Collaborative shaping of Research Agendas in WoodWisdom-net

Workshop for researchers and industrial leaders

Wood products

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Solicited research issues

Contents

Sub-area 1.5 Creating new innovative wood and fibre structures for different end-uses

1.5.1 Compression Behavior of Fiber Composites

Positioning: Basic

Short Description: Materials fail by separation. In other words, in a molecular level, failure always is tensile failure. Instability in compression occurs as plastic flow, or through some kind of buckling or splitting. In the case of non-brittle structures, macroscopic failure is preceded by damage evolution, often in the form of evolving damage bands. Most of the research, regarding fiber composites and laminates, has been of empirical nature, and of limited value for in-depth understanding of their compression behavior. Using modern techniques, damage evolution can be monitored during compressive loading of structures. The design of relevant experiments does require thorough analysis of the mechanics of composites and laminates.

Justification: Fiber reinforcement very effectively improves apparent tensile fracture energy in the fiber direction. Thus, such reinforced structures tolerate tension, but they are vulnerable to compressive loading. Compressive loading however appears rather frequently, in particular in the case of structural and packaging applications. Improved compression behavior not only prevents failure, but makes it possible to apply composites in lighter basis weight.

European relevance and collaboration: http://power2.fsv.cvut.cz/qfs/ http://cml.fsv.cvut.cz/~milan/ http://www.chalmers.se/HyperText/Prof-E/Petersson-E.html http://www.byggmek.lth.se/ http://joyx.joensuu.fi/~karenlam/petri/petri.htm

1.5.2 Fatigue Behavior of Fiber Composites

Positioning: Basic

Short Description: Under cyclic loading, materials get damaged at stresses and strains far below those typical for failure within single loading event. Mechanical fatigue is induced by some sort of local kinematic irreversibility. Such kinematic irreversibility may be manifested in the formation of slip bands or other kinds of shear bands, grazes, rotation or other changes in orientation of molecular chains, nucleation of pores, or a variety of other microscopic mechanisms. Fatigue damage does not need to be due to external mechanical loading – themperature or moisture variations, for example, may cyclically induce internal stresses. Surprisingly little is known of fatigue damage in fiber reinforced composites, or laminates made thereof. Careful analysis of the mechanics of such situations should lead to computer experiments, from which the most promising results should be subjected to physical experimentation.

Justification: Vast majority of structural failures is related to fatigue situations. Hygroscopic materials are particularly vulnerable due to cyclical hygroexpansive loading, which often is combined by external mechanical loading. Premature failure may be prevented through careful design of materials, as well as structural configurations, provided the necessary knowledge is available.

European relevance and collaboration:
http://www.mct.ro/web/2/fp6/3/parteneri/Polonia/midi/data/57.html
http://www.lms.polytechnique.fr/annuaire_nom.php?id=26 http://www-mech.eng.cam.ac.uk/profiles/vsd/ http://fb7-fg6.uni-duisburg.de/nowack/
http://joyx.joensuu.fi/~karenlam/petri/petri.htm

1.5.3 Solid Timber Constructio

Positioning: Basic

Short Description: Solid wood constructions are, originally located in North America and Central Europe, the traditional technology for residential timber construction. Specific deficiencies of log constructions – subsidence, deflection and air leakage for instance – have recently led to advanced solid wood construction elements: large-scale, massive, monolithic elements, manufactured from small cross-section boards are massive, dimensionally stable, rigid and load bearing elements autonomously developed by several wood-working enterprises in Central Europe. Even though massive wood elements applied in (multi-storey) residential buildings, public and business facilities possess, compared to conventional construction methods, eminent economical and ecological advantages, missing standards and insufficient design rules often inhibit design and building permits and hinder implementation, opening of new markets and export. The aim of further research has to adapt basic principles of design, calculation and dimensioning. Assumption for heat requirement prognosis, thermal insulation and heat retention of massive timber structures will be identified by long-time investigations. Missing or inadequate calculation methods require measurement of full-scale experimental building, fundamentals of security levels and seismic design of massive timber construction are to be investigated in laboratory testing. Accompanying work groups have to ensure technology transfer and incorporation into accredited standards.

Justification: extend timber part in the construction area

European relevance and collaboration: standarisation

1.5.4 Timber concrete construction

Positioning: Applied

Short Description: In the last three years the Austrian market in wood construction for residential buildings has tripled. However the part of industrial and public buildings in wood remained constant. Wood-concrete connected slabs are used since 15 years but never a prefabricated system has been intended. The aim of the research cooperation is to provide a high performance wid-span slab with timber concrete elements in order to allocate a competitive floor system with an industrial production.

Justification: extend timber part in the construction area

European relevance and collaboration: standardisation since there is a large research activity in the field of timber concrete composites there is a high demand for collaboration

1.5.5 Structures made from imperfect logs using CNC machined connections

Positioning: Applied

Short Description: At present, durable timber structures in Europe are only possible by either using structural protection, e.g. a building envelope, treated timber or naturally durable tropical timber. This presents a difficult competitive situation for timber structures like bridges. There are naturally durable species like Robinia pseudoacacia with high strength and stiffness properties and a high natural durability. European Robinia is not available, however, in straight, large diameter logs needed to economically produce sawn or glued laminated timber. Round timber even containing large imperfections is perfectly feasible for truss structures, where the member shape between the joints is not important. There are two research areas to be covered to enable the use of imperfect logs in structures: The load-carrying capacity of tensile or compression members with large geometrical imperfections and the production and the load-deformation-behaviour of precise mechanical connections for imperfect logs. The load-carrying capacity of members can be studied using both, tension and compression tests on full-size members as well as mechanical models based on the stochastic geometric and strength and stiffness properties of the logs. The production of precise connections in imperfect logs has to be studied in co-operation with CNC machine producers and the load-deformation-behaviour by calculation and testing.

Justification: The load-carrying capacity of timber is only known for members whose imperfections do not excess limits defined by visual strength grading. Members having larger imperfections will have lower capacities and, due to bending, lower axial stiffness. On the other hand, round timber members show higher strength and stiffness values than sawn timber. With the knowledge regarding large imperfection timber and their connections it is possible to design and build weatherproof structures for bridges, masts and towers, if durable timber like Robinia pseudoacacia is used. The industrial competitiveness of the timber industry would be strengthened since new markets would open for timber structures. Examples are pedestrian and road bridges, masts and towers for power lines or windmills, or guard rails. Using imperfect round timbers of durable European species would significantly decrease material costs. The socio-economic impacts envisaged include the increased work in rural and forested areas, the increased value of hitherto low-value trees as well as the new opportunities for SMEs in the timber industry. The environmental impacts comprise the abandonment of chemical treatment and an increased lifetime for weather exposed timber and the decreased zinc deposit from corrosion protected steel members.

European relevance and collaboration: While the main producers of durable Robinia are situated in Eastern Europe, the main producers and operators of CNC woodworking machines as well as the main knowledge regarding mechanical timber connections are placed in Central Europe. Moreover, for the machine strength grading of imperfect round timber there is knowledge available in Finland. This necessitates a collaboration between the forest research institutes in Hungary and Slovakia, the timber structures research and

the CNC development for the machining of imperfect round timber in Germany and the machine strength grading of logs in Finland. Possible European research groups are: VTT Finland Lehrstuhl für Ingenieurholzbau und Baukonstruktionen, Universität Karlsruhe, Germany Faculty of Forestry and Faculty of Wood Sciences, Sopron, Hungary Forest Research Institute, Zvolen, Slovakia

1.5.6 High capacity building systems from sustainable hardwoods

Positioning: Applied

Short Description: The main species for structural timber in Europe are spruce and pine. These two species are mostly used as sawn or glued laminated timber or as laminated veneer lumber. Many structural applications are not yet possible in timber because of the low strength and stiffness values of coniferous timbers and hence the necessary large cross-sections. For sophisticated filigree structures like wood-glass-facades, steel or aluminium is therefore often used. European hardwoods, showing much higher strengths compared to softwoods, often cannot be used efficiently in sophisticated structures because of the missing strength and stiffness properties. Suitable European hardwood species have to be identified regarding availability, esthetical properties, durability, and strength and stiffness properties. Many species are not yet used structurally, but they will be increasingly available because of the changing supply in Europe's forests. The main strength and stiffness properties of European hardwoods have to be determined by testing in order to allow a classification into the European strength class system. For this purpose, also an efficient log grading procedure needs to be developed, based on non-destructive measurements. Additionally the suitability for the use of adhesives has to be studied and highly efficient mechanical connection systems need to be developed for hardwoods.

Justification: The timber supply from Europe's forests will change considerably in the future. While the share of softwoods is decreasing, hardwoods of different species will be abundantly available. It is necessary to find additional high-value applications for this future source of material. One example for sophisticated structures are wood-glass-facades where the load-bearing structure is made of timber and the building envelope of glass panes. Advantages of timber for these structures are the low thermal conductivity of wood, the low thermal elongation, the lower production energy and the lower costs. The results of the project will enable highly competitive structures for ambitious buildings in timber. The customers may then chose from different hardwood species according to different esthetical requirements. Invisible mechanical connections will contribute to the overall esthetical quality of the finished structures. The industrial competitiveness of the timber industry would be strengthened since new markets would open for timber structures. Examples are wood-glass-facades or visible engineered structures in public buildings. The socio-economic impacts envisaged include the increased work in rural and forested areas, as well as the new opportunities for SMEs in the timber industry. The environmental impacts comprise the decrease of the use of aluminium and hence a CO2 reduction.

European relevance and collaboration: There are many hardwood species in Europe and the problem of finding suitable applications applies to any European country. Because of the large number of species, the effort to determine strength grading procedures and characteristic values for sawn and glued laminated timber will exceed the capacity of each single country. European cooperation therefore is the key to solve this

problem. This necessitates a collaboration between the forest and timber research institutes in most European countries. Possible European research groups are: Universität Karlsruhe, Germany: Determination of characteristic values, mechanical connections TU München, Germany: Forestry, wood supply, determination of characteristic values and strength grading VTT Finland: Determination of characteristic values and strength grading

1.5.7 Alteration of wood based particles and fibres for building blocks of sensing and monitoring and special functionalities providing structures

Positioning: Applied

Short Description: Biobased polymers, such as wood-based particles and fibres, offer an excellent substrate or matrix for integration of novel and more effective functionality. Cellulosic materials are known to have pronounced absorption properties. These properties, for instance, can be modified towards more specific and controllable functionality by means of enzymatic or nanotechnological approaches altering the porosity and/or the chemical properties of the material. The ability of biobased matrices to pass through moisture and volatile compounds (VOC) can be adjusted by making the materials breathable; the CoreTex-products are good examples of this concept. In these products, the mechanism is based on vapour transport through a microporous structure where small holes in the film allow the water vapour molecules to pass through but not liquid water. The same analogy can be utilized to trap molecules responsible for unpleasant odours. In addition, biopolymer network can be enzymatically modified to a matrix which contains capsules or capsule moieties for pigments, organic dyes in waterbased systems, functional dyes, active agents (monitoring and sensing materials), and other ingredients. The capsule systems may perform in a way that capsules or the components of the capsules react with (harmful) chemical or biological compounds and as an active barrier. capture of spesific agents from the environment could lead to chemical and biological detectores. Enzymatic and nanotechnological modification methods themselves are environmentally friendly by minimising the consumption of chemicals and additives. The approaches to improved the properties and functionality of the matrix will be included the modification by tuning the pore size of the material or by binding functional groups to the matrix by means of nanotechnology, chemical or enzymatical reactions. The materials to be developed can be utilized in a variety of applications: controlled moisture behaviour, elimination of odours, encapsulation of emissions and controlled release of active agents are included in these applications.

Justification: The study will result in following products and innovations • lignocellulosic fibre/particle containing film-like matrix with moisture and odour absorption properties o for buliding material use (wall papers, inslulation materials) o for health care targets (daily sanitary products, such as diapers, sanitary towels, bandages) • lignocelluloic fibre/particle conatining matrices with active agents for monitoring and sensing purposes o moisture sensing /monitoring agents (colour indicators) o odour and emission sensing/monitoring agents • lignocelluloic fibre/particle containing matrices with antimicrobial properties The research area will intensify the exploitation of wood raw material side streams in a the most economically feasible phase and way. In addition, environmental aspects will be considered in the study by using waste wood in combination with other materials to make new high performance products.

European relevance and collaboration: The topic on improvement of the use wood material has raised interest throughout Europe. In some European and Nordic research

institutes, extensive work on wood based particles and fibres have already carried out. .However, the utilisation of lignocellulosic material in the novel product applications as well as improvement of the degree of upgrading of wood -based products need more multidisiplinary research. Combining the expertise areas of the different institutes lead more cost-effective research concept. The potential research groups implementing the research would be the following: Finland Sweden France Germany VTT, Technical Research Centre of Finland, Espoo, Dr. Anne-Christine Ritschkoff, Dr. Salme Koskimies, Dr. Liisa Viikari Dept. of Fiber & Polymer Technology Royal Institute of Technology (KTH), Stockholm, Dr. Lars A. Berglund University of Bordeaux, Bordeaux Dr. Gilles Sebe University of Potsdam, Potsdam NN University of Helsinki, Department of Polymer Chemistry Prof. Heikki Tenhu Institute for surface Chemistry (YKI), Stockholm Max-Planck Institute, Potsdam NN

1.5.8 Conseptualisation of wood based products for leisure, moving and transportation

Positioning: Applied

Short Description: Based on user oriented setting and different future scenarios, the project aim to conceptualise products for leisure, moving and transportation. The wood based product applications will be composed and tested. The project creates opportunities to developing new type of constructions and aesthetic solutions.

Justification: The wood industry is currently renewing and expanding its product categories. In the field of wood industry in Northern Europe, new businesses are evolving. The main tendency is to develop products, which can utilize the wood materials from Finland and neighbouring regions. Kuopio Academy of Design is a part of Savonia-Polytechnic which is multidisciplinary institution of higher education. It offers degree programmes and R&D in seven fields of study and has 5000 students. Kuopio Academy of Design has 60 to100 co-operation projects/year with enterprises. During 2005-2007 it has PUUMI-wood design project funding by ESF. Participators are wood working enterprises from East Finland.

European relevance and collaboration: International exchange of experts is essential in order to efficiently utilize the latest technology. The project brings together a versatile group of wood specialists from different countries. Furthermore the project utilizes know how and experience concerning the traditional ways to using and manufacturing wood products.

1.5.9 Prefabricated wall-elements out of biogene-based materials and timber for building and renovation

Positioning: Applied

Short Description: Europe's dependency on fossil energy should be dimished, according to the political point of view of the European Union. One of the essential instruments to achieve this is the use of potentials to save energy. The reduction of energy consumption of buildings becomes more important due to the 25-30% part of the total energy consumption and the reduction potential of CO2-emissions resulting from this fact. Especially buildings, which have been constructed between 1950 and 1980, have extremely high consumptions of energy. In the new European countries also modern buildings offer additional potentials of saving energy. In addition to the huge demand for improvement of thermal insulation there is also a fundamental demand for renovation to improve protection against moisture and the architectural design. Nowadays such renovations are usually done with thermal insulation and stucco systems out of polysterol or mineral wool. The implementation of these renovations happens in situ and leads, in addition to the use of predominant petroleum-based products, furthermore to long times of construction, as building with elements / prefabrication is not done. So in addition to the further development and standardisation of the application of pre-manufactured timber elements in reinforced concrete skeleton constructions the target is the development of a dimension-evaluation and fabrication system for the production of pre-manufactured timber parts including insulation, façade panelling and windows for the application on existing window facades (masonry, reinforced concrete).

Justification: This project should enable the timber engineering to get in touch with the amazing field of renovation of facades in order to make use of CO2 neutral and easily manufacturable constructions when thermically renovating the necessary building stock. In doing so the existing methods of survey should be further developed, especially by using laser technics. Also CAD-based planning and fabrication instruments should be further developed. This requires a close cooperation between survey engineers, building engineers, civil engineers, architects and the manufacturing industry. A successful research and development would open up a complete new market for the whole area of timber engineering and it would contribute to the goals of saving energy by the European Union. In addition to design-engineering and questions relating to technical production especially questions regarding noise insulation, fire protection, thermal insulation and moisture protection should be considered.

European relevance and collaboration: A specific European relevance exists due to the reduction of energy consumptions of buildings by using low energy biogene-based construction and insulation materials. Particularly the building stock of the new European countries is predestinated for appropriate applications. This is also valid for concrete and masonry constructions of the sixties and seventies in all European countries. Therefore a cooperation between Scandinavian, East European, Middle European and South European institutes is necessary. In doing so the basic questions such as dimension evaluation and data transfer to production need to be solved in a collaborative way,

whereas for application, architecture and construction regional construction traditions need to be considered. The research could be done e.g. in cooperation of Technische Universität München, Helsinki University of Technology, Universität Innsbruck, Universidad Politecnica de Madrid and other interested groups from other European countries. The development needs to be done in close coordination with the manufacturing industry.

