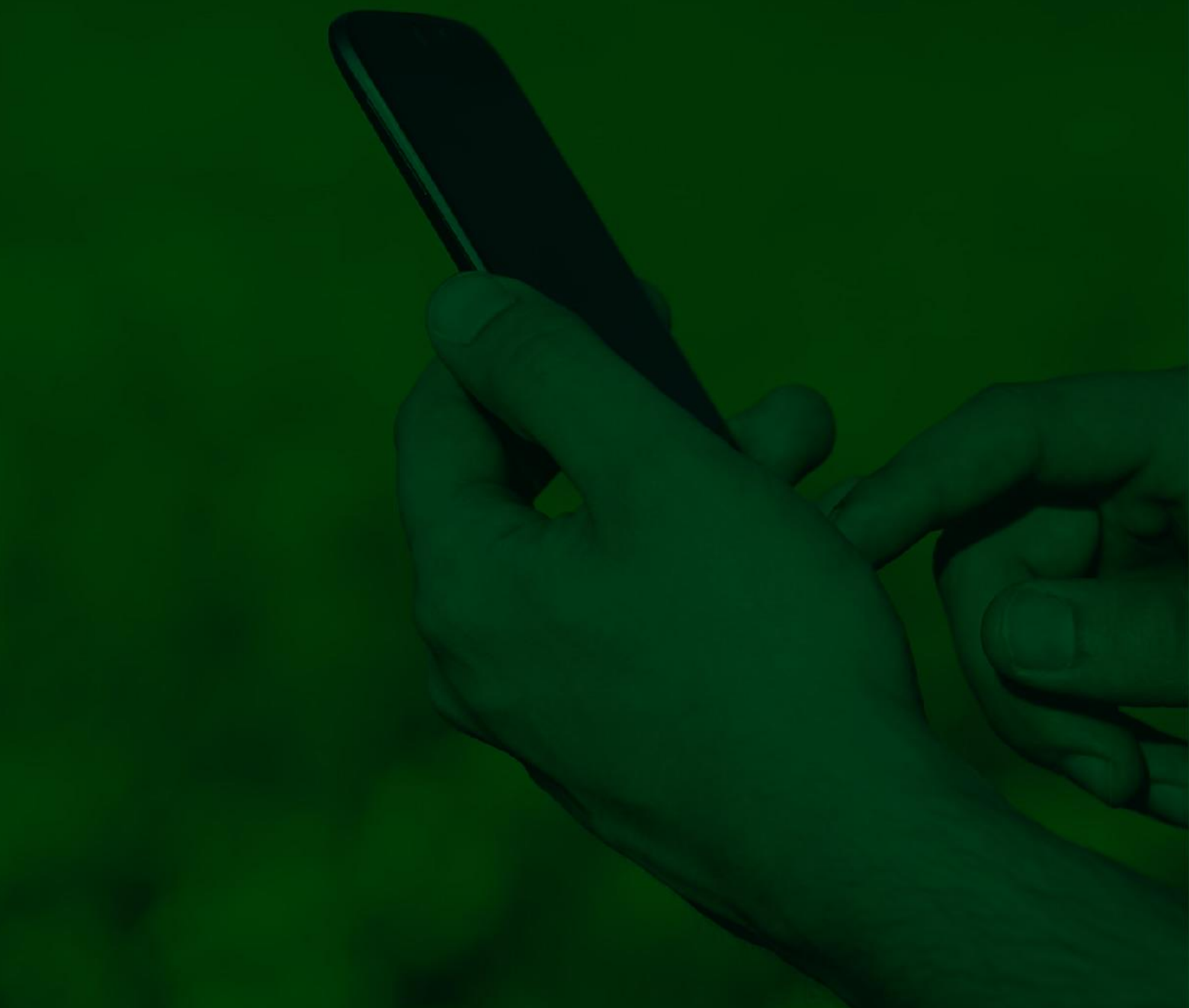
FAIRshare

DIGITAL TOOLS FOR FARM ADVISORS



Technical References

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Contents

D3.1: Factors Influencing Adoption of Digital Agriculture (DA) Tech by Farmers and Advisors

1. Introduction

The aim of Work Package 3 (WP3) is to identify how Digital Advisory Tools and Services (DATS) have become an effective and embedded extension tool in the farmer/advisor professional interface.

Previous WPs are dedicated to the DATS PNF (Permanent Networking Facility; DATS inventory) and the Good Practices collection. The DATS inventory has demonstrated the huge diversity of applications available today to help and support farmer's activities. Digital tools using innovation such as GPS guidance or herd monitoring sensors are designed to enhance farmer's life and to optimise everyday farming practices. Data from such tools provide farmers and advisors with useful and more accurate measurements which are able to provide constant evaluation and benchmarking of activities while delivering efficiency metrics.

However, several studies from European countries and various sectors have identified the digital divide that slows down the implementation of DATS usage and impairs access. This deliverable focuses on the different factors that can affect or improve the engagement of novel digital technologies by farmers and advisors especially in the interface between the advisor and farmer. This includes knowledge exchange, cooperation and mutual influence.

D3.1 is a scoping exercise. Whilst farmer engagement with digital tools has been widely researched the same cannot be said about research concerning advisors engagement with DATS. Nevertheless, there has been increased focus in the advisory field recently and this trend is expected to continue, and hopefully intensify, over the lifetime of the FAIRshare project. This document will consequently remain open in an effort to capture relevant content as the project progresses.

2. Methodology

The objective of this report is to outline the main barriers, incentives, and engagement factors in the development and use of DATS. Two workshops with partners were organized during the consortium meetings (Dublin, Athens) to list factors and to evaluate their relevance. Topics included in the workshops include; DATS type, digital gaps, and involvement in novel technologies and systems of dissemination. These potential factors are supported with scientific and industry literature.

