PROGRESS REPORT 2015

FOR THE RESEARCH ENVIRONMENT AT MID SWEDEN UNIVERSITY

Sensible Things that Communicate

PART OF MID SWEDEN UNIVERSITY

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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.**

Development Area
Initiative to build a new Strategic Action. Currently we have two Development Areas; **Measurement Systems** and **New Cellulosic Materials**.

Research Area / Competence 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 organizational structure. Currently we have two internationally recognized strong Research Areas, High-yield Pulping and Embedded Sensors, and one area, Nanomaterials Systems, where our goal is to reach such a status. "New Cellulosic Materials" and "Measurement Systems" are tentative names for additional Research Areas that are under development.

Research Group
Organizational unit that has a group leader. 18 research groups currently 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 Progress Report 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 areas where we have strong research (the core of our research) concerning issues related to the core business of our partner companies. Edge refers to new areas of research and coproduction that enable new businesses and 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*.

Mid Sweden University in partnership with

Knowledge Foundation

Progress Report 2015
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Photo: Tina Stafrén
Feature: Processing of silicon detectors in the clean room,
STC Research Centre, Mid Sweden University
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Executive Summary

This Progress Report completes the first phase of the development process KK Research Environment at Mid Sweden University. The strategic goal is to build a strong joint research unit based on the research centres FSCN and STC. Together they correspond to one-third of all research at the university. In the years 2012-2014 we have made a large change in our Research Program and implemented a systematic Quality Process. We have created new and transformative Strategic Actions, **Embedded Industrial Sensor Systems (EISS)** and **Large Functional Surfaces** (**KM2**), the latter a joint action of the centres. Two Development Areas were initiated, **New Cellulosic Materials** and **Measurement Systems**. Traditional paper research has essentially ended. As we will show, we have reached most of the goals that were set for the three-year period.

Our vision is to support the Transformation of the Industrial Ecosystem (TIE) – an obvious need for our region and the national forest industry, and a great opportunity for the ICT industry. During 2014, we have continued to clarify and implement this vision in our Research Program. We have started to assess the strategic impacts of research findings and the projects as such. Further improvements are clearly needed so that we can better secure that the selected projects really build a strong research profile. First steps have also been taken towards setting quantitative targets for our organization, e.g. in terms of personnel and scientific production.

Four fifths of our externally funded projects are performed in coproduction with industrial companies. Applied research on the Core issues of our strategic partners in the forest and ICT industries has grown more intensive. These collaborations are increasingly a source for projects that focus on creating business opportunities at the Edge of their businesses. A whole range of qualitatively new partners have been engaged in coproduction with us. This has happened through the Strategic Actions, participation in the national strategic innovation programs, and even through our own conference, the Science and Innovation Days in October. In comparison, systematic efforts must still be improved in order to increase international collaborations and mobility – so that we will be recognized as a truly prominent academic research unit.

Contents

1. Introduction

This document is a summary of main strategic developments and operational changes that occurred during 2014 in the joint Research Environment of FSCN and STC. The focus is on our progress in building a strong research profile. External effects on the industrial ecosystem and society at large (TIE Vision) are not discussed. The report is submitted to the Knowledge Foundation but discusses all our research irrespective funding source. We have considered the remarks made in the Ad Hoc Group report 2014 and those made by the Expert Group in 2014. We have especially strived to make the report simpler than before and still maintaining a clear connection to the structure used in the latest 3 Year Plan and Work Plan.

Chapter 2 considers progress made during 2014 in our research. By systematically developing our Research Program we aim to reach an internationally recognized position. In the 3-Year Plan 2015-2017 we have defined two dimensions of the Research Program that we find central in this pursuit: *Goal #3: Broader and deeper coproduction*, and *Goal #1: Stronger research profile nationally and internationally*. Progress in these respects is discussed in Chapter 2.1. Technical results obtained during 2014 are summarized in Chapter 2.2 and the follow-up of KK Research Actions is in Chapter 2.3. The emphasis in Chapter 2 are in the qualitative content and technical results of our Research Program.

Chapter 3 discusses our quantitative results and other progress in the organizational development. Organizational strength is the second component of a leading research unit. Central goals are *Goal #2: Systematic development of personnel resources* and *Goal #4: Efficient organization characterized by a well-functioning quality system*. The status with personnel development is presented in Chapter 3.1, last year's results of scientific production in Chapter 3.2, and the progress in collaboration and quality system in Chapters 3.3 and 3.4, respectively.

Chapter 4 is intended to give a clear picture of how well we have by the end of 2014 achieved the 3-year goals that were set for the period of 2012-2014 (in "Bilagan till Ramavtalet") and more specifically for 2014 (Work Plan 2014). We have organized this report according to the new set of long-term goals for 2015-2017 even though the reporting period is 2014. There is little real difference between the two set of goals except that the new set of goals has better structure and specificity.

2. Progress in Building Strong Research

2.1 Strategic Goals for the Research Program

In the development of a strong joint Research Environment of FSCN and STC quite a lot of work has been needed on the conceptual framework to secure common understanding of our strategy and of the TIE Vision. In addition, we have systematically worked to improve our coproduction so that it supports the TIE Vision, and strengthens our scientific research profile. These three components are discussed in this chapter.

Conceptual framework

In 2013 we introduced the concepts Strategic Actions and Strategic Initiatives as a way to describe the main research directions, whether already established or under planning. In the strategic planning during 2014, we have agreed upon the following five Strategic Actions:

- **Energy-efficient mechanical pulp (e2mp)** which has de facto been running since 2011,
- **Educational programs** since 2013, with **FLEX** as the core,
- **Large functional surfaces (KM2)** which started in 2014 with a number of separate projects,
- **Embedded industrial sensor systems (EISS)** which combines the actions **EnergyWiser** and **Industrial Communication Systems** presented in the Work Plan 2014, and
- **Forest as a Resource (FORIC)** which was planned during 2014 and launched in January 2015.

Of these five Strategic Actions, **KM2** offers us the most obvious opportunity to build a new strong international research position, as pointed out also in the ARC13 evaluation. The outlook with **e2mp** and **EISS** is to maintain and improve, respectively, our already good international position. **FLEX** and **FORIC** will strengthen our position nationally when it comes to models of competence development and innovation networks.

We have also included two Development Areas (or Strategic Initiatives) in the Research Program:

- **Measurement Systems** (earlier **Measurement Technology**), and
- **New Cellulosic Materials** (originally Advanced Paper Materials)

Measurement technology (sensors) has been the area where we have strongest international collaboration. The purpose of the development action is to renew the research agenda. **New Cellulosic Materials** has evolved from our strategic process to identify how our research can help in the renewal of forest industry. **KM2** is one outcome of this process, positioned to integrate research at STC and FSCN but further away from forest industry. Our ambition with both Development Areas is to strengthen our profile.

Another important conceptual improvement during 2014 is the framework Core vs. Edge. In our discussions with the Reference Group, the Expert Group and the leadership of the Knowledge Foundation it became clear that we must be able to better describe the meaning of our TIE Vision. We used the Core vs. Edge theory of Hagel and Brown[1] to define the framework for transformative research and analysed our Research Program using this Core vs. Edge framework. The challenges differs between the Core and the Edge. Coproduction is a significant challenge for Edge actions, whereas in the case of Core, the strongest interest for coproduction tends to occur in areas of lower academic interest. Thus for Edge projects industrial support is the limiting factor, while for Core projects academic relevance is the challenge.

