Horizon 2020

Societal Challenge: Improving the air quality and reducing the carbon footprint of European cities

Project: 690105 – ICARUS

Full project title:

Integrated Climate forcing and Air pollution Reduction in Urban Systems

MS16: Completion of the first release of ICARUS Business plan

WP 7: Motivating citizens towards the vision

Lead beneficiary: UPCOM

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1 Introduction

The purpose of this milestone report is to present the work done so far for the creation of an interim business plan for the commercialization and exploitation activities of the ICARUS Decision Support System (DSS) and of the ICARUS User-Centric Tools (UCT). The Interim Business Plan will be the object of D7.4, due on M24 of the Project, which is currently in progress. Its purpose will be an initial approach on the commercialization and exploitation activities of the products, rather than a consolidated plan, which will be concluded by the end of the project.

The Interim Business plan will have two main parts: one referring to the ICARUS Decision Support System (DSS) and the other to the ICARUS User-Centric Tools (UCT). For each of those, the focus points are:

- A clear product description
- The potential customer categories
- A detailed market analysis
- A SWOT Analysis
- An investment plan
- A strategy for the implementation of the exploitation plan

2 ICARUS Decision Support System

2.1 Product description

A clear product description is very useful in all the stages of the elaboration of the business plan. The product description for ICARUS DSS has been elaborated as follows:

The ICARUS Decision Support System is targeting policy makers of all levels of administration, NGOs and research institutes whose activities relate to air quality and climate forcing. Policy makers of municipal, regional and national level will be able to use the DSS in order to design and simulate the impact of potential measures. ICARUS DSS will provide policy and measures impact estimations at many levels, namely: emissions, pollutants concentration, population exposure, health impact, monetary evaluation. To this end, it will implement the models developed in the ICARUS research project taking into consideration the particularities of each region, including population activities and habits based on their socioeconomic status. Apart from selecting among predefined policy scenarios of which the different impacts will be calculated, the policy makers will be also able to import their own data for their jurisdictions and to also define their own custom policies they may want to assess. In this light, an essential feature of the DSS will be the ability to evaluate the policy impacts while it is being applied so as to assist stakeholders in the selection, application and evaluation of the available datasets and tools for urban impact assessment in support of air quality and climate change governance at different spatial and temporal scales. Finally, NGOs and researchers may use the DSS to retrieve data and facilitate their research.

Great emphasis is being put into the usability, security, interoperability and scalability of the DSS, which will be accessible through a Web-based Geographical Information System (WebGIS). This will enable access from any computer through a browser, without requiring installation. Two-factor authentication via SMS or e-mail have been predicted, and data import and export will be possible in several formats. Finally, the modular, cloud-based architecture of the DSS ensures its seamless scalability and the possibility for integration of new features.

2.2 Potential customers

The potential customers of ICARUS DSS are mainly the regulatory bodies for air quality climate change and health protection of all levels of administration (municipal, regional, national) throughout Europe, with the potential to expand to the rest of the world. NGOs and research institutes are also a target customer group. The major end-user groups of ICARUS DSS are provided below.

- *Cities and local authorities.*

- *Ministries and national authorities.*

- *International organizations and networks,*

- *Large industries.*

- *NGOs.*

- *Scientists.*

- *Consulting companies and individual consultants.*

Detailed information on targeted end-users/potential customers that have already been identified and engaged or will be engaged until the end of the project, can be found in Deliverable D8.3 Stakeholder engagement strategy.

2.3   Market Analysis

Air-pollution and GHG monitoring and reduction in urban systems involve products and services encompassing almost all aspects of life and well-being. They address environmental, societal and economic challenges, examples of which include climate change, population health and exposure, urbanization and globalization. Such products and services are increasingly evolved and they are penetrating a large number of sectors including environmental monitoring, health (exposure) and well-being, transportation and automotive, and energy. Given their aforementioned pivotal importance across a wide range of industries and services, **advancements in such system technologies will have a disproportionately large impact, as well as substantial and rapid market uptake**. ICARUS objectives and products address a wide market including environmental monitoring, healthcare and well-being, Internet of Things (IoT) and ICTs.

Over the last decades, environmental awareness has grown rapidly and environmental legislation is introducing and tightening standards in many fields. Moreover, public participation and the "right to know" are mandated by law in many cases, making environmental information an essential element of the policy making process in civil society. In accordance with this trend, environmental information and DSS have emerged over the last decades as important tools for environmental planning and management.

Monitoring facilitates planning and management purposes and includes, apart from sensors, devices and models, systems and tools that integrate information and support decision making. Specifically, DSS technology is expected to bring large market potential for the private sector. The following market descriptions built on the above consensus to further analyze the expected impact of ICARUS in specialized industrial sectors, namely, in environmental and air quality monitoring.

ENVIRONMENTAL MONITORING MARKET: The global market of environmental monitoring is expected to reach a value of $20.5 Billion in 2020, growing at a rate of 7.5% over the period 2015-2020 (marketsandmarkets.com 2015). The main drivers of growth in this market are: the growing global population, the emergence of policies and actions to reduce air, soil, and water pollution, increased government funding for pollution reduction and management, an expanding network of environmental monitoring stations, support for environmentally sustainable industries, and the reduction of export tariffs on environmental monitoring technologies in both

emerging and developed markets. The growth potential in the sector is moderated by the high cost of monitoring solutions, slow reform of pollution control legislation and tariffs on environmental technologies in some emerging markets (markets and markets, 2015).
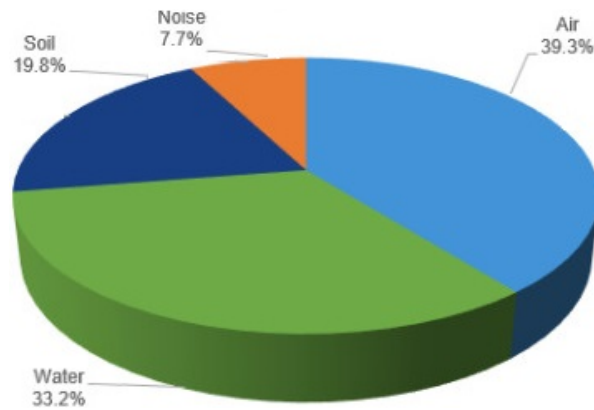

Figure 1: **Global environmental sensing and monitoring market segmentation by application 2019 (Technavio, 2015)**

AIR QUALITY MONITORING MARKET: Apart from the societal impact that air pollution management would have to the general public, air quality monitoring is the main application segment of the global environmental monitoring market as illustrated in Figure 1. Air-pollution and air-pollution control are the main targets of this market and include tools and systems for efficient monitoring and decision making.

