio. Motivations for new KK Research Actions are given in Chapter 4, the plan for organizational development in Chapter 5, and the proposed budget for new funding from Knowledge Foundation in Chapter 6.

2. Progress report

This section concerns our progress during the first half of 2014. In the organizational development (Chapter 2.1), we have concentrated on strategy development, communication and educational programs. Improvements of the Quality System and changes in personnel and other resources are also reported. Progress in research is reported in Chapter 2.2, and the follow-up of KK Research Actions in Chapter 2.3.

The comprehensive discussion and analysis of the fulfilment of the 3-year goals 2012-2014 and the goals set in the previous Work Plan 2014 will be given in the Progress Report 2015 when all the results from 2014 are available. This includes the Indicators, which are not yet available for 2014.

2.1 Improved organization

Strategy development

Our long-term ambition is expressed in the *TIE Vision*: to build a strong research environment that supports and stimulates industrial transformation. Since the two parts of our Research Environment, FSCN and STC, are very different, the strategic process needs to successively build a strategic agenda. The plan is to let the common identity be formed through the creation of large Strategic Action partly driven by a top down perspective. These Strategic Actions will be evaluated using scenario analysis where the initial strategic position is revised. In this way we can use the creative power of researchers to develop the research focus. Basic guidance to the selection of new Strategic Actions is provided by the *TIE Vision*. However, since the pursuit of transformation must engage also new industrial partners, we need a strong framework for the strategy process and rational ways to evaluate alternative directions. This need was also recognized by the ARC13 reviewers who recommended that we establish a scenario process to assess new and refine existing Strategic Actions.

Together with the Reference Group (see below, the section on Personnel and Other Resources) we have identified the concepts of Core and Edge, (cf. "*The only Sustainable Edge"*, 2005[1]) as a good starting point. Appendix H gives a summary of their framework applied to our *TIE Vision*. In brief, Core refers to established business where development is incremental and focuses on efficiency improvements, and Edge to the periphery where no established business yet exists and new strategic thinking is therefore needed. In our Core of research we develop knowledge and skills especially for established industrial partners that are closest to us. However, *TIE vision* also charges us to develop new research in line with global opportunities. That forms the Edge of our research. The challenge is to determine how the global opportunities may provide value on the local scale.

The current processes utilized in the development of the Research Environment are described in Figure 1. Two iterative processes guide the development; the strategy process guided by the TIE vision (right hand side) and secondly the learning process where feedback from ongoing and finished Research Action is used to form new initiatives (left hand side). The iterative scheme provides a method to successively develop a Research Environment that supports industrial transformation.

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

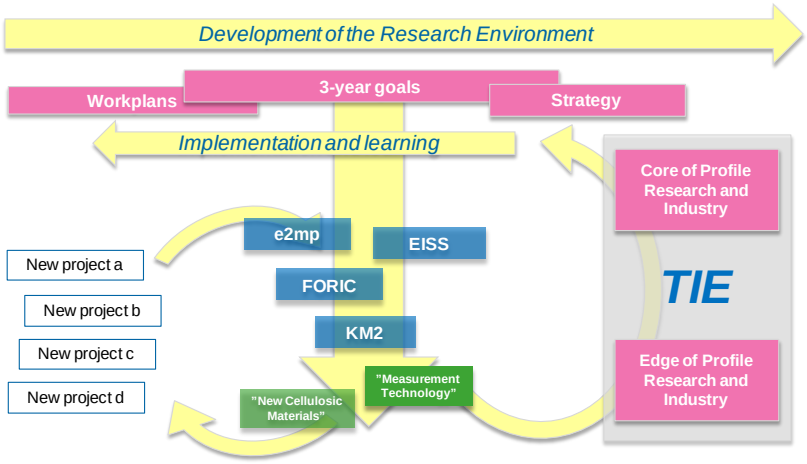

Figure 1: Description of the processes involved in the Development of the Research Environment.

The strategic process (right hand side) was initiated using the strategies of STC and FSCN respectively. During the first years of the common Research Environment, the *TIE vision* has guided us in the process of building Research Actions from these strategies. This guidance has been particularly important for the formation of the large Strategic Actions **e2mp**, **FORIC**, **KM2** and **EISS** (revision of **EnergyWiser**).

Based on the above discussion, the experience accumulated so far, and the advice from the Reference Group, we have identified following features that we must include in our strategy process:

1. *Robust theoretical framework* to secure support to both incremental and disruptive renewal, robust so that it can handle the different natures of research at FSCN and STC, and the respectively different dynamics of industrial development
2. *Understanding of our strengths and weaknesses* as compared to competition in our various research areas; and our opportunities and threats based on future scenarios of the Edge and the Core (see also next point)
3. *Future scenarios* in order to be able to evaluate the potential of our Research Actions to contribute to industrial transformation in our own region and in Sweden

Utilizing these features in the strategy development will successively allow a common identity to grow that forms the foundation for a *joint thematic university research profile of FSCN and STC* i.e. replacing the current formulation *Forest as a Resource* and *Industrial IT and digital services.*

The action plan to achieve these goals is explained in Chapter 5.2.

Communication and the innovation systems

The past year we have worked to build efficient communication of our Research Environment. In this work it has become clear that the whole Mid Sweden University has to reconsider the structure used to describe its research. Currently, the university has four thematic Research Profiles (such as *Forest as a Resource* and *Industrial IT and digital services*) and eight Research Centres (such as FSCN and STC). Each centre has clear core and disciplinary strengths, as confirmed by the ARC13 evaluation. In contrast, the Research Profiles tend to mix disciplinary subject areas and societal challenges. STC and FSCN belong to two different Research Profiles and therefore the development of the joint Research Environment of FSCN and STC, combined with the TIE Vision gives even more complicated message about MIUN's research. From the communication perspective, our development process should logically lead to a situation where the Research Environment replaces the two Research Profiles. Such a change is complex and takes time because it challenges the very structure of research communication used by the Mid Sweden University (cf. Chapter 5.2).

Given the above internal situation, we must build the communicative identity of our joint Research Environment step by step. This is also wise because we are part of the regional and national innovation systems. The TIE Vision asserts that we want to play a strong role in the innovation systems. It is important that our communication is aligned with our strategic partners in the innovation system (Vinnväxt initiatives, administration and governments at city and county levels, national innovation clusters, and funding agencies). The Faculty has initiated a systematic dialogue with these partners regarding communication strategies. Since 2013, an important part in this work has been a dialogue with the city of Sundsvall. The goal has been to create common understanding and a strategic agenda in order to establish a strong national and international position for the region. Similar dialogue has now been initiated with the county administration.

In June 2014 a collaboration agreement was signed between the city of Sundsvall and Mid Sweden University and a 30 MSEK strategic program was started. The program provides seed capital for research and innovation initiatives (cf. **FORIC**, **EISS** and **KM2** in Chapter 2.2) in line with the TIE ambition to profile the most exciting future opportunities and the Edge of industrial transformation. The city has a strong ambition to promote sustainable industrial growth and develop city infrastructure. Sustainable growth depends on the supply of competent new employees. For this purpose we have a co-operation platform with the city and regional industries, see the next section.

A major improvement in communicating about our role in the innovations system was the two-day conference, Science and Innovation Days, in 13-14 October 2014. STC and FSCN organized it together with the BioBusiness Arena and Fiber Optic Valley in conjunction with the IT conference Sundsvall42 that is organised by the IT cluster BRON. The conference was a good starting point for building coherent communication for the parties involved. The collaboration with the city gives us better capacity to host also international workshops and conferences in Sundsvall, as demonstrated by the WinterWind 2014 conference. Such events help in positioning our research and demonstrating the region's industrial strength in important emerging field, in this specific case renewable energy harvested by wind mills in arctic environment.

In 2015 we will continue to collaborate with our strategic partners in the innovation system in order to jointly profile and communicate what is exciting in our research and innovations, educational programs and industrial opportunities. See Chapter 5.2 for more details.

Education and competence delivery

We are working to improve the quality of doctoral education and support to the competence needs of industry. Through **FORIC** we will establish a novel cross-sectorial network for doctoral education and a coherent study environment for the industrial students. **FORIC** works with the BioBusiness Arena (BBA) that provides a platform for identifying knowledge and competence needs related to the research and development of the regional industry. The development of a flexible approach to answer to these needs at the master level is developed in **FLEX**. In the **FLEX** project seven master level courses have been developed and included in the university´s Master by Research concept. In addition they provide complementary courses for industrial and international PhD students in order to synchronize the common values and understanding.

The university is currently making a major investment in the educational programs in order to implement its Education Strategy. At the undergraduate level the Faculty has started a number of collaborative platforms where industry, researchers, teachers and students are engaged in systematic development of our curriculum. These platforms also serve as a meeting point between employers and student groups. The increasing volume in e-learning based programs demands new approaches and integration schemes to ensure industrial experience and relevance in the education. We have found that education programs utilizing distributed e-learning method can develop even stronger

relationships to industry since the interaction surface may be larger when space and time are no longer limitations. However, the new approach demands a higher degree of system support and we are currently developing such tools and practices for all our educational programs within the framework of the Strategy for Higher Education at the university.

We have also collaborations for new undergraduate educational programs together with partner universities both nationally and internationally. We are convinced that there is a win-win situation in sharing content in higher education and refocus resources from mass-communication to tutoring of student groups and fostering individuals in an academic culture through projects and real life learning outcomes.

The above ongoing development projects must be finalized before we can initiate other changes in the education program. However, the systematic approach introduced on the undergraduate level will also provide a good foundation for future Strategic Actions on the master level. Such new education development actions related to our research will be proposed in the Work Plan for 2016 (cf. Chapter 3.8). This will concern information technology, electrical engineering, automation, energy systems and chemical engineering. The experience gained in **FLEX** will be utilized in the new actions.

We are also working on the national level to improve graduate education. In Electronics we develop common graduate courses with the University College of Gävle. In the Forest Products Industry Research College (FPIRC) new courses have started and international graduate student collaboration is developed. Together with Karlstad University we are evaluating study plans and the quality evaluation system for doctoral studies. Some changes have already been implemented. However, the largest work remains which are related to revision of the subject structure for our doctoral program.

See Ch. 3.8 for our development plans of education and competence delivery for the nest year.

Quality System

In 2014, the current form and structure of the Research Environment Quality System was finalized and implemented. The system now includes five main processes; strategic process, quality process, reporting process, administrative process and communication process. This was described in the report to the Ad Hoc Group in Mars 2014. Following this, focus has been on consolidating and on implementing routines for continuous follow ups and revisions. Below are listed mayor improvements during 2014.

- The quality process was expanded to also include external scientific review of finalized projects.
- The University Library was engaged in the process of recruiting external experts as reviewers. Library staff is now responsible for investigating conflicts of interest through co-authoring or other documented collaborations. The routines for this were originally set up for ARC13 and have been adjusted for the needs of the quality system.
- The time plan for external reviews of new actions was adjusted so that evaluation of scientific quality and of coproduction is both done in May. The evaluation of co-production was before this done in August. This gives the research teams and their industrial partners more time to work on planning the project. It also gives valuable time for internal strategic considerations and for feedback from the Reference Group and the Faculty Board.
- The ambition to establish long-term collaboration with reviewers that are highly engaged in the process has continued. Reviewers are routinely asked if they are interested in reviewing projects in the future. In addition, the network of reviewers has continued to broaden, to ensure a continuous input of new approaches and feedback to the process.

