Classification of digital tools in agriculture

CHAIRE AgroTIC

aspexit
Precision Agriculture

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AGRICULTURE & NUMÉRIQUE

Foreword

This document is the result of work initiated and carried out by **Aspexit** and then reworked in collaboration with the **AgroTIC Chair** (of which Aspexit has been a member since 2020). It follows the launch of the directory of digital tools for farmers by Corentin Leroux and Alexandre Touraine in the summer of 2021 to **centralize** and **disseminate knowledge** about **the digital ecosystem in agriculture.**

Summary

1

Project background and objectives

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The issues of a classification

A workshop on the classification of digital tools was organized at a day-long meeting attended by all members of the **AgroTIC Chair**. This theme aroused strong interest among the group, with different ambitions for each participant.

**The interests identified for the members of the Chair were as follows:**

➜ Initiate a standard/ontology for digital tools

➜ Better position their tools in the agricultural digital ecosystem

➜ Facilitate competitive intelligence and benchmarking

In addition, the interests identified for the community are to:

➜ Gain a better understanding of the ecosystem

➜ Facilitate monitoring and inter-tool comparison

It was with this in mind that the Chair's working group set out, based on the first classification established by **Aspexit**. This first classification already made it possible to classify over 1,500 tools:

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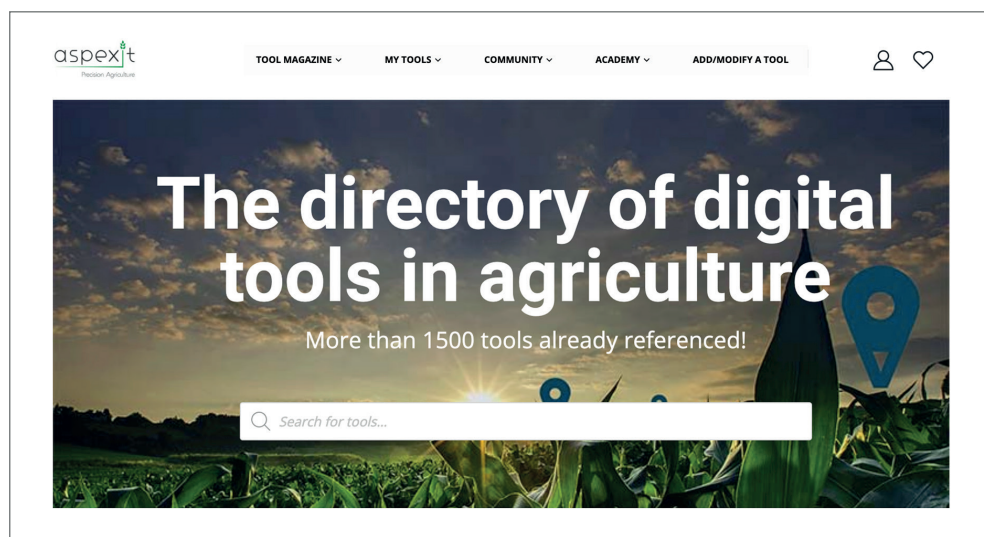
1 Project background and objectives

Methodology

For this project, we have focused on **digital Agtech technologies**. This term, a contraction of the words agriculture and technology, refers to the use of digital technologies and services in agriculture (plant and animal production).

We have deliberately left out tools positioned downstream in the processing and food sectors, as these are more closely integrated into FoodTech (digital technologies in the processing and food sector).

In parallel with this work on the classification of digital tools, a second working group of the Chair is tackling the issue of the evaluation of these digital technologies.

The themes of classification and evaluation of digital tools are quite closely linked, as classification enables tools to be better positioned in the ecosystem, thereby facilitating their future evaluation. Work about the classification of digital tools will therefore feed into this second working group.

Involvement of the AgroTIC Chair

Following the first face-to-face workshop that took place during the **AgroTIC Chair** members'day, a working group of approximately ten participants (including software publishers, distributors and technical institutes) with complementary visions, was formed on a voluntary basis.

