MEMORANDUM OF UNDERSTANDING

Subject: Memorandum of Understanding for the implementation of a European Concerted Research Action designated as COST Action FP1303: Performance of bio-based building materials

Delegations will find attached the Memorandum of Understanding for COST Action FP1303 as approved by the COST Committee of Senior Officials (CSO) at its 187th meeting on 15-16 May 2013.

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MEMORANDUM OF UNDERSTANDING
For the implementation of a European Concerted Research Action designated as
COST Action FP1303
PERFORMANCE OF BIO-BASED BUILDING MATERIALS

The Parties to this Memorandum of Understanding, declaring their common intention to participate
in the concerted Action referred to above and described in the technical Annex to the Memorandum,
have reached the following understanding:

1. The Action will be carried out in accordance with the provisions of document COST 4154/11
   “Rules and Procedures for Implementing COST Actions”, or in any new document amending
   or replacing it, the contents of which the Parties are fully aware of.

2. The main objective of the Action is to improve the knowledge on the performance of bio-
   based materials used as building products and the assessment of chemical and physical factors
   influencing these, with the aim of increasing their service life.

3. The economic dimension of the activities carried out under the Action has been estimated, on
   the basis of information available during the planning of the Action, at EUR 76 million in
   2013 prices.

4. The Memorandum of Understanding will take effect on being accepted by at least five Parties.

5. The Memorandum of Understanding will remain in force for a period of 4 years, calculated
   from the date of the first meeting of the Management Committee, unless the duration of the
   Action is modified according to the provisions of Chapter IV of the document referred to in
   Point 1 above.

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A. ABSTRACT AND KEYWORDS

Maintaining and expanding the market potential for bio-based building products in indoor and outdoor construction uses remains a key activity for European industry in the forestry and biotechnological sector. Performance data for many "environmental friendly" building materials are lacking as well as suitable comprehensive test methodologies to determine their resistance against mould, stain, and decay. The similarity in terms of decay hazard, resulting response on climatic loads and thus performance of different bio-based building materials has not yet been recognised adequately, wherefore this Action will provide a platform for networking and scientific exchange between different disciplines, such as material sciences, wood technology, biology, biotechnology, building physics and engineering. Consumer demands and preferences, which might serve as limit states to develop service life prediction and performance models, will consider aesthetical aspects as well as the functionality of building assemblies. A coordinated effort to put the issue of biodegradability of organic building products on the agenda will contribute to the control and prevention of this imminent threat to use bio-based building materials, which in turn could severely damage a pan-European low carbon building agenda.

**Keywords**: Lignocelluloses, wood, timber, bamboo, monocotyledons, wood polymer compounds, performance, product classification, prevention, preservation, protection, biodegradation, biodeterioration, mould stain, decay, rot fungi, bacteria, insects, termites, marine borer, construction, functional service life, aesthetic service life, service life planning, prediction of service life PSL, building physics, performance based design PBD, life cycle analysis, reference service life, consumer preferences, and coatings

B. BACKGROUND

B.1 General background

The ‘bio-based economy’ represents an increasing area of development globally and covers a wide range of activities incorporating bio-based materials. ‘Bio-based’ in this context means that the materials and products are derived/made from renewable resources, with the criteria that a renewable resource recovers faster than it is drained, in contrast to many mineral and fossil resources. The processing of the forest biomass into value adding and durable building materials and products, also taking into account the by-product streams; clearly fulfil these criteria today and with pro-active strategies also in the future. In addition to this, compared with aluminium, steel and
concrete most such bio-based materials are made with considerable lower energy consumption and their use act as a carbon sink which means that a replacement of materials made from non-renewable resources directly reduces CO₂ emissions. The future strategies for the world’s energy and materials supply must consider these facts since some prognoses indicate that the fast growth of the bio-energy sector could result in a higher use than growth of Europe’s forest and agricultural biomass.

The development of building materials incorporating bio-based materials is also an area of rapid development. As well as solid timber, wood-fibres and other materials, such as bamboo, miscanthus, phragmites, and other gramineae are now being used for structural purposes as well as for roofing and cladding. In particular the combined use of wood-based and other bio-based materials allows the configuration of diverse composites, such as particle and fibre boards, sandwich panels or in combinations with polymers as extruded profile members (WPC and BPC) and shaped components. Traditional agricultural food plants also have the potential being used for various building applications, e.g. light-weight building boards or insulation wall fillings. Flax, hemp, sisal, coir, corn cobs, and rice or wheat straw are just a few examples of bio-fibres used in different applications in the building trade. Wood itself is used in its native character, but also chemically and thermally modified. Finally, the use of classical and new preservatives allows the use of timber products even under severe outdoor exposure conditions.

However, whenever and wherever organic material is exposed to favourable moisture and temperature conditions as well as to degrading organisms its functional and aesthetic service life might get negatively affected. To a certain extent, all bio-based building materials are susceptible to discolouring and degrading organisms. Discolouration by staining and mould fungi as well as fungal, bacterial, and insecticidal decay limits the performance of bio-based building materials. In particular, mould plays an important role not only in outdoor environment, but also in the building envelope with dramatic impact on the indoor air quality and thus on the health of occupants. Furthermore, the aesthetical appearance of building components (e.g. window frames, cladding) is compromised by stain, which becomes an increasing issue in nearly all European countries. The timber industry is now seeking for effective methods and treatments to protect wood and other bio-based building materials from surface mould growth and fungal disfigurement because of the perceived threat of losing costumer preference. In addition to improved protective measures for wood and bio-based materials, better design within the built environment is essential to minimize risks from the build-up of moisture, interstitial condensation, issues related to ineffective thermal bridging and effects caused by moisture traps. These developments also require the inclusion of building physics to ascertain moisture transport. However, as yet there is no clear consensus among
specialists, industry and stakeholders regarding the causes, occurrence, implications and methods of prevention of surface mould growth.

Organic materials are generally heterogeneous in terms of their anatomical and chemical constitution, and their susceptibility to different decay organisms. The degradation agents themselves and the exposure conditions are also very variable, so it is no surprise that determining the durability of bio-based building materials is a major challenge, even without adding the variety of measures used to enhance the biological resistance. Consequently, numerous test methods using different decay organisms under laboratory and field conditions have been established to help us understand likely performance and hopefully in predicting service life, these need to be better linked to aspects of building physics to create a comprehensive understanding of risks to bio-based materials in construction, which will help alleviate concerns across the sector and for end-users.