3. The farmer/advisor interface

The aim of FAIRSHARE project is to improve the application of DATS in different advisory-farming contexts across the EU. An important aspect is the interface between the advisor and the farmer which is in place during the supporting phase of advising. It includes cooperation, collaboration, mutual influence and trust. The interface takes a wider view of the processes involved in transferring knowledge and support farming activity. Advice relating to social change or innovation is drawn from many scientific fields (Dockès et al. 1999). These include economics; sociology (in particular rural sociology), which has studied the diffusion of techniques in the agricultural domain; social psychology, which understands the individual factors of change; and educational science, to provide a better understanding of the advisor's work.

3.1. Factors influencing farmer behaviour

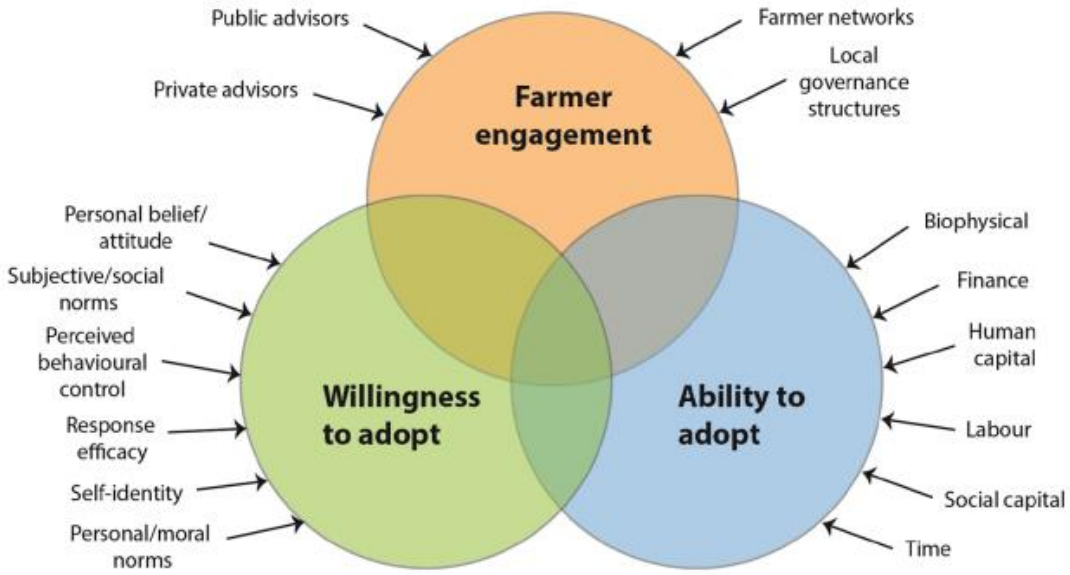

Figure 1. Factors influencing farmer behavior (Mills et al., 2017)

Farmer behaviour is dependent on their level of willingness to adopt, their ability to adopt and their level of engagement. All of these are determined by a multitude of factors such as engagement with advisors, attitudes, perceived behavioral control, social capital, financial resources etc. (Figure 1).

3.2. Factors influencing advisor behaviour

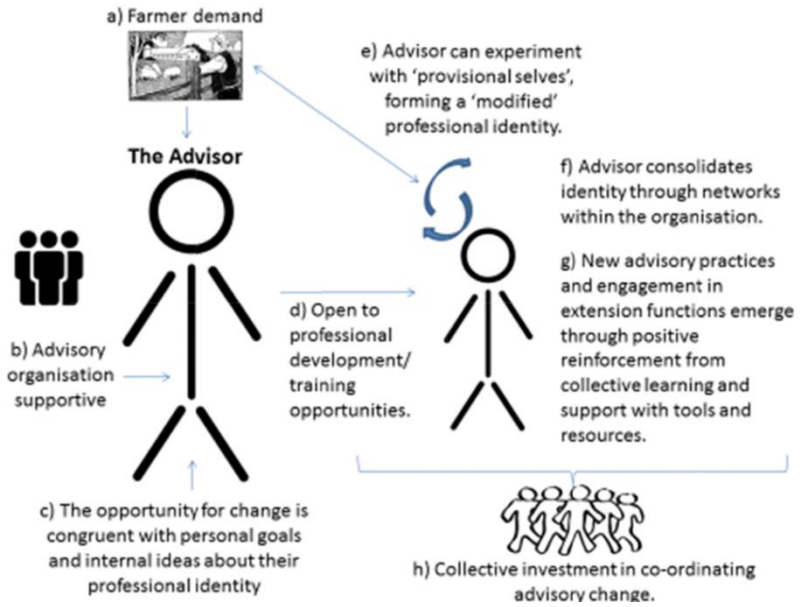

Figure 2. Diagrammatic representation of the processes involved in advisors changing practices (Nettle et al., 2018)

Factors involved in changing advisory practice involves: a) demand from farmers for support; b) support of the advisor's organization to engage in developing new practices; (c) congruence between the opportunities that could come from making changes to advisor practices or services and the advisor's personal goals, including their professional identity; (d) professional training and development; (e) professional identity; (f) organizational networks; and finally (g) new advisory practices (Figure 2; Nettle et al., 2018). Upskilling advisors is particularly pertinent in dynamic contexts such as ditalisation and is addressed in the framework in Section 4.

3.3. Factors related to facilitating farm change

The following diagram conceptualizes agricultural advisory practice around factors related to farm change (see Fig. 3 below).

