Wildland-Urban Interface Virtual Essays Workbench

WUIVIEW

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Abstract	This document details the market analysis and the business models performed by the established brand WUIVIEW Lab for a sustainable commercial activity as consultant on fire risk assessment services based on the WUIVIEW project outcome. A preliminary version of the associated exploitation agreement is also provided.

(1) *Draft / Final*

(2) *Public / Restricted / Internal*

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1. About this deliverable

WUIVIEW stands for Wildland-Urban Interface Virtual Essays Workbench, and it is a project funded by the Directorate General for European Civil Protection and Humanitarian Aid Operations (DG ECHO) and coordinated by the Universitat Politècnica de Catalunya (Spain). The project objective is to develop a 'virtual laboratory' based on Performance Based Design (PBD) and Computational Fluid Dynamics (CFD) models for the analysis and assessment of the processes and factors driving structure affectation in forest fires. The results will serve as guidelines and recommendations of good practices for the protection and prevention of forest fires in European communities inserted in forested lands.

The project is divided into 8 work packages, out of which work package 8 is devote to dissemination and exploitation, including a business case description. The brand "WUIVIEW Lab" will be leading into a sustainable commercial activity providing assessment services and transfer of technology activities based on WUIVIEW project outcome. According to the market analysis, we detail the services foreseen during the exploitation phase together with a preliminary estimation of costs. Among our services, we highlight consultancy services on communities' vulnerabilities and consultancy services on structure's vulnerability to fire impact. Other services (either included into those or complementary to those) are: services of photogrammetric survey and point cloud data extraction, services on fuels hazard assessment, evaluation of fire protection strategies, training and education. The deliverable includes, as annex, the template for an exploitation agreement among all WUIVIEW partners.

2. Introduction

Extreme wildfires and megafires are a growing problem across the world. Over the past few years, unprecedented wildfires have raged with intensity and across geographical regions never seen before, killing people, destroying housing areas, severely affecting economic activity and impacting ecosystems.

In Europe, extreme fire behaviour was observed in Portugal 2017 fire season, with a dead toll of 66 in Pedrógao Grande blaze, in 2018 in Greece killing 102 in Mati fire and in regions hardly seen before, such as 2014 Vastmanland fire in Sweden. In all these events the population is experiencing extraordinarily challenging threats to their lives, their properties and their businesses, and barely understands the factors, processes and consequences involved for proper contextual risk awareness. Responders are overwhelmed by the size, intensity and evolution of fire fronts, facing highly demanding emergency operations, sometimes involving the evacuation of thousands and managing the reality of multiple casualties and severely injured people, with poor access to communication and information services, particularly in rural areas.

The abandonment or substantial reduction of activity in rural areas, the poor or inadequate forest management and the exclusion of fire as a component of the landscape, have led to an over-accumulation of forest fuel load and large extensions of continuous fuel coverage. This also responds and relates to the change observed in social structure over the populated landscapes across Europe, such as the depopulation of rural areas and the evolution towards landscape-detached society and overpopulated cities, and the expansion of urban sprawl in the outskirts towards forested lands creates communities sitting in the wildland-urban interface (WUI) with poor perception of wildfire risk and inadequate behaviour prior, during and after wildfire events. Together, and associated to WUI areas, the wildland-industrial interfaces (WII) are also at risk and pose a potential NaTech threat to population and the escalation of risk due to multi-danger cascade effects. Finally, European critical infrastructure (ECI) is also potentially exposed to such events with the consequences of disruption of activities and essential services.

The extreme weather, the increase of fuel load and continuity and the severe dryness of vegetation lead to multiple fast-growing and highly intense fire outbreaks, quickly displaying extreme fire behaviour and frequently evolving into fire complexes and megafires. These events commonly develop complex atmosphere-fire interactions and strong convection currents creating their own fire spread conditions, with high flame lengths, fast propagation of fire fronts, projection of flying firebrands and emission of vast amounts of smoke. Besides, commonly fire fronts spread at maximum intensity in the vicinity and inside of developed populated and industrial areas, due to the inexistence of firebreaks, transition zones or fuel treatments around or within communities. This leads to the exposure of structures, facilities and population to the thermal radiation, the flame impignemet, the dense smoke and the flying firebrands. Population exposed to these danger factors is eventually trapped in chaotic, last-minute self evacuation processes or in their attempt to shelter in their homes and communities unprepared for the pass of fire and smoke and for the proper management of the emergency.

While society is currently expecting an effective response of fire fighters and rescue services in these type of events, reality is showing that current and future challenges will require new approaches, involving integral management of forest fire-prone populated landscapes, self-protection of communities and individuals, and preventive measures to minimize consequences over critical infrastructure and industrial areas.

According to the European Commission report on how to manage megafires, one of the main challenges the European society is facing in the future is promoting resilient landscapes and communities, integrated fire management, in particular improving safety of people and housing, economic growth and ecosystem services.

3. Market analysis

3.1. Description of target market

Following, a brief reference to the identified sectors of activity which could benefit of the WUIVIEW services is presented. These should serve as baseline for the definition of the market in the business case presented.

Developed areas and the Wildland-Urban Interface

Europe's level of urbanisation is expected to increase to approximately 83.7% in 2050. Trends in the total population of EU27 and UK from 1961 to 2018 show a decline in the share of population living in rural areas over the total population, while towns and cities experienced a smooth and constant increase. The migration of population to cities is one of the factors driving agricultural land abandonment, which is expected to reach 4.2 million ha net over the period 2015-2030, bringing the total abandoned land to 5.6 million ha by 2030, the equivalent of 3% of total agricultural land. By 2030, built-up areas are expected to expand across most of the EU. They are likely to expand by more than 3% between 2015 and 2030, reaching 7% of the EU territory by 2030.

The presence of WUI areas is a common phenomenon in European countries. Their presence is observed in Central Europe and in most important peri-urban areas confirming trends towards more urban land uses in rural regions and shrub encroachment into the peri-urban environment. The increase in European forest areas and the intensive use of agricultural areas also leads to a growth of Wildland Urban Interfaces and therefore also Wildland Industrial Interfaces. Modugno et al. (2016) analysed wildland urban interface regions in Europe and showed that in some areas between 30 and 50% of the surface region can be defined as WUI area (Figure 1).

Large burned surfaces tend to occur more frequently in proximity to WUI areas in many European countries, including Albania, Bulgaria, Cyprus, France, Italy and Spain(ROC>0.5). Their probability of occurrence tends to be highest in a buffer zone of up to 5 km around the nearest WUI. Besides, an influence of the presence of WUI areas on the frequency of large burned surfaces is observed in the Mediterranean countries.

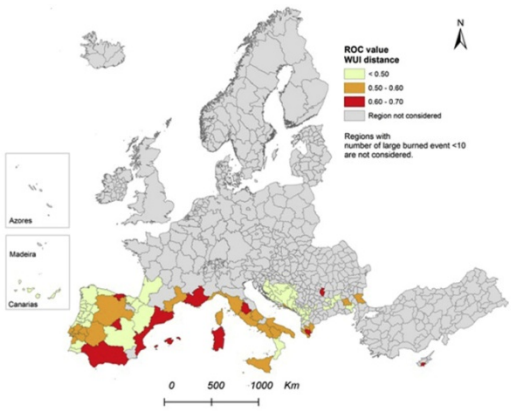

Figure 1. Large burned surface probability (ROC) considering the WUI distance. Source Modungo et al, 2016.