There is a need to establish better links between research and industry in understanding the issues affecting the performance of bio-based materials in construction, and what factors can help address avoiding issues around moisture entrapment in modern buildings. This is evident in the strong need for performance data, physical interaction and reaction as a result of natural moisture and moisture in service, building design and consumer expectation. Much of this derives from the European Construction Products Regulation as well as from various consumer groups becoming more adept to safety and health aspects, but also to environmental friendliness. To compete with other building materials such as steel, concrete, glass or petrochemically derived plastics, the lack of performance data and physical performance for bio-based building materials needs to be reduced. Therefore it seems indispensable to intensify networking between different European research organisations and institutions as well as between disciplines such as material science (wood, lignocellulosics, agricultural products, and polymers), sorption properties of materials, biology and plant pathology, engineering, biotechnology, and building physics.

Whilst these activities are closely related, they often represent areas of R&D that have limited interaction. In order to advance both the understanding and the long term use of bio-materials in construction, the development of a multi-disciplinary platform is necessary. Given the wide range of activities and the wealth of experts in individual areas within the topics defined herein, the advancement of the performance of bio-based materials in construction is best served through the creation of a COST Action. This proposed COST action will provide the platform demanded by industry, academia and end-users for scientific exchange and collaboration and help identify where key activities need to be undertaken in future collaborative programmes between participants.

B.2 Current state of knowledge
It is recognized that the construction market is one of the major employment sectors across the European Union. It was estimated in 2008 that the sector provided direct employment to around 26 million jobs across the Union. This comprised approximately 75% construction enterprises (many of which were micro to medium sized enterprises), who combined generated a turnover of €1.6 trillion (approx 5% of the EU-27 GDP in 2008). Whilst this sector has faced a significant downturn in activities and income due to the current economic downturn, there is a continued demand for new and/or improved housing. This is being further affected by increased awareness into resource efficiency and performance. This has led to a reconsideration of approaches to issues such as energy, climate change, impacts on natural resources (energy, water and materials) and public convenience and welfare (accessibility, safety, security, indoor air quality, etc.). Not only is this relevant to new building programmes but also to the existing building stock (where the greatest levels of change may be achieved). This has led to an increased demand for sustainable construction.

Sustainable construction as defined by the European Commission’s “Lead Market Initiative for Europe - Mid-term progress report” is the dynamic for developing new solutions involving investors, construction industry, professional services, industry suppliers and other relevant parties towards achieving sustainable development, taking into consideration environmental, energy, socio-economic and cultural issues. It embraces a number of aspects such as design and management of buildings and constructed assets, choice of materials, energy use the physical and functional performances of building as well as interaction with urban and economic development and management. A key means of achieving sustainable construction is through a greater use of bio-based resources in innovative products.

The European Commission, through its “Ad-hoc Advisory Group for Bio-based Products” has undertaken a range of studies into the market potential of bio-based products. Its “Measures to promote the market introduction of innovative bio-based products” aims to encourage Green Public Procurement for bio-based products. Recent outputs from the task groups involved in developing measures to promote the market introduction of innovative bio-based products suggested that:

Preference should be given to bio-based products unless the products are not readily available on the market, the products are available only at excessive cost, or the products do not have an acceptable performance.

A key issue for the competitiveness of wood and other bio-based materials is the delivery of reliable components of controlled durability with minimum maintenance needs and life-cycle costs. The importance of service-life issues is reflected in the existing Construction Products Directive (CPD)
with its six essential requirements:

- Mechanical resistance and stability,
- Safety in the case of fire,
- Hygiene, health and the environment,
- Safety in use,
- Protection against noise,
- Energy economy and heat retention,

which should be fulfilled by construction products during a ‘reasonable service life’. This will be formally replaced by the Constructions Products Regulation (CPR) in 2013, which mirrors the requirements of CPD whilst also including sustainability. Bio-based materials, and more specifically wood, are fundamental building materials for most of the nations across the globe. It has potential to be one of the truly lowest impact embodied energy materials for construction yet at the same time work to be able to predict and satisfy the performance of the products in service is lacking.

A key issue in building construction is durability. Traditionally, durability design of building components and structures is based on a mixture of experience and good building practice. New wood, and bio-based building materials, as well as more environmentally friendly protective treatments are appearing on the market. Reliable performance data for these materials and products to provide constructors (stake-holders in the market place) and end users with relevant information is lacking. In contrast to other building materials, wood and bio-based building materials feature a susceptibility to colonization and degradation by microorganisms. For service life prediction it is indispensable to consider also biological processes, which can be neglected for metals, minerals, and most other inorganic materials. It is therefore important that 'green' products perform the same as 'standard' products over their expected life cycle.

The functional service life of timber structures is predominantly affected by the interdependency of wood resistance on the one hand and climatic loads on the other hand. Biological degradation in terms of fungal decay is the most common reason for surface disfigurement and structural failures. Therefore, consolidated knowledge of the interrelationship between the intensity of fungal
degradation over time and the numerous decay-influencing factors is needed to estimate the service life to be expected for building components in outdoor applications. The establishment of dose–response functions allows overcoming the drawback of long exposure times needed for field trials. Attempts to creating prediction models of fungal degradation of wood based on dose-response of moisture and temperature have been made, though specific knowledge on the susceptibility of impregnated, modified, and surface treated wood and bio-based building materials to superficial fungal growth is still lacking.

Protection of wood by impregnation has been extensively been studied. Two COST Actions (E22 and E37) have been dedicated to this area. However, performance data on the susceptibility of surfaces to mould and staining fungi of contemporary impregnations are still lacking. Extensive mould development on the surface of impregnated wood as well as surface disfigurement by staining fungi are being reported by producers and end users in Europe, especially in northern Europe and Scandinavia.

Prevention of dimensional instability and photodegradation of wood by chemical modification offers protection of wood either with or without a coating. Chemical modification is known to result in wood with superior qualities which may be used in tailor-made products, whereby the treatments may confer protection from light, water, heat and microorganisms. Acetylation, furfurylation, and thermal modification are commercial processes of modifying wood which properties are continuously being studied, to better understand the effects of different timber species and degree of treatment. Although modified wood usually have improved resistance to rot, surface disfigurement / staining due mainly to fungal growth usually occurs on these materials. However, the chemical changes occurring in the material substrate can result in increased risk from degradation from less common fungi, some of which are not considered among standardised decay tests.