- Work with establishing a yearly schedule in which all activities within the research environment are collected and communicated has begun. When completed, the yearly schedule will provide a good overview of the activities over the year, and facilitate long-term planning.
- A file management system, BOX, has been introduced for documentation of all stages of activities and actions within the research environment. The system is easily administrated, and while maintaining high security, it can easily be made accessible for all participants, even outside of the University. The BOX system was first time introduced for documentation in the ARC13 evaluation process.
- In WP 2014 the importance of routines for follow up, accounting, and up-to date prognostications were addressed. In 2014, most of these routines are being integrated into the university´s regular systems and processes. Efforts have been to not to establish separate systems but instead adjust university processes to also address the needs of the KK Research Environment. In return, the research environment´s system for scientific evaluation of proposals for new research actions have during 2014 been adopted for proposals targeting other financiers, including applications to VR and EU´s Regional Fund. Lessons from these processes will in turn be considered when revising the KK Environments processes.

Personnel and other resources

Changes in personnel

- Björn Lindman was recruited to FSCN as an internationally renowned guest professor. He will work in the Surface and Colloidal Engineering group especially in the development of "New Cellulosic Materials"
- The Strategic Actions **KM2** and **FORIC** have led to a consolidation of FSCN's research groups from nine to five groups. The Computational Mathematics and Physics group and Digital Printing Centre have in effect merged with Materials Physics, and the Bioenergy group (former Gasification) with High-yield pulping. We also terminated the Organic Chemistry group.
- Jan Andersson's (Acreo) adjunct professorship has been extended with another three years, with a special assignment to be a part of building the development of the development areas **Measurement Systems** together with the STC researchers. Jan has also a strong connection to the innovation
- Mikael Gidlund has now both an adjunct professorship in interaction with ABB and a professorship at STC that will be fully active starting from April 2015. This is an important strengthening of the Strategic Action **EISS** and the connection to the strategic partner ABB.

Number of personnel is 89 at FSCN and 66 at STC. Research groups are given in Appendix A.

New funding Appendix B shows our current project portfolio. New funding decisions received during 2014 amount to 16 MSEK

New infrastructure

- Smart street lights have been erected on the campus by Sundsvall Energi. These will be used in the Strategic Action **KM2** (see Chapter 2.2) to study the performance of small solar cells and develop stand-alone service concepts, such as WiFi hotspots.
- New laboratory facilities for wireless sensor systems and a common laboratory for RF and electronics characterization have been built up. They are shared by the several research groups. The revision of the facilities will continue during 2015 with new investments in equipment and better maintenance organization.

Reference Group

The external Reference Group with experts from both industry and academy were formed with the outspoken purpose of being a support to the strategic process and considerations within the Research Environment. The Reference Groups had its first meeting in April and will continue to meet with the research environment management four times a year.

The reference group consists of the following members;

- Danny Crookes, Director of Research, Speech & Vision Systems Cluster, Queens University, Belfast
- Janne Laine, Dean of the School of Chemical Engineering, Aalto University, Finland
- Örjan Petterson, President, SCA R&D Centre AB
- Jonas Wallberg, Director ICT, Teknikföretagen (The Association of Swedish Engineering Industries)
- Johan Åkerberg, Global Research Area Coordinator, ABB Corporate Research
- Rickard Andersson, Vice President, Bio Technology and Environmental Systems, Valmet Technologies Oy

See Chapter 3.8 for competence development and chapter 5.1 for development of personnel resources.

2.2 Progress in research

Summary

After the Progress Report 2014 was written in March, we have made progress especially in the Strategic Actions **EnergyWiser** (renamed to **EISS**) and **KM2**. In the first case, we sharpened the focus of the Strategic Action according to the feedback on earlier plans and the final evaluation of the KK Profile+ **STC Industrial IT**. The focus was redirected to **Embedded Industrial Sensor Systems (EISS)**. The goal is to enable new methods for condition monitoring and control in industrial processes. Aside from our national partners (e.g. ABB), the technologies developed will also be highly relevant regionally because of strong new partners (Bosch Rexroth) and because of the stimulation of innovations. Vinnova funding has been received to support **EISS**. In **KM2** the project portfolio has grown rapidly. A dozen companies are now working with us, most of them new partners to us. The strongest application direction so far is electrical energy storage in vehicles financed by the Swedish Energy Agency. We are testing our paper-based kinetic energy recovery system (KERS) with the equipment manufacturer STT Emtec. Both **EISS** and **KM2** thus make an increasingly strong contribution in progress towards the current 3-year *Goal #1 Stronger research profile and higher quality* and *Goal #3 Quality of co-production*.

The efforts to strengthen our research profile include the coordination of one proposal (**RadDetec**) to the European Training Network program and membership in another (**CellMat**). **RadDetec** involves 12 partners around Europe in detector technology. **CellMat** failed but a new application with the same consortium will be made next year. Another international EU project **COMPAC** on the plastization of paper has just started. In other developments related to the strength of our research profile and quality of co-production, the final reviews of **STC Industrial IT,** the HÖG10 project on CTMP and the half-time review of Research Profile **e2mp-rp** gave excellent results. The industrial graduate school **FORIC** will start in January 2015 with 15 students as planned.

In relation to *Goal #2 Increased synergies and stronger competences of FSCN and STC*, most of the new projects in **KM2** engage several research groups from both FSCN and STC. **KM2** is thus our strongest synergistic effort. Also in **FORIC** strong cross-disciplinary collaboration was our original goal. However, this turned out to be difficult to achieve because most of the industrial candidates to the program have training in chemical engineering. In **Measurement Systems** we combined initiatives of STC and FSCN into the HÖG proposal **SURF** (see Chapter 3.6).

Next follows more detail account of results achieved under the different Strategic Actions and development areas. All our current projects are listed in Appendix. B.

Energy-efficient manufacturing of mechanical pulp (e2mp)

The focus in **e2mp** is the energy-efficient manufacturing of mechanical pulp. **e2mp** consists of the KK Research Profile **e2mp-rp**, the industry initiative **e2mp-i** (funding from Energy Agency and industry) and the Norwegian part **e2mp-ox**. The target is to save 50% of the currently typical electrical energy consumption of 1500-2000 kWh/t. This can be achieved if the interactions between different unit processes are understood when combining their savings potentials. The half-time review of **e2mp-rp** proved that we are making good progress towards the goals (see Chapter 2.3).

An important complement to **e2mp** is the HÖG13 project **Wood disintegration** (now starting up) that continues the joint research of STC and FSCN on the wood mechanics and control of the chipping process. This project uses the characterization methods developed in **EISS** and **Measurement Systems**. In the previous project Modifiering av flisningsprocessen (see enclosure) we demonstrated clear energy savings in paper mill trials with a new chipping geometry. A new chipping knife is now commercially available. On the academic side, fundamental understanding of wood materials opens up research opportunities in future wood products.

Research on hardwood CTMP manufacture is a very important complement to **e2mp** because it extends our high-yield pulping research from printing papers to packaging materials where the market outlook is good. Another strategic motivation is that the implementation of future fibre-based cellulosic materials to industrial production will require long-term collaboration and accumulation of competence (e.g. on inter-fibre bonding) between industry and MIUN researchers. This is what we do in this area. Last year we had so many highly ranked proposals that the application for HÖG13 **Hardwood CTMP** was left without funding. Luckily Troedsson's foundation decided to finance us in 2014 so that we could maintain our team and the collaboration with industry. A revised application for a HÖG14 project is explained in Chapter 3.2.

Forest as a Resource Industrial College (FORIC)

The Forest as a Resource Industrial College **FORIC** will start in January 2015 with 15 graduate students. The second intake of 15 students will be in 2016. The strategic importance for us is that **FORIC** builds a broad network of companies that build new business on the processing of forest-based biomass. Many of the companies (Ragn Sells, Frontway, Sundsvall Energi) we have not worked with before. **FORIC** establishes a coherent study environment for our industrial graduate students. Parallel to **FORIC** we have started long-term collaboration with the city of Sundsvall to improve resource efficiency in city operations. This is part of the collaboration explained in Chapter 2.1. We believe that the network building around **FORIC** will significantly contribute to regional renewal and improve the chances of success in BioBusiness Arena (BBA). BBA is the Vinn-Växt initiative led by Åkroken Science Park.

Prior to **FORIC** we had a large **FORE** project (Forest as a Resource) with the regional Structural Fund. **FORE** has now ended. Its strategic impact was to increase our competence in the processing of wood-based biomass. The industrial processes studied were the manufacture of biodiesel with gasification (partial funding from the Swedish Gasification Centre), the separation of dissolved polymers from process waters and manufacture of biopolymers thereof, the manufacture of nanocellulose from TMP fines fractions, and the control of three-dimensional fibre network structures. Three bioactive product concepts were developed in **FORE**. Outside our Research Environment, **FORE** increased synergy in the research on forest ecosystem. We now have several pre-studies in progress in order to build new regional projects in the area of **FORE** and **FORIC**, as explained in Chapter 3.3.

Embedded industrial sensor systems (EISS)

The focus of **EISS** is in new embedded industrial sensor systems. The goal is to generate knowledge and competence that can drive industrial transformation through new business models for process

control and condition monitoring. This Strategic Action was previously called **EnergyWiser**. However, the focus and therefore name were changed after the feedback on the earlier plans and the final evaluation of the KK Profile+ **STC Industrial IT**. Aside from our national partners (e.g. ABB), the new focus in **EISS** is highly relevant regionally because of strong partners (Bosch) and because of the stimulation of innovations in the wake of the coming paradigm shift.

Our technology base has been created in the KK Profile+ **STC Industrial IT** and further strengthened in partnership with ABB in the adjunct professor project **Robust**. The combination of embedded sensors to measurement technology is also a highly interesting and innovative area. That is illustrated by the **ORESS** project that develops a completely new electric engine platform with potentially considerably energy savings. Another current example is the use of embedded sensor systems to integrate laboratory measurements with a machine. This is done in a project we run with Bosch Rexroth to verify a failure detector based on the characterization of particles in the machine oil system.

The new KK Synergy plan **Autonomous Systems for Industrial Sensing ASIS** (Chapter 3.4) will form the core of **EISS**. The related service development is already investigated in a large regional project **Remote**. This as well as three pre-studies are financed by the Structural Fund. In addition, we have funding to **EISS** from the Energy Agency and Vinnova. As a part of the collaboration with the city of Sundsvall (cf. Chapter 2.1) we have started pre-studies on the influence of service-oriented thinking on our technology development. These activities strengthen our competence in relation to the Internet of Things area.

Large functional surfaces (KM2)

Our strategic vision in **KM2** is to enable the manufacture of very large areas with electronic functionality that can be used for the harvesting (e.g. solar cells) and storage (supercapacitors) of electricity. In these applications large homogenous layers are needed. We focus on thin films of inorganic materials to produce the desired functions. Thus we are not competing with the traditional printed electronics research that aims at producing electronic circuits usually with organic materials. **KM2** engages researchers of FSCN and STC, and has many aspects that are new to us (e.g. the industrial companies, material systems, coating processes, and laser processing). The scope of **KM2** will be sharpened as our collaboration with the industrial and academic partners builds up. A dozen companies are now working with us in **KM2**, most of them new partners.

The project portfolio in **KM2** has grown rapidly and divided in three main areas: manufacturing processes, vehicle energy systems and IT services. In the manufacturing processes we concentrate on coating with inorganic materials. The project **COAT** that is now ending has developed competence on the coating processes of functional layers. **Paper Solar Cells** will be working on the roll-to-roll manufacture of layered semiconductors, and **Biocomposites** on graphene-nanocellulose coatings. Three regionally funded pre-studies are focused on the creation of a laboratory facility for research on the coating processes. In the area of energy systems for vehicles, the Swedish Energy Agency is funding three projects: **KEPS** develops a graphene-based supercapacitor to meet an industrial specification, **Modulit** is to demonstrate the integration of energy storage and control electronics in one device, and **LION** will focus on the electrodes of lithium-ion batteries.

Two IT service developments are in progress that complement the materials focus of **KM2**. In **ID-POS** we develop RFID technology for identification, positioning and interaction using large functional areas that will **KM2** enable. **Smart City Lights** is another part of the collaboration with the city of Sundsvall (cf. Chapter 2.1). The goal is to determine if stand-alone streetlights using only solar and wind power can be used to distribute community services via wireless signals. This is also a case study for the communication collaboration of the university and the city.

