Start-ups and digital innovation in the agri-food sector

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Start-up companies represent a powerful innovation process to push forward digital innovation and develop disruptive products and services based on digital technologies. At the same time, they challenge well-established companies that need to involve themselves in more ambidextrous innovation processes to stay competitive, pushing them to launch initiatives focusing on both internal innovations and organizational changes and external or open innovation opportunities.

Introduction

The entrance of digital technologies in agri-food value chains has taken place in stages. At first, digital technologies began with the development of web pages presenting information, before setting up new distribution channels and dematerializing a lot of documents and processes, such as, for example, declarations or registrations of fertilization practices. Since the end of the 2000s, digital technologies have developed new, more multimedia, more social, and more applicative attributes, allowed a change in the media used in communication strategies (such as farmers sharing practices on YouTube or Twitter), and contributed to new markets and business service models (*e.g.* apps or platforms for the sale and/or exchange of goods and services).These developments have been made possible thanks to the influence of two important phenomena: the end of the principle of product ownership in favor of the logic of service access, such as, for example, platforms for sharing agricultural machinery, and the development of the start-up ecosystem, at first in the Silicon Valley, characterized by a technological environment, a culture of innovation and risk, and a desire to push forward the boundaries of what already exists.

The rise of digital technologies has resulted in the explosion of the start-up phenomenon everywhere in the world, due to the ability of these high-potential and high-growth companies to seize new opportunities offered by these technologies, to imagine their uses, to associate them to existing products, and to create new needs. Gradually, all well-established companies have seen the emergence of new competitors, placing digital innovation at the center of their value proposition, modifying markets as well as the behavior of value chain actors. Thus, digital technologies not only inspire entrepreneurs around the world to develop new services, markets, or enterprises, but also impact established companies, through the development of more ambidextrous innovative processes, supported by both internal and external digital innovations.

Digital innovation in the agri-food sector

Many innovations are nowadays based on digital technologies that increase the human capacity to acquire, produce, disseminate, and use information at an unprecedented level and speed. This is made possible by a set of activities in which digital resources are combined in their design and use to create together new value propositions. Indeed, the proliferation of mobile devices and the ubiquity of Internet in everyday life have radically changed the expectations, preferences, and behaviors of customers, and have forced enterprises and industries to evolve.

The agri-food sector faces various challenges in terms of production, the environment, natural resources, and food waste, and has an urgent need for innovative solutions. One of the identified, potential approach is digitalization (FAO, 2020). Digitalization refers to the use of digital technologies, and often digitized information, to create value in new ways (Gobble, 2018). In the agricultural sector, it can be described as the process of applying digital innovations (Klerkx *et al*., 2019) in the production activities and all along the value chains. Thus, it involves the development and adoption of digital technologies, taking into account the tasks on and off farm (Shepherd *et al*., 2020). Precision agriculture is the use of digital technologies on farm to improve the production process, while digital agriculture is related to the use of digital technologies both on and off the farm (United Nations, 2017). Besides, the "farm-to-fork" approach refers to all the structures and activities of the agri-food chain, from production to consumption (Kamble *et al*., 2020), meaning access to and production of inputs (*e.g.* fertilizers, seeds, machinery….), production of agricultural products (*e.g.* from land preparation to harvest), trade of raw agricultural products, food processing (*e.g.* from raw products to processed ones), transportation, retail, and consumption (Prause *et al*., 2020) as well as food waste management.

Start-ups play a key role in innovation processes (Spender *et al*., 2017). A start-up is a company, a partnership or a temporary organization designed to search for a repeatable and scalable business model. Through the start-up phase, new ideas are brought to the market and transformed into economically sustainable enterprises (Blank, 2013). Due to their smallness, start-ups can offer a dynamic and agile environment to develop breakthroughs in conventional innovation processes, or to offer disruptive products and services that impact value chains and dominant market positions. Concerning the French AgTech sector, start-ups are developing digital solutions all along agri-food chains. Florez *et al*. (2022) found that the different types of digital technologies used are mainly Artificial Intelligence (AI), Internet of Things (IoT), big data, blockchain, cloud computing, robots and e-commerce. However, the services offered mostly focus on production and retail/consumption, with a predominance of AI, IoT, and e-commerce usage. AI is the only digital technology that is currently developed in all segments of agri-food chains.

Innovation at the core of corporate strategies

The rise of digital innovations based on new, disruptive technologies, such as AI, blockchain, augmented reality AR, virtual reality VR, connected objects (IoT), robots, autonomous vehicles…, will continue to influence human behavior, but also to change business models, organizations, value chains, and industries. Around the world, major corporations, and not just start-ups, are embracing the digital transformation and undergoing organizational changes. The opportunity to innovate by means of products incorporating digital services or by developing new services has become a challenge for well-established companies that have seen digital start-ups launching large waves of digital innovations over the past two decades (Svahn *et al*., 2017). Now, all companies, and in particular large groups, face a new type of potential competition, coming from start-ups that innovate in terms of services, sales models, distribution or communication channels, and have a

strong capacity to grow quickly when they are able to raise important sources of funding. Thus, the start-up model has strongly reinforced the importance of innovation in corporate business strategies, in order to develop an ability to offer products in a new way, invent new products, increase market shares, and not be overtaken by the competition. The digital transformation is becoming a strategic imperative to maintain and enhance their competitive advantage, which requires accelerating investments to gain in the expertise, acquire promising start-ups, and display of digital innovations (Serval, 2018) in their value propositions.