Our Core research on resource efficiency includes optimization of processes to make better use of material and energy resources, as well as better utilizing IT to enhance resource efficiency. At the Edge we envision research to innovate new cellulosic materials and functional surfaces, as well as rethinking industrial manufacturing on the basis of new enabling IT technology.

Table 2 shows a crude classification of the Strategic Actions (excluding **FLEX**) with respect to the Core vs Edge framework. Notice that the role of a project may vary depending on the industry concerned. For clarity we have included only two industrial sectors in the table. Strategic Actions (such as **KM2** and **EISS**) that rely on new industrial partners in a new technology area (Edge) are the most demanding ones to develop. In comparison, new partners are easier to engage when we already have relevant technology (i.e. Core) from previous research to offer (e.g. **FORIC** and **Measurement Systems**).

Industrial Business							Industrial Business
	EDGE	New Cell Mat FORIC	KM2	EISS KM2 FORIC	EISS KM2 Meas Systems	EDGE	
	CORE	e2mp Meas Systems FORIC	New Cell Mat FORIC	Meas Systems	Meas Systems	CORE	
		Existing	New	Existing	New		
		Coproduction forest sector		Coproduction ICT sector			

Table 2: Role of the Strategic Actions in creating new business (Core vs Edge) to our existing or new coproduction partners in the two main industry sectors that we work with.

[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

Broader and deeper coproduction

Figure 1 shows the distribution in volume of projects that were running during 2014 with respect to different classes of coproduction. About 40% of our Research Actions last year concerned Core issues with established partners, while 47% were new either in terms of Edge issues or new partners. Only 14% (in volume) of the externally funded projects had not defined coproduction partners explicitly in the project plan. As indicated in the ARC13 review, it is important that resources are secured also to such "free" research. Research without any external funding is excluded from Fig. 1. This means that the share of "free" research is larger than Fig. 1 shows. We consider that the current level of "free" research is quite good. A reasonable balance between Core and Edge is important for the industrial transformation (the TIE Vision), although we believe that the share of Edge should increase slightly. Even more important is that the share of new industrial partners increases so that we can improve our position in the national research competition.

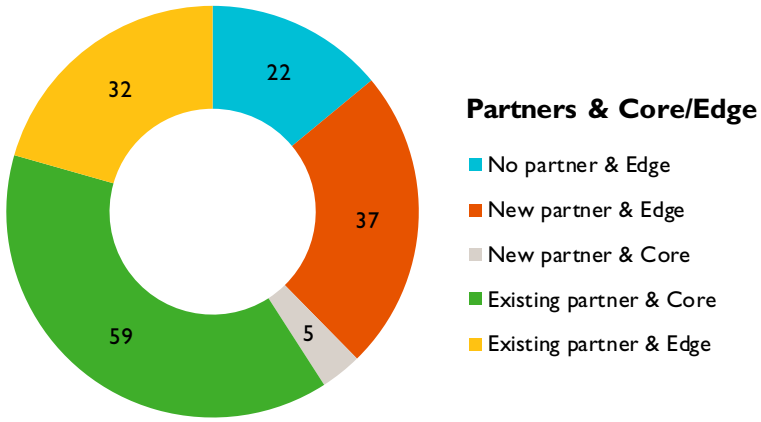

Figure 1: Distribution of research according to coproduction partners (Existing, New or None) and nature of industrial development (Core vs Edge). Numbers give the total volume (in million SEK) of the corresponding projects. NB: The numbers exclude MIUN's own funding that is not used to leverage the externally funded projects.

Looking at our progress, the engagement of new industrial partners outside the forest sector has been a strategic goal. In this respect the three new **KM2** projects that started 2014 with funding from the Knowledge Foundation and Swedish Energy Agency were important. These Edge projects include coproduction with six new "non-forest-sector" companies. On the other hand, we had trouble in completing the **LEAP** consortium. More resources are needed to build the industrial network in **KM2**. This motivates the proposal of an adjunct professor (see Fig. 2 in Chapter 2.3).

Also **FORIC** expands our networks beyond the traditional partners. Strategically the most important coproduction aspect of **FORIC** is that the industrial graduate school has proven to be an efficient model to organize a broad industrial network of competence development, research and innovation. IPR concerns are smaller as the students are employed by the participating companies, and the technology agenda is more flexible as it is composed of thesis projects. **FORIC** is therefore a useful model even for the regional innovation platform BioBusiness Arena[2].

Growing number of regional collaborations with different companies, municipal business units and the innovation networks Bron, Fiber Optic Valley and BioBusiness Arena are being planned throughout our joint Research Environment. These include two large projects (**SMART** and **Miljöhorisont)** and several smaller. A faculty-wide collaboration agreement has been signed with the city of Sundsvall, with seven bi-lateral projects in progress so far.

[2] BioBusiness Arena is a Vinn-Växt initiative led by Åkroken Science Park

The building of the **ASIS** synergy has led to a platform for sharpening and refining the **EISS** strategy through a deeper cooperation with strategic partners. This is further formalized in two proposed recruitment actions (Fig. 2), and three new Edge proposals aim at further broaden the coproduction for **EISS**. Additionally, new partner constellations have been initiated in the project **Internet of Things for Trees** of the national program Internet of Things[3]. Several other new consortia resulted from the partnering event Business Innovation Day in October. Some of them contribute to the **SMART** project.

The company meetings during the Business Innovation Day have also resulted in valuable input to the formulation of a focused strategic agenda for **Measurement Systems**. From these meetings, several pre-studies partly funded by Fiber Optic Valley have led to a valuable broadening of coproduction. An adjunct lectureship (Fig. 2) has been proposed to further formalize that. The cooperation of the city of Sundsvall and Mid Sweden University led to pre-studies in the area of environmental monitoring which then resulted in three new Edge actions. Additionally have intense discussions with Luftfartsverket around their unique concept Remote Air Control Tower resulted in formulations of projects that harmonize the overall strategic refinement of the area. Towards the regional development program, activities from Measurement Systems are taking part in formulating the large projects.

The collaboration with forest industry around **e2mp** is also growing ever deeper. We have significant new applications to the Swedish Energy Agency that will further intensify the applied research on energy savings. The other Core projects (one current and one proposed, Fig. 2) give us a strong role in the active development of CTMP-based packaging materials by Swedish paper industry. The collaboration in these projects is strategically valuable because the future implementation of new materials to full-scale production will require mutual trust and shared competence (on e.g. inter-fibre bonding) between industry and MIUN researchers. As first precursors for future products, the collaboration in **e2mp** has led to two new Edge proposals to the Development Area **New Cellulosic Materials.**

Stronger scientific profile

According to the 3-year Plan 2015-2017 we have two areas of strong competence, High-yield Pulping and Embedded Sensors. Here our strategic goal are, respectively, to maintain and improve international scientific leadership. We also want to establish a strong international position in Nanomaterial Systems. In other words, the Embedded Sensors and Nanomaterial Systems are the two areas where we see the best possibility to strengthen our international position. This was also concluded by the ARC13 evaluators. Below we discuss the new conclusions that have been reached since then.

