PORTFOLIO OF BUSINESS MODELS

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	OPERA Consortium partners	Short name
1	Wageningen Environmental Research (Alterra), The Netherlands	WEnR
2	Stellenbosch University (SU), South Africa	SU
3	Evenor Tech (Evenor), Spain	Evenor
4	Instituto de Recursos Naturales y Agrobiologia de Sevilla (IRNAS – CSIC), Spain	IRNAS
5	French National Institute for Agricultural Research (INRA – EMMAH), France	INRA
6	University of Florence (UNIFI – DISPAA), Italy	UNIFI
7	Council for Agricultural Research and Economics (CREA) – Research Centre for Policies and Bioeconomy (CREA-PB), Italy	CREA
8	Institute of Technology and Life Sciences (ITP), Poland	ITP

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Executive summary

OPERA (Operationalizing the increase of water use efficiency and resilience in irrigation) is a two-year and half research and technical development (RTD) project, financed under the ERA-NET Cofund WaterWorks2015 Call. This ERA-NET is an integral part of the 2016 Joint Activities developed by the Water Challenges for a Changing World Joint Programme Initiative (Water JPI). The WaterWorks2015 ERA-NET Cofund, that was launched in support of the Water JPI, is funded by the EC under H2020. WaterWorks2015 aims at tackling water challenges at European and international levels through the development of transnational and transdisciplinary research and innovation actions. In particular, it is designed to stimulate an operative concept for the development of services (Information and Communication Technologies -ICT- and Decision Support System tools -DSS) for irrigation water management.

The OPERA project consists of a network of scientific parties and small and medium enterprise's (SME) that collaborate with the users (e.g. farmers, water managers, policy makers) to increase crop productivity by constructing an efficient and sustainable water management in irrigation. Local Service Providers (LSP) have the main role within the project: their task is to process data and to create and deliver value-added products according to different user specifications. In this production process, the service providers rely on a wide net of external resources, like satellite data providers and local facilities, and the links between the various levels should be neatly defined for allowing an efficient functioning. One way to go is to help the (present and future) providers in finding an efficient line of functioning in terms of necessary and/or desirable characteristics.

In this document, expected by work package 4, we propose a "OPERA Conceptualization of practical service models" with specific focus on deliverable: 4.2 Report on Porfolio business model. In particular, we develop OPERA business by defining a final product used to build the service and we describe the rationale for our choices. The elaboration of a business model is used to identifying business roles of the system, defining the relationships and building the overall business model framework to establish operative and self-supportive downstream service activities with the user community of irrigation water management.

We start identifying the users involved and their needs, describing how we approach them for marking our services and for communicating with them, our business strategy, our key activities, resources and partners. We concentrate part of our analysis on the description of the OPERALSPs. Then we clearly define the value proposition by identifying what are the elements that bring value into our proposition.

The last part of the document is dedicated to cost analysis structured in relation with our six case studies and to design a revenues model.

1. Introduction and scope

Water scarcity is one of the biggest problem globally and it severely affects the arid and semiarid regions and/or countries. Climate change, that has led to an increase in global average temperature, can contribute to further limitation of the availability of water in many regions of the world and, this determines other uncertainty in the various regions vulnerable to the impacts of climate change on the availability of water resources in future. Water limitation reflects its negative effect on the entire economic system, but agriculture is expected to suffer the greatest impact since it accounts for 70% of global fresh water withdrawal. (FAO, 2017). Create an efficient and sustainable water management for agriculture means reduce the consumption of irrigation water ensuring a stable food production for a higher food security all over the world. Increase water and crop productivity through sustainable solutions will increase farmer's resilience.

In Europe, crop productivity is negatively affected by climate change and this is expected to further increase in the next years. Invest in a sustainable agricultural water management system **is the preferable way** to prevent future food insecurity and **economic losses**. Knowledge and information are needed to predict water shortage and increase crops resilience. Technology is essential. Despite the progress made in the development and application of sensors and models to analyse soil-crop water dynamics, a significant gap remains in applying the necessary combination of such techniques to predict upcoming water demands.

OPERA project is developed in this context with a specific aim: to deliver guidelines on the most adequate combination of sensors, remote sensing, weather forecast and simulation models that allow better consideration of rainfall, evapotranspiration and soil moisture in irrigation scheduling. OPERA will strengthen farmers' adaptation to climate change by:

1) Identifying how farmers can react more flexible to predicted water variability;
2) Delivering adequate combinations of ICT tools in irrigation scheduling;
3) Integrating experiences in operationalizing precision irrigation from various climatic zones to identify applicable service models for more robust decision making.

The short-term impact expected from OPERA is the possibility to pick up elaborated combinations of ICT products to forecast agricultural water needs OPERA will deliver an operational methodology for SME service providers, cooperatives and big agri-food companies, to improve production as well as to reproduce successful cultivation experiences. At the regional level, the administration institutions will have a DSS tool to simulate the water requirements of each location and crop and use it to optimize the crop distribution according to the water supply capacity. The benefits in the medium and long-terms will result mainly from realizing a better advisory service in the agricultural sector that can lead to a better water demand management, to avoid harvest losses, and to a more sustainable socioeconomic development in the rural farming areas in times of water scarcity and drought. The advantage that OPERA brings with respect to other research projects is a transdisciplinary approach that ensure co-development and co-learning with the involved stakeholders. Moreover, thanks to the multidisciplinary technique OPERA is able to collect and process different types of information and data provided by various sources. This allows us to make available a tool with all the useful knowledge for farmers, SME's and all the other stakeholders that deal with water management.

Consistently with the objectives of the project, in this report we propose some guidelines to establish a prototype of irrigation advisory system that operationalize the methodology investigated within OPERA research work package and use all the information provided by a selection of Local services providers (OPERA-LSPs).

The OPERA service network consists in a range of local providers, which have to answer the needs of their array of users and to deal with the specificity of their area. The providers also rely on a wide net of external resources, like satellite data providers and local facilities, and the links between the various levels should be neatly defined for allowing an efficient functioning. Different tools will be integrated in a ICT solution that will enable our product to give more precise responses on irrigation management. The range of information will be available in the six areas covered by OPERA project: in each area our ICT tool will be specifically dedicated to give information about the economically most relevant crops in the region.

As a first step, we created the basis of having at least one Local Service Provider in each pilot area (six) of the project. In some pilot areas, we have SME OPERA partner organizations established as a clear LSP (i.e. Italy). In other pilot areas we have intermediate solutions (public administration or university institutes acting as LSP). The second step consists of developing the vision of the future LSPs (always grounded and anchored in the available LSPs).

In the face of growing challenges of climate change, the pressure on farms to implement new sustainable development models is increasing. These new sustainable business models can be a driving force for change in the sector and the literature on business innovation highlights how such strategic approaches can be at the heart of business model innovation. In this perspective, the design of the service offered with the OPERA project implies the resolution of problems through a service response, which unlocks the value for each stakeholder in a value chain. This document analyses how farms can take advantage of service design for sustainable innovation of the business model. Therefore, the OPERA business model exposed here is conceived in this perspective: to support the successful development of local service providers and to give a concrete base to further development of the ICT solution. The business model consists of chosen tools to give a first operationalization to all the results and outcome of OPERA project. Furthermore, the framework of the document includes components that can help private and public sector investors understand entry point for strengthening and sustaining market development in the Agricultural Water Management sector. Notably, this deliverable describes a possible 'fair competition' business model framework, with the support of the investigations undertaken in Work Package 4 (WP4).

2. Methodology

Farms, today, are confronted with a rapidly evolving, increasingly competitive and uncertain economic environment that makes corporate decisions truly complex. Over the last few years, science and technology have shown considerable progress and, therefore, the farms must have confronted with new technologies (i.e. information, communication, marketing), global markets, *etc*. who should be able to understand and manage. Competition pushes farms to pursue profits through two main means. Firstly, the conquest of new markets by geographical expansion and/or the introduction of new products, such as new technologies or skills. Secondly, reducing costs by adoption of new technologies and new skills.

In fact, in recent years the technologies and methods for the integrated planning and management of water resources systems have matured considerably. However, only a few of them are effectively and regularly applied in irrigation decision-making processes.

Farmers, therefore, can use various tools, or work with agronomists, to create a specific economic model for their farms. The model enables farmers to evaluate how changing production practices, such as irrigation, can change their crop and whole-farm profitability, financial ratios, and performance measures. However, the effort is often time-intensive and involves sensitive information. Typically, farmers need to provide projected yields, prices, and input costs for each of their anticipated crops for the affected crop year.

Market adoption of precision irrigation for some crops in different climatic conditions requires the coordination of different technologies, information and processes through the involvement of all relevant stakeholders throughout the project. In other words, we want to form a value chain. Of course, no single member of the value chain can provide all the products and services. The goal of the precision irrigation value chain is to define more uniform solutions for farmers. Indeed, farmers are more interested in cost savings and yield-increasing potential of precision irrigation, but do not want to run the risk of new solutions until they have some proof that they work.

The farmers often look to their neighbours for this proof. In fact, farmers talk to one another when considering new purchases, the impact of one farmer sharing one “bad” experience would be much greater than the impact of several farmers sharing “good” experiences.