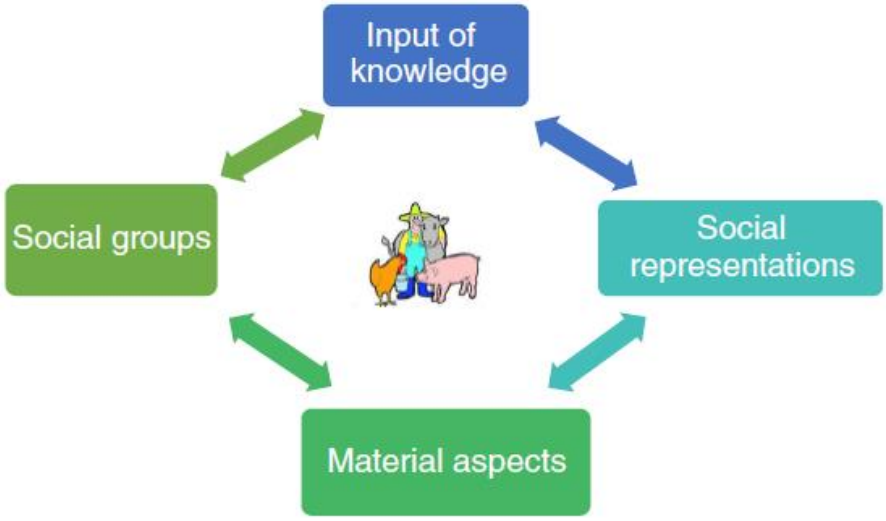

Figure 3. Four factors facilitating change in agriculture

1. The **input of knowledge and information** (technical, economic, market or scientific) is essential when farmers have to make decisions. As an example, having a clear vision of agricultural policy or social regulations can help when making choices.

2. **Social representations** play a central role in the implementation of a technique. Representations are a way for every individual to organize his or her knowledge according to a coherent system specific to him or herself. They refer to precise objects (the profession, working practices, the status of the animal, the human-animal relationship, the situation of livestock farmers in society) and are expressed in terms of judgements, opinions and mindsets
3. These representations are shaped within **social groups** (family, professional and technical). It's the place to exchange between peers and work out technical standards Advisors often take part to these discussion networks and quality of the farmer/advisor debate is one of the factors in the success of advice.

4. Finally, the **materiality of practices** and their economic and organizational relevance are central elements of change.

This process is not static and will change in time, through implementation and experimentation on fields and with reevaluation of costs and benefits.

3.4. Advisor position and action

The PROAKIS Project (2012) highlighted the great diversity of advisory services. From the top-down process engaged since a long time between experts and learners to the uprising of multi-actor process where knowledge exchange between pairs are enhanced by the advisor-coach supports. It showed also the huge diversity of AKIS actors mission and skills. Some are involved in production support whereas other are engaged in the societal or environmental regulations respects.

Advisory actions can be classified according to their purpose, the main method applied and the role or advisors attitude (Dockès et al. 2019).

Broadly speaking, advisory activity can be classified around four groups of objectives: technical control, economy or strategy, work organization and responses to social expectations. Advice with a technical purpose can relate to various aspects of the operation of a unit (outputs, optimization of inputs, feed, fertility, quality of products, buildings, etc.). Economic approaches aim to help farmers optimize the economic performance of their farms within sectors and a territory. Strategic advice helps to analyze and prepare some changes in the evolution of the enterprise, integrating any change (economic, environmental, social…) in the farmers' projects and objectives. In recent times, it has been essential for advisory activities to take into account the expectations expressed by society, whether in relation to environmental protection, animal welfare or the quality of food products.

3.5. The farmer/advisor interface

The advisor/farmer interface needs to be considerate of different activities:

- **Individual exchanges and contacts**. As it enables the farmer to become closely involved in the definition of his project, providing him with aids to decision-making and tools to analyze his situation, this support supposed to be the most efficient.
- **Collective advice**, with dialogue between an advisor and a group of farmers, is a way to forge points of view, practices and organizational methods that are adaptable to each farmer's own particular situation. This kind of approach, which enables discussions between peers and dialogue with one or more advisors, can be enriching for the participants but requires a real involvement from the farmers.
- **Mass distribution** primarily consists of informing farmers of results or technical information through the general media (e.g. press, bulletins, and websites). This form of advice has the advantage of reaching a wide audience at a modest cost and of
Preserving individual autonomy in decision-making.
- **Integrated advice** is a combination of the methods presented above. It targets a numerically large audience (e.g. several thousand livestock farmers) and brings together different forms and tools of advice. Participatory meetings or focus groups are generally a

key element of these actions. The combination of processes can also a adaptation to the time request and needed to answer to the support demand.

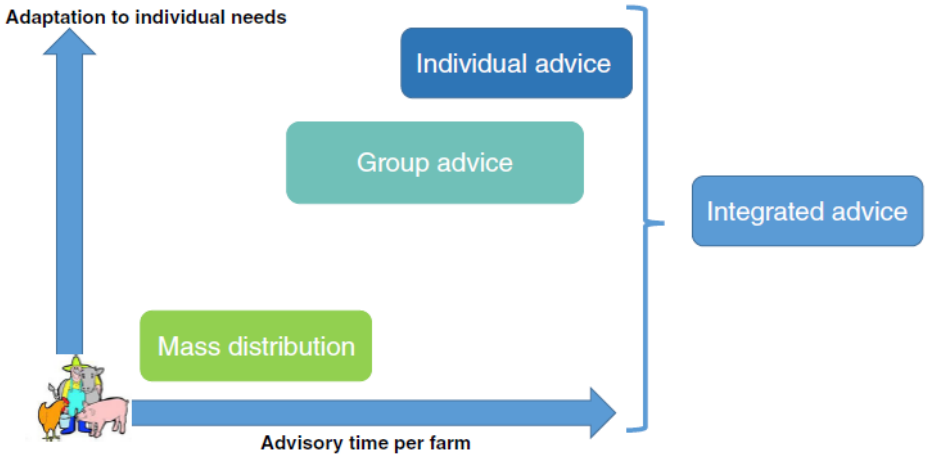

Figure 4. The main advisory methods

Finally, different advisor behaviour needs to be distinguished from the expert attitude to the coaching position. They can act as **expert** delivering knowledge to producers engaged in specific tasks and process. This interaction is a top-down procedure which allows few exchanges with farmers. This can be helped by self-audit tool too and proposes a technical change in a rather directive way. On the other hand, a 'reflective observer' or **'coach'** mission is to build solutions together. It gives more responsibility to the farmer for the results and capacity building. The advisor's task is limited to feeding back observations and impressions, which can have a dynamic effect on the client. This posture fits well to strategic decision support and need a wide range of tools able to simulate alternatives and new options for the farmers.