In High-yield Pulping we have a very strong position in the applied research on energy consumption. However, the international research community is small. Therefore the leadership here does not secure us a strong scientific position in research related to forest-industry. We must broaden our research agenda so that it attracts larger scientific interest. As a typical example, the national program BioInnovation[4] puts most attention in bio-chemicals, bioenergy and new materials such as textiles and composites. We will have a unique position in these areas if high-yield pulping can one of the starting points. Interestingly, the two Edge proposals (Fig. 2) for **New Cellulosic Materials** are of this kind. They combine our High-yield Pulping competence respectively with Organic Chemistry, and with Surface and Colloidal Engineering. The latter two areas are of high scientific interest and offer good opportunities for high-impact publications.

We therefore see a promising outlook for strengthening our strong research profile by combining the applied research in High-yield Pulping (**e2mp**) as the foundation, and **New Cellulosic Materials** as the

[3] www.iotsverige.se

[4] www.bioinnovation.se

area of high scientific impact. Aside from the two proposals mentioned, we already have two KK Research Actions of high scientific ambition, and one international project. These rely on our competence in Complex Materials but have no connection to High-yield Pulping. We need a couple of years to come up with the identity of **New Cellulosic Materials**. National and international collaboration is growing especially in the research group of Surface and Colloidal Engineering.

Regarding the ambition of a strong international position in Nanomaterial Systems, we can show a good track record in scientific publications but lack in international collaborations. One international project application has been submitted. The operational challenge is broad scope of the corresponding action **KM2** that simultaneously includes a large regional innovation component, a national industrial network (**LEAP**) and the international scientific ambition. The planned new adjunct professor will be an important extra resource for **KM2**, but some internal reallocations will also be needed before we can start building a strong international profile in Nanomaterial Systems.

The establishment of the Synergy project **ASIS** has been a breakthrough in profiling the area of **Embedded Industrial Sensor Systems EISS**. This will be a foundation to formulate a research agenda for international profiling together with the recruitments of an international guest professor. Two researchers in the EISS area are enrolled in the university post doc program and will have a two month stay each at selected strategic international partners. Two new actions have complemented the synergy with aspect of Internet of Things technology. The **SMART** project that is under development for the regional development funds has the potential to strengthen both international (includes several international postdoc positions) and national profiles in embedded industrial sensor systems with respect to making sensor/actuators wireless and connecting service intelligence to this. This will complement the other actions from a regional perspective and will attract new coproduction partners that can further refine the strategic agenda.

2.2 Research Results 2014

We next discuss the important research results obtained during 2014 and the questions that require further research (new Research Actions). Aside from the technical issues as such, we show how the current and proposed new projects strengthen our position. Our ambitions vary between the Strategic Action, as was described above.

Energy-efficient manufacturing of mechanical pulp (e2mp)

This research program together with forest industry has grown very strong. The Core is the KK Research Profile **e2mp-rp**. The goal is to save 50% of the currently typical electrical energy consumption (1500-2000 kWh/t) in the manufacture of printing paper grades. The research profile is complemented by a number of other Research Actions funded by the Knowledge Foundation and the Swedish Energy Agency.

The half-time review of **e2mp-rp** was performed during 2014. The external peer review witnessed of high quality and good progress towards the goal of energy savings. On the other hand, the review administered by the Knowledge Foundation questioned our academic ambitions in **e2mp-rp**. The nature of the pilot and industrial-scale experiments limits the relevance of the research outside the area of mechanical pulping. FSCN's strategic plan has been to broaden the scope of high-yield pulping research instead of trying to make the energy-savings research "more academic". The evaluations will naturally be taken into account when deciding about the research content in the second half of the profile.

Of the different research directions within **e2mp**, the engineering mechanics study of the wood chipping process has had the highest scientific impact. Among others the results on the compressive damage of wood were published in Holzforschung. This was jointly funded by **e2mp-rp** and the HÖG project

Flisning that ended last year. The publication of results from two mill trials has been delayed because of IPR reasons. The FSCN-STC collaboration that started in **Flisning** continues in the HÖG13 project **Wood disintegration** and applies the characterization methods developed in **EISS** and **Measurement Systems** for more advanced process control. The fundamental understanding of wood materials could be applicable in collaborations with wood research but this has not yet been explored.

The research on energy-efficient hardwood CTMP manufacture attracts increasing industrial interest. In the **CTMP** project that ended last year, we demonstrated the improvement of inter-fibre bonding with a multilayer treatment. The external project evaluation praised both the fundamental and applied knowledge created. The next project (**AHYP)** is now starting, with focus on the removal of extractives. It involves Surface and Colloid Engineering, which promises increased scientific production. The proposed new KK Synergy (**e2ctmp**) will study the CTMP refining process and an organo-catalytic method to improve the middle-ply strength.

Forest as a Resource Industrial Research College (FORIC)

The Industrial Research College was launched in February 2015 with 14 graduate students. Parallel to the graduate school we have started long-term collaboration with the city of Sundsvall to improve resource efficiency in city operations. We work with the BioBusiness Arena. Two related applications to the Regional Structural Fund are also in progress. Thus the Strategic Action **FORIC** will become a dynamic network of competence development, research and innovation.

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** and the project **COINS**. 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 that 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) forms the core of **EISS**. The related service development is already investigated in a large regional project **Remote**. From pre-studies financed by EU´s Structural Funds, a large project (**SMART**) has been formulated to meet the regional needs in the area. 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 together with projects in the Vinnova Internet of Things Innovation 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. **KM2** engages researchers in 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 project portfolio is very

strong, with funding from the Knowledge Foundation, Swedish Energy Agency and EU´s Regional Funds. Only international collaborations are still largely lacking.
The Strategic Action is divided in three main areas: manufacturing processes, vehicle energy systems and IT services. In the first area, one regionally-funded project ended in 2014. We learned about the coating processes of functional layers. The HÖG14 project **Paper Solar Cells** is in progress to develop the roll-to-roll manufacturing of semiconductor layers. The first results with the semiconductor inks, colour for graphene electrodes and laser sintering are positive. However, our candidate for the photovoltaic material requires more work than we expected to reach good conversion efficiency. Several scientific and technical publications have already been produced.

The Synergy proposal **LEAP** is planned to complete the manufacturing portfolio with the method to "prime" paper surface with a glass film (instead of plastic) and manufacture semiconductor circuits on it. Plans for the laboratory facilities were developed in 2014 and the regional funding applications will be submitted this summer. In the area of energy systems for vehicles, the Swedish Energy Agency is funding three projects that involve national interaction. Two IT service projects complement the materials focus of **KM2**. In **ID-POS** we develop RFID technology for identification, positioning and interaction, and in **Smart City Lights** the integration of IT services in off-grid light posts.

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 the network to connect the regional industry with 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 national program Electronic Components and Systems[5] 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 have been reformulated and submitted in the ordinary application process, outside the current Work Plan. The third one was replaced by a pre-study with the city of Sundsvall and will be included in the regional project **Miljöhorisont**. Also these projects and new coproduction partners from the Business Innovation Day have led to the initial formulation of a sharper research agenda.