The global air quality monitoring market is expected to reach 4.90 Billion by 2022 from USD 3.92 Billion in 2017, at a CAGR of 4.6%. The major factors driving the growth of the air quality monitoring system market include the supportive government regulations for effective air pollution monitoring and control, ongoing initiatives towards the development of environment-friendly industries, increasing public-private funding for effective air pollution monitoring, rising levels of air pollution, and increasing public awareness related to the environmental and healthcare implications of air pollution (marketsandmarkets.com, 2018).

2.3.1 Market barriers and expected measures

Porter's 5 forces of Competitive Position Analysis is the framework used for assessing and evaluating the competitive strength and position of the DSS and user-centric tools developed in the ICARUS project. Porter's 5 forces is used to identify areas of strength and weaknesses of the ICARUS products and understand whether they are potentially profitable and attractive for customers. Porter's 5 forces are:

Competitive rivalry (Competitors): Competitors affect the profitability of the market industry. Many competitors, offering undifferentiated products and services, will reduce market attractiveness. Competitors can increase the product improvements or introduce a new product in the market, downward pressure on prices, increase advertising campaigns, and service improvements. Factors that influence the intensity of competition are:

- number of competitors,

- high exit barriers,

- gradual industry growth,

- high fixed or storage costs.

Threat of new entry (new Entrants): In general, new entrants desire to gain the market share. New entrants decrease the profitability by introducing new capacity in the market industry and put pressure on the rate of investment, downward pressure on prices, and upward pressure on costs for the purpose of competition. The threat of new entrants depends on the height of the present entry barriers and the lowness of the exit barriers. Significant barriers to new entrants include government barriers, product differentiation, capital requirements, supply-side economies of scale, demand-side benefits of scale, and unequal access to distribution channels.

Threat of substitution (Substitutes): Close substitute products that perform the same or similar function increase the likelihood of customers switching to alternatives. Factors that influence the increase of threat of substitutes are: increase of the substitute quality, imposition (introduction) of an attractive price of the substitute, and low switching cost to consumers.

Supplier power (Suppliers): Suppliers capture their value by limiting quality or services, prices changes, and shifting costs to the participants. The risk of suppliers power is driven by the: number of suppliers of each essential input; uniqueness of their product or service; relative size and strength of the supplier; and cost of switching from one supplier to another.

Buyer power (Buyers): Buyers drive prices down, demanding better quality. This is driven by the: number of buyers in the market; importance of each individual buyer to the organisation; and cost to the buyer of switching from one supplier to another. If a business has just a few powerful buyers, they are often able to dictate terms.

PORTER'S 5 FORCES ANALYSIS	

Competitors:
 Although a significant number of potential competitive solutions has been identified, the analysis revealed that very few are targeting to address the same objectives and goals as ICARUS, target the same range of end-users, as well as provide the integrated solutions that ICARUS DSS offers. Potential competitors offering DSS with similar features are described below:
 • *RIAT+ Integrated Assessment Modelling tool developed during the OPERA project.*
  - *http://www.riatplus.eu/html/eng/home.html*
  - *RIAT+ is a DSS (Decision Support System) developed during the OPERA project (LIFE09 ENV/IT/000092) that helps policy makers and technicians solving a multi-purpose optimization problem to select the most effective air pollution abatement strategies minimizing the intervention measures deployment cost and maximizing result in terms of air quality improvement. In this sense, the RIAT+ tool supports regional/local authorities in the definition, application and evaluation of air quality plans policies, devoted to the reduction of population and ecosystems exposure to air pollutant.*	

Launch year:	2013 (First version)
Data available for countries:	Italy (Emilia-Romagna, Lombardy), France (Alsace), Belgium (Brussels), Portugal (Porto)
Data used in the model:	Measure DB (GAINS), Emission Inventory data Source Receptor (S/R) Function

Advantages:	-it can be applied to different regions in Europe - evaluates the efficiency of various types of air quality policies -integrated assessment approach -open-source - free license - user friendly interfaces
Disadvantages:	-stand-alone desktop application -input data are required by the user -applied only to five cities

- ***ACEPT-AIR Cost Efficient Policy Tool for reduction of Particulate Matter in AIR***
  - *http://www.aceptair.prd.uth.gr/index.html*
  - *ACEPT-AIR is an Environment Policy & Governance project (LIFE09 ENV/GR/000289). ACEPT-AIR Policy Tool is an operational platform developed in the form of a software tool that allows the assessment of the relative trends in emissions and observed concentration levels in parallel to the resolved contributions from the different sources so that identification of the results from previous control strategies can be achieved and new measures can be proposed. The policy tool includes databases of concentration levels of particulate matter mass, chemical composition of major and trace substances, emission inventories and source apportionment calculation module for analysis of the results and aims to support policies concerning the reduction of key environmental factors and their interdependencies and to respond to benefits and the problem of particulate matter concentrations in air in a competent way.*

Launch year:	2013
Data available for countries:	Greece (Athens, Thessaloniki, Volos)
Data used in the model:	Emission Inventory data for PMs, Field Measurement data, Source Apportionment data, other data (Measures), Parameter data (Regions, Sectors, Key Categories, etc.)
Advantages:	- pollution sources recognition and estimation of the contribution of various sources - evaluates the effectiveness of various policy measures already applied -comparison between PM emission scenarios - GUI
Disadvantages:	- not available to download (no link exists) - communication is required. -stand-alone desktop application -input data are required by the user -applied only to three Greek cities - cost effectiveness is not included

- ***AirWare air quality management information system for urban and industrial applications (Environmental Software and Services GmbH AUSTRIA)***
  - *http://www.ess.co.at/AIRWARE/*
  - *AirWare is a model-based real-time and web-based information and DSS for urban and industrial air quality assessment and management. AirWare supports intergrated data management and modeling tools for:*
    - *Compliance monitoring, alerts and alarms, reporting.*

- *Nowcasts, forecasts and public information, 3G mobile client support.*
- *Scenario analysis and source apportionment, EIA and SEA studies.*
- *Multi-citeria emission control optimization, policy design.*

*Designed primarily for **urban** agglomerations and **industrial** areas, the modular software system integrates monitoring data acquisition and analysis in real-time, emission data bases and an embedded GIS, simulation and optimisation models with coverage from local and near-field to regional scales with a nested grid apporach and several, nested models with different resolution and scope.*

A rule-based expert system for environmental impact assessment, and a range of decision support tools, including the multi-criteria optimization of cost-effective emission control strategies complement the basic simulation models and associated data bases.