The Business Model concept has become one of the most important domains in the field of information systems, thanks to rapid advances in technologies. In effect, the digital era has led to the fact that the availability of appropriate levels of information and knowledge have become critical to the success of the business. In this contest, the farms are operating in a world characterized by high levels of uncertainty and competitiveness.

Farms must therefore quickly adapt to the new scenarios that are emerging in order to survive. Their ability to make a profit directly depends on their ability to respond to environmental changes with high quality business decisions. In this operation, entrepreneurs can be supported by the adoption of appropriate business models for this new, dynamic and competitive scenario (Al-Debei *et al.*, 2008).

Obviously every entrepreneur has an intuitive capacity for understanding how his business works and how value is created. In other words, (s)he has an intuitive understanding of the farm's business model, but even though this business model influences all important decisions, in many cases (s)he is rarely able to communicate it clearly and simply (Linder and Cantrell, 2000).

The concept of water use efficiency is normally used to evaluate the performance of an irrigation system. Improving irrigation efficiency is a process that can take time and can sometimes be expensive. Certainly, it requires willingness, know-how and action at various levels. The efficient use of irrigation refers to the optimal level of water applied to a crop in a particular region that produces the maximum profit or the highest crop yield per hectare of surface or per litre of water used. In this regard, often in the literature, reference is made to water productivity, defined as the quantity of food produced per unit of volume of water used.

Furthermore, it must be remembered that irrigation efficiency measurements are specific to the region not only due to the variation of the physical environment, but also because of variation in the physical infrastructure and the management capacity reflected in each region.

"The business model explains how value is created for customers and how value is captured for the farm and its stakeholders" (Henriksen *et al.*, 2012). While the concept of a business model as a "theory of a business" is not new (Drucker, 1955), business model research has only relatively recently gained the attention of many scholars (Joyce and Paquin, 2016). In fact, in the literature, the concepts of business models for setting up and analysing farms arose in the mid-1990s (Henriksen *et al.*, 2012). Many different definitions and interpretations of business models are in use; however, a common understanding of business models is obvious.

The business model is not a strategy but includes a series of strategic elements. While the term business model is widely used by professionals, its appearance in the academic literature is less common (Schweizer, 2005).

A good business model is essential to every company, because it positions the company within its value network, shows how it transacts with customers and suppliers, and highlights the products that are exchanged (Magretta, 2002). In particular, a business model makes explicit the underlying economic logic that defines how the firm creates value. In fact, many firms operate with a very simple business model: they supply a product or service that meets a consumer need and sell it at a price that exceeds the cost of production (Grant, 2008).

2.1 – Overview

"Whenever a business enterprise is established, it either explicitly or implicitly employs a particular business model that describes the design or architecture of the value creation, delivery, and capture mechanisms it employs. The essence of a business model is in defining the manner by which the enterprise delivers value to customers, entices customers to pay for value, and converts those payments to profit. It thus reflects management's hypothesis about what customers want, how they want it, and how the enterprise can organize to best meet those needs, get paid for doing so, and make a profit" (Teece, 2010).

Creating a business model is like writing a new story (Magretta, 2002). It narrates the organizational and financial architecture of a business. It clarifies the business logic required to earn profits and outline specific assumption about customers, behaviour or costs (Teece, 2010). In essence, a business model is a conceptual model of business, rather than a financial one.

Describe "how firm does business" is the main purpose of any business model. As a conceptual tool, a business model provides a great support in assess performance, management, communication and innovation of a business.

The business model construct builds upon many theories like the value chain concept (Porter, 1985), the resource-based theory (Barney, Wright and Ketchen, 2001), the strategic network theory (Jarillo, 1995) and cooperative strategies (Dyer and Singh, 1998). Further, the model involves choices (e.g. vertical integration, competitive strategy) about firm boundaries (Barney, 1999) and relates to transaction cost economics (Williamson, 1981). Porter (2001) essentially classified businesses among cost leaders and differentiators; Timmers (1998) classifies business models among degree of innovation and degree of integration. Additionally, Amit and Zott (2010) view a business model as a system of activities that depicts the way a company "does business" with its customers, partners and vendors. More precisely, as the bundle of specific activities that are conducted to satisfy the perceived needs of the customers, including the specification of the parties that conduct these activities (i.e., the focal firm and/or its partners), and how these activities are linked to each other.

However, in his research Osterwalder (Osterwalder, 2004; Osterwalder and Pigneur, 2010) believes that modern business models are increasingly complex and different variables influence its success, it could be interesting to apply a more fine-grained characterisation or classification. According to Osterwalder (2004) a business model can be defined as:

"A conceptual tool that contains a set of elements and their relationships and allows expressing a company's logic of earning money. It is a description of the value a company offers to one or several segments of the customers and the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, in order to generate profitable and sustainable revenue streams".

He proposed a standard business model on nine axes which are the nine basic building blocks of a business model. Every block is a characterisation of a specific part of a particular farm's business model. Next are the nine blocks explained (Figure 1).

As mentioned above, a business model describes "the rationale of how an organization creates, delivers, and captures value" (Osterwalder and Pigneur, 2010). In particular, the business model that we adopted in this work, as can be seen from Figure 1, constitutes of 9 building blocks:

1) **Customer Segments**: defines the groups of people or organizations a farm aims to reach and serve;
2) **Value Proposition**: describes the products and services that create value for an explicit customer segment;
3) **Channels**: illustrate how a farm communicates with and reaches its customer segments to deliver a value proposition. Channels: are customer touch points (for example communication,

distribution and sales) that play a key role in the customer experience. Channels serve several functions, including:

- ✓ Creating awareness midst customers about the farm's offers;
- ✓ Support customers to assess a farm's value proposition;
- ✓ Enabling customers to procure the products and services;
- ✓ Delivering a value proposition to customers;
- ✓ Offer post-purchase customer support.

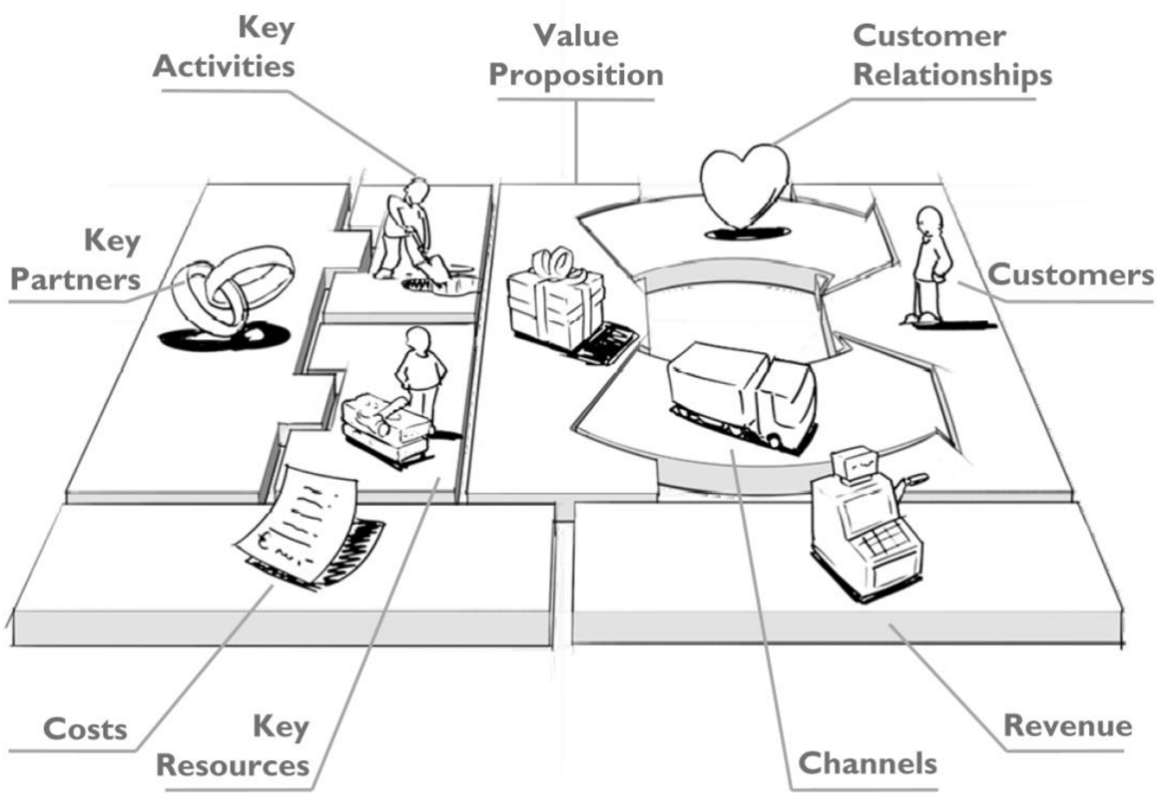

Figure 1. *The Osterwalder business model (Osterwalder and Pigneur, 2009).*

4) **Customer Relationships**: define the categories of relationships a farm establishes with the customer segments. Relationships may span from personal to automated.
5) **Revenue Streams**: describe the revenue an enterprise generates per customer segment. A business model can include two different forms of revenue streams: a) Recurring revenues from continuing payments, and b) Transaction revenues from one-time customer purchase.
6) **Key Resources**: represent the most essential assets required to make the business model work. Key resources can be either intellectual, human, physical, or financial in their character.
7) **Key Activities**: illustrate the key things a farm must do to ensure its business model work. Key activities are e.g. production, platform/network or problem solving.

