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### ► To cite this version:

Thomas Crestey, J A Taylor, Bruno Tisseyre. Le Mas Numérique: A new model to promote on-farm innovation among digital service providers and to support adoption. First International Conference on Farmer-centric On-Farm Experimentation, Oct 2021, Montpellier, France. hal-03761793

**HAL Id: hal-03761793**

**<https://hal.science/hal-03761793>**

Submitted on 26 Aug 2022

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## **Le Mas Numérique: A new model to promote on-farm innovation among digital service providers and to support adoption.**

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### **Abstract**

The objective of the article is to present the results of a project that led to the design and development of a long-term digital Mediterranean farm (commercial wine estate) in the south of France. This farm is intended to demonstrate both the technical and functional interest of digital agricultural tools being adopted by winegrowers and technical services. It presents the original collaboration, the organisation and the financing model that was chosen in order to design a real digital farm with continually up-to-date and updating agri-technologies. This model is new and brings industry, academic and consultancy into the process and allows the digital farm to be continually supported. In 2019, there were 15 digital services embedded on the farm to answer practical issues related to production management and crop protection as well as practical issues related to the interoperability of these services. This model has promoted on-farm interoperability experimentation by digital agriculture service providers and led to new services to fill information gaps.

**Keywords:** viticulture, demonstration

### **Introduction**

The value of digital agriculture (DA) technology for improving the profitability of agricultural operations and/or to mitigate their environmental impact has been highlighted by numerous works (Larson et al., 2008, Reichardt et al., 2009). More recent work has also focused on the impact of these technologies on the farmer's work (e.g. Hostiou et al. 2014). An important change with DA is the complexity of the tools and equipment required. This complexity requires new knowledge to enable appropriate implementation and technical expertise to ensure optimal interoperability. These constraints explain why farmers are sometimes reluctant to adopt PA technologies on their own farm (Reichardt et al., 2009, Aubert et al., 2012), especially when DA services are employed as 'stand-alone' services. Other work (e.g. Erickson and Widmar, 2015) have highlighted the essential role of demonstration 'digital' farms in promoting the adoption of DA by supporting farmers in making the appropriate technical choices and investments on their own farms. However, the establishment of such digital farms is not easy. It cannot be a purely commercial showroom run by a few companies. Farmers must trust the system and have a clear understanding of the specific contexts in which the demonstration farm operates so that they can assess the constraints faced on their own farms (production profitability, interoperability with existing digital tools and services, employee skills and support, etc.). Meeting all these conditions is not easy and this is certainly why, to our knowledge, there are few examples of digital demonstration farms in the world.

To address this challenge a project was initiated to co-design and develop a long-term digital farm (commercial wine estate) in the south of France with service provider companies, institutes and academics. The originality of the project was in the way in which solutions have been organised in order to demonstrate digital solutions to wine-growers and advisors and to enable service providers to experiment in a safe environment.

## Methods for designing a pilot Digital Agriculture farm.

### Origin and genesis of the project

Viticulture is the main agricultural production in the Occitanie region of southern France and represents > 250,000 ha (nearly 40% of the region's agricultural area) and > 19,800 farms. Digital agriculture (DA) has been identified as a driver for placing this production in a more sustainable, economically profitable and environmentally friendly context. Supporting these small farms in the implementation of DA tools is an important challenge because of the number of actors involved and the diversity of the structures to be addressed. This context has highlighted the need for a demonstration digital vineyard.

### Steps of the project establishment

The project was initiated in April 2015. It was organized in 6 main stages (Fig. 1) and operated in an Agile manner as the form, organization and funding of the Demonstration Farm (DF) was unknown in advance. The project required a long maturation phase (2 years) that raised questions about the animation and financing of this maturation phase. The following describes the approach and methods used to organize and finance the different stages. It is not a question of presenting this experience as an example to follow, but rather of sharing it so that other similar projects can learn from it.

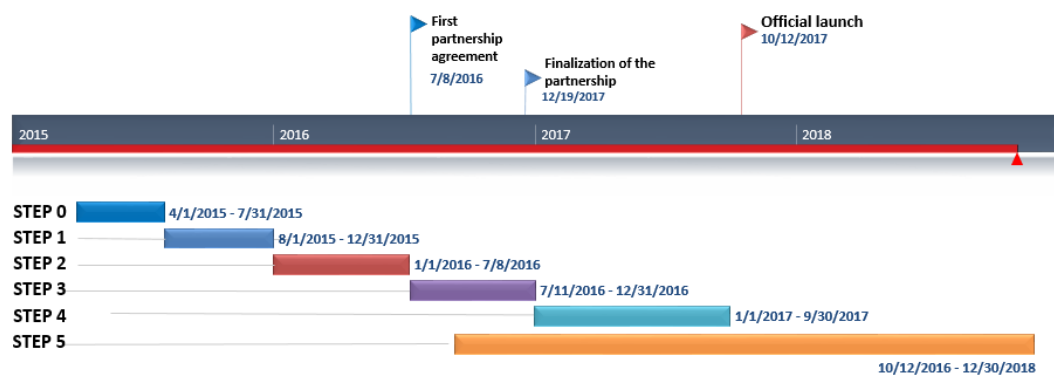


Figure 1. Gantt diagram of the project presenting the steps and the main milestones

Step 0: corresponded to the definition of the DF specifications. Its objective was to define: i) the expectations to be met by the DF, ii) a typology of the companies interested in the project, iii) the choice of the commercial vineyard that the DF will be implemented on, as well as iv) the project leader. Three consultation meetings were held at the end of which a document presenting the DF was drafted and validated by all the initial partners.