1.5.10 Wood-Concrete Composite Action for Prefabricated Housing

Positioning: Applied

Short Description: Timber floors have been a long quest in research due to its low stiffness combined with a relatively high strength, which leads to vibrations resulting in uneasiness for residents. The combination of timber joists and a concrete slab is not new. The current practice is to install the timber beams and cast the concrete on top of these, then leaving the concrete to set for an appropriate time. For industrial construction (lean construction) this approach is impossible since the curing time for concrete would set back the production time severely. This research project is instead founded on the idea of establishing a connection useful for connecting timber to concrete after the curing of the concrete slab. Similar approaches can be found in bridge engineering where prefabricated slabs are mounted with studs to steel beams. Theoretically, the approach will lead to discrete points in the structure where forces are transferred i.e. the composite action of the structure is discontinuous. Currently, mechanical shear tests are carried out on potential connections, with the aim of testing a full scale timber floor with respect to load carrying capacity, stiffness and vibrations. A parametric FE model focused on the discontinuous composite action will be made.

Justification: The result from the research will present an efficient way of incorporating old technology into modern construction. It will combine two materials in a way that the components are separable after use, which is environmentally friendly and gives the possibility to enhance the system in use. For the timber housing industry it will present a high performance building component, enabling larger spans in timber buildings leading to a potential market share increase. Composite timber-concrete floors would also be a possible constituent in commercial buildings, where timber today has difficulties competing due to the large spans and open spaces required.

European relevance and collaboration: Research within the field timber-concrete components has been carried out in Europe for some fifty years. Knowledge on the composite action between timber and concrete is available. The idea behind this project is to introduce this technology into the modern construction industry, which is currently moving towards more prefabrication and less on-site work. In Sweden the lean construction trend is prominent, providing good settings for testing the product. However, research groups in Germany, Switzerland and Italy are the ones who are excellent on the theoretical framework behind composite action in timber-concrete components.

1.5.11 Strengthening of Glulam with Natural Fibres

Positioning: Applied

Short Description: Glulam members are commonly used as high performance girders in timber floors, roof systems and bridges. The applications are sometimes limited due to the low strength perpendicular to the grain of timber. Strengthening in the direction perpendicular to the grain has been tested by others using glass fibres, nail plates, plywood, glued-in rods etc. All of these approaches, however, rely on technology which is not environmentally friendly in the sense that a structure not easily dismounted or combustible is created. Since one of the arguments for choosing timber as a material is the environmental friendliness, it is logical to look into the quest of strengthening timber using natural fibres such as hemp, flax, wool or even wood. To achieve the strengthening effect a matrix to carry the fibres is needed, commonly some plastic resin (polyurethane, polyester, epoxy etc.). This research investigates the possibilities of using natural fibres in combination with glulam to achieve high performance structural elements. Different types of natural fibres are currently investigated and the work is now focused on finding suitable matrices. Laboratory tests on simple coupons will commence the laboratory work which will finally focus on strengthening of full size glulam beams.

Justification: The result from the research will present a new technology to increase the competitiveness of timber yet preserving its environmental benefits. In the industry context, timber strengthened with natural fibres will lead to a high performance product that can be made competitive for demanding applications thus increasing the market for wood. Ongoing efforts in the field of wood composites can also be canalised towards the construction market, which is the largest recipient of sawn lumber and glulam. From an environmental point of view the use of natural fibres is commercialised and spread, which in the long run supports the development towards a sustainable material use in the construction industry.

European relevance and collaboration: Research within the field of composites and wood composites has been a growing area. However, there is currently a lack of large scale applications used in a real industry setting. This project idea is very much funded on the thought of establishing a cross industry setting for the product to develop. This means communicating between material scientists and construction scientists, two worlds with quite differing functional requirements on the product. The project can be seen as a technology transfer project guiding material science into the framework of construction.

1.5.12 Development of new cellulose fibres for nonwovens in hygienic and health-care products (CELCARE)

Positioning: Applied

Short Description: A new patented method for production of regenerated cellulose fibres in lab scale for nonwovens has been developed in 2005. These cellulose fibres are specially suitable for hygienic and health care applications due to their purity, mechnical characteristics, and absorpency chracteristics. The CELCARE project developes a pilot production line of 100 kg/d of biocelsol fibres and produces optimised fibres for carding, hydroentangling and blend-thermobonding processes. The properties of nowovens are investigated by the manufacturer and the end-users. The results of the CELCARE project are used for planning an industrial-scale fibre production line of 5000 kg/d.

Justification: The results offer to fibre producer a new environmentally friendly and economically feasible process and for nonwoven manufacturer competitive accepted products in hygienic and health care sector.

European relevance and collaboration: The basic technology is developed in laboratory scale in EU project Biocelsol. The fibre working group with research and industrial partners fullfilled by end-users could be the partners of CELCARE project as follows: TUT Finland, Inst Chemical Fibres Poland, VTT Processes, Säteri Oy, Suominen Nonwovens, Mölnlycke Health Care, Procter&Gamble

1.5.13 Incorporation of smart features into fibre-based materials

Positioning: Applied

Short Description: 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.

Justification: 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.

European relevance and collaboration: Various expertise areas are needed to accomplish the goals. Partners can be identified among groups specialized in: enzymology, wood chemistry and packaging industry and will be named later.

1.5.14 Interactive and intelligent paper products:

Positioning: Applied

Short Description: New enabling technologies will be strong drivers of industrial development. This will create opportunities for responding to the new habits and fashions of future consumers and responding to the increasing competition, from other ma-terial sectors and the electronic media. Cooperation and alliances with other industrial sectors and technologies offer op-portunities for creating new, high-value added products and services. These will incorporate combinations of fibre-based materials with other materials, utilizing, micro-electronics, information technology and automation, bio-technology, nano-technology and other emerging technologies. This will be an opportunity for the European fibre-based sector to change its product mix from "bulk commodities" towards a new range of knowledge-demanding and high value-added specialty products. These specialties include both packaging solutions and new communication prod-ucts.

Justification: Developing printed static markings, visible or invisible codes and information to be read by specific optical devices (e.g. cell phone cameras) Developing multilayered structures of electronics and optics for producing active components like displays, indicators, or batteries. Developing anti-counterfeit effects like decorations, tracking and identification features etc. Developing low-cost, printed, package integrated systems for controlling packed product quality (e.g. time-temperature history etc.) Developing intelligent components, printed optics and electronics (smart or intelligent codes, tags etc. like printed RFID) having the capability of being read and also updated.

European relevance and collaboration:

1.5.15 Enzymatic modification of cellulosic fibres with spatial control

Positioning: Basic

Short Description: The uncontrolled degradation of cellulose occurring throughout the cell wall during enzymatic treatment of cellulosic fibres severely limits the use cellulose degrading enzymes for the manipulation of cellulose and fibre properties. The main reason for this is the porous structure if the fibres allowing for rapid penetration of enzymes into the interior of the cell wall. If the infiltration could be minimized or prevented selective manipulation on the true fibre surface (as opposed to the total surface, including all pore surface) could be achieved. A possible approach would be to increase the size of the enzymes. The possibility to specifically target e.g. tumour cells has lead to the development of a large number of strategies for the coupling of proteins to different carriers. Such an approach can increase the apparent size of the enzyme to several *f*Ým. Different coupling strategies will be tested and evaluated by e.g. the measurement of conjugate activity, cellulose molecular weight and disintegration of treated fibers.

Justification: Possible applications could be e.g. selective degradation of surface cellulose increasing the number of short chain molecules extending from the surface or the selective removal of the outermost part of the cell wall improving the possibilities to disintegrate fibers into micro fibrillar cellulose (MFC). The molecular weight of surface cellulose has important implication for the formation of interactions with other fibers and other materials such as a polymer. The weakening of the S1 layer can have important implication both for the energy consumption during MFC production and more generally when activated cellulose is needed e.g. during cellulose derivative production. If successful the use of developed techniques would enable decreased energy consumption in industrially important processes.

European relevance and collaboration: Many countries in Europe have a large industry involved in the processing of cellulose or cellulose containing raw materials. In order to continue to be competitive in the future continued development of processing techniques are needed. This is recognized and many strong groups are active within the cellulose field in Europe. In order to develop new methodologies for enzymatic treatment of cellulose collaborations between different groups will ensure success.

1.5.16 Next generation wood based composites

Positioning: Basic

Short Description: Four main research issues: 1) Impact of raw material changes on the production of wood based composites, short term and long term performance 2) Innovative processing parameter and its impact on the property of wood based composites 3) Bio-resin binding systems for the production of wood based composites. 4) Zero defect wood based panel production (on line quality control) Trends are towards the use of increased levels of recycled fibre and these bring problems of the need to sort, identify and classify types and identify contamination. Current press temperatures require large energy input and lead to internal stresses, which results in problems such as thickness swelling. The challenge is therefore to develop the use of lower, or even cold, curing adhesives for the panel industry, without a loss in performance. Bio-resin is currently being considered as an alternative for traditional formaldehyde based resin systems for wood based composite manufacture. This could lead to produce a true eco-composites for construction. However, the research to verify its viability has yet to be carried out.

Justification: This research will address the above issues and examine the impact of these innovations to the final performance of wood based composites and their life cycle costs. The production of zero defect wood based composites will be the goal of both panel and construction industries. Quality control procedures are currently based on destructive testing of small samples taken from each batch of production. Some non-destructive (e.g. ultrasound) tests are used for monitoring the panel manufacturing process, for example to check mat density, but are not in regular use for monitoring the properties of the finished panel. EN326-2 allows the use of alternative procedure for demonstrating compliance with the specification and this research will develop and apply non-destructive test procedures that can achieve this with the finished panel. Thus every panel produced could be inspected and accepted or rejected on a panel by panel basis, thus improving the consistency and reliability of the finished product. The results will enable: 1. high quality next generation wood based composites 2. innovative applications of composites in construction 3. efficient use of European resources

European relevance and collaboration: These issues are related to both European timber and construction industries. There is insufficient critical mass to address these issues through individual member states. The research should be carried out by a collaboration of major European research institutes in partnership with construction companies and composite manufacturers.

1.5.17 Highly stressable flexible connecting system

Positioning: Basic

Short Description: We want to find a highly stressable connecting system for a modular timber construction in the housing sector. The system should be used for most timber construction details. This new product should be manufactored fast and easy. The customers are carpenters, joiner and prefabricated house sector. First we have to collect the data of the most timber construction details. With this informations we will develop a flexible connecting system for this sector.

Justification: The customers are joiner, carpenter and the prefabricated housing sector. With this new connecting system the customers can manufacture their products more cost efficient and faster. KNAPP delivers connecting systems all over the world, it results in a significant economic factor such as extensions for a large range of applictions. KNAPP can save market shares and maximize the sales volume. For enviromental impacts we can save buildung material. Apart from that there is no positive or negative enviromental impact.

European relevance and collaboration: In the near future the housing sector will manufactures timber construction walls, ceilings and roofs faster and the production costs should decline. The demand of a flexible wood connecting system with low costs will be rise in the European countries, North-America and Japan. KNAPP will be develop this new connecting system with the European collaboration . In most of the European countries KNAPP requires for the new connecting system the national technical approvals from the testing laboratories.

1.5.18 Solid Mechanics for wood

Positioning: Applied

Short Description: Wood has different mechanical properties in axial, radial, and tangential direction. Further it differs in strength between tension and compression. This makes it very hard to calculate the strength of different structures by use of modern software, e.g. the Finite Element Method. The project aims to examine how close it is possible to predict movements in different members of the structure because of applied known forces.

Justification: Finite Element calculations for wooden structures, such as furniture and buildings, will almost always fail to predict the true behaviour of that structure. Because of this, many structures are far too strong, while others collapse earlier than expected. In order to utilize wood efficiently we must therefore learn how to optimise wooden structures far better than is possible today.

European relevance and collaboration: Linköping University, Chalmers Institute of Technology and one university in Poland have contributed to research on small wooden structures, such as chairs and furniture. Larger stuctures are dealt with in civil engineering at many universities.

Sub-area 1.N Other

1.N.1 R&D of composite products. Researching emotions originated from sensing

Positioning: Applied

Short Description: The project studies potential uses of composite materials and different material applications such as wood combined with plastics, metals, stones and stone ingredients. The project also maps the services and competencies of research institutions specialized on wood materials. Special interest will be concerned with reactions and emotions originated from the sensing of materials.

Justification: The project produces designs for products and environments, where the selecting of the materials and their combinations create new types of product appearances. Eventually the designs improve cosines, comfort and well being. The research and testing is needed for to consider the social and psychological influence of natural materials. Kuopio Academy of Design had 2002-03 a research project LUMA concerning sensing of natural materials. Results were published in LUMA report.

European relevance and collaboration: European organisations will develop activities like seminars and work shops as well also the exchange of experts. On basis of the cultural anthropology the project observes how new product concepts apply to different user groups as well as to the built cultural surroundings in different countries.

1.N.2 INFLUENCE OF WOOD-BASED PRODUCTS ON INTERIOR AIR QUALITY

Positioning: Applied

Short Description: Nowadays, Wood is widely used in building industry, from walls, timbers, frames, floors to furniture and source of heating energy. But these different wood-based products have a significant influence on the quality of air indoor and could be somehow hazardous for our health. Indeed interior air quality constitutes a major topic for which the European Commission worked on many regulations in order to impose emission ceilings. Thus, it would be interesting to follow and characterize the emissions of Volatile Organic Compounds (VOC), Carbon Monoxide, Carbon Dioxide, Formaldehyde and Particle Matters generated by wood-based products (that could be composed of adhesives or preservation products, or during wood combustion, …) in a room of a building. It would be necessary to define a standard way of measurement and a standard room in order to be able to compare the pollution of the emissions of different materials and different uses.

Justification: This study would enable to define clearly if some materials have a serious influence on the pollution of interior air and if they can be dangerous for our health. The results could lead to change the composition of some materials and to work on the production of new products, environmentally friendly and suitable for a use indoor. This study could also help industries to understand the influence of their made products on air pollution : everybody is concerned and directly exposed on his work place or inside his house.

European relevance and collaboration: Depending on weather conditions, cultural habits or architectural preferences, each country owns its proper style of construction and uses different materials to build or to decorate a house. Thus, it would be possible to compare the quality of interior air for different buildings representative of the European standard types of construction. This study would be interesting not only to collect data on the air pollution in Europe but would also interest scientists working on environment and sustainable development, chemistry, construction …

1.N.3 The innovation system for sustainable materials development

Positioning: Applied

Short Description: An important part of the innovation system is an end-user and an enduser that has the force to benchmark and also order the first products. When developing composite material from renewable resources it is important to remeber that there has to be a potential buyer and that the benchmarking in order to select unique materials properties in order to justify a reasonable price has to be done in collaboration with the enduser. New production processes adapted to biofibres and biopolymers has to bedeveloped in the project. Fibre composites that are dimensionally stable and has a controlled lifeexpectancy. Renewable polymers need to be developed that are compatible with natural fibres. Micromechanical modelling is needed in order to speed up development and to leave the empirical era of "blend and see what happens materials research" behind.

Justification: Renewable materials and products to be used in the interior of buses and trains, at hospitals and schools etc. Materials with superior accoustic properties, high performance per weight unit and being carbondioxide neutral. These materials will contribute to a sustainable growth and a better environment. Through the force of the collective public ordering of these new materials it will be easier to find risk capital for starting production units for renewable products. There also need to be a system for the recovery and reuse of these materials. The impact of the research depend upon the market and the strength of a European public buyer.

European relevance and collaboration: A European project with identified regions that strive to follow the Lissabon protocoll on sustainable growth could together put some pressure on the market to develop renewable materials through the collective ordering of renewable products for the medical sector, public transportation, energy etc. In that way there will be a driving force for the development and also a strong incentive for the establishment of an efficient technology transfer to new or already existing industries.

1.N.4 Modified wood – eco-efficient alternative to tropical and preservative treated wood

Positioning: Applied

Short Description: The overall objective is to make an assessment of the long-term suitability, in a sustainable society, of wood modification methods that may serve as alternatives to conventional wood preservatives (toxic agents) and/or durable tropical timbers. Specifically: A) To reach a fundamental understanding the protection mechanisms of the new "non-toxic" preservation methods against decay by fungi, bacteria, insects and marine borers. B) To assess the environmental impacts of alternative wood preservation (i.e. wood modification) methods, and their effect on the products structural performance. Most non-tropical wood species are susceptible to moisture changes and decaying organisms. To increase the durability of non-durable wood species, wood is traditionally impregnated with toxic preservatives. However, alternative and more environmentally acceptable treatments, e.g. heat treatment and furfurylation are emerging on the market. Another treatment close to commercialisation is acetylation. These modified wood products show high resistance to microbial decay, insect and marine borer attack. They are also less moisture sensitive and thereby dimensionally stable, leading to less maintenance of the wood product. Preliminary ecotoxicological studies of preservative-treated wood and naturally durable wood species clearly indicate that the water leachates of these materials have a fatal effect on aquatic organisms unlike modified wood leachates.

Justification: Most studies indicate that an increased use of wood will contribute positively to a sustainable development of the society. The total environmental impact of wood products is highly influenced by the limited durability of the untreated wood material. However, methods to improve the durability by conventional wood preservation, may also lead to increased environmental impact due to the highly persistent toxic compounds introduced to the wood. Non-toxic alternative wood preservation methods should therefore be attractive in a life cycle perspective. The design of timber structures is very often governed by serviceability requirements. Insufficient knowledge exists especially when it comes to the climate effects on structures and material performance. More reliable data of the performance of new chemically modified wood materials will increase the understanding of the protection mechanisms of these new wood materials. It would strengthen wood manufacturing industry and end-users in their choice of product for a desired product life time with minimal environmental impact, and it also contributes to the fulfilment of central goals of the European Commission concerning human health issues.

