Forest-Based Sector
Technology Platform

Developing the Strategic Research Agenda (SRA)

for the Forest-Based Sector Technology Platform (FTP)

Collected themes: Specialties / New Businesses

May 16, 2005

Theme 1

Title: ORGANIC FILLERS AND PIGMENTS FROM RENEWABLE SOURCES
Positioning:

- Environment: Expected impact on main environmental drivers (water consumption, wastes, emissions/effluents, climate, chain issues etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Obtaining an economic and environmental balance in using forest biomass for products and energy, as well as substantially improving the industry's energy efficiency.
- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Substituting non-renewable materials through innovative solutions from forest-based materials.

Description: The European fibre supply is increasingly based on recycled fibre. In 2002, 83.8 million tons of paper and board products were produced for consumer market. The amount of non-fibrous materials used in papermaking process during year 2002 was 14.5% of total material flow. The non-fibrous material consists of mineral fillers and pigments. In recycling process, these materials are separated from the fibres. The resulting sludge consists of ink particles, fibre residues, mineral fillers, other impurities and water. Organic material of the sludge may be burned and the remaining ash is disposed to landfill sites. During the year 2002, the estimated amount of disposed de-inking sludge was 12 million tons. The main idea is in the development of novel types of organic fillers and coating pigments to be used in various stages of papermaking processes instead of mineral fillers and pigments. When fully implemented, the results of this theme will change especially the amount of waste deposited currently on the landfill sites. The possibility of waste combustion that this project opens as well, will also further strengthen the European targets of using renewable energy and striving towards the targets of the Kyoto protocol.

Approach: The objective of this research theme is to reduce the amount of sludge directed today to the landfill sites. This will be achieved e.g. by replacing mineral fillers and pigments with renewable raw materials and by reusing the recycling rejects in energy production. Another objective is to create paper products that can act as a substrate for adding smart and functional features. This may be achieved by applying a range of recently developed techniques of nano-technology and nano-engineering of natural polymers and composites. This will call for knowledge in o Chemistry of natural polymers o Manufacturing and control of polymer properties o Designing electrical and functional end-use properties of products o Transferring special coatings on paper substrate o Engineering of smart value added features on paper substrate This theme requires as the first step, identification of interesting product concepts and as the second step identification of economically viable route for its manufacturing. Various competencies such as polymer chemistry, polymer synthesis, electronics, measurements,

nanotechnologies, papermaking, printing techniques and equipment ranging from lab to pilot scale would be required.

Theme 2

Title: GREEN CHEMICALS
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Securing the availability of renewable raw materials, while supporting the varied uses of forests and safeguarding biodiversity, through sustainable forest management.
- Increasing the share of high value added products offered to consumers.
- Developing new industrial activities based on "green chemicals" from wood.

Description: The aim of the program is to identify and develop chemicals or raw materials from natural renewable sources. The wood based raw materials from side streams find application as additives in process industries, health food, materials and paint industries. E.g. extractives can be refined to biopolymers, composites and specialty chemicals. Tall-oil fraction is useful for various coatings, adhesives, and bio-resins, as well as for the development of new sterols for food and cosmetics applications. In the second research line hemicelluloses and sugars will be converted by chemical and biological methods, not only to bio-ethanol and other fuel components, but to more valuable chemicals and precursors for fine chemicals. The other proposed research line consists of fractionation and degradation of lignin containing raw materials for several interesting products. Novel innovation is lignin conversion to products ranging from bio-fuels to precursors for polymeric products, adhesives, solvents, and plasticizers. The third research line is related with the remaining organic matter from the aforementioned processes. The residuals are object to gasification and thereafter via catalytic purification for conversion to various products like methanol, gasoline, diesel, or synthetic natural gas.

Approach: A key concept for the first item is the development and valorisation of existing industrial raw materials in forest based industries. This requires knowledge on the composition of the existing raw materials and capabilities in separation of the components from the feedstock and synthesis or purification of these materials. For the application, development of knowledge on health care products, paint and composite material is needed. For the second and third item, knowledge and capability of modifying catalyst systems are required and application development knowledge in industrial chemicals is needed. The research will be focused on the most feasible ways to recover and utilize the organic chemicals from black liquor. Chemicals (green chemicals) prepared from renewable raw materials can be used to synthesize novel biopolymers, new textile fibres, bio-resins and adhesives. Side products of pulping (tall oil and turpentine) are also good material candidates for biopolymers.