As we can see, in both situations, the farmer needs a mirror to check the situation and take a decision. Digital tools are mainly used to improve the process.

4. DATS implications

4.1. The role of digitalisation in advisory services

According to GFRAS DATS have a particular role in agricultural extension (Davis et al., 2018):

- Contribute directly to the use of agricultural innovations to improve livelihoods and develop skills;
- Allow advisory services to be more effective and efficient, and contributes to the introduction of innovations to improve skills;
- Successfully engage farmers with approaches that are successfully adapted to fit local conditions and the institutional context to establish productive and profitable relationships.
- Embrace pluralism (the provision of advisory services by different types of organisations);
- Increase accountability to clients;
- Develop human resource capacity;
- Increase sustainability.

4.2. The impact of digitalisation on advisory services

The increased digitalization of agriculture has potential implications for future agricultural knowledge systems as data can be made remotely accessible to others within a farmers' network to farm advisors. This has implications for how advisors interact with farmers. It is therefore important to identify the enabling factors which will allow agriculture knowledge systems to adapt to digitalisation.

Like all the products and services, DATS design needs to follow a logical way to reach the user needs and to put in place the conditions of sustainability. Eastwood et al. (2019) proposed a conceptual framework regarding factors related to capability requirements and knowledge exchange in smart farming innovation systems.

To understand the potential of digitalisation on advisory practices the conceptual framework incorporating advisory, farmer, and technological aspects of the technology innovation process. Three aspects are covered in the overall framework (Table 1); however, the first two, 'Characteristics of the target population and market' and 'Technological design and innovation' are mostly focused on defining technology and user attributes. These factors will be discussed in the sections that follow.

The framework helps consider the wider implications of new farming technologies. It draws on the orgware, hardware, and software typology and concepts of innovation uncertainty. It includes aspects of adoption theory, such as user expectations, impacts of the technology, and capability required to support technologies. Aspects of technological innovation systems (TIS) are included, for instance the importance of having different actors involved in the innovation process. These broad aspects have been paired with specific lessons from studies of technology development and the roles of technology suppliers, farmers, and research and extension actors via the questions presented in the framework.

The framework can be used as a Participatory Technology Assessment tool enabled us to identify the role of different actors, including the potential interactions between advisors and producers.

Table 1: Factors related to capability requirements and knowledge exchange in smart farming innovation systems (adapted from Eastwood et al.(2019)).

Factor	Main aspect	Questions for consideration
1. Characteristics of the target population and market	1. Gap in knowledge or technology	Does it address a pre-existing need in farming systems?
	2. Expectations of users	What are the minimum performance requirements for end users?
	3. Enterprise or market scale	What is the probable market?
	4. Impacts of the innovation	Does the innovation have wider implications (e.g. for the sector or public?)
	5. Influential actors	Who are the main actors who will influence the successful implementation of the tool?
	6. Innovation uncertainty	What are the potential perceptions amongst the network of practice and how can uncertainty amongst end users be minimized?
2. Technology design and innovation	7. Platform integration	How will it integrate with other relevant technologies?
	8. Continual learning and feedback loop	How will on-going innovation be captured and utilized for continual product improvement?
	9. Technology performance	Does the technology function well (i.e. will it do what it is supposed to in relation to 'aspect 2')?
	10. Design and development timelines	What are the implications of the lead time to take it right through to commercialization?
3. Capability requirements and knowledge exchange	11. Adaptation of on-farm practices and technology	How much farm management adaptation will be required to use the technology?
	12. Learning load	What are the new skills required for a farmer and his/her network of practice to effectively integrate the tool into farm practice?
	13. Capability mapping	Where are the skills/capability required? How might skill requirements change actor's professional identity?
	14. Human capital in innovation system	Who are the main actors required to support use of the technology?
	15. Capability development	How can the main actors be organized to develop and share knowledge, and create legitimacy around the innovation? What is the influence of organizational contexts? Who is best placed to develop capability

DATS aim to improve productivity, profitability and sustainability compatible with the food security and environmental protection. But their relevance is highly related to the type of activities and the coverage of specific needs: build and design knowledge and innovation, support the transfer and help in the mediation, provide arguments for the innovation adoption, help in the application and improvement, feedback, benchmarking and assessment steps.

In Athens, a workshop identified a range of DATS and their specificities (by asking questions such how, who and why). We can see from the table below how vast the range of DATS is as well as the demands requested by both farmers and advisors.

Table 2 What/How/Who and Why use DATS in agriculture (Synthesis of 3 workshops-Athens 2019)

What/Where	How	Who	Why
Knowledge Transfer (OK Eleveur) Data and notification alerts Keep up to date Exchanging with peers Statistics Gathering clients demands Increase digital communication	Online and one-to-one (peer-to-peer) Real life User friendly Technology apps: WhatsApp , Viber , Skype Initial training required and promotion of use	Wide range of actors, farmers and advisors included and Policy makers Reach a huge audience (i.e. Facebook group)	Opportunity to involve and reach different stakeholders Efficiency Add more value to the farmer New value/opportunities Effective in giving advice
What/Where	**How**	**Who**	**Why**
Farm management (business intelligence) (e.g. AGRO BI & Irristrat Portugal)	One-to-one advisor to farmer Technology apps: WhatsApp, Viber, Skype	Advisors interacting with farmers Government	Improve efficiency Time management Monitoring Business development
Animal Plants (Weather)	Online One window approach	Farmers NGOs Advisors	Daily decision and Strategic decision making Environmental Impacts
Weather based plant the service providers Farming system GIS	face to face settings with real data	Mixed (advisors and farmers) protection and crop developmnt (e.g. machinery rings, cooperatives)	Improve decision making To develop and implement an evidence/data based risk management strategy Up to date information
What/Where	**How**	**Who**	**Why**
Safety – Animal welfare (e.g. AMR sensors to monitor animal health)	Web Online	Advisors Farmers Students	To reduce antibiotic use More accurate and real time information
What/Where	**How**	**Who**	**Why**
Benchmarking (e.g. ICBF (IRL), Diapason (FR)	Farms data base Breed index	Advisors Farmers Students	Observatoire References

5. Factors influencing the use of digital tools

A workshop conducted at the first annual meeting in Athens depicts the different motivating factors influencing farmers and advisors to adopt DATS. Participants were divided into four groups (two groups focusing on farmers and two groups focusing on advisors) and asked what are the motivating factors to use digital tools (one group on advisors and one group on farmers) and which are the obstacles/problems (one group on advisors and one group on farmers) (Figure 5).