European relevance and collaboration: The research group established within the European Thematic Network of Wood Modification (that ended 2003) would naturally be a suitable basis for further cooperation within this area and implementation of this research. Furthermore, these researchers have been cooperating in several EU-projects before. Members of this group were e.g.: Dr. Callum Hill, University of Wales, UK Waldemar Homan, SHR, the Netherlands Dr. Dennis Jones, BRE, UK Dr. Prof. Holger

Militz, University of Göttingen Dr. Nils Morsing, DTI, Denmark Antti Nurmi, VTT, Finland Dr. Andreas Rapp, BFH, Germany Prof. Joris VanAcker, Ghent University, Belgium Dr. Mats Westin, SP Trätek, Sweden Suitable additional partners would be: Dr. Morten Eikenes, Skogforsk, Norway Dr. Bartek Mazela, Agricultural University of Poznan, Polen

1.N.5 Knowledge-Based Building with Wood

Positioning: Applied

Short Description: Erection of homes, offices and production sites account for a very significant part of all building activities in Europe. The role of wood and wood-based products as a sustainable construction material has a long history. Throughout Europe enormous differences exist in the way wood is used in construction and the assumption quantities vary to a large extent. Increasing the share of wood in construction helps to improve sustainability and to reduce CO2 emissions. For achieving this goal existing building products and novel concepts have to be optimised and further developed. In future living and working of European citizen will be closely related to urban planning and rural development. People will spend at least half of their time at work and an increasing part is consumed by travelling to workplace. Due to this fact, European citizen desire to live in dwellings which provide a pleasant living environment and which are located close to workplace and leisure activities. Character of the work (R, T, D): All types of research (generic, applied), technology development, transfer from and between different sectors, demonstration activities Major competence needed: Civil engineering, material sciences, process design, process engineering, process development, systems analysis, LCA, information technologies, standardisation

Justification: -Reduction of GHG emissions resulting from production and use of buildings by increasing the share of wood and wood-based products. -Securing of comfort and flexibility of European citizen taking into consideration the needs of the increasing share of aged population. -Improving the living quality of the European citizens by increasing the use of wood and wood-based materials for interior furnishings and furniture. Novel and improved concepts for realising environmentally friendly construction and erection of buildings. Provision of healthy and safe living and working conditions for European citizen. Realisation of sustainable building concepts in a large share of all newly erected buildings in Europe. Substantial contribution of the building industry to the GHG emission reduction targets in Europe. 2015 Newly erected buildings consume in average 30% less energy compared to 2000. Share of wood in construction has increased by 20% compared to 2000. Wood, concrete, steel and glass sector have fully realised the

European relevance and collaboration: Strong effort is needed to promote renewable building material systems. Competitiveness and efficiency can only be reached with harmonisation and industrialised pan-European systems. Too much overlapping and locally differentiated systems exist now. Compeating materials more consolidated and rule the market.

1.N.6 Indoor environment in wooden houses

Positioning: Basic

Short Description: Untreated wood emits natural volatile compounds, very often what you would recognize as the smell of wood. In softwood the terpenes are the dominating the emissions. Engineered wood also emits natural volatile compounds, and if glue has been added, these products might give increased levels of formaldehyde. Improvement of positive and negative aspects of wood emissions, as well as obtaining substantiated documentation on the positive properties of wood, will be central in this part of the project. This project will investigate and verify research already accessible, and supplement this with new knowledge if needed. - Health effects on the different emissions from wood and wood products will be investigated through existing knowledge and new research on the emissions effect on human health - New technologies for reducing or eliminating natural emissions from wood will be developed - New test methods and assessment/certification of natural emission from wood will be investigated

Justification: Indoor environment factors has become an important environmental argument in the wood industry. It is therefore important to gain knowledge and information on how the most typical indoor environmental factors influence human health. The project can be closely linked with projects dealing with other indoor environment factors. Germany has notified a draft decree “Principles for the health assessment of construction products used in interiors”, based on the German AgBB-scheme. This AgBB scheme is still subject to substantial debate and opposition from experts in the wood sector, because it does not take account of the fact that wood emits natural and non-harmful VOCs (Volatile Organic Compounds). So far no scientifically-based relationship has been established between emissions exceeding a threshold value and a risk to health. If such a decree is approved and implemented, products that do not achieve the requirements may no longer be used in interior applications in Germany. This could establish a dangerous precedent.

European relevance and collaboration: There are movement within CEN on emissions from construction products where VOC and formaldehyde are high in the agenda. A common European collaborative work will therefore be suitable as there should a common European understanding on the health effects of wood emissions. Key roles in this project will need to be established at a later stage, several research groups and types of research will be needed to implement this research.

1.N.7 Analysis of wood demand structure of Chinese solid wood processing/using industries

Positioning: Applied

Short Description: The research is to clarify the implication of the growing Chinese solid wood processing/using industry to the European wood industry as wood demand is concerned. China now has a fast-growing wood processing industry to supply both its rapidly surging domestic market and international market. This research is to analyse wood demand structure of Chinese industrial buyers of solid wood to understand its price pattern for wood raw material input in various processing degrees, quality requirements, operational environment and business practice etc. Special attention will be paid to the current wood supply sources, availability, tree species, quality features etc. Such industrial buyers would include sawmills, secondary processing mills, various wood products manufacturers ranging from wood floor factories, furniture mills to window/door mills, and building constructors. The research also address issues of quality, price level, market targets of the final wood products of those industrial buyers. A qualitative approach will be adopted for the research. Mill visits and field survey will be done to 30 representative Chinese solid wood processing/using companies ranging from small to large firms. A large literature review on the topic area will be carried out to collect secondary data for the research topic. Collaboration with some Chinese universities and research institute will greatly facilitate successful implementation of this research.

Justification: The research results will benefit European wood industry in following ways: • Help European wood industry to understand the solid wood demand structure of Chinese market along with operational environment, business conditions, and operational practice of Chinese wood business. • Provide information for spotting possible business opportunities, export of wood products or/and wood processing machines and investment ventures in China. • Provide useful information for European wood industry to develop its global business strategy. • Find opportunities for cooperation in business and research area between Chinese wood industry and European wood industry.

European relevance and collaboration: The issue is suitable for a collaborative European research project for following reasons: • Chinese wood industry is large and growing. It consumes a lot of both softwood and hardwood species for various end user products. So both European softwood and hardwood processing industries will be covered while assessing business implications of Chinese solid wood processing/using industries. Therefore wood species considered would include such as pine, spruce, larch, oak and beech etc from Nordic countries and middle and south European countries. • As European Wood Council (EWC) has been established to coordinate business development efforts of European wood industry, this research project would be in line with the business development spirit of EWC.

Sub-area 2.1 Modification and processing of wood raw material into innovative, eco-efficient products

2.1.1 Increasing permeability of refractory wood species

Positioning: Applied

Short Description: Spruce (Picea spp.)represents 35% of the European forest resource and is therefore highly significant in terms of potential wood supply. While this timber has many of the physical attributes necessary to allow it to be used for a wide range of applications the species is refractory in nature. This means that any attempts to treat the wood with, preservatives, fire retardants, wood modifying chemicals etc is difficult to achieve therby limiting the applications of the timber and making it difficult to add value to the product. The reason for the refractory natue of the wood is in the anatomical structure of the timber and novel reasearch methods are required to address this issue. While some success has been achieved through incising and oscillating pressure treatments they have been hampered by cost and variable effectiveness. Recent patented research has established that fungal pretreatments can also significantly improve the penetration of solutions into sapwood and heart wood of spruce and pine species without significant detrimental effects on the timber. The effectiveness of these technologies however need to be established at inductrial scale.

Justification: If this technology can be sucessfully scaled up to industrial production there are likely to be significant economic benefits as the range of potential markets for spruce and other refractory species can be increased. Although the technology can be seen as increasing preservative uptake into spruce it is likely to be more permanent in the timber as it is impregnated into deeper depths in the timber and is also a technology that can be used for many ogf the newer more environmentally acceptable wod preservastion technologies that are currently being developed. Local socio-economic benefits for spruce producers are obvious given that the technology will add value to spruce products for the producers across a broad range of European countries.

European relevance and collaboration: Given the range of countries across Europe who are producers of spruce of different species and variable quality in terms of its growth properties in the different European regions, it is anticipated that there would be wide interest in anty process that can improve the treatability of the material. Likewise there are a number of novel preservatives and wood modification chemical processes being developed in a number of European countries however all face the same basic problem when working with spruce i.e. how to get the active agent deep enough into the timber. It is envisaged therefore that a broad project could be developed with a range of European partners from a number of countries to examine the fungal pretreatment technology and perhaps any competing technologies for this purpose.

2.1.2 CATALYST-AIDED MECHANICAL DEFIBRATION

Positioning: Basic

Short Description: The objective is to utilize the latest enzymatic technologies and new chemical approaches to reduce energy consumption in mechanical pulping and/or prepare pulps with new functionalities. Current CTMP processes are based on softening the wood structure by alkaline chemicals, but large amounts of caustic needed reduce pulp yield and deteriorate its properties. Small well-focused attacks on the wood fiber wall by chemical and enzymatic catalysts could enhance its opening and defibration during mechanical pulping. By oxidative treatments, modified pulp properties can be obtained. Three main approaches are explored in cooperation with the research partners. The most promising approaches are selected for more goal-oriented implementation studies together with the industrial partners 1) Enzymes, e.g. peroxidases and other oxidative enzymes 2) Biological catalysts; fiber-wall-opening and swelling enzymes 3) Chemical catalysts; biomimetics, e.g. metal-ligand complexes

Justification: If successful, the project will allow development of new wood processing alternatives for producing high-yield, eco-efficient mechanical pulps. The industrial competitiveness will be promoted by * Reduction of alkali use in hardwood defibration * Reduced energy consumption of mechanical defibration by catalyst- aided treatments * Enhanced mechanical defibration of dry wood. * Increases further the sustainability of the process

European relevance and collaboration: Increases the European competitiveness by enabling wider usage of European wood species in mechanical pulping. Mechanical pulping of wood is restricted by high energy costs. In addition, the range of tree species currently accepted as wood raw material is limited. New alternatives for mechanical processing of wider range of wood species and raw materials of lesser fiber properties are needed to be utilized. Current CTMP processes are based on softening the wood structure by alkaline sulfonation, but the use of caustic chemicals at higher dosages reduces pulp yield and deteriorates its properties. Catalyst and enzyme development needs cooperation on European level. Potential collaboration instances are: University of Helsinki: prof. Fagerstedt, Dept. of Biological and Environmental Sciences; Prof. Leskelä, Doc. Sipilä; Dept. of chemistry, KTH: prof. Teeri, Wood Biotechnology, Krause, TKK, University of Aveiro, Portugal, prof. Neto, University of Torvergata, prof. Galli, CTP, France, dr, Petit Conil Industrial partners: Genencor, Kemira

2.1.3 Modification of semi-finished products

Positioning: Applied

Short Description: Modification of semi-finished wood products in order to develope value-added products.

Justification: Patents / new enterprises

European relevance and collaboration: Knowledge spread all over Europe to small research groups

2.1.4 Full Strength of Wood and Wood Fibres Composites

Positioning: Basic

Short Description: The high tensile strength properties of defect free wood and wood fibres are poorly utilised in practise. In engineered wood products the strength of wood can be increases up to the level of 50 MPa compared to the strength of 20…30 MPa sawn lumber. However, the tensile strength of 150…200 MPa can be reached in defect free wood and the tensile strength of wood fibre cell wall can be as high as 1 500 MPa. The aim of this research is to study theoretically and experimentally how the micro-structure of wood (cell wall, cellular structure of earlywood, latewood and ray cells) and wood based composites affect strength properties and what are the technical key factors (in wood material, in other components of the composite and in the interfaces between material components) to minimise effects of defects and to more efficiently or fully utilise wood fibre strength in bio-based composites. It is essential to study short- and long-term properties and the effects of moisture content and moisture content variation.

Justification: More fundamental understanding of wood and wood composites at nano- and micro-level strength behaviour and properties will be obtained. Based on this knowledge a new concept of innovative high tech eco efficient wood based products can be generated. At the long run new industry will be obtained. The increasing raw-oil price makes wood based composites more attractive for industry.

European relevance and collaboration: The research requires wide co-operation between different research laboratories to utilise existing knowledge, research equipments and other facilities optimally (Micromechanics, Environmental Scanning Electron Microscopy, AMF, Image Analysis Methods, surface analysis and advanced numerical calculation methods must support each other). The strong knowledge on the chemistry is also needed to understand the adhesion mechanisms and its development during production of wood composites. Possible research groups with key roles: 1) Helsinki University of Technology Laboratory of Wood Technology 2) Helsinki University of Technology Laboratory of Forest Products Chemistry 3) Department of Materials Sciences and Process Engineering Insitute of Physics and Materials Science BOKU – University of Natural Resources and Applied Life Sciences 4) Max Planck Institute of Colloids and Interfaces Department of Biomaterials 5) Swiss Federal Institute of Technology, Lausanne Laboratory of Construction Materials 6) Centre for Biomimetics School of Construction Management & Engineering Reading University 7) BioComposite Centre University of Wales

2.1.5 Use of Bio-foam for production of novel light-weight materials

Positioning: Applied

Short Description: Durable and water resistant bio-foams should be developed based on mais, wheat or other cereals or even based on wood derivatives. Such foams in combination with other materials could be developed into a new family of novel products

Justification: Bio-based matierials with new properties and inproved environmental behaviour are needed to overcome the expected shortage of fossile carbon resources

European relevance and collaboration: Joint trans-national and collaborative research and development between research institutes and industry will help to speed up the process of development of novel solutions.

2.1.6 Improving timber products from beech

Positioning: Applied

Short Description: For European Beech, the discoloration red heartwood (red core) is very common, as well as it is the occurrence of tension wood. Both factors restrict the log quality of beech stems and end products significantly and lead therefore to severe economic losses. One of the goals of research of the institute is to investigate the reasons for red heartwood and tension wood formation, the consequences for the timber quality and the possibilities to compensate the unfavourable properties by innovative processing technologies. This work is based on detailed dendrometrical and wood technological analyses of beech trees of different sizes and growth characteristics, the resulting timber from these trees and wood processing trials to develop new or improved products. The results will be implemented into wood quality models on one hand and into innovative wood processing technologies and products on the other.

Justification: The results gained from this research are relevant for silviculture and wood utilisation as well: Silviculture: the findings will allow to emphasise the impact of silviculture on red heartwood and tension wood formation and to deduce recommendations for stand management strategies. In a long-term, wood quality of beech might be improved by adequate silvicultural treatment. Wood utilisation: innovative processing technologies (gluing, sawing) will improve the quality and the market opportunities of timber products coming from otherwise almost worthless beech wood, which will be for the profit of forest owners and beech wood processing industry as well. This will be decisive for the acceptance of this ecologically very important tree species.

European relevance and collaboration: The aspects mentioned above are relevant for the forestry and forest industry of all European countries, where beech is a relevant tree species. Therefore the research performed in this field will be of general interest for these countries as well. European research groups besides forest faculties being possibly interested in this work are for example INRA/ENGREF (France), FVA Baden-Württemberg, LWF Bayern, FVA Trippstadt (Germany), WSL Birmensdorf (Switzerland), and DFLRI Hoersholm (Denmark).

2.1.7 Wood based materials based on subarctical plantage shortfiber corps

Positioning: Applied

Short Description: The fibers in eudicotyledonic wood (hardwood) are considerably shorter than the fibers from conifer wood (softwood). Pulp made from hardwoods is therefore called, short-fiber pulp, whereas pulp made from conifers are called long-fiber pulp. Long fiber pulp are suitable for strong papers as for instance liner, whereas short-fiber pulp are suitable for products where the formation and surface of the paper need to be of very high quality as fine paper. Often shor-fiber- and long-fiber pulps are mixed. In northern Europe it is an excess of conifers for production of long-fiber pulp, but hardwood need to be imported as pulp or logs for the production of short-fiber pulps. There is however possibilities for produce large amounts of short-fiber raw material in Northern Europe - the plantage cultivations of Salix and Aspen can be used for the higher value of pulp and fiber production instead of the lower value of energy production. Special tailor made pulping procedures is then however needed to be developed due to the special chemical composition of these wood species, not only for traditional pulps for paper and board production, but also for novel composite type materials.

Justification: The use of non-renewable resources for production of materials of different kinds is not compatible with a long time resistant technical culture. Furthermore, the use of petroleum products for plastics is hazardous on the global climate, since it increases carbon dioxide to atmosphere, which lead to a green-house effect with increased temperature as a consequence. With the growing population and increased living standard in the third word, an increased need for cheap renewable raw materials is expected. Fast growing hardwoods is here one of the interesting alternatives, but the industry need have access to processes tailor-made for the properties of these materials.

European relevance and collaboration: Presently the production of short-fiber in plantage cultivations of for instance Eucalyptus for pulping is increasing very fast in tropical countries as Brazil and Indonesia. Except for the southernmost Europe, the climate in the EC does not allow production of these trees comparable to the tropical countries. However, cultivation of other trees suitable for a colder climate as different Poplar and Salix species, allow a comparable production per area as in Brazil even in Scandinavia. The farmers are in need of alternative crops and plantage type cultivation of fast growing hardwood can be an interesting alternative. The European industry, both the present and the future, have a large need for cheap, high quality short fiber. The project is therefore suitable as a common European project involving many laboratories. The project shall be coordinated by the department of Fiber and Polymer Technology, at the Royal Institute of Technology, Stockholm, Sweden.