8) **Key Partnerships**: represent the network of suppliers and partners that make the business model work. An organization may forge partnerships for many reasons, and are thus a common cornerstone of business models. Organizations build alliances to optimize their business models, reduce risk, and/or acquire resources.
9) **Cost Structure**: illustrates all costs incurred to operate a business model. An organization can be either cost-driven or value driven. A cost structure usually includes one or more of following characteristics of costs: Fixed costs, variable costs, economies of scale, and economies of scope.

As we have previously mentioned, various definitions of business models are available in the practical and theoretical literature. In creating this document, we mainly consider the following definition: "**a business model describes the rationale of how an organization creates, delivers and captures value**". Following the methodology proposed by Osterwalder, we have identified the main elements of our business. First, we defined who the customers are and their needs in relation to our expertise. From this analysis we deduce the type of products and services we can provide them, the value proposition. The way the products are promoted and distributed is then described along with the expected interaction between us (the Local Service Providers) and the users (e.g. farmers, irrigation water managers).

The following step consists in describing the organization of the Local Service Providers' activities (key resources, key activities and key partnerships) in terms of necessary and/or desirable characteristics. Additionally, we consider potential competitors and complimentary services already available to the users. We conclude with a financial analysis and recommendation for implementation.

The value proposition represents the core of the work. It is defined as the products or services that create value for a specific segment of customer. Value is created to solving problems and addressing to specific needs of the users. In a sustainable business model, the value proposition would provide measurable ecological and social value in concert with the economic one (Boons and Lüdeke-Freund, 2013).

An additional contribution to the sustainable business models is given by Joyce and Paquin (2016). They identified a further development of the business canvas proposed by Osterwalder: The Triple Layered Business Model Canvas. It is a tool for exploring sustainability-oriented business model innovation. It extends the original business model canvas by adding two layers: an environmental layer based on a lifecycle perspective and a social layer based on a stakeholder perspective. When taken together, the three layers of the business model make more explicit how an organization generates multiple types of value – economic, environmental and social. In our work exploring the environmental context is essential to guarantee a correct product development.

So, a business model is not just about technology anymore. It can be sustainable. Business model innovation for sustainability are defined as innovations that create significant positive effects or reduce negatives impact for environment and society (Boken *et al.*, 2014). A sustainable business model creates comparative advantage for users by contributing to a sustainable development (Boons and Lüdeke-Freund, 2013) and it is a useful tool to coordinate technological and social innovation with the desired level of sustainability.

Looking at the literature, our business model can be classified as an archetype that develops scale-up solution. With this kind of business model, it is possible to “deliver sustainable solutions at large scale to maximise benefits for society and the environment”. This definition perfectly fit into our aim of operationalize specific methodologies that will benefit agricultural water managers and will create a new practice of sustainability in water management.

Table 1. *Sustainable business model archetype “develop scale-up solutions”.*

Value Proposition	Value Creation & Delivery	Value Capture
Scaling sustainability solutions to maximise benefits for society and the environment	Ensuring a sustainable business model solution can achieve scale by employing the right channels, and partnering with channels, and partnering with others. New, and potential unusual partners (e.g. government for infrastructure change) and business relationships are required to scale the business.	Ensuring a variable (e.g. franchising, licensing) or fixed (mergers and acquisitions) fee is paid for scaling up a solution/venture and that other mutual benefits between partners are achieved through scaling up (e.g. market penetration).

The value delivered by a scale-up solution business model is maximised by the opportunity to use open innovation and give free access to information. Moreover, the broad participation of stakeholders increases the value of the business model.

In this regard, our business model outlines how one should operate to generate a positive return on investment, creating market opportunities for water management technologies and meet sustainability objectives. It also identifies ways to build on strengths, mitigate threats and/or risk, and ultimately capture the benefits from all the market opportunity in this context.

During the last years, the academic discussion has shifted away from goods dominant logic and the traditional thinking of sequential value creation process to new business logics that emphasize customers’ active role in value creation.

In our analysis on the business model, great importance was given to customer / market orientation. Indeed, market orientation emphasizes both market information and customer needs.

Therefore, in a context in which market orientation represents, among other things, the generation of market information on the current and future needs of customers, customer / market orientation represents a dominant view of supplier. This is because the attention is focused on the specific “needs” of the customers defined by the firm, rather than on a profound vision of the contexts, logic and patterns of activity of the clients. Service marketing empirical literature places a certain emphasis on customer perception of services. In particular, this activity shows several researchers engaged in measuring both perceived quality and perceived value. This made the customer the judge of the service provider’s actions. The latter is therefore faced with a really challenging task since different customers may have different expectations. Customer relationship management plays a crucial role in defining the success of a project idea, that is, an offer from a company designed and built to meet the different needs of customers. Even though "the offer" is focused on customer-specific solutions, the starting point is still the firms' capabilities and resources, not the customers' business (Strandvik and Heinonen, 2015).

In addition to the criteria described above, an attractive and viable business model aims to promote an economic return on investment. The financial viability is also linked to the financing, institutional and regulatory factors, because it uses information on market and financial drivers (e.g., interest rates, insurance, payment schedules, licensing fees, taxes, *etc.*) that emerge from those sectors. Furthermore, the financial viability for irrigation also depends on the objectives of the business implementer. The objective may be a comparative increment in economic benefit, but does not necessarily imply profit maximization. Technology suppliers, individual or groups of farmers, irrigation service providers all have different investment options and potential returns. Investors such as donors and governments might also support business models that have multiple aims, such as improved livelihoods of smallholder farmers, improved health and nutrition, or reduced agricultural greenhouse gas emissions, *etc.*

2.2 – Data input

The growing integration between science and technology presents important aspects of integration between the scientific and economic actors, as well as public and private entities. In particular, the scientific content of new technologies has been raised and, at the same time, the technological content of the scientific approach has increased. For this reason, the more the productive activities become frontier, the more the acquired knowledge should be systematically structured and the methods become common to those who produce the knowledge and to those who apply it.

All this contributes to the acceleration of production processes, to the dissemination and enhancement of knowledge and a set of other conditions that generate new opportunities for research actors, including those dedicated to its economic and social development.

However, doing research requires substantial investments in highly technological sectors, the involvement of highly qualified human capital and the maintenance and updating of structural and infrastructural equipment. This is why in planning a scientific infrastructure we must also envisage investments aimed at reducing the level of obsolescence.

The success of innovation projects is evaluated based on specific measures. Most of these measures concern quality, safety, functionality, time and, above all, costs. In fact, estimating costs can be considered one of the most important activities needed to succeed in innovation projects.

The cost analysis (and also that of the benefits) is the process of using theory, data and models to study products, services, exchanges and activities for measuring relevant ideas and alternative solutions in order to support decision-makers in choosing the most appropriate alternative.

In socio-economic sciences, studies on the process of developing an innovation (such as the technological efficiency of irrigation proposed in the OPERA project) within a system have become increasingly important.

Schumpeter (1942), in the early twentieth century, was among the first to analyse how farms make a decisive contribution to making an invention become innovation (through a process of "creative destruction") and then spread into an economic system, through some social evolutionary dynamics. In the "development theory" he states that the real objective of the farm is not to maximize profit, but to introduce elements of innovation to compete on the market in a dynamic way, in order to differentiate from others. Profit maximization is the logical consequence of this process.

One of the most important problems that researchers face is the choice of the most appropriate research method for the observed phenomenon. Harrison *et al.* (2007) argue that one can choose between theoretical analysis and deduction, or empirical analysis and induction. The first alternative implies questionable validity of the conclusions, which might require further empirical inquiry. When the second alternative is concerned, the problem is accessibility of data from companies. Even if reliable data is available, the most appropriate method of data gathering and analysis must be carefully chosen.

The information provided in this document is based on the experience acquired in the case studies, in the context of OPERA research projects dedicated to irrigation water management and to research and technology transfer to application. We dispense a questionnaire for each pilot area that was articulated in five parts providing multiple-choice questions that represent the basic set of common information to all the pilot areas. Variables were classified in four categories as follows:

A) **General information** that allow characterizing the users profile, providing basic non-economic information about the infrastructures, facilities and skills.

B) **Description of value proposition**, providing non-economic information about products & services that the Service Provider intends to offer, including alternative technical solutions, their strengths and weaknesses.

C) **Demand analysis**, including the **description of the users** and their activities/expectations, as well as providing non-economic and economic (e.g. willingness/capacity to pay) information about the potential local/regional or national market.

D) **Finances**, providing qualitative and quantitative (when available) economic information about Operation and Maintenance (O&M) costs, investments costs, funding sources and availability and cost of capital. Additionally, it provides economic information about the potential market.

This document is based on this information and reports our interpretation of the current situation.

In order to facilitate cost information accessibility and interpretation, it would be interesting to associate this information to the corresponding elements of the business process model. Indeed, this enables decision makers to easily have accurate cost information about each element of the business process model.

Business analysis involves understanding how organizations function to accomplish their purpose, and defying the capabilities an organization requires to provide products and services.

Business Model Canvas (Figure 1) is a tool to map a business with its nine building blocks that is able to give the corporate a clarity on what its key activities, key resources, main partners, customers, its proportion of values, the way it relates to the customers, the financing structure and the revenue source of the business.