Step 1: corresponded to making contact with potential business partners and analysing their expectations and fears. Its objective was to define the project's partnership and governance model. This step was led by an academic and accompanied by a full-time engineer and a company specialized in setting up research and development projects in AgriTech (Abso conseil, Montpellier, France). The working method consisted of 42 individual interviews with each identified potential partner. This step finished with a workshop that brought together 39 interested institutional and industrial partners to propose the governance model and the intention of the partners to participate.

Step 2: This step aimed to define how digital tools/services should be integrated into the DF as well as the temporal organization of the deployment and was led by a full-time Agritech engineer. The challenge was to implement digital services while respecting the work organization of the commercial vineyard (and clear issues expressed by the vineyard manager). The deliverables of this step included documents describing: i) an inventory of the digital solutions that determined the operation, ii) the expectations, motivations or reticence of employees, iii) the need for support and training. It was completed on July 8, 2016 with the ratification of an agreement by the financial partners of the DF.

Step 3: consisted in finalizing the business partners, choosing the digital solutions to be deployed permanently and the organization of the digital solutions within 2 connected processes. This step was carried out by a full-time AgTech engineer.

Step 4: corresponded to the implementation of the DA solutions and the development of a communication strategy (name, website, logo and communication leaflet, visit program). The official launch was held on November 12, 2017 under the name "Mas Numérique" (MN). The launch was made more than two years after the start of the project and almost a year after the deployment of the DA solutions to allow the project to have a full production season of results and applications to show at the launch.

Step 5: corresponded to the management of the project, communication and mediation between the partners and the vineyard staff, as well as the organisation of visits and students/professional training.

## **Results**

The project leader and the selected farm: The initial partners decided that the project should be led and managed by a teaching and research team (UMR ITAP, Institut Agro Montpellier/INRAE) competent in the field of Agritech. This choice provided the project with an academic legitimacy and impartiality that reassured professionals. The selected farm vineyard, Domaine du Chapitre, Villeneuve lès Maguelone, is owned by the Institut Agro Montpellier, but is ideal as it is i) representative of regional vineyards, ii) subject to profitability constraints, i.e. run commercially and iii) located in the Montpellier urban area, close to research and training centres and internationally renowned conferences.

The recruitment of a project manager: A master's level engineer with dual expertise in agronomy and agricultural information technology was recruited to analyse and animate

the missions necessary to carry out the project. The recruitment was performed by L'Institut Agro Montpellier (formerly SupAgro) within the AgroTIC teaching and research unit with the financial support of two companies (SMAG and Vivelys). Incorporating the project manager within a research team offered a particularly favourable context for the interface between teaching, research and companies.

A sponsoring framework: The project was funded under a sponsorship framework made possible by L'Institut Agro Montpellier Foundation. This offered various advantages: i) it allowed companies to engage with the project in the form of donations (financial, equipment, skills) as well as in the management and coordination of the project, ii) it permitted tax exemptions on donations, whether financial or in-kind, (iii) it allowed the project to start without the need for a project call and, iv) it allowed a modularity partner involvement, either as a financial partner, that included involvement in project steering, or a non-financial partner (whose commercial DA solutions were deployed in-kind).

Organization and implementation of digital solutions: The demonstrative nature of "Le Mas Numérique" (MN) required that DA solutions were organized in such a way as to meet major challenges for growers and advisors in the region and could be directly implemented by the estate (operations manager and employees). Step 2 (Fig. 1) identified two major issues for the wine industry: i) the management and proper use of plant protection products for vine and fruit health and ii) quality and yield management. These challenges were used to define and structure two connected processes to showcase DA solutions in a coherent and complementary way. The companies associated with each showcase operated in a non-competitive framework.

Implementation of solutions: The technologies were deployed during the first "digital" production campaign (Fig. 1 - Step 3), as would have been done on a conventional farm. Estate employees received training for each connected process and technical meetings were held every 3 months. These brought together the companies involved, the vineyard manager, the project manager and academics from the Institut Agro Montpellier with the objective of i) sharing the deployment of solutions and the prerequisites/training necessary, ii) promoting mutual knowledge of the different solutions deployed in order to identify possible collective improvements and, iii) identifying missing complementary functions in the connected processes in order to consider the integration of new solutions and potential partners. During this stage, the role of animation was decisive in making the link between the vineyard and the partner companies. It made it possible to support employees in the field who were confronted with the implementation of 15 new tools/solutions in a few weeks.