Theme 3

Title: BIOPOLYMERS
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Substituting non-renewable materials through innovative solutions from forest-based materials.
- Developing new industrial activities based on "green chemicals" from wood.

Description: A number of drivers are spurring the new emphasis on developing the biobased economy, such as inreased demand and price increases of petrochemical products, concern about energy security, global warming, directives (packaking and land fill waste) and environmental administration. In the USA the natural polymer business $ 2,9 billion) is predicted to grow 6.4 % yearly and the US National Research Council predicts 50 % of US fuels and 90 % of US organic chemicals will come from renewable resources. Natural polymers, such as cellulose, starch, lignin and proteins and polymers made from monomers prepared from renewable resources and synthetic biodegradable polymers are normally classified as biopolymers. Polymeric components of wood, such as cellulose, lignin, hemicellulose can offer good material basis for upgraded products such as biodegradable thermoplastics, natural fibre reinforced composite materials and packaging, adhesives and coatings, new textile products and materials for controlled release of drugs or agrochemicals. New technologies (nanotechnology, biotechnology) are well suited for integration in the Forest-based sector. Micro fibrillated cellulose and its surface modification can generate new potential material applications in composites, hygiene materials, and non-woven products. Biotechnology could offer technologies in processing, modification and functionalisation of wood fibres.

Approach: The aim of the research is to develop new biopolymer products using renewable forest-based raw materials. First research area is modification and functionalisation of fibre surfaces to develop novel, high-performance materials based on wood fibres. New ways of modification of natural polymers is studied using enzymatic, chemical and thermo mechanical processing. Biodegradable polymer blocks are introduced to cellulose backbone and the surface properties of bio-fibres are taylored by radical polymerisation. Nanotechnology will be used to develop totally new biopolymer structures or active functional surfaces. Another objective is synthesize novel biopolymers, new textile fibres, bio-resins and adhesives using green monomeric chemicals, based on renewable raw materials. Side products of pulping (tall oil and turpentine) are also good material candidates for biopolymers. Functionalised fibre products, innovative derivatives of natural polymers and novel biopolymers are new materials and solutions for composites and packaging area improving barrier properties and bringing e.g. intelligence to packaging. Possibilities to prepare foamed biopolymers

(microcellular foam) and novel bio-adhesive materials offer also technologies to prepare light weight packaging materials.

Theme 4

Title: Hybrid media and functional printing
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Increasing the share of high value added products offered to consumers.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: Functional printing implements new functions to flexible paper, board or plastic substrates. With conventional and digital printing technologies functionality can be added to substrate surface and with paper making machines inside substrate. Printing can also activate the component inside the substrate. Functional printing can be visible or invisible codes leading to additional information, visual effects and images, multi-layer structures, electronics and optics such as displays, batteries, memories and passive components, as well as indicators and sensors. Hybrid media means integration of fiber-based products and digital media. The functional components utilized in functional printing can serve as a printed link to a digital media when read with a suitable reading device. When accessing the digital media up-to-date and tailored information can be found independent of time and place. The benefits of hybrid media and functional printing include better tracking and identification of products. Codes can also be used to compress information. Components difficult to copy provide protection against counterfeiting. Indicators and sensors can maintain, improve and sense the product quality. Electronic components provide interactive functions such as moving images. With hybrid media European forest-based industry can improve the competitiveness of fiber-based products by integrating printed media with digital media. Functional printing adds new functionalities into fiber-based products thus making them more attractive to industry and consumers.

Approach: Development of hybrid media and functional printing requires knowledge in printing and paper making technologies, digital media, substrate and ink as well as functional materials, identification and coding technologies as well as related reading technologies, understanding of media experiences, nano technologies and electronics and optics. The required research methods include material development, printing process development, printing trials, component design, quality and usability and logistics analysis as well as development of reading technologies and digital media. Co-operation between research organisations, paper companies, equipment and material manufacturers, media industry, advertisers and advertisement offices, usability researchers, printing houses as well as electronics and optics companies is needed.