OPERA project has not produced a universal Decision Support System (DSS) but, we collected and showed applications of components that could later be used for a development of a DSS.

3. Analysis and results

Climate change, water supply limits, and continued population growth have intensified the search for measures to conserve water in irrigated agriculture, the world's largest water user. In fact, irrigated agriculture is facing rising competition worldwide for access to reliable, low cost, high quality water.

Policy measures that encourage adoption of water-conserving irrigation technologies are widely believed to make more water available for cities and the environment. However, most farmers' concepts of water efficiency are linked to maximising the farms' economic productivity rather than saving water per se, except perhaps when their own allocated resources may be inadequate.

This chapter presents results of our analysis. In particular, we provide a more detailed description on the key elements of the business model, that analyses an adoption of more efficient irrigation technologies, just as the OPERA project does.

3.1 Users and their needs

The scope of this section is to define who would be willing to pay for the service identified in each pilot area of the OPERA project.

The OPERA users and stakeholders will be all those who manage water resources for irrigation purposes and those who make decisions or policies about irrigation water resources management. This covers all scales from farm to irrigation scheme and on to river-basin or country. The user that will benefit from an OPERA final product will be farmers, water managers and policy makers from regional and national governing bodies and water user associations.

In facing climate change and water scarcity the stakeholders involved in water management need to have access to a great deal of information coming from different sources. Weather forecast, status of crops, irrigation advices, or informative workshop are all tools that facilitate users in irrigation management. In Figure 2 we provide a general synthesis on who the users are and their main needs.

In this regard, in our analysis, once we identified the main actors in the management of the irrigation system, we talked and, above all, we listened to them in order to identify which are the main technical solutions in which they have a greater interest.

The problem in this type of analysis is that the human beings are often not well able to make rational decisions involving more "dimensions". In fact, as soon as one comes up against a decision with more than two dimensions, the unconscious loses rationality and is alienated from the decision to be made. In theory, "our listeners" were aimed at reducing decision distortion, structuring the conversation in such a way as to help the stakeholders reduce their decision bias.

Individual experts' experiences are utilized to estimate the size and relative importance of the individual structural and functional characteristics that each project must have to guarantee the agreement between the parties involved. In other words, it means wanting to visualize the problem from different perspectives, thus reducing the prejudice of each individual.

In particular, after having introduced the research project and its objective, were asked the stakeholders to express their opinion on the design idea proposed.

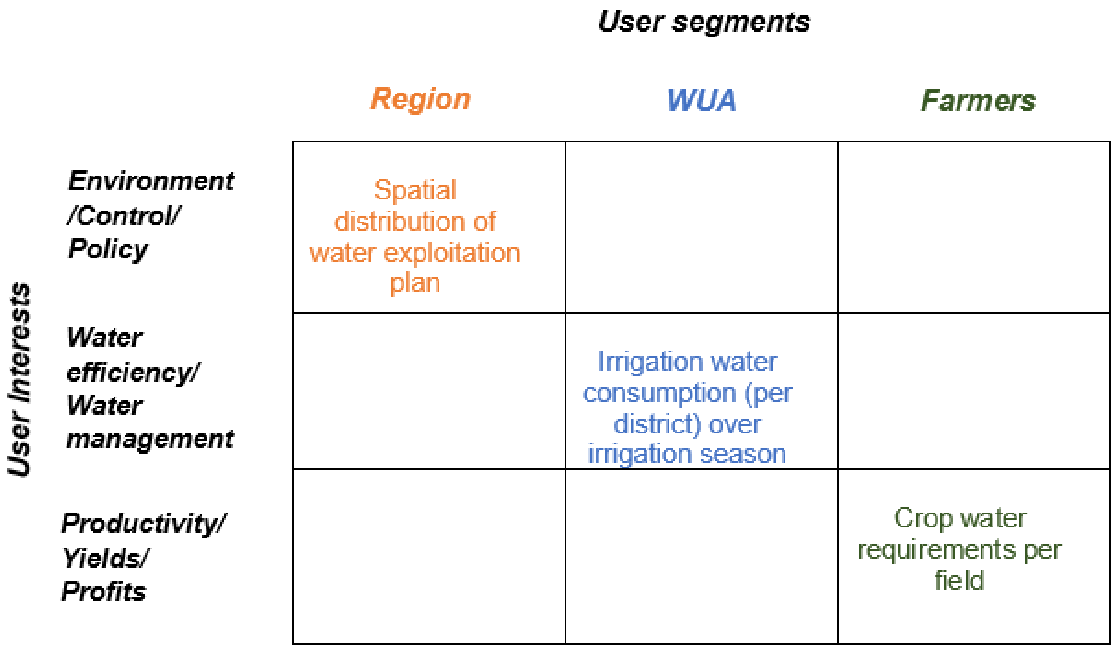

Figure 2. *User segments and their needs.*

According to the interviewed stakeholders the OPERA project could make several improvements to the irrigation practice. Among these, the following are worth mentioning:

- ✓ Improving easy access to the information. Refers to the ease of access to information for farmers, either through electronic information (sms, email, *etc.*), more traditional communication systems, technical operators and journals, newspapers, etc.
- ✓ Ensuring coherent data and data reporting. Refers to the ability to implement an IAS based on high quality data providing valuable technical information to farmers.
- ✓ Improving delivery efficiency. Refers to ability to ensure prompt and constant delivery of information to farmers.
- ✓ Improving private and public awareness. Refers to improving public awareness and preparedness by informing the public about the risks and consequences in cases of excessive use of water for irrigation related to environmental and economic phenomena (e.g., water scarcity, conflict for use of water with others economic sectors).
- ✓ Assuring economic sustainability. Refers of cost of IAS that should be economically justified (i.e. economically affordable).

In particular, to develop a scale-up solution suitable to all end users, we have evaluated the needs coming from the six case-study areas involved in the project. In each pilot area the end users are involved in the development process through a transdisciplinary approach. The description of the users and their needs is generalized in the next section.

3.1.1 Evidence from case-study areas

In the OPERA project six areas are involved in which the need of the main water users was evaluated (Figure 3). A total of 123 stakeholders from different sectors were identified and selected to participate in the questionnaires elaborated by identifying the needs and demands of the users. Stakeholders will be involved during the project lifetime as final users of the proposed methodology. A group of end users is represented by farmers, technicians or advisors of agricultural extension services and research units, who will be supplied with high quality information for supporting short- and long-term decision-making process. In order to promote an efficient and effective interdisciplinary research foundation, the stakeholder and institutional analysis was designed for the case study partners to lead the analysis for their own study.

Figure 3. *Map of the involved area.*

First, we provide a general description on the case-study areas and then we report a brief resume of the questionnaire outcomes that underline needs and limitation identified by the stakeholders.

1. The users in the **French** pilot area (Crau aquifer and Ouveze river basin) are farmers, irrigation association, water agency, aquifer syndicate, municipalities, and the “Chambre d’Agriculture du Vaucluse”. Due to climate change, water tension is expected in this area. So, water uptake will be renegotiated and irrigation will be regulated at the territory level.

The options that allow a better use of water irrigation were evaluated by the stakeholders. The results of questionnaires showed two main options that stakeholder select to allow a better use of water irrigation: “Optimization of irrigation dates and doses” and “Improvement of irrigation infrastructure”. Here, the identified needs of the users are: direct access to easily use information, and availability of affordable irrigation technologies. In the case of France, the analysis showed that those involved in irrigation management are willing to pay for the following products, services and technical solutions: Improving water management activities; Improving water use efficiency and production performance; Reduction of production costs; Drought risk assessment; Damage assessment.

2. The **Italian** case study is localized in Campania region. The main need is to optimize water usage in an area under significant hydro-climatic uncertainty. This implies a strong decision-making process that should increase efficiency of irrigation and reach sustainability targets.

   For the interviewed Italian stakeholders, the main limitation to improve irrigation efficiency related to the costs and administrative/legal constraints. The results of the questionnaire highlighted that the stakeholders preferred improvement of the irrigation strategy and of field infrastructure, but also change in the crop/variety versus the increase on the crop density. According to their preference and needs, an advice tool should include costs/benefits associated to improvement of the field infrastructure, prediction of water demand along irrigation season and advice on alternative crops/varieties. In Italy the analysis showed that those involved in irrigation management are willing to pay for the following products, services and technical solutions: Improving private and public awareness; Assuring economic sustainability.

3. In the **Poland** case study, located in two river catchment Zglowiaczka and Upper Notec, various user segments were identified: individual farmers, water associations, regional agricultural advisory centres and local policy makers. The main issue to take on is the reduction of crop water shortages through the optimization of irrigation and the stabilization of crop yields.

   According to the limitation identified by the stakeholder, to improve water efficiency is necessary to reduce the costs of irrigation technologies while increasing the availability of a catalogue of the best technical and organizational solutions. Also, to reduce the administrative limitations (obtain a water intake permit is long and complex). The options preferred by the stakeholders to increase the water efficiency were improvement of the field infrastructure and improvement of the irrigation strategy. In addition, limitations for adopting alternative crops/varieties were identified by the stakeholders. In particular, they indicated the uncertainty of prediction on market demands as well as the knowledge/advice on suitable alternative crops in relation with plant physiological requirements, soil and climate characteristics. The stakeholders identified a lack of specific information on water, fertilizer and cultivation requirements for alternative crops or varieties or lack of sufficient training. In Poland, those involved in irrigation management are willing to pay for the following products, services and technical solutions: Ensuring coherent data and data reporting; Improving delivery efficiency; Assuring economic sustainability.