Industrial Interface zones

Wildfires can trigger disasters or cascading events around critical infrastructure, industrial complexes or hazardous sites with major accident potential via thermal radiation (heat), ember flight or direct flame impingement to industrial infrastructure or process equipment (NaTech events). When wildfires intersect with hazardous industry in Wildland Industrial Interfaces (WII), they can potentially trigger toxic spills, fires or explosions. Remote areas surrounded by vegetation are more endangered by wildfires than industrial sites in more urbanized areas, due to Wildland industrial Interfaces mostly occur associated to WUI areas. The constant need for risk reduction in populated areas drives production facilities and hazardous industrial operations towards rural areas with lower population density and more vegetation. Keeping in mind future wildfire scenarios, this might lead to an increase of Natech risks. Currently, there is no integrated European fire management system that would meet the requirements for the prevention of wildfire triggered industrial accidents.

Natechs triggered by wildfires can lead to a variety of events, depending on the infrastructure or installation they intersect with. Fires in complex industrial environments pose severe risks inside and around these facilities. From an industry perspective, wildfires can have two main types of effects: direct and indirect effects. Both can lead to critical situations in a chain of events. Direct effects of wildfires can be smoke, flames, thermal radiation and spot fire ignition by firebrands. Most process installations are designed to withstand a certain level of thermal radiation to prevent rapid escalation or domino effects during fire events. Wildfires pose a specific threat in terms of thermal radiation due to their nature of forming large and intense fire fronts.

In the last decade (2008 – 2018) the number of major accidents and near misses was significantly higher in the oil and gas sector as well as in chemical production compared to other industry sectors About one third of all chemical companies in Europe are situated in south and southeast Europe as well as around 50-60% of Europe's refinery capacities (European Commission, 2010). This brings together emerging wildfire danger and large numbers of facilities susceptible to such events (Figure 2).

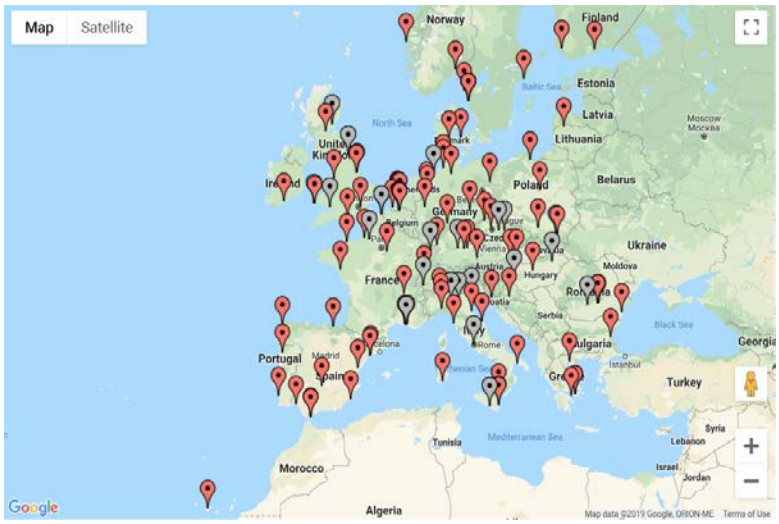

Figure 2. Location of refineries in Europe. Source: JRC.

In Europe, particularly in the Southern regions, wildfires threatening touristic installations and hotels are a growing concern for this sector. Such developments are considered separately as

target in the WUIVIEW business model. In Europe, around 205 thousand hotels provide services to tourism and businesses. A significant percentage of such installations are sitting in fire-prone areas, such as in the Mediterranean coastline and in the rural interior. Several wildfires over the past years entailed evacuations of hotels and touristic installations (Portugal, 2017, 2018; Greece 2018).

Critical infrastructure

The power grid, the transport network and information and communication systems are among the so-called European Critical Infrastructures (ECI), which are essential to maintain vital societal functions, potentially exposed to damage or destruction by natural disasters. The European Programme for Critical Infrastructure Protection (EPCIP) is a package of measures aimed at improving the protection of critical infrastructure in Europe, across all EU States and in all relevant sectors of economic activity. The considered infrastructures potentially affected by wildfires are:

Energy

- Electricity. Infrastructures and facilities for generation and transmission of electricity in respect of supply electricity
- Oil. Oil production, refining, treatment, storage and transmission by pipelines
- Gas. Gas production, refining, treatment, storage and transmission by pipelines LNG terminals

Transport

- Road transport, roads, highways
- Rail transport, railorads
- Air transport, airports and ground support facilities

The European Programme for Critical Infrastructure Protection (EPCIP) is aiming at critical infrastructure located in Member States, which destruction or disruption would have a significant impact on at least two Member States. At present, 89 ECIs are designated in total.

It is presently understood that climate related hazards have the potential to substantially affect the lifespan, serviceability, or even devastate other critical infrastructures (CI), such as the energy, transportation, telecommunications, buildings, health, and water management facilities. CI, and especially electricity networks and roads, are highly vulnerable to climatological threats and especially forest fires. Modern CI are complex entities with many interactions and interdependencies, between and across the various CI systems, which manifest themselves in many ways, including operational, economic, physical, cyber, geographical, and legal.

If a transportation CI asset is affected by fire, its operation usually stops (road closure), whereas assets affected by smoke are occasionally not disturbed or their functionality can be maintained until a certain smoke density is reached. Wildfires have important consequences for the power sector. They can directly damage transmission towers and other electricity infrastructure. However, the greatest risk comes from smoke and particulate matter. Smoke and ash from fires can ionize the air, creating an electrical path away from transmission lines. Some of the identified threats and effects on such installations are:

- Distribution lines Extra-High Voltage (EHV)
- Transmission lines: Fires in and around distribution lines can burn down the lines and damage distribution towers: Structural threshold: Temperature = 500–600 ◦C. Functional threshold: Temperature = 420 ◦C (melting point of zinc)
- Distribution substations
- Transformers
- Electrical grid operation: Fires can create a "flashover" from electricity infrastructure as the greatest risk comes from smoke and particulate matter which can ionize the air, creating an electrical path away from the lines
- Step up down substations: possibility of a physical damage occurrence to substation facilities
- Wooden pylons: Wooden pylons are exposed to fire front leading to their destruction

Insurance companies

In recent years, extreme fire behaviour and megafires have exposed insurers and electrical utilities to risks and underlined their particular vulnerability to such events. Wildfire can damage assets, interrupt business operations and disrupt supply chains. Promoting the uptake of market-based insurance amongst communities settling in fire-prone areas will be paramount, to help homeowners to transfer risk and to reward them through lower premiums for taking action on their properties to reduce risk. In turn, insurance companies should discourage them through higher premiums from building homes in risky areas. Thus, insurance companies require to count on detailed risk assessments over large communities and isolated pricey properties potentially exposed to wildfires. The increase in urban development in contact or intermingled with wildlands is presenting a growing challenge to insurance companies, particularly with the evolution of climate and societal change. The insurance industry could play a key role in reducing the risk of losses through direct engagement with legislators, communities and individuals. Some of the European insurance companies operating on the WUI areas exposed to wildfires are Allianz (Germany), Axa (France), Zurich (Switzerland), Talanx (Germany), Generali (Italy), Mapfre (Spain), Prudential (UK) and Crédit Agricole Assurance (France). There are other smaller companies at national and local level which must be considered as well, particularly for the risk assessment of certain installations and infrastructures.

3.2. Competence

WUIVIEW service is rather unique in its own. As of today, PBD risk assessment is applied to buildings and installations in the fire engineering domain, but little has been transferred to the forest fire case. Competence for WUIVIEW services, however, is identified in the partial set of services offered by consultancy companies and experts on fire risk assessment, the research departments of universities and technological institutes, other research projects on related matters and some technical departments of certain administrations. At current time, much of the identified competence is, instead, potential collaborations for the improvement of critical mass on consultancy services in such an emerging solution, such as WUIVIEW. Conversely, these identified entities may also constitute a list of potential customers, at least in the incipient period of the business development. Following, some examples of the identified competence are provided:

Wildfire risk assessment consultancy

Tecnosylva (https://tecnosylva.es/en)

Tecnosylva is a Spanish company providing advanced GIS-enabled software solutions for wildfire protection planning, operational response & firefighter and public safety. Also is offering expertise in Land Engineering and Geotechnologies consulting services. Tecnosylva is specialist in developing and implementing planning projects of a wide set of subjects such as, emergency management, wildfire risk, natural resources or urbanism. However, Tecnosylva is not providing specific services on risk assessment at the micro-scale of the WUI, nor fire protection engineering solutions.