Launch year:	2010
Data available for countries:	- Poland (Gdansk, Sopot, Gdynia)
	- Croatia (Sisak)
	- Iran (Tehran)
	- South Korea (Seoul)
	- Cyprus (Limassol, Larnaca)
	- Malta (Delimara)
	- Peru (Lima)
	- Brazil (Porto do Acu)
	- Austria (Vienna and Lower Austria)
	- Arabian Gulf (United Arab Emirates)
	- South Africa (Vaal triangle)
	- Argentina (Buenos Aires)
	- Switzerland (Geneva)
	- Finland (Helsinki)
	- Italy (Milan, Genoa, Pisa)
	- Portugal (Lisbon)
	- Israel (Tel Aviv)
	- Jordan (Aqaba)
	- Spain (Vitoria)
	- Russia (Tomsk)
	- Japan (Kanto, Morioka)
Data used in the model:	- Emission Inventory data
	- Field Measurement data,
	- Air quality and Meteorological data
	- Other data (e.g. population data, land use, fleet composition, etc.)

		- GIS data (road network, point sources, cities, buildings, DEM etc.)
Advantages:		- suite of simulation and optimization models
		- compliance monitoring, alerts and alarms, reporting
		- multi-criteria optimization, scenario analysis, policy design
		- embedded GIS
		- open architecture, modular system
		- nowcasting and forecasting
		- mobile client support
		- available as stand-alone desktop application or bespoke cloud solution
Disadvantages:		- old-fashion, not updated website
		- complex system, specific expertise is needed
		- a massive amount of input data are required by the user
		- cost effectiveness/monetary evaluation is not included

- **HERON Decision Support Tool (DST)**
  - *https://heron2017.wordpress.com/heron-dst/*
  - *HERON DST is a tool developed during the HERON project (H2020 grant agreement No 649690) and aims at facilitating policy makers of multi-level governance in EU, to develop and monitor energy efficiency policies in building and transport sectors, through forward-looking socio-economic research. The DST is incorporating Energy Efficiency socio-economic barriers in scenarios development and allows the calculation of the barriers' negative impact, created by the input the end-users behaviour has, on forward looking energy efficiency scenarios and clearly presents the deviation from the expected targets. The barriers in each sector are compared through pairs and the importance of each barrier is presented. The Total Impact is a numerical outcome, expressing the contribution of the concerned barrier in preventing the achievement of EE targets. The numerical outcomes, through mathematical expressions can be incorporated into the initial developed scenarios' inputs and HERON DST provides the deviation and diversification of the initially set targets, allowing correctional modification. Lastly, the tool offers the capacity to examine various combinations, allowing scenario analysis inputs' optimization.*

Launch year:	2017
Data available for countries:	- Greece
	- Bulgaria
	- Estonia
	- Germany
	- Italy
	- Serbia
	- United Kingdom
Data used in the model:	- Sector data (Buildings and Transport)

		- Set of barriers for each sector
		- Technologies data
		- Socio-economic data
Advantages:		- reflects end-users behaviour
		- definition and calculation of barriers (social-cultural-educational, economic and institutional) towards EE targets and their negative impact
		- capacity to examine various combinations, allowing scenario analysis inputs' optimization
		- no need for input data
		- freely available
Disadvantages:		- limited to energy efficiency
		- focuses in two sectors: Buildings (residential and tertiary) and Transport (passengers and freight)
		- stand-alone desktop application

- **SHERPA tool, JRC**
  - *http://aqm.jrc.ec.europa.eu/sherpa.aspx*
  - *SHERPA (Screening for High Emission Reduction Potential on Air) tool calculates how changes in emissions – stemming from actions on traffic or residential heating for example – affect air quality. It has been designed by JRC scientists to support public authorities in selecting sound policies to improve air quality in urban areas. The tool is based on the relationships between emissions and concentration levels. SHERPA is configured to work with a predefined set of input data (including emission inventories) that cover the whole of Europe at high (roughly 7x7 km^2) resolution. This allows for the simple and straightforward testing of new air quality policies on any given domain in Europe. At the same time, SHERPA can also use locally produced high quality data.*

Launch year:	2016
Data available for countries:	EU-wide
Data used in the model:	- Gridded emission inventory
	- Meteorological input data
	- A series of AQM simulations on pollutant concentrations
	Fed by user for regional adaption.
	- Gridded emission inventory detailed in terms of activity sectors and precursors (left to user choice) over the area of interest
	- A series of 15-20 simulations performed with an AQM for a series of pre-defined emission scenarios to generate the SRR
	- A correspondence table matching the user-defined shapefiles with the emission grid cells

Advantages:	- distributed with EU-wide data on emissions and source-receptor models, so that it is very easy to start working on any region/local domain in Europe.
	- source allocation
	- spatial flexibility, namely the possibility to assess the contributions from different regions to air quality at any given location
	- adequate speed, delivering fast responses to guarantee interactivity during the decision support process.
	- light set-up
	- allows scenario analysis and testing of their impacts on air quality levels
	- freely available
Disadvantages:	- spatial resolution is 7x7 km^2
	- cost effectiveness/monetary evaluation of measures is not included (need to provide input data in RIAT+ to access cost effectiveness)
	- stand-alone desktop application

- **MURE database**
  - *http://www.measures-odyssee-mure.eu/*
  - *The Odyssee-Mure project is supported by H2020 programme of the European Commission and is part of the activity of the EnR Club. The project relies on two complementary internet databases, that are regularly updated by the network of national teams (once per year):*
    - *Odyssee database that contains detailed energy efficiency and CO$_2$-indicators with data on energy consumption, their drivers (activity indicators) and their related CO$_2$-emissions.*
    - *Mure database that contains a description, with their impact evaluation whenever available, of all energy efficiency measures implemented at EU or national level.*

  MURE (Mesures d'Utilisation Rationnelle de l'Energie) database provides information on energy efficiency policies and measures that have been carried out in the Member States of the European Union. The information is accessible by query in the database. The distribution of measure by type can be visualized through radar graph. Finally several facilities enable specific queries.