4. In **South Africa** (Breede River catchment) the users are farmers, officials in the water sector, consultants and academics. The aim is to improve irrigation requirement info for planning during water shortage periods.

   Most farmers were of the opinion that improving field infrastructure, adapting their irrigation strategies and reducing the cost of technology are the best ways to improve efficiency. Their main needs are related to knowledge and competitiveness. Innovation and sustainability could be used as an engine for local farmers' development while information on new technologies and more adaptable crops and staff training are needed. In the case of South Africa, the analysis showed that those involved in irrigation management are willing to pay for the following products, services and technical solutions: Improving water use efficiency and production performance; Reduction of production costs.

5. **Spain** case study in Andalucía involves farmers' associations, irrigation associations, local policy makers and NGOs. Different tools and programs (RECARE, RestEco, EU-HYDI, CarboSoil, Cambio de Usos y Servicios Ecosistémicos) are employed to optimize water use to face present drought and future predicted severe water scarcity in the Mediterranean area.

   For Spanish stakeholders the main limitations to improve water efficiency are high cost of infrastructures and technologies, lack of help from the public sector and also market uncertainty. In this framework, their needs are an improvement of the field infrastructure, new irrigation strategy and change in the crop selection versus the increase on the crop density. In addition, the preferred options that an advice tool should include are "costs/benefits associated to improvement of the field infrastructure" and "the irrigation strategy" also. In Spain, on the other hand, those involved in irrigation management are willing to pay for the following products, services and technical solutions: Improving water management activities; Improving water use efficiency and production performance.

6. In **The Netherlands** the research area is the potatoes farm Van den Borne in Reusel. The user involved are farmers and meteo service. To improve water use efficiency in agriculture the method employed in the case study was to use weather forecast ensembles to predict future (up to 15 days ahead) temporal dynamics in the root zone. Local soil sensors were used to check the validity of the predictions by the SWAP model (Soil, Water, Atmosphere and Plant).

   The questionnaire highlighted that the main need is to acquire information and knowledge on new technologies and crop varieties. Dutch farmers in fact, are willing to use new technologies to improve water efficiency and crop productivity. There is not much investment of farmers in knowledge development because most of them are conservative regarding their farming system and a serious limitation is market demand uncertainty. Finally, in The Netherlands, those involved in irrigation management are willing to pay for the following products, services and technical solutions: Improving private and public awareness; Improving delivery efficiency; Assuring economic sustainability.

Broadly, stakeholders observe several factors constraining private sector market expansion: affordability (cost of the technology relative to farmer income levels), awareness (knowledge about the technology), accessibility (options for obtaining the technology), and lack of customization (capacity to match farmer needs with technological solutions).

3.2 The Value Proposition

According to Osterwalder (2004) "Value propositions are products and services that create value for specific customer segment". In other words, it describes the way a firm differentiates itself from its competitors and is the reason why customers buy from a certain firm and not from another.

The general concept behind the operative service proposed in OPERA is based on the following key elements:

1. To provide **a new ICT product** that integrates the currently available technologies on the market.
2. To realize a better advisory service in the agricultural sector that can lead to a better water demand management and improve the customization of the service by making them more useable, convenient and attractive.
3. To help the farmers to **optimize** irrigation and consequently to **reduce the production costs**.
4. To **provide accessibility to advisory service to large areas** and to more users, including multiple user segments.

The OPERA research group aimed to demonstrate how a combined use of mechanistic models (soil + crop) of crop response to water stress, meteorological data (short and long-term predictions), soil and crop sensors (at local scale), and remote sensing data (at larger scale) can be realized to better determine crop water needs, and transferring research results into an operational practice for irrigation scheduling.

In implementing value proposition, must be concentrated strives on integrating available services in a complete ICT tool adaptable to a wider range of users involved in water management.

In fact, we focused attention on the customization of products and on the improvement of existing methodologies, including testing and adapting models and processes to different environments through the research in our different case study areas. The main scope for this customization process is to improve the usability of the services, while improving the models would provide better results from a quantitative perspective. OPERA's ambition was to elaborate a technical concept capable of supporting water users in more robust decision-making and irrigation management, particularly under the anticipation of climate variability and critical moments of water scarcity.

Practically, an OPERA-LSPs Decision Support System (DSS) should have been (or should be) proposed. A DSS is an IT architecture that can support the user by providing him with a valid support. The instrument works with a decision maker who can provide indications on:

- the availability of all the information necessary for understanding the problem;
- the ability to explore data from different points of view and based on user needs;
- the possibility of evaluating the scenarios resulting from the choices.

In agriculture and in irrigation management a DSS is a powerful tool. It supports the farmer or technician in maintaining control over all the information necessary to make decisions; it helps the farmer or the technician by providing numerical forecasts, even in the very short term; can be managed remotely; it is useful to predict scenarios; it stores all the information by creating a historical database. The use of a DSS in irrigation allows to have a more sustainable water management.

OPERA-LSPs (designed but not implemented), should store and use all the information provided by LSP, so as to be able to give an immediate response to users. The tool should be available in the six areas involved in the project: in each of them the DSS should use the specific methodology identified in the research phase.

3.2.1 What it's our value added?

The value added of OPERA-LSPs product should derive by the operationalization of the data and experiences collected in the six case studies. The new knowledge created by the experiences represents a great advantage compared to the one of our competitors. OPERA-LSPs tools should provide to collect all the information provided by our LSP in the countries involved in the projects. Furthermore, the information should be elaborated and returned to the user with a practical irrigation advice. Therefore, Local services providers play a key role in the entire process because they should allow us to develop a large-scale solution. Value is brought by the participation of international stakeholders as well. In fact, the consortium of scientific parties and SME's utilize joint experience in stimulating business development from different countries and success stories, how public investment can leverage private investments and how to realize a stronger implementation of future public private partnership projects in the field of managing water scarcity and drought. Principally, a harmonization of research, data and experience is one of the strength of the project. Finally, a prototype interface of OPERA-LSPs should be proposed to provide the needed accessibility of the information. In fact, an intuitive interface allows the users to use the products in the easiest way and to visualize complex information in a simple graphic vest.

3.2.2 Competitor analysis

The technological tools designed within the OPERA-LSPs are unique and differ from other available products for some characteristics as for the integration of different technologies in a unique and complete product. The use of remotely sensed data at high spatial and temporal resolution and their integration with field agro-meteorological measurements, weather forecast, and its participatory approaches results in an innovative technological solution. Alternatives and/or traditional methods are however available to users in some cases. These can provide crop water requirements or similar information for water management purposes.

Table 2. *Summary of irrigation advisory services that are complementary to OPERA-LSPs, possible threats and potential integration.*

Competitors /Alternatives	Strengths	Weaknesses	Threats for OPERA	Partnership potential
On-farm consultancy service	Direct/personal contact with the users (mostly at farm scale); High customization; Specific knowledge of the territory	Service delivery is subject to the consultant´s time-table; Service is related to the consultant´s skills; It can be subjective; Limited infrastructure; Expensive	Long running and well known and accepted; Small enough to adapt quickly to specific problems; Extensive experience; Focused on small areas and specific crops	Focused on small areas and specific crops of OPERA products
In-field sensor-based irrigation management	Precise measure at plant/field level; Actual water stress measure; Direct connection with irrigation management software	Difficult to derive spatial variability and to monitor large areas; Requires extensive knowledge of sampling methodology and technical field competences; Expensive	Focused on small areas and specific crops	Integration of OPERA products with field sensors/controlling devices
Not EO-based irrigation advisory services	Easy to register a new account/user Information simple to read; Low operational cost; Cost independent from the number of users; User driven: user can input irrigation, precipitation; Based on a water balance model; Estimation of water stress	Requires up-to-date crop type information; Difficult to derive spatial variability; Only some information is spatialised; Based on standard crop coefficients (non-calibrated locally); Aggregation of water use at basin/district scale is limited; User interface and communication channels are limited	Easy to replicate and produce; Extensive distribution; Cheap to run Requires a minimum of knowledge of information technologies	Evolution and integration with OPERA products

We identified three main alternative products that are established at farm and field scales:

1. On-farm consultancy services: it is based on the guidance of professionals often hired directly by the farmers for specific water management or, more generally, for integrated crop management, including fertilizer, diseases and production quality monitoring.
2. In-field sensor-based irrigation management: it comprises the installation of dedicated agro-meteorological stations, including in-field point-based measurements of soil moisture. This technique is often applied for site-specific irrigation management or deficit irrigation of high-value crops, such as in the case of vineyards.
3. Non Earth observation (EO)-based irrigation advisory services: the calculation of the crop water requirements is based on standard FAO-56 crop coefficient tables. The knowledge of the spatial distribution of the crop types is necessary for the application of this approach at field and/or at catchment scale. Land cover and use are often based on the seasonal farmers´ declarations or, rarely, on image-based classification approaches.

3.3 Key activities

In this chapter we are going to explain the key activities. These are the most important tasks that must carry out in order to fulfil OPERA-LSPs business purpose.