Compared to most synthetic fibres, natural fibres are low-cost, are easier to handle, and have good specific mechanical properties. Using natural materials and modern construction techniques reduces construction waste and increases energy efficiency while promoting the concept of sustainability. Advances in the use of natural fibres (e.g., flax, cellulose, jute, hemp, straw, switch grass, kenaf, coir, bamboo, and others) in composites have been reviewed by several authors. However, many drawbacks of natural composites include their inferior fire resistance, lower mechanical properties, higher moisture absorption and subsequent lower durability. Many researchers have been working to address these issues, with particular attention paid to the surface treatment of fibres and improving the fibre/matrix interface. One major concern with natural composites is their long-term behaviour when exposed to different environments, though there has been limited work carried out on the biodegradation of natural fibre composites. The growth of fungus and bacteria in natural
composites due to biodegradation or moisture retention is a major concern in their development as structural materials. Recently, natural fibres have come into use to reinforce traditional thermoplastic polymers, whilst there are limited commercial examples of products incorporating chemically modified wood fibres into composites. However, the surface properties of these materials regarding surface fungal growth have not been fully assessed.

The service life of building components and commodities is hereby determined by very different criteria, e.g. colour stability of coated or uncoated surfaces, crack performance, occurrence of mould, blue stain, or fungal decay, damage by insects or marine borers, resistance to abrasion and wear and others more. The functional service life of bio-based materials in structures is predominantly affected by the interdependency of material resistance on the one hand and climatic loads on the other hand. Biological degradation in terms of fungal decay is the most common reason for structural failures. Therefore consolidated knowledge of the interrelationship between the intensity of fungal degradation over time and the numerous decay-influencing factors is needed to estimate the service life to be expected for wooden components in outdoor applications. In principal, there are three different sources providing information about decay processes:

1. Laboratory experiments

2. Field trials, and

3. Surveys on structures in service (in-service performance).

Laboratory tests allow setting up exactly defined conditions, e.g., in terms of moisture, temperature, and organisms involved. On the other hand it is difficult to mimic real life conditions in the laboratory, because many factors occurring in the field are not reproducible or are even unknown. In addition to failure in service, it is important to recognize aesthetical failure, whereby consumers and end-users may decide upon the replacement of a given element due to its appearance, which may not be related to in-service failure. There are a range of factors that need to be considered when assessing the performance of bio-based materials in service:

- Protective methods to enhance the service life of bio-based materials,

- Material-moisture interactions and the risk of decay,

- Correct detailing in construction.
Recent pan-European research projects such as Woodexter and Woodbuild have started to build the information needed to develop the first steps in predictive models for wood based on understanding the moisture risk and the resistance of the material. This presents a significant standardisation opportunity to consolidate the technical background to the standards we do have for durability (CEN TC38) which we link to performance. Existing standards are largely mature and were developed for the assessment of wood preservative technologies, now there are numerous ways of enhancing durability of a wood product (e.g. wood modification, coatings, design, water repellents). The tests were exacting but collectively used to determine if a treatment was fit for purpose in a specific end use.

To date, there has been little work on determining consumer preferences for building materials. Such information is presently sought within the recently started FP7 project PerformWOOD, but it is very likely that, for the sake of the proposed COST Action, the scope needs to be widened further and the results complemented. In general, homeowners have a positive impression of wood and bio-based building materials. However, this is a segment that has some concerns regarding performance and health related aspects. Homebuilders seem to lack adequate and relevant information on the materials properties. More knowledge is needed on stake-holders preferences (constructors, architects, and others), as well as consumer behaviour and acceptance of wood and bio-based building materials. For such preference to make a significant impact on bio-based materials, there needs to be a more consistent way of assessing issues surrounding the use, maintenance and service life prediction of wood and bio-based components. This will require activities from many different groups: wood scientists, fibre technologists, building physicists as well as architects, planners, civil engineers, craftsmen, and house builders. At any time during the construction phase, when decisions about the most suitable solutions have to be taken, the durability and hence the expected service life of a material or a component needs to be considered. This will allow for orientation and/or reorientation of research and efforts towards a more sustainable use of the products.

B.3 Reasons for the Action

Changes in construction practices, combined with increased awareness of the green agenda and reduction in carbon release have created a demand for novel materials incorporating bio-materials, including solid wood, and wood/plant fibres. These new products, as well as existing products are continually being examined under more rigorous operating conditions, particularly from building regulations. These changes in construction practices, as well as consumers assuming the
behavioural pattern of new products, can lead to premature failure in service. This is evident with wood and plant-fibre based products, which due to their biological structure, are naturally susceptible to decay mechanisms.

The challenges from society on modern materials are significant: reduced carbon footprint/profile, water efficiency, reducing demands on non-renewable resources, climate change and mitigation, toxic chemical release and environmental consideration, whilst maintaining or improving product performance. The ability for timber and plant fibres to store carbon during its use represents a clear way of mitigating carbon levels, whilst developing new markets for various resource streams represents sound business reasoning.

The increase in natural products, primarily wood-based, but with an increasing percentage of plant-fibre based systems needs to establish optimum in-service operating conditions, establish key factors in predicting performance and provide better guidance on the use and maintenance of these products. Given the various related disciplines necessary to achieve these goals, the adoption of a COST Action would provide the critical mass necessary to advance the understanding across these areas and how they apply to naturally derived materials in the preparation and subsequent commercialisation of innovative products in construction.

Thus the key benefit from this COST Action will be to raise awareness across the wider scientific community and associated industries of the potential of using wood and plant fibre products where performance and service life are critical parameters. These will help address issues in the following themes:

*Societal:* the Action will increase demand and supply issues for novel bio-based materials and help generate greater revenue within the forestry and rural economy sector. It will also provide greater income for low revenue material streams.

*Environmental:* More efficient use of wood and plant fibre streams will reduce demand on energy, water consumption and the use of pollutants during primary and secondary processing stages as well as during manufacture, and can provide an extra solution to carbon entrapment.

*Impact on human health:* The Action will help reduce the risk of human exposure to moulds within restricted areas, particularly within buildings.

*Scientific:* The Action will also provide a platform for innovative research and development to be showcased to peer audiences as well as the industrial sector. This will help combine understanding between different research sectors, which will accelerate research potential and collaborative approaches as well as improve market potential and commercialisation. This will help maintain the European Union at the forefront of alternative forest-based industries.
B.4 Complementarity with other research programmes

This COST Action will be based on the scientific and technological achievements of work done in Europe and other parts of the world, in areas of wood and fibre protection, product durability, moisture interactions, performance assessments and classifications, service life predictions, product maintenance and building design and technology. This will be achieved through a combined enhancement of synergies between these current research activities. The preliminary structure and identified experts allow for the extension of those participating in the Action to include those active in the relevant themes. Thus, this Action can provide complementarity to a wide range of on-going and future projects that have been funded either through national grants or pan-European programmes, placing significant emphasis on the future EU programme “Horizon 2020”, which will run from 2014-2020. Given the multi-disciplinary approach necessary for this Action to be successful, it will require activity and interaction with a range of existing COST Actions, which are listed in Section E3.