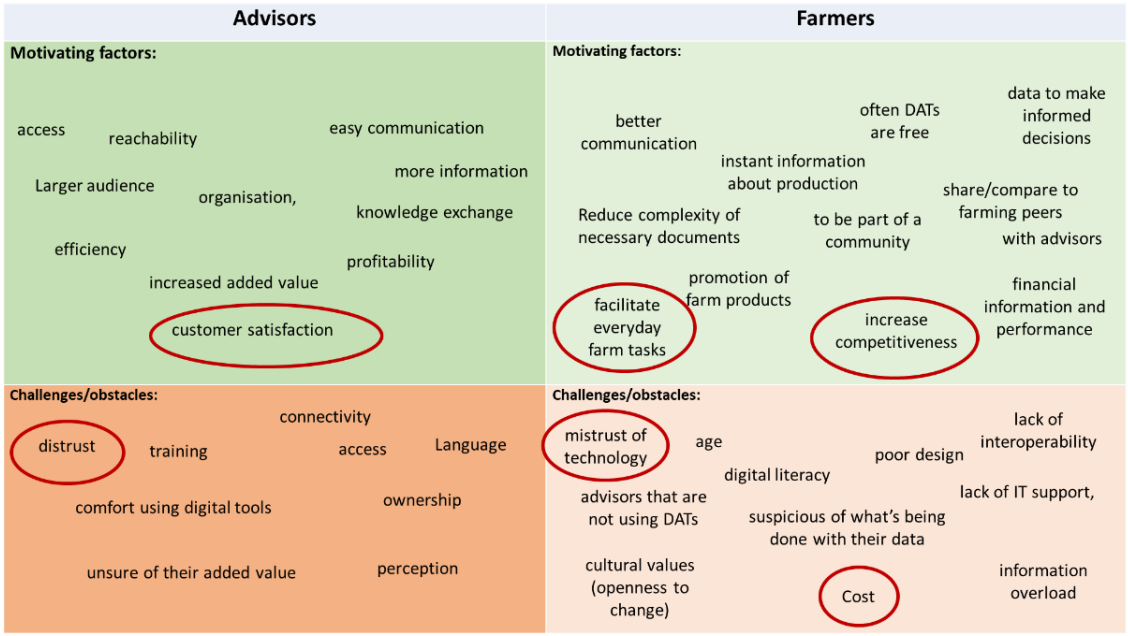

Figure 5. Motivating factors and obstacles and challenges to incentive the use of DATS Workshop Athens

This exercise showed how different components of tools adoption are engaged for DATS. Partners gathered to give a primacy for two types of factors:

The factors involved in the coverage of the needs

In other word, the tool or service impact is mainly dependent from the user satisfaction in getting the service or usable information. It's also included in the impacts of the changes implemented.

As presented here, farmers and advisors needs should be distinguished by their differences of objectives. When the former wants to increase his farm activity efficiency, the latter should improve his/her impact by satisfying the farmers need and expectation as a minimum (customer satisfaction).

The factors involved in communication and dissemination

DATS aim to improve information transferring but there are communication barriers that warrant consideration. Some are basics such as language or technical (Internet access) some are more complex such as distrust or lack of skills. The study entitled 'Exploring digitalisation to enhance knowledge flow in EU agricultural knowledge and innovation systems (AKIS)' commissioned by the strategic working group (SWG) SCAR AKIS and financed by the EU CASA project listed barriers and success factors in the use of digital tolls in AKIS (Figure 6).