Pyro Fire Extinction (http://www.pyro.es/)

Pyro is a novel Spanish company devoted to the transfer of technology and research outcome in the form of fire protection solutions to tackle the upcoming challenges in wildfires. They provide solutions and services on the following matters:

- Devices, materials and methods for fire protection and suppression
- Wildfire risk monitoring devices and early detection
- Improve firefighters safety and efficiency

Fire protection engineering and fire safety companies

Fire Safety Management (http://assurity consulting.co.uk)

Fire Safety Management is a company based in UK for the provision of consultancy services on fire risk management, assessment and training. The solutions they provide are:

- Fire safety management reviews
- Fire risk assessments
- Fire management documentation systems
- Fire Warden training (awareness, duties, evacuation, first aid and firefighting)
- Fire evacuation drill support

Other generic companies on risk assessment

Arup (https://www.arup.com/)

Arup is a large engineering company with a division focusing on fire protection engineering, aimed at all types of structures. They also provide fire safety training and perform research on different aspects of fire safety, particularly in regards to Informal Settlements.

Other EU-funded projects and initiatives

EU-Circle

A pan-European framework for strengthening Critical Infrastructure resilience to climate change (http://eu-circle.eu)

This project aims at providing assessment of the current risks of a specific climate hazard to a single CI or a CI network or even an area of interest with interconnected and interdependent CI. In particular:

- Examination of how climate change may alter risk in the future, or expose new risks.
- Identification of climate change adaptation or risk mitigation options and definition of priorities.

Heimdall

Heimdall is an EU-funded project aimed at improving preparedness of societies to cope with complex crisis situations by providing a flexible platform for multi-hazard emergency planning and management,

FirEfficient (http://firefficient.ctfc.cat/)

FirEfficient is a EU-funded project on the subject of risk management and adaptation of population, based upon the lessons learned. In particular,

- Capitalization of knowledge of innovative tools for a cost-effective wildfire risk management in the context of climate change.
- EU context adaptation of operational transfer tools for prior fire assessment and actor participatory processes.
- Development of a knowledge base and "lessons-learned" platform of innovative tools and means for wildfire hazard assessment.

3.3. SWOT analysis

Strengths

Here are some points that WUIVIEW Consortium considers it performs particularly well and that distinguishes from the potential competitors, advantages and values that drive the proposed business:

- Strong experience on the required subjects
- Scientifically-based design of procedures and methods
- Unique capacities for PBD computation
- Well-developed testing study cases
- International outreach
- Networking over the scientific community and technological institutes

Weaknesses

Following, some aspects on what WUIVIEW Consortium could improve, and the sorts of practices to be avoided:

- There is no commercial spinoff or company in the Consortium onto which build the activity.
- Most of the entities in the Consortium are universities or research entities

- Some of the entities in the WUIVIEW Consortium are NGOs
- Response time for future clients is heterogeneous from the different partners
- No established quality control chain and procedures across the Consortium
- Non-patented or registered methods
- Not structured commercial marketing taskforce for a proper market penetration

Opportunities

- There is an increasing need of fire risk assessment for critical infrastructure and homes across Europe
- Most of the communities and critical infrastructure in Europe do not have a wildfire risk assessment report.
- There is a change in policies in favour of demanding prevention plans and risk mitigation, aimed at local scales (municipalities) and owners.
- There are new funding opportunities aimed at integral fire risk management in Europe, new and innovative approaches and tools.
- Fire protection industry is opening a new business horizon in the WUI, using experience, solutions and approaches developed over the years in other domains (i.e. industrial installations, structural protection etc.)

Threats

Following, some of the points that can negatively affect the WUIVIEW business development from the outside, for the anticipation of such threats to take action against them:

- The expertise is not transferred across team members in partners' organisations
- Change in licensing policy of the supporting software for commercial exploitation
- The required computing facilities stop being available for commercial exploitation
- Lowering of prices of the associated services, particularly photogrammetry and 3D-modelling
- Some of the large risk assessment companies with which WUIVIEW Consortium will eventually collaborate take over the idea, methods and tools and strongly develop their own business line.

3.4. Market penetration

Market penetration of the WUIVIEW services will be progressive over the upcoming years and depending much upon the factors mentioned below (Figure 3):

For the WUI areas. These will be the core target for WUIVIEW Lab business model. The penetration depends much upon the improvement of risk awareness by homeowners, the local implementation of prevention policies and the establishment and enforcement of national and regional regulations on prevention and protection plans of communities and installations. Besides, this will be closely related and influenced by the response of insurance companies and the new events of forest fires affecting developed areas. It is realistic to expect a linear progression of market penetration, starting with promotional activities in the first year, a target percentage of 5% the second year, 10% the third year, 15% the fourth year and a final target penetration of 25% of communities in fire-prone areas of the participating countries.

For the Industrial areas. Given that WUI areas and industrial installations are closely related, the penetration will follow similar driving factors and linear tendency, starting at year three after the consolidation of first projects over WUI areas and promotional activities over the second year, with a target penetration of 5%, following10% for the fourth year and a final 20% for the fifth year.

For the Critical Infrastructure. In this case, the number of critical infrastructures potentially affected by wildfires is less significant, but the risk assessment project size is much larger. In this sense, a realistic but ambitious penetration rate will be closely related to the successful cases and the potential events affecting such installations, which are rare. This is why, after promotional activity in the first year, a modest penetration of 1% is envisage for the second year, 3% in the third, 5% in the fourth and finally a 10% in the fifth.

For the touristic installations and hotels. Hotels in fire-prone areas and touristic installations will be another of the main targets for WUIVIEW Lab business case. Nevertheless, it is expected to start the activity once the methods, tools and results are consolidated in the previous years. For that reason, the penetration is expected to follow a similar rate as in other cases, with 5% in the fifth year and continuing with 5% per year afterwards.

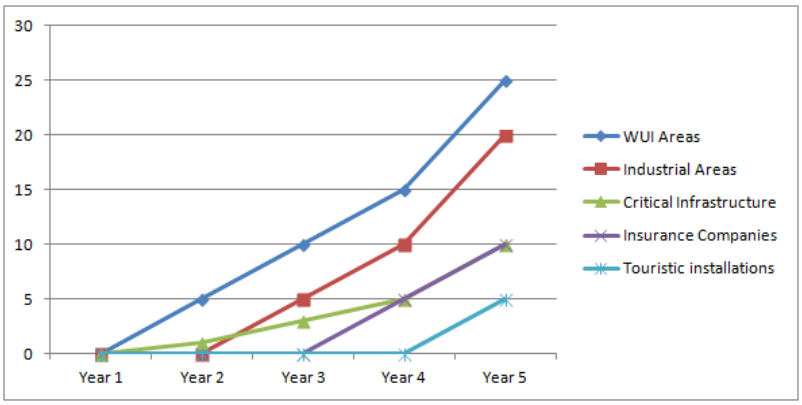

Figure 3. Expected market penetration of WUIVIEW Lab services

4. Description of risk assessment exploitation models

4.1. Consultancy service on communities' vulnerability

This service consists on a community survey through visual assessment of properties by using VAT and SAT check-lists (see deliverable 7.2 to find the last version of these). Target clients are municipalities and associations of property owners.