The research team has been very busy with all the new projects. Therefore, little capacity has been left to define the long-term positioning of the **KM2** Strategic Action (internally regarding scope and externally regarding competition) or to develop international collaboration. These areas require further systematic work next year as discussed in Chapters 3.5 and 5.1.

Development area Measurement Systems

In the portfolio of our Research Environment we have a number of projects in **Measurement Systems** that have evolved from the KK Profile and KK Profile+ **STC Industrial IT** and complementary projects. Through the development of the research agenda we want to build **Measurement Systems** into a Strategic Action that makes use of the accumulated broad competence. Current projects focus on environmental and industrial process measurements. The environmental monitoring for wind power farms is developed in the projects **Foggy** and **OnEagle**. Pre-studies in progress aim to connect this line of research with **FORIC** and **EISS**. Of the three projects on industrial process measurements, **Wood disintegration** complements **e2mp** (see above), another one develops **Fibre optics for industrial applications**, and the third, **OnTop 2.0**, is motivated by the coating processes to be developed in **KM2**.
Our international network in Detectors Technology is by far the largest in the entire Research Environment. It is important to use it so connect the regional industry to international partners. In this spirit, we coordinate an application for a European Training Network in Detectors technology. Through adjunct professor Jan Andersson we are also well engaged in the Strategic Innovation Area Electronic Systems of researcher and will prepare applications to the coming calls. There is an ongoing discussion regarding an increased engagement of Jan Andersson as a strategic recruitment for development of the Strategic Action Measurement System.

In the previous Work Plan we had three project proposals that did not receive funding from the Knowledge Foundation. Two of these, **RHINO** and **SPECTRA** have been reformulated and submitted in the ordinary application process, outside the current Work Plan. The third one (**ASKA**) was replaced by a pre-study with the city of Sundsvall. Also these projects build valuable competence to develop the research agenda.

Development area New Cellulosic Materials

We are working to define the direction and future structure of research in this area. This has motivated our strong participation in BioInnovation[2]. This is a Vinnova-funded Strategic Innovation Area where the paper, chemicals and textiles industries are committed to strategic collaboration. Professor Per Edström of FSCN leads the Expert Team Materials. We also recruited Prof. Björn Lindman in order to strengthen our position within surface and colloidal engineering in the planning and implementation of BioInnovation, and other national and international collaborations.

We have considered two manufacturing paths, one of fibrous materials and another of polymeric materials. Both were initiated in the **FORE** project (see above) but are not represented in the first student intake to **FORIC**. In our current projects on fibrous materials, the purpose is above all to see if and how one could extend the usability of webs manufactured on a papermachine. The hardwood CTMP research explained under **e2mp** belongs also to this category. Two other projects are currently running and one new is planned. In **Light-weight Structural Composite from Fibre-based Materials** we determine the factors that limit the long-term durability of materials and structures. Inhomogeneity and moisture-sensitivity are inherent to the natural (wood-based) raw material. In new applications one must be able to accurately specify long-term performance as it is done with other industrial materials. **COMPAC** is an international collaboration that develops means to make paper formable like plastic. The project itself is small but involves us in a new international network of academic and industrial partners, which is strategically valuable.

[2] www.bioinnovation.se

After **FORE** ended we have in polymeric materials only faculty-funded doctoral students and a small project on hemicellulose processing. We were partner in one application to Horizon 2020 which did not get funding. Other collaborative projects are under development as explained in Chapter 3.7.

2.3. Follow-up of the KK Research Action

Completed projects

In spring of 2014 the Research Environment´s quality system was extended to include scientific evaluation of finalized research actions. The final reports were reviewed by external reviewers in the same way as proposals for new actions are evaluated. The half-time report for the KK Profile **e2mp-rp** was also evaluated. The results of these evaluations are summarized in Appendix C. We will evaluate all finalized actions also in the future. The main purposes are learning so that we can develop even better projects in the future, to get input to new research following the completed projects, and insight concerning early action when something is going wrong.

The feedback received on the completed projects will be highlighted in internal follow-up dialogues later this year. Results from the external evaluation of new proposals (to Knowledge Foundation and the Structural Fund) will also be addressed. The feedback sessions will be included in the annual schedule of the quality system

Deviations in on-going projects

The current portfolio of the Research environment has nine KK Research Actions. The majority of them are proceeding according to agreements. We report following deviations:

- One of the partner companies in **e2mp-rp**, Andritz, has decided to leave, and the industrial network will therefore change for the next three years. Discussions with the remaining companies are under way to reorganize the industrial co-financing accordingly.
- In the Adj professor action (**Internationell gästprofessor – Robust Wireless Communication**, ABB now invoices Mid Sweden University for the salary costs instead of as previous when salary was payed by the university. This is according to the agreement, but affects the economic reporting compared to the initial budget.
- Since the ProSpect **Plenocap** (**Penoptisk infångning och beräkningsbaserad fotografering**) funding instrument is meant for an individual researcher, we see a need to extend the project by three month, to end 30 June 2015 instead of 31 March. This allows the researcher acquire teaching merits. The change is will only affect the internal handling of the project since the final report will still be included in the next Work Plan. The co-production partners have accepted this extension.
- Some of the original partner companies in **FORIC** have pulled out due to lack suitable candidate. New companies have filled the vacancies. The start will be in January 2014 as agreed with the Knowledge Foundation.
- Due to errors in company reports, the final report of **ORESS** (On-Rotor Embedded Sensor Systems for rotor-dynamics measurements) will be delayed one week so that signature on right documents can be included. The full final report will be sent separately by the 7th of November 2014.

3. Project portfolio for 2015-2017

3.1. Summary

The project portfolio is the most powerful tool that we have to strengthen our Research Environment and help in the transformation of the industrial sectors and regional ecosystem that we work with. The first part is relatively easy since it involves an evolutionary development of research in close collaboration with established industrial networks. However, as discussed in Chapter 2.1, we must also secure our support and stimulation to the long-term industrial transformation. For that we need

strategy development together with emerging new industries. This challenge underlies the 3-year *Goal #3: **Broader** and more intensive co-production*. Key question thus becomes: What are the companies in emerging industries that we should work with?

Figure 2 shows how we plan to develop our industrial network. In the Core of our research that is already well connected to industry we have the Strategic Actions **e2mp**, **EISS** and **FORIC**. The new actions that are important to co-production with our established partners are the new Research Actions **ASIS, AHYP** and **SURF.** The role of these, like all the other new actions is explained in more detail later in this Chapter. Three more actions extend our Core network. **FORIC** connects high-yield pulping research with companies new to us. **Miljöhorisont** is a large regional program that is planned to engage many research environments at the university, including ours through bioenergy and environmental measurement technology. Finally, **FNMech** initiates collaboration with a new sector within paper industry that is very different from that of our main partners.

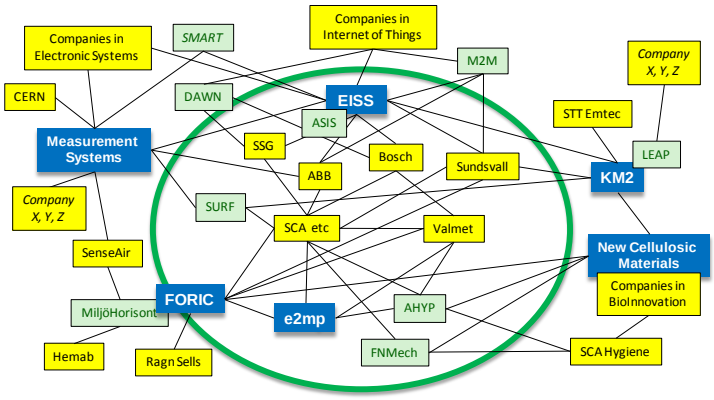

Figure 2: Selected Research Actions inside and outside the Core (green circle) of our Research Environment. The yellow boxes show selected partner companies and lines sharing of competences.

We organize the Edge of our Research Environment under **KM2, Measurement Systems** and **New Cellulosic Materials**. Here the industrial network is more subtle. In **KM2**, electrical energy storage in vehicles shows the most potential for strong industrial collaboration. The proposal **LEAP** aims at building an industrial cluster around manufacturing issues. In **Measurement Systems**, the same is true for environmental measurement systems. In addition, **Measurement Systems** is connected to our Core at **EISS** through three new projects. **SMART** is a large regional program that will enable the application of new measurement solutions in embedded industrial systems. **DAWN** explores methods for high-level analysis of industrial processes (SSG), and **M2M** collaborates with the Edge of the energy sector that has to cope with proliferation of renewable energy sources (e.g. Sundsvall Energi). The development of research in **New Cellulosic Materials** will be guided by the BioInnovation program where main focus will be the use of wood raw material in the manufacture of chemicals, energy and textile yarns. The challenge that remains for us is to strengthen the links between **KM2** and papermaking, especially high-yield pulping. We consider the new projects **AHYP** and **FNMech** as precursors for new fibre-based materials.

We also systematically steer our project portfolio in accordance with the 3-year *Goal #1: Stronger research profile nationally and internationally* and *Goal #2: Systematic development of personnel resources*. We need more projects with national and international collaboration and with competitive funding (VR, FORMAS). Since we already have strong international position connected with the Strategic Actions **e2mp, FORIC, EISS** and **Measurement Systems**, most improvement is expected from **KM2** and **New Cellulosic Materials**. The planned projects also foster young researchers and increase collaboration

between research groups in accordance of *Goal #2*. Appendix D shows what new projects are planned over the three year period to meet *Goal #1* and *Goal # 2*. Appendix A gives a detailed picture how the different groups are involved. The different instruments that we plan to use in the development of personnel are discussed comprehensively in Chapter 5.1
We explain next the plans made for each of the four Strategic Actions and two development areas. All projects that have already secured funding are shown in Appendix B. For the current and proposed KK Research Actions we give also the time-line in Appendix E, and in Chapter 4 explain the significance of new KK Research Actions to the strategic development of our Research Environment. Considering the new research program as a whole, we have two large actions under way (KK Profile **e2mp** and Industrial Graduate School **FORIC**), two KK Synergy proposals (**ASIS** and **LEAP**) as pre-stages for future KK Profiles, and two large regional program in planning phase (**SMART** and **MiljöHorisont**). Actions for competence development are in part embedded in the other KK Research Actions and partly driven in educational programs (**FLEX**) as explained in Chapter 3.8.

3.2 Energy-efficient manufacturing of mechanical pulp (e2mp)

The Strategic Action **e2mp** has long-term funding for a large part of the research. The research profile **e2mp-rp** will proceed to 2017. The industry initiative **e2mp-i** will continue even longer, to the end of 2022. HÖG **Wood disintegration (FLIS)** continues to 2017. In addition to these research actions we have planned a HÖG14 project **Advanced HYP for paperboard** (**AHYP**) and Nordic collaboration in nanocellulose. **AHYP** is important because it extends our High-yield Pulping research to demanding packaging grades. This project will develop the hardwood CTMP process, including the removal of extractives, and the surface treatment of fibres, as well as study the fundamentals of strength formation in high-temperature wet pressing. As discussed above, CTMP research area is strategically very important for us because it extends the application range of high-yield pulps and the related competence. In the future this will include non-conventional products that are targeted in New Cellulosic Materials. The project plan has been improved from last year. Co-production has been very strong in this area, but now it is even stronger because Valmet has joined the project with the help of adjunct professor Thomas Granfeldt. Also the academic resources are stronger than last year in the removal of extractives.

3.3 Forest as a Resource Industrial College (FORIC)

The industrial graduate school **FORIC** will start in January 2015 with 15 companies involved through their graduate students. We believe that **FORIC** will contribute significantly to regional renewal. We work in close collaboration with the BioBusiness Arena (BBA) that connects us to a wide regional network. New regional and national projects will arise from those discussions.