This group subsequently met 3 times, on a monthly basis, for 2-hour video-conference workshops. These workshops were facilitated by **Aspexit** using the MIRO (collaborative whiteboard) tool. At the end of each workshop, the initial classification was updated and consolidated for subsequent workshops.

Following these 4 worshops, the produced classification was then challenged by several organisations outside the **AgroTIC Chair** members during a final workshop.

2

A classification with several entries into the agricultural digital ecosystem

2   A classification with several entries into the agricultural digital ecosystem

The way in which a professional tool is represented may vary widely according to the stakeholders interviewed, whatever the activity sector under consideration. The same applies to agricultural digital technologies.

For example, some stakeholders (perhaps the geekiest among them) will be more at ease directly considering tool categories, others will prefer to describe their day-to-day activities and define classes of tools according to their use or usefulness, while still others will be more concerned with longer-term agricultural objectives and will seek to find out whether digital technologies meet their expectations.

Rather than favouring a single entry, we have chosen to build a classification with several ones, so that everyone can find their path into the agricultural digital ecosystem in their own way.

In this working group, two main entries were considered: **the digital technology entry and the farming objective entry**. These are detailed in the following sections.

> **i** Other approaches would have been possible, but were not considered in the context of this work:
>
> • **Profession entry**, whether these roles are on the farm or within the actors gravitating around farms (e.g.: chamber of agriculture, agricultural cooperatives, consultancies...)
>
> • **Agricultural operation entry**, i.e. all the agricultural activities carried out on a daily basis by farmers - from the main production activities to all support activities (e.g. business management, research and experimentation, human resources management, etc.)
>
> These entries will be available in the new version of the directory of digital tools for farmers.

2

A classification with several entries into the agricultural digital ecosystem

TECHNOLOGY ENTRY
Classification of digital tools

Entering by technology allows to quickly identify the digital tools available on the market. But you still need to know what exists in the digital ecosystem...

We have divided this technology entry into 3 hierarchical levels.

→ A first level of 5 classes - expressed with an action verb - to clarify **the function or use of the tool** on the farm;

→ A second level clarifying **the categories of tools** available for each main function;

→ A third level detailing **the types of tools** available in each of these categories. This is where we'll find the names most commonly used when talking about digital tools in agriculture.

Our classification of digital tools offers a first step so that everyone can visualize the digital ecosystem as a whole. The number and the diversity of existing tools made the exercise complex. Classifying a few dozen tools may seem reasonably accessible. But when we try to classify several thousand (the directory of digital tools for farmers currently includes over 1,500), the organization becomes far more complex.

Figure 1 brings together all the functions, categories and types of digital tools proposed. The five main digital tool functions we suggest are detailed below:

1. Observe and Measure

This function groups together all the measuring instruments and sensors used to collect data to measure, describe and quantify a soil, a plant or a stand, an animal, a flock or a herd, a climate, a topography, etc. This function also includes geolocation data and services to support and/or improve geo-positioning on the farm. This also includes geolocation data and services to support and/or improve geo-positioning on the farm. Scouting robots are also represented in this observation function - and are to be distinguished from those present in the last major function "Act and Apply in the field".

A classification with several entries into the agricultural digital ecosystem

2. Organize, Manage and Trade

This function brings together tools for centralizing and organizing data on and around the farm. This includes FMIS (farm management information systems), which structure and display data on plant and animal production, farm machinery and any other connected objects on the farm. We've also included data portals, whether open-source or not, that can be mobilized by agricultural players. Last but not least, we've included agricultural e-commerce sites (market places), which bring together structured information to enable the ecosystem to buy or sell production results or inputs. This "Organize, Manage and Trade" function may seem a bit of a catch-all, but in reality it brings together all the technologies needed to prepare, structure and manage data.