The service has two phases, the first one devoted to training and briefing of the community, which has to be developed together with municipalities and residents, and the second one devoted to perform technical work, which will be developed by WUIVIEW surveyors in cooperation with home-owners. In the first phase, meetings with local authorities and representatives of communities will be held in which the aim, methods and outcomes of the survey will be explained. Material for educational purposes (see deliverable D8.4) will be distributed and surveys will be agreed and scheduled. The technical phase comprises, in turn, two main tasks: i) field work and ii) data analysis. Field work is performed by WUIVIEW local surveyors who have to assess all properties of a community. A surveyor, in cooperation with a homeowner, assesses structure vulnerability and sheltering capacity of a property according to VAT and SAT protocols. VAT and SAT tools are implemented in an easy-to-use google form questionnaire which, in addition, allows coordinates, photos and comments related to the property to be uploaded.

Final data gathering and analysis of scores is reported together with vulnerability mapping and statistics of the most common vulnerabilities observed in the community. Recommendations for improvement are included as concluding remarks.

4.2. Consultancy service on structures' vulnerability to fire impact

This service consists on an in-depth PBD analysis applied at property level (see Deliverable 7.2 to find pilot examples). Target clients are property owners (private or public owners) and fire engineering or architecture companies that may need to externalize fire safety analyses.

The service workflow has three main phases: i) the data collection phase in which rough data needed to construct a CFD model is gathered and processed, ii) simulation phase in which a FDS scenario is built and run and iii) analysis and reporting phase in which simulation results are analysed and discussed and main conclusions are reported.

4.2.1 Data gathering

In order to construct a FDS model, the entirety of the property (main structure, secondary structure, residential fuel and environment) has to be represented in a 3D scenario. WUIVIEW has developed 3D reconstruction techniques based on airborne photogrammetry and subsequent 3D modelling to obtain 3D data to feed FDS (see Deliverable D5.2). In parallel to these tasks, field work has to be devoted to gather physical characteristics of building systems and surrounding fuels. Furthermore, details on fire weather are also needed. Details on these jobs are as follows:

3D Photogrammetry and modelling

3D photogrammetry include several key steps to obtain an initial 3D model: design of flight patterns, geo-referencing and photo-processing. Following, the 3D model is converted into FDS compatible data through a process of voxelization, properties assignment and cleaning.

Residential fuels and environment assessment

All residential ornamental fuels present in a property have to tallied and characterized in terms of location within the lot, species, geometry, fuel particle distribution and density. Presence of non-natural fuels (e.g. wood piles, hydrocarbons, piled synthetic material, outdoor furniture, etc.) have also to be surveyed. In this case, location and distribution, types of materials and geometry have to be numbered. Wild fuels close to the WUI community have to be recognized in terms of standard fuels (Scott and Burgan, 2005). Meteorological data (temperature, relative humidity, wind rose) of the site has to be obtained (last 10 years). Those are key data for subsequent fire scenario definition.

Materials assessment

Building materials have to be tallied with particular attention to combustible systems that may be part of the structure envelope. Also, glazing systems are of particular importance being the type of glass together with its depth the key variables to assess.

4.2.2 Simulation

The PBD framework has to be initially defined in terms of goals, objectives, performance criteria and design fire scenarios together with stakeholders involved (homeowners, local firefighters or anyone that has interest in the protection of the property). Types and number of scenarios/simulations will be outlined with stakeholders (see deliverable D 7.1 for further details on PBD methodology).

Following, all data gathered has to be organized and implemented into subsequent FDS codes (complemented with Pyrosim when needed). Geometry, materials and computational domain have to be defined for each trial design. Fire source is prescribed according to the characteristics of the residential and wild fuels. Environmental variables are set, with special attention on boundary conditions regarding wind. Desired outputs (temperatures, species concentrations, velocities, mass and heat fluxes etc.) are specified in specific domain points, 2D slices oriented along the three Cartesian axes and on solid surfaces.

Once one trial design is built, this has to be evaluated to determine if a design meets all predefined performance criteria. The simulation has therefore to be run with supercomputing machines, due to the high computational cost that these type of scenarios usually entail.

4.2.3 Analysis and reporting

Results from different trial designs have to be gathered, analysed and discussed. A final report of the overall fire impact study is written highlighting main messages regarding vulnerabilities and actions to implement to mitigate fire risk.

4.3. Simplified version of consultancy service on communities' vulnerability

This service consists on a simplified version of the service described in past section 4.1. In this case, the community survey through visual assessment of properties by using VAT and SAT check-lists is conducted only by home-owners surveyed by representatives of the community who have received specific training. As such, the training phase gains importance (compared to service detailed in section 4.1) as it not only consists on briefing the community but educating local surveyors on how to assess structure's vulnerability and sheltering capacity with their neighbours. Technical work is a cooperative effort between the community (who will be in charge of doing the survey) and WUIVIEW technicians who will be in charge of processing data and reporting.

4.4. Simplified version of consultancy service on structures' vulnerability to fire impact

This service consists on a simplified version of the service described in past section 4.2. In this case, the service does not involve the performance of a full PBD analysis, which usually entails the consideration of high frequency/low consequences scenario, low frequency/high consequences scenario and special problems like semi-confined spaces, presence on LPG tanks, etc., as described in deliverable D7.1. In this case, the analysis will be performed considering only one scenario, which will be the one involving conditions of high frequency/low consequences. Special problems will be analysed according to WUIVIEW available databases, without modelling (i.e. without considering all specificities of the property) and fire sources will also be prescribed according to WUIVIEW data repository of similar cases. In addition, the 3D model to be built for the scenario under consideration will be a simplified version of the structure obtained through direct measurement of dimensions and geometries.

5. Description of complementary assessment services

5.1. Experimental fire tests for new building systems fire impact assessment

This service consists on applying the experimental protocols developed within the framework of the WUIVIEW project (see deliverable 3.2) to perform ad-hoc tests for studying fire protection performance of new building systems (new materials, new configurations). Tests will involve the combustion of different types of residential fuels (natural or non-natural fuels), according to the client's need. Target clients are companies within the fire protection industry developing new products on which standard testing is still non-existent.

The service workflow has three main phases: i) experimental design: which comprises the design of the set of fire tests according to building systems specifications and variables under analysis (e.g. temperatures, heat fluxes, velocities, firebrand potential ignition, etc.); ii) execution of experimental tests in WUIVIEW partners facilities and iii) analysis and reporting phase in which experimental results are analysed and discussed and main conclusions on performance of the building systems are reported.

5.2. Evaluation of fire protection strategies

This service consists on an in-depth CFD analysis of the performance of suppression systems (e.g. water mist systems, water canyons, etc.) and other strategies devoted to harden structures to be implemented in properties like dwellings, commercial infrastructures, and industrial infrastructures (see deliverable 4.3 on current fire protection strategies). Target end-users are home-owners, private companies or public owners (municipalities) wishing to increase fire protection of assets located at the WUI by a particular fire protection strategy (previously defined by the owner).

The service workflow has three main phases: i) the data collection phase in which rough data needed to construct a CFD model is gathered and processed, ii) simulation phase in which a FDS scenario is built and run according to owner specifications and iii) analysis and reporting phase in which simulation results are analysed and discussed and main conclusions on performance of the fire protection systems are reported.

5.3. Risk assessment on LPG and hydrocarbon fuel installations

This service consists on an in-depth analysis on LPG tanks WUI fire vulnerability by means of CFD modelling. The analysis will be performed according to methods described in deliverable D3.1. Target clients are home-owners and business owners with small and medium sized LPG tanks and LPG distribution companies.