One new regional project to support **FORIC** is currently under planning. This is called Miljöhorisont. Our strategic goal with Miljöhorisont is to combine MIUN forces in the research on the forest resources and to help the regions of Västernorrland and Jämtland in the development of new business opportunities ("bioeconomy") based on these resources. Thus parts of Miljöhorisont obviously extend beyond the scope of the Strategic Action **FORIC** and our joint research environment with its focus on industrial transformation. On the other hand, processing of wood-based biomass and (environmental) measurement technologies are areas where Miljöhorisont will support **FORIC**. Depending on how the scope of Miljöhorisont turns out, we will during 2015 prepare other regional Structural Fund projects that complement **FORIC**.

On the national level, the Strategic Innovation Area BioInnovation will most certainly build collaboration with **FORIC** and also the BioBusiness Arena. Some other regional pre-studies such as *Sustainable Living* with the city of Sundsvall could also become part of our regional counterpart to BioInnovation. As BioInnovation is only starting up it is too early to say when this happens. Currently

the clearest connection between BioInnovation and our research is related to New Cellulosic Materials (see below).

3.4 Embedded industrial sensor systems (EISS)

The purpose of **EISS** is to generate knowledge and competence that can drive industrial transformation through new business models for process control and condition monitoring, in line with visions such as Industry 4.0 (German government) and Smart Manufacturing (US government). This Strategic Action has the drive to change how manufacturing processes is done in industry. The technology base is cyber physical system and Internet of Things and has been established in the KK Profile+ action **STC Industrial IT** and further strengthened in partnership with ABB through the adjunct professorship in the **Robust** project. The technology areas where we will build knowledge are robust wireless communication, energy harvesting methods, in-sensor processing architectures and methods, internet connectivity for the services in Internet of Things. The core of this area is in enabling technologies but also there is a highly interesting and innovative area where the **EISS** technology is combined with **Measurement Systems** development area. Example of these cross field technology includes a project funded by ÅForsk on verifying that **EISS** technology can be used to create new electric engine platform that has potential of considerably energy saving. Other examples include embedded sensor systems that integrate lab measurement into a machine such as the verification project together with Bosch Rexroth on failure detector based on characterization of particles in oil. An important part of this edge area is the involvement in Strategic Innovation Areas of **Electronic Systems** and **Internet of Things**.

The new KK Synergy plan **Autonomous Systems for Industrial Sensing (ASIS)** consists of three subprojects; Energy Harvesting in Industrial Environments, In-Sensor Embedded Processing, and Robust Wireless Communication. For energy harvesting, we build competence in characterization, modelling and the evaluation of harvesting and storage technology for industrial environments. The characterization will be done together with the wireless communication subproject, where also methods for low latency and predictable communication will be developed. For in-sensor embedded processing the focus is to analyse the needs and requirements for embedded processing in embedded sensing. We will then use this knowledge to perform quantitative analysis of computing architectures and to propose suitable architectures.

We will also plan a regional project to develop methods for the positioning of things and people with the aim of better efficiency and security. Another larger regional project (**SMART**) is under planning to support **EISS** with technology from Measurement Systems. The development of efficient production in **SMART** will be enriched by the collaboration with the City of Sundsvall (cf. Chapter 2.1) with a more service-oriented technology development. Funding for the intersection of these two areas will also be applied from the Energy Agency and from two of Vinnova's Strategic Innovation Areas; Internet of Things and Electronic Systems. Finally, we will coordinate international Horizon2020 application (**Smart Cameras for condition monitoring**) for a European Training Network with a dozen partners.

3.5 Large functional surfaces (KM2)

The purpose of the Strategic Action **KM2** is to support industrial transformation and to develop international position in Nanomaterials Systems. In the core of **KM2** is the manufacturing of large functional surfaces by means of coating processes. The efficient manufacturing opens up new opportunities in renewable energy systems (harvest and store electricity) and in IT services (cf. **EISS**). As the project portfolio has grown rapidly (see Chapter 2.2), there are several areas where we need to work systematically. Competence development and new facilities are needed to increase our capacity,

broader industrial network to maximize relevance, and international collaboration to increase speed and to understand competition.

The new KK Synergy plan **Large-Area Electronics Platform (LEAP)** is designed to improve our competence and grow the industrial network. Junior researchers are in charge of two of the three subprojects, which empowers them to lead the development of the research. In comparison to the current projects, especially **Paper Solar Cells**, what **LEAP** adds to **KM2** is glass-on-paper (substrate for electronics), solution coating with metals, and study of layered semiconductors for two applications, field-effect transistors and thermoelectric components. Another strategic motivation for **LEAP** is the creation of a strong industrial network for **KM2**. We already have ten companies engaged but stronger expertise on manufacturing and applications. As in all new areas, companies cannot be recruited without a clear proposal. Since we are still recruiting partner companies to **LEAP**, it appears as preliminary funding allocation in our budget proposal to Knowledge Foundation. Final application will be submitted to Knowledge Foundation in March 2013.

Regional and national funding will be applied for (see App. D) in order to set up experimental facilities for the manufacturing processes and to continue system demonstrations (**City Lights**, together with the city of Sundsvall). Collaboration with Swerea IVF and Smart Textiles (**WIND**) will be explored in 2015 with the target of a joint project application for 2016. In order to speed up the initiation of international research collaboration, we will employ professional partner search. The goal is Horizon2020 funding in 2016. Best chances for competitive national funding are in the nanomaterials area, where we are at the research front with our studies of MoS_2 and graphite composites.

3.6 Development area Measurement systems

Our goal is to see if we can build a coherent research agenda so that **Measurement systems** would become a Strategic Action. Together with **EISS**, this area is motivated by the transformative power of information technology. In the *TIE* vision, IT is identified as a key enabler of transformation. The challenge in the formation of the research agenda lies in the large number of application areas that draw the research in different directions. Flexibility in terms of applications can be great asset in our pursuit of new industrial partners at the Edge of our Research Environment.

At the same time, support to the already established Strategic Actions is also most valuable. This is why we propose the new HÖG project, **Surface characterization of industrial large-area products (SURF)**. It answers to the needs of the Core of our industrial network but at the same time the methods for surface characterization will be needed when the development of the manufacturing processes in **KM2**. Similar driving forces motivate the proposal for a new HÖG project, **Data Analytics in (Wireless) Industrial Networks (DAWN)**. It addresses the need of technology suppliers to process industry, the results from the project will also offer a new possibility for process control on a larger scale than offered by the methods used today by Core companies such as cellulose industry in **e2mp**.

One possible result of the planning process in progress is that the research area must have an intra-disciplinary technological and academic identity that exploits the strong international position that we have but is motivated by the multitude of different industrial needs and opportunities that the industrial transformation will bring.

3.7 Development area New Cellulosic Materials

Our strategic idea with the development area New Cellulosic Materials is identify a specific research area (alike High-Yield Pulping, Embedded Sensors and Nanomaterial Systems) where we can achieve

strong position, and build a Strategic Action that links our research in High-Yield Pulping (**e2mp** and **FORIC**) and Nanomaterials Systems (**KM2**). Strong identity is necessary so that we can contribute to the (coming) developments of new materials in BioInnovation. We explore possibilities along two main paths, fibrous materials and polymers. In fibrous materials the initial focus today's products, but in a manner that creates generic knowledge (competence) which in turn will be crucial for new uses of wood-based fibres. In the area of polymers the focus is in new manufacturing processes that transform wood raw material into industrial polymers. The intersection of these two areas would be composite materials, but that is currently outside of our scope.

Our plans for polymeric materials extend from regional to international level. Our goal is to receive funding for at least one international EU project by 2016. We are now partner in one European project plan **CreaLig** submitted to the NMP call of Horizon2020. The goal is to develop lignin-based polyurethane for design applications. The lignin platform will have strong position in BioInnovation. Research on cellulose dissolution, and manufacture of textile fibres and nonwovens thereafter is in focus in a FORMAS application (**Biobased nonwovens for a sustainable society)** together with Swerea IVF. We will continue to develop this collaboration and include the Swedish School of Textiles under BioInnovation. We have also other collaboration plans especially in the area of water-based cellulose dissolution where Prof. Björn Lindman is now an important resource. We will submit another application (**CELLO**) to FORMAS in order to explore the use of unmodified cellulose polymers in biocomposite applications and as a stabilizer of water-oil dispersions in food, pharmaceutical and paint applications. There is also connection from the above plans to **FORIC** since some of the research topics will be included in the **Miljöhorisont** application.

In fibrous materials we propose one new HÖG project, **Fibre Network Design: Application to Hygiene Products** (**FNMech**). It expands our co-production and research scope beyond printing papers and packaging products. The development of hygiene materials aims at better comfort and functionality (softness, control of fluid flow). Hygiene products are typically of composite layers of textile, nonwoven and fibrous materials, and absorbent polymers. The understanding of real end-use requirements that will be created is a good starting point for the future development of new nonwoven materials. Also the HÖG proposal **Advanced HYP for paperboard** explained above (see e2mp) builds generic knowledge, in that case on fibre bonding. Our current and new planned projects will thus build generic knowledge relevant to the Materials area of BioInnovation. In order to accelerate the creation of new products based on fibrous materials, we will help BioBusiness Arena to establish a prototyping platform that can acquire national position within BioInnovation. The goal is that the concept will be defined by the end of this year and funding arranged next year. We can then use this platform in planning research collaboration with the Swedish School of Textiles and others to start from 2016.

3.8 FLEX and other competence development actions

The **FLEX** project will take in first Master-by-Research students during 2015. The program will give us an important new tool to further improve our coproduction and attract new partners. We have also identified several areas where further develop advanced-level educational programs are needed in order to deliver research students to our Research environment. We will therefore submit several proposals for the KK program IT in Higher Education. One such area is our new "Civilingenjör" program in Chemical Engineering which is organized in collaboration with several universities. The program responds to an urgent industrial need and there is a common understanding that the education structure and organization needs to be changed in order to fulfil this need. Our earlier experience in the development of a completely new distributed engineering program in the area of electric power systems will be utilized. In this type of education collaborations, between industry and several universities, new IT based learning methods have to be developed and customized to the particular needs. Another change needed is in the specialisation direction of our "Civilingenjör"

program in Electronics Design to better match the needs of our industrial partners and the content in our engineering program in Automation. Finally, we are in a pre-study phase to develop a proposal for the KK program Competences for Innovation to support **EISS**. Currently, all these initiatives are under initiation or in pre-study phases financed by internal strategic resources. Some of the pre-study cases are supported by the collaboration agreement with the city of Sundsvall.

Development projects with the city of Sundsvall are explained above (cf. **FORIC**, **EISS** and **KM2**).

4. Strategic motivation for new KK Research Actions

In this chapter we explain (Section 4.1) *WHY* the new KK Research Actions are *crucial* for our long-term goal of building a strong research environment that joins the forces of FSCN and STC, and (Section 4.2) *HOW* they support and stimulate the transformation of the industrial sectors and regional ecosystem that we work with. The quality assessment of each proposal, based on the results of external expert review, is shown in Appendix E. Finally, the priority order of the proposed new KK Research Actions is given in Section 4.3.

All the new KK Research Actions are included in Fig. 2 in Chapter 3.1 where we illustrated how we work in order to both broaden and deepen our industrial network. In the Core of our research we deepen our co-production with important established partners in the industrial ecosystem. A number of actions connect the Core to new opportunities that support business evolution of these partners. Finally, we propose new KK Research Actions that are clearly outside the Core of our research and the Core of our established partners. These actions are in the Edge of our research where established industrial network do not yet exist and industrial transformation is anticipated.