At the onset of the Action, national members to the MC will help identify previous and existing projects in areas about product development, product assessment and service life protocols, indicating if these are nationally, centrally (i.e. EU) or internationally funded. Where possible, and without jeopardising existing IPR, companies will be asked to indicate on-going activities, as well as expressing areas of interest. This will help in addressing the knowledge gaps where discussion, development and collaboration is necessary. The identification of comparable programmes in individual countries will allow experts to develop new multi-national collaborative projects, helping to achieve the technological advance desired, as well as identify differing needs across the various climatic regions of Europe and globally.

C. OBJECTIVES AND BENEFITS

C.1 Aim

The main aim of the Action is to improve the knowledge on the performance of bio-based materials used as building products and the assessment of factors influencing these, with the aim of increasing their service life. This Action will help in understanding the interlinked relationships between durability, product aesthetics, fibre-moisture relationships, decay hazards and achieving a better understanding of the biology and mechanisms influencing the growth of fungi and other degrading organisms and the consequent damage in terms of discoloration and decay of wood and bio-based building materials with building design and maintenance. The evaluation of the efficacy of
impregnation, chemical modification and surface treatments of the materials against fungal growth will be targeted. A better understanding of the inter-relationship between the intensity of fungal degradation over time and the numerous decay-influencing factors needed to estimate the service life to be expected for building components in outdoor applications is expected to be gained. The development of a durability plan with material information and systems decisions assessing potential risk factors and damage functions is aimed. Thus, through these combined activities, this Action will develop a more scientific approach to determining service life and ultimately the performance of a material as a building component. This will be achieved by bringing together experts from such fields as wood and fibre technologists, chemists, analytical scientists, wood scientists, polymer scientists, materials scientists, mycologists, biologists and building physicists from academia and industry. These experts will share knowledge and expertise and drive forward the understanding of issues surrounding premature failure of building materials, help develop better methods for assessment and prediction and provide the construction sector with multi-disciplinary scientific evidence of how to use these materials more efficiently.

C.2 Objectives

Some of the issues related to the biological degradation of wood and plant-fibre materials have been well established over the years. However, as material combinations, uses, and operating conditions change with modern methods of construction, there is a degree of uncertainty on the long term performance of conventional and new materials in use, with many of the standard methods of assessment not directly relevant to the material being assessed. Among the objectives of the Action will be:

Creating a platform for performance testing – The Action will link ongoing national and international activities looking at aspects of testing of the performance of a range of materials, and how these should be altered to account for changes in treatments, uses, micro and macro-climatic issues. Findings from this can then be fed into standardization committees (such as CEN).

Establish a critical appraisal of innovative materials – As more materials progress from laboratory development to commercial production, information gathered to their properties and how they perform in use will be created. This will help identify correct materials for specific uses.

Guidance for users – There appears to be considerable misunderstanding on how natural materials perform in use and protective maintenance schemes that should be followed to ensure they reach their expected service lives. The Action will determine best practice methods suited to both professional bodies and consumers (the general public).
Networking as a group and among other groups - As this Action proceeds, it is anticipated that the majority of European countries will be represented, providing the pan-European dimension necessary for achieving close collaboration. The topics within this Action transcend several other Actions and research initiatives, and as such members will be encouraged to promote the Action and to engage in cross-theme development, not only with research peers but also the industrial community. This offers the potential of the Action having a global presence.

In summary, the Action deliverables will comprise:

- Dissemination of knowledge to alleviate consumer misconceptions and misunderstandings regarding the presence of mould growth, decay and other damage caused by organisms,

- Guidelines for preventing building indoor and outdoor surfaces and the building envelope from mould growth and stain,

- Improved and harmonized assessment protocols and procedures for various bio-based building materials linking materials to building physics,

- Overviews and recommendations on available and implementation of novel protection methods,

- Initiation of combined efforts to develop new protection technologies, Online documentation of the Action progress.

C.3 How networking within the Action will yield the objectives?

The aims and objectives for this Action will be achieved through collaborative exchange of ideas and knowledge, based around the concepts being developed within academia and industry in the multi-disciplinary areas relating to the topics of this Action. The means to reach the objectives will be:
• Identifying, assembling and engaging experts and young scientists from European academia and industry as well from other countries, and in particular Balkan countries, Mediterranean countries and Eastern European countries (identified by COST as Near neighbour countries), as well as countries where COST reciprocal agreement countries and other international groups from countries currently outside such reciprocal agreements. Meetings, whether arranged as stand-alone meetings or as part of another Action / conference, will encourage dissemination of the latest work through the exchanging and developing of ideas. Wherever possible, meetings will be arranged in parallel to visiting sites with recognised expertise, specialist equipment and/or opportunities for visits to commercial or semi-commercial facilities. Sites of recognised expertise will also be selected as venues for Training Schools;

• Coordinating research activities within countries and between countries to help ensure the best practical use of resources, particularly across several of the themes identified within this Action. This will not only help to minimise duplication, but create a common development programme which in turn will considerably accelerate developments in this Action, the scientific field in general and the prospect of greater commercial opportunities;

• Joint collaboration among the different laboratories and research activities, including the exchange of personnel and the provision of access to specialist equipment, especially to Early Stage Researchers. This will encourage greater synergy between centres of excellence across different disciplines, accelerate the learning of students and provide academia and industry with new, highly trained and highly innovative thinking staff;

• Develop a recognised suite of processes, test methods and analytical tools for better synthesis and characterisation of bio-based building materials for consideration within national and international standardization committees;

• Create and maintain technical guidance for the selection of correct materials in correct uses for interested stake-holders.
C.4 Potential impact of the Action

This Action aims to provide the scientific community across Europe (including the Balkan countries, Mediterranean countries and Eastern European countries, as well as Neighbouring countries) with a platform to allow open discussion, planning and collaboration in areas related to the manufacture, modification, production and assessment of innovative bio-based products within the construction sector. As this is a rapidly expanding technology area, the prior knowledge needs to be assessed, modified and disseminated, which requires not only the direct involvement of the scientific community but also their subsequent education in new methods. This applies not only to the current scientific community, but also to the future experts. Thus, this Action aims to have a high percentage of Early Stage Researchers, whilst also ensuring gender balance as stipulated within the European Community.

The Action will focus on developing new links between scientific communities, specifically between wood science, building physics and biologists, with a drive towards new collaborative projects in forthcoming scientific calls (such as those expected to be proposed within the Horizon 2020 programme).