Theme 5

Title:
Positioning:

- Environment: Expected impact on main environmental drivers (water consumption, wastes, emissions/effluents, climate, chain issues etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Substituting non-renewable materials through innovative solutions from forest-based materials.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: In my mind the focus in research should be on those plans or actions that promote to create new large scale applications or products. Today wood is used as raw material of wooden products, printing and tissue paper and paper packages. All of these will certainly survive although the share of printing paper will probably decline in the future. To find new bulk uses it is obviously necessary to replace existing products. I could see as the most potential development replacement of existing synthetic polymer materials with composites of wood, wood fibers and modified native polymers. In addition to being of renewable origin, these materials could be made as biodegradable. Also there could be possibilities in developing of bone-like composites of inorganic materials with wood based or other native organic materials.

Approach: The theme is of general nature but at least the following needs can be identified: - synthesis, screening and testing of modified starches or other native polymers as matrix substances - engineering of composites of the matrix polymers with fibrous materials or inorganic substances - development of techniques to fluidisize wood as a composite - manufacturing various prototypes made of the composite materials

Theme 6

Title: Integration of printed and electronic media by information technology
Positioning:

- Customer: Expected response to future consumer needs.
- Society: Expected impact on prioritized social and general economic goals of the EU (employment in rural areas, development of SMEs, etc).

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Responding to new competition from other regions.
- Increasing the share of high value added products offered to consumers.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: Different media (print, television, internet and mobile) are often seen to be in competition through allocation of consumers' time and money. New thinking recognises that different media have inherent strengths and weaknesses and combinations fit better in the everyday life patterns of users than any single media alone. The research theme is concerned with combinations of print and electronic media as enabled by information technology. It is distinguished from materials technology driven combinations of paper, printing and electronics, which is another research theme. The objective of the research is to generate knowledge and build implementations which enable the following functionalities: • Print-based access to ubiquitous information repositories • Printed media as interactive tangible user interface (to support coordinated use of information in print and on display) • Ubiquitous on-demand printing • Security verification and originality checking • Support for reading by aging people

Approach: The research requires information, systems, process and usability oriented research approaches and competencies which cover the printed media process end-to-end.

Theme 7

Title: Integration of paper, printing and electronics by materials technology
Positioning:

- Customer: Expected response to future consumer needs.
- Society: Expected impact on prioritized social and general economic goals of the EU (employment in rural areas, development of SMEs, etc).

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Responding to new competition from other regions.
- Increasing the availability of renewable resources, e.g. through afforestation, and extending their use in new and existing applications thus securing forest-based materials as the material of choice.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: Paper and printing form on optical system, which modulates light. Printing and related technologies have, on the other hand, been for long used for making electronics. The research theme is concerned with extending the functionality of printed products, information products as well as packages, with electrical components. The challenge is to manufacture them by printing.
Approach: The research requires methodologies and up-to-date knowledge on materials sciences such as material physics and chemistry but also understanding of fibre-based materials and their characterisation and the performance of printing technologies.

Theme 8

Title: Target oriented functionalization of fibres by biocatalysts
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Increasing the share of high value added products offered to consumers.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: There is a clear demand for increasing the science based development of value-added products of the forest sector. Novel, targeted methods for introducing novel functionalities into fibres have been recently developed. Among these, methods utilizing enzymes capable of directly introducing covalently bonded substituents can be considered more specific and targeted than eg. adsorption or chemical coupling of functionalized components to the fibres. For the first time, this approach also allows to understand what the consequences of a single, designed chemical substituent on various fibre properties are, without simultaneously affecting other chemical structures. Thus, these technologies will increase the research based knowledge of fibre structure-function properties. In addition, almost endless possibilities for introducing novel functional properties into fibres are created. These functionalities can be explored both for improving the processability (for improved process performance or saving of resources), as well as for designing completely novel properties into fibres. The latter option is especially tempting with regard to extending the uses of paper for novel areas, such as a carriers for printed electronic circuits or novel consumer products. Thus, the proposed theme is in the central scope of the Vision 2030.