2.1.8 Surface modification using biomimetic concept

Positioning: Applied

Short Description: The maybe most resistant biopolymer that exists is suberin, that is located in bark and on the surface of roots. There is works as a resistant and hydrophibic barrier that efficiently protects the plant tissues from attack by microorganism and physical damage. Chemically it is similar to lignin, i.e., a product of radical polymerization of propylphenols, but it also contains strongly hydrophobic building blocks as fatty acids. The idea of this project is to construct a synthetic polymer similar to suberin according to a biomimetic strategy by combining phenolic by products from the pulp and paper industry – black liquor – with fatty acids that are produced in large scale in the agriculture. The obtained material will probably interact excellent with cellulose and other wood components simultaneously as it produce a hydrophobic and strongly resistant surface layer, that can be applied in novel high performing paper- and wood based products.

Justification: Poor resistance to water is in many ways the weak point in papers and other wood based products. This limits the use of these renewable and environmentally friendly materials toward the non-renewable petroleum based plastics. Thus methods to increase the humidity resistance on wood based materials by methods based on renewable resources, as described in this application, is strategically very important in the process for developing an environmentally resistant technical culture.

European relevance and collaboration: Europe has a large access to wood raw material, and has an over production of agricultural products. Contrary, the EU is a net importer of petroleum. Therefore it is of economical as well as environmental interest to increase the use of forest and agriculture products on the behalf of petroleum, and thus the present project is of common interest in the European Union. To manage the project many research groups with various specialities need to be involved and a European network is therefore the best form for the project. It will be coordinated by the department of fiber and polymer technology, Royal Institute of Technology, Stockholm, Sweden.

2.1.9 Improved coatings for wood

Positioning: Applied

Short Description: Although there are finishes which are highly durable on metals or plastics, these finishes have a considerably shorter service life on wood. Therefore, this research should mainly aim at improving the coatings to significantly elongate the service life of coatings on wood materials. The research work should be carried out on the following contents: 1) Develop new or modified present binders based on waterborne, to enhance the bonds with wood substrate. The binders should be suitable to fast cure at room temperature or with irradiation; 2) Coatings with enough flexibilities to meet the dimensional changes of wood substrates; 3) Addition of effective UV absorber or HALS, and fungal biocides, which are leach-resistant; 4) Improve the water/moisture resistance of coatings by using hydrophobic additives; 5) Improve the coating properties by chemically modifying the wood substrates, for instance, grafting UV absorber or HALS onto wood surface before coating, or modified wood with chemicals.

Justification: Possible results expected from this research are: 1) The wet adhesion of coatings is increased, therefore reduces the damage at the moist condition. 3) The sufficient flexibilities of cured coatings will reduce the stress originating from the dimensional changes of wood substrates. 3) The UV absorber or HALS will prevent the coatings from photodegradation, therefore reduce the brittleness of coatings. The addition of fungal biocides may prevent the biodegradation. 4) Cured coatings should be high efficiency in blocking water penetration and reducing moisture ingression; 5) Modifying wood substrate may improve the coating properties from another side. The increased dimensional stability, reduced moisture level in the wood may reduce the cracks and prevent the biological attack. If the UV absorbers or HALS are grafted onto wood surface, the leachability of them is limited. If the researches are successfully carried out, the improved coatings may have longer service life, thus the times of maintenances are reduced. Therefore the costs and labours are saved. The products will be more competitive in the market. Waterborne coatings with low VOC would have little effects on people and environment.

European relevance and collaboration: Since the research involves the coatings and wood, it is particularly suitable for collaborative research activities. The suitable groups may be: 1) Institute of Wood Biology and Wood Technology, University of Goettingen, Germany. 2) LERMAB, Université Henri Poincaré, France 3) BRE, Centre for Timber Technology & Construction, Watford WD25 9XX, UK 4) PRA Coatings Technology Centre, UK 5) SHR Timber Research, Holland 6) VTT Building Technology, Finland

2.1.10 Thermal treatment of wood in a liquid phase

Positioning: Applied

Short Description: The aim of the study is to destroy selectively the wood mollecules, in particular hemicellulsic material mainly responsible of the hygroscopic properties of wood and its low durability. The research activity consists in the development of a thermal treatment of wood in a liquid phase at moderate temperature in which is included a light chemical impregnation. The final step of the process should be a drying phase characterize by cycles of pression and depression. The characterization of the final product obtained is requested (mechanical tests, measurement of the size variation coefficient, the durability of wood,...). The understanding of such a process should request to model heat and mass transfers between wood and its liquid environment and also during the last step of drying.

Justification: The main results expected are the following ones : - the development of a process that could improve the durability of european wood species for external uses. - a new process that could join the advantages of a chemical impregnation and the ones of a thermal treatment. This process could allow to improve the competitivity of wood material compare to the other materials (plastics, metal, ...). The last interest of such a study is to develop the use of european wood species instead of tropical species.

European relevance and collaboration: Some thermal treatments of wood already exist in Europe. The problem is the level of the operating temperature that is required. With a moderate temperature of treatment and a simultaneous light chemical impregnation, a more eco-friendly process could be developped (lower energy cost, lower polution).

2.1.11 High strength and slim timber structures

Positioning:

Short Description: European timber strength information is not adequate, it is based on small separate projects, not on representative sampling. Testing of strength, bending, tension, compression and shear. Wide sampling of Central European and Nordic spruce and pine which at the same will be tested with new NDT detection techniques before actual strength tests. Reniewed test and product standards to be developed.

Justification: Developing integrated strength grading processes from log raw-material to timber structures. Cost efficiency in whole value chain. Utilization and development of new NDT measuring tools to be integrated as total control systems in production. New performace values for EuroCodes and safety targets for timber structures. Attractive, slim and competive structures for timber buildings.

European relevance and collaboration: At the moment there seems to be disagreement between countries and country groups for European approach for grading and standards. This eliminates the development of free market for building products in EU. The competitivess of timber building needs full European level research and industry cooperation.

2.1.12 Chemical and physical changes in heat treated wood

Positioning: Basic

Short Description: Heat treatment has become widely approved and utilized industrial process all over in world. However basic understanding of the chemical and physical changes in wood is narrow and restricts the product improvement and development. We need to finalize the missing basic research to enable real break through technology development in future.

Justification: The results might be as follows: - control over PH (acid acetics) in process - improved strength properties (less brittle product) - improved durability - better understanding of the durability of product in use - reniewed production processes - posibility to develop new products with new modification processes

European relevance and collaboration: This issue should be researched on wide basis in Europe to get common knowledge and data base but also for education for universities. Recommended network: LTU Sweden, TUM Munchen, Boku Austria and VTT Finland

2.1.13 INNOVATIVE CHEMICALS AND POLYMERS FROM BARK (INNOBARK)

Positioning: Applied

Short Description: Bark is one of the large volume residues in mechanical forest sector. Nowadays it is mostly utilized as energy source and landfill material. However processing of bark of certain wood species such as birch, pine and cork offers an interesting, reasonable and simple way to produce environmentally friendly potential new products in food, pharma, agrochemicals area as well as new intermediates for coatings and composites. In INNOBARK project modern chemical and biochemical methods, such as selective synthesis and enzyme catalysis as well as new separation techniques are applied to achieve targeted products.

Justification: Birch bark extracts, such as betulin or hydrolysates, especially phenol derivatives, can be used as raw material for potential new drugs, active ingredients in cosmetics as well as environmentally friendly plant protection agents. In addition the other large volume bark hydrolyzate fraction, suberin acids, is a potential new raw material for coatings and composites. Pine phloem again is interesting carbohydrate source for numerous down stream applications especially for functional food. INNOBARK project offers new feasible options to produce environmentally begin chemicals and polymers from forest residues. It will support local activities in undeveloped regions in Europe leading to new businesses in forest sector area.

European relevance and collaboration: Nordic countries, especially Finland, Sweden and Norway as well as Austria, Germany and Portugal should have key role in INNOBARK project because of their strong forest research actities.

2.1.14 Moisture-resistant wood based material through thermoplastic WPC pressed top layers

Positioning: Applied

Short Description: A crucial criterion for the permanent durability of wood based materials (particle boards, fiber boards, OSB (Oriented beach board), plywood) are their hygrical properties. The hygroscopic properties of the wood first are causing irreversible swelling in wood based materials. Periodic swellings and shrinking can completely destroy the bonding of the wood particles. The material will become unusable. Therefore apart from the optical aspect all coatings have to protect the carrier material against substantial wetting. Conventional press coatings (duroplastic foils, melamine papers and laminates) can fulfil the requirements concerning water resistance of the material only under certain circum-stances, since at least water can penetrate from the boundary area via the joints. Thick thermoplastic coatings however would be expressively water-resistant. Thermoplastic plastics (PP, PE) are clearly more expensive than the usual foils and melamine papers. Due to cost factors until now no procedures have been developed with those thick coat-ings from PP or PE to be applied. If the thermoplastics are mixed before with particles from laminar lignocelluloses (fibers, splinters), clearly lower material costs would result, since such mixtures can utilise up to 90 % wood fibers or wood particles. Mixtures of this kind are used for the production of WPC (Wood Polymer Composite) as well. In the focal research material and process engineering solutions are to be compiled for the functional coating of wood based materials with a thermoplastic mixture containing wood (WPC).

Justification: The technical emphasis of the project lies in a process development in combination with higher in-use properties of coated wood based materials. If a WPC material can be ap-plied on a wood based material, the permanent durability of the wood based material would considerably improve. In relation with today's coatings thermoplastic coatings have considerably technical advantages. Coatings of this kind are nonporous and alkali resistant, therefore water cannot penetrate into the carrier board. The regenerating raw material wood could thus be used in fields not being applicable before due to its hygri-cal properties and/or lost market shares can be gained back (external fronts, covering boards, garden furniture). Thus e.g. the market share of covering boards of wood based material as carrier material has extremely decreased in the last 10 years. This is neither ecologically meaningful nor economically justified, because concerning the price wood based materials as carrier material can fully compete with alternatives. The project serves to secure the operation of mainly medium-size enterprises, who are producing improved wood based materials for the industrial and private use and/or are producing special products of high real net output for the external application and/or special niche appli-cations. Enterprises using this technology to be developed could offer a unique product. The carrier material is less expensive and more ecological with lower weight than other competing products. In addition, its durability is improved.

European relevance and collaboration: The wood-based material industry is beside the saw mill industry (without paper and cardboard) the most significant utiliser of various wood raw materials. Today European-wide more than 50 millions m³ wood based materials are manufactured per year. Just a few years ago the transport of wood based material over larger distances was considered as uneconomically. This has fundamentally changed. The interior European trade and export to overseas are meanwhile of great importance. Furthermore the wood based materials industry is European-wide set up, the important industrial enterprises have production plants in different countries. Nevertheless the wood based materials industry and manufacturers have been faced with a strong competition pressure. The strong position of the wood based materials industry in Europe could so far resist only by their production of particularly high-quality or special nice products. Further product improvements will provide better compatibility for new markets and strengthen the economic position of the wood based materials industry in Europe. With regard to the development of wood based material several institutes of wood research are active (Trätek, CTBA, DTI, VFF, BM TRADA, WKI, HFA), which could compile in close collabora-tion new coating technologies for WPS. In addition, with this special development R&D institutes active in the plastic technology should be considered as partners as well. This could form a interdisciplinary approach.

2.1.15 Fine chemicals from wood based key precursor (LIGFINE)

Positioning: Applied

Short Description: The goal in LIGFINE project is to develop new environmentally begin products, especially pharmaceuticals and food additives, from easily available wood precursors such as á- pinene, hydroxymatairesinol and levulinic acid. A new way to separate sulfur free á- pinene from saw mill volatiles will be explored. New chemical and biochemical options to transfer á-pinene to geraniol, citral and ionones and further to medically active compounds and vitamines (A and E) will be studied. In addition synthetic procedures for new potential drugs, enterolactones, will be developed from hydroxymatairesinol, a product which occurs in large amounts of fir tree brances. Possibilities to utilize levulinic acid, produced for instance from saw mill waste, will be also studied. Potential products will be tested in co-operation with participating industry.

Justification: In recent years there has been a growing interest to develop fine chemicals especially pharmaceuticals and food additives eg.vitamines and antioxidants from wood. This is because some of the key precursors such as á- pinene, hydroxymatairesinol and levulinic acid can be easily separated from wood waste. These molecules also have a chemical structure which minimizes the number of synthesis steps needed to reach the final active product. In addition their metabolic decomposition is mostly known, making them easier to use than totally new synthetic products.

European relevance and collaboration: LIGFINE project will create new business opportunities for fine chemical industry in Europe and will support local activities in undeveloped regions of Europe while leading to better utilization of mechanical forest sector residues. Nordic countries, especially Finland, Sweden and Norway as well as Austria, Germany and Poland should have a key role in LIGFINE project because of their strong forest research activities. In addition pharmaceutical companies, SMEs as well as large ones, should participate.

2.1.16 BioRef - Sustainable wood based refinery products

Positioning: Applied

Short Description: The objective is to develop new competitive and breakthrough eco-efficient process and synthesis routes for the manufacturing of high added value chemical products and materials, exploiting the potential that is offered by renewable materials. Regarding actual tendencies of oil prices economic competitive materials have to be developed. BioRef makes use of an integrated approach by means of the 'bio-refinery' concept. The bio-refinery is operated comparable to an oil refinery, which also produces numerous chemical intermediates for further processing. In this project the whole chain from biomass feedstock to materials and markets / applications will be covered. BioRef will develop cost-effective and environmental friendly processes for basic materials, substances, plastics and intermediates that are attractive to investors and acceptable to planning authorities and the public in general. Those materials will have a basic impact on the sustainability of key industries in Europe (e.g. automotive, construction, durable goods, consumer products, etc). To come to an early decision support, a sustainability analysis, regarding the whole life cycle of the products, will be done in parallel to their development, comparing the wood based bio products to conventional products, to get innovative eco-efficient products.

Justification: The cost and security risks of fossil feedstock imports, the environmental concerns with increased pollution, the global greenhouse gas emissions from fossil feedstock use and the desire to improve the rural economy should stimulate Europe's interest in bio-based feedstock for basic materials. The potentially more labour intensive beneficiation of bio-feedstock compared to crude oil promises a positive net job-effect in rural regions of the EU. BioRef will provide society with the breakthroughs in science and technology that will be necessary to successfully address these challenges. Further aim of this proposal is to establish Europe as the technology development and technology commercialisation leader in this field. Providing a competitive manufacturing sector to achieve Europe's long term economic, social and environmental targets -Fostering Europe's lead in chemical technologies, and increasing the share of target chemicals that are based on renewable resources to a higher share -Contributing to cost reduction of chemical processes by the development of new and safe industrial process concepts that consume less energy, produce less waste and are characterized by a significantly reduced number of process steps -Decreasing Europe's dependence from fossil feedstock - Contributing to new employment opportunities.

European relevance and collaboration: Providing a paradigm shift in energy and material consumption patterns towards sustainable use of natural resources creating new opportunities for Europe's materials transformation industry in existing and new markets and applications. Further results will be -Fostering Europe's lead in chemical technologies, and increasing the share of target chemicals that are based on renewable resources to a higher share -Decreasing Europe's dependence from fossil feedstock - Results will meet the future needs of key markets and industries in Europe. The consortium should consist of a critical mass of expert organizations throughout Europe

(industry, academia, institutes, SME's) and interdisciplinary research teams with members in the fields of forestry, chemistry, process technology, materials science, market development, economy and life-cycle analysis, such as -TNO MEP, Netherlands Organisation for Applied Scientific Research -Deutsche Gesellschaft für Holzforschung, DGfH, München -Biomass Technology Group BV -Stuttgart University, IKP, dept. Life Cycle Engineering

2.1.17 Wood property based separation and sorting of wood components for a biorefinery

Positioning: Basic

Short Description: Wood property based separation and sorting of wood components for a biorefinery.

Justification:

European relevance and collaboration: Groups in Sweden, Norway, Finland, France a.o.

2.1.18 Forest biorefinery for green chemicals and polymers

Positioning: Basic

Short Description: 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.

Justification: 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.

European relevance and collaboration: Various expertise areas are needed to accomplish the goals. Partners can be identified among groups specialized in: enzymology, wood chemistry etc and will be named later.

2.1.19 Sustainable bio-based methods for paper manufacture

Positioning: Applied

Short Description: Biotechnical methods applicable in the pulp and paper industry are emphasized by two specific features; sustainability and specificity. Sustainability means that biotechnical methods do not introduce harmful chemicals and can even diminish the consumption of chemicals or energy. Enzymes are generally considered as the most specific catalysts for fibre modification. During recent years, knowledge on cellulose or the polysaccharide modifying enzymes has been substantially increased, and novel enzymes are entering markets with a wider divergency and improved specificity. The performance of enzymes has been significantly improved; thus on one hand novel cellulases with low hydrolytic, high fibrillative activity, and on other hand more efficient hydrolytic enzymes have been identified. Additionally, these novel enzymes often are more temperature tolerant, allowing development of combined physical and enzymatic treatments. The proposed theme will focus at exploring novel uses of these enzymes in innovative applications. The methodologies will involve comparison, choice and improvement of enzymes for various applications including combined treatments to improve fibrillation, fractionation of recycled fibres into higher and lower value fractions or hydrolytic degradation of value-less fractions into other potential products.