Development Area New Cellulosic Materials

We are working to define the direction and future structure of research in this area. As precursors, we have two HÖG projects and one international project in progress. Two other international applications were submitted last year but did not succeed. In the BioInnovation program we have two proposals for innovation projects, and two HÖG projects are proposed for next year. One industry-funded project is starting. Our current projects focus mainly on fibrous web materials. Polymeric materials are to be in

[5] www.smartareelektroniksystem.se

the new proposals. The main purpose in the current projects is to see how one can extend the usability of webs manufactured on a paper machine. In the HÖG13 project **Light-weight** we have experimentally proven correct the initial hypothesis that long-term performance is not controlled by conventional strength or its variability. Surprisingly, the long-term performance of paper materials shows less variability than webs of man-made fibres, despite the large natural variability of papermaking fibres.

All the projects and proposals included in this development area have a solid scientific basis in Complex Materials, Surface and Colloidal Engineering, or Organic Chemistry. Last year we recruited Prof. Björn Lindman to further strengthen our resources in Surface and Colloidal Engineering. We believe that we can build a strong research program from these elements.

2.3 Follow-up of KK Research Actions

The purpose of this Chapter is to report our performance with KK Research Actions. We outline the turn-out of finished projects, and indicate where deviations or problems have occurred in the on-going or currently starting projects. Preliminary plans for new KK Research Actions are also summarized. The current and planned Research Actions are summarized in Fig. 2 and the economic result of 2014 in the subsequent table.

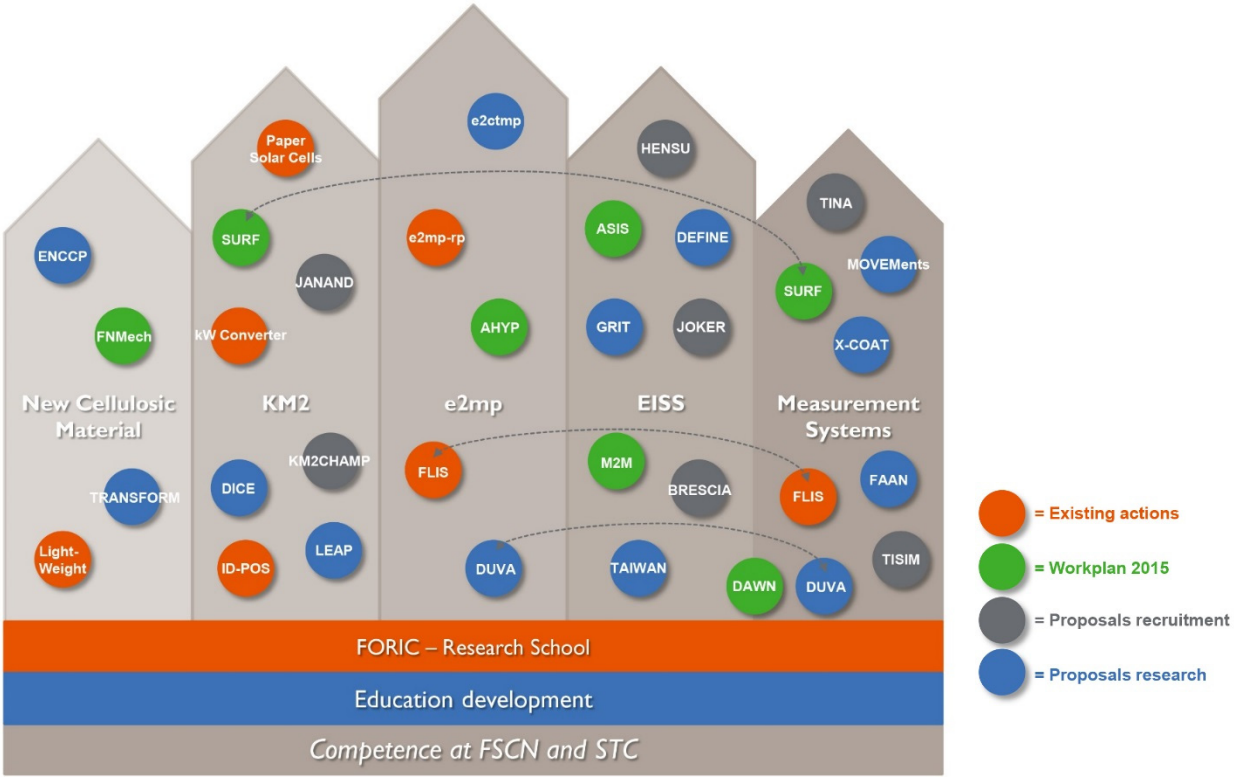

Figure 2: Existing and new KK Research Actions in planning relative to the Strategic Actions. Red colour denotes the existing actions, green those that are now starting (Work Plan 2015), grey new recruitment proposals and blue new project proposals.

Financing from KK-foundation, Mid Sweden University and Companies 2014			
	KK-foundation *Accountancy at MIUN*	**MIUN** *In-kind & direct funding*	**Companies** *In-kind*
Salary costs *(per project)*		*(Salary and other costs summarized)*	
e2mp - rp (Dnr 20100281)	5 200 006	1 482 645	8 128 296
FLIS (Dnr 20130321)	503 857	0	763 000
FORIC (Dnr 20130319)	473 864	0	0
ID-POS (Dnr 20130324)	320 788	0	1 250 000
kW Converters (Dnr 20130323)	504 601	0	743 000
Light-weight structural composites (Dnr 20130320)	901 751	0	3 200 048
Paper Solar Cells (Dnr 20130322)	764 863	0	1 340 250
Plenocap (Dnr 20120328)	648 661	0	865 400
Robust Wireless Communication (Dnr 20120330)	219	55 561	0
Total Salary costs *(excl. overhead)*	**9 318 610**		
Other Costs *(all projects summarised)*			
Equipment	114 809		
Material	190 346		
Travel	560 674		
Premises	892 694		
Consulting costs	626 924		
Other costs *(incl. communication)*	158 905		
Total other costs	**2 544 352**		
Total	**11 862 962**	**1 538 206**	**16 289 994**
Overhead *(approved by financier)*	3 087 918		

KK Research Actions completed during 2014

All these actions have been evaluated by external reviewers, with overall good results. The research projects with major strategic impacts were discussed in Chapter 2.2. The remaining two actions are:

- **InkMedia Interaction** – ProSpekt, Petru Niga: The project produced good scientific results but we nevertheless decided strategically to focus on the **KM2** path instead of printing.
- **Faskontrast, Online characterization with phase- and energy resolved x-rays** – HÖG, Börje Norlin: The project is a precursor for developing the radiation research towards an industrial transformation context. The results are a valuable input into the work on formulating a strategic agenda for the Measurement System area.

Deviations during 2014 in on-going KK Research Actions

- **Energy-efficient mechanical pulping e2mp-rp** – Profile, Per Engstrand: The profile has on purpose progressed faster than originally planned. The plan for the second half is under discussion, based on the evaluations we have received.
- **Robust Wireless Communication** - Adjunct professor, Mikael Gidlund (ending beginning of 2015): The project proceeds according to plan, the only change from the initial plan is that the costs for the candidate is changed from salary to invoiced cost from ABB. This is according to the project agreement and will not change the plan or the overall costs.
- **PlenoCap** – ProSpekt, Roger Olsson (ending mid 2015): Due to increased teaching for the candidate in the project, the project will end a few months later than planned. This still means that the project will fulfil the economical and reporting requirements in the agreement.
- **Paper Solar Cells** – HÖG, Håkan Olin: Slower start-up than planned but will catch up in 2015.
- **Light-weight Structural Composites from Fibre-based Materials, Reliability-based Design** – HÖG, Tetsu Uesaka: Minor delay due to equipment reparation; expect no change in final schedule.
- **Flis – HÖG**, Benny Thörnberg: The project had a late start due to problems with coproduction as earlier reported, the plans has been adjusted to this.
- **kW Converters** – HÖG, Kent Bertilsson: Due to reorganization, Elektronikgruppen decided to withdraw and Elektronikkonsult replaces them. The project budget and plan remain unchanged.