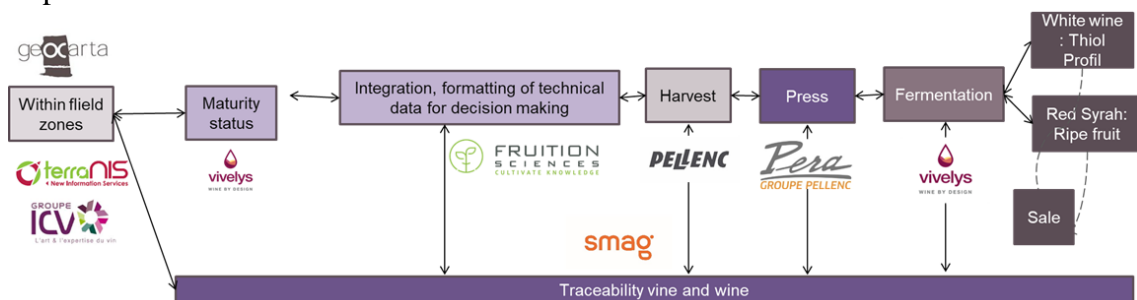


Figure 2: Functions (and associated DA solutions) of the connected process dedicated to yield and quality management at the Domaine du Chapitre.

Connected processes: Only one of the two connected processes implemented on the Mas Numérique is presented here. This process involves the practical use of precision viticulture tools and DA solutions for quality and yield control in the vineyard and the traceability of this into the winery and vinification process (Fig. 2). It combined the complementary digital and precision viticulture solutions of 12 companies.

This connected process combined functions to characterize the spatial variability of the soil (Geocarta, Paris, France) and vegetative expression (ICV, Maurin, France and Terranis, Toulouse, France) at the plot level. . All these dated, geo-referenced and heterogeneous data were integrated into a no-SQL data management platform (Fruition Sciences, Montpellier, France). Some functions used data stored in the technical management software of the vineyard (SMAG, Montpellier, France) or meteorological data, whether local (Agriscope, Mauguio, France) or virtual (Cap2020, Montpellier, France). Maturity monitoring data were used to help in the decision of the harvest date (Vivelys, Villeneuve-lès-Maguelone, France) according to previously defined quality profiles (Rosé, fruity red, aromatic white). The control and monitoring of the vinification was ensured by measuring and recording pressing characteristics with a connected press (Pera-Pellenc, Florensac, France) and evaluating and controlling oxygenation in fermentations (Vivelys). All oenological operations were traced by the cellar's technical management software (SMAG).

Although complementary, most of the DA solutions implemented in the two processes did not initially fully communicate with each other, i.e. there was low interoperability. The representation of the connected processes resulted in a very functional objective and led the companies associated with the "Mas Numérique" to experiment and adapt their commercial services in order to provide interoperability and to use all the solutions in a 'system of systems' framework.

Feedback for companies: For partner companies, Le Mas Numérique is also a demonstration site for customers. However, the project offered much more, since it allows actors in the PA and digital sector to experiment on a commercial farm and to identify and develop complementarities and relevant synergies with other enterprises. To date, five collaborative multi-actor industry-driven projects have emerged from Le Mas Numérique. For partner companies, Le Mas Numérique provides a controlled environment in which to identify their place and the role of their solutions in a 'smart' agriculture ecosystem. It is also an opportunity for companies to easily access the reality of how a farm operates. This direct access has been used by some companies to raise awareness among their non-agricultural people (computer developers, modellers, experts, etc.) of the reality of organizing a digital agricultural operation on a commercial farm.

Supporting employees in the field after one and a half years of operation has offered a unique experience. This experience has helped make it possible to identify the key issues faced by growers to adopt PA and digital services. This experience was used by the L'Institut Agro team to define the content of internships and continuing training

programs for agricultural advisors. For the wine profession and in particular the advisers, six continuing training sessions were carried out in a 2 year period. For initial training, Le Mas Numérique was used for practical illustration of digital technology in a real context. Several student training courses have also benefited from this unique real framework (master's degrees, bachelor's degrees, etc.). Le Mas Numérique has become a unique educational site to carry out training, lead alternate theoretical sessions, generate feedback on agri-technologies and showcase field activities.

## **Conclusion**

This paper aimed at sharing the experience and the organisation of a demonstration digital farm in the south of France. This is an example and each project of this type will necessarily have specific features that will require different choices. However, this project highlights organizational elements that appear to be critical to the success of the project. A key point is the project manager profile with dual competence in agronomy and in the field of AgriTech. The integration of the project manager into a research and teaching team was an important factor for success. It guaranteed academic legitimacy of the project and provided security for the commercial enterprises supplying various digital services as well as promoting trust among visitors and growers in the digital farm's activities.

**Acknowledgement:** Montpellier SupAgro Foundation and ANR-16-CONV-0004.

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