Approach: The novel enzymatic functionalization methods can be used for introducing a variety of substituents directly onto fibre components. However, further improvements and optimization are needed for the full exploitation of the possibilies offered. Furthermore, discovery of novel funtionalization biocatalysts may further expand the applicability and specificity of the method. Thus, eg the exact requirements of the enzymes involved, boosting their action on the fibre matrix and optimization of the various details will be needed for fully understanding the mechanisms. A knowledge based approach is needed for further improving this approach. In this context, it is also important to emphasize the possibilities offered by various biomimetic approaches, in which the natural reaction may be mimicked by chemical or chemo-enzymatic methods. The methods involve basic enzymology and fibre chemistry and physics, as well as knowledge on specialized product development areas. The proposed theme combines novel technologies, such as biotechnology and material sciences and is strongly oriented towards nanotechnologies, and consequently requires strong competencies in these areas.

Theme 9

Title: Forest biorefinery for green chemicals and polymers
Positioning:

- Energy: Expected impact on energy production and use (energy from forest biomass, energy efficiency etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Developing new industrial activities based on "green chemicals" from wood.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: As described in the Vision 2030, an extended use of renewable resources for the production of a new range of knowledge demanding and high value added products is a central goal of the FTP. In addition to niche products for new small scale and specialized industries, also bulk products based on renewables will be needed for energy and chemical sectors. Woody raw materials contain a wide variety of chemically interesting compounds with potential functionalities, already recognized or to be still explored. Some of these chemicals and polymers are separated during the pulping processes, but to a large extent incinerated, and utilized only for the heat value. Such sources of potential starting materials and intermediates are fractions separated during the processes, such as bark and extractives, as well as waste liquors containing lignin and other dissolved polymers. These fractions can be upgraded based on the existing or targeted functional structures present in the original woody material. Another type of raw material are the carbohydrates often in waste streams which can be potentially degraded into sugars and further converted into fuel or chemicals. The goal of this theme is to develop novel biotechnology based methods for upgrading these fractions.

Approach: A variety of technologies is available for the conversion and upgrading of the different raw material streams. Among these, biotechnical methods offer some advantages due to their specificity. Presently, a number of enzymes is available for converting the lignocellulosic residues into their building blocks. More rare are, however, enzymes which eg. stereo- or regioselectively transform the desired building blocks into target products. The theme will focus in the development and use of biotechnical methods for production of novel biobased products. More importantly, the theme will also search for optimal choices and combinations of methodologies, including physical, chemical and biotechnical methods. Advanced analytical methods will play a key role in exploring the potential functionalities of these products. The potential products could find uses in food, feed, fine chemical or chemical industries, and comprise polymers, adhesives, composites, surfactants or bioactive compounds. In addition to products based on structural functionalities, the formation of simple building blocks (sugars) will be optimized from the unused residues or wastes for further conversion or fermentation into chemicals or fuels.

Theme 10

Title: Incorporation of smart features into fibre-based materials
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Increasing the share of high value added products offered to consumers.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: As described in the Vision 2030 the high standard of living continuously supports new consumer demands for e.g. high-quality food products. Smart features incorporated into the packaging material offer a tool to enhance the quality of the packaged products. Concepts reacting to the time-temperature history or gas-space composition of the package (product) are already commercially available. The presently available concepts are, however, separate label-type structures. Other production methods, like printing, would enable the production of low-cost, package integrated systems. The goal of the present theme is to produce new, smart features to be utilised in fibre-based packaging applications. Among these are e.g. printed, indicator systems based on reactions catalysed by selective biological molecules. Even printable biofuel-cells can be utilised to introduce more sophisticated sensor functionalities into or on the fibre-based packaging material. The theme strongly supports the Vision 2030 by introducing a possibility to create new, high value-added products among fibre-based products.

Approach: During the recent years the research on smart, packaging related features has proceeded considerably. The trend is definitely to replace the separate labels with printed or material integrated solutions. First smart concepts based on printed, intelligent inks have been presented. However, the vast reservoir of biological molecules having the capacity to specifically react with numerous microbes and their metabolites has been underutilised. In this theme the research will combine the profound knowledge of biocatalysts, their modification and their reactions to technologies developing different printing methods for fibre-based products. Additionally, electronics will be combined to the system when biofuel cell based sensor constructions are developed. In addition to the main methods related to biocatalysts and their reactions, printing and electronics, the methodologies involved in the theme will include studies related to the correlation between the packaged product and the parameter to be measured using the new, smart features combined to the fibre-materials.