Launch year:	2001 (ongoing)
Data available for countries:	- EU member countries (28)
	- Norway
	- Serbia
	- Switzerland
Data used in the model:	- Sector data
	- Policy data
	- Impact data
Advantages:	- provides information on energy efficiency policies and measures that have been carried out in the Member States of the EU

		- offers specific data and policy tools including policies interaction
		- covers all sectors and end-uses with an homogeneous and harmonised approach and provides an overall picture of the trends and measures by sector
		- includes several facilities that enable specific queries
		- provides impact evaluation (whenever available)
		- multiple benefits analysis of energy efficiency policies and measures
		- on-line (web) database
		- no need for input data
		- free for all EU Ministries, universities and research centres for non-commercial uses
Disadvantages:		- limited to energy efficiency
		- impact evaluation is not available for all measures.
		- visualization of MURE database outputs and results is restricted to radar graphs and summary tables

New Entrants:
Potential ICARUS DSS new entrants: At the point of submission of this interim business plan, no threats to ICARUS DSS by new entrants have been identified.

Substitutes:
Potential ICARUS DSS substitutes: At the point of submission of this interim business plan, no substitute products to the ICARUS DSS integrated solution have been identified. ICARUS DSS follows an unprecedented integrated approach that minimizes the likelihood of customers switching to alternatives. Substitutes performing similar functions to the ICARUS DSS can be identified only per functionality (or groups of functionalities) of the DSS and thus, are not considered as substitute products to the ICARUS solution (since they partially address the user-needs addressed by ICARUS DSS).

Suppliers:
Potential ICARUS DSS suppliers: All ICARUS DSS suppliers are members of the ICARUS team/consortium. ICARUS DSS can be characterized as an in-house product. The only external supplier is the cloud server and utilities provider. Cloud services market is very competitive and is developing really fast and, at this point, no threats can be identified regarding limiting the quality or services, price changes, and shifting costs to the buyers.

Buyers:
Potential ICARUS DSS buyers:
ICARUS DSS has a very wide audience. Also, the alternatives to which potential buyers can turn to seem rather limited (if not none). Thus, the scenario of having a few powerful buyers that will be able to dictate terms and affect the exploitation regime of ICARUS DSS is considered unlikely. The major end--user groups of ICARUS DSS are provided in Chapter 2.2.

2.3.2   Potential collaborations

Some of the key players in the field could be considered as potential collaborators in the exploitation of ICARUS products due to their innovative character. At the current point no strategy involving potential collaborations

with competitors has been developed. Nevertheless, it is foreseen that synergies with the iSCAPE (improving the Smart Control of Air Pollution in Europe) and CLAiR-CITY (Citizen-led air pollution reduction in cities) Horizon 2020 projects will be investigated in order to provide integrated policy analysis and recommendations.

2.4   SWOT Analysis

Based on the information collected in §2.3, a SWOT analysis will be done and included in the final version of the deliverable.

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2.5   Investment Plan

The commercialisation of the DSS is a complex process involving different steps. The first step is to understand the potential market for the DSS, as well as to understand the intellectual properties and various patents. Developing tools as good as possible within the current resource constraints is a next step that should be followed. Moreover, drafting a business plan is vital for the commercialisation procedure. Furthermore, the demonstration of DSS to potentially interested organizations will provide valuable feedback to the process and will reveal potential bugs and/or improvements to be addressed before production phase. Lastly, promoting and disseminating the DSS is a vital step before its actual launch.

Following, we present our preliminary financial plan, based on some assumptions regarding costs and market share. The financial figures provided in this section should be interpreted as first estimates, which may be subjected to modifications during the implementation phase of the project and of the IT tools.

Our business plan is based on two main income sources:

- A licence fee
- An execution fee

2.6   Strategy for implementation

Work in progress. The strategy for implementation will be included in the in the final version of the deliverable.

3   ICARUS User-Centric Tools

3.1   Product description

The user-centric tools consist of a web-based platform and mobile application(s) created to track and analyze the individual (user's) activities and their impact on the air quality and climate change. The tool combines information about GHG and air pollution emissions based on aggregated input data analysis, data collections, models, etc. The platform is designed in a way that offers easy operations and quick information accessibility. The user-centric tools are mainly focused on the end-users (i.e. citizens) taking into consideration the user's needs and limitations.

Their purpose is to raise awareness of citizens on AQ and climate change in urban environment by promoting a more environment-friendly behavior through citizen engagement and behavioral change. We will investigate ways of doing this through ethical rewards such as health and air quality impact combined with gamification for users that give up habits with high environmental footprint. The possibility of offering rewards such as discounts, offers and promotions to users that will prove to have achieved a milestone can be offered by corporations and/or administrative bodies will be also considered.

3.2   Potential customers

The principal target users of ICARUS user-centric tools are citizens of large cities, cities with on-going policy related environmental programs. Potential customers are large companies with an operational program on Corporate Social Responsibility or certified under ISO 14001, companies with a large fleet and tourist operators. Furthermore, companies providing environmental-friendly solutions, such as public transport operators and (electric) bicycle manufacturers will have a common interest to invest in promotions via the ICARUS user-centric tools. Finally, administrative authorities (municipal and regional) that want to promote environment-friendly behavior in their jurisdiction are also potential customers.

3.3   Market Analysis

At the beginning of the valuation process of a product, investigation of the market and start-up strategy is necessary. In order to achieve qualitative and quantitative assessment of particular market, market analyses are indispensable part of any business plan. The focus of a market analysis is to determine the attractiveness of particular market or market's product. The market analysis examines the various costumer segments and buying patterns. Its focus is to understand (identify) the evolving opportunities and threats in the market related to the

product. Important segments of the market analysis are: market size and market growth rate, market profitability, market trends, industry cost structure, key success factors and distribution channels.

The market analysis for the ICARUS product should contain:

- Market segmentation

- Strengths of the product

- Weaknesses of the product

- Target Audience

- Competition

3.3.1 Market barriers and expected measuers

PORTER'S 5 FORCES ANALYSIS
- 5 key forces in achieving an attractive and potentially profitable product

Competitors:

Potential competitors offering user-centric tools with similar features (tracking, analysing the individual activities, calculating their impact on the air quality and climate change):

- **CoolClimate Carbon Footprint Calculator of the University of California at Berkeley, USA**
  Website: *http://coolclimate.berkeley.edu/calculator*
  Tool developed in the Renewable and Appropriate Energy Laboratory (RAEL) in the Energy and Resources Group and the Department of Nuclear Engineering based at the University of California, Barkley. CoolClimate provides tools and programs to promote, educate and motivate individuals and organizations to take action in making low-carbon choices to reduce greenhouse gasses emissions.

