International Food and Agribusiness Management Review
Volume 26, Issue 3, 2023; DOI: 10.22434/IFAMR2022.0122

Received: 27 September 2022 / Accepted: 18 December 2022

Special issue: Agrifood systems transformations

Exploring how EU agri-food SMEs approach technology-driven business model innovation

RESEARCH ARTICLE

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Abstract

The EU agri-food sector, which is mainly composed of small and medium-sized enterprises has become more demanding in terms of technological inputs to reduce costs, improve the added value of food products, achieve sustainability issues, or address new market opportunities. The introduction of new technologies poses challenges for SMEs that lack the resources and time to cope with the technological transformation, which involves not only the assimilation of new technology in organizational processes but also business model innovation. In this context, this research aims to empirically explore the paths of agri-food SMEs engaged in the technological transformation process, based on the drivers and barriers, as well as the strategies used by these companies to overcome these barriers. In-depth semi-structured interviews with 14 EU agri-food SMEs were conducted and analysed using a combination of deductive pattern-matching and inductive approach. Based on similarities in terms of drivers, barriers, and strategies, seven main groups were identified to draw the paths of the technological transformation process for agri-food SMEs. Findings reveal that there is one common strategy that is adopted by all 14 companies, namely the employment of different types of partnerships and collaborations that allow companies to successfully enter new markets. The study contributes to the literature on technology transformation related to the agri-food sector, by proving insights into how EU agri-food SMEs cope with this process.

Keywords: technological transformation, drivers, barriers, business-strategies, agri-food SMEs, in-depth interviews
JEL-codes: M2

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1. Introduction

Agri-food small and medium-sized enterprises (SMEs) are business organizations that play a prominent role in economic development, employment generation, and wealth creation in most countries of the world (Fanelli, 2021). The EU agri-food sector, which is mainly composed of SMEs, has become more demanding in terms of technological inputs, due to rising food quality and safety requirements and globalization trends amongst others (Minarelli *et al.*, 2015). Technological innovation can support agri-food SMEs in reducing costs and improving the added value of food products, accomplishing multiple stakeholder requirements, and addressing new market opportunities. Although EU agri-food SMEs face competitiveness pressures to adopt new technologies (De Velde and Kretz, 2020), their transformation to exploit these technologies is challenging given their inherent lack of resources (Minarelli *et al.*, 2015; Voytovych *et al.*, 2020). The technological transformation process is complex involving not only technology assimilation but also business model innovation (BMI) (Smajlović *et al.*, 2019). To cope with that complexity, agri-food SMEs need to develop strategies, which are delimited based on the motivations to introduce new technology (i.e. drivers) and are also shaped by the barriers encountered during this process (Priyono *et al.,* 2020).

Previous research acknowledges the interplay of technology assimilation and BMI in achieving the outcomes of new technology (Baden-Fuller and Haefliger, 2013; Chesbrough, 2007), but fails to capture the process of technological transformation comprehensively, by considering both aspects. In the context of agri-food SMEs in particular, current literature on technological transformation is limited. Within this context, to the best of our knowledge the available studies focus either on technology assimilation (e.g. Abecassis *et al.*, 2018) or business model innovation (e.g. Ulvenblad *et al.*, 2018) rather than taking a comprehensive view of the technological transformation process. Consequently, those existing studies also fall short of identifying, the main strategies used by agri-food SMEs to accomplish innovation activities given the scarcity of their resources. Moreover, within this context, to the best of our knowledge the available studies focusing whether on technology assimilation (e.g. Abecassis *et al.*, 2018) or business model innovation (e.g. Ulvenblad *et al.*, 2018) rather than having the overall view on the technological transformation process.

To fill this gap, this study takes a comprehensive approach to analyse the experience of agri-food SMEs with technological transformation, considering both technology assimilation and BMI. To understand the experience of agri-food SMEs with technological transformation, we explore the motivations of agri-food SMEs to introduce new technologies, the challenges encountered in the technological transformation process, and how these companies coped with these challenges. In sum, the present study aims to explore (1) the drivers and barriers of agri-food SMEs for technological transformation; (2) the strategies used by these companies to overcome barriers related to technological transformation, given their drivers. With these objectives, an exploratory qualitative multiple case study design was applied to this research (Yin, 2009) on 14 agri-food SMEs within the EU that have engaged in technological transformation, based on Technological Transformation theories (Priyono *et al*., 2020). With its results the present study contributes a comprehensive approach to exploring the paths of agri-food SMEs in the technological transformation process, considering both technology assimilation and BMI.

The paper is structured as follows. Section 2 delineates the theoretical background. Section 3 details the methodology followed to conduct this qualitative study. Section 4 presents the results and section 5 discussion and conclusions.

2. Theoretical background

The literature recognizes technology innovation as a key factor for SMEs' competitiveness (Popa *et al.*, 2018), and its importance for agri-food SMEs to comply with multiple market requirements (Minarelli *et al.*, 2015; Voytovych *et al.*, 2020). Previous research has investigated the environment that enables SMEs to obtain benefits by introducing new technologies (Müller *et al.*, 2021), from which technology assimilation and business model innovation has been highlighted.

Technology assimilation[1] can be defined as the organizational process that includes the stages from the awareness, and initial evaluation of a technology, its adoption, and its routinization (Zhu *et al.*, 2006), which is required to enable effective technology use (Baird *et al.*, 2017; Bruque and Moyano, 2007). Business model innovation refers to the search for new logic and new ways to create and capture the value and define new value propositions (Casadesus-Masanell and Zhu, 2013), which is required to utilize the opportunities offered by new