Justification: The goal of the present theme is to design new combined processes, where bio-based unit operations are intelligently combined with traditional or novel physicochemical/mechanical unit operations, resulting in sustainable hybrid processes with substantial energy or chemical savings, or alternatively in improved product quality. The enzymatic unit operations can facilitate refining by eg. increasing the fibrillation, improve the bonding ability or the quality of recycled fibres. Beneficially, the new combined methods could also lead to an optimal fractionation leading to reuse of fibres with higher quality and utilization of the lower quality fibres for production of eg. biofuels. Thus, this proposal meets well the future challenges; improved sustainability and eco-efficiency by advanced recycling and increased use of renewables for energy production.

European relevance and collaboration: In Europe, only few research laboratories have so far expertise on these novel cellulases and other hydrolytic enzymes. Combined competencies and close collaboration of both top quality laboratories of biotechnology and fibre engineering.

2.1.20 Cellulose-based polymers

Positioning: Applied

Short Description: At present, the use of cellulose for higher technology products is marginal as compared to the volume for paper and board products. One reason is that this is due to very strong fibrillar structure of cellulose, which complicates its chemical processability. Thus, most of the regenerated cellulose items as well as the modified cellulose for a wide range of products are currently manufactured by the derivatisation of cellulose. Existing derivatives demonstrate inhomogeneities at different hierarchical levels, which results in poor performance of the products. If it would be possible to prepare new derivatives with controlled chemical and supramolecular structure, there is a large potential to apply them for high value products, such as sophisticated pharmaceutical and fine chemical applications and in composites. By developing knowledge about how the accessibility of crystalline and amorphous regions in different morphologies, it will be possible to use new polymerisation reactions, which results in a better control over the degree of substitution, molar mass and molar mass distribution.

Justification: The research area as such is directly relevant to the search for new value added products, i.e. made by use of modified cellulose fibres from renewable resources. The products that might be formed from these modified fibres are of large interest for the industry where the development of new products has been given large interest. Apart from this it is not difficult to envision the start-up of new entrepreneurial companies around the products described above. Due to increasing prices on oil based raw materials, there is a renewed interest in products made from renewable raw materials. The results can create new routes for producing sustainable products based on modified wood based fibres. It is obvious that these new types of products would be ideal for the creation of small start-up companies. In the longer perspective this development will most probably create a more modern image to the use of wood based fibres/products and in conjunction with the already existing forest industry this will attract skilled young students that are so important for an efficient use of the renewable resource we have in our forests.

European relevance and collaboration: Due to the strong competence within this area at universities an institutes in Europe the possibility to success is large. Competence can be found at KTH (Ek, Karlsson), Boku (Rosenau, Pothast), Cermav, Hamburg (Saake), Finland VTT ,...

2.1.21 Phenols in wood and bark

Positioning: Applied

Short Description: Phenolic compunds play a key-role in tree defence againts wood decaying fungi and bacteria. However, they have also shown to have health promoting properties. More and detailed chemical analysis is needed to characterise these compounds in various tree species and how they could be processed and used.

Justification: New chemical compounds could be purified during traditional wood processing from wood residue and bark. New products could be developed as anti-fungal and anti-bacteria agents and health promoting compounds.

European relevance and collaboration: Chemical analysis and product development as well as testing is suitable for European collaboration. Several laboratories work with the issue.

2.1.22 Reduce the overall material usage of fibre based products

Positioning: Applied

Short Description: Sustainability will be an increasingly important value and overriding goal in the society. The growing affluence needs to be created with a smaller environmental footprint. These goals are supported by various political initia-tives and public concerns. Awareness among customers and consumers about environmental and social responsibilities will grow. Supply of clean water and climate change will be critical issues. These issues need to be considered both in the selection of manufacturing technologies and in prod-uct design. Getting “more-from-less” needs to be an overriding criterion of all industrial operations and systems. To achieve sustainability the growing society needs to be economizing on resources. At the same time the materials need to deliver the same or better performance than today’s fibre based or alternative materials such as fossil based materials (metal, glass, aluminium) or syn-thetic, crude oil based materials.

Justification: Reducing specific wood consumption: Increasing the material yield from wood raw material and its processing Improving fibre properties through better control of processes and fibre engineering Further reduced fresh water consumption Developing improved sheet structures Fostering creative converting and end product design Re-engineering the value chain and logistics

European relevance and collaboration:

2.1.23 Modified wood as structural material – reliable relationship between important properties

Positioning: Applied

Short Description: The good knowledge of mechanical and physical properties of modified timber (MT) is essential when using it as a load-bearing member in a structure. There are at least three modification methods; heat treatment, acetylation with acetic anhydride and furfurylation, for example, which are produced industrially and sold as durable alternatives. However, the knowledge about these products structural properties is limited and construction industry has to rely on the information provided by the producers. Often Eurocode 5 for design of timber structures does not apply to modified wood. The aims are to define the requirements and create both the opportunity to apply modified version of Eurocode 5 and the quality control system for MT products and components to ensure fitness for purpose and optimal value. Studies include: · summary of the performance requirements for finished components/elements/structures imposed by society for safety and by commissioners for functional and aesthetic reasons where MT would be superior to conventional timber, · produce reliable inter-relationship between important mechanical material properties, · inter-relationship between performance requirements and grading parameters for MT products, · mechanical properties of connections and joints when using MT, · quality control techniques for MT products and use of suitable equipment for ND measurements to facilitate quality control.

Justification: In order to stay competitive, the producers of MT must increase their knowledge about other aspect than durability of their products. Durability and maintenance are very important for the load-bearing timber components especially for out-door applications. The scientific programme focuses on developments related to defining structural and moisture properties as well as assessment of distortions, strength, stiffness, connection properties and stress grading system. By identifying new measuring and assessment techniques this project will promote increasing application of MT to the specific needs of building sector as well as support the development of reliable, cost-efficient quality control systems. It will also provide the basis for improved specifications for timber products and contribute to economic optimisation of production so that the full environmental and sustainability benefits of timber can be realised. Timber is very attractive sustainable alternative to steel and concrete in many structural applications. The trend of increasing timber production is expected to continue. As durability is one of the main weaknesses of timber, the advantage of modified wood is obvious. However, the mechanical properties must be reliable to make the impact on the market.

European relevance and collaboration: Within this project, collaboration is essential to gather and generate qualitative and quantitative knowledge about modified wood in European countries. In order to revise and validate Eurocode 5 to include modified timber, the collaboration within this project is essential Improved quality control systems will help to increase the competitiveness of the wood sector, ensure that MT is optimally processed and that European wood industry provides wood products which are well adapted to end user requirements. Identifying the performance and relevance of non-

destructive testing (NDT) and grading technologies on the European level is essential to propose quality control techniques for modified material and modified-wood products and NDT's suitability for measuring parameters to facilitate quality control systems.

2.1.24 Measuring, characterizing and bucking wood with logging machines

Positioning: Applied

Short Description: The project prosposal 3.1.28 wwill support this sub-area

Justification:

European relevance and collaboration:

2.1.25 Expanding use of tree species for wood modification

Positioning: Applied

Short Description: In Germany the commercial use of wood is concentrated on only few tree species. A lot of more unknown or less used species would also be able for wood utilization, if special wood properties could be improved. During the last years an increasing number of wood processing factories made use of wood modification in order to enhance the quality of wood. Wood modification is a well acccepted technique to increase the utilization of wood additional use. In case of wood modification also less suited wood species can be used for more qualified use, especially for outdoor use under wet conditions. In order to increase the number of useable tree species for wood utilization, additional research has to be done to get more information about the natural properties of less known European wood species. Special treatments of species-adapted wood modification techniques have to be developed to increase the wood quality. Those modified wood materials would be able to enter to different wood processing industries.

Justification: The growth and use of native wood species help towards a sustainable production of industrial raw-materials. Fossil raw-materials can be saved and the less sustainable use of tropical rain forest species or traditional input of toxic compounds in wood protection can be reduced. In order to enhance also the ecological stability of forests, an increased diversity of tree species is necessary. The use of this additional species would lighten the consumption of the main tree species. The availability of those important commercial species is limited, the price of better wood qualities is high. A higher utilization of less used and cheaper wood species with modified and enhanced properties would help to increase the consumption of local and sustainable produced wood.

European relevance and collaboration: Big efforts have been made to increase the healthy condition and the stability of European forest with the help of different pan-European environmental programs. In order to support the ecological and economical basis of the sustainable development of our forests and their diversity a commercial use of all potentially useable tree species is necessary. Treatments to enhance the sustainability of forests and the quality of wood by wood modification have been developed by many European research institutes and several COST-Actions (e.g. COST-E21, COST-E37, COST-E44), which can help the to improve the economical situation of the European forests and the wood industries. The IfHH in Goettingen is already cooperating with different German and European companies and institutes working on the field of sustainable forestry, wood modification and quality tests (e.g. BFH/D, IHG/D, LCSVB/F, LWT/Ghent, NFRI/N, SHR/NL, SLU/S, UWB/UK).

2.1.26 Development of wood modification treatments and special tests to improve wood properties

Positioning: Applied

Short Description: Wood is a natural and sustainable produced raw-material which is suited for many industrial uses. The commercial utilization of wood for special use, above all outdoor utilization under wet conditions, is concentrated only on few local growing tree species. For higher quality use the input of less sustainable produced materials like natural protected wood from tropical rain forest, wood protected with toxic compounds or further industrial materials like polymers, metals or concrete is necessary. The technique of wood modification with non-toxic compounds is able to decrease the consumption of those less sustainable materials. Wood modification is able to increase the properties and the utilization of wood for additional use. In case of wood modification also less suited wood species can be used for more qualified use. A number of wood modification techniques are already used in the wood processing industry, for example the treatment with silicone-, furfuryl- or acetyl groups, with oils or waxes or with heat. The example of wood linked with N-methylol-compounds developed for the textile industry and the increased wood properties after treatment shows the potential of property-increasing chemicals already existing in the chemical industry. A survey of various chemicals, which can be able to improve the wood quality, has to be carried out in order to enhance the input of local grown wood and the economical situation of the local forestry and the local wood industry.

Justification: The addition of special chemicals to wood can help to increase various wood properties. A number of such non-toxic chemicals are already used in other industrial products to improve the quality of non-wooden materials like agricultural fibres, animal products or chemical polymers. The growth and use of native wood species help towards a sustainable production of industrial raw-materials. Fossil raw-materials can be saved and less sustainable use of tropical wood species or traditional input of toxic compounds in wood protection can be reduced. This helps to improve the ecological and economical status of the local wood producing and wood processing industry.

European relevance and collaboration: Treatments to enhance the sustainability of forests and the quality of wood by wood modification have been developed by many European research institutes and several COST-Actions (e.g. COST-E21, COST-E37, COST-E44), which can help the to improve the economical situation of the European forests and the wood industries. The IfHH in Goettingen is already cooperating with different German and European companies and institutes working on the field of sustainable forestry, wood modification and quality tests (e.g. BFH/D, IHG/D, LCSVB/F, LWT/Ghent, NFRI/N, SHR/NL, SLU/S, UWB/UK).

2.1.27 New pulping process for high-end use fibres, bio-based energy and chemicals.

Positioning: Applied

Short Description: The processes for production of chemical pulps for use in high brightness products do not in an efficient way make use of the wood raw material. About half of the wood substance is dissolved in the cooking liquor and subsequently burnt for production of energy and recovery of cooking chemicals. The use of sulfurous compounds also reduce potentials for an efficient use of the dissolved wood material. This research is aimed to develop a new process for chemical pulping of wood and production of fibres with new potentials. The side-streams with dissolved wood components are additionally thought of as product streams for production of bio-based energy and chemicals. The research comprise studies on oxidative low-temperature delignification of wood by the use of designed conditions including catalysators. Post-treatment methods of pulp for design of fibre properties. Processes for extraction of e.g. organic substances from pulping streams for furhter purification and tailoring. Recovery systems for re-use of pulping chemicals. Economical assessment of the process through system analysis and process simulation.

Justification: are these impacts dependent on? (max 200 words) More efficient and adaptable chemical sulfur-free pulping process for wood than compared to the current dominating kraft process of today would improve and strengthen many of the ideas for new and emerging biorefinery concepts. Further refining techniques and prerequisits for further refining of process streams containing dissolved wood components for the production of biobased chemicals and fuels are greatly facilitated. A substantial increase in pulp yield, as compared to the kraft process, would also improve the potential and economy for production of biobased fibres with different properties. The lower temperatures used in the pulping process also implies a better utilisation of the strength properties of the fibres impairing possibities for a better targeted pulps. A process that from the beginning is designed for accomodating ideas within the biorefinery concept and production of pulp fibres with high potential for further tailoring would broaden the business opportunities related to the new pulp mill. Since side-streams previously regarded as waste streams instead are transformed into product streams, new emerging business areas will be created. Earlier sulfur-free processes suffers, apart from generally low fibre qualities for use in high-valued products, efficient recovery systems. Traditional or modified kraft-based recovery systems were used resulting in processes without remedies for economically justified recovery of pulping chemicals. Recent developments however, e.g. black liquor gasification, give new possibilites for in-house production of efficient sulfur-free delignifying chemicals.

European relevance and collaboration: The competition within the area of forestry is continuously increasing as a result of the development in e.g. South America and Asia. The cost of the wood raw material in Europe is increasing and considerably higher than in competitive countries. In fact the cost structure in Europe is in all aspects unfavourable compared to the main competitive countries. In order to maintain the European pulp

industry it will be necessary to improve the effectiveness within the European pulp plants as well as to develop the pulping qualities to expose more qualified and designed properties. This type of research could well be suited for collaborative efforts between teams in Sweden, Finland, Germany, France and Austria.

2.1.28 Upgrading wood and wood-products characteristics and behaviour by novel bio-based and biochemistry-based treatments

Positioning: Basic

Short Description: The expected results lay the foundation for the development of enhanced as well as new sustainable and cost-effective products for the European woodworking industries. During evolution nature has "invented and further developed" wood to fulfil a number of functions for the survival of plants. These functions are not necessary identical with those, which humans expect when using wood as a raw material. The use of wood shows a wide range of applications from sawn timber to wood-based products. Despite its manifold and very positive characteristics wood exhibits properties, which need improvement for strengthening wood and wood-based products in competition with non-renewable materials. A new generation of such products will allow a shift from bulk commodity products to highly specialised products. By utilising, activating, modifying (biologically, chemically, mechanically) the unique and very versatile natural properties of lignin, cellulose, hemi-cellulose and the other natural constituents of wood, bio-based materials with new and improved property mix will be developed, forming the basis for a new generation of wood and wood-based products. This research theme deals with development and application of methodologies and techniques to upgrade existing and create novel characteristics for wood and wood-based products. In a knowledge-bio-based European economy stakeholders in science and industry actively try to improve the raw material base and the properties and characteristic behaviour of the produced products. Many of our modern "artificial" man-made materials, especially plastics, are based on fossil carbon sources, which are broken down in small units and re-modelled to form new materials. Learning from nature will help us to gradually become independent from fossil carbon sources and at the same time save energy by using the embedded solar energy in biomass. Bio-technology, genetic engineering, chemical and physical treatments as well as modification processes are well advanced and allow the design and production of materials with tailored properties. A new generation of bio-based materials will combine the advantages of natural and artificial materials leading to products with excellent environmental profile and at the same time homogenous, predictable and reliable properties which allow the use of such materials for product design and engineering. Wood-based materials with high durability, good shape stability and low demand for maintenance have proved to be competitive compared to non-renewable materials. In few words: “A new Bio-based carbon chemistry and new physical-chemical treatments for innovative products and functionalities” Major competence needed: Biotechnology, nanotechnology, chemistry, genetic engineering, mechanical, thermal and chemical engineering, standardisation, product design, market research, etc.

Justification: Better knowledge and advanced utilisation of the natural wood constituents. Implantation and improvement of specific characteristics of wood and wood-based properties for adaptation of the behaviour to specific end-use related requirements. Improvement of competitiveness of wood in relation to non-renewable

materials in terms of biological, physical and chemical behaviour and service life under a wide range of environmental conditions, in full respect of the environment. Provision of a new generation of bio-based materials with improved properties, including wood polymer composites. Provision of a new generation of novel biological and chemical treatments and modification methods for better bonding, gluing and surface treatment.

European relevance and collaboration: Society/economy: Successful innovation along the proposed lines will enhance competitiveness of the EU industry and hence increase economy. Another aspect of this, particular important in rural areas, is the preservation of jobs in the industry. Environmental and other gains from reduced reliance on fossil fuels and carbon sources are other benefits from Society's point of view. Energy: Depends a lot on the new production technologies of the advances made. Competitiveness: Obviously positive Consumers: New, sustainable bio-based products along the lines described will of course be a benefit seen from the consumers point of view EU's R&D-policy objectives: This directly addresses the ambitions concerning sustainability, competitiveness, knowledge-based etc. Key role for the leading wood and wood chemistry institutes

2.1.29 Novel biotechnical tools from soil organisms

Positioning: Basic

Short Description: The wood degrading organisms, especially the fungi, have given man a large number of useful biotechnical tools. Today hydrolytic enzymes attacking cellulose, hemicelluloses and pectin are the most technically used of all enzymes, and are found in textile industry, laundry detergents, food industry and pulp and paper industry. In one aspect the wood degrading micro-organisms have been a disappointment – it has not been possible to develop an efficient and specific enzymatic method for degrading lignin, which can be applied in the pulp and paper industry for bleaching and pulping. This is due to that the wood degrading organisms do not use the classical enzymatic concept with substrate enzyme binding in the lignin degradation. Instead low molecular weight reactive and non-specific species as the hydroxyl radical is generated. Therefore also polysaccharides as cellulose are damaged by treatment of these lignolytic enzyme systems. However, soil organisms that lives on the degradation of humic acid, that mostly consist of incompletely degraded lignin, appears to degrade lignin by a more classical concept with enzyme substrate binding. The purpose of this project is to unveil the mechanisms of these very little studied enzyme systems.