In addition, we have initiated the planning of several new actions for competence development and education (see Chapters 2.1 and 3.8). They will be ready for submission to the Knowledge Foundation with the next Work Plan 2016

4.1 Importance to profiling the Research Environment

a. AHYP: This project generates process knowledge that is important for both improving current paper products and enabling new cellulosic materials to be manufactured on the paper machine (industrial transformation). This project is also crucial for us because of the intensive and broadened co-production and the fact that it extends our High-Yield Pulping competence from printing papers (the focus in **e2mp**) to packaging products. The collaborative relationship with industry will be critical the day when new product concepts are to be moved from laboratory to pilot and mill trials. The project does not directly aim at such products but develops knowledge (of fibre bonding and control of extractives) that will be needed in new products and thereby strengthens our research profile. The specific research topics in this project have been selected jointly by the researchers from MIUN and the participating companies.

b. ASIS: This Synergy proposal represents the necessary next step in the process of building a Research Profile out of the Strategic Action **EISS**. **EISS** has been chosen as the strategic action in the area of enabling technologies for embedded wireless sensing is an area that we have an opportunity to significantly strengthen our research profile through increasing academic ambitions, improved coproduction and internal synergy. A fully established research profile will significantly drive the industrial transformation through enabling completely new possibilities to process control and also enabling new business models for supplier / producer relations in process control and process surveillance. Apart from addressing the research question in **ASIS**, i.e. investigate how wireless sensor systems can be as good as or better than wired ones used in process control, the partners and MIUN will together refine the research directions so that the industrial relevance in combination with

academic excellence is focused in the establishment of the **EISS** research profile. This will lay the foundation for a Research Profile.

c. DAWN: The project generates knowledge of methods based on BIG data analysis to enable improved process status monitoring and totally new methods for controlling whole processes. This makes the project a fore-runner project how this methods can be used to strengthen the efforts in the Strategic Action **e2mp** to bridge to a global wave front within industrial IT that will eventually affect the core of our research. The project is also test balloons for the building the research agenda for the **Measurement Systems** area, where the **DAWN** project should be regarded as critical for the future.

d. FNMech: The most important strategic merit of this project is that it raises the position of our research in terms of strong technical expertise and high academic quality in an industrial area where most growth is predicted in the future but little academic is present. The industry in hygiene products has very deep (but proprietary) expertise. Still there are important issues where fundamental understandings are lacking. We will provide the answers. The improvement of hygiene products aims at better comfort in terms of properties that are shared by many textile and nonwoven materials. Thus the project will significantly strengthen our position within BioInnovation and the development of New Cellulosic Materials. The specific research topics in this project have been jointly selected by the researchers from MIUN and the participating companies.

e. LEAP: This Synergy proposal represents the necessary next step in the process of building a Research Profile out of the Strategic Action **KM2**. Already when choosing **KM2** to be a Strategic Action we recognized that this is an area where we have the opportunity to significantly strengthen our research profile through increasing both academic ambition and internal synergy. When successful, **KM2** will also drive industrial transformation through completely new product and manufacturing concepts. The research plan in **LEAP** is the first one that shows the role of different research topics and research groups in a long-term research plan. With it we can recruit different companies to participate. During **LEAP** project, the partners recruited will work with us to refine the research directions so that its industrial relevance is secured. This will lay the foundation for a Research Profile.

f. M2M: This project builds knowledge about a challenge that all industry will face when the energy system will move from few stable energy producers to a large set of heterogeneous energy sources. When we have energy systems that is less stable than the one we have today, the industry will need to integrate their control into a smart grid technology and to be reactive to the fluctuating prices and energy availability. This is a project that starts to build knowledge that will be important for building the Strategic Action **EISS** but also generate knowledge that can be used to formulate future challenges in the **e2mp** industry context. The specific research topics in this project have been selected jointly by the researchers from MIUN and the participating companies.

g. SURF: The project generates knowledge about for improved process control of large surface production. The project focuses on characterization of both exciting (as addressed in **e2mp**) and future materials (as addressed in **KM2**) and features on large area products based on cellulosic material or other materials. This way the project the project has a good combination of high academic ambition and process improvements in coproduction. Thus the project will strengthen our position within industrial measurement and the development of research agenda for **Measurement Systems**. The project has an important role in the integrating the two research centres and the different Strategic Actions. The specific research topics in this project have been selected jointly by the researchers from MIUN and the participating companies.

4.2 Impact on the industrial transformation

The common Core for FSCN and STC is the focus on resource efficiency in industrial processes. The definition of Core projects is especially based on the *TIE Vision*, exploiting the competitive advantages of the region and supplying Supply competence and skills to the industries we work with (cf. App. H). The proposed HÖG project **AHYP** and **FNMech** are proposals from FSCN that have a strong motivation from the vision. Also the HÖG project **SURF** and the Synergy proposal **ASIS** from STC belong to this category. All of these have been planned in collaboration with strategically important industrial partners who are well experienced in coproduction.

The Core constitutes of a common critical mass available at Mid-Sweden University and its industrial partners. The TIE Vision on the other hand is challenging the Core by introducing a transformative ambition and turning our lenses from the Core to the periphery i.e. following the TIE Guideline – *Adapt to changing markets.* This does not mean that the Core competence and research is less important. It simply states that we cannot settle with just the Core. We also need to define aggressive research goals at the moving Edge.
The 2015 portfolio of new KK Research Actions contains two projects that fall into the above category of Edge projects; **DAWN** and **M2M.** Both projects targets essential and important issues for the future of industrial IT and industrial services. They can be regarded as fore-runner-projects loosely related to the core of our research but providing a bridge to a global wave front within industrial IT that will eventually affect the core of our research. These projects are also test balloons for the emerging field of research currently labelled **Measurement Systems**.

The forest industry is providing a renewable material with many strong and interesting properties. It is clear that we need to replace petroleum-based materials with renewable materials. The targeted Edge research area of FSCN, New Cellulosic Materials, will address these issues. It is clear that a multidisciplinary approach is needed. FSCN is currently developing such a research agenda and it will be part of our portfolio of KK Research Actions in the future.

There are several technology sectors where large-area functionality has been identified as an important enabler for innovation. For example, efficient energy harvesting of solar energy and thermoelectric power, large area light sources and sensing devices for positioning applications. The thematic research field of large functional surfaces combines research competences of STC and FSCN. This is why we have started the Strategic Action **KM2** that clearly fits the TIE Guideline – *Profile the most exciting future opportunities*. The Synergy proposal **LEAP** is under development in this area but the coproduction consortium is not yet sufficient, and the faculty has therefore decided that it will be submitted to the Knowledge Foundation later when the consortium is ready. This is expected to happen in March 2015. The coproduction in Edge projects is the inherent challenge in the TIE vision and we need to boldly address it due to its importance for the transformation process embraced in our vision.

4.3 Conclusions

Based on the strategic importance to our research environment (Section 4.1), the results of the external quality review (cf. App. E) and the role in industrial transformation (Section 4.2), Mid-Sweden proposes the following new KK Research Actions (ranked in priority order). These have been strategically verified by the Research Environment's Reference group that all projects develop our research towards the vision described in TIE.

1. SYNERGY **Autonomous Sensors for Industrial Wireless Sensor Networks (ASIS)** – for its role in building up the Strategic Action **EISS** and its importance to our Core industrial partners.

2. HÖG **Advanced HYP for packaging board (AHYP)** – for its industrial importance and its position in the Core of the Research Environment.
3. HÖG **Surface characterization of industrial large area products (SURF)** – for the synergies established within the Core of Research Environment and the development of a research program in **Measurement Systems.**
4. HÖG **Fibre Network Design: Application to Hygiene Products (FNMech)** – for its scientific quality and its position in the Core of the Research Environment.
5. HÖG **Data Analytics in (Wireless) Industrial networks (DAWN)** – this is a combined Core and Edge project with strong links to **EISS** and it also supports the emerging field of research currently labelled **Measurement Systems**.
6. HÖG **Reliable and Secure M2Mmunication in Cyber Physical Systems (M2M)** – for its edge character utilizing IT as an enabling technology of increasing relevance in our region and its Core industries.

The proposal for **Large-area Electronics Platform (LEAP)** will be submitted in March 2015 with the Progress Report 2015.

5. Plan for organizational development 2015-2017

In the 3-year plan 2015-2017 we identified two important development areas for our organization, *Goal #2: Systematic development of personnel resources*, and *Goal #4: Efficient organization characterized by a well-functioning quality system*. The corresponding implementation plans for 2015 are discussed in Sections 5.1 and 5.2, respectively.

5.1 Personnel and other resources

Competence development

One of the findings of ARC13 was the need for clear carrier paths for junior researchers and a program for competence development at university level. The evaluation also pointed at the importance of mobility of junior research staff. As a result, Mid Sweden University starts in April 2015 a new two-year 50 MSEK program to train talented junior researchers to become research leaders. The programme has 28 positions, of which the NMT faculty will appoint 14. Alignment with the research strategy of the university is required. We expect that some of the young researchers in our Research Environment will be admitted to the program. The KK Synergy proposals and two HÖG proposals for 2015 also include a clear focus on the career development of young researchers, as explained in Chapters 3.4 and 3.5 and summarized in Appendix D.

Recruitments

By 2020 two of our professors working in mechanical pulping and three professors in materials technology will retire. Therefore we will prepare a plan for senior recruitments during 2016-2020. We want to use the recruitments for two purposes, to build stronger research profile nationally and internationally, and to develop co-production. This means that we will look for individuals with both strong academic credentials and industrial experience. In some rare cases one person is strong in both respects. Industrial experience supports MIUN goals in undergraduate education while academically merits increase MIUNs attraction in graduate education.

Collaboration between our Research Groups is an important mechanism to maximise the impact of strong professors. As shown in Appendix A, especially the Strategic Actions **FORIC**, **EISS** and **KM2** are fruitful in this respect.

International visitors and post-docs

Visiting professors and post-docs are an important resource to support the organisation and its pursuit to international and national collaboration and position (*Goal #1*). Our target is to have on the average two visiting professors of this calibre. Currently Björn Lindman in the Surface and Colloidal Engineering group is the only one. New visiting professors are under planning to High-Yield Pulping, Embedded Sensors and Nanomaterial Systems. Always when possible, we use the funding instruments provided by Knowledge Foundation. In practice this is limited to the Core areas of our research where the industrial network is sufficiently strong for the co-financing.

We also need to increase the number of national and international visiting post-docs. Currently we have five post-docs at STC, but none at FSCN. The ambition level defined in the 3-year plan 2015-2017 implies that especially post-docs who support **EISS** and **KM2** are important. Our target level is that by 2017 we have on the average four post-docs per year enrolled in our Research Environment. One element in our collaboration with the city of Sundsvall is that the city will support international professors and post-docs in areas that increase the visibility of the city and the university. We will also increase the number of short-term visitors, such as seminar and conference speakers; see Communication plan in the next Chapter.

Competence from industry

We plan to keep on recruiting 1-2 new adjunct professors per year. The Research Groups that already have a strong body of adjunct professors are High-yield Pulping (in connection with **e2mp**) and Measurement Systems (in relation to our CERN collaboration). In Embedded Sensors we have one adjunct professor that will end the coming spring. Thus we will especially work to find and recruit adjunct professors in Wireless Communication, Embedded Measurement, Industrial Measurement, Material Physics, and Surface and Colloidal Engineering, for the needs of **KM2, EISS** and **New Cellulosic Materials**. In **KM2** we need more capacity to build industry relations and build a network of companies. Our plan is to organize a Business Innovation Day for this purpose, with the same model as in October 2014.