In its role of providing technical and scientific knowledge the Action will also contribute to public awareness, by helping demonstrate the environmental benefits to be gained from the correct use of bio-based materials.

In summary the Action can help bring the following benefits:

Scientific benefits: The creation of a more thorough understanding of issues linking novel treatment and processing with performance and durability and to design and moisture interactions of innovative materials. This will require a programme of interaction and co-operation between such research disciplines as wood science, fibre technology, polymer science, materials technology, analytical chemistry, biology (especially mycology) and building physics. The planned activities will not only be undertaken by established researchers, but also by young scientists, who will also be actively brought into activities through Short Term Scientific Missions (STSMs), training schools and participation in workshops. Such educational programmes will be aided by the personal involvement of the recognised experts in the relevant subjects.

Technical benefits: Generating a greater portfolio of potential use, performance and maintenance of a wide range of wood and plant-fibre based products as a result of product improvement and development. This will have direct application within the construction sector, where commercial activities will be directly employed.
Ecological and societal benefits: Not only do timber and plant fibres represent renewable and sustainable resources, their use for an increasing range of product ranges can help reduce demands on non-renewable resources. It is already recognized that greater volumes of timber (and hence plant fibres) in a building envelope can increase the entrapped carbon present within a property. Since it is envisaged that modern buildings will have minimum service lives of between 30-60 years, this carbon will remain locked for that period. As both the forestry and non-food crop sectors are strong (and increasing in size) across Europe, the increased use of resources from these sectors will help maintain employment prospects. The improvement in understanding issues related to exposure of humans to mould due to product failure will also provide significant ecological and societal benefits through healthier buildings.

C.5 Target groups/end users

The target audience of the Action is mainly a combination of academic and industrial researchers interested in advancing both the basic and applied research surrounding the use and performance of wood and bio-derived components aimed towards the Built Environment. A range of potential stakeholders have been involved in the development of this Action. Whilst the emphasis within COST is increasing the European dimension, the success of this Action can be increased through the involvement of experts from worldwide. The Action will help to advance the construction sector confidence and ultimately consumer confidence in the performance and durability associated with this Action, realising materials from sustainable, renewable resources. This Action will bring together a critical mass of wood and fibre technologists, chemists, analytical scientists, wood scientists, polymer scientists, materials scientists, mycologists, biologists and building physicists to develop cross cutting themes for both the mutual advancement of knowledge and the training of Early Stage Researchers. The Action will help provide benefits towards:

- Wood industry,
- The wider "agrotechnical fibre industries from non-food crops",
- Wood protection industry,
- Building industry,
- Construction material trading,
- Scientists working within the fields of the Action as well as on other related disciplines,
- Retailers,
• End users: Construction companies, architects, consultants, and ultimately private individuals.

D. SCIENTIFIC PROGRAMME

D.1 Scientific focus

The Action will be a concerted effort to overcome lack of communication and exchange between wood and material scientists, biologists, building physicists (including experts on moisture transport), and experts in performance assessments working with different wood and bio-based building materials to provide means to improve the understanding of their interaction with their surroundings, particularly in their resistance against discolouring and degrading organisms. In order to achieve the goals of this Action, it will be necessary to overcome many of the challenges in this area some of the major challenges indicted below need to be overcome. These will be coordinated by the Action into the Working Groups formulated in Section D2 below.

**Key area 1: Material capability and enhancement** - Any material that has a defined use MUST perform adequately in order to meet its target use and service life. The use of wood and bio-based materials remains popular, especially for visible features, but this places these materials under the greatest risk from adverse conditions and attack. Any product used where there is a risk of failure from degradative effects to surface or inner core must be capable of withstanding such threats. Methods exist for increasing the resistance of these materials, through methods such as preservation, modification and surface treatments. Many of these have been the focus of previous COST Actions, and it is not the intention of this Action to repeat this work, predominantly undertaken on wood. There is, however, a need to critically assess changes in processing since the expiry of previous Actions, taking into account the application and use of less toxic treatments, issues surrounding the effectiveness of microemulsions and nanoemulsions, factors dealing with penetrative depths (particularly for refractive timber species), determining the effects of novel treatments and coatings on a material as a whole (as compared to COST Action FP1006, which deals specifically with the wood surface). These factors are of more innovative aspect for the bio-based product sector, where there has been less work undertaken as compared to timber. Thus, the flow of information between groups specializing in the different materials will be important, in order to create a common programme of treatment. This will also take into account remedial effects, where processes will be considered *in situ* or remotely.

Methods of assessment are of key importance, but as materials and conditions change, so there is a need to modify test parameters accordingly to take into account these changes. It has already been
noted in some sectors that biological attack from supposedly less aggressive species can occur with certain types of treatments. This can lead to incorrect performance classifications. The modes of action during degradation need to be better understood, using specialist skills such as gene expression to determine points of early onset of biological attack and identifying attacking species. How these modes of attack vary in different regions will be a critical outcome of work. Thus, a treatment that may give good performance characteristics on one region may be affected by different attacking species in another region. As new materials enter use, modes of assessment may also need to be modified to take into account their different modes of interaction, e.g. with other materials and with moisture. In addition to physical assessments, there is a need to establish improved protocols for qualitative assessments, such as those involving aesthetical appearance.

**Key area 2: Functionality and performance** – The functionality of a material is a key to its performance in use. This functionality is closely related to the physical surroundings, and incorporate secondary influences such as heat, moisture and material-material interaction. Within the Built Environment, many of these aspects fall under the consideration of building physics. Increasing building standards are constantly altering conditions in which a material operates, so that without some degree of innovative modification, a product may find it is no longer suitable for a given application. The interaction in service environment establishes a strong link with experts from areas of building physics, and will take into consideration aspects of moisture interaction and flow, condensation risks, exposure to thermal gradients, and the physical and chemical compatibility between materials. The development of performance-based service life design methods requires that models are available to predict performance in a quantitative and probabilistic format. This means that the relationship between product performance during testing and in service needs to be quantified in statistical terms and the resulting predictive models should be calibrated to ensure that they provide a realistic measure of service life, with reasonable degree of certainty. In order to achieve this it will be necessary to determine and collect data for reference service lives and individual factors affecting this. These will be used to determine more sophisticated probabilistic methods and simple deterministic methods. The combination of factors will help define better performance ratings and hence classifications that can be recommended as a means of achieving better service life.