The service workflow has three main phases: i) the data collection phase in which rough data needed to construct a CFD model is gathered and processed, ii) simulation phase in which a FDS scenario coupled with ANSYS-FLUENT is built and run and iii) analysis and reporting phase in which simulation results are analysed and discussed and main conclusions are reported.

5.5.1 Data gathering

Data on LPG installation layout, tank characteristics (geometry, content, conditions, PRV and additional protections) and surrounding fuels and environment will be surveyed in the field. For details on residential fuels key variables see past section 4.2.1.

5.5.2 Simulation

Simulation effort will consist on coupling fire scenario FDS outputs to ANSYS FLUENT CFD model in which thermodynamic process inside the tank will be explored. Fire scenario will be represented accounting for the most probable scenario (as in service detailed in 4.4)

5.5.3 Analysis and reporting

Results from simulation will be gathered, analysed and discussed. A final report of the overall fire impact study is written highlighting main messages regarding vulnerabilities and actions to implement to mitigate fire risk.

5.4. Training and education

This service consists on developing training programs to WUI stakeholders. We establish two different programs: 1) training program on PBD WUI analysis offered to fire safety engineers and architects, and 2) education program on vulnerabilities and risk prevention offered to communities and local authorities. Target funders/clients could be fire engineering companies and associations of fire practitioners for the first program and municipalities for the second program.

The training program on PBD analysis consists on an online course (30h) UPC-certified on the use of PBD methodology for the analysis of WUI vulnerabilities. The course is structured into the following blocks: 1) Introduction on fire modelling: key concepts, hardware and software requirements; 2) Performance Based Design foundations; 3) Introduction to FDS simulation: coding, meshing, geometry, fire sources, boundary conditions, outputs. 4) Introduction to PYROSIM simulation: modelling, importing and exporting geometry, post-processing. 5) Case studies.

The training program on vulnerabilities and risk prevention consists on an face-to-face tailored course (15 h) on the main vulnerabilities and risk prevention measures to be adopted at the WUI microscale, with particular attention of the main vulnerabilities of the target community. The course is structured into the following blocks: 1) Wildfires and wildfuels in the vicinity of a community; 2) residential fuels: hazards associated to natural and non-natural fuels; 3) Vulnerabilities in building systems; 4) Vulnerability and sheltering capacity self-assessment tools; 5) Case studies (field trip) and fire prevention and risk mitigation tips.

6. Analysis of assessment services costs

Services gathered in sections 4 and 5 entail several types of cost categories: direct personnel costs, depreciation costs of equipment, computational costs, materials, travel and subsistence costs associated to field work, indirect costs and taxes. Moreover, a profit margin will also have to be considered to guarantee sustainability. Most of these items have some degree of uncertainty at this stage. For instance, personnel costs vary with personnel categories and countries, computational costs vary with the MPIs used to run simulations, which, in turn, depend on the geometry of the scenario to be analysed, depreciation depends largely on the type of equipment being used, travel and subsistence depend on the location of the WUI community/property and on the size of it. Therefore, for the sake of simplicity, we have made the following assumptions to provide an estimate of services costs:

- Personnel costs are considered with an average daily rate of 400 €/day.
- Computational costs for PBD simulations have an average daily rate of 75 €/day (24 non-stop run).
- Travel and subsistence include meals and local transport to visit communities for meetings, surveys or data gathering. A flat daily rate of 100 €/person is considered.
- A general overhead item of 20% will be considered over the sum of personnel costs, computational costs and travel and subsistence. This item includes indirect costs, depreciation, profit margin and consumable materials when needed.
- VAT taxes will be considered to be a 21% of the overall sum of costs.

6.1. Consultancy service on communities' vulnerability

The costs related to this service are estimated for an average community of 100 properties (Table 1). Considering that one property can be assessed by one surveyor in 40 min, the total estimated time needed for 100 surveys is 67h, which in turn represents 9 days of actual field work (in which 0.2 days for travelling each day should also be included). Adding costs associated to training and analysis/reporting and considering all above-mentioned assumptions, the service costs is estimated to be around 11,000 €. Once the assignment of the service is confirmed, final report can be delivered approximately in 1 month (subject to home-owners accessibility).

Table 1. Cost details for a community (100 properties) vulnerability survey

Phase	Activity	Personnel costs (400 €/ day)	Travel and subsistence costs (100 €/person day)	Computational costs (75 € /day)	TOTAL (€)
Ph1	Training and briefing	1 day	1 day	n.a.	500
Ph2	Surveys	11.4 days	11 days	n.a.	5660
Ph2	Analysis and reporting	4 day	n.a.	n.a.	1600
				Subtotal 1	7760
				Overhead (20%)	1552
				Subtotal 2	9312

VAT tax(21%)	1955.52
TOTAL	**11267.52 €**

6.2. Consultancy service on structures' vulnerability to fire impact

The cost estimation of this service has been performed considering the following average figures:

- Dwelling 200 m^2 in a 1000 m^2 lot
- 4 trial designs / simulations defined with stakeholders agreement with a simulation time of 100 s.
- Computational domains involving 8,000,000 cells each run with ~ 40 MPIs, which represent an average computational time of 1.5 days.

The overall service costs is estimated to be around 10.000 € (Table 2). Once the assignment of the service is confirmed, final report can be delivered approximately in 1 month (subject to home-owner accessibility).

Table 2. Cost details for a consultancy service on structures' vulnerability to fire impact

Phase	Activity	Personnel costs (400 €/ day)	Travel and subsistence costs (100 €/person day)	Computational costs (75 € /day)	TOTAL (€)
Ph1	3D Photogrammetry	0.5 day	1 day	n.a.	300
	3D modelling	2 day	n.a.	n.a.	800
	Residential fuels and environment assessment	0.3 day	0.5 day	n.a.	170
	Materials assessment	0.2 day	0.5 day	n.a.	130
Ph2	Simulation	8 day	n.a	6 day	3650
Ph3	Analysis and reporting	4 day	n.a		1600
				Subtotal 1	6650
				Overhead (20%)	1330
				Subtotal 2	7980
				VAT tax(21%)	1675.80
				TOTAL	**9655.80 €**

6.3. Simplified version of consultancy service on communities' vulnerability

The costs related to this service are estimated for an average community of 100 properties (Table 3). Compared to the costs of the full consultancy service on communities' vulnerability (section 6.1), this service results much cheaper in terms of surveys as they are entirely

performed by the community who has been previously briefed. Analysis and reporting remains the same as in the previous case. As for the time for delivery, it depends entirely on the community and how they get organized to perform surveys. Overall cost is roughly half of the price of the full service.

Table 3. Cost details for a community (100 properties) vulnerability survey (simplified version)

Phase	Activity	Personnel costs (400 €/ day)	Travel and subsistence costs (100 €/person day)	Computational costs (75 € /day)	TOTAL (€)
Ph1	Training and briefing	2 persons, 2 days	2 persons, 2 days	n.a.	2000
Ph2	Surveys	n.a.	n.a.	n.a.	0
Ph2	Analysis and reporting	4 day	n.a.	n.a.	1600
				Subtotal 1	3600
				Overhead (20%)	720
				Subtotal 2	4320
				VAT tax(21%)	907.2
				TOTAL	**52272.2 €**

6.4. Simplified version of consultancy service on structures' vulnerability to fire impact

The cost estimation of this service has been performed considering the following average figures:

- Dwelling 200 m^2 in a 1000 m^2 lot
- 1 trial design with a simulation time of 100 s.
- Computational domains involving 8,000,000 cells with ~ 40 MPIs, which represent an average computational time of 1.5 days.

The overall service costs is estimated to be around 3000 €, roughly 1/3 of the cost of the full service (Table 4). Once the assignment of the service is confirmed, final report can be delivered approximately in 20 days (subject to home-owner accessibility).