3. Advise and Support

This function mainly covers advisory tools (decision support tools come to mind, but the range is actually much wider, with tools for identification [of plants, diseases, animals, etc.) or assistance with machine settings, for example). Also included in this main function are training tools (still not very present on the market) and a category known as "Swiss Knives and Gadgets" (no disparagement intended), which often free up the farmer's mental workload. A "Services" category has been added for requests and support that go beyond simple digital technology. Keep in mind that this category is more about companies than tools as such.

4. Exchange, Share and Collaborate

This function covers tools that are concerned with data exchange and its derivatives (traceability, telemetry, exchange security, etc.), as well as collaborative technologies that enable users to work in teams, exchange information between peers, and meet up in groups.

5. Act and Apply in the field

A function that highlights digital technologies for acting in the field, once a decision to take action has been made. Unsurprisingly, we find here the vast majority of robotic technologies (to be distinguished from those dedicated solely to monitoring, which are present in the first major function), but also actuators of various forms, mainly positioned to complement data collection by tools referenced in the "Observe and Measure" function.

2 A classification with several entries into the agricultural digital ecosystem

Classifying so many tools cannot simply be done on a theoretical basis, because new tools regularly appear on the market. Classification has been, and will continue to be, fluid and dynamic in order to absorb this diversity.

Let's also add that although it seems important to be very precise about the vocabulary to be used to form the categories and types of tools, in practice it is above all for the vocabulary to be as meaningful and eloquent as possible. This classification of tools must be operational, adapted to use in the field and speak to its main users, i.e. farmers. We have therefore favored explicit terms wherever possible, sometimes to the detriment of established terms (from a technical point of view).

The classification must be general enough to enable users to discover tools they might not have thought of, but precise enough to be discriminating and keep an acceptable number of tools in the same categories or type of tool. We consider that it will be necessary to limit the number of tool types to be associated with each digital technology, and thus give priority to the main categories and/or tool types with which the tools are associated. Let's take the example of a company providing a nitrogen recommendation service based on drone imagery. Even if we imagine that the company can also supply raw imagery (Function "Observe and Measure" > Category "Drone and Airborne Sensor" > Tool type "Multispectral – Hyperspectral Camera"), the main service is still to supply a nitrogen recommendation map. In this case, we would classify the service with the function "Advise – Train – Support" > category "Advisory tools" > tool type "Decision support").
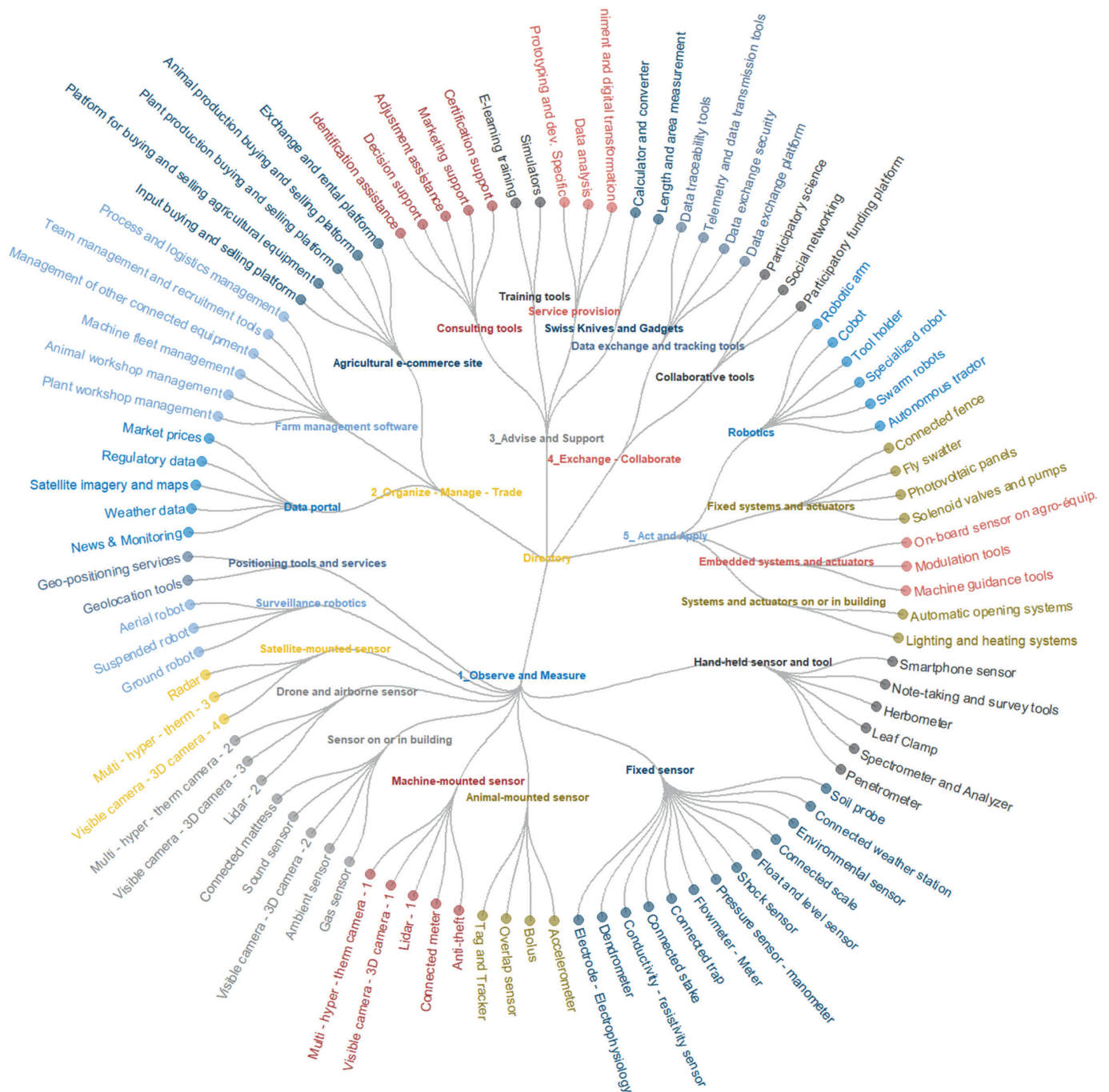
Figure 1 - Classification of digital tools in agriculture
Some terms have been truncated and/or simplified to fit into the figure.
The Agri-Tech Wiki (WAT) is the new version of the directory of digital tools
to be launched in the first half of 2023.