Theme 11

Title: Hybrid media
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Increasing the share of high value added products offered to consumers.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: - Increasing the impact of printed media by introducing advanced functionalities, like digital information, light, sound and electrical conductivity. These functionalities can be applied already during the paper (or other substrate) manufacturing phase, by printing or by other paper converting methods. - Development of new technology products and processes utilising traditional paper and printing industry processes and competencies. For example: electronic paper, printable electronics, light-emitting displays and flexible solar cells. These products can emerge as convergence between paper and electronics industries.

Approach: Both basic and applied research combining different scientific disciplines, like physics, chemistry, electronics and engineering. Close follow-up of emerging technologies, cooperation with their developers.

Theme 12

Title: Smart packaging
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Meeting the growing impact of large retailers.
- Responding to new competition from other regions.
- Increasing the share of high value added products offered to consumers.
- Substituting non-renewable materials through innovative solutions from forest-based materials.

Description: Introduction of new advanced (e.g. active, intelligent, functional, sensing, indicating) features to packages. These features can be applied on packages by for example printing or laminating, or as labels. R&D is needed on active materials and their production and application processes. They should most often be thin and flexible. These products can emerge as convergence between paper and electronics industries. For example: RFID, indicators, sensors, displays and power sources.
Approach: Both basic and applied research combining different scientific disciplines, like physics, chemistry, electronics and engineering. Close follow-up of emerging technologies, cooperation with their developers.

Theme 13

Title: Waste to products
Positioning:

- Environment: Expected impact on main environmental drivers (water consumption, wastes, emissions/effluents, climate, chain issues etc).
- Energy: Expected impact on energy production and use (energy from forest biomass, energy efficiency etc).

Challenges and Opportunities:

- Helping society to mitigate climate change.
- Securing the availability of renewable raw materials, while supporting the varied uses of forests and safeguarding biodiversity, through sustainable forest management.
- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Substituting non-renewable materials through innovative solutions from forest-based materials.

Description: Forest and paper industry generates millions of tonnes of by-products and waste annually. Examples include: De-ink sludge, label laminate waste, packaging material waste and ash from power stations. Many of these materials could be re-used rather than e.g. dumped to landfill sites and there should be R&D on where and how these materials could be re-used. Completely new products and businesses can be created by using such by-products. For example: Re-use of de-ink fillers in paper and board manufacturing; use of ash in concrete manufacturing; use of packaging and laminate waste in different construction materials. Environmentally conscious consumers tend to prefer recycled products.

Approach: Take waste and side-products as given materials, analyse their contents and develop methods for using them in existing or new produts. Requires close cooperation between the research community, manufacturing companies and end users.

Theme 14

Title: Development of materials from renewables
Positioning:

- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Securing the availability of renewable raw materials, while supporting the varied uses of forests and safeguarding biodiversity, through sustainable forest management.
- Developing and designing products that can be recycled, reused and finally converted to bio-energy.
- Increasing the availability of renewable resources, e.g. through afforestation, and extending their use in new and existing applications thus securing forest-based materials as the material of choice.
- Substituting non-renewable materials through innovative solutions from forest-based materials.

Description: The development of materials from renewables as adhesives, binders, coatings and pigments. Modification of natural polymers in innovative way to replace the existing fully synthetic or inorganic phases in converted paper.
Approach: Continuous synthetic development to produce polymers from renewables in high mass volume. Innovation chemistry and innovative attitude to merge paper and biopolymers. Development of converting technologies.

Theme 15

Title: New functional materials as paper coatings
Positioning:

- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Achieving a signifi cant decrease in capital intensity and increased production flexibility through process innovations.
- Responding to new competition from other regions.
- Attracting young talent to the sector.
- Increasing the share of high value added products offered to consumers.
- Substituting non-renewable materials through innovative solutions from forest-based materials.

Description: New converting technologies development by using todays material development together with production development in coating technologies. Merging functional resins on paper by using reactive methods affected by corona, plasma UV or heat treatments. Coatings including hybrid polymers and reactive chemicals or sol-gel structures to give the functionality.
Approach: Chemistry to make formulations and compounds from innovative hybrids and sol-gel structures. Converting tachnology development to give the right impulse to create the functionality of the coating. Application method development. The modelling of reactive phenomeno.