- **ID-POS** – HÖG, Johan Sidén: The project partner SweProd Graphics withdrew from the project its key expert moved to a new company (Atlas Print) that replaced SweProd in the project. The overall budget and project plan need no revision.
- **FORIC** – Industrial graduate college, Per Engstrand: One company is looking for a new doctoral student. Otherwise the program has started according to the agreement.

KK Research Actions in the start-up phase

- **SURF**, Surface characterization of industrial large area products – HÖG, Jan Thim: No deviations.
- **DAWN, Data Analytics in (Wireless) Industrial Networks** – HÖG, Tingting Zhang: One partner (Umetrics) made a large reorganization and left the project. After some work, we identified two new partners that will replace Umetrics. The negotiations will be finalized in the coming weeks.
- **M2M Com, Reliable and Secure M2M Communication in Cyber-Physical Systems** - HÖG, Patrik Österberg: Some delay in the agreement process due to reorganisation at Sundsvall Energi, this will be solved within a few weeks.
- **AHYP, Advanced HYP for paperboard** – HÖG, Gunilla Pettersson: No deviations.
- **FNMech, Fibre network design: applications to hygiene products** – HÖG, Tetsu Uesaka: No deviations.
- **ASIS, Autonomous Sensors for Industrial Wireless Sensor Networks** – Synergy, Bengt Oelmann: The late decision of the project forced a one-month delay in the project start. The revision of project plan and budget has started. To meet this tight time plan, the recruitment of PhD students has been prepared and the companies are prepared for the agreement process.

Planning of new KK Research Actions

The initiation process for new actions started last fall with input from companies meetings and during Business and Innovations Day. From this and from strategic discussions with the researchers on the building of Strategic Actions, the process generated 26 new drafts targeting the next Work Plan. In addition, the Synergy proposal **LEAP** was postponed from the current Work Plan 2015. In the internal screening process together with the Reference Group we have reduced the number of proposals to 21. They consist of 7 recruitment proposals, 2 education development proposals, 10 research projects (HÖG and Prospect) and 2 synergies. They are all shown in Fig. 2. We are also working on two additional plans for education development, one supporting **FORIC** and one supporting research on industrial transformation. Full application will be written for the proposals left in the process and go through the quality process before the final selection.

3. Improvement of Organization

3.1 Development in Personnel and Infrastructure

Researcher capacity

Figure 3 and Tables 1.1.1, 1.1.2 and 1.1.3 show the development of the research personnel during last years. The number of PhD students decreased clearly and the number of full professors slightly. These reductions were necessary because of a reduction in funding caused by the gap in EU´s regional development program in 2014-2015. We have also restructured some of our senior research capacity in order to better support the strategic position targeted.

We have made two senior recruitments (Gidlund and Lindman) in order to support the strategic development in **Measurement Systems** and **New Cellulosic Materials**. Systematic recruitment efforts will be increased in coming years in accordance with the new 3-year goal *#2 Systematic development of personnel resources*. This is necessary in order to strengthen our position but also to prepare for upcoming retirements.

Increased collaboration between the research groups is the essence of joint Research Environment of FSCN and STC. It was therefore identified as one of the three development areas in the previous 3 Year Plan 2012-2014. We now have five KK Research Actions that engage groups from both centres. Current and upcoming regionally-funded projects will also include significant collaboration between FSCN and STC. We therefore find that we have reached the 3-year goal.

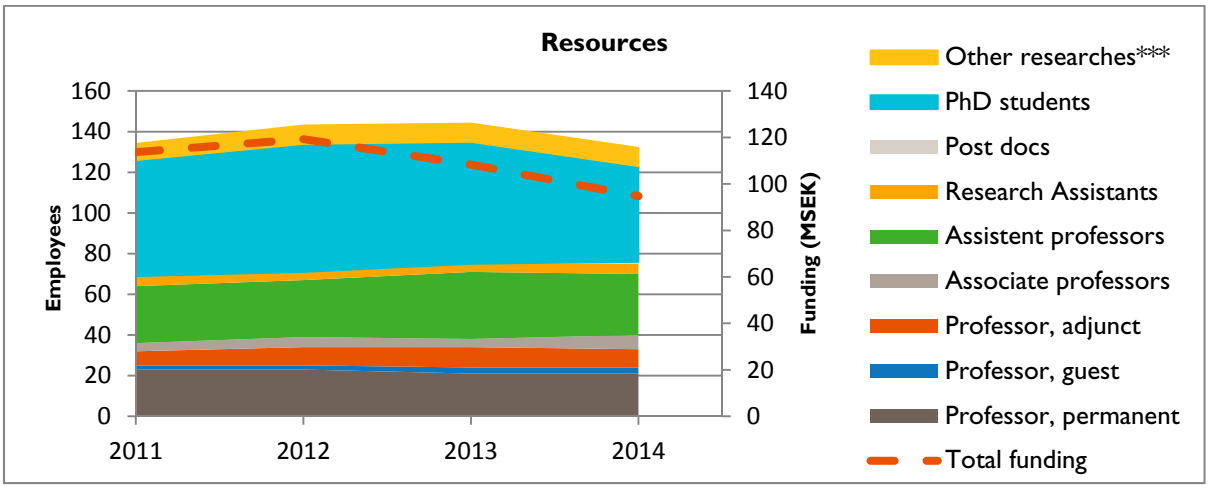

Figure 3: Development of different personnel categories and total funding (dashed line) in 2011-2014.

Table 1.1.1 Doctoral students in the Research Environment

Year	2011		2012		2013		2014	
Gender	M	W	M	W	M	W	M	W
PhD-students	39	18	46	17	46	14	39	8
FTE*	30,72	11,85	35,34	12,22	33,74	12,81	26,43	5,47

Table 1.1.2 Post docs and Research Assistants

Year	2011		2012		2013		2014	
Gender	M	W	M	W	M	W	M	W
Post docs	0	0	0	0	0	0	1	0
FTE	0	0	0	0	0	0	0	0
Research Assistants	2	3	2	2	3	1	4	1
FTE	1,96	1,29	1,89	0,77	2,41	0,92	2,97	1

Table 1.1.3 Assistant Professors, Associate Professors and Professors

Year	2011		2012		2013		2014	
Gender	M	W	M	W	M	W	M	W
Assistent professors	23	5	22	6	26	7	22	8
FTE	15,02	3,87	12,18	5,07	17,81	5,86	14,34	5,84
Associate professors	4	0	5	0	4	0	7	0
FTE	2,91	0	3,66	0	2,8	0	4,05	0
Professor, permanent	22	1	22	1	20	1	20	1
FTE	15,15	0,5	14,72	0,5	13,72	0,48	11,59	0,45
Professor, adjunct	7	0	9	0	10	0	9	0
FTE	0,8	0	1,2	0	1,2	0	1,1	0
Professor, guest	2	0	2	0	3	0	3	0
FTE	1,35	0	0,55	0	1,2	0	1,2	0

* Full Time Equvalent

** Professor denotes persons employed as full professors. Associate professor denotes staff qualified to act as principal advisor for PhD students (docent appointment or similar). Assistant professors denote the rest of staff with a PhD.