2 A classification with several entries into the agricultural digital ecosystem

OBJECTIVE ENTRY
Classification of farm objectives

Entering by objectives enables to maintain a business vision as understood by farmers. This entry is practical and much more field-oriented than the previous classification of digital tools, which focused on technology. This objectives-based approach is important because it forces technology and digital service providers to think about what business objectives their tools meet. It also provides an opportunity to identify objectives that may not be covered by digital technologies, or may at least be poorly covered.

The objectives presented here are those of the farm, not those of the individual farmer. These farming objectives depend both on the characteristics of the farm and the profile of the farmer:

➜ **for the farm:**
- soil and climate characteristics (location, soil type, climate…),
- agricultural characteristics (surface area, types of production, sectors…),
- business characteristics (investment, equipment, employees…).

➜ **and for the operator:**
- level of farming experience,
- digital skills and experience,
- business profile,
- human profile (risk aversion, cultural profile…).

We have identified six main objectives, each further broken down into secondary objectives.
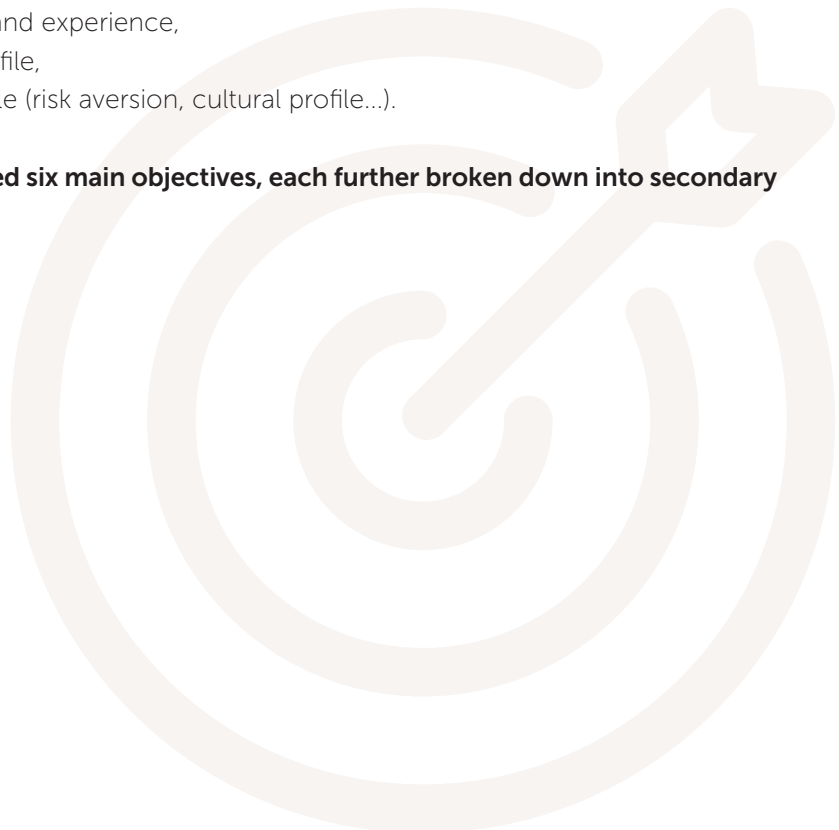
2 A classification with several entries into the agricultural digital ecosystem

The main and secondary objectives of farming

1 MANAGE

- Gain comfort on my farm
- Be better organized and save time in my day-to-day work
- Improve the technical aspects of my practices
- Improve productivity and increase production
- Preserve the health of my livestock
- Preserve the condition of my production
- Observe and support my field tours and herd observations
- Manage the purchase of my inputs and equipment
- Manage the sale of my production

2 RATIONALIZE

- Rationalize the use of water
- Rationalize the use of phytosanitary products
- Rationalize my fertilization and soil amendments
- Rationalize my GHG emissions/carbon footprint and store carbon
- Rationalize the use energy on my farm
- Rationalize the use of healthcare products and antibiotics
- Rationalize my farm's profitability
- Better adjust my farm equipment

3 ADAPT

- Experiment on my farm
- Improve biodiversity and the sustainability of my practices
- Improve soil functioning
- Adapt to climate change
- Connect old equipment (retrofit)
- Free myself from a service provider
- Respond to a labour shortage
- Improve data governance and security

4 COLLABORATE

- Find support for a digital project
- Find experimentation networks or partners
- Lead a farmers' collective
- Join a farmers' network
- Exchange and access data

5 TRAIN AND INFORM

- Progress in the use of digital technology
- Progress in the use of AgTech tools
- Keep abreast of agricultural news
- Inform the general public

6 TRACE AND CERTIFY

- Label my practices and certify specifications
- Ensure traceability and control of my production
- Digitize my field notebook - health notebook

These objectives serve as an entry point for finding digital technologies that meet these uses.

A classification with several entries into the agricultural digital ecosystem

These objectives are presented with action verbs to make them operational. Some secondary objectives are specific to plant or animal production. It is important to note that digital technologies can meet one or more of these secondary objectives.

1. Manage

This objective corresponds to tactical management of the farm, i.e. reactive, in-season management of issues as wide-ranging as technical production, marketing, comfort, organization and time management.

2. Rationalize

This objective covers the efforts to be made on farm inputs (water, fertilizers, energy, etc.). The secondary objective "Rationalize my farm's profitability" is concerned with the evaluation of both the products and the costs and expenses of a farm, with a view to not necessarily seeking higher sales, but rather a higher net result. We prefer to use the term "Rationalize" rather than "Reducing" or "Optimizing", because it is synonymous with a broader reflection that does not necessarily lead to reduction or optimization, but potentially to substitution or redesign.