New research infrastructure

Following investments are being planned:

- Modular coating equipment (starting 2016) in order to be able to develop and test the functional coatings, and demonstration facilities (the project **City Lights**) both in **KM2**
- Wireless communication laboratory (starting 2016) in order to complete the facilities for the characterization of embedded sensors that are under construction for the needs of **EISS**
- Investment strategy for renovation of the clean room for the needs of **Measurement Systems** (also motivated by **KM2**), and expansion of laboratory space for the characterization of industrial measurement systems.
- Prototyping facility for 3D forming of sandwich structures of cellulosic materials under the auspices of the BioBusiness Arena, motivated by **New Cellulosic Materials**, national opportunities within BioInnovation, and the demonstration needs of **KM2**.

5.2. Management processes

Strategy process

As explained in Chapter 2.1, during 2014 we have worked with our Reference Group in order to establish the strategic framework for the development of our Research Environment. The framework is based on the concepts of Core and Edge developed by Hagel and Brown (cf. "*The only Sustainable Edge"*, 2005). Their analysis is applied to our *TIE Vision* in Appendix H. The analysis especially calls for us to learn to evaluate the frontline of technology and systems development on the global level and to create future scenarios based on that analysis. Better understanding of our alternatives is

needed to guide the development of e.g. the Strategic Action **KM2** that is directly linked to global transformation in energy supply. We will use this area as a pilot case for our strategy process.

During 2015 we will start developing the following components to the strategy process:

1. Future scenario process:. We use **KM2** as the pilot case in collaboration with the regional and national innovations systems (BioBusiness Arena, Fiber Optic Valley, and ACREO/ Vinnovas Strategic Innovation Area Electronic Systems). On the international level professional partner search will be employed in order to form a SWOT analysis of the research landscape. In the other areas we will at the first stage engage in the national processes driven by Vinnova's strategic innovation areas BioInnovation, Internet of Things, and Electronic Systems. Our Reference group will be very important in the designing and monitoring of the future scenario process.
2. Strategic feedback from Research Actions. The formats for project evaluation will be developed to include sharper strategic dialogue with researchers. The purpose is to systematically (1) collect learning from projects to the strategy development, and (2) discuss the drivers that strategy development creates for the formulation of new Research Actions.
3. Open strategic forums. The matchmaking system in the Science & Innovation Days provides a basis for strategic discussions with new partners in emerging areas. It will be further developed to support the strategic process. The seminar series on business development that FSCN and BioBusiness Arena have run will be reformulated to cover all industrial sectors that we work with.
4. Research on industrial transformation. We believe that it is valuable to use collaboration with researchers on industrial transformation processes in order to further strengthen our strategic framework (App. H) and the approaches we use in our strategy process. During 2015 we will explore how such interaction can be organized with the relevant research groups at Mid Sweden University.

Communication plan

Internal communication

- The internal website is the highest priority for 2015: During 2015 Mid Sweden University establish a common internal website for the university. Such infrastructure will further increase the communication efficiency within the Research Environment. The internal website will display continuously information regarding external events, internal seminars, deadlines related to the internal processes, internal progress reports, and links to internal documents and contracts.

External communication

- **Communicating the TIE profile and the joint efforts by the research centres STC and FSCN**
  The target will be to build a communicative identity of our joint Research Environment. The TIE vision provides the initial framework and long term ambition, and the Strategic Actions and its relation to the Core and the Edge of our profile provides the body of the Research Environment. The links in coproduction and synergies between Research Actions, Key Partners and external Innovation Clusters will provide a context for the Research Environment. This context should be described using a form and a structure that is consistent and clear. To establish a common structure and form within the internal and external context of the Research Environment will be our highest priority during the coming three years.
- **External cooperation development**
  An important part of the development is the cooperation with the regional and national innovation systems. The communication process should also include cooperation with the administration and governments at city and county levels and founding agencies. The Faculty has initiated a systematic dialogue with these partners for the strategy development process and here the communication process is included. This platform will be utilized during 2015 to form a common communication strategy in the regional context.

- **External visibility and BID development**
  In 2014 we integrated four conferences, STC Expo, FSCN Day, the Fiber Future conference and the FOV-conference, into one larger conference concept called the Science and Innovation Days. The new conference is a joint effort between STC, FSCN, BioBusiness Arena and Fiber Optic Valley. During 2015 we will further develop the concept. Our ambition is to create an open forum where industrial partners from all aspects of the Research Environment will meet and share their perspectives on the science and innovation. This provides an important forum and melting pot for new transformative ideas in both the Core and Edge of our research profile. An interesting concept introduced in the conference is the Business Innovation Day, where the companies can send in challenges that will be matched with researchers for discussions. Thus, this is a platform to develop new consortiums and to form new coproduction networks. During 2015 we will further develop this event and its communication platform.
- **Communication support for Research Actions**
  The current support for individual Research Actions are related to scouting and packaging of press releases of research and innovations results. In the development of new platforms for learning and communication in the quality system there is also a need to integrate a communication support. During 2015 we will start to formulate a communication strategy for such new instruments of the quality system.
- **International workshops and conferences**
  In 2015 we will start the development of a strategic plan for hosting more international conferences and workshops in areas that are important to the Research Environment. This has to be done in close cooperation with the regional cluster initiatives BioBusiness Arena, Fiber Optic Valley and the new IT cluster BRON.

Portfolio administration and learning

The portfolio administration related to the Knowledge Foundation has been used as model to develop similar quality systems for projects funded by other financiers;

- In early 2014, applications for VR were scientifically evaluated in an review process similar to the KK quality system. The process included a workshop with researchers who are or who used to be engaged as VR reviewers. The system will be further developed in 2015.
- For the new program for EU´s regional funds we are using the quality process to ensure strategic focus in the forthcoming EU portfolio. In this process all research proposals will be scientifically evaluated through an external review process lead by the faculty, while the evaluation administrated by the Swedish Agency for Economic and Regional Growth (Tillväxtverket) will provide evaluation of coproduction and regional impact. In this process we have introduced sharp strategic hearings for early proposals indicating the start point of a strategic coaching process. The process aims to include organized dialogues with the county administrations in both Västernorrland and Jämtland as well as priority discussions with Tillväxtverket before the closure of each call.
- In a research contract with the City of Sundsvall we have developed a coaching process where all new actions are initiated as pre-study project that allows project incubation and coaching during its initial phase. This form allows early stage project ideas to be tested and developed before being introduced to other funding schemes. We believe that this will increase the quality of the initial projects drafts in the initiation process.
- In preparation for ARC13, the faculty organised internal peer review of the Unit of Assessments´ (UoA) self assessment reports in which researchers from different UoA read and commented on each other's reports.

The experiences from working with different models of the quality system bring valuable feedback back to the ongoing work with improving the system. The positive experience from internal panel

evaluations suggests such systems could be used in the learning and sharing process with the Research Environment to grow a common quality culture and share best practice experiences. Such system will be piloted for Research Actions within the Research Environment. The experience from early hearings is also considered for the strategic process of formulating new KK research actions.
The quality process includes internal evaluations of yearly reports from all research actions and external review of final reports.
In discussions within the reference group we have addressed the need for adequate indicators for different aspects in the portfolio i.e. classification of projects and research outcomes including innovation and value delivered to industry. This discussion will continue in the reference group as we propose new measures and indices to be implemented.

One outcome from the ARC13 review was the recommendation to include publication plans in research proposals to ensure dissemination awareness and to benchmark ambitions as well as allow to measure project outcomes with respect of targeted goals. Such actions are planned to be included in quality process during spring 2015.
There is also a need to fine tune some parameters in the formats for the project archives such as classification of research projects (especially different types of EU projects), records of the project history such as time from idea to a ready proposal and the time from idea to funding, log of communication actions and invitations, as well as classifications of the content of coproduction.

The improved structure of the strategic process will also provide significant improvements in the learning process. Important learning processes are included in the future scenario analyses as well as in the strategic dialogues and the planed open strategic forums.

6. Budget proposal to Knowledge Foundation for 2015

For 2015 we propose seven new research actions to be funded by the Knowledge Foundation; five HÖG and two KK Synergi projects. Together with the funding for ongoing projects this would mean a total research funding of 26.3 MSEK from the Knowledge Foundation in 2015. To this should be added 20 % OH coverage for all actions and an additional 3 % OH coverage for actions approved for 2014 or later, targeting costs for the internal Quality System. In all, this summarizes to a total proposed funding from the Knowledge Foundation of 32,1 MSEK. To this sum, the faculty´s contribution of 11.4 MSEK for additional financing of the quality system and coverage of university OH should be added.
The budget for funding from the Knowledge Foundation is summarized in Appendix G. The budget for the KK Research Environment´s Quality System is presented separately and includes management, implementation and organisational developments as described in Chapter 5.

Appendices

Appendix A Strategic impacts of new projects
Appendix B Current portfolio of externally funded projects
Appendix C Final Reports of finished KK Research Actions
Appendix D Impact of new projects towards 3-year goals
Appendix E Portfolio of KK Research Actions 2011-2017
Appendix F Evaluation of proposed new KK Research Actions
Appendix G Budget funding from Knowledge Foundation
Appendix H Development of a Strategic Framework for the Research Environment.
(Summary of Hagel and Brown applied to TIE Vision)

Appendix A. Strategic impacts of new projects

The following table lists all the research groups that belong to the joint research environment of STC and FSCN, and the Strategic Actions and new development area they are involved in. Under each of these, we show all the projects that are currently planned to be running during 2015, with the new projects that start next year in red font.

Research groups and integrating projects 2015

		STRATEGIC ACTIONS				DEVELOPMENT AREAS		
RESEARCH GROUP	**GROUP LEADER**	**e2mp**	**FORIC**	**EISS**	**KM2**	**Measurement technology**	**New Cellulosic Materials**	**Other**
High-Yield Pulping	Per Engstrand	**Leader** e2mp, AHYP	**Leader** FORIC				AHYP	
Techn Design	Per Gradin	FLIS						
Bioenergy	Wennan Zhang		FORIC, SFC, Miljöhorisont					
Visual Sensor Systems	Mattias O'Nils	FLIS	SURF	ASIS, Foggy, SMART, Haveri	SURF	Foggy, SURF, SMART, FLIS, Haveri		FLEX
Radiation Sensor Systems	Christer Fröjdh		Miljöhorisont			X-ray, KROM, Miljöhorisont		
Detector and Photonics	Göran Thungström		Miljöhorisont		LEAP	Detectors, Miljöhorisont		
Sensor Network & Security	Tingting Zhang		DAWN	ASIS, DAWN				
Sensor based Services	Mikael Gidlund			Robust, ASIS, M2M				
Wireless Sensor Systems	Bengt Oelmann		Miljöhorisont	**Leader** ASIS, PMDC				FLEX
Power Electronics	Kent Bertilsson			kW Power conv	kW Power conv			
Realistic 3D	Mårten Sjöström					Plenocap		
Printed Sensor Systems	Johan Sidén			ID pos	ID Pos, Paper Solar Cells			
Material Physics	Håkan Olin				**Leader,** Paper Solar Cells, KEPS, Modulit, LION, LEAP			FLEX, Si Vestra, Kubal
Comp Math and Physics	Per Edström				Paper Solar cells etc.		BioInnovation	
DPC	Mattias Andersson		SURF		Paper Solar Cells etc. LEAP	SURF		
Complex Materials	Tetsu Uesaka		FORIC		Biocomp, LEAP		Reliability, COMPAC, FNMech	
Surface and Colloid Engineering	Magnus Norgren	AHYP	FORIC, Uniclean 2.0, Miljöhorisont				COMPAC, AHYP, BioInnovation	
Ecochemistry	Erik Hedenström		FORIC, **Leader** Miljöhorisont					

Appendix B. Current portfolio of externally funded projects

Project portfolio sorted by strategic actions.