Competence development

The ARC13 evaluation identified the support to the career development of young researchers and increased international mobility as the most important development areas regarding personnel. The university is therefore starting a career development program for talented junior researchers with a recent PhD degree. From STC and FSCN 6 persons were elected. The program includes education and a minimum of two months research at some international institution. Another group of broader age profile will be selected this spring to participate in the same courses. During 2014 STC had one KK Prospect running to support the development of **Measurement Systems**. Another one is planned under the Strategic Action **EISS**. FSCN had one KK Prospect in 2013. During the last two years FSCN has lacked suitable Prospect candidates, but the number of applications from FSCN will increase as PhDs start to graduate from **KM2** and **New Cellulosic Materials.**

In April 2015 researchers from STC and FSCN together with the vice Chancellor of the Mid-Sweden University will visit Georgia Tech, North Carolina State University, and University of Delaware to discuss collaboration and strategic outlooks in common research and education areas. FSCN has during four years run a business-oriented seminar cycle, in 2014 together with the BioBusiness Arena, with the title "Forskning möter näringsliv". The purpose is to help researchers learn how industry leaders think about future business development. From fall 2015, ICT industry and STC will be included so that we can learn from the broad spectrum of companies that we work with. The seminar program will also be coordinated with the conference Science and Innovation Days.

International visitors and post-docs

Our goal by 2017 is to have four post-docs per year. STC is doing well in this respect, with two international visiting scientists during 2014 and two international guest professors (Liguori and Sisinni) planned for 2016. FSCN hired one international guest professor (Lindman) last year and international exchange of MSc students is growing.

New research infrastructure

During 2014 we built two new laboratories, one for wireless sensor systems and one for RF and electronics characterization. We have started to build a laboratory for manufacturing of functional materials and surfaces (**KM2**) in the premises vacated by SCA R&D Centre. Further investments are planned within the new EU regional fund program that opens in the autumn. The new facilities will make an important contribution to our international research profile. The infrastructure for 3D of sandwich materials included in the Work Plan 2015 will be developed by BioBusiness Arena.

3.2 Academic Production and Funding

Figure 4 and Tables 2.1 and 2.2 show how our scientific production has evolved. There is a clear correlation between academic production and the available funding over the years. The decrease in funding is to a large extent due to the gap in EU regional fund programs during 2014. The number of PhD examinations normally increase as the funding decreases since a large part of the external funding include PhD positions. We expect the external funding to increase during 2015 to 2017. This will first increase the number of licentiate examinations. In order to increase our impact in the research community we have strategically targeted journal publications over conference proceedings (see 2014 in Fig. 4). In order to further emphasize this, a publication plan will be included in all projects plans, starting with the new KK applications this year.

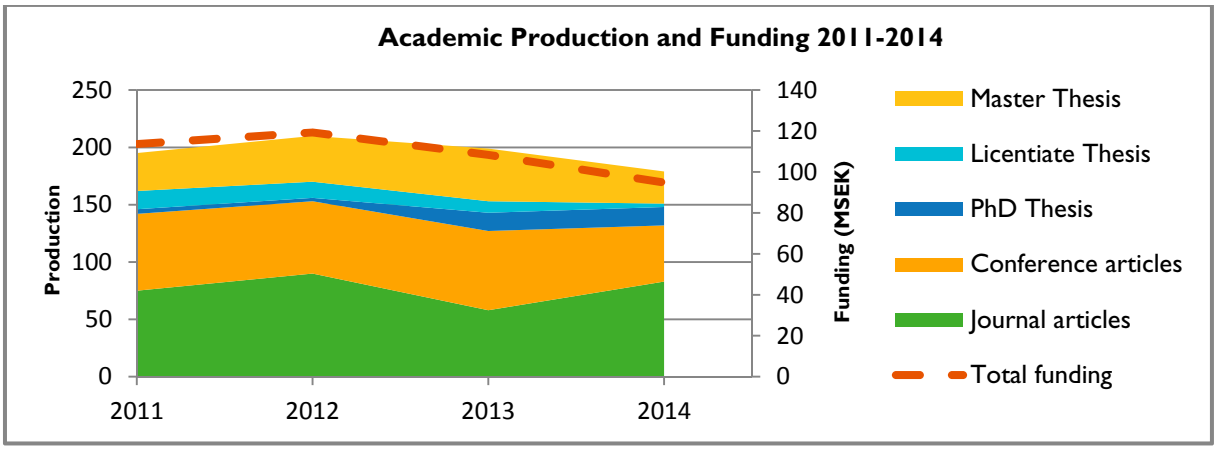

Figure 4: Development of publications and graduate examinations in 2011-2014 in relation to funding.

Table 2.1 Results of the Research Environment, Number of doctoral, licentiate and master degrees

Year	2011		2012		2013		2014	
Gender	M	W	M	W	M	W	M	W
No. Doctoral degrees	4	0	0	3	12	4	10	6
Proceeded to external position	4	0	0	2	9	4	8	3
No. Licentiate degrees	12	4	14	0	6	4	2	1
Proceeded to external position	0	1	1	0	0	2	1	0
No. Masters degree	31	2	38	8	36	11	27	1

Table 2.2 Number of scientific publications

Year	2011	2012	2013	2014
Article in Journals	75	90	58	83
Conference Articles	67	63	69	49

Table 2.3 Recently appointed promotions

Year	2011		2012		2013		2014	
Gender	M	W	M	W	M	W	M	W
No. Docent promotions	2	0	2	0	0	1	2	0
No. Professor promotions	1	0	1	0	0	0	0	0

Funding

We have succeeded well with funding applications last year (Table 2.4.2) and new funding of 60 million SEK was approved, up by 20% from the year before. We also received one grant from the Swedish Science Foundation (VR). It is gratifying that our success rate with Swedish Foundations doubled from 40% to 80%, corresponding to almost 50 million SEK in new funding approved last year. As the EU Horizon 2020 calls are launched we will continue our efforts to build European collaborations and attract H2020 grants.

Table 2.4.1 Funding (money spent in SEK)

Financiers	2011	2012	2013	2014
Faculty funding (MIUN)	45 462 605	41 579 928	38 588 205	43 915 831
Research Councils (VR, FAS, Formas etc.)	573 597	791 297	1 306 617	705 307
Swedish Foundations (e.g. Wallenberg, SSF, Vinnova, RJ, KK, Swedish Energy Agency etc.)	22 457 174	31 822 870	35 232 562	28 074 414
EU**	28 349 654	29 243 560	19 761 799	21 482 451
EU, International funds				452 638
Direct funding from non industrial organizations in society	6 583 051	6 471 125	5 410 759	2 523 545
Direct external funding from industry	2 911 831	3 253 335	2 832 731	4 133 482
Others (Bo Rydins stiftelse, Kempestiftelserna)	7 382 196	6 163 683	5 248 816	6 502 670
Total Funding	**113 720 108**	**119 325 798**	**108 381 489**	**94 808 965**

**the sums in year 2011-2013 consists of our overall EU funding - from 2014 we divide into regional and international funds.