Table 4. Cost details for a consultancy service on structures' vulnerability to fire impact (simplified version)

Phase	Activity	Personnel costs (400 €/ day)	Travel and subsistence costs (100 €/person day)	Computational costs (75 € /day)	TOTAL (€)
Ph1	3D Photogrammetry	n.a	n.a	n.a.	0
	3D modelling	1 day	n.a.	n.a.	400
	Residential fuels and environment assessment	0.3 day	0.5 day	n.a.	170

	Materials assessment	0.2 day	0.5 day	n.a.	130
Ph2	Simulation	2 day	n.a	1.5 day	912.5
Ph3	Analysis and reporting	1 day	n.a		400
				Subtotal 1	2012.50
				Overhead (20%)	402.5
				Subtotal 2	2415
				VAT tax(21%)	507.15
				TOTAL	**2922.15 €**

6.5. Experimental fire tests for new building systems fire impact assessment

The cost estimation of this service (described in section 5.1) has been performed considering the following average figures:

- Set of laboratory fire tests involving 3 different scenarios with 3 replicates each.
- Key variables under study: surface temperature and radiative heat flux received at the building surface.
- Material to be tested provided by the client.
- Residential fuels acting as burning elements and other consumables included in overhead.

The overall service costs is estimated to be around 3500 € (Table 5). Once the assignment of the service is confirmed, final report can be delivered approximately in 30 days (subject to materials accessibility).

Table 5. Cost details for experimental analysis of fire impact on new building systems

Phase	Activity	Personnel costs (400 €/ day)	Travel and subsistence costs (100 €/person day)	Computational costs (75 € /day)	TOTAL (€)
Ph1	Experimental design	1 day	n.a.	n.a.	400
	Laboratory set-up	0.5 day	n.a	n.a	200
Ph2	Experimental work	3 day	n.a	n.a.	1200
Ph3	Analysis and reporting	1,5 day	n.a	n.a	600
				Subtotal 1	2400
				Overhead (20%)	480
				Subtotal 2	2880
				VAT tax(21%)	604.80
				TOTAL	**3484.8 €**

6.6. Evaluation of fire protection strategies

The cost estimation of this service has been performed considering the following average figures:

- Property of 200 m^2 in a 1000 m^2 lot
- 2 trial design with a simulation time of 100 s each (with and without the fire protection strategy implemented)
- Computational domains involving 8,000,000 cells with ~ 40 MPIs, which represent an average computational time of 1.5 days.

The overall service costs is estimated to be around 4000 € (Table 6). Once the assignment of the service is confirmed, final report can be delivered approximately in 20 days (subject to owner accessibility).

Table 6. Cost details for the evaluation of fire protection strategies.

Phase	Activity	Personnel costs (400 €/ day)	Travel and subsistence costs (100 €/person day)	Computational costs (75 € /day)	TOTAL (€)
Ph1	3D modelling	1 day	n.a.	n.a.	400
	Residential fuels and environment assessment	0.3 day	0.5 day	n.a.	170
	Materials assessment	0.2 day	0.5 day	n.a.	130
Ph2	Simulation	3 day	n.a	3 day	1425
Ph3	Analysis and reporting	1,3 day	n.a		520
				Subtotal 1	2645
				Overhead (20%)	529
				Subtotal 2	3174
				VAT tax(21%)	666.54
				TOTAL	**3840.54€**

6.7. Risk assessment on LPG and hydrocarbon fuel installations

The cost estimation of this service has been performed considering the following average figures:

- 1 LPG tank of 1 m^3 (diameter = 1000 mm, length = 1470 mm, wall thickness = 6 mm, with semi-elliptical ends.
- Simulation time of 300 s.
- FDS computational domain involving 4,000,000 cells with ~ 40 MPIs, which represent an average computational time of 2 days.
- ANSYS FLUENT simulation run with 16 MPIs, which represent an average computational time of 6 days.

The overall service costs is estimated to be around 4000 €, (Table 7). Once the assignment of the service is confirmed, final report can be delivered approximately in 20 days (subject to owner/company accessibility).

Table 7. Cost details for risk assessment on LPG tanks

Phase	Activity	Personnel costs (400 €/ day)	Travel and subsistence costs (100 €/person day)	Computational costs (75 € /day)	TOTAL (€)
Ph1	Data gathering	0.3 day	1 day	n.a.	220
Ph2	Simulation	3 day	n.a	8 day	1800
Ph3	Analysis and reporting	1.5 day	n.a		600
				Subtotal 1	2620
				Overhead (20%)	524
				Subtotal 2	3144
				VAT tax(21%)	660.24
				TOTAL	**3804.24 €**

6.8. Training programs

The two training programs defined in section 5.5 have two main phases: Phase 1 or preparation phase and Phase 2 or implementation phase. Cost have been estimated for a total amount of 20 and 15 attendees in PBD and vulnerability courses, respectively (Table 8 and Table 9). In both cases, the course represent a cost of around 300-350 €/attendee.

Table 8. Cost details for a training course on PBD analysis at the WUI

Phase	Activity	Personnel costs (400 €/ day)	Travel and subsistence costs (100 €/person day)	Computational costs (75 € /day)	TOTAL (€)
Ph1	Materials preparation	3 day	n.a.	n.a.	1200
Ph1	Academic coordination	3 day	n.a.	n.a.	1200
Ph2	Lectures	4 day	n.a	4 day	1900
				Subtotal 1	4300
				Overhead (20%)	860
				Subtotal 2	5160
				VAT tax(21%)	1083.60
				TOTAL	**6243.6 €**

Table 9. Cost details for a training course on vulnerabilities and risk assessment

Phase	Activity	Personnel costs (400 €/ day)	Travel and subsistence costs (100 €/person day)	Computational costs (75 € /day)	TOTAL (€)
Ph1	Materials preparation	3 day	n.a.	n.a.	1200
Ph1	Academic coordination	3 day			1200
Ph2	Lectures	2 day	2 day	n.a.	1000
				Subtotal 1	3400
				Overhead (20%)	680
				Subtotal 2	4080
				VAT tax(21%)	856.8
				TOTAL	**4936.80 €**

7. Exploitation organisation, calendar and payment models

7.1. The WUIVIEW Lab. Organisation and responsibilities

The organisation of the WUIVIEW exploitation business is founded in the creation of a new entity, whether it is a real company or a virtual one (as presented in the Expoitation Agreement below).

This entity will have a commercial name, which tentative indication is “WUIVIEW Lab”. The company will be constituted by the participating partners of the Consortium and coordinated by a representative of the leading entity. Initially this coordinating entity will be the same as the one entitled in the original project (CERTEC/UPC).

Each of the constituting partners in the Consortium will have a technological role to solve each of the challenges and provide the services of their domain of expertise, in combination and coordination with the others and according to the work plan established for every project. This will respond, consequently, to the workflow presented in each of the service types offered and explained before.

- A WUIVIEW Exploitation Board (WEB) will be constituted, and will be in charge of marketing common actions, provide a consistent, unified approach to the explotation of results. This board will also take over the customer care and post-service attention.

- A WUIVIEW Management Board (WMB) will be constituted, and will be in charge of the proper running of the activity, the economic and quality control, the coordination of agreements, acting as referee in internal disputes and looking for the improvement and promotion of WUIVIEW Lab activity. The WMB will also estimate the required resources and promote a price for each future project.

- A WUIVIEW Development Board (WDB) will be constituted, and will be in charge of improving and extending the technical and scientific capabilities and excellence, participate in conferences and fora, contribute to the research actions and identify new pieces of technology, approaches and methods that could enrich and benefit the business.

Each of the boards presented will have a responsible which will be head an unique voice for the communication inside and outside the Consortium on the matters of their competence.