Launch year:	2015
Data available for countries:	United States of America
Data used in the model:	GHG emission factors from CEDA 3.0 Climate-Comprehensive Environmental Data Archive for Economic and Environmental Systems Analysis
Model's advantages:	-visually attractive website -easy accessible calculator -the input of individual consumption data is divided into different categories - a detailed overview of the various possibilities for the individual total CO_2 reduction plan -provides comparison of the results with the average household in the United States with similar income
Model's disadvantages:	-an average complicated model for individual users -numerous input data required, divided into five categories i.e. intro, travel, housing food, shopping (requires input data for transportation-personal, public and air traveled miles per year, energy and fuel use per year, average daily

food consumption and services and goods expenses per month)
-calculates only the total CO_2 emission per year
-applied only to U.S .countries

- **Carbon Footprint Ltd. UK**
  Website: *https://www.carbonfootprint.com/*
  Carbon Footprint multi-language software developed to raise awareness in reducing the carbon emission. The software disposes with carbon calculation tools, CO_2 reduction and energy costs calculations available for individuals, small and large businesses and also enables product emission assessment.

Launch year:	2015
Data available for countries:	All
Data used in the model:	-International Energy Agency- IEA database -US Environmental Protection Agency (EPA) -US Department for Energy (DOE) -DEFRA Guidelines for Reporting Greenhouse Gas (GHG) emissions -Green House Office- Australia -Canadian Standards Association (CSA) GHG Registries
Model's advantages:	- easy accessible calculator -the site gives rich information about CO_2 reduction, Carbon offsetting, Climate Changes -Direct selection of individual, business (small and large) and products online carbon footprint calculator - Multi-lingual calculator -the input of individual consumption data is divided into following independent categories: house, flights, car, motorbike, bus & rail and secondary (carbon footprint calculator of various personal activities and costs)
Model's disadvantages:	-calculates only the total CO_2 emission per year or per chosen period -individual total CO_2 reduction plan is not implemented directly to the calculation results, but separately in the CO_2 reduction section

- **CARMACAL- carbon management tool for tour operators, NL**
  Website: *https://www.cstt.nl/carmacal*
  It is an application that allows tour operators and other organizations to measure the impact of their tour packages and trips on the carbon emission level. The carbon management tool measures the impact of the total journey including the tour location activities.

Launch year:	(not found)
Data available for countries:	EU countries, no information about other
Data used in the model:	(not found)
Model's advantages:	-YouTube tutorial to help users https://www.youtube.com/watch?v=RSTbFJjGVYI&feature=youtu.be -three topic categories to fulfill: general information of the product (code, name and country of the destination, period, etc.), transport to the destination (air, train, car) and accommodation (location and type of accommodation)

	-choice of various activities available to fulfill for separate days - additionally, the transport section can calculate the emission of the separate daily activities including the information of the locations, number of travelers and the traveled distance -the results are made for the total calculation of the carbon footprint as well as for the separate daily calculations -compares the amount of the emission from the transport to the touristic destination if is made by plane, car or train
Model's disadvantages:	-the model is not free available online (tour operators and other parties can purchase annual user licenses)

- **WWF'S Footprint Calculator, UK**
  Website: *http://footprint.wwf.org.uk/*
  It is an application that calculates the individual carbon emission built up from the energy used for transportation, electricity, food, etc. and compares the results with other individuals and countries. The application is customized mainly for users from the United Kingdom. The WWF'S calculator is created by the Stockholm Environment Institute at the University of York and the University of Leeds.

Launch year:	2007
Data available for countries:	United Kingdom
Data used in the model:	UK's office for National Statistics Eora MRIO database Shrink That Footprint Defra Energy Savings Trust
Model's advantages:	- easy accessible calculator -easy to use and attractive website -quiz structure of the required input data -does not require exact input information, offers more basic options for use -the input of individual consumption data is divided into four set of questions: food, travel, home and stuff -compares the result with the UK average and world average annual carbon emission
Model's disadvantages:	-calculates only the carbon footprint -applied only for UK users -requires registration for reduction tips

- **EPA's Household Carbon Footprint Calculator, United States Environmental Protection Agency, USA**
  Website: *https://www3.epa.gov/carbon-footprint-calculator/*
  The EPA's footprint calculator is created to estimate the footprint of individuals by using U.S. average values. The household's carbon footprint is based on home, waste and transportation energy use of individuals in the U.S.

Launch year:	(not found)
Data available for countries:	United States of America
Data used in the model:	-EPA -Federal Register US -Intergovernmental Panel on Climate Change (IPCC) -Federal Highway Administration (FHWA) -U.S. Energy Information Administration (EIA) -U.S. Department of Energy

Model's advantages:	-website with good clarity - while filling in the input user's data, there is a continuous overview of the current results -the input of individual consumption data is divided into three sections: Home Energy, Transportation and Waste -next to each field that has to be filled up is a brief explanation where average consumption values and average annual CO_2 emission for a household and the number of persons living in it, for the US standards is additionally added -an additional component "Reduce Your Emission" is part of every section which gives direct options to the user for the actions that can be taken - the result are compared with the U.S. annual average CO_2 emission - estimations of the CO_2 reduction and money savings for the chosen reduction actions are additionally calculated in the results section
Model's disadvantages:	-ZIP Code is demanded to enter the calculator - applied only for U.S. users -calculates only the CO_2 emission

- **Carbon Footprint Estimate, The Nature Conservancy, USA**
  Website: *https://www.nature.org/greenliving/carboncalculator/index.htm*
  Calculates the annual average CO_2 emission of individuals in households in the US countries. The carbon footprint calculator is developed by the University of California and the CoolClimate Network.

Launch year:	(not found)
Data available for countries:	United States of America
Data used in the model:	Econometric analysis of national household survey, U.S.
Model's advantages:	-the input of individual consumption data is divided into following categories: Travel, Home, Food, Shopping -in every category is graphical comparison of the user's household footprint and similar households -the result of the calculated total footprint is in percentage terms compared with the average U.S. footprint -"Take Action" category offers a list of numerous options to CO_2 reduction
Model's disadvantages:	-ZIP Code is needed to start the calculations - applied only for U.S. users -calculates only the CO_2 emission -explanations are needed in each category -not simple enough to use i.e. some values and fields to fulfill are not comprehensible

- **Emission Calculator, Cleaner + Greener Leonardo Academy, USA**
  Website: *http://www.cleanerandgreener.org/resources/pollutioncalculator.html*
  The calculator is created for U.S. users to calculate the emission of CO_2, CH_4, N_2O, NO_x, SO_2 and Hg based on estimations of annual electricity and natural gas usage.