Justification: Enzymes are by the high specificity and mild working conditions the ideal catalysists for an environmental industrial production of high quality materials. The lack of specific lignolytic enzymes have been an obstacle for the development of biotechnological, environmentally friendly and cost effective processes related to the pulp and paper industry. But the knowledge of how the humic acid/lignin is degraded in soil is very low, and need to be increased before large scale production of such enzymes can be started.

European relevance and collaboration: The future of the European industry is high technological production, since Europe probably cannot in the long time perspective compete with low production costs with Far East and Latin America. Biotechnological solutions fit well into this, since Europe traditionally have a leading position in this field. The forest industry is also an important branch in Europe, which however is challenged by industry in for instance South America and Indonesia. The biotechnology can be the possibility for Europe to keep its leading position in this branch, but for this efficient and specific lignolytic enzymes must be available. The project need cooperation between microbiological, biochemical and wood chemical laboratories and is well suited for a European cooperation. The project shall be coordinated by the Department of Fiber and Polymer Technology at Royal Iinstitute of Technology, Stockholm, Sweden

Sub-area 2.5 Utilization of enabling technologies to improve productivity and reduce capital costs

2.5.1 Raising productivity in wood processing by advanced tool technology

Positioning: Applied

Short Description: Developing tool techniques in wood processing in order to get more productivity and lower capital costs.

Justification: Applied research in co-operation with wood processing industries and tool manufacturing companies.

European relevance and collaboration: The processing and manufacturing companies are working globally.

2.5.2 On-line drying of wood

Positioning: Applied

Short Description: To use up-to-date experimental devices, modeling tools and knowledge of wood properties (transfer, rheology, thermal degradation) to imagine a process able to ensure on-line drying of wxood at the industrial level

Justification: On-line drying of wood would allow : - stacks to be formed only for final product, without stickers - product quality to be assessed once all potential defaults (grain angle, reaction wood...) have been revealed

European relevance and collaboration: A former COST action (E15) devoted to wood drying continues to be active as a European group

2.5.3 Improved headbox design allowing paper products applying twin-wire roll dewatering

Positioning: Applied

Short Description: The basic idea is to produce superior paper products applying dewatering by only twin-wire roll units. This will require a high quality jet to be delivered, containing a minimum of fibre flocculation. This will be possible by suitable fibre properties (including surface friction) combined with extensional flow fields in the headbox to disrupt fibre flocs

Justification: Pure roll forming is the simplest way of dewatering a fibre suspension to form a paper web. It allows an inexpensive wire section with high time efficiency and low operating costs. The properties of the paper/board produced will be superior in comparison with the dominating techniques applied today, which also include blade dewatering. The blade pressure pulses involved have a negative effect on paper properties. This is avoided with pure roll dewatering.

European relevance and collaboration: Worldwide, activities within the area of paper forming is mainly taking place in Europe. The two main paper machine manufacturers are European: Metso Paper and Voith. Research within the area is carried out also by VTT Jyväskylä and STFI-Packforsk in Stockholm. The STFI FEX pilot paper machine is suitable for process/product evaluation. Technical universities are also involved, like those in STockholm and Tampere.

2.5.4 Holistic production concepts for the wood-working industry

Positioning: Applied

Short Description: The aim of the research issue is the development of new machine and production concepts to raise the productivity as well as the environmental friendliness of the manufacturing process. This can be achieved by the development and implementation of simulation tools which represent stand-alone machines and their integration in the manufacturing process under technical, economical and ecological aspects. Therefore a simulation environment linking different simulation and evaluation techniques (finite element method (FEM), multi-body simulation (MBS), material-flow simulation, life-cycle assessment (LCA)) has to be created and adopted to the requirements of the wood-working industry. Simulated variables are for example machine vibrations and thus noise emission, processing times and energy consumption. Based on this simulation model new machines and production concepts will be developed allowing a faster, more beneficial and more ecological manufacturing of wood-based products. The prediction of the manufacturing process will also increase process stability and quality. The branches covered by this issue might range from the furniture industry to the building industry (timber construction).

Justification: The result of the research activities is a holistic model of production processes which supports the design and construction of new wood-working machines, the evaluation of new investments for wood-working companies and moreover the optimization and development of new production concepts. This way, wood-based products ranging from pieces of furniture to timber-frame houses can be produced and thus sold to lower prizes, raising interest and demand in eco-friendly high-quality products. This will strengthen the entire wood-working industry and promote the use of the sustainable resource ‘wood’.

European relevance and collaboration: The research issue will lead to a more economical production of wood-based products and thereby to an increased competitiveness of the European market compared to other economic areas like Asia. Therefore the expertise of European research groups, machine manufacturers and end-users has to be concentrated. A cooperation of researchers dealing with machine tools, production technology, life cycle assessment, factory planning, wood working and timber construction is the precondition for a successful research activity.

2.5.5 New machine concepts in stationary and throughfeed technique for furniture production

Positioning: Applied

Short Description: The issue is about new concepts for machine tools in wood machining. A very progressive approach is to replace the nowadays primarily used serial kinematic structures of machine tools by modern parallel kinematics. Thereby the main aim is to raise machine rigidity and to enhance dynamic behavior and thus to increase productivity of the machines. The requirement for low moved masses causes the development of lightweight structures for machine tools, primarily in combination with parallel kinematics. Further equipment for optimized dust and chip removal as well as image processing systems for quality assurance are developed to integrate them into common and newly developed machines. A detailed process control in furniture production, for example by the use of a CCD-camera, is important for a timely cognition of incorrect aligned workpieces, missing bores, cracks in the edge, faultily clotted edge bands or similar. There has to be knowledge in machine tools, parallel kinematics, construction, fluid mechanics, material science, production and measurement technology (image processing) to study the issue.

Justification: Development of new machine concepts based on parallel structures and lightweight constructions, which enable a raise in productivity of machining because of a higher structural stiffness, acceleration ability and accuracy. On-line quality assessment of processed workpieces in furniture production and thus a minimum of unrectifiable rejects and a maximum of quality. Reduction of power consumption and environmental pollution by process- and flow-optimized suction hoods for dust and chips in wood machining.

European relevance and collaboration: The issue deals with the development of new concepts for machine tools in wood machining. Mechanical engineering is a traditional and important part of European economy, so that research in this domain has to be raised. The issue includes many different fields of research (parallel kinematics, lightweight construction, measurement technology or fluid mechanics), so that a co-operation of various researchers suggests itself. Institutes etc. that deal with machine tools, production technology, measurement engineering, fluid mechanics, lightweight construction or quality assurance are predestined for this research.

2.5.6 Active noise and vibration reduction by integration of adaptronical systems in wood-working tools and machine structures

Positioning: Applied

Short Description: In the last view years the wood-working and furniture industry are demanding a high flexibility and productivity from production systems. At the same time a continuous improvement of production efficiency with a simultaneous improvement of product quality is required. This can only be achieved by increasing machining speeds, better dimensional and shape accuracies and better tool life. The consequence of higher machining speeds is the occurrence of dynamic loads and vibrations. These cause on the one hand a high noise level at the workplace; on the other hand a negative effect on the manufacturing quality of the wood-working machines. To achieve a better dynamic behaviour of the machines, the structural stiffness and damping properties have to be improved in order to interrupt the transmission path of the vibration energy. In the past years, active and passive damping systems are used more and more for vibration reduction. Compared to the passive ones, active (adaptronical) systems have the ability to influence the properties of the structure with the help of new materials in form of sensors and actuators, which are completely integrated in the tool or machine structure. These materials can be designed in different shapes. They have good flexibility, functionality and poor fault tolerance properties. To accomplish an optimal integration of these adaptronical systems in wood-working tools and machine structures, besides engineering design, accompanying finite-element and multi-body simulations have to be done.

Justification: By using adaptronical systems new design strategies for wood-working machines are possible to achieving an improvement in production efficiency and manufacturing accuracy. To these systems belong for instance: active frame bases to isolate the machine structure from ground vibration, adaptive workpiece clamping systems to reduce vibration of plane workpieces during processing, vibration reduction on tools, drive units and guidance systems, as well as adaptronical balancing systems for high-frequency spindles. Thereby new concepts emerge for reducing machining time, improving and monitoring manufacturing quality, increasing tool life and reducing overall noise level. The last one can reduce the percentage of industrial disease like noise-induced hearing loss.

European relevance and collaboration: The field of adaptronics sustain on new and further developments in the area of new functional and structural materials (e.g. piezoelectric ceramics, electro- and magnetorheological fluids), which becomes in the last years an important research field in Europe. In next years the design and development of these materials will advance to series-production readiness. Therefore, to obtain a high accuracy and performance of wood-working machines and to maintain the development leading position of these in Europe, research groups in the field of production technology, structural mechanics, control and engineering design have to collaborate interdisciplinary. Thus, new adaptronical systems for wood-working machines will be faster integrated in industrial applications and will be profitable.

2.5.7 Knowledge-based defibration for eco-efficient mechanical pulps

Positioning: Basic

Short Description: The ultimate goal is to reduce refining energy consumption in mechanical pulping of wood through applying precisely controlled breaking work for opening the fiber structure at refiner plate gap. During mechanical pulping of wood, fibers should be separated from each other and peeled with out cutting them. The forces applied should be targeted in breaking the outer layers of fibers without any elastic by-work, which just turns into heat. Currently the distribution of applied shear and compression forces at the refiner plate gap as a function of the radius of the refiner are not known. This arises from the lack of appropriate measurement techniques, and results in in-efficient and excessive refining energy consumption. The precise information of the peeling work put on fibers at each radial position within a refiner is required to understand the energy wasting mechanisms. This requires measurement of shearing and compressing forces as a function of refiner radius and sampling as a function of radius, which shows the progress in peeling degree of fibers. The precise influence of changes in refiner segments/plates is impossible to follow without good measurements and thus leads refiner-developments to be based on trial and error.

Justification: This research would develop measurement techniques for obtaining realistic shear and compression forces at different positions within refiners. This in turn would guide in developing more effective refiners for mechanical pulping of wood. The stepwise energy savings up to 50 % are possible through precise control of the forces that affects on the fibers.

European relevance and collaboration: For keeping competitive, the European paper industry needs to find more eco-efficient ways of producing paper and paperboard products. Some of the key means are more efficient use of wood raw material for given amount of products (shift from chemical pulps towards higher-yield mechanical pulps) and more efficient pulp production (reduced energy consumption in defibration of wood and modification of fibers). Possible collaboration partners include: measurement instrument manufacturers, pulping equipment manufacturers, research groups familiar with measuring and modelling of wood, wood fibers and pulp fibers, flows within systems, engineering, and pulp usability.

Sub-area 4.1 Combining social and natural/engineering sciences

4.1.1 Economic relevance of internal labour in small scaled forestry

Positioning: Applied

Short Description: About 46% of the 10.700.000 hectares forest area in the Federal Republic of Germany is managed by private forest enterprises. One third of these enterprises are smaller than 50 hectares with characteristic small-scaled management units. The general condition for these small-scaled forest enterprises have changed fundamentally within the last two decades. The economic development is extremely difficult. The ownership structure and the objective targets of many, primarily urban forest ownerships change continuously. The owners reduce their internal labour and silvicultural activities, try to submit the management responsibility to other organizations or tend to adjust the classic management at all. These results in combination with insufficient wood harvesting technology in low profitability, the usual wood structural practices hardly anymore practicable in the future. For example the possible increase of forest utilisation by 2 m3 per hectare and year the small- scaled forestry set about 3.000.000 m3 of rough timber aside for the commercial use in the wood industry. The negative effects of this trend on the developments of rural regions be hardly to assess. Prerequisite for the development of instruments which seem suitable for the mobilization of these rough timber reserves is the knowledge about the exact business and owner structures, their dynamics as well as its inner and outer influence factors, which shall be analysed by statistical and social scientific methods.

Justification: The meaning of the cluster forest and wood in Germany is already stressed considerably in various well-known studies. Decisions affecting sustainable forest management shall be based on a differentiated knowledge of forest ownership structures, particularly its dynamics and influence factors like development, range and costs of typical equipments or the trend of internal labour workload. The relevance of the small-scaled ownerships the into cluster forest and wood doesn't fade only in Germany but also in the rest of Europe

European relevance and collaboration: Already numerous scientists and working groups have dealt with the extraordinary significance of forestry and wood industry for the development of rural regions in Europe, which are characterized by high rates of unemployment, narrow occupational bases, poor new job opportunities and raid emigration. By foundation of an international research network the previous research results could be collected, experiences exchanged and synergy effects used. This research network is especially important for the European forestry policy priorities, which has to deal with rural development, employment and income in rural areas, increased utilisation of forest products, renewable energy and climate change aspects.

4.1.2 Improving the competitiveness of wood products with a credible substance brand

Positioning: Applied

Short Description: Although wood has been used in construction for centuries, there are still problems with the quality and usability of wood products. In many cases wood in its end use application either does not last as long as or does not look as aesthetic as it is supposed to. The visually observable problems weaken the image of wood and the competitiveness of wood products. The aim in this research is to find solutions for wood products industry to eliminate the sources of the most common problems. This is achieved by indicating the deficiencies in the wood product chain, which cause the problems in end use. The emphasis is on analyzing what the connection between the chain and the competitiveness of wood products is from the viewpoint of 1) the technical properties and usability of wood products and 2) the profitability of wood product companies, i.e. value generation in the different stages of the chain. Both qualitative and quantitative methods are applied: in-depth interviews, statistical analysis of the numerical data provided by companies, usability research and product and material testing. In this study wood product chain is perceived in a broad sense, including also such activities as architects, constructors and coating producers.

Justification: For wood to be competitive against other materials in different end use applications, one of the most important issues is to build a credible substance brand for wood. This requires collecting and evaluating research information as well as delivering the information efficiently across the actors in the wood product chain. Thorough understanding of the end use environment and the wood product chain can be utilized to improve the quality and competitiveness of wood products. Although the idea of grading the wood according to the end use seems self-evident, it does not realize in practice. The interactions in the wood product chain and the connections between technical and economic aspects are analyzed to develop a procedure for directing the wood material to different wood products and wood products to different end uses correctly. This would yield in improved competitiveness of the wood products industry as whole and better profitability of the individual wood product companies. Higher-quality products, in their turn, yield in a more sustainable living environment. The key quality issue is to develop more durable wood products, which in its turn have positive environmental impacts in the form of longer product life cycle and easily and safely disposable products.

European relevance and collaboration: Understanding the end use environments in different countries is extremely important, because there are great differences between different wood species and the quality and types of wood products across Europe. Combining studies in Finland and Central European countries provide a broad view and the results can be generalized to other areas, such as Russia, too. Other European research groups working with similar aspects of the use of wood include the Technical University of Munich and the University of Hamburg. The first investigates durability problems of wood products, such as blue stain, from the perspective of building physics. The latter carries out biological research of wood material. Both support the proposed research

theme well. In Otaniemi, Finland, there is a large knowledge reservoir combining expertise from the areas of wood technology, architecture and building physics. The group consists of different university laboratories and the Technical Research Centre of Finland.

4.1.3 Wood and timber constructions for development and disaster areas

Positioning: Applied

Short Description: Development of houses and housing units based on wood/timber constructions and wood-based materials (panels, flooring, insulation) for disaster and development areas, which are pre-fabricable, need a few transportation space, are easy to assemble and dismountable; self-sufficient with regard to energy and conditioning, offer multifunctional applications such for housings, hospitals, administrations.

Justification: Business goals is the increase of wood sales from EU producers (saw mills, houses, wood based products; Connections of opening a new market for wood products with social and humanitarian engagement of the EU and support to both disaster and war areas and development areas. R&D in this field will increase the use of wood as a renewable material for new applications and value-added products. Additional effects: development of new assembly systems; creation of "intelligent" houses and modular housing units, reduction of waste material to "0"

European relevance and collaboration: Comprehension of woodworking industry, construction specialists. In result of the project in the participating countries different solution concepts may be developed, such as different solutions for various demands and applications, e.g. for different climate conditions.

4.1.4 Increasing the quality of life by using new wood products

Positioning: Applied

Short Description: Increasing the quality of life is a pan-European challenge; leads to an improvement of the image of wood and paper products; Intelligent connections for wood and paper products within the living environment; variable flat and building systems (i.e. variable number of rooms and room size):Targets are : multi-purpose intelligent and healthy and environmental friendly solutions (e.g. furniture, interiors) for all living ages; concepts for flats with removable inner walls.