7.2. Payment models

In the exploitation of WUIVIEW results, three main payment models are envisaged:

Per project payment

A price is established for the full set of services, tools and data required for the full completion of a risk assessment project. An advance payment can be negotiated (up to 40% of the total price) and a guarantee quantity envisaged (usually 15% of the final price). Partial payments can

also be negotiated depending upon the complexity and length of the project, usually coinciding with major milestones in the workflow.

Per service payment

WUIVIEW Consortium is entitled to offer separate particular services of the workflow (i.e. photogrammetry, 3D modelling, material assessment, fuel assessment and modelling, preparation of PBD simulation, computing services, risk assessment, training etc.) and so charging independently for each of them. In general, established price includes overheads for and commercial margin for each service which, in sum, results in higher price than when contracted the whole package of services for a full assessment (as explained above). A table of prices will be established and agreed by the Consortium in the Exploitation Agreement, and will be reviewed yearly. Other particular or special non-listed services will be provided by demand, and a price will be discussed and agreed by the Consortium in each case.

Yearly fee

Alternatively, WUIVIEW Consortium may offer consultancy and modelling services to customers who require a continuous or periodic risk assessment on their structures and facilities, such as large developed areas or industrial installations. In such cases a yearly fee will be discussed and agreed based upon the planned activities required for the assessments. The final price will be calculated according the identified services required by the customer and applying a discount of 15% over the final figure. This payment model will ensure continuity in the activity and customer fidelity. Advance payments could be envisaged as well, particularly in the beginning of activities involving large infrastructures or spanning over extensive areas.

7.3. Tentative exploitation calendar

A five-year timeline is envisaged for the starting-up and running of the WUIVIEW Lab business model. In particular:

Year 1

- Constitution of the WUIVIEW Lab company
- Establishment of the headquarters, address.
- Nomination of the WUIVIEW Lab Director
- Registering of the WUIVIEW Lab brand
- Establishment of the final methods for risk assessment, protocols, guides
- Description of the full assessment services, the partial services, the side services
- Establishment of the first-year cost rates
- Marketing and promotional activity, focusing on private WUI areas
- Minimum expected loses 10 K€ (investment)

Year 2

- Review of cost rates and price policy
- Execution of the first batch of projects.

- Promotion of WUIVIEW Lab nation-wide in the participating countries
- Consolidation of the WUIVIEW Lab brand
- Collaboration with local entities
- Penetration of 5% of market in WUI lands
- Minimum expected gross income 10K€, recover investment

Year 3

- Review of cost rates and price policy
- Execution of the second batch of projects.
- At least one customer with yearly fee payment mode
- Promotion of WUIVIEW in critical infrastructures nation-wide
- Penetration of 10% of market in WUI lands
- Promote training activities to responders and civil protection
- Improvement of computing capacity in 30% (investment)
- Minimum expected gross income 30K€

Year 4

- Review of cost rates and price policy
- International promotion of WUIVIEW activities
- Collaboration with other firms and entities (technological, research)
- Improve and extend personnel, add other subjects of application
- Promotion of WUIVIEW for large insurance companies
- Penetration of 15% of market in WUI lands
- At least three customers with yearly fee payment mode
- Execution of the third batch of projects
- Minimum expected gross income 50K€

Year 5

- Review of cost rates and price policy
- Promotion of WUIVIEW for large touristic installations, hotels etc.
- Penetration of 25% of market in WUI lands
- At least five customers with yearly fee payment mode
- Execution of the fourth batch of projects.
- Minimum expected gross income 100K€

ANNEX: Model of Exploitation agreement

A.1. Introduction and definitions

This document refers to the terms of collaboration and exploitation of the WUIVIEW services beyond the project lifecycle by the constituent Consortium.

This exploitation agreement arises as a need for the common understanding and terms of collaboration of a multi-disciplinary activity for which the WUIVIEW Consortium has proven to be complementary, with the common aim to exploit the results and to use them in real cases of application, and acting under the framework of good will and common benefit.

The **Consortium** refers to the current set of partners that joined for the elaboration of the WUIVIEW project, under the auspices of the EC-ECHO Programme for Prevention and Preparedness. These are:

1. Universitat Politecnica de Catalunya (UPC)
2. Associacao para o Desenvolvimento da Aerodinamica Industrial (ADAI)
3. Pau Costa Foundation (PCF)
4. Association pour la recherche et le developpement des methods et processus industriels (ARMINES)
5. Università di Bologna (UNIBO)
6. Research Institutes of Sweden (RISE)

WUIVIEW services are aimed at the fire risk assessment of buildings (houses, infrastructures) through the use of Performance-Based Design simulations and the use of check lists, as described, developed and tested in the WUIVIEW project. Hence, the main final product of exploitation is fire risk assessment **reports** and recommendation **guidelines**. Some of the offered services are:

- Services of photogrammetric survey and point cloud data extraction
- Services of 3D modelling o building, vegetation and other components
- Natural fuels assessment
- Non-natural fuels assessment
- Fire behaviour and smoke production assessment
- Building methods and materials assessment (passive fire protection)
- Consultancy services on communities' vulnerabilities
- Consultancy services on structures' vulnerability to fire impact

Besides, a set of complementary services are identified:

- Laboratory testing of new building systems and materials
- Evaluation of fire protection strategies
- Risk analysis of LPG and hydrocarbon fuel installations
- Training and education

Exploitation refers to all modes of use of WUIVIEW project outcome which result in a commercial transaction with assigned revenue with public or private clients.

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- Non-natural fuels assessment
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- Risk analysis of LPG and hydrocarbon fuel installations
- Training and education

Exploitation refers to all modes of use of WUIVIEW project outcome which result in a commercial transaction with assigned revenue with public or private clients.

A.2. Organisation of the exploitation activity

The Consortium join forces to commonly or individually exploit the results of WUIVIEW project, in particular the knowledge, methods, tools and services for the risk assessment in case of forest fires of buildings and service infrastructure. Given that the Consortium is compound of universities, research entities and NGOs, no initial commercial structure is serving as baseline. In this sense, several options for the organisation of the exploitation are foreseen:

1) Creating a New Company

The first option to commercialise WUIVIEW services is to create a new company that owns all the rights of the tools and methods and is participated by all the Consortium partners. This company will focus on the promotion and exploitation of direct and associated services. This company, legally established, will have its own sales force and marketing staff, as well as the development team to assure the services evolution and support.

Advantages

- *Best customer services*
- *Best tool image*
- *High possibility to easily add new services in the future*
- *Best tool evolution*
- *Unique promotional and marketing effort*

Disadvantages

- *Great effort to start a new company (financial costs, organisational efforts, etc.)*
- *Requires a big amount of sales to be maintainable*
- *Loss of existing customers contacts*

2) Individual exploitation

The second option is let the Consortium entities to individually provide particular WUIVIEW services, using their own resources and only communicating the sales so to sharing out the incomes, according to what is stated in the agreement.

Advantages

- *Minimum organisational effort*
- *Low financial costs*
- *Customer portfolio*

Disadvantages

- *Bad tool image.*
- *Difficulties to easily add new services in the future*
- *Bad tool evolution*
- *Possibility to duplicate efforts*
- *Possibility to perform contradictory promotions*

3) Virtual company with service division

An intermediate solution consists on organising the Consortium sales efforts as an independent virtual company, that is, the company never exists, but the different partners act as departments of such virtual company, each one providing services of their competence and expertise.