Launch year:	2013
Data available for countries:	United States of America
Data used in the model:	EPA

Model's advantages:	-calculation of CO_2, CH_4, N_2O, SO_2, NO_x, Hg
Model's disadvantages:	-poorly looking website -only two input data needed to fulfill: annual electricity usage, annual natural gas usage -looks unconvincingly because only two values are needed to be entered -applied only for U.S. users

- ***Calculator for greenhouse gases and common air contaminants, Environment Canada (EC), Canada***
  Website: https://www.canada.ca/en/environment-climate-change/services/environmental-funding/tools-for-applying/calculator-greenhouse-gases-air-contaminants.html
  The tool is created for environmental groups and other users to estimate the GHG and Criteria Air Contaminants emission reduction according to the actions taken to reduce electricity use, fuel oil use, natural gas use, water use, fine paper use and recycle fine paper and increase recycling of mixed material. The tool is intended to be used to calculate emission reduction for Environment Canada funded project activities. The calculator is available in Excel format.

Launch year:	(not found)
Data available for countries:	Canada
Data used in the model:	Canada's GHG Inventory Canada's Air Pollutant Emission Inventory
Model's advantages:	-calculation of the GHG emissions -calculation of the criteria air contaminants -different entry categorization depending on the reduction choice of: Reduce Space & Water Heating, Reduce Electricity Use, Reduce Natural Gas Use, Reduce Fuel Oil Use, Reduce Water Use, Increase Recycling of Mixed Material, Reduce Fine Paper Use, Recycle Fine Paper
Model's disadvantages:	-the calculations of GHG and CAC emissions are directed only for the purpose of the Environment Canada funded project activities -Excel format -complexed to use -calculates only the GHG and CAC emission reduction per year from the applied activities

- ***Website: Carbon Footprint Calculator - Carbon Independent, independent authors from the UK***
  Website: *http://www.carbonindependent.org*
  The calculator is created by an independent group of authors to give information on the CO_2 emissions and the climate change. The leading authors are Ian Campbell (statistician in medical and related fields) and Margaret Campbell (environmental projects developer). The calculator puts an accent on the reduction of the fossil fuels use and the possibilities of the actions that can be taken in the fossil fuels replacement. The actual version, Version 3 is published in 2008 and was updated with coal, bottled gas, wood and newer "green" electricity tariffs in 2013. The first version was published and superseded in 2007.

Launch year:	2008 (Version 3)
Data available for countries:	All *Note: The data used in the calculator is mostly from the UK*
Data used in the model:	-Department for Environment, Food and Rural Affairs, UK -National Energy Foundation, UK

	-Department for Transport journey planer, UK -Department for Business, Energy & Industrial Strategy, UK -Office for National Statistics, UK -American Physical Society Sites-Energy Units -EMEP/CORINAIR Emission Inventory Guidebook 2001
Model's advantages:	- website with good clarity and data is easy reachable -the input of individual consumption data is divided into two sections: Section 1 (household) and Section 2 (personal) -it has a questionnaire structure with selection of few options - next to each question that has to be filled up is a note where are given explanations on units, CO_2 emission factors and CO_2 emission reduction - the results are compared with the world average, UK average, USA, Sweden, Switzerland, China, India, Tanzania CO_2 emission
Model's disadvantages:	-calculates only the CO_2 emission -the comparison with other countries is based only on CO_2 emission, except the UK average emission which includes adjustments for GHG other than CO_2 and imports

- **My Climate CO_2 calculators, myclimate shape our future, Switzerland**
  Website: *https://www.myclimate.org/*
  My Climate CO_2 calculators are created by an international non-profit organisation in Switzerland. The myclimate website offers CO_2 emission calculations in separate carbon footprint calculators and carbon offset projects.

Launch year:	2008
Data available for countries:	All
Data used in the model:	(not found)
Model's advantages:	-calculators operating separately for calculation of the CO_2 emissions: Flight, Car, Cruise, Footprint, Household, Company and Event -easy accessible calculators -brief explanation in every separate calculator (section) -calculator for private events -direct overview of the calculated CO_2 emission -compensation in climate projects in developing countries of currency values (EUR, USD, CHF, GBR) derived from the individual contribution to CO_2 emission, resulted and calculated by myclimate calculators - comparison of the calculated individual CO_2 emission with the average annual CO_2 emission produced by EU citizen -comparison of the calculated individual CO_2 emission with the maximum amount of CO_2 a person should produce per year to curb the contribution to climate change
Model's disadvantages:	-calculates only the CO_2 emission

- **BreezoMeter Air Quality Index, Israel**
  Website: *https://breezometer.com/*
  Mobile App: https://play.google.com/store/apps/details?id=app.breezometer&hl=en

Founded by Technion, Israel Institute of Technology graduates Ran Korber, Ziv Lautman and Emil Fisher. The tool provides location based air quality data and informs the users about the level of the air pollution at a specific location. The users can check the air quality index and the possible air pollution exposure at a street level through real-time notifications, air quality forecasts, pollution heat maps, historical air analysis, and reports. The tool also includes health and quality life advising.

Launch year:	2012
Data available for countries:	29 countries up to date
Data used in the model:	-Satellites Data -Raw Data from Air Quality Monitors -Traffic Data -Meteorological Data

Model's advantages:	-visually attractive website and mobile application
	-easy to use and understand
	-fast location determination
	-brief advices followed by the momentary detected AQI for indoor and outdoor exposure, children, health sensitive people and sport activities
	-information about the AQI (0 to 100) on the chosen location and local AQI (1 to 6)
	-website:
	   • CO, NO$_2$, O$_3$, PM$_{10}$, PM$_{2.5}$, SO$_2$ momentarily concentration data at the chosen location. Additionally, the dominant air pollutant is pointed out
	   • information about the detection of pollen [grains/m^3] in the air
	-number of installers: 100,000 – 500,000

Model's disadvantages:	-differences in the website and the mobile application - information about the concentration level of CO, NO$_2$, O$_3$, PM$_{10}$, PM$_{2.5}$, and SO$_2$ in the mobile app was not found - calculates only the air pollutants emission, GHG emission is not included

- ***hackAIR mobile app with current and historical air quality, EU***
  Website: https://play.google.com/store/apps/details?id=gr.draxis.hackair
  HackAIR provides reliable information on the current and historical air quality, based on official data and measurements from users, and helps you make informed decisions to protect yourself. The Mobile app does not estimate ambient air quality impact and GHG emissions based on personalized activities.