Justification: The ageing of the population is, as ar as permanent and global nature of the problem is concerned, a pan-European challenge for science, politics and social work. Predictions assume that by 2010 appr. 25 % of the European population will belong to the category of old people. These have special needs to their living environ-ment. There are a lot of products from wood and paper industry around people in their living environment e.g. construction materials for cladding, flooring, interiors, furniture such as for wellness and hygienic applications. The research area includes facts like individuality, barrier-free living, ergonomics, communication, reduction of harmful substances, mobility, safety, intelligent linkage of products, connected with an increase of the sale and use of wood and paper products, based on renewable resources. In the living (private) environment products from both wood and paper industry meets at the customers direct environment. Improvements will have a strong effect on their health, well-being and ability.Business goals are: increasing of wood and paper product sells; development of solutions based on products for constructions, interiors, furniture, wellness and hygienic applications; use of healthy and environmental friendly material and coatings.

European relevance and collaboration: Increasing the quality of life by use of new wood and paper products for accomodation: after studies on life types (domiciles, interiors, furniture)in EU member states (the different and typical requirements are compiled. This is basis for development of new wood and paper based products which leads in turn to an increased quality of life. Key research groups: social reserach, futurology, wood and paper related research

4.1.5 Factors influencing on perception of wood in interior use and their potential influence on human well-beeing

Positioning: Basic

Short Description: The objective is to research the factors of attractiveness of various wooden surfaces and peoples`prefencies in different european cultural surroundings. The study should be made in comparison to certain substituting materials and the influence of mode or traditions should be separated from attractiveness factors.

Justification: Goals are: - to test survey methods - to build a common knowledge base for product & marketing development - to build scientific basis to better understand consumer behaviour - to evaluate the efficiency of marketing and trade in different areas - to develop understanding what does it mean to human person if he/she lives in "attractive surrounding"

European relevance and collaboration: The study should be made among 4-5 different countries in Europe and this leads to network structure.

4.1.6 Woodwisdom-net

Positioning: Basic

Short Description: To aim for a sustainable wood production in Europe, related technical, ecological, economic and social aspects have to be integrated. Ecological criteria are effectively and efficiently covered in a life cycle perspective, applying the proven method of LCA. With an LCA, global, regional and local impacts on the environment can be analysed. But social criteria are derived from either conditions stipulated by law, regulations/conventions, or by the direct consequences of a decision, which could affect an individual or the society in general. For example, in changing a harvesting procedure or the kind of grown wood job profiles can change and jobs can be created or eliminated. In the wood production e.g. the question of accidents is very relevant as the wood production has one of the highest rates of accidents per Euro of created added value. However so far there is no agreed method to assess these social effects. Therefore the relevance of different social indicators should be examined with regard to the requirements and particularities of the wood industry and the necessity of further indicators should be identified.

Justification: For the use and production of wood the social dimension will play a major role, as the agricultural production is rather labour-intensive and creation of additional jobs – especially in rural areas – can be shown using this method. It can be used to evaluate certain social impacts under a life cycle perspective and demonstrate how the gained knowledge can be used for decision support, by fostering the sustainability approach. For consideration of the social effects related to the production of wood a life cycle based approach is needed for the same reasons as in the ecological field: • to avoid shifting of social problems from one life cycle phase to another and • to locate “hot spots” where it is most pressing to change something. • to avoid shifting from the environmental realm to the social field As supplement of the classical Life Cycle Assessment (LCA)-approach the social aspects of the wood production so far have not been thoroughly assessed concerning their potential integration.

European relevance and collaboration: Social assessment includes employment, working conditions and qualifications as well as health and safety aspects. These issues are important to ensure safe and healthy work places for European citizens in the future. The wood industry – not only in Europe – did/does have some serious challenges, especially regarding accidents. However, from a European perspective it is not enough to only consider these single numbers, but an improvement should on the other hand side not cause any impairment in another field of social, environmental or economic measures. This is also in Line with the aim of the EU to promote corporate social responsibility (CSR). Therefore a holistic approach dealing with all of the mentioned aspects in the different European countries is needed. Possible Research Groups are: • National Board of Forestry, Sweden • University of Stuttgart, IKP, Dept. Life Cycle Engineering • Finnish Forest Industries Federation • Timber Trade Federation (TTF)

4.1.7 landscape and woody plants for energy

Positioning: Applied

Short Description: Increasing area of abandoned agricultural land with natural succession of woody plants changes dramatically the scenery of landscapes and nature protection values. Public perception of these changes is negative but public funding to maintain the character of the landscape is likely to diminish. Using the natural regeneration of woody plants on those areas, combined with partially enriched plantings, to produce materials for bioenergy in short rotation could essentially contribute to keep the patchiness of the landscape and at the same time to provide a valuable product. Natural succession composition, harvesting techniques,population of rare species, but also socio-economic effects such as income to local people and public perception of the landscape has to be studied on test sites on a European scale.

Justification: The results and innovative techniques will possibly enable a balanced and cost-efficient landscaping in a multifunctional way. At the same time local bioenergy factories can be based on an extended supply of a scarce resource and income for employers will be generated along the production chain to counteract the loss of population in rural areas. Also the impacts on the environment are predominantly positive. As the effectiveness and utility of using abandoned agricultural land for woody energy plants are very much site dependent and at the same time directly determined by the socio-economic and legal frame a broad variety of situations throughout Europe have to be taken into account.

European relevance and collaboration: The demand for energy and the use of woody biomass for energy will most probably increase throughout Europe. At the same time landscape protection is an important issue emerging in many European countries. There are many research groups in Europe working on different ends of the problem (bioenergy, energy plantations, harvesting technique, landscape management, rare species protection, economic situation and rural development etc.). What is needed is a cooperative effort to bring these ends together for an integrated, transdisciplinary approach.

4.1.8 Conservation of painted wooden panels from European cultural heritage

Positioning: Applied

Short Description: Artistic paintings performed on wooden support require special care because of the effect of hygrothermal conditions of the movement of the wooden substrate and resulting deformation of the paint layer. Inappropriate conservation techniques of the 19th century followed by the wide-spread of temperature control in buildings in the last decades have often resulted in dramatic damage. The wood-workers and cultural staff involved in conservation operations are in high demand of technical help from wood scientists to rationalize their decision regarding modification of frames, or condition for allowing movement of paintings or public access. A multidisciplinary approach is required to address this type of problem: structural mechanics of the wooden support, physico-chemical analysis of the paint layer, conservation issues.The projects consider the development of numerical tools based on simplified finite-element analysis of the hygrothermomechanical behaviour of asymmetrically painted wooden panels. Validation can be done through non-destructive observations of real paintings and more extensive experimentation of imitations.

Justification: The considerable added value of this type of wooden products motivates a considerable scientific input taking advantage of the latest advances in the field of wood mechanics, especially the hygromechanical couplings, ageing processes, crack propagations analysis. The benefit for wood scientists lies in the prestige often associated with the handling of such problems, but also in the increased knowledge on the long-term behaviour of wooden structures that can result from such studies.

European relevance and collaboration: The issue concerns major European museums and organisations responsible for the conservations of historical buildings, where wooden painting can be found. Often the research is performed locally but would benefit from co-operation of involved laboratories.

4.1.9 Social network determinates of organizational inquiry in forestry

Positioning: Basic

Short Description: This research issue considers how different features of informal organizational structures affect organizational learning in forest industry organizations. By using social network analysis and an organizational learning inventory instrument, we investigate relational and formal characteristics that facilitate knowledge utilization in forest industry organizations. The research is dedicated to helping forestry organizations improve performance through better knowledge transfer and enhanced learning processes. The analytical model in this research will relate organizational learning and social network characteristics. Data on social network information and organizational learning will be collected in case studies through surveys and interviews.

Justification: Increasing market globalization, the complexity of linked economic relationship structures and modern information and communication technologies have led to radical changes in many sectors of business and social life. Knowledge is increasingly becoming recognized as a critical resource in many fields of endeavours, yet its importance in the forest sector is undervalued. The forestry industry is subject to changes from many different sources, which are characterized by an increased mechanization and capitalization, and the increasing pressure of competition through internationalization and globalization. This leads to the requirement for improved productivity. One important step in this direction is to focus on knowledge utilization and learning in forestry organizations.

European relevance and collaboration: Work environments of the 21st Century place people in an information-rich world. New technologies and new information come to people every day. Organizations and their members need to deal with the changing environment in order to live well in the world. The research programme sets out to develop a Europe of knowledge and thus better cater for the major challenges of this new century.

4.1.10 User centered design of interior wood products

Positioning: Applied

Short Description: Project aims at identifying: a) information needs related to designing and decising about interior wood products b) decision making and material acquisition practices c) preferences concerning such products. Research methods: survey and interview based documentation of design and decisionmaking practices and participatory design sessio. Carried out in three european areas: Scandinavia, eastern and western central Europe.

Justification: Results: requirements for interior wood product design, product and customer needs information and new delivery channels Information can be used as basis for implementing new design practises into the wood industry.

European relevance and collaboration: As the end-product markets of interior products are global should the information be gathered within different European market areas. Marketing, design and social sciences orientated research groups could have a key role in the implementation.

Sub-area 4.2 Values and perception

4.2.1 Preference studies on wood products

Positioning: Applied

Short Description: It is to see which factors influence peoples preferences and appreciations of wood products. It include sensory and aesthetical aspects, but also preferences with regard to origin, service, env. labeling. The approach involves using accepted methods from marketing and from the psychological and behavioural sciences. The correct methodological approach should be emphasized Data could be collected through surveys and panel studies etc. It would be an advantage to conduct international comparative studies.

Justification: It would assist in implementing a greater conciousness about the final consumer in the otherwise too "production-oriented" European wood industry. The results could be used indirectly in product development. In some case maybe even directly. Development of methods for consumer-led product-development.

European relevance and collaboration: The problem of marketing of wood products and communication with consumers is a common European issues. Europe's wood industry (including building sector) is also an important exporting sector. The European scope would facilitate international comparative studies and enhance the methodological relevance of the study by involving research parties with complementary and specialist knowledge.

4.2.2 Landscape effects of energy woods - conflict potentials and acceptance

Positioning: Basic

Short Description: Expanding the production of energy wood may impact to a greater or lesser extent on the cultural landscape. The shape of the landscape varies depending on the production system, the (spatial) dispersion of energy woods, and their integration into the greater landscape; say on the production management. However, the public´s perceptions of the newly composed shape of the landscape will decide on whether the expansion of energy wood production gains the acceptance of the public or not. Landscape changes implicate conflict potentials that may lead to considerable economic costs if appropriate conflict resolution strategies are not successfully implemented. Hence, research is needed in order to find forms of energy production which gain the acceptance of stakeholder and other affected groups and minimise economic conflict costs. The scenario method is an appropriate instrument to display future shapes of the landscape and to provide a basis for decision-making. Based on an acceptance analysis perceptions and the public acceptance of energy wood production and its impact on the shape of the landscape can be revealed. These research methods are particularly qualified to be employed in an international context as differences in perceptions and acceptance between several countries can be elaborated.

Justification: One of the main targets of the EU´s energy policy is to increase the share of the renewable energy sources to 12% by 2010. In order to successfully embark on this strategy research is needed not only on technical innovations, but also on the human and societal dimension. The proposed research topic reveals preferences of the public what kinds of landscapes are preferred and how energy woods may be integrated in a societal appreciated shape of the landscape. This knowledge provides the basis for further research activities as well as for product development in order to implement appropriate management strategies for energy wood production and product innovation.

European relevance and collaboration: Perceptions of energy wood – like of all management measures – differ between countries because of cultural differences and institutional weighting of wood policies. The experiences of different European countries can build the starting point for future strategies of increasing the acceptance of energy wood production. Research is engaged in analysing perceptions and appreciations of nature by the public and different stakeholder groups. While the scenario method is applied to a certain degree in landscape research, to our knowledge there do not yet exist any studies on the perception and acceptance of energy wood and biomass production. The innovative approach of the proposed topic is the combination of an instrument of strategic planning with empirical social research. Research can be based on conducted acceptance analyses of nature conservation strategies and recent projects on sustainable impact assessment of different land-use forms and policies which are financed by the EU 6th framework programme.

4.2.3 Customer Perception of Wood or Wood based Products Surfaces

Positioning: Applied

Short Description: Marketing strategies will more often direct appeal to human senses. Therefore it is necessary to know, what customers perceive or feel, when they get in contact with wood or wood based materials. Up to now, many factors in this perception process are not researched. So the effects of the material on the receptors of the different senses should be examined in field research or in laboratory situations.

Justification: We assume, that customer's perception is different in the various culture areas in Europe. Innovation processes and new product developments in the industry could better meet the requirements and perceptions of the customers. The better understanding of customers feelings and needs create a competitive advantage in the markets. The fit of wood products to the articulated or unconscious needs of customers creates a value added for both partners in the buying process. So the results of this research could improve product developments and marketing strategies with better information for market segmentations.

European relevance and collaboration: As we assume, that the perception of customers is different culture areas in Europe, the determination of the shared and divided preferences of various culture areas could be done best with the knowledge of local habits and requirements in the surrounding of the research. So a network of local partners would be the ideal form of organisation. Research groups in the fields of market research, psychophysics and surfaces of wood and wood based products could play a key role in this research.

4.2.4 Leading concepts of woodland nature by different stakeholders in the EU and their social relevance

Positioning: Basic

Short Description: Up to now the relation between the (scientific and public) perception and understanding of woodland nature on one hand and forestry or woodland management on the other hand is not understood. Due to differences in cultural meaning of woodlands and tradition in forestry a broad range of leading concepts is to be assumed at different actors and stakeholders in the various European nations. Needed is (especially) qualitative empirical data on varoius EU nations (comparison studies) but also on common interests and differences in nature relation,i.e. perception, reflection and understanding of wood natures, the herein hidden normative and social relevant implications and their influence on managing concepts and their acceptance.

Justification: To detect the included social concepts and values in woodland managment concepts of stakeholders will offer new perspectives on arrangements for public participation and discourse on woodlands management concepts, on the understanding of the function and connection between social and natural aspects and therefore on the possibilities for changing the relation between nature and society.

European relevance and collaboration: The sustainable management of natural resources is not ending at national borders. Basic knowledge about social conditions for acceptance, ignorance or refusion of management concepts is needed in all European countries and should analysed on developmental possibilities for common strategies to change the attitude to woodlands in cooperation with stakeholders due to the sustainable development approach.

4.2.5 Urban Wilderness in Central Europe. Concepts, Projects and Perspectives

Positioning: Applied

Short Description: Focal question: Contribution of the wilderness approach to urban woodlands to public perception/Understanding of nature and acceptance of wilderness, to support biodiversity and ecological performance of woodlands and to create a new professional habitus of foresters or wilderness managers. State of the art: National efforts to "create" or allow wilderness in urban / suburban woods. Impact on forestry, economic and working situation (change in staff, in professional skills, in economic demands and success). Socioeconomic analyses and analysis of ecological performance (biodiversity,ecosystemic parameteres)

Justification: Results will show the actual situation in Europe (description of the present urban woodland wilderness, of the cultural conditions and backgrounds leading to the perfomance, public understanding and social acceptance of such areas...); results will show, wether urban woodland wilderness could serve as spezific nearby recreation regions in the understanding of "wilderness learning centres" and their sustainable economical, social and ecological utilization.

European relevance and collaboration: The wilderness understanding and the amount of wilderness regions in Eurpe are different due to geographical conditions and population density. It should be interesting to get an idea of europeanwide urban wilderness amounts, the national specifities and the possibilities of mutual benefitting from experiences.

4.2.6 Measurement of biodiversity

Positioning: Basic

Short Description: Biodiveristy is a central concept when use of forests is discussed. However, the concept is only vaguely defined and this may lead to major misunderstanding. Biodiversity is a multifacted concept (genetic/species/ biotypes; geographical scale; in relation to "natural state") and thus quantifying it with small set of characteristics is not plausible. The concept should be analyzed from measurement information theory point of view where entropy is a measure of disorder/diversity. This research would consist of conceptual analysis and systematic development of measuring methods for finer aspects of biodiveristy. One basis for measurements are digital images (not in genetic biodiversity).

Justification: This research would explify the concept of biodiveristy for stronger basis of political discussions. The aspects of biodiveristy made measurabale would systemize the analysis of the impacts of actions (political, industrial, technological) on biodiveristy.

European relevance and collaboration: The concpet of biodiversity has different aspects in different envirionments and thus a pan-European approach is a necessity. The research consortium needs to have groups with backgrounds in biology, information theory and measurement technology.

4.2.7 Identifying, communicating and promoting the sustainable potentials of wood

Positioning: Applied

Short Description: Wood has always been in focus during political discussions on "Sustainable Development". This product group offers many advantages concerning environmental, economic and social aspects. Nonetheless, at present, only specific products are assessed regarding their environmental impact. The complete picture is missing. An assessment to identify and communicate the possible environmental advantages and potentials of wooden products and their economic and social impacts has to be carried out Europe-wide and on a scientific and reliable basis. Initially a market analysis of wood products and their corresponding material flows must be carried out to identify application fields and quantify relevant flows and products. The most important competing products need to be characterized and evaluated regarding their relevance. In order to assess strengths and weaknesses of the relevant products and their competitors, a characterization of their technological and economic criteria will be the next step. Only then can the respective ecological performance analysis be conducted in a purposive way since only then will it be representative, close-to-reality and relevant. This leads to final guidelines addressing the relevant products and not niche products. A subsequent detailed analysis of selected wood products will present optimization potentials over the life cycle of the products.