Project	Project leader	Financiers	External funding, SEK	Schedule
e2mp and related				
e2mp Research Profile	Per Engstrand	KK-Stiftelsen	36 000 000	2011-2016
e2mp Industry initiative	Per Engstrand	Energimyndigheten	10 927 500	2012-2015
Avsalumassa av CTMP	Gunilla Pettersson	Troedssonfonden	1 026 000	2014-2015
SUM			**47 953 500**	
FORIC and related				
FORIC Industrial Research College	Per Engstrand	KK-Stiftelsen	15 000 000	2014-2021
Miljöhorisont - Förstudie	Erik Hedenström	EU mål 2, MIUN	365 000	2014
Uniclean 2.0	Håkan Edlund	LST	1 500 000	2013-2015
Tillverkningsmetod - Förstudie	Magnus Norgren	EU mål 2, MIUN	241 136	2014
Pheromone brewery	Erik Hedenström	Formas	350 000	2012-2014
Svenskt förgasningscenter	Wennan Zhang	Energimynd/Chalmers	5 700 000	2011-2017
Bränsleflex	Wennan Zhang	LKAB	450 000	2012-2014
Biofuels 2030- - Förstudie	Wennan Zhang	EU mål 2, MIUN	150 000	2014
Lignofuel - Förstudie	Armando Córdova	EU mål 2, MIUN	183 000	2014
SUM			**23 939 136**	
Renewable energy systems from large surfaces: KM2				
COAT	Håkan Olin	EU Mål2, LST	5 535 154	2013-2014
KEPS	Sven Forsberg	Energimynd, LST, BRS	10 000 000	2013-2016
Paper Solar Cells	Håkan Olin	KK-Stiftelsen	5 334 000	2014-2017
Modulit	Acreo Swedish ICT	Energimyndigheten	2 000 000	2014-2017
Blixtsintring - Förstudie	Mattias Andersson	EU mål 2, MIUN	196 000	2014
KM2 Smart Street Light	Håkan Olin	EU mål 2, MIUN	300 000	2014
ID Pos	Johan Siden	KK-Stiftelsen	2 904 440	2014-2017
kW Converters	Kent Bertilsson	KK-Stiftelsen	2 513 396	2014-2017
Several projects printing	Mattias Andersson	Different financiers	1 300 000	2014
Projects on optics, illumination	Mattias Andersson	Kempestift, B Svenssons	850 000	2013-2014
2D Inks	Sven Forsberg	Vinnova	640 000	2014-2015
Kisel-kolkompositanoder för litiumjonbatterier	Joakim Bäckström	Energimyndigheten	7 692 769	2015-2019
SUM			**39 265 759**	
New cellulosic materials				
Hemicellulosa	Magnus Norgren	Processum	50 000	2013-2014
COMPAC	Bo Westerlind	EU/WoodWisdomNet	1 100 000	2014-2016
Professur Stukturmekanik	FSCN	Bo Rydins Stiftelse	7 700 000	2007-2015
Nya pappersmaterial, kompositer	Bo Westerlind	SCA R&D Centre	2 200 000	2013-2015
Morfologistudier biokomposit	Christina Dahlström	ÅF Forskningsstiftelse	500 000	2014-2015
Reliability of fiber-based materials	Tetsu Uesaka	KK-Stiftelsen, SCA R&D	4 334 323	2014-2017
Eurostar Paperboard	Armando Córdova	Vinnova	687 635	2012-2014
SUM			**16 571 958**	

Project	Project leader	Financiers	External funding, SEK	Schedule
Embedded Sensor Systems: EISS				
MobiSense - NFC för enkel och intelligent informationshantering via smarta telefoner	Johan Sidén	EU mål 2	880 000	2013-2014
Remote - Demonstrator- och coachningsprojekt för att skapa bredbandstjänster	Mattias O'Nils	EU mål 2	3 450 000	2013-2014
KITT - Kontextinformationsdelning för IoT-Tillämpningar	Ulf Jennehag	EU mål 2	1 300 000	2012-2014
Co-op in Enabling Improved Prod. & Safety in Underground Mines between Sweden and South Africa	Mikael Gidlund	STINT	149 000	2014-2015
Robust Wireless Communication	Mikael Gidlund	KK-Stiftelsen	874 860	2013-2015
MakeSense!	Johan Sidén	EU Botnia Atlantica	150 000	2014
Haveridetektor	Mattias O'Nils	Vinnova	497 935	2014-2016
Permanent Magnet DC	Peng Cheng	Ångpanneföreningen	700 000	2014-2015
Luftkvalitet	Bengt Oelmann	Sundsvalls Kommun	234 000	2014
SMART	Mattias O'Nils	EU mål 2	250 000	2014
OnTop 2.0	Mattias O'Nils	Vinnova	150 000	2013-2014
SUM			**8 635 795**	
Measurement systems				
PlenoCap - Plenoptisk infångning och beräkningsbaserad fotografering	Roger Olsson	KK-Stiftelsen	2 102 344	2013-2015
HET - Högteknologiska E-tjänster	Mårten Sjöström	EU mål 2	1 680 000	2013-2014
FUNKKVYZ - Visualisering i Mellannorrland - förstudie	Mårten Sjöström	EU mål 2	250 000	2014
Semiconductor Radiation Detector Platform	Christer Fröjdh	Vetenskapsrådet	200 000	2014
KROM	Börje Norlin	Sundsvalls Kommun	170 000	2014
Foggy - Avbildande mätmetod för bestämning av luftens innehåll av flytande vattenpartiklar	Benny Thörnberg	Statens Energimyndighet	4 450 660	2013-2016
IRPrint -Ink-jet tryckning av detektorer för infrarött ljus	Henrik Andersson	Ångpanneföreningen	300 000	2013-2014
Gränslös miljö för Innovation, Forskning och Utbildning - GIFU	Benny Thörnberg	EU Interreg	2 523 300	2012-2014
FLIS	Benny Thörnberg	KK-Stiftelsen	3 326 902	2014-2017
Fiberoptik för industriella tillämpningar	Magnus Engholm	EU mål 2	1 710 000	2012-2014
SiC för nya detektortillämpningar	Göran Thungström	Vinnova	300 000	2013-2014
HYCK	Göran Thungström	EU mål 2	395 000	2014
SKALBAR	Magnus Engholm	EU mål 2	500 000	2014
SUM			**17 908 206**	
Education				
Flexibel Master-by-Research	Bengt Oelmann	KK-Stiftelsen	3 995 053	2013-2015

Appendix C. Final reports of finished KK Research Actions

Following projects have been finalized during 2014.

Finished KK research actions reported 2014									
Projekt	**Program**	**KKS ID**	**Start**	**Finished**	**Project leader**	**Center**	**Type of report**	**Approved by KKS**	**Evaluated by external reviewers**
Modifiering av flisningsprocessen	HÖG 10	20100178	2011-01-01	2014-03-31	Per Gradin	FSCN	Final		Process started
COINS: Coexistence and Interference Avoidance for Industrial Wireless Applications	HÖG10	20100258	2007-03-31	2010-03-30	Tingting Zhang	STC	Final		Process started
CTMP för kartong	HÖG 10	20100259	2011-01-01	2013-12-31	Gunilla Pettersson Jessica Sjöberg	FSCN	Final	Yes	Yes
ORESS	HÖG 10	20100261	2007-03-31	2010-03-30	Bengt Oelmann	STC	Final		Process started
SysPack	HÖG 10	20100263	2006-12-31	2009-12-30	Hans-Erik Nilsson Håkan Olin	STC/FSCN	Final	Yes	Yes
Faskontrast	HÖG 10	20100264	2006-12-31	2009-12-30	Börje Norlin	STC	Final	Yes	Yes
STC Industriell IT	Profil+	20100318	2007-09-30	2009-09-29	Mattias O'Nils	STC/FSCN		Yes	Yes
e2mp	Profil	20102019	2011-04-01	2017-03-31	Per Engstrand	FSCN	Half time		Yes
Vätska-substrat växelverkan för tryckteknik: ett nanoperspektiv	ProSpekt	20120326	2013-01-01	2013-12-31	Petru Niga Jonas Örtegren	FSCN	Final	Yes	Yes

Final reports enclosed with WP 2015-2017

COINS: Coexistence and Interference Avoidance for Industrial Wireless Applications – Tingting Zhang

Modifiering av flisningsprocessen - Per Gradin

ORESS – Bengt Oelmann

Due to errors in company reports, the final report of ORESS (On-Rotor Embedded Sensor Systems for rotor-dynamics measurements) will be delayed one week so that signature on right documents can be included. The full final report will be sent separately by the 7th of November.

Results from completed evaluation of final and halftime reports for KK Research Actions 2014

Project	Program	Type of report	Review results				
			A	B	C	D	E
CTMP	HÖG	Final	5	4	5	4	5
Faskontrast	HÖG	Final	4	3	3	4	4
Syspac	HÖG	Final	4	3	5	4	4
			5	5	5	5	4
E2MP-RP	Profil	Halftime	5	5	5	5	5
STC industriell IT	Profil +	Final	5	4	5	5	5
Ink Media Interaction	Prospect	Final	5	4	4	4	5

Evaluation categories

A. Overall results and effects

B. Fundamental research results

C. Applied research results

D. Overall scientific quality

E. Objectives and goals

Grading scale

0 - The **project did not adress this aspect** or cannot be judged due to missing information

1 - **Poor**. The project was inadequate or it had serious inherent weaknesses.

2 - **Fair**. While appropriate work was done, there were significant weaknesses

3 - **Good**. The project was good in many ways, but it could have been better in some important aspects.

4 - **Very Good**. The project was very good in all relevant aspects, but still had some room for improvement.

5 - **Excellent**. The project was excellent in all aspects of the question. Any shortcommings are minor

Appendix D. Impact of new projects towards 3-year goals

Here we show new projects planned for 2015-2017 to support national and international research profile (*Goal #1*) and development of personnel resources (*Goal #2*).

Strategic Action / Development area	Start year	*Goal #1*			*Goal #2*	
		Inter-national projects	Prospect for VR or FORMAS funding	National academic collabor-ations	Foster young researchers	Engage several research groups[1]
e2mp	**2015** **2016** **2017**	**Nanocell**				**AHYP, Nanocell.**
FORIC	**2015** **2016** **2017**			**BioInn**[i]		
EISS	**2015** **2016** **2017**	**IoT**[ii] **H2020**[iii]		**SMART**	**ASIS, M2M SMART OnRotor**	**SMART** **ASIS**
KM2	**2015** **2016** **2017**	**H2020**[iii]	**MoS_2**	**LION** **WIND**	**LEAP**	**LEAP City Lights**
Measurement Systems	**2015** **2016** **2017**	**EleSys**[iv] **H2020**[iii]	**Neutron detectors**	**SMART** **H2020**[iii] **Neutron detectors**	**DAWN, SMART**	**SURF, SMART**
New Cellulosic Materials	**2015** **2016** **2017**	**CreaLig** **CellMat**	**Non-wovens CELLO**	**BioInn**[i]		**FNMech**

[i] BioInn –Project in Vinnova's Strategic Innovation Area BioInnovation
[ii] IoT – Project in Vinnova's Strategic Innovation Areas Internet of Things
[iii] H2020 – Project in Horizon 2020
[iv] EleSys – Project in Vinnova's Strategic Innovation Area Electronic System

[1] The internal collaborations between research groups in all projects are shown in Appendix A.