3. Adapt

This objective covers transformations of the agricultural model to meet the challenges, constraints and crises facing agriculture (difficulty in finding labor, volatility of input and product prices, regulations, poor soil conditions, biodiversity crisis, climate change, etc.). We have also introduced notions of adaptation around governance and tool ownership ("Freeing oneself from a service provider" by using open-source technologies, for example, or by manufacturing one's own equipment) but also a notion of adaptation to existing equipment ("Making old equipment connected" to modernize existing equipment with digital technologies).

4. Collaborate

A goal that encompasses the need to connect with peers and the local fabric - and to work as part of a team; quite simply, because we are all social beings first and foremost. More specifically, we've also added a secondary objective ("Find support for a digital project") which is aimed not only at farms, but also more generally at players in the agricultural ecosystem who, rather than a particular technology, would like dedicated support for a broader project.

5. Train and Inform

This objective corresponds to the desire to improve skills and knowledge. Here, we have highlighted the need to progress in mastering digital agricultural technologies, so as to be able to make the right choices on the farm and use these technologies in the most appropriate way possible. But we insist on adding here the need for more general progress in digital technology (the basic concepts of which are not necessarily always mastered), so that farmers are masters of their tools...

6. Trace and Certify

This objective concerns the monitoring, control and/or labeling of production along the agricultural value chain (not only during production, but also upstream and downstream). Here, we distinguish between objectives that focus more on production as such ("Ensure traceability and control of my production") and others that focus more on image or proof of achievement ("Label my practices and certify a specification"). The secondary objective "Digitize my field notebook - health notebook", perhaps the first step towards a digital transformation of the farm, is also an important condition for progress on the main objective of traceability. We could have placed these secondary objectives under farm management. However, this main objective, "Trace and Certify", is more a response to a demand from society and the players involved in the farm, and is therefore surely more suited to a separate objective.

Next steps

The classifications and organizations proposed to find one's way around the ecosystem will be included in the directory of digital tools for farmers. These classifications may evolve in response to feedback from readers of this white book.

3

Project
stakeholders

3 Project stakeholders

Presentation of the directory

Corentin Leroux and **Alexandre Touraine** launched **the directory of digital tools for farmers** in the summer of 2021, with the aim of centralizing and disseminating knowledge about the digital ecosystem in agriculture.
www.lesoutilsnumeriquesdesagriculteurs.com/en/

At the end of 2023, Corentin and Alexandre will launch the **Agri-Tech Wiki (WAT)**, a more advanced version of the digital tools directory.

Professional background

Corentin Leroux is an agronomist, popularizer and trainer. He writes freely-accessible popularization dossiers on his blog combining agronomy, digital technologies, energy and climate. He has launched the Aspexit consultancy, which offers data analysis, training and consulting services in the field of digital agriculture.

Alexandre Touraine specializes in digital business transformation and innovation support. He founded Binaree Consulting to support companies in setting up digital infrastructures and to coach managers in the challenges and uses of digital technology.

Project stakeholders

Presentation of the Chair

The AgroTIC Chair is supported by two higher education institutions, Institut Agro Montpellier and Bordeaux Sciences Agro. Created in 2016, it is entering its third 3-year cycle and brings together a collective of 27 companies from the agricultural world and 4 scientific and technical partners.

It is a philanthropic project whose vocation is to contribute to the common good by **shedding light on the challenges of digital technology in agriculture**. The Chair's publications are intended for wide distribution.

Technical partners

Acknowledgements

In addition to the members and technical partners of the AgroTIC Chair involved in the various workshops, we would also like to thank Clément Fraigneau (Permagro), Marine Louargant (CTIFL) and Thomas Crestey (Mas Numérique) for their contributions to this reflection on the classification of digital tools.

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