1) The first key activity in developing our product is the **identification of the Local Service Providers** in each case study area. LSP must bring value to the product by providing processed high-quality information.

2) **Defining the resources needed** for proper functioning of the system that would enable realization of the value proposition.

Access to financing represents a great challenge to scaling up agricultural and irrigation technologies, therefore, to identify the financial mechanism is an essential step in the business model development. The framework includes *finance mechanisms* as a component, recognizing that the institutional, policy and regulatory context influences financing, but also that finance mechanisms affect supply chain development. Financing deserves closer analysis as it is essential to catalyse the scaling up of small-scale irrigation technologies. Therefore, the effects of financial drivers are considered in the analysis and include (Otoo et al., 2018):

I. financing mechanism options available and suitable for key actors in the value chain;
II. level of awareness about the technology and market among financial institutions;
III. interest rates;
IV. terms of payment; and
V. insurance availability, among others.

Different finance mechanisms can include national direct and indirect support programs, such as credit guarantee funds, value chain financing and price smoothing. In doing this it is important to evaluate the economic and financial climate of the interested countries, which influences the probability of private sector engagement but also, we need to look at the institutional and regulatory context. Government and public funds, private financing or loans and microcredit are the best financing options chosen to acquire the financial resources to operationalize and commercialize our product. Also, providing direct financing to the farmers is an option.

3) **Develop the ICT solution at programming and graphic level and then complete the products by introducing the information provided by LSP**

There are different types of methods for irrigating farm fields for different types of crop fields. Alongside traditional systems there is obviously also a new intelligent irrigation system.

In this new irrigation system, the technology helps the farmer, by sending “messages and/or alerts” that inform him about the conditions of the farm field and crops in order to reduce water waste and intervene only when really necessary. Is helping sustain healthier landscapes and a healthier planet.

Existing irrigation technologies are well advanced and would conserve large amounts of water if fully implemented. Adoption of this technologies could potentially extend these water savings even more.

Some of the most common reasons for farmers to invest in advanced irrigation technologies are to:

1) reduce labour costs;

2) minimize water costs due to pumping (higher irrigation efficiencies);
3) improve farm field scale yields with better application uniformities;
4) use the saved water on other fields (often referred to as water spreading).

However, acquisition of an advanced irrigation technology does not always result in improved levels of management, which is often due to a lack of time by the operator to devote to better management or a shortage of appropriate scientific agronomic and irrigation knowledge by the operator.

Experience of the authors indicates that new agricultural technologies must overcome several stumbling blocks or expectations, all of which must be individually addressed in order to be accepted by producers. To be successfully adopted the new agricultural technologies farmers expect that it will meet some of the following criteria, for example (Evans and King, 2010):

1) to do what they are designed;
2) to be flexible to meet farmer's expectations;
3) to be easy to use;
4) to be intuitive to operate for the end user;
5) to have good data management and interpretation capabilities and for future evaluations and analyses of the results;
6) reduce production costs and increase net returns.

In developing this project, we believed, from the very beginning, that it is our responsibility to develop or to contribute to the developing of products and technologies that use water efficiently. So here we also designed a smart irrigation technology in low cost which is usable by farmers.

The work carried out highlighted how some specific tools are needed for continuous commercial development which, in turn, will be necessary for the prolonged adoption of the technology conceived in the OPERA project. Therefore, it will also be necessary to propose an integrated decision support systems guideline (OPERA-LSPs) also in terms of graphics, which was subsequently completed by introducing the information provided by LSP.

4) Identifying the willingness of the users to adopt the service and define a price for the service

Considering that OPERA-LSPs proposed should have different services related to different information, a good solution to reduce costs for the users is to adopt a pay-as-you-go or buy-as-use strategies. These strategies should allow to users to pay only for the service (or more than one) they chose to use and for the period that they want. Specific tariffs and offers will be listed.

5) Testing phase

The stakeholders previously involved in the OPERA project will be the first tester of OPERA-LSPs solution. Test phase should last among 1 to 3 months. This period should be used to resolve eventual problems related to system bug, malfunctioning, information upload and graphic problems. The testing phase ensures the good functionality of the product and establishes its prompt marketing.

6) Commercialization of the products and publicity promotion

OPERA-LSPs contents should be accessible through an on-line platform (Figure 4). The users will be able to subscribe to the service or enjoy a free trial simulation. To help the user in understanding the functioning of our DSS, as we have already seen before, should be a technical guide that can be downloaded.

Figure 4. *Example of a proposed OPERA website homepage.*

The user guide should provide information on the applied methodology, the explanation of the available indicators and finally a technical manual with all the instructions to download, install and work with the software. Figure 5 show a possible preview of the contents of the user guide. The user guide should be a powerful tool in order to introduce the user to the practical functioning of the DSS. It should be organised in sections that examine in depth different topics. For the first, it should have and introduction paragraph with a detailed description of OPERA project and a fist overview on the OPERA DSS tool. The second section "Methodology" should recover all the methodology used in the six case study areas and to collect the information available in the DSS. "Performing indicators" paragraph should provide a detailed description of all the indicators consultable in the tools in order to guarantee a better comprehension and usage of them. We should provide these information as open access knowledge.

SUMMARY

INTRODUCTION ....
METHODOLOGIES ....
PERFORMING INDICATORS ....
  Data made available by OPERA....................
USER TECHNICAL GUIDE....................
  Download and installation ....
  Access and configuration ....
  Basic features....................
  Input parameters....................
  Elaboration....................
  Analysis and evaluation of results ....

Figure 5. *Example of how the contents of user guide could look like.*

The second part of the document should illustrate the technical steps to download, install and use the application. The usage part is completed with instruction on the DSS tools for elaboration and its plug-in. A final paragraph should be dedicated on the analysis and the interpretation of the results obtain by data elaboration. The guide should be enriched with illustrative figures that show the processes step-by-step.

3.4 Key partners

The business model element that plays an important role is that of the key partners. This is understandable since one of the fundamental bases of this business model incorporates the collaboration between two or more products and / or services.

Key Partnerships offer the opportunity to create more flexible business models and may allow structural change and the development of more appropriate business models for the consumer.

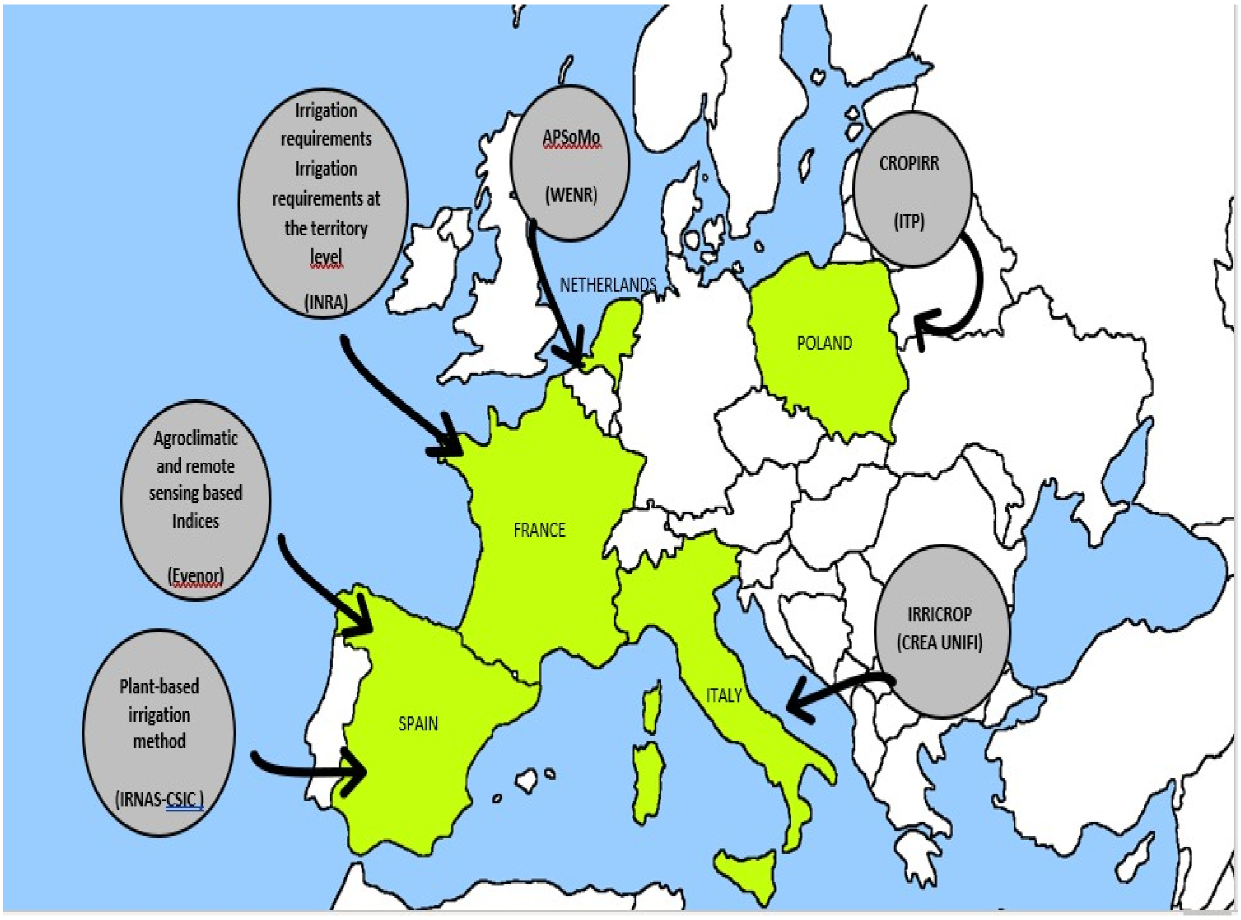

Figure 6- Geographical distribution and name of the partners

3.4.1 Project partner

OPERA consist in a consortium of national and private research centers and SME's that will bring an added value to the WDI Agenda by integrating efforts from different EU member states and South Africa. All the partners have great an experience in efficient water management.