Theme 16

Title: Hybrid media products
Positioning:

- Society: Expected impact on prioritized social and general economic goals of the EU (employment in rural areas, development of SMEs, etc).
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Increasing the share of high value added products offered to consumers.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: Hybrid media utilizes two strong industry clusters: paper and board industry and ICT industry (electronics, teleoperators, software and media companies). The lack of vital hybrid media product and business concepts is evident but challenging. The European technological leadership in paper industry and strong position in ICT industry (e.g. mobile and internet services) opens up a unique opportunity to combine these two major industries to create new products and business and speed up the growth in SMEs. Changes in life style change consumers' media use. While printed media is valued because of its reliability and easy-to-use interface, the need of mobile and fast communication increases the share of electronic media. Hybrid media combines the two and provides consumers the services they need regardless of the place and time. Technological solutions vary from clever combinations of existing technology to entirely new intelligent products. The scope of hybrid media includes innovative combinations of media products and multi-channel access to and distribution of different media. It helps in designing interactive and personalized media services even for very small target groups. It may be used to ensure local and targeted services in distant provinces and it certainly helps in attracting young talent to the sector.

Approach: Co-operation with Mobile and Wireless Communications platform and Intelligent Embedded Systems platform is needed.

Theme 17

Title: New, efficien value chains for Packaging
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Substituting non-renewable materials through innovative solutions from forest-based materials.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: Fiberbased packaging industry has a long and expensive value chain including large as well as small/medium sized companies. Packaging industry is experiencing a period of restructuring and consolidations, leading to the re-organisation of both market and companies. At the same time, there are opportunities for small suppliers to exploit fast-growing niche markets with high added value potential. As USA and Japan are the major packaging suppliers, Europe should develop an organized and extensive network of the packaging industry including research institutes, packaging and machine suppliers and other companies from the value chain. It is important to introduce novelty packages that are sophisticated and economical without forgetting the material recovery system. Highly personated products, small production and packaging sizes, internet sales, busy way of living and aging population are just few examples of the drivers to rationalize the packaging value chain and ensure its competitiveness. Faster and flexible value chains are essential when reacting to future customer needs. New value chains could include intelligent materials based on renewable resources, merging of primary and secondary packages or changes in retail models. Rationalizing the value chains by novel innovations and networking is a key to the competitiveness through creating new business opportunities to European packaging industry.

Approach: Co-operation with the following platforms is important: Sustainable Chemistry, Intelligent Embedded Systems, Advanced Engineering Materials and Future Manufacturing.

Theme 18

Title: Tailored Media Concepts
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Responding to new competition from other regions.
- Increasing the share of high value added products offered to consumers.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: Our media environment is changing because of the rise of new electronic media. It will affect our ways of communication and information retrieval and also our ways of spending free time. Even though this is a global trend, the cultural end economic history of the country may have an effect on how people value different media and actually use them. For example, media use and the preferences for the choice of media may be quite different in Northern Europe (e.g. Finland and Sweden) and Southern Europe (e.g. France and Italy), as well as in some new EU member states (e.g. Slovenia and Hungary). The sector needs new media concepts to improve its competitiveness against electronic media. Understanding the needs people have on communicating, including different media for work and leisure use, education, information retrieval, transactions, contacts etc., enables the production of services that respond to the changes in societal needs. Entirely new business opportunities will open up when the technological potential is combined with the unconscious or hidden needs of different user groups. Personal and local high value added services improve the quality of life and help to gain a more sustainable society.

Approach: Conpetencies: behavioural sciences, future anticipation Link to Hybrid media products

Theme 19

Title: Paper Based Electrical Sensors for Low-cost Applications
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Increasing the share of high value added products offered to consumers.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: In future packages and printing products more and more new types of sensors or indicators will be required. Sensors can measure or detect the temperature, humidity, pH, wettability etc. from paper based products and signal a change in conditions to a controller. Today most of the indicators are based on optical detection (color change) and only very few electrically measurable solution are proposed. This is probably due to the high material or manufacturing cost. In this proposal inherently conducting polymers such as polyanilines or polytiophenes are used to transform an ambient condition to the electrical form and is therefore possible to measure by using an electrical reader. Detection of the atmosphere surrounding packages or printing products is carried out by using polymers that are sensitive to temperature, pH, humidity, UV or some other condition which affect the conductivity of the inherently conducting polymers. All used materials are relative low cost and are therefore suitable for this application area. Indicators are possible to manufacture by printing or by adding material directly in the paper manufacturing process. This theme comprises an increased competitive of renewable forest resources and therefore is closely related to the vision of 2030.