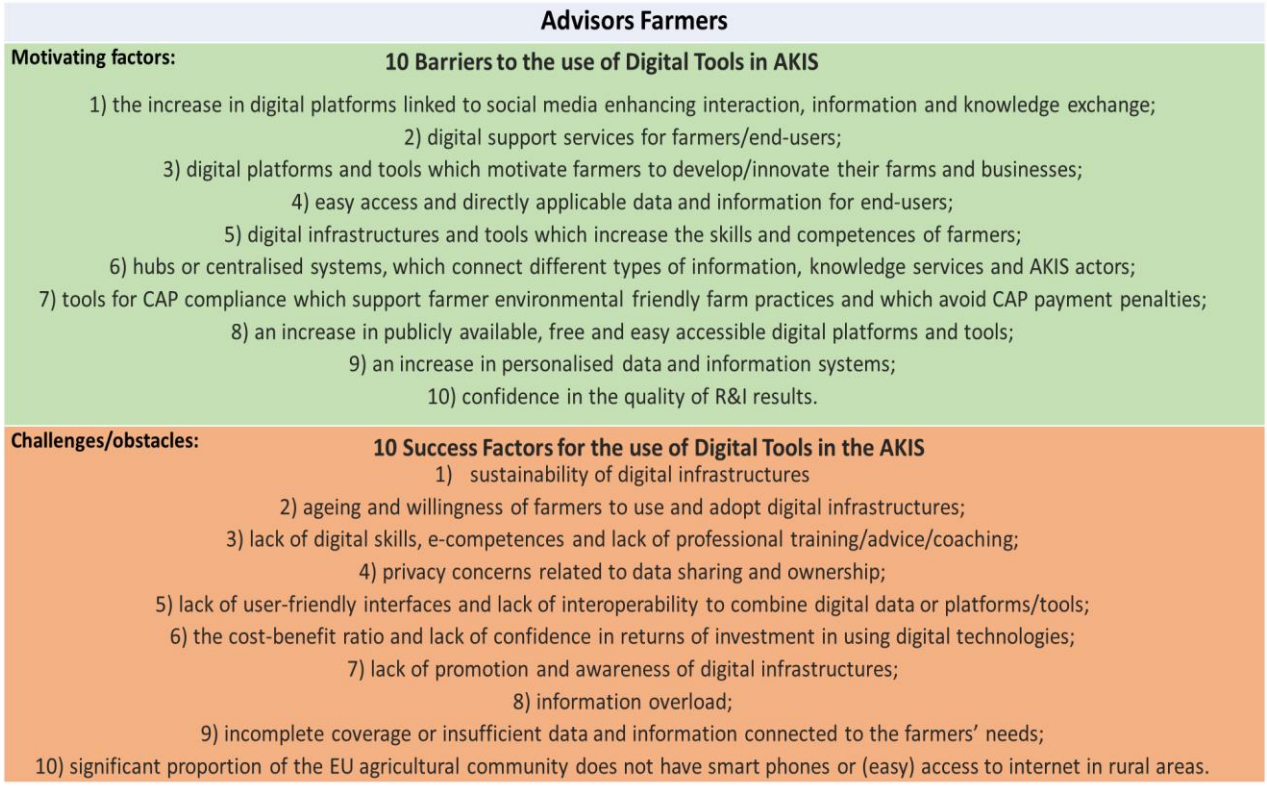

Figure 6. Barriers and success factors in the use of digital tolls in AKIS (SCAR-AKIS, 2019a)

The digital revolution enhances farmer's lives and their work efficiency. Its impact particularly occurs with regards to communication: greater engagement between actors with digital platforms related to social media, easier access to information, and new tools to ease administrative procedures. However, acceptance of these new tools face some reals obstacles. The social barriers seemed to be effective as it restrained the trust in the carried information. The lack of confidence is amplified by an unawareness of the provenance and the origin of the information

5.2. Core factors influencing intention to use a digital tool

Considering the "disappointingly low" DATS uptake, Rose et al., (2016) expressed the different elements that impact the adoption of Decision Support Tools. They found that particular factors affected uptake of digital tools: performance, ease of use, peer recommendation, trust, cost, habit, relevance to user and farmer/advisor compatibility.

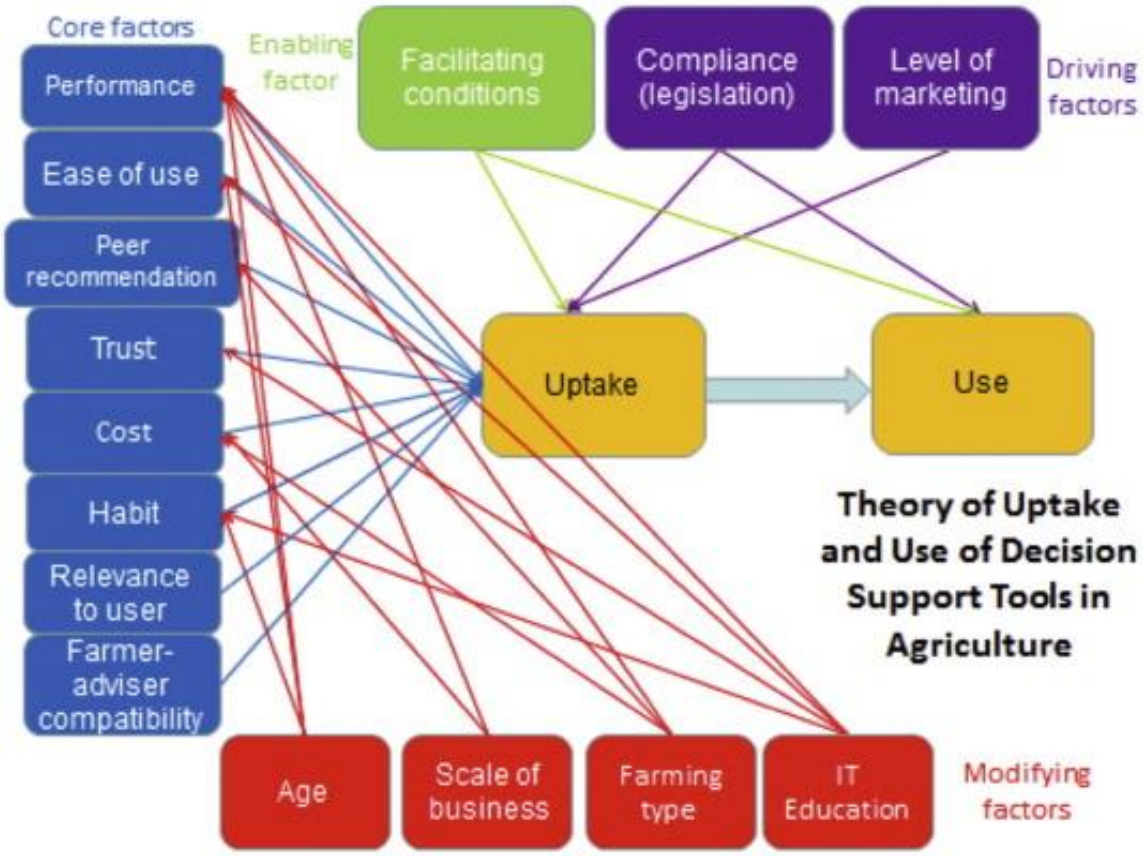

Figure 7. Theory of uptake and use of digital tools in agriculture (Rose et al., 2016)

The performance expectancy

The performance of a decision support tool is widely mentioned as factor to motivate its use. Irrespective of whether the mode of delivery was via software, apps, or paper, both farmers and advisers wanted it to improve decision-making and productivity. The purpose is here to express the efficiency to reach the user need. For instance, a farmer needs to know a tools benefit to his/her enterprise.