Justification: This project combines and evaluates knowledge of the different disciplines of wood products and their competitors (economy, technology, environment and social aspects). This enables the channelled promotion of wood products to areas where they are of high importance for sustainable development and where the benefits in sustainability are greatest due to their relevant market volumes. Aim is to assess the sustainable market potentials resulting from a shift from non-wooden products to wooden products and from the increase in demand for wood products. It will deliver guidelines for companies active in the wood product market or other (political) actors interested in market potentials. The study supplies the most important arguments for a target group oriented communication. The holistic approach of determining environmental as well as socio-economic impacts over the life cycle, allows the realisation of product-specific information for each individual product. A comparison with other products with the same function provides arguments for advantages and disadvantages and identifies optimisation potentials. This research approach is only possible with an integrated co-operation between science and economics/industry. With the early involvement of partners from industry, trade and politics and the subsequent guaranteed expansion of the project results, the sustainability of this approach is ensured.

European relevance and collaboration: EU-wide a multitude of different environmentally political frameworks, promotion concepts and incentive programmes on national levels do exist. In most cases, little is known about the interaction with other environmental policy objectives. Objective information regarding potentials towards sustainability in relation to the respective market is not only in demand in Germany,

where a project is currently underway, but is also creating great interest in the rest of Europe. It appears necessary, to carry out similar studies in other EU-countries since the market shares and volumes of wood products differ significantly between them. The study enables future activities to be focused on areas with high sustainability potential. Within this study, the results of the COST E9 "LCA on Forestry and Forest Products" will be referred to, through which a scientific platform on sustainability questions along the forest-wood chain is already available and partners play a key role in this work again.

4.2.8 Lifestyle-changes and future economic potentials for wood products

Positioning: Applied

Short Description: The differentiation und pluralization of lifestyles has resulted in a highly differentiated market for nearly all consumer products. Marketing studies show that changes in lifestyle will have far reaching consequences for housing and furniture demands and accordingly for the demands for timber and high class wood for furniture and other products. This is even true for the demand for firewood and wood products for energetic use. Furthermore, it is to be expected that the acceptance of new wood products strongly depends on lifestyle. Thus, for reliable prognosis for the future wood market a detailed analysis of attitudes and preferences of the different lifestyle groups and their future development should be made. For such an analysis the Sinus milieus could act as a suitable basis, since they take into account all dimensions of the social situation as well as value orientation, lifestyle, and aesthetic preferences, have been used in many marketing studies, and are used in a current study within the German Sustainable Forestry-Research Program. A suitable method to determine attitudes relating to wood and wood products are milieu specific focus groups.

Justification: The aim of the proposal is a prognosis of the future development of lifestyles and the consequences for the demands for wood products that at least in the private household sector strongly depend on lifestyle patterns. The study thus would give valuable information for the development of wood products and their economic potentials.

European relevance and collaboration: The wood market to a large extend is a transnational market. The processes of the differentiation und pluralization of lifestyles can be observed in all European countries with strong common trends but also with developments, that are specific for individual countries. The Sinus milieus are available for several European countries. In addition, there is a supranational Everyday Life Model ("Meta Milieus") available both for Western Europe (Austria, Belgium, France, Germany, Great Britain, Italy, Luxembourg, The Netherlands, Spain, Sweden) and for Central / Eastern Europe (Bulgaria, Croatia, Czech Republic, Hungary, Poland, Slovakia, Slovenia) which is based on empirically validated national Lifestyle Models. European research groups that could have a key role in the implementation of this research are: Sinus Sociovision (based in Paris (F) and Heidelberg (D)), ECOLOG-Institute for social-ecological research (based in Hannover (D); studies on milieu-specific consumption patterns and communication strategies).

4.2.9 Wood products for an economic growth and climate change mitigation

Positioning: Applied

Short Description: Carbon fluxes in the forest sector can be influenced directly by carbon stock changes in forests or forest products, and by substituting bioenergy for fossil fuels. They can be influenced indirectly by using wood products in place of more greenhouse gas intensive materials and products, such as steel, aluminium, concrete, etc. The aim of the research is to establish the importance of wood as a substitute for other resources to mitigate climate change and to increase economic growth, and to understand the implications of such substitution by integrating engineering, natural and social science perspectives on the subject.

Justification: The wood substitution allows for a viable transition towards a society that is less dependent on energy and material resources that cause higher greenhouse gas emissions. Such a transition will improve the competitiveness of forestry industries and improve the market conditions for wood-based products. However, analysis of wood substitution is a very complex issue, since the underlying system is complex. The influencing factors can be found along the entire wood chain; they include several industries, socio-economic and cultural aspects, traditions, cost dynamics, technical and structural change etc. Research in this field is also still quite limited. Furthermore, the prerequisites for wood and biofuel substitution are also affected by climate change. Hence, we have to improve our knowledge about how to consider effects of climate change in forest management practices.

European relevance and collaboration: A viable transition towards a society that is less dependent on energy and material resources that cause higher greenhouse gas emissions is of general importance of Europe. Fruitful research in this area requires cooperation among several research groups in Europe. Here, only a few examples of groups are listed. Department of Ecology and Natural Resource Management, Agricultural University Norway; Finnish Forest Research Institute, Finland; Institute of Energy Research, Joanneum Research, Austria Utrecht University - Copernicus Institute for Sustainable Development and Innovation - Utrecht, The Nederlands

Sub-area 4.3 New business models

4.3.1 New innovative business concepts for SMEs in the wood processing industry

Positioning: Applied

Short Description: The main aim of this is to strengthen the business concepts of SMES in the wood working industry. The basis for this area are R&D oriented concepts that will be developed e.g. from research projects (spin-offs).

Justification: New business concepts, better knowledge/information platform in SMEs

European relevance and collaboration: Infromation exchange / export oriented business

4.3.2 Construction of multi-storey timber houses, business and process development

Positioning: Applied

Short Description: The goal of the research project is to develop models and methods to strengthen the business- and process development in the industrialised building of multi-storey wood houses, as well as methods to ensure continuous learning from project to project. The following research questions will be answered: How can coordination between the wood component and building industry be achieved so resource-limiting method development take place? What demands do economically stable business models place on suppliers? How can methods documenting the experiences of demonstration building be developed further to increase learning? The theoretical focus on business and process development and learning between projects makes the efforts of research interdisciplinary where the object of research (the demonstration project) provides a focal point for theory building regarding the integration of technology, market and organisational development. From our point of view the concept of business- and process development is the bridge between timber frame/construction technology and market. Business development is studied in terms of "the value constellation". Our view of development is influenced by "lean thinking" – a resource-limiting philosophy. Research to develop the above methods and models is built on the "multiple case" methodology in the form of demonstration projects, i.e. real construction projects.

Justification: A concept for multi-storey construction of timber frame houses is by VINNOVA pin-pointed as important to achieve a wood-products innovation system. Development of industrialised (lean construction) systems will act as a catalyst to achieve cost effectiveness and sustainability, generally speaking, in construction. However, house building activities, requires the integration of all elements and components of a building and actors/members in the supply chain i.e., the developer, the builder, the contractors and the timber frame suppliers. The research will focus on finding and adapting methods to apply and integrate supply-chain control and lean construction to the building and wood industries. Distinct advantages of a industrialised multi-storey housing concept to achieve better economics, business economics and environmental impacts are: Timber frame construction is cost effective and a systematic development can help to decrease the building costs further; timber has excellent prefabrication qualities making prefab. systems easily manufactured with a higher control (moisture, tolerances, transportation) than any other building material; practical experiences indicate that the working environment is increased for timber frame construction (i.e., the conditions are improved for the construction personnel); a lean philosophy is elsewhere shown to be a tool to achieve efficient process and production innovation processes.

European relevance and collaboration: During the 60s and 70s, the production-focused and non-customer oriented systems building approach was developed and used in European countries like Sweden and Great Britain.. However this form of industrialisation was not successful from a socio-economics perspective. The whole European house building sector is affected by the present debate around economic,

environmental and social sustainability in the society and is discussing and evaluating technological changes in supply and production methods. The solid wood value chain is a large supplier of products and services for the European construction industry, approximately 70 % of total sawn timber production are used for constructional purposes. The European house building sector produces about 1.7 million apartments per annum. Successful implementation of new innovations (i.e. multi-storey timber frame housing) depends on factors which are often nationally or regionally defined why an European perspective and involvement is crucial.

4.3.3 Innovation of the forest-based sector by integrated rural development

Positioning: Applied

Short Description: Integrated cross-sector development is the major strategy for rural areas in Europe. The basic idea is that all sectors cooperate closely together in developing the region. The cooperation is done by joint cross-sector programs, new cross-sector institutions comprising state and private institutions and civil society and integrated financial support. New governance instruments are used to integrate stake holders from different sectors and different levels. The expectation is that integrated development will foster additional innovation which cannot be developed by a insolated sector. The research theme is whether and how integrated rural development can foster the transition into a sustainable market and a knowledge driven forest-based sector: - Scenarios of the short and long term, linkages and contributions of the forest-based sector to different types of rural areas - Cross-sector potentials of the forest-based value chains - Options for an active role of the forest-based sector within rural governance - Multi-level political strategies for fostering forest innovation by partnerships of stakeholders from private, state and civil society within integrated rural development Methods of research: 1. Basic analysis and scenarios: - National case studies in the potential for innovation of the forest-based sector by integrated rural development - European wide comparative studies in the potential for innovation of the forest-based sector by integrated rural development 2. Pilot projects in implementation - Joint development and implementation of national strategies for the forest-based sector within rural development - Joint development and implementation of international strategies for the forest-based sector within rural development 3 Evaluation reports of the progress of the forest-based sector within rural development - Scientific evaluation reports - Communication with the national and international stake holders of the forest-based sector and rural development

Justification: Integrated rural development is a most promising strategy to strengthen the contribution of the forest-based sector for consumers as well as for society, environment and energy demands. The cross-sector integration is aimed to open additional potentials for the competitiveness of the sector. Enhanced cross-sector cooperation with all stake holders in rural areas will improve the locations for all business activities of the forest-based sector where it is most important, namely, in rural areas Bringing the development strategies for rural areas and for the forest-based sector together will create a reasonable potential to improve the economic and ecological situation in rural areas throughout Europe. The project contributes strongly to the priority of the EU to develop rural areas.

European relevance and collaboration: Integrated rural development is an important issue for most European countries. Nevertheless the concepts are highly divers and the potential to learn from other countries is very high. Additionally integrated rural development is a priority strategy of the European Union and needs a common concept which can only be developed by a joint research effort. A key role in the research could have the group “Integrated Regional Development” at the Unviersity of Göttingen

(www.modellregionen.de) (2005-2006)and the international group of the European Union (STREP): New Modes of Governance for Sustainable Forestry in Europe (2005-2007).

4.3.4 Business development and innovation through new manufacturing concepts

Positioning: Applied

Short Description: Dynamic and flexible responsiveness to new market needs, ability to intro-duce and implement innovations quickly will be key success factors in the competition between different industries. This needs to be a design criterion for future manufacturing concepts. The EU is today the global technology leader throughout the fibre based value chains but the existing technology has definite handicaps. The pulp, paper and converting value chain is very capital intensive. The present tech-nologies have lead to very large production unit sizes. New machines tend to operate within a very narrow window with little flexibility to produce dif-ferent grades or to take advantage of market swings or emerging technolo-gies. The result is a value chain that is inflexible, causes long transportation dis-tances and warehousing between processing stages. This increases invest-ment and manufacturing costs and risk in exploiting emerging technologies. New production concepts that facilitate introduction of new technologies and enhance/support product and process innovations are needed. Also smart logistics systems are needed to counteract the negative environmental and economic impacts of transportation.

Justification: Paradigm for high integrated development and production networks (enlarged value-chain integration, local industry network concepts, life-cycle and overall efficiency assessment, data-networking..) Adapted and optimised scale of production units (degree of integration of production processes, decreasing specific capital intensity, adaptation to material supply and consumer needs, transport ..) Flexibility and modularity of production units (operating window, time-to-market, efficiency) Simplification of units and stability of processes (on-site-additive production, maintenance, man-machine-interface)

European relevance and collaboration:

4.3.5 Strategies of forestry contractors coping with structural change

Positioning: Applied

Short Description: The overall research objective of this project is the development and implementation of new business models for forestry contractors in European countries for the reason of competence development to improve entrepreneur's competitiveness in the forestry-wood-chain. Forestry contractors need competences to meet the actual requirements on work performance and business development. Competence development will improve the competitiveness of forestry contractors to cope with current problems. This leads to the following objectives: (1) Forestry contractors will cope with competence development through new business models. (2) The share of SMEs in the added value on the forestry-wood-chain has to increase. (3) Factors, contributing to the improvement of the market position and economic integration of SMEs will be identified. (4) The attractiveness of the job needs improvement. Projects need to be based on a participative research approach. Forestry entrepreneurs will be partner in this project to ensure valid development and evaluation. It guarantees access to active SMEs in the forestry sector in the different regions, problems are detected and reported from bottom to the scientific level and during piloting innovative business models results can be discussed immediately.

Justification: Knowing that the phenomenon of continuous changes and the need to cope with new situations in a best possible way, SMEs have to find solutions to meet these new demands and challenges. Therefore the approach of new business models needs to be successfully developed and introduced in forestry harvesting and logging SMEs. New business model is the innovative mechanism by which a business intends to generate better value or revenue and increase their profits in a social and sustainable way and at the same time a tool for competence development. It is a summary of how an enterprise plans to serve its customers, namely forest owners and fortified wood processing industries. Such new innovative business models will be developed, piloted and evaluated within this project. It involves both strategy and implementation.

European relevance and collaboration: The Ministerial Conferences on the Protection of Forests in Europe (MCPFE), starting in the 1990s in Strasbourg and it follow-up conferences in Helsinki, Lisbon and Warsaw highlighted the need to manage forests in an ecological, economical and social way. Therefore, forestry needs competent and viable work. Trends in Europe show an ongoing shift towards forestry contractors carrying out the work during the last two or three decades. In many countries throughout Europe the forestry sector has been moving backwards in terms of skill levels, work safety and health, working conditions and work quality. Lack of qualified entrepreneurs and workforce might be the most crucial barrier for competitiveness of forestry and forestry based industries in Europe. Research groups from all European countries should participate in order to collect various samples for benchmarking and to transfer experiences and results to other countries.

4.3.6 Developing sustainable future markets for wood

Positioning: Applied

Short Description: The main objective of this research activity is the identification and development of sustainable future markets for wood in Europe. Suggested approaches to exploit market innovations are network cooperation and customer integration concepts. These approaches will eventually enable the European forest and wood industry to enter sustainable future markets and drive business towards higher competitiveness in the international markets.

Justification: The European forest and wood industry is situated in an economic crisis which demands structural change and innovative approaches for sustainable development. Side effects are the difficult profit situation for small and medium companies but also their need to increase the efficiency within the forestry-wood-chain. The need to identify and explore future markets as well as to comply with sustainability standards in the product chains earmark the current business situation. Furthermore, the use of wood has in a number of applications compared to other materials some advantages regarding the sustainability implications, i.e. regarding social and environmental effects. On this background research is needed that investigates and provides market innovation processes in the forest and wood industry. This type of research could contribute to the improvement of competitiveness of and employment by the European forest and wood industry.

European relevance and collaboration: The research regarding the development of sustainable future markets for wood has just been started in Germany. At the European level there has virtually no research done in this area. However, the similar and interlinked market condition within Europe require a research activities at the European level.

4.3.7 Do different Corporate Cultures in Forestry Organisations affect their function?

Positioning: Basic

Short Description: Recently, new tasks have been added to the traditional tasks of the German and other European forestry services. These include the function as an intermediary between the forest and the society. For this, the service will need a new sensitivity for modern social perceptions, ideas and developments in a national and international context. The German Forestry Service is, compared to other European forestry services, strongly affected by the traditions and ideas of military, hierarchic and bureaucratic organisations like the armed forces or the Prussian civil service. It can be questioned, whether the German forestry service is equipped for the new tasks. We propose that the service will need more and different competences and a reorganisation of its corporate structure to perform the new tasks.

Justification: The corporate culture of an institution is the universal set of the commonly shared, conscious and preconscious perceptions, values, ideas, patterns of thought and patterns of behaviour. Thus, corporate culture is extremely effective in manipulating the perceptions, thoughts and behaviour of organisations and their members. We assume that the corporate culture of German forest services is highly effected by tradition and therefore these services show a low tendency to perceive the changing (needs of the) society, social developments and other trends. Thus, this corporate culture is more an obstacle for exchange than a intermediary between forest services and society. Consequently, the service acts autonomously and is dysfunctional towards new challenges and dynamic changes in society. The assumption will be verified by describing and analysing the origins of the corporate culture in the German forest services, its function in the structure of the service and its impact on the functioning of the service. The results of this study will be used to compile tools and recommendations for the reorganisation of the German forestry service, therewith leading to an improved functioning of this service in view of its new tasks.

European relevance and collaboration: The increasing significance of a common European policy towards forestry issues (e.g. FFH guidelines, Natura 2000 Initiative, certification of wood and wood products, Kyoto Protocol and Process) will inevitably have an enormous impact on the function and structure of the national forestry services. They will have a key role in the design of a structural and socio-economic framework for the realisation of an European-wide sustainable forest economy. Therefore, the integration of the national forestry services in a wider European network is inevitable. The integration process will be greatly aided by a thorough understanding of the individual national corporate cultures. Research groups also working on this or on related topics are situated at the forestry/environmental departments/faculties of the Universities in Vienna/Austria, Wageningen/The Neatherlands, Florence/Italy, Bangor/UK, Nancy/France, Zurich/Svizerland and at the EFI, Joensuu/Finland.