Consequently, innovation, which was most often developed based on products and within companies, now emerges from multiple horizons. In particular, it leads large groups to opt for open innovation approaches, in order to enrich themselves with new ideas and increase their capacity for renewal. For not being confined to restricted initiatives, most large companies develop their innovation process in two directions. They conduct interval innovations within the boundary of the company, in the form of R&D projects, and open innovation, by sharing of knowledge inputs and resources with external partners (Du *et al.*, 2014). They navigate in a distributed innovation environment where ideas and knowledge derive from external sources, require companies to organize for agility (*i.e.*, the ability to detect and seize market opportunities with speed and surprise), while, at the same time, carry out transformation programs aiming to create a real culture of innovation (*i.e.*, evolving towards a less hierarchical model and more horizontal structures), by promoting collaborative work, developing multidisciplinary teams, and encouraging individual initiatives. In doing so, the innovation processes of companies are becoming more and more ambidextrous (Lewin *et al.*, 2011), with a need to keep a balance between their internal and external innovation components. Therefore, both internal innovation benefits and open innovation benefits are important for achieving superior innovation performance at the organizational level, and both internal and external value-creating mechanisms are developed.

Open innovation approaches

Open innovation can be accomplished by collaborating with science-based innovation partners, such as universities and research institutions with a large pool of scientific knowledge (Van Beers *et al.*, 2008). In addition, innovation can be jointly developed and commercialized with market-based partners, through collaborating with suppliers to improve input quality and reduce production costs, collecting new and valuable ideas from customers, and sharing production and marketing resources with competitors (Hensen and Dong, 2020). Collaborating with different types of innovation partners increases the likelihood to be exposed to different new ideas, gain access to a broader range of market information and complementary resources, benefit from the co-development of new products, or win new markets.

Among the open innovation approaches most often implemented by companies, we can find:

- The creation of venture capital funds makes it possible to invest in companies with an innovative business model to help them develop, while being able to observe their development and measure the impact of the innovations developed on markets. For example, the CapAgro Innovation venture capital fund, created in 2014 by five industrial groups and financial institutions, is committed to developing the agri-food and agro-industrial sectors, by investing, in particular, in new digital technologies.
- The participation in private or public acceleration programs by most often sponsoring a theme close to the corporate business core, which allows companies to develop strategic intelligence, while having a limited financial and human investment. For instance, Xavier Niel, already at the origin, in 2017, of Station F, a start-up campus

located in Paris, has launched, in 2022, Hectar, an incubator whose objective is to propel 80 agricultural start-ups in two years. On the public side, the FrenchTech has launched the FrenchTech Agri20 program in 2022, which supports breakthrough innovations in the agri-food sector, coming from high potential start-ups, in order to bring out technological champions.

- The launch of sectoral incubators or accelerators makes it possible, for companies, to identify the emergence of innovative projects, as early as possible, to guide them, and also to position themselves on a possible equity investment. For example, the « Les Champs du Possible » incubator, run by Le Village By CA (Crédit Agricole), welcomes 15 start-ups each year and offers a whole set of services that facilitates the emergence of start-ups, while allowing them to access a rich network of industrial partners, local authorities, financiers, and farmers.
- The establishment of a start-up studio, whose vocation is to launch multiple projects by internally developing many strategic and operational skills, such as business, legal, design, prototyping, development… For instance, the Crédit Agricole Group has launched in 2018 « La Fabrique by CA » to promote the Group's innovation, gain in agility and accelerate the time to market of new projects, by creating or promoting the growth of start-ups and supporting them for their financing as well as their commercial and operational development.
- The creation of an innovation lab can have various purposes, such as foresight (anticipation of the future in 5-10 years), agility and incubation (by adopting methods from start-ups), open innovation (aiming at disruptive innovations through the contribution of external assets), facilitation of collaborations… For example, the living lab "OccitANum – Occitanie Digital Agroecology", winner of the "Territories of Innovation" call for projects, has been created with the aim of testing full-scale services, tools, or new uses able to facilitate the digital transformation of agriculture while responding to the societal demands, such as the environmental preservation, fair compensation of producers, producing healthy and local food products…This new research-action device develops an innovation system where users are not simply end-users, but become actors and collaborators, and, in particular, farmers and consumers who are placed at the center of it.
- The sourcing of external ideas through the implementation of hackathons, reverse pitches, competitions, and other calls for projects, such as, for example, the Hackathon du Varenne agricole de l'eau et de l'adaptation au changement climatique, which took place in 2021, or the Global Wheat HEAd deTection Challenge on the Kaggle platform in 2020.

The different approaches are rarely exclusive. They are generally implemented in parallel, with most often relatively blurred boundaries between innovation labs, accelerators, and sourcing initiatives. Whatever the chosen options, the major issue remains the return on investment for companies, because it can take several years for start-ups or new activities to become profitable. This also involves major changes for companies, especially moving from their conventional innovation processes based on specific programs focusing on time-limited projects to a continuous and integrated approach at the very core of the corporate values and operations.

Conclusion

More than ever, companies must continue to innovate in terms of services, processes, sales models, distribution channels, or communication to remain competitive. Digital technologies offer tremendous opportunities and, guided by everyday uses that also tend to invade business activities, it constitutes in many areas a lever for value creation.

Driven by the emergence of increased competition, companies are forced to take new risks and launch new initiatives that materialize in open innovation programs together with the development of an internal transformation in terms of culture, working environment, and ways of collaborating. This also requires an increasing ability to continuously digitize their activities in order to ensure their resilience, sustainability, and transition to new sources of business. At the same time, companies have to manage and gain new markets created by the unfolding of digital technologies, either by integrating promising start-ups or by creating them from scratch. Thereby, models, such as incubators/accelerators and start-up studios seem to have a bright future ahead of them insofar, as they allow not only to be immersed in the innovation ecosystem, but also to potentially escape the inertia and the weight of the existing business activities.

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