**Key area 3: Adaptation and application** – Ongoing work will eventually lead to new materials entering the market place. In order for these to be successful, there needs to be sufficient scientific proof to their fitness for purpose, with this information being of particular importance to stakeholders in the building sectors. This information can also help inform experts and consumer preferences.
The acceptance of any product will depend on the application of methods in life cycle assessments for these materials, as well as an environmental evaluation of both the materials and the construction in question. In order to do this there will be considerable emphasis on establishing relevant interventions aimed at guiding towards more sustainable products. In early development stages, screening methods that show potential solutions in different future scenarios may be the best way to guide technology development while Life Cycle Costing (LCC), Life Cycle Assessment (LCA), and Social Life Cycle Assessment (SLCA) can be used when a product life cycle can be defined and quantified. These tools can also be used after the product system has been finalized. LCA is defined in ISO standards (ISO 14040, ISO 14044). Recent developments have led to a handbook for LCC, and a code of practice for SLCA, covering work environment and user health impacts, that was published within the UNEP/SETAC Life Cycle Initiative. There are already several assessment tools developed from previous wood-based projects, but these will be reviewed and modified to develop new tools suited to bio-based materials.

An environmental declaration, is defined, in ISO 14025, as quantified environmental data for a product with pre-set categories of parameters based on the ISO 14040 series of standards, but not excluding additional environmental information. Environmental Product Declarations (EPD®) add several new market dimensions to inform about environmental performance of products and services with key characteristics and guiding principles resulting in a number of advantages both for organisations creating EPD®s as well as for those making use of EPD® information. The overall health improvement from the use of a material will also be a key focus, whereby volatile release and risks from biological pathogens (resulting from degradation) will be critically reviewed.

D.2 Scientific work plan methods and means

The Action aims to advance activities and collaboration in both a European and global dimension in areas related to the use of bio-based materials within the Built Environment, increase understanding in their interaction and reaction within this environment and provide technical solutions to determining and prolonging service life. The use of bio-based materials has mainly, to date, been limited to timber and timber products in both indoor and outdoor activities, though there are an increasing number of innovative systems under consideration based on non-wood fibres. This step change coincides with changes in building design, which alters the physical behaviour within buildings. As a consequence, conventional assessments and predictions on how a material performs over time may have changed. Thus, this Action aims to better understand these inter-related issues,
and in so doing, help dispel any developing doubts on the long-term performance of bio-based materials in conditions which may place them under risk of degradative processes. This can be done by the Action and its contributors by creating a reporting platform to increase knowledge dissemination and education. The work plan, equipment and methods required for achieving the objectives are presented in relation to the three principal research areas formulated in section D.1. The Action itself represents a significant interdisciplinary approach, which whilst operating under a single Domain, brings together expertise and methodologies from across several Domains. The development of such an interdisciplinary Action is relatively novel within the Forest, their Products and Services (FPS) Domain and suggests this will become a highly dynamic Action. This dynamism will further increase as more experts and nationalities register their intent to participate once adoption by COST has been undertaken. This dynamic nature will necessitate improvements to the scientific programme, whilst still operating within the envisaged 3 Working Groups (WGs). Thus it may be necessary for participants to consider, modify and accept revisions to the scientific programme at the kick-off meeting and potentially within the first year of the Action’s existence. The WGs and their relevant research areas within this Action may be described as:

Working Group 1: Material capability and enhancement
- This WG will be dedicated to the fundamental understanding of the interaction between decay organisms and the substrate and includes:
  - Aesthetical aspects related to rot, staining and mould fungi,
  - Contributing factors related to degradation,
  - Gene expression techniques,
  - Protective measures (physical, chemical, biological, organizational protection),
  - Remediation strategies.

Working Group 2: Functionality and performance – This WG will concentrate on the suitability of bio-based materials in terms of their overall performance, identifying issues affecting their service lives. Among key activities considered will be:
• Issues related to building physics (moisture, heating, material reactions),

• Understanding fibre-moisture relationships,

• Assessing and developing service life models,

• Performance modelling as a tool to predict reliability,

• Establishing links between theoretical and experimental data.

Working Group 3: Adaptation and application - will gather knowledge about preferences within industry stake-holders and end-users, and tools used in assessing environmental performances. Among the key topics will be:

• Life cycle methodologies for bio-based products in service,

• Guidance in creation of Environmental Product Declarations and CE markings,

• Review environmental effects from material and volatile release,

• Preparation of documentation as information tools,

• Increase opportunities for bio-based building materials.

E. ORGANISATION

E.1 Coordination and organisation

The organization of this COST Action will follow a similar structure for most Actions, as outlined in "Rules and Procedures for Implementing COST Actions". Thus the Action will benefit from elected individuals, selected at the kick-off meeting, these individuals acting within a Management Committee (MC) and Steering Committee (SC). The SC will comprise the Chair and Vice-Chair of
the Action, the Leaders and Vice-leaders of the Working Groups, a nominated manager for Short Term Scientific Missions, and if deemed necessary at the kick-off meeting or through the duration of the Action, others through appointment by the MC. Given the direct relevance to commercial applications, industrial involvement will be promoted, through direct involvement within the MC/SC as a result of the creation of a dedicated industrial sub-committee. The Action will promote active participation of Early Stage Researchers in the managerial aspects of the Action, with the aim of appointing a number of Early Stage Researchers to key positions.

Throughout the lifetime of the Action, it is aimed that the SC will meet twice a year in person, with the additional option of e-meetings via Skype/Lync etc., especially when planning forthcoming meetings. Among the key roles for the SC will be to ensure efficient completion of tasks within the Action, including budgetary control, planning and preparing meetings and workshops, approving Short Term Scientific Missions (STSMs) and Training Schools and implementing dissemination activities. SC activities will be reported throughout the Action via MC meetings on their work in the MC meetings and will be bound to decisions made there. The MC (minimum one per year) will provide a platform for discussions about the scientific focus and the work programme of the Action. It will supervise and coordinate the research activities in the Action, draw up detailed plans, and track the progress in relation to the scheduled objectives.