Approach: In this approach an understanding of inherently conducting polymers as well as manufacturing methods of electrical sensors is needed. A basic understanding of paper as a material is essential for realization of applications. This research theme is multidisciplinary and therefore the research methods needed can be divided into three different part: 1) modification/functionalizing of conducting polymers 2) choosing a functional polymer which cause a change of conductivity of the conducting polymer (for example amine complex) and finally 3) manufacturing electronic indicator/sensor by printing or manufacturing methods used in paper manufacturing, and finally electrical characterization and optimization of the indicator. Optimization is needed since all current electrical readers are limited to a certain conductivity or impedance region. Part 3 is probably the most demanding and needs the most effort due to the fact that many practical problems (e.q. manufacturing methods) must be solved and new innovations for reading electrical sensors may be needed.

Theme 20

Title: User-centred new concepts for print products
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Providing products and services that respond to changes in societal needs.
- Achieving a significant decrease in capital intensity and increased production flexibility through process innovations.
- Meeting the growing impact of large retailers.
- Responding to new competition from other regions.
- Attracting young talent to the sector.
- Increasing the share of high value added products offered to consumers.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: The theme focuses on conceptualizing print products from a user-centred standpoint. This includes following aspects (from top to bottom): -constraints of everyday life and media practices -ergonomics in use -information ergonomics such as the relation of editorial and advertising content and -optics and colour
Approach: The research methodology should be experimental and it requires cooperation between partners with competences in product and graphic design and usability, cognitive psychology and usability.

Theme 21

Title: Development of molecular biology based technology for commercial use in forest sector.

Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Responding to new competition from other regions.
- Attracting young talent to the sector.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: Development of molecular technology-based applications for forest sector by utilizing and developing database of genetic characteristics of tree species and developing microarrays for practical purposes. The applications may cover microarrays for example to provide biocertification of the origin of forest products, biocontrol of diseases, control of environmental stress factors etc.

Approach: Microarrays will be developed through high throughput cDNA cloning of expressed genes and subsequent generation of EST libraries from important tree species by using methods of molecular biology. These studies should be conducted by arranging large research groups in several laboratories and to achieve ESTs covering several different developmental, environmental and stress conditions. Existing and published available molecular data should also be utilized. This research area is increasing with high speed and increasing number of innovative and competent people affiliate the research field. A competence of data mining is demanded to process the enormous amount of data obtained from scanning the microarrays.

Theme 22

Title: Research on health promoting non-timber products of the forest
Positioning:

- Customer: Expected response to future consumer needs.
- Society: Expected impact on prioritized social and general economic goals of the EU (employment in rural areas, development of SMEs, etc).

Challenges and Opportunities:

- Securing the availability of renewable raw materials, while supporting the varied uses of forests and safeguarding biodiversity, through sustainable forest management.
- Providing products and services that respond to changes in societal needs.
- Balancing forests as a resource for renewable raw material with other important functions such as offering recreation and safeguarding biodiversity.

Description: Health promoting non-timber products from the forest including societal perspective should be developed. Picking up berries and mushrooms promotes both mental and physical health of people, which is supported by findings that forests have beneficial ameliorating effects on human mental stress. Furthermore, berries and mushrooms contain large variety of health promoting compounds. Despite of active research, the healthy compounds are, however, largely unknown and berries and mushrooms may be a source of large number of pharmacologically interesting chemicals. The natural heritage in some countries (China, Japan) has a lot of information of medical utilization for example of mushrooms, which however, is not much utilized in modern science or in Nordic countries, where mushroom collection is a common tradition. Evaluation and investigation of possible interesting sources of health promoting products and also forests as a healthy environment for people would be important.
Approach: More numeric data is needed and scientific basis for the health promoting effects as well as the mechanism how the forests effect on mental health should be investigated. Multidisciplinary scientific approach is needed to conduct these investigations including expertise from psychology, forestry, biology and medical sciences. Studies on chemical components in berries and mushrooms will need highly developed organic chemistry such as different mass spectrometry applications and pharmacological expertise. Magnitude of natural variability in health promoting compounds and the factors affecting the variability should be investigated.