Launch year:	2018 (mobile App)
Data available for countries:	Belgium (Brussels) Germany (Berlin) Greece (Athens and Thessaloniki) Norway (Oslo) United Kingdom (London)
Data used in the model:	-EEA's official Air Quality Index -public data sources provided by government -photographs of the sky
Model's advantages:	-visually attractive website and mobile application -four options to contribute air quality measurements (mobile phone pictures, low tech measurements, open hardware sensors and open air quality datasets) -number of installs:500 - 1000

Model's disadvantages:	-registration request to use the web and mobile applications -available only for the listed cities above -users from others cities then the listed ones can access the application but cannot receive accurate air quality data -it looks more difficult to use compared to other apps -not found information about the concentration level of the air pollutants or GHG (except for PM_{10} and $PM_{2.5}$ that the sensor measures, stated in the FAQ section of the Hackair website)

- **EuropeAir – Air Quality Europe, EU**
  Website: http://airindex.eea.europa.eu/
  Mobile App: https://play.google.com/store/apps/details?id=com.girosystem.europeair&hl=en
  The tool provides information about the air pollutants concentration based on the geographical location of the user. EuropeAir makes possible for the users to choose specific monitoring station and check the last air quality data statement. The tool is created by 4sfera Innova with European Environmental Agency for the EEA member countries citizens.

Launch year:	2013
Data available for countries:	European Environment Agency (EEA) member countries
Data used in the model:	EEA
Model's advantages:	- visually attractive mobile application -the App offers a station type choice (Background, Traffic, Industrial, and All) and air quality information choice (Index, O_3, PM_{10}, $PM_{2.5}$, NO_2) - direct map access and current available data for all European countries - five statements of the current air quality: Good (blue color), Fair (green color), Moderate (yellow color), Poor (red color), Very Poor (dark red color) -current available air quality data from the measuring stations for AQI, O_3, PM_{10}, $PM_{2.5}$, NO_2 including data for the last updated time, station type and station ID -users can add in the menu favorite station and follow the station's air quality data -explanations about the AQI rate, the measured data, air pollution, ozone, nitrogen dioxide, articulate matter, and the App -languages: English, Spanish -number of installs: 1000 - 5000
Model's disadvantages:	-information about the air pollutants emission, GHG emission is not included

- **Air Quality: Real time AQI, China**
  Website: http://aqicn.org/map/world/#@g/3.478/8.6133/2z
  Mobile App: https://play.google.com/store/apps/details?id=com.insdio.aqicn.airwidget.Asia&hl=en
  The tool provides AQI information for users in more than 60 countries in the world. The overall AQI is updated every hour and is based on the air pollutants concentration level of O_3, PM_{10}, $PM_{2.5}$, NO_2, SO_2 and CO. The Air Quality Index App is a worldwide team project with a base team location in Beijing, China.

Launch year:	2007

Data available for countries:	All
Data used in the model:	-World EPAs (Environmental Protection Agencies) -US Embassy measurements for Beijing, Shanghai, Chengdu, Guangzhou and Shenyang -State Environment Protection Agency (SEPA) for China
Model's advantages:	-visually satisfying look of the App and the website -information about the hourly measured AQI, PM_{10}, NO_2, SO_2, O_3 from the nearest monitoring station and current meteorological information i.e. temperature, pressure, humidity and wind flow velocity - six statements of the current air quality: Good AQI 0-50 (green color), Moderate AQI 50-100 (yellow color), Unhealthy for Sensitive Groups AQI 100-150 (orange color), Unhealthy AQI 150-200 (red color), Very Unhealthy AQI 200-300 (purple color), Hazardous AQI 300+ (dark red color) -hourly measured values of the pollutants are graphically presented in the App - direct map access and current available data for most of the all world's countries - -languages available on the website: English, Chinese, Japanese, Spanish, Korean, Russian, Traditional Chinese, French, Polish, German, Portuguese, Vietnamese -number of installs: 100,000 - 500,000
Model's disadvantages:	-information only about the air pollutants emission, GHG emission is not included

- **AirVisual**
  Website: https://www.airvisual.com/
  Mobile App: https://play.google.com/store/apps/details?id=com.airvisual&hl=en
  AirVisual is a tool that provides air quality data aggregated from the world's air quality database across over 9000 cities globally. The AirVisual's international team is part of IQAir company, based in Switzerland, specialized in technology solutions for air pollution protection.

Launch year:	2015
Data available for countries:	All
Data used in the model:	Local monitoring data
Model's advantages:	-visually attractive mobile application and website -fully informative App - direct map access and current available data for most of the all world's countries - two types of air quality maps: AQI stations map and AirVisual Earth -information about the current AQI, current concentrations of $PM_{2.5}$, PM_{10}, O_3, NO_2, SO_2, CO - displayed main pollutant concentration -current meteorological information i.e. temperature, pressure, humidity and wind flow velocity - seven days AQI and weather forecast -health recommendations for the current air quality statement - historical hourly and daily graphic information of the AQI, $PM_{2.5}$, PM_{10}, O_3, NO_2, SO_2, CO available separately -information for the location data source

	-App section News & Ranking
	• ranking list of world's cities and the current AQIs
	• news about air pollution and its health and environment impact
	• information about resources of GHG, Volatile Organic Compounds, Ammonia, CO_2, Black Carbon, $PM_{2.5}$, PM_{10}, CO, NO_2, SO_2, O_3 and "what pollution measures should I watch out for?"
	-number of installs: 100,000 - 500,000
Model's disadvantages:	-information only about the air pollutants emission, GHG emission is not included

- **CityAir mobile app to express the public perception of the outdoor air quality at their location, EU**
  Website: https://www.nilu.no/Forsiden/tabid/41/language/en-GB/Default.aspx
  Mobile App: https://play.google.com/store/apps/details?id=io.cordova.CityAir
  CityAir gives the user the possibility to rate the air quality in their immediate surrounding by using a code of four colours. This information will help to create a citizens air quality map, and answer the question, how do citizens perceive the air pollution in their city. The user can ALSO choose to download other users' perceptions reported through CityAir for the same day. The Mobile app does not estimate ambient air quality impact and GHG emissions.