Table 2.4.2 External Funding (applied, approved)

Financiers	2013			2014		
	Applied	Approved	Success rate*	Applied	Approved	Success rate*
Research Councils (VR, FAS, Formas etc.)	59 651 000	200 000	8%	29 221 000	3 400 000	13%
Swedish Foundations (e.g. Wallenberg, SSF, Vinnova, RJ, KK, Swedish Energy Agency etc.)	97 716 819	38 365 168	41%	68 850 907	49 507 907	76%
EU, regional funds	15 573 000	5 286 500	20%	2 941 710	2 941 710	100%
EU, international funds				10 746 181	1 100 000	25%
Direct funding from non industrial organizations in society	16 230 000	3 530 000	22%	10 881 609	2 810 609	76%
Direct external funding from industry	2 400 000	2 400 000	100%	0	0	0%

* ratio of approved and applied funding

3.3 Coproduction, Competence Development and Interaction

Coproduction

Our direct funding from industry was 4.1 million SEK last year and the indirect in-kind support 26.7 million (Table 3.1). These numbers are at the same level as before, even if the annual variations are large. The enlargement of our industrial networks (especially last year) does not yet show in the funding volume because the new KK Research Actions are just starting. Tables 3.2 and 3.4 show the number of partners that we have, but we must still improve on the process of collecting and controlling the background data (Table 3.3, not shown). The reduction in the numbers for last year reflects changes made in the compilation criteria. The actual number of collaboration partners has not decreased.

The qualitative and strategic development in coproduction was discussed in Chapter 2.1. FSCN has had the strategic goal of expanding its network. The intensive coproduction in **e2mp** attracts new paper companies, while **KM2** and **FORIC** have brought a dozen new "non-forest-industry" partners. In **New Cellulosic Materials**, project planning is under way with a group of new partners in BioInnovation.

For STC, the new event Business Innovation Day generated new coproduction partners. They can assist in the formulation of a strategic agenda for **Measurement System** and widen the coproduction of **EISS** during the coming years. The strategic partners of STC are connected formally through the proposed adjunct recruitments. In addition, over twenty companies contribute to **Measurement System** and **EISS** in the **SMART** project that is under development for the regional funds.

Table 3.1 Direct and indirect external money (money spent in SEK)

Year	2011	2012	2013	2014
Direct external funding from industry	2 911 831	3 253 335	2 832 731	4 133 497
Indirect funding from non industrial org (in kind*)	0	735 498	495 246	296 658
Indirect funding from industry (in kind*)	20 976 301	26 664 867	34 905 768	26 687 123

*value of working hours done by external partners, value of equipment, databases, software, laboratories etc. that external partners provide in joint research projects.

Table 3.2 Collaborative Organizations

Year	2011	2012	2013	2014
No. of partners from industry (SME)**	49	50	50	66
No. of partners from industry (non SME)	41	41	34	41
No. of partners from society excl. industry and academia	10	10	10	17
No. of partners from national academy***				11
No. of partners from international academy***				27

**Enterprise with no more than 250 employees and an annual turnover not exceeding 50M €

***New indicator from 2014

Table 3.4 New Collaborative Organizations

Year	2011	2012	2013	2014
No. of new partners from industry (SME)**	6	3	11	18
No. of new partners from industry (non SME)	7	2	4	12
No. of new partners from society excl. industry and academia	0	1	2	3
No. of new partners from national academy***				1
No. of new partners from international academy***				5

**Enterprise with no more than 250 employees and an annual turnover not exceeding 50M €

***New indicator from 2014

Educational programs

The number of researchers who move to industry after the PhD or Licentiate exam was one of the measures of our success in the old 3-year plan 2012-2014. The target is set at ten such departures every year. Last year the result was eleven PhDs and one Licentiate departing (Table 2.1), so we are performing in line with the target level. This year the numbers will probably be smaller because fewer examinations are expected (see Fig. 2).

To further increase our impact we have developed new courses and IT based methods to provide easy online access to learning objects of relevance for competence development in Swedish industry (**FLEX)**. The development is done jointly by STC and FSCN. For the next year we propose an education action (**SANDAS**) in order to refine the Master programme in Electronics Design so that our education better supports industrial transformation. This proposal is corroborated by two applications for adjunct lecturers (Jonsson and Sundberg) from industry. They will establish a strong coproduction platform for our Master programme. Discussions are also going on between Computer Science and Industrial Economics to formulate education actions that target the systems and organisational processes needed in industrial transformation and visualisation (**SMARTVIZ**).

The Faculty has previously submitted to the Knowledge Foundation a **CoMOOC** application with a scope wider than our Research Environment. The purpose is to develop a generic platform for open on-line courses for academic and industry personnel. This platform will enable courses on new materials and their characterization also within the Research Environment. The coming fall we will launch a new

Chemical Engineering program at the "Civilingenjör" level. It was created to meet the needs of the regional paper and related industries. The preparations for the first three years are now intensive. Next year we plan to apply for the support of the Knowledge Foundation for preparations of the last two years at the Masters level.

The university has created a model for Competence Contracts with companies in order to supply specific education that they need. Acting on a recent request from the industry, we are also evaluating the market for specific education and competence development services in the area of pulping and papermaking. These would support the Strategic Action **FORIC**.

Interaction with academia and society

We have typically 5-10 graduate students who come from or are financed by public sector or industry (Table 4.1). This corresponds to approx. 20% of all our graduate students. In **FORIC**, 14 new graduate students have now been admitted.

Table 4.1 Mobility between academia and society

Year	2011	2012	2013	2014
No. of collaborative doctoral students*	11	12	10	7
No. of researchers with temp pos outside university**	2	0	1	1
No. of adjunct researchers	6	8	9	10

*Doctoral students in the UoA who are financed by non-academic external partners. Note that this does not mean doctoral students who are financed by any non-academic funding body, but students who are financed by external partners of the UoA (e.g. industry or public sector organizations).

** Permanent university staff who are temporary employed in non-academic society

Regional collaboration developed well last year. We have started a 15+15 million SEK collaboration program with the city of Sundsvall, funding projects that are important for the city. Contacts with Fiber Optic Valley and BioBusiness Arena have increased, in part because of the Science and Innovation Days that we jointly organized for the first time in October 2014. The conference will return this year. A number of project proposals are also under planning for the regional development fund to engage public organizations and smaller companies.

Table 5.1 Number of scientific publications with representatives from outside the university

Year	2011	2012	2013	2014
No. of scientific publ with repr from society (not academia)	21	24	23	28
No. of scientific publ with repr from academia	34	32	24	31
No. of scientific publ with repr from academia and society	5	10	16	13

*Doctoral students in the UoA who are financed by non-academic external partners. Note that this does not mean doctoral students who are financed by any non-academic funding body, but students who are financed by external partners of the UoA (e.g. industry or public sector organizations).

** Permanent university staff who are temporary employed in non-academic society

Adjunct professors

We had ten adjunct professors last year from industry and research institutes to facilitate collaboration and bring in special competences (Table 5.2). Two new adjunct professors are planned, Sandberg (Acreo Swedish ICT) to help us develop the industry network in **KM2**, and Åkerberg (ABB Corporate Research) to support competence development in the area of industrial automation (both education and research).