Appendix E. Portfolio of KK Research Actions 2011 – 2017

Ongoing and planned KKS funding, FSCN and STC

2011	2012	2013	2014	2015	2016	2017	2018	2019
Resource efficient production and bio economy: e2mp and FORIC								
PROFIL: e2mp-rp		6,0	6,0	6,0	6,0	1,5		
				Forskarskola: FORIC 3,7	3,7	3,4	1,9	evaluation
				HÖG: AHYP 1,8	2,5	0,6		
Embedded sensor systems: EISS								
	AdjProf: Robust Wireless Com. 0,4		0,5	0,2				
				Synergy: ASIS 2,25	3	3	3	0,75
				HÖG: M2M COM 1,2	1,6	1,6	0,4	
Renewable energy systems from large surfaces: KM2								
		HÖG: Paper solar cells 1,6		2,2	2,2	0,6		
				Synergy: LEAP 2,2	3,3	3,3	1,1	
			HÖG: ID-POS 0,9	1,2	1,2	0,3		
		HÖG: kW Converters 0,8		1,0	1,0	0,3		
New cellulocic materials								
				HÖG: FNMech 0,8	1,1	1,1	0,3	
		HÖG: Light Weight Composites 1,2		1,7	1,7	0,4		
Measurement systems								
	ProSpekt:PlenoCap 0,8		1,1	0,2				
			HÖG: FLIS 1,0	1,4	1,4	0,3		
				HÖG: DAWN 1,2	1,6	1,6	0,4	
				HÖG: SURF 1,2	1,6	1,6	0,4	
Educational programs								
		Master: FLEX 1,2	2,4	1,2				

Appendix H. Development of a Strategic Framework for the Research Environment

Introduction

The Research Environment program from the Knowledge Foundation is unique in the sense that it provides a program for strategic development. From the Research Environment´s point of view the strategic development is a continuous process that needs a strategic framework to guide the development. The starting point for our Research Environment has been formulated in the vision *Transforming the Industrial Ecosystem* (TIE). The vision provides long term goals and an initial strategic framework.

The Research Environment contains two Research Centres, STC and FCSN, that initially had two separate strategic directions. Both directions were and still are important for the regional development. They include two pervasive global transformative technology trends;

- information technology as a key enabler for industrial growth, and
- material technology to enable a bio-based economy.

Each of these directions have to respond to global perspectives and join forces with the global research community in solving research problems of global significance. As a small university we need the courage to contribute in such areas of global importance at the same time as we engage in the regional challenges of our industrial ecosystem. The global perspective and the regional challenge are linked and we believe that there are synergies between them.

Our challenge is not to define research fields of importance, but rather to develop Strategic Actions that will be used to define a portfolio of Research Actions that supports the long term goals expressed in the TIE vision. This challenge can only be addressed in a strategic process and we need to develop a strategic framework and strategic concepts to guide us in this process.

Thus, we need to regard our strategic thinking as forming an image that initially has some contours and some areas with a higher resolution. The strategic process will provided an ever increasing sharpness to the image. Each Work Plan should be regarded as a step forward in this process, including new areas of the image and revision of parts already clearly expressed.

This document is an attempt to summarize our current views on the strategic process and to present the strategic framework that we are currently utilizing when discussing Strategic Areas and defining Research Actions in our Research Environment.

Building a common strategy for STC and FSCN

In 2014 large efforts has been directed towards refining our strategic position utilizing the strength given by the TIE vision and its guidelines for development. Our starting point, the TIE vision, provides an initial framework to guide us in the development of a strategic program for our research. The framework contains six guidelines utilized in the strategic development;

- Exploit the competitive advantages of the region
- Choose opportunities from a global perspective
- Use information technology as a key enabler
- Adapt to changing markets
- Supply competence and skills
- Profile the most exciting future opportunities

The next phase in our strategic development has been to relate the regional TIE framework to a more general theoretic foundation addressing the TIE challenge from a global perspective. We aim for a strategic framework defined from a global perspective utilizing global findings to address the regional strategic dilemma. Thus, our strategic approach will follow the TIE guideline - choose opportunities from a global perspective.

One of the theoretical frameworks supporting the ideas put forth in the TIE vision are given by Hagel and Brown in the book *The only sustainable edge* from 2005 (Deloitte Centre for the Edge Innovation). Hagel and Brown expresses the TIE challenge in the following way: *Analysts and consultants call on businesses to create more value through innovation, yet most companies have been optimized to provide greater efficiency, not greater innovation. As a result, any innovation-driven strategy will likely falter unless we fundamentally reframe our strategic thinking.*

The TIE vision challenges all partners in the research ecosystem, i.e. academia, industry and financing organisations, and we all share the dilemma outlined by Hagel and Brown. In discussing the global dilemma Hagel and Brown states:

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.

The above recommendation, to regrind our lenses, illustrates the difficulty to refocus on the transforming edge and emerging business cases. Academic research, at its best, has the ability to assist in the process of regrinding our lenses. However, even academia suffers from a tendency to narrow down the perspective and focusing on core disciplinary research question where excellence has already been achieved. The rhetorical tool or image used is the cutting edge research, which is envisioned as a narrow peak piercing through a barrier and leading into a new dimension.

However, the *cutting edge* metaphor is most often used to motivate research in the core of an industrial sector. It is used as a synonym to critical mass or the hard core i.e. not the edge of the business but rather the centre. Hagel and Brown argue that the edge should be envisioned as a boundary to the unknown and where we have to regrind our lenses in order to see the opportunity.

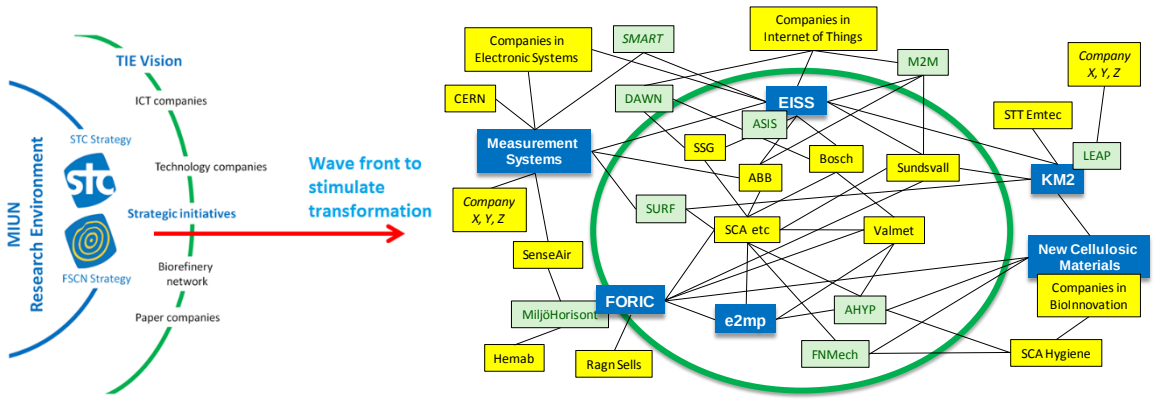

Fig. 1. Illustration on the wave front impact envisioned from the research environment (left) and the corresponding Core and Edge clusters (right). Core Actions are inside the circle and Edge Actions are outside the circle.

Thus, the edge is on an expanding boundary and by definition not so easy to identify. It is more related to a wave front than a point in space. FSCN and STC are identities with two cores, i.e. forest industrial research, and research on industrial IT respectively. We envision the possible impact that these centres can have on the industrial ecosystem as providing a wave front of research that may stimulate and inspire transformation (see the left image above). The visible interference between the

wave front and the industrial ecosystem creates a number of visible interactions linked together in a network structure (see the right image above). The interactions are called Research Actions and are concentrated around Strategic Actions which represents areas of particular importance for the Research Environment.

The Core contains a dense packed network of Research Actions, Key Partners, and Strategic Actions. At the Edge partners are connected to the Core through Research Actions or emerging Strategic Actions such as KM2, New Cellulosic Materials or Measurement Systems. Therefore, our strategic approach should not only be understood as a number of disciplinary cross-sections between STC and FSCN, but rather as a network of Research Actions and Key Partners linked to Strategic Actions that should build knowledge in the Core and stimulate transformation by the Edge.

Exploring Core and Edge in the regional context

In the initial state of our development we have utilize the TIE Guidelines in our strategic discussions and formulated initial principles for selecting Research Actions and future Research Areas. We are step by step expanding this approach with strategic discussions utilizing the strategic framework derived from Hagel and Brown. This approach is in-line with the TIE vision and in addition it adds a scientific depth and a theoretical foundation for the strategic process.

Hagel and Brown highlights that *we must regrind our lenses to monitor the periphery, that is, the edges, of our business.* The inertia of the core can some time hinder important research at the edge and in the boundaries between disciplines.

The core research in each part of our Research Environment has a well-established research tradition with existing key partners. Our strategy for the Core is to maintain and develop these research relations in-line with the TIE Guideline – *supply competence and skills*. At the same time Core research includes aspects of the TIE Guideline – *adopt to changing markets*.

The Edge challenge demands reframing our strategic thinking and new perspectives needs to be derived. Edges are available in many different dimensions and the Edge perspective should explore the boundaries between FSCN and STC as well as the boundaries between our Core partners. Finally, the Edge perspective demands exploring boundaries to other industrial sectors.

Pairs of TIE guidelines can either describe strategic synergies or illustrate a contrast and a challenge between the edge and the core perspective. For example, the globalization and its opportunities demands the ability to develop strategies on the local level, i.e. forming a local strategy to meet opportunities from a global perspective. Strategies have to be relevant on the local level in order to obtain transformative power and be trustworthy on a global scale. Therefore, our strategic development will have to focus on both the Core and its partners as well as on the Edge of the regional Core. A *global input is needed* and the strategic process are suggested to include invitation of international experts to challenge and stimulate the Core in sharp strategic discussions.

Information technology is a global transformative power and regional strategies has to include its opportunities in order to be trustworthy. All industries has to develop strategies for how they will utilize information technology in their operation and future development. As a research environment we have to make sure that we do not fall behind in the area of information technology and therefore the strategic process is suggested to include workshops and cross disciplinary seminars with invited Edge partners and Core industries.

Transformation demands adopting to change and in order to do that competence and skills are needed. Both skills to change and competence to endure is needed. This need may be regarded as obvious, but we think that it is important to stress this in our strategies. By such statement we declare that it is

important to develop research competence in a wider range of industrial sectors, both regionally and nationally. Our research environment will therefore propose initiatives targeting industrial research schools on master, licentiate and doctor levels. To promote such initiatives we aim to arrange open forums where Core partners can help motivate a wider industrial sector to engage in research schools.

Profiling the most exciting future opportunities provides two folded challenges. First, the most exciting depends on perspective. In the TIE vision this Guideline has been formulated in order to attract talent to the region. It is, however, impossible to foresee the future. The future is perceived with eyes of the presence and therefore the most existing future opportunities often tend to coincide with the current trend and most common perspective on the future. In our case the most exciting opportunity needs, by some means, to be relevant for the Core, and in addition be well in-line with established theories on future developments and future opportunities. The largest challenge for initiatives in this category is the formation of a strong industrial Edge team. Therefore the strategic process will have to include open forums where researchers together with Core and Edge partners find ways to develop such innovative long term research projects.

Final remarks and conclusion

It is evident that the strategic development in the Core is significantly different from that of the Edge. The most striking difference is the fact that Core strategies are developed within a tight and well functioned partner group which over time has developed trust in methods and objectives. In order to formulate strategic initiatives at the Edge one has to realize that the Edge is defined by differences and contrasts. Therefore, the strategic process must to be aware of tensions and find its strength in the contrasts. The time perspective in the strategic process at the Edge is much longer than in the Core, on the other hand, the benefits at the Edge may be significantly higher than in the Core.

Eventually the Edge will grow and become a part of the Core. However, initially the Edge needs its own domain to develop and the Core has to provide the time and space needed for the seed to grow. The transformative power from the Edge comes partly from its inner passion and partly from the interaction with the Core. The strategic process needs to ensure a balance between these aspects. In a profiled environment, a significant part of the power in the Edge is its closeness to the Core.

Nevertheless, it is an important conclusion that the TIE vision approach demands special efforts to build a common strategic culture where both Core and Edge partners and researchers feel at home and can contribute in a constructive way.

In order to include the Edge perspective when defining and refining strategies we need to have the courage to invite actors of relevance for a certain edge to envision and sketch the contours of an Edge strategy while embracing the needs of the Core.

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