The MC meetings will allow national representatives define the ongoing work in the Action, as well accelerate efficient networking between participating laboratories and institutes. In effect the MC members will become the spokespeople for the Action, helping to promote its activities to the wider scientific community, to industrial contacts and to end users. The participating members from each country will be required to be active in one or more of the proposed Working Groups, though it is envisaged that a given country will not have both its MC members active in the same WG. Workshops will help compliment the WG meetings by helping fostering contacts and scientific exchanges between participating groups / countries. These Workshops will be seen as specific milestones in the progression of the Action. Workshops will be held as often as possible within the financial frame of the Action, and at least annually, their structure including both plenary sessions for all participants and parallel sessions for the individual WGs, depending on the topics being presented and the levels of interest generated. Whenever possible, the SC or MC meetings will be organised in connection with WG meetings or workshops in order to minimize the costs for the coordination of the COST Action. Ideally, the annual workshop will be extended into a public conference where the activities of leading academic and industrial fellows will be presented to a broader audience: during the first year to advertise the new Actions among scientist within and outside Europe, and at the end of the 4-year period to disseminate the outcomes of the Action.
toward the international community and discuss follow-up activities. The workshops in years 2 and 3, although open to external participation, will mainly be dedicated to discussions about on-going research. It is hoped that at least one of the planned workshops will be in conjunction with an international conference, where there are overlapping interests. This will allow a greater degree of scientific cooperation, expanding the influential boundary of the Action. During the workshop of year 2, there will be an internal evaluation of the Action in conjunction with the Action Rapporteur (as part of the mid-term evaluations), and an assessment of the further research work necessary to successfully complete the Action. MC meetings held in conjunction with the Workshops will allow the wider Action participants to learn more of ongoing COST activities though updates from the SC and the Scientific Officer from the COST Office.

Short Term Scientific Missions (STSMs) will be encouraged, especially among young scientists, as a means of furthering activities within the Action, with a minimum of 6 missions per each year granted. Evaluation of STSM applications will be via the SC and the chair will be responsible for the final approval, based on a continual application system. Persons undertaking a STSM will be required to participate and present at the next MC / WG / Workshop. This will both advance the capabilities of the ESRs but also provide justification to other members of the Action of the work being undertaken. Furthermore, Training Schools will be held to provide information and understanding of methods, instruments, and applications. Held annually, these will be organised by a participating institution or laboratory (or combination thereof) based on a formal proposal to be evaluated and approved by the SC. Special attention will be paid to the requirements and the standard of knowledge of young researchers.

The Action will make maximum use of electronic media to ensure its smooth progression. Not only will a website be created and regularly updated, but the Action will create pages in social media sites such as LinkedIn, Twitter and Facebook. It is envisaged members will volunteer to help run these sites, these being selected where possible at the kick-off meeting. In addition, the website will make use of electronic archive, whereby Action members will be provided with an opportunity to upload relevant articles, presentations and educational material, which will then be openly accessible to interested scientists.

Among the key milestones of the Action will be:

- Increased knowledge of factors affecting bio-based product performance through the sharing of results and experiences,
• Determination of non-traditional modes of attack due to substrate changes and locality of use,

• Better understanding of how issues in building physics affect product service life,

• Stronger links between academia and industry,

• Creation of a forum for improving codes and standards for bio-based products.

The ultimate aim of the Action will be to provide a platform for improving understanding in areas around the performance of bio-based materials and increase opportunities for their use by advising towards improved codes and standards.

E.2 Working Groups

As specified in Section D, three Working Groups will be established within this Action. For each WG a leader and a deputy will be elected at the first Management Committee (MC) meeting for coordinating the work within the group and for representing the group in the Steering Committee (SC). Where possible, the deputy WG leader will be an Early Stage Researcher (ESR), who after two years’ mentoring by a more experienced scientific peer will take over the role of WG leader in the second of half the Action. The participation of individual researchers in more than one WG will be possible and welcomed to encouraging the information flow between the different groups. A close relationship between WGs will be of paramount importance for the MC and will be fostered by joint workshops and Short Term Scientific Missions (STSMs) across different WGs.

E.3 Liaison and interaction with other research programmes

There are a range of existing Actions within COST that have links to this Action, though in the cases of existing Actions these links are indirect, and for previous Actions, there were only partial links. This Action has the benefit of establishing a series of new focus groups and collaborative innovations capable of establishing a new market opportunity for timber-based materials. The following Actions can be seen as having potential links with this Action:
• FP1105 “Understanding wood cell wall structure, biopolymer interaction and composition: implications for current products and new material innovation” – this Action offers a range of complimentary areas whereby the understanding of natural mechanisms linked to decay could increase the understanding of chemistry, analytical tools and modelling within this proposed Action.

• FP1006 “Bringing new functions to wood through surface modification” – this Action has considerable expertise in wood chemistry, fibre-moisture interaction, characterisation and modelling. It is envisaged that joint activity and information exchange will advance understanding and activity in modification of bio-based materials and understanding moisture relationships, especially in terms of surface effects.

• FP0904 “Thermo-Hydro-Mechanical Wood Behaviour and Processing” – this Action focusses on issues where thermal modification occurs either in or without the presence of moisture. Within it, there are activities linked to modelling of processes occurring which may help in increasing the understanding of how thermally modified materials may behave in service.

In addition to these, there are a range of experts, documents and recommendations from several previous COST Actions that might have a significant impact on this COST Action. Among these are:


• E55 “Modelling of the performance of timber structures” (2006 -2011),

• E49 “Processes and Performance of Wood-based Panels” (2005-2009),

• E41 “Analytical tools with applications for wood and pulping chemistry” (2004 – 2008),

• E22 "Environmental optimisation of wood protection" (1999 - 2004),

• E18 "High performance in wood coatings" (1999-2004),

• COST 847 “Textile quality and biotechnology” (2000 – 2005), specifically those from the plant fibre science sector

In addition, the experts identified to date in this Action have a range of on-going activities linked to the structure herein, which brings together active groups in the areas outlined. This will provide a means to greater promote on-going work, develop new programmes of work as well as helping identify other key experts capable of taking areas of work to the next dimension. The links with existing and previous Actions will help prevent duplication, whilst expanding the knowledge base of participating experts. It is expected that a combination of joint activities, training schools and research-based seminars will provide the fora necessary to achieve the needs of participating experts and the Action in general. Similarly, existing or new conferences will be identified to assess their suitability for joint meetings or special sessions.

The arrangements for any interactions will be in the overall responsibility of the Steering Committee (SC) by appointing liaisons, co-organising conferences, joint events and meetings, and providing mutual information on planned events. In particular, coordination with other identified and future COST Actions will be a permanent item on the agenda for Management Committee (MC) and SC meetings. It is anticipated that the content of this Action will draw in experts present within other Actions, so helping to build links and facilitate the scientific exchange and joint activities.

The need to foster existing and establishing new contacts with researchers of other disciplines and sectors will play an essential role in this Action. To achieve this, links will need to be established early in the Action, and planned joint activities given as much advanced notification as possible. Where possible meetings will be held at sites with specialist equipment or processing capabilities to help increase the levels of knowledge exchange and potential for collaboration.

E.4 Gender balance and involvement of early-stage researchers
Increasing the involvement of women within the scientific community is a key policy within the European Community. This COST Action will respect an appropriate gender balance in all its activities and the Management Committee will place this as a standard item on all its MC agendas. The Action will also be committed to considerably involve early-stage researchers. This item will also be placed as a standard item on all MC agendas. Thus wherever possible, priority will be given to the active participation of women in the work programme of the Action, in particular when deciding on WG composition and task coordination.