Table 5.2 Adjunct professors with employment outside the university

	Name	Company
New Cell. Mater.	Folke Österberg, *Chemical engineering, wood chemistry*	SCA Forest Products AB, R&D Centre
e2mp	Lennart Salmén, *Chemical engineering, fibre physics* Thomas Granfeldt, *Chemical engineering, mechanical fibre technology* Magnus Paulsson, *Chemical engineering, fiber technology*	Innventia AB Valmet AB Akzo Nobel Pulp and Performance Chemicals
EISS	Mikael Gidlund, *Computer Science, Wireless sensor systems/networks*	ABB
Measurement Systems	Heinz Graafsma, *Electronics, Radiation detectors* Jan Andersson, *Electronics, Detector technology* Richard Hall-Wilton, *Electronics, Detector technology* Kjell Brunnström, *Computer Science, 3D Video perception*	Desy (Deutsches Electronen-Synchrotron) Acreo Swedish ICT ESS (European Spallation Source) Acreo Swedish ICT
KM2	Lars Norin, *Materials physics, printed electronics*	Acreo Fiberlab

3.4 Quality System

Our Quality System consists of the development of strategies for our Research Environment (Strategic Process), ensuring the quality of Research Actions (Quality Process), internal and external communication (Communication Process), composing the Progress Reports and Work Plans (Reporting Process), and the administrative support to these (Administrative Process). During 2014, we made progress especially in the Quality Process and Communication Process, while in 2015 we are working especially with the Strategic Process. In the following, we summarize the most important changes made and planned in these processes.

Strategic process

During 2014, our research leaders have worked to identify the strategic challenges that need to be addressed in order to support the TIE vision. In this work we have used the Core and Edge framework (Ch. 2.1). The transformation challenge requires a shift of focus from improved manufacturing efficiency to more innovation. The most important challenge is therefore to initiate and lead a strategic discussion with the reference group, researchers, and partner industries to define and select a balanced portfolio of Research Actions that support both industrial transformation and improved efficiency, while addressing general scientific problems of academic relevance. Several adjunct professor recruitments are planned in order to better address the challenge of Core vs Edge. The Research Strategy of the Research Environment will be updated during spring 2015.

During 2014 we have also started to develop the process on strategic feedback on the Research Actions. Our current thinking is to evaluate the impacts with respect to our strategic goal of building a strong research unit and our vision of helping the industrial transformation. This approach demands reviewers that are familiar with our research fields. This approach demands reviewers that are familiar with our research fields, such the academic members in the Reference Group (Prof J. Laine and Prof D. Crook) to form an evaluation group. In addition, we have contracted two external coproduction evaluators (Faugert and Realisator).

Communication process and the innovation systems

During 2014, we accomplished the following:

- Internal and external web pages for the KK Environment.
- We started the two-day conference Science and Innovation Days together with BioBusiness Arena and Fiber Optic Valley. It consisted of a Business Innovation Day, followed by a Science Innovation Day. The concept and collaboration will be further developed 2015.
- The collaboration agreement and joint communication with the city of Sundsvall in order to support the development of the university and the growing attractiveness of the city.

During 2015, the most important improvement areas are:

- Communication about the Research Environment and the TIE vision.

- Communication synergies with BioBusiness Arena and Fiber Optic Valley, especially for improved visibility and partner relations of the Science and Innovation Days.
- Support to project leaders and researchers in their communication of projects and results.
- Support to the arrangement of international conferences and workshops in Sundsvall.

Quality process

During 2014, the present format for the evaluation of new Research Actions was established. Minor changes were made to facilitate for the researchers and give them more time to work on their proposals;

- A timeline was published on our internal Research Environment website, guiding new and existing project leaders in the process of applying for new actions and reporting approved projects. The purpose is to make the process more transparent.
- For the same reason as above, we arrange project leader meetings each January and August, to inform about the upcoming reporting to the Progress Report and Work Plan.
- We have standardized the forms for requesting financial reports from participating companies
- Templates, forms and check lists are routinely revised when the Knowledge Foundations releases new calls.

In all, the internal understanding and approval of the quality process have increased. Most researchers are familiar with the various steps of the process and why they are needed.
The practice of pre-evaluations has also been extended beyond the KK proposals:

- A version of the quality process was applied to applications submitted to the Swedish Research Council (VR). The process included external peer reviews and a workshop with researches with experience from VR´s evaluation committees.
- Another version has been developed for applications to the European Regional Development Fund. The process includes external peer review, internal strategic evaluation, and external evaluation of co-production.

In 2015, we will develop the process to systematically follow up and analyse Research Actions, as well as to document decisions on changes. This will give input to the Strategic process. We need three new indicators: International mobility, Share of high-impact publications, and planning time of applications.

4 Comparison with the Goals that we defined for 2014

Achievement of the 3-year goals 2012-2014

Three main goals were defined in the previous 3-year plan (free translation):

1. *Lift the profile of the KK Environment as an internationally prominent Research Environment*
2. *Based on the joint TIE strategy, increase the synergies and respective strengths of FSCN and STC*
3. *Develop the forms of coproduction in terms of both closer relations with existing partners and broader relations with new competence clusters and application areas*

We regard our good progress in the first goal. Following specific areas were cited in the plan:

- *Research in Industrial IT becomes nationally leading within more efficient and environmentally-friendly energy production and use*
- *Forest sector research is broadened by increasing and consolidating research in 1-2 areas of advanced paper materials that open new applications for paper*: **KM2** has meant a clear increase in the research volume and even if **New Cellulosic Materials** is still under development, in practice all other paper research has been terminated.
- *Increase the share of publication in high-ranking journals*: Postponed to the new period 2015-2017.
- *Perform systematic quality development in graduate education*: In progress, led by the Faculty Board.

- *Clear communication about the strategy and identity of the KK Environment:* We have allocated significant resources to communication and claim that progress is demonstrated by our documents, web pages and press releases.

Under the second goal, four research themes were described: Augmented functionality, Efficient processes, Renewable energy and Clean environment. As has been explained in the preceding two Work Plans and previous Progress Report, these themes were too broad to guide the research. We therefore replaced them with the five Strategic Actions and two Development Areas. Two of these, **FORIC** and **KM2**, are joint actions of FSCN and STC, while the others primarily strengthen one or the other.

The third goal was achieved well considering the measures that were defined:

- *Recruit adjunct professors in the areas of green products, processes and intelligent services:* We now have ten adjunct professors in these areas, eight of whom were recruited after 2011
- *FSCN's Steering Group is broadened to include other materials and bioenergy*: Done.
- *Industrial doctoral students are offered a coherent study environment*: Done, see **FORIC**.
- *Deliver competence to industry through 8-10 PhDs or Licentiates per year:* Achieved 2013 and 2014.
- *Create clear structures for follow-up and evaluation of results, actions, and strategies for coproduction, development of international networks and alliances, and efforts to broaden the financing of the Research Environment:* Good progress has been made. Largest gap in strategic planning.

Fulfilment of the Work Plan 2014

The Work Plan for 2014 contained the proposed portfolio of KK Research Actions and a development plan for the system and the quality process. The portfolio was approved in part and is now in progress. The plans made for the system and quality process development have been mostly fulfilled:

- *Adapt the accounting system for tracking of project costs and create a project database*: Done
- *Internal qualitative follow-ups of projects*: Done
- *Further develop the external quality evaluation*: Done
- *Develop dynamic and auto-updated indicators for output*: Presently not feasible
- *Continue integration of the environment*: Progressing well

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