Ease of use

In each tool, the handling of it is the first step of the adoption. It should be simple, practical and rapid to show its effect. A decision support tool should be simple to understand and provide information in a quick, user-friendly manner. As time is scarce, farmers and advisors have little time to extract information from a tool, the main message and statement need to be clear and comprehendible.

Peer recommendations

Reinforcing the social representation, the peers point of view and recommendation are essential to establish the interest to undertake a tool. The main reason is that this DATS will become such a common language and will provide ideas and common values. Therefore, tools are object of exchange and communication and feedbacks will strengthen the adoption. For instance DATS uses within farmer groups appear to be really efficient to develop peers comparison and practical feedbacks.

Trust

Part of the acceptance of a digital tool is based on the confidence in information and statement provided. It's founded on several aspects: the origin (national/regional) the source (scientist/neighbour), the practicality, the purpose (private and commercial/objective and non-commercial). Trust is mainly based on proximity acknowledgement in the production context: same agricultural sector, same interest in farming and it's often a combination of all those aspects that can explain the farmer or the advisor interest in particular DATS. To achieve trust open dialogue, education and awareness raising and good data governance are essential to increase adoption of agricultural technologies and address issues concerning data ownership data sharing (CEMA, 2020; CEMA et al. 2018; Wiseman et al., 2019).

Tool cost

In some instances there is a financial cost associated with DATS use. It needs to be acceptable in regard of the performance expectancy. Free apps are often preferred, but any digital tool is supported by an economic model built with investment and maintenance costs. Its application and the way costs are covered by licenses can be a major barrier for the user accordingly to their means.

Habit

Habit is a significant factor affecting use. A regular tendency to make a decision in a particular way holds back the uptake of new ideas, particularly modern technology like software and apps. Habit is related to the digital divide and its social components: matter of age, skills and competences, know how change. Rose et al. (2016) expressed that farmers who had embraced software-based decision support indicated that they would find it hard to move away from their current tools if new ones were developed. Therefore, habit is probably one of the most difficult factors to overcome, as it will not be affected by designing more user-friendly systems that perform better.

Co-design and co-creation with involvement of peers cooperation and collaboration, farmer/advisor mutual influence and trust are crucial. In regard of the farmer's engagement with technology, Higgins et al. (2017) explain that rural sociologists and geographers have long argued that farmers' knowledge, and the broader social and cultural relations in which such knowledge is embedded, is crucial to understanding farmer engagement with and adoption of new programs, techniques and technologies.

This 'socio-cultural' approach to knowledge has generated significant insights into making sense of why farmers might partially adopt or not adopt at all. It has also drawn attention to farming knowledge as a relational achievement; that is how farmers' tacit, experiential knowledge relates to and is integrated with other forms of knowledge (such as 'scientific' knowledge), and the consequences of these relations for programs or initiatives seeking to change farming practices.

Relevance to user

DATS should be sufficiently flexible to serve the needs of an individual user. As it has been said the farmer or advisor should rapidly recognize how this application can cover its needs expectation (What?). But furthermore, the process (How?) should also encourage the farmers trust by taking into account the social, economic and ecological environment, and—above all—the farmers' projects and objectives. The success of DATS are notably reduced when they are not "tailored to your situation, rather than just be generic.

Farmer-adviser compatibility

The DATS adoption will be strengthen by their adaptation to the interface farmer/advisors relationship. It includes cooperation, collaboration, mutual influence, trust and common skills and values. Tools are often based on benchmarks based on units or production systems. It's important that benchmarking tool enables comparisons to promote exchanges and farming support. Conversely, specific farmer tools could be used by advisors in order to collect information or to help in planning and decision making.

Like Higgings et al. (2017), we can add that "a relational approach to knowledge should remain a key focus for rural studies scholars researching farmer engagement with and adoption of technology. However, in doing so, the more-than-cultural dimensions of knowledge need to be recognised. Greater emphasis should be placed on 'knowledge in action' the relationality of materials and the multiple modes of ordering through which materials intertwine with, shape, and are shaped by, farming knowledge and practices.

Three other obstacles warrant attention: the digital divide, the adaptation (or the lack) of uncertainty and the advisors skills and posture

The digital divide

Several gaps need to be explored to describe the digital divide and its impact on innovation transferring and acceptance:

- Knowledge gap: this includes the high diversity of skills and competences needed to benefit from digital equipment.
- Technological divide: level of access to the technology expressed in material and internet broadband.

If 97% of EU households including 90% of rural households are now covered by basic broadband, it seems also that farmers who do not adopt SF technologies and digital tools have insufficient skills and competences (Shenglin et al., 2017; Grant Agreement p. 147). Furthermore, the rural population in Europe is ageing rapidly with more than 55% of farm managers being above 55 years[1]. This indicates a potential problem for the agricultural sector in terms of adoption rate of SF technologies because older farmers can have diminished incentives to change and less exposure to SF technologies.

The lack of high-speed broadband connections in rural areas is a major barrier for the establishment of an efficient ICT platform for communication and free exchange of knowledge in the agricultural sector (i.e. farmers, extension services, food and feed processing enterprises, agricultural scientists etc.), especially in the eastern and southern countries with poor economies and high prices on the use of the broadband connections (Figure 8).