Theme 23

Title: Development of applications of nanotechnology to forest sector.
Positioning:

- Customer: Expected response to future consumer needs.
- Competitiveness: Expected impact on the competitiveness of European industry/companies in global competition.

Challenges and Opportunities:

- Responding to new competition from other regions.
- Attracting young talent to the sector.
- Taking advantage in process and product developments of alliances with other sectors and of exploiting emerging technologies.

Description: Development of nanobiosensors offers new possibilities in the area of analytics of different compounds. For example stress indicating polyamine sensor would help monitoring stress indicators in the forest. This technology could be developed to cover different areas of forest research and management.
Approach: Development of carbon nanotubes embedded with specific enzyme proteins, which actively react with specific substrates requires highly developed technology. Production of carbon nanotubes should be combined with molecular technology, which is necessary to produce specific enzyme proteins for specific purposes. Natural enzyme proteins and the genes coding those enzymes should be investigated to be able to clone the genes and to synthesize those proteins.

Theme 24

Title: Transparent Fibers
Description: The research theme aims at development of new techniques to modify fibers (e.g with very high pressure) to make them transparent. This would provide fully transparent packaging materials or e.g. an opportunity to have “windows” in otherwise non-transparent packaging.

Impact assessment:

1. Response to European objectives.
Support the vision of “bio-based, customer-driven and globally competitive European economy” by increasing usage of renewable fibers processed to end-products according to consumers preferences.

2. Response to business goals (industrial relevance).
Would have very high influence on food packaging sector, but possibly also on high tech industry (“transparent paper”).

3. Response to “impact dimensions”.
Would response to consumers desire to have easy use transparent or at least partly transparent packaging materials for food and other goods.
Would improve competitiveness of fiber based products with transparent packaging materials currently on the market.
Would have impact on environment and sustainability by increasing the use of renewable fibers instead of non-renewable materials.

4. Response to Vision Document (challenges, opportunities, strategic objectives).
Would be an opportunity to substitute non-renewable materials troughinnovative solutions.

Expected deliverables: New production processes and new end-products.
Time frame: 2030
Risk level: High

Approach: Would require fundamental research in fiber science and fiber chemistry and handling.

Theme 25

Title: Recovery of low-energy heat
Description: The research theme aims to develop economically viable technology to recover low-energy heat from board/paper machines drying section. This energy could be utilized e.g. in surrounding municipal in a similar wayas ground heat is used to heat households.

Impact assessment:

1. Response to European objectives.
Support the idea of competitiveness by better energy efficiency.

2. Response to business goals (industrial relevance).
Would have relevance to industry if "waste heat" could be transformed toa commercial "product".

3. Response to "impact dimensions".
Consumers and society as well as environment would benefit from recovery of waste heat, because it would replace energy from primary fuels which are typically fossil. This would also improve energy and cost efficiency of the industry and have positive influence on competitiveness.

4. Response to Vision Document (challenges, opportunities, strategic objectives).
Response to society's challenge to mitigate climate change. It is an opportunity to the industry to provide "green energy" by substituting fossil fuels with recovered heat.

Expected deliverables: Designed process and technology to utilize recovered heat.
Time frame: 2015
Risk level: Medium

Approach: Would require specialists in energy technology.

Theme 26

Title: Microbiological pulping
Description: The research theme aims to select and utilize microbes and their metabolites for delignification, bleaching and de-inking of wood fibers.

Impact assessment:

1. Response to European objectives.
Support the vision of "bio-based, customer-driven and globally competitive European economy" by introducing a concept of "biological pulp and paper industry" instead of "chemical pulp and paper industry".

2. Response to business goals (industrial relevance).
Would support the industry's business goals with simplification of production processes.

3. Response to "impact dimensions".
Consumers and society as well as environment would benefit from replacement of traditional and often synthetic chemicals with more simple and "natural" options. Simplification of processes may lead to cost savings for the industry. The "green image" would have positive influence on competitiveness.

4. Response to Vision Document (challenges, opportunities, strategic objectives).
Innovative simple processes would response to the need for significant decrease in capital intensity. This would also attract young talents (biochemists) to the sector. Exploiting emerging biotechnology is an opportunity to the whole sector.

Expected deliverables: New "greener" production processes.
Time frame: 2030
Risk level: High

Approach: Would require involvement of research institutes specialized in biochemistry and in fiber sciences.