Table 10. Services and competences of the WUIVIEW consortium

Service / partner	UPC	ADAI	PCF	ARMINES	UNIBO	RISE
Services of photogrammetric survey and point cloud data extraction		X	X			
Services of 3D modelling o building, vegetation and other components		X	X			
Natural fuels assessment		X				X
Non-natural fuels assessment				X		X
Fire behaviour and smoke production assessment		X				
Building methods and materials assessment (passive fire protection)				X	X	X
Consultancy services on communities' vulnerabilities	X	X	X			X
Consultancy services on structures' vulnerability to fire impact	X	X	X			X
Laboratory testing of new building systems and materials		X		X		X
Evaluation of fire protection strategies	X	X				X
Risk analysis of LPG and hydrocarbon fuel installation	X			X	X	
Training and education	X	X	X	X	X	X

All partners could sell WUIVIEW products and services through their consultancy activities, and will communicate with the partners in the same country to avoid competence, and cooperate in the provision of associated services and support activities, depending on the expertise of the partners.

These companies will establish their own commercial structure to be able to sell the product.

Advantages

- *Low to Medium cost on start-up*
- *Commercial costs assumed by seller companies, not consortium*
- *Possibility to easily add new services in the future.*
- *Good tool evolution*
- *Use of existing customer portfolio.*
- *Well management of WUIVIEW required competencies for services provision.*

Disadvantages

- *Difficulty with specific agreements for tool enhancements.*
- *Possible competence among partners.*

This option seems to be the most realistic given the consortium structure and partner types, the strong requirements for the creation of a new company, and the weaknesses of the individual exploitation in an area in which the cooperation of different competencies is required.

In order to diminish disadvantages, the virtual company will be managed as follows:

- Creation of a WUIVIEW **Exploitation Board** in charge of the co-ordination among partners. It will be responsible for establishing the general market policy as well as for the resolution of any problem that could arise among partners (competence, etc).
- Creation of a WUIVIEW **Development Board** in charge of the control and follow up of any development task.
- Creation of a **Pricing Policy** that defines price structure, discounts, royalties, etc.
- Definition of partners roles for the cooperation in the maintenance and support of a customer (after-sales support)

Pricing policy

A price for each consultancy service will be fixed according to the normal rates charged by each of the Consortium members in their regular activities. Margin of benefit will result of the sum of the normal percentages applied in each of the entities, and 0% for the NGO PCF. Revenues will also take into account such percentages. Overhead rates will be included according to the normal rates applied in each of the entities, resulting in a common overhead rate for the service. An extra percentage for the overhead costs resulting from the normal operation of the Consortium activity will be charged, and managed by the management board. Computing costs and use of laboratory installations will be included in hourly rates, using the same price as normally charged in their activities. Use of specific new hardware or purchase of specific equipment will not be included in the project, instead a depreciation rate will be charged.

Communication

In order to ensure the follow-up of the exploitation activities, the intention of the partners is to maintain contact, according to the following guidelines:

- The WUIVIEW Exploitation Board (EEB) will have meetings quarterly, in which the balance of the previous period should be drawn, and also plans and budgets for the new period should be agreed. At the end of each term (six-month period) the overall situation of WUIVIEW sales will be evaluated and revised.
- The Configuration Management Board (CMB) will meet every quarter in order to evaluate the suggestions received by the users and to decide future improvements. Each Partner should describe in detail the proposed developments they would like to work on, and all such developments should be evaluated and approved by all partners. Decisions in this matter will affect directly to the WUIVIEW Development Board. For each such development a corresponding effort (financial and other resources) should be agreed and communicated to EEB.
- A permanent contact will be maintained via telephone, e-mail and tele-presence meetings when required.

Decision Making

In order to take decisions in regards of the Consortium join activity, some issues are considered:

- Participation in decision is exactly proportional to royalties' participation.

- Decision will be taken according with simple majority procedure (the most voted option will be taken). Proportion in revenues is the proportion of vote value.
- Any disagreement among partners will be solved by a WUIVIEW Exploitation Board decision.

Marketing common actions

Marketing actions related with WUIVIEW promotion must be selected by WUIVIEW Exploitation Board and followed by all partners, in order to find the best way to reach the widest market, giving a common point of view of the services and having the same strategies, or adapted to respective markets but, under consortium agreements. WDB must give technical support to these actions focused in:

- A common Web address for the WUIVIEW services, collecting specifications, product image, solutions to known errors, FAQ's, etc.
- Unique WUIVIEW presentation body for the Consortium, with specific adaptation to each country partners.
- Co-ordinated participation on international events considered appropriates forums for WUIVIEW promotion, such as international meetings, conferences, exhibitions, scientific publications, etc.

Procedures for Control of Changes

Changes to the agreement will be performed according to the following procedure:

- Each partner interested in changing any of the terms signed in the agreement will be notified to the WUIVIEW Exploitation Board.
- The WUIVIEW Exploitation Board will evaluate the consequences of adopting the modifications proposed by the partner.
- If an agreement is reached by the Management Board in regards to adopting the changes proposed, the agreement will be amended by annex, after every partner signs a formal document based on the text describing the change.

WUIVIEW Development Board

Once the WUIVIEW project has finished, further development and support matters will be inherited by WUIVIEW Development Board (WDB) in the context of new services provided to the final users. The WDB will improve and extend WUIVIEW management, focused in user service attention, and WUIVIEW co-ordination between partners.

The two aspects of WDB are closely related, not only considering that those directions assumed by WDB will involve user supporting, but that user supporting will generate requirements which WDB will decide to translate to WUIVIEW product.

According with these two sides of the WDB, different supporting resources must be provided. In order to take decisions about new functionalities to be added, or dates of new upgrades, etc. (all of them related with technical matters of WUIVIEW), a committee will be formed by taking one representative person from any partner. This committee will advise management board

whenever a decision would involve some reasonable implication on WUIVIEW services and associated tools, in order to obtain strategic directions to deal new versions, new markets, etc.

On the other side, WDB will give end-user support. This support will be related with warranty period service, after-sales services, etc. All of them are closely related to establish and maintain direct relations with current and future clients.

The matters considered in next paragraphs, will involve different aspects of WDB, and some of them, will connect the end user support, with the highest decision making level of the WDB, which are explained next.

Attached conditions to the establishment of the WDB

First, compulsory conditions are assumed in order to define WDB attributions:

- Consolidated and operational WUIVIEW service workflow to be commercialised.
- Available technical documents.
- Commercial agreement between WUIVIEW partners.
- Principle of warranty is that any fault discovered in a limited period will be rectified free of charge by the supplier. The warranty is not free of charge i.e. the warranty costs must be included in the sale prices, and will be derived to the partners responsible of the services.

Organisation of the WDB for Service Management

A unique contact point is necessary for the second line support once a complex or significant problem has been identified.

The contact point analyses WUIVIEW incidents and indicates solutions if the related problem is well known.

If the problem requires a deeper investigation, the contact point will examine the situation in order:

- To identify the nature of the problem: technical, functional, organisational,
- To estimate the necessary effort in terms of resources (time and equipment)
- To contact the concerned WUIVIEW partner for resolution of the identified problem.
- Should be accepted by all the signed partners.

Roles

Three role levels will be considered:

- Managing partner and Contact Point, the partner obtaining the contract, in behalf of the Consortium
- Technical/Development partners: All partners giving technical support to the contracting partner for the development of new tools and applications in the project
- Consulting partners: All partners giving other technical and scientific support to the contracting partner for the development of the project.

Meetings

Virtual meetings using teleconference applications, telephone etc. will be used to co-ordinate and solve any problem arising.

Costs

The cost of service provided by a WUIVIEW partner must be determined and agreed by all members in the Consortium through a *shopping list of services and costs*. This will be based upon the following premises:

- Any partner not contributing in a fairly basis with their effort or funding to the maintenance of the WDB activities, will lost their rights over the product.
- Initially a 10% of the royalty incomes from all the partners during the first year, plus another 10% of the shares of the selling partners.
- For the second year, a different funding approach could be agreed between the partners.

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