[1] http://ec.europa.eu/eurostat/statistics-explained/index.php/Agriculture_statistics_-_family_farming_in_the_EU#Farm_managers_by_age_.E2.80.94_an_analysis_for_the_EU-28

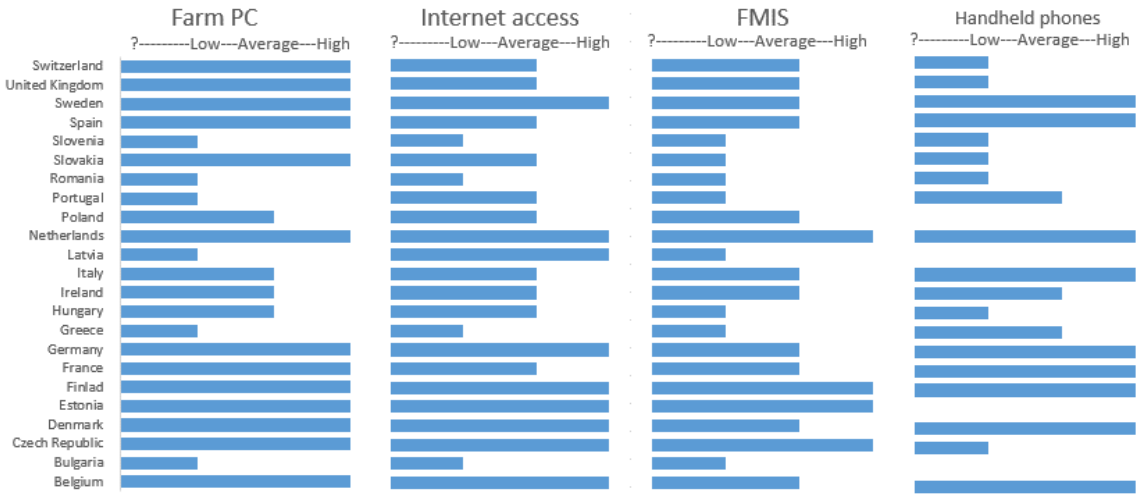

Figure 8. Relative level of access to Farm PCs, Internet, FMIS and Handheld phones/devices in 23 European countries (Holster et al., 2012).

There may also be a mental barrier to some (mainly older) farmers and other actors in the food chain to acquire and use ICT hardware and software tools. In 2007, 31 % of holders of agricultural holdings in the EU15 were 65 years of age or older and the number has been steadily growing since 1990.

Finally, the lack of interoperability between databases is an obstacle. Often end-users framers as advisors cannot simply combine technologies of their choice or several digital solutions are not connected so the basic farm data have to be entered repeatedly. Therefore, the DATS ecosystem need common language to question of language (informatics as well as human) to develop high level of relationship and use of tools.

Innovation Uncertainty

Eastwood et al. (2020) highlighted perceived impacts of political uncertainty, and the impact of technological uncertainty around not only immature smart farming technologies but also the on-farm adaptation that such technologies can require. They highlighted the potential impact of negative experiences associated with new technologies from farmers who struggle with the adaptation process as such occurrences may act to stall the uptake of smart farming technologies. To reduce uncertainty with emerging smart technologies, greater effort is required to foster knowledge development and exchange and greater public and private R&D collaboration is required to foster knowledge development and exchange.

The advisor skills and behavior

SWG SCAR-AKIS (2017)

"The future advisor should be more listening oriented, able to take an intermediate position and support the farmer in particular by tailoring the breadth of information to the specific farm conditions and aspirations of the farmer. Farmers may find some technical issues themselves and share them peer-to-peer"

An innovation facilitator helps to move the group of actors towards innovative solutions and supports their energy; on condition s/he has the trust and the belief of the group. Combining information with various experiences, skills and attitudes forms quite a challenge in terms of building trust among all actors' involved, mutual understanding and the ability to cooperate.

Real changes in the advisor implication in the interface farmer/advisor will implicate DATS evolution, with regards to:

- Sharing information
- Self-evaluation
- Co-design of solutions
- Peers exchange

5.3. Enabling factors influencing intention to use a digital tool

The Irish Farmers' Association (IFA, 2019) highlights five essential steps to increase the adoption of digital tools. Training and education programs can tackle the causes of digital exclusion through increasing confidence and openness in digital technologies which in turn will change attitudes. From there the focus on building motivation in incremental steps trough aligning training and education with on-farm practices that digital technologies can make better (Figure 9).

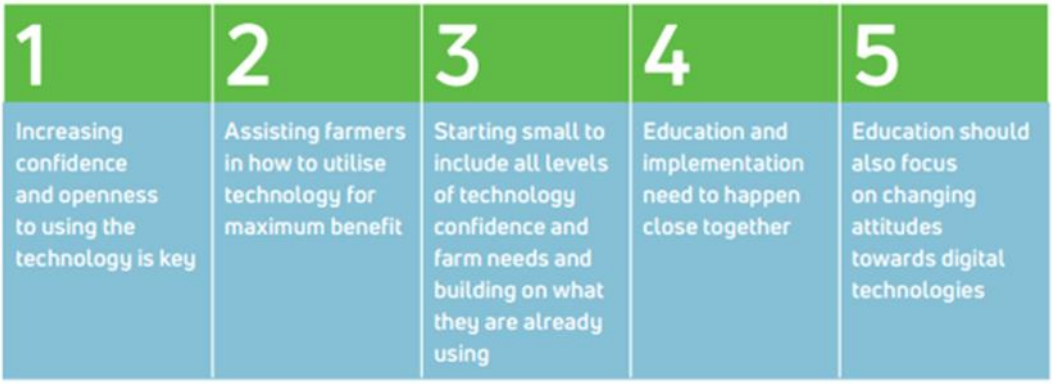

Figure 9. Recommendations to promote the continued digitalisation of agriculture in Ireland. IFA (2019)

DATS should fit within the workflow of end users to facilitate their use. Additionally, user-friendly interfaces are an attribute that enable use of digital tools. DATS are more likely to be used if it could help a farmer or advisor to satisfy legislative (or market) requirements. They should also be well marketed to increase general awareness (Rose et al., 2016)

6. Conclusion

D3.1 is a scoping document. Advisors engagement with DATS has not been as widely researched as farmer's engagement with digital tools. However, there has been increased focus in the field in recent years. This trend is expected to continue over the lifetime of the FAIRshare project. Therefore, this document will remain open in an effort to capture relevant content as the project progresses.

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