Here we briefly present the partners and their main tasks implemented during the project duration.

All the partners actively contribute in the project development adding precious contributions through their experience and reliability.

Table 3. *Partners description.*

Name	Country	Description
Evenor Tech (Evenor)	Spain	Evenor-Tech, is a Technology-Based Company and belongs to the sector of ICTs applied to land use planning. It provides a combination of technical and R+D services to contribute towards advanced and sustainable land management both for public and private sectors.
Wageningen Environmental Research (Alterra)	The Netherlands	Wageningen Research is a center specialized in agri-food research and education. Alterra is coordinator of the European WSSTP Working group "Water and AgriFood" which enables access to a large network to disseminate results.
Stellenbosch University	South Africa	The University is amongst South Africa's leading tertiary institutions based on research output, student pass rates and rated scientists, and is recognised internationally as an academic institution of excellence.
Instituto de Recursos Naturales y Agrobiologia de Sevilla (IRNAS – CSIC)	Spain	It is a research center of the State Agency Spanish National Research Council (Consejo Superior de Investigaciones Científicas, CSIC), attached to the Ministry of Economy, Industry and Competitiveness. The purpose of the IRNAS is to conduct research on the use and conservation of soil-plant-water natural resources, focusing mainly on tackle problems derived from their exploitation in arid and semi-arid areas.
French National Institute for Agricultural Research (INRA – EMMAH)	France	INRA is Europe's top agricultural research institute and the world's number two centre for the agricultural sciences.
University of Florence (UNIFI)	Italy	The University of Florence is an important and influential centre for research and higher training in Italy.
Council for Agricultural Research and Economics (CREA) – Research Centre for Policies and Bioeconomy (CREA-PB)	Italy	Main Italian research institute for agriculture, supported by the public Ministry of agricultural policies.
Institute of Technology and Life Sciences(ITP)	Poland	ITP as independent, non-commercial research and development unit (R&D) under the Ordinance of the Minister of Agriculture and Rural Development. The Institute conducts research and development in the life sciences and technology among the others in: protection, landscaping and infrastructure in rural areas, water resources management in agriculture, irrigation and drainage, agro-ecosystems, permanent grassland.

In implementing the project, a specific work package it was assigned to each partner. IRNAS (Spain) is responsible for WP1 - Identifying sector needs to increase resource use efficiency; INRA (France) for WP2- Forecasting water availability and critical water demand; ITP (Poland) for WP3-Guidance for optimal irrigation water strategies (case studies): CREA (Italy) for WP4 - Conceptualization of practical service models and finally ALTERRA (The Netherland) is responsible for the WP5- Project management and dissemination.

3.4.2 Local service providers

Local service providers (LSPs) are small-medium enterprises and local regional-based commercial and academic laboratories – operating according to different governance and business models.

Within OPERA, Local service providers are those who:

1) furnish products dedicated to sustainable irrigation water management, like maps detailing irrigation water requirements in different areas, crop water consumption estimates, and a range of additional information products in support of sustainable irrigation water use and management;
2) Are responsible for producing customized and integrated services;
3) engaged in providing high quality standards, and in respecting data regulations and fair competitiveness in the provision of the service.

OPERA-LSPs have a leading role in the project by providing services needed to develop our operationalized methodology.

1. ***Satellite data providers***

Satellite data are the basic information used to derive value added products and services. A partnership might be important to guarantee special conditions for data delivery (including cost). Often, multi-seasonal contracts might already offer the opportunity to obtain data at a discounted price. Significant new opportunities will arise with the advent of Landsat 8 and Sentinel2 data.

2. ***Agro-meteorological service***

Weather data represent the key dataset for the calculation of the reference evapotranspiration and precipitation. Service providers with no expertise or interest in developing the “agro- meteorology” sector as an internal resource might acquire data from the local/national agro- meteorological services or from external partnerships.

3. ***Research institute and academic***

Research institutes might open to new mutual opportunities to test and apply theoretical approaches and to develop and advance applications. This offers also opportunities for personnel exchange and possibilities for students to work on applied problems.

4. ***Existing advisory or extension services***

Their current services are normally based on field data and/or FAO procedures. Some have already entered in strategic partnerships with nearby research institutes and/or universities and are generally open to extend their capacity to include satellite-assisted services.

3.5 Key resources

Key resources are the resources that are necessary to create value for the customers and support the business. They represent essential elements in terms of people, technologies, data, facilities and equipment need to run the project operational step.

1. People and technical capacities are the main pillars of the OPERA service. Key figures are: a) project managers for supervision and work organization; b) a geo-informatics or remote sensing expert for data processing and management and c) a user support specialist for acquisition of user requirements and feedback d) researcher (agronomists, meteorologists, *etc.*)
2. Data: EO-data and non EO-data:
   a. Earth observation data to cover the area of interest with adequate temporal and spatial resolution; Sentinel 1&2 and Landsat 8 remote sensing data to monitor evapotranspiration and crop water stress.
   b. weather data from local agro-meteorological stations to anticipate climate variability and reduce the risk of drought and water scarcity;
   c. Geographic Information System of the irrigation unit boundaries, including farmers´ database or irrigation scheme;
3. Image processing software (i.e. Erdas, ENVI, ArcGIS or open source solution);
4. Surveying (GPS) and field equipment (LAI, spectroradiometers) for model tuning and validation purposes.

3.6 Market channel and strategies to communicate with the users

OPERA-LSPs prototype was developed directly with the farmers and the water managers through a transdisciplinary involvement process. After a development research stage, we deliver an operational methodology to the users to improve production as well as to reproduce successful cultivation and irrigation experiences.

OPERA-LSPs product should be delivered to the final users through the creation of an on-line platform. The website should contain all the information about the projects, information about the tool and how to use it and the instructions to download it. A section should be dedicated to explaining cost and tariffs of the service. Also, a free simulation page should be available to try the product.

The market strategy should be structured to disseminate the results of our research and to commercialize the final product. It should be provided for different steps:

a. **Presentation workshops** with the users involved to present them the final product, its functionality and potentiality and discuss about its usage and benefits
b. **Scientific conference** to present the results of the entire OPERA research process and to introduce into the scientific community OPERA-LSPs. This step is fundamental to encourage scientists and researchers to carry on future research to implement the technology available and to extend the operational area.

c. **Workshop to collect feedback** from the stakeholders that already use ICT products and should be use OPERA-LSPs. The aim is to gather advices to better implement the service.

3.7 Willingness to pay and cost analysis

In this section we will present a way to define a willingness to pay and cost analysis for OPERA-LSPs business model.

In our analysis we consider the results of the Report D4.1 related to both the willingness to pay and SWOT analysis as a proxy for defining the cost of services. In fact, local service providers in each pilot area are under development and the actual cost necessary for their development cannot be calculated.

In order to be able to recommend a business model that can improve the effectiveness of irrigation advisory service implementation in many farm, in the analysis we used two different evaluation tools: the SWOT analysis (for more details on the SWOT analysis please see the deliverable *D4.1 Report on socio-economic assessment*) and the choice experiment (for more details on the choice experiment please see the deliverable *D4.1 Report on socio-economic assessment*).

A SWOT analysis is a tool of evaluation which is used to detect the internal and external environment of the company. It is also used to maximize the strength and the opportunity owned by the firm which is finally expected to minimize the existing weaknesses and threats.

During the last years there has been an interest in a class of non-market stated-preference valuation methods known as choice experiments. The overall objective of a choice experiment is to estimate economic values for characteristics (or attributes) of an environmental good or service comprises several characteristics. A choice experiment is a multi-attribute evaluation methodology, that allow to evaluate complex environmental assets. In fact, in the case of evaluation of the irrigation advisory service it requires tools able to consider all the features/attributes that characterize the service offered. In these evaluative contexts, choice experiment is the best solution.

The choice experiment therefore allows monetary valuation (Willingness to Pay, WTP) of an asset and/or service without market. In its applications, each interviewee is presented with alternatives, in turn composed of attributes expressed in different levels. To define the attributes and their levels it is therefore necessary to break down the good into its fundamental components, identifying the essential characteristics. The interviewee does not evaluate the good/service as a whole, as a single block, but as a sub-unit.

3.7.1 SWOT Analysis

The result of SWOT analysis highlights several aspects for internal parameters: Strengths and Weaknesses, and for external parameters: Opportunities and Threats. In particular, the results of the analysis performed are summarized in Table 4.

The results of this analysis provide important indications to improve the implementation of irrigation advisory service (IASs) at farm level. Through an analysis of strengths, weakness, opportunities and threats (SWOT analysis) it was possible to examine farmers’ opinions about IASs implementation on their farms. In addition, the study may also provide valuable recommendations to farmers to better understand the potential, strengths and future opportunities related to their use in agricultural water management.