The Action will also be committed to considerably involve Early-Stage Researchers. This item will also be placed as a standard item on all MC agendas. The Action will aim to actively involve at least three young scientists via active participation in each WG, whilst each WG having an early stage researcher identified to undertake a managerial role for that WG from the onset of the Action. During Workshops, at least one session will be dedicated to presentations from Early-Stage Researchers, providing them with valuable experience in participating and presenting to their scientific peers. In addition, the involvement of early-stage researchers will be promoted in STSMs, active participation in state-of-the-art reviews and in participating in Training Schools.

**F. TIMETABLE**

The following timetable will be followed, subject to any necessary alteration voted by MC, SC of COST Officers.
G. ECONOMIC DIMENSION

The following COST countries have actively participated in the preparation of the Action or otherwise indicated their interest: AT, BE, DE, DK, EE, FI, FR, HR, HU, LT, LV, NL, NO, PL, PT, RO, SE, SI, UK. On the basis of national estimates, the economic dimension of the activities to be carried out under the Action has been estimated at 76 Million € for the total duration of the Action. This estimate is valid under the assumption that all the countries mentioned above but no other countries will participate in the Action. Any departure from this will change the total cost accordingly.
H. DISSEMINATION PLAN

H.1 Who?

Since this COST Action has a wide impact potential, there will be a wide primary target audience for dissemination, comprising:

- The network partners and their colleagues,

- Other researchers in the field (outside the COST Action, including other COST Domains),

- Research institutes and academic units (in closely related fields, especially plant fibre technology groups),

- Stakeholders from industry (construction industry, building technology, green product manufacturers),

- Identified networks of excellence,

- Relevant European and national associations and confederations

- National and European funding platforms, and

- The general public.

Effective communication channels between the researchers and the European manufacturing and construction industries will be maintained through the cooperation between the proposer and the Action and existing and future networks of excellence, whether funded via central European funding or by national companies. Close contact will be maintained with the wider COST network, so ensuring maximum dissemination.
H.2 What?

The Steering Committee, on the behalf of the Action, will make efforts to disseminate the objectives and progress of the COST Action not only to the participants, but also to the wider scientific community and to the major stake-holders and general public. The scientific/technical content of the Action will be responsibility of the Management Committee, in their role of organising Working Group meetings, workshops, and scientific conferences. The idea behind the conferences will be the congregation of academic and industrial researchers from all disciplines related to this Action and to discuss the progress achieved to date and will be an important part of the dissemination plan, as well as providing a focus for discussions and learning through communication on the personal level between all the researchers (not only between peers, but more especially between young researchers and established experts) coming from different communities, thereby enhancing the creativity and problem-solving ability of the participants. This intellectual collaboration is expected to result in new developments key to furthering the objectives of the Action. All Action publications will be internationally recognised (through the use of ISBN/ISSN numbers), as well as being available electronically via the Action website.

In addition to the organisation of regular meetings, more traditional methods of dissemination such as publishing in peer-reviewed journals and international conferences will be promoted by Action participants. Wherever possible, the Action will actively support the publication of papers co-authored by various research groups internally (i.e. at Action conferences / workshops) and externally (via journals and international conferences). Participants will be encouraged to publish results of work resulting from collaborative exchanges and Short Term Scientific Missions. It is hoped that scientific publications will be linked to activities of the Action through the publication of themed issues, which will help promote the Action and the innovative work of participants therein. All publications linked to the Action will be required to acknowledge COST for its support.

Electronic dissemination will be key to reaching the wider audience. In order to fully exploit this, a dedicated, regularly updated website will be created and populated. Key activities in the Action are highlighted in bold. Information to be included on the website will mainly be based around the planned meetings and activities of the WG and MC, but will also include:

- General information on the Action's programme and objectives,
- Brochures, posters and leaflets advertising the scope of the Action and its targets within the Built Environment,
• Basic information on participating groups (contact person, available equipment, scientific focus and expertise, current and optionally completed research projects) with a link to the group’s website,

• Information and forms to be used for Short Term Scientific Mission applications,

• Information for scientists willing to join the Action,

• Updated timetables of the Action activities (planned conferences and meetings, Training Schools, etc.).

Other items to be housed in the Action website could be restricted in the first instance by password control, though this would need to be decided upon by the Management Committee/Steering Committee. These items could include:

• Information on recent scientific and technical achievements and related links,

• New assessment tools for predicting the performance of bio-based building materials,

• Reports linking the disciplines within the Action, in effect creating a State of the Art,

• An electronic archive of important documents, including new articles by participants,

• Summary reports from other conferences / Actions,

• Full technical presentations given at meetings/workshops,

• full contact details of participants, plus technical capabilities,
• **Recommendations for new test methods and standards,**

• **Information on the correct use of bio-based materials in buildings.**

However, wherever possible, members of the Action will provide permission for items to be placed on the open section of the site. The website will also include key links to COST, the Forest-based Sector Technology Platform (FTP), as well as participant websites.

The Action will also make use of Social networking sites, such as Facebook, Twitter, LinkedIn etc to further promote the activities and outcomes throughout the 4 year programme, and hopefully beyond. Given the levels of interest in the content of this Action, there should be a continued legacy arising from this Action.

**H.3 How?**

The outputs from the Action will be promoted by participating groups through active links on their websites, drawing attention to the Action in newsletters, reports etc. The website will feature extensive information concerning the Action, including its research agenda, activities, reports, and publications. Up-to-date information will be made available about meetings, conferences, Training Schools, and past and upcoming events, not only within the COST Action but in related subjects.

Particular care will be made by the Website Manager to ensure the accuracy and availability of the most current information on the website. Furthermore, once the Action is completed, the website will remain open and the information available.

The scientific conferences will be of great importance to reach a broad audience and to increase the external visibility and publicity of the Action. The Management Committee will finalize the details regarding the activities and publications of the Action, and a Dissemination Group will be nominated in the early phase of the initiative and held responsible for the development and maintenance of all methods of dissemination. Where possible the Action will link with an international conference on a topic within the Action, to further widen awareness of the activities and outcomes reached.

The creation of an electronic archive of information and recommendations for improving assessment methodologies and tools will help increase the publication rate around the topics within the Action, as well as encouraging input from related areas. The preparation of a suite of information guidelines on how to make optimum use of bio-based materials in buildings will help define the success of this sector over the coming years, and will form a fitting legacy to the Action.