Launch year:	2012-2016 part of the CITI-SENSE project
Data available for countries:	EU countries (not found information for the countries)
Data used in the model:	(not found)
Model's advantages:	Model's advantages: -the App is available in the following languages: English, Norwegian, Spanish, Catalan, Serbian, Czech, Slovenian Personal information (gender, year of birth and education level) needed for statistical purposes. The users contribute to the creation of the air quality map by user's report of the personal air quality perception and opinion. Four available selections by color of air quality rate: • Green – the air quality is very good • Yellow – the air quality is good • Orange – the air quality id poor • Red – the air quality is very poor Number of mobile app installs is more than 1,000.
Model's disadvantages:	

- **Plume Air Report – Live and forecast smog reports**
  The application is developed for the users in order to reduce the risk of peak times exposure. The Plume Air Report is created by Plume Labs and is available in 150 cities around the world.
  Website: https://plumelabs.com/en/products/air-report
  Mobile App: https://play.google.com/store/apps/details?id=com.plumelabs.air

Launch year:	2015
Data available for countries:	All
Data used in the model:	Satellites Data Data from Air Monitoring stations Meteorological Data "Plume's" forecasting algorithms to predict real-time pollution levels

Model's advantages:		Visually attractive mobile application and website -information about the current AQI, current concentrations of $PM_{2.5}$, PM_{10}, NO_2, and O_3 -current meteorological information i.e. temperature, pressure, humidity and wind flow velocity and direction -meteorological forecasts and air quality data for the upcoming 24 hours - historical hourly and daily information of the AQI and $PM_{2.5}$, PM_{10}, NO_2, and O_3 concentration levels -available options for the use of different units: • AQI (Plume AQI, AQI (USA), CAQI (Europe), AQI (China) • Pollutant unit (Selected AQI, Physical units) • Temperature (Celsius, Fahrenheit) • Wind speed (kilometers per hour, mile per hour) -notifications: • City notifications • Smart notifications – tips and alerts when it matters • Morning report – start the day ahead of pollution • Evening report – go to bed in the know -world air map with air plume index in seven different color statements -Plume Labs blog - information about the air quality, air pollution, and health advice -number of installs: 100,000 +
Model's disadvantages:		- information only about the air pollutants emission of $PM_{2.5}$, PM_{10}, NO_2, and O_3 - SO_2, CO and GHG emissions are not included

New Entrants:
Potential ICARUS user-centric tools new entrants:

- *Mobile app calculator of pollution impacts from travel, EU*
  Website: http://www.claircity.eu/game-app/
  The tool (currently under design, will be launched in Spring 2018.) will be an app for smartphone users. The ClairCity app is aimed at organisations and employees, encouraging businesses and other organisations to identify how travel impacts their efficiency and staff wellbeing. For individual users, once the app is downloaded they can choose whether to interact with it to understand their personal air pollution exposure and health impacts. The app data will be also used to demonstrate the impact of pollution on all our lives and help city policymakers plan a better future for each partner city of the EU project.

- *Computer Game for people involved in finding solutions for their city regarding air pollution and climate change*
  Website: http://www.claircity.eu/game-app/
  The awareness tool (currently under design, will be launched in Spring 2018.) will be a computer game not only for fun: the data used to build the game is real, so player decisions will show the real impact of different choices. The solutions and winning strategies that players find will "crowdsource" future scenarios for the city. The data used to build the game – from the impact of building new roads, through to the average life expectancy of citizens – is real.

Substitutes:

> *Potential ICARUS user-centric tools substitutes:*
> At the point of submission of this interim business plan, no substitute products to the ICARUS UCT integrated solution have been identified. Substitutes performing similar functions to the
>
> *Suppliers:*
> *Potential ICARUS user-centric tools suppliers:* All ICARUS UCT suppliers are members of the ICARUS team/consortium. ICARUS UCT can be characterized as an in-house product. The only external supplier is the cloud server and the Android and iOS application marketplaces.
> *Buyers:*
> *Potential ICARUS user-centric tools buyers:*
> - *Citizens*
> - *Cities and NGOs*
> - *Large companies*
> - *Companies with an operational program on Corporate Social Responsibility (CSR)*
> - *Companies with operational program certified under ISO 14001*
> - *Mobile phone network operators*
> - *Tourist operators*
> - *Community groups*

3.3.2 Potential collaborators

Potential ICARUS user-centric tools collaborations:

- *EuropeAir – Air Quality Europe, EU*

  Website: http://airindex.eea.europa.eu/

  Mobile App: https://play.google.com/store/apps/details?id=com.girosystem.europeair&hl=en

  EuropeAir provides information about the air pollutants concentration based on the last air quality data statement from the monitoring stations in the European countries. The air quality data that EuropeAir disposes could help the ICARUS tool in creating the air quality improvement strategies. This could lead to a possible collaboration between the ICARUS UCT and the EuropeAir tool.

- *AirVisual*

  Website: https://www.airvisual.com/

  Mobile App: https://play.google.com/store/apps/details?id=com.airvisual&hl=en

  AirVisual provides air quality data aggregated from the world's air quality database. This tool has a direct map access with AQ data for most of the all world's countries. The AirVisual application is fully informative including AQI, current concentrations of $PM_{2.5}$, PM_{10}, O_3, NO_2, SO_2, CO, seven days forecast as well as historical hourly and daily graphic information. In the tool is included information about the emission data source for the chosen city and health recommendations for the current air quality statement.

3.4 SWOT Analysis

Based on the information collected in §3.3, a SWOT analysis will be done and included in the final version of the deliverable.

3.5 Investment Plan

The commercialisation of the User-centric tools (UCT) is a complex process involving different steps. The first step is to understand the potential market for the UCT, as well as to understand the intellectual properties and various patents. Developing tools as good as possible within the current resource constraints is a next step that should be followed. Moreover, drafting a business plan is vital for the commercialisation procedure. Furthermore, the demonstration of UCT to potentially interested organizations will provide valuable feedback to the process and will reveal potential bugs and/or improvements to be addressed before production phase. Lastly, promoting and disseminating the UCT is a vital step before its actual launch.

Following, we present our preliminary financial plan, based on some assumptions regarding costs and market share. The financial figures provided in this section should be interpreted as first estimates, which may be subjected to modifications during the implementation phase of the project and of the IT tools.

Our business plan is based on two main income sources:

- A licence fee
- Ads

3.6 Strategy for implementation
Work in progress. The strategy for implementation will be included in the in the final version of the deliverable.