The results of the SWOT analysis showed how in environmental terms, more inclusion and adoption of advisory systems for irrigation could provide an improvement of irrigation management with clear benefits in terms of sustainable use of water resources in agriculture and production related to them. While, in economic terms, the increase via IASs for the appropriate management of water resources could contribute to a substantial reduction of the energy prices linked with irrigation. The effects of careful irrigation management can be successful in terms of increasing the income of farmers and to diminish the energy costs incurred by the managing bodies of water resource in the field.

In terms of strength the expert farmers gave information that the most important aspects are water saving, cost reduction, capacity and competence, good network of land reclamation and irrigation consortia, innovation development, water measurements. In terms of water saving, there is a consensus among farmers regarding the use of water efficiency obtainable for IASs utilization and that in environmental terms farmers are also aware that the water saving in agricultural sector is a very important aspect in terms of sustainable. In terms of reducing the volume of water in agriculture with the use of IASs, the farmers are aware that this adoption has positive effects in terms of saving energy for pumping water in irrigation networks of farms. Adoption of IASs in terms of opportunities can provide additional water measurements; according to the respondents, there is a prevailing perception that IASs could help farmers and other stakeholders involved in water management practices in accounting water applied for irrigation. This interest is primarily due to the increase of the constant regulations in water use in agriculture sector, which depends on conflicts related to competition for its use in various production sectors such as industry and services. Farmers are aware that many farms installed a wide range of devices for measuring water flow, but often these measurements are not carried out routinely and results are not useful to define the amount of water used for irrigation.

The high attention by farmers for this tool is also due to cost-free use of IASs at farm level (especially in Italy for high level of IASs adoption). IASs weaknesses highlighted by farmers focus on their implementation. In fact, the lack of funds from farmers, the low levels of information dissemination at the farm level, the negative perception of information provided by the IAS, the low use of electronic devices among farmers and the sharing of knowledge provided by the IAS for farmers, are one of the main aspects that prevent fast access to these tools. Negative perception of information provided by IASs due to in many cases the high age of farmers that are involved in water management by use of IASs within the areas under investigation in our study showed unfamiliarity with the information provided by IASs. In fact, they are convinced that their knowledge of crops is the best tool for water management practices. Other aspects, low use of electronic devices for water management. The most common shared weakness among farmers is related to their low use of electronics devices (smartphone, computer, etc.). This lack is a significant aspect regarding the diffusion and adoption of information provided by IAS, in fact the most common method to share information with farmers by land reclamation consortia of water to apply, coming from IASs elaborations, to crops during the growing season consist in the use of these instruments.

The threats that can be mainly attributed to social and technological aspects are: social aspect and education, lack of funding, institutional mechanisms to link rural communities. Regarding the social aspect and education, farmers believe that threats to the spread of the IASs within farms could come by the low level of education and the high level of age of the farmers themselves, who own most of the farms. Additionally, in recent years, this aspect was responsible for determining the leave of the rural areas. The high levels of the innovation could be considered an obstacle for their adoption by farmers that are unfamiliar with an electronic device. Finally, in terms of opportunities, improving agricultural productivity by IASs can significantly contribute to increase in water resource management and therefore the increase of the efficiency of farms production. Furthermore, regarding new markets and consumers, farmers are convinced that the adoption of IAS can provide a competitive advantage for their activities not only in productive terms but also in public awareness.

Table 4. *Results of SWOT analysis.*

Internal parameters (present)		External parameters (future)	
Strength	**Weakness**	**Opportunity**	**Threat**
S.1: Water saving	W.1: Low use of electronic devices for water management	O.1: Improving agricultural productivity	T.1: Social aspect, education
S.2: Cost reduction	W.2: Negative perception of information provided by IASs	O.2: New markets and consumers	T.2: Lack of funding
S.3: Capacity and competence	W.3: Lack of funds for IASs implementation	O.3: Increase the water management through ICT	T.3: Lack of institutional mechanisms to link rural communities
S.4: Good network of land reclamation and irrigation consortia		O.4: Reducing the environmental pollution	
S.5: Innovation development			
S.6: Provision of water measurements			

As showed above the SWOT analysis conducted in this project has provided an interesting framework to correctly understand since the large share territories and farms do not utilize IASs. The low adoption of this service represents a very great opportunity to increase the use of irrigation advisoryservices.

3.7.2 Choice Experiment

In order to understand the level of importance of technological innovation in the agricultural water management, and to improve the business model approach in this project, we have used the choice experiment for identifying preferences of the farmers' and making analysis of marginal willingness to pay for the service offered.

This method analyses farmers' preferences but, not for the service offered as a whole, but for its different technical attributes and its characteristics with respect to the delivery of the contracts.

In particular, in the choice experiment method, interviewees were presented with a number of choice sets consisting of a menu of alternatives relative to service options. They are asked to choose their preferred alternative from each of these choice sets. At this regard, to elicit preferences on service characteristics, respondents were asked to examine a series of hypothetical alternatives of water irrigation service. Attributes and levels were then assigned into choice sets.

The survey was conducted in different places related to OPERA partners to have a uniform perception about irrigation advisory services. Furthermore, a monetary attribute is needed in order to estimate implicit prices for each level that we decompose the service offered attributes.

We designed three possible levels for the price level, which were chosen based on average and indicative value carried out from different European Countries. Thus, the price vector was 5, 10 and 15 euros per hectare. A null level was associated to the "no choice" scenario; it is not included in the price vector because a 0 € price (namely pay nothing) does not seem realistic in the case of an increasing water use efficiency and productivity.

The importance, or weight, of each attribute was assessed by estimating Willingness To Pay (WTP), which measures consumers' preferences in monetary terms. Willingness to pay was estimated as the ratio, changed sign, between the coefficient of each attribute and that attribute related to the price.

The values of the average WTP, expressed in euros per hectare. They are reported for each of the attributes and, moreover, the differentiation of the same is also provided between the different countries involved in the OPERA project.

Considering the irrigation advisory service, it appears with greater evidence how the farmers of the countries involved in the OPERA project have a different behaviour both towards the specific attributes of the service and for the price they would be willing to pay in order to obtain it. While taking into consideration what was said previously, it is clear from the analysis obtained from the willingness to pay shown in the D.4.1 report, allowed us to define an average value of 4.17 euro/ha per year.

As previously reported, two cases of estimating the cost of project per each area. The considerations described above allow us to suggest that for having a sustainable product (OPERA-LSPs) the cost of development for the LSP of service should be less than 4.17 euros /ha per year and a "sale value" equal to or greater than 4.17 euros / ha per year.

4. Conclusion

The analysis carried out has demonstrated that the highly unequal land distribution between the farms in the different Countries depicts a difficulty experienced by farmers to implement large-scale irrigation systems and to reduce the costs of operating irrigation. This means that farmers turn their interest towards those tools that can improve their performance. Indeed, the results suggest that farmers predict a significant increase in agricultural benefits due to an efficient and sustainable irrigation and they are willing to pay significantly higher than what they are currently paying to secure these benefits. This implies that improved irrigation increases not only the farmers' benefits but could potentially increase the government's revenue, resulting in a win–win outcome.

The management of the irrigation advisory service engaged in the OPERA project should commit itself to involve farmers in the decision-making process so that their opinions and concerns can be captured during the conception and implementation of commercial policies to promote the dissemination of the service. This will help to ensure regular implementation and commitment of farmers in the management of the system itself.

We can conclude that the establishment of irrigation schemes is a feasible venture and should be considered as a policy option for improved supply and, mostly, increase in the productivity of agricultural water. The results suggest that the policy makers, rather than following conventional method of irrigation management, will have to take into account the preferences and associated willingness-to-pay (WTP) values of the farmers in a meaningful way while formulating irrigation policies.

Finally, it is necessary to propose and support at the government level the adoption of innovative irrigation assistance. This activity should be pursued through the integration of functions and powers of the different stakeholders at the public level. Moreover, improve communication within the systems are served by the IASs, one could argue the greater involvement of associations in the agricultural world that often have affiliated farms that do not fall within the areas covered by land reclamation and irrigation.

Estimating the economic value that farmers place on incremental changes in demand for irrigation has become vital in the process of deciding the economic viability of new irrigation projects.

The high willingness expressed by the farmers to pay for operationalizing the increase of water use efficiency and resilience in irrigation makes the project economically viable and sustainable on the long term basis.

The study advocates integration of the socio-economic attributes, as well as the geographical variable that positively influence willingness to pay of farmers for irrigation services in order to promote an efficiency and sustainable use of water.

However, this cannot be attained if institutional, political and economic constraints hindering farmers' willingness to pay for improve irrigation efficiency and to adopt an irrigation advisory service are not addressed headlong.

It is suggested that the time is ripe to come up with a workable and feasible irrigation advisory service scheme since the farmers are willing to pay for its sustainability and should streamline the functions to be more effective in meeting the water need of the farmers.

The farmers should be encouraged to adopt this service for larger scale, showing them the benefits, they derive from it, but all of this requires further study, greater analysis and, above all, a wider and more widespread dissemination of the results obtained. In other words, there is a need for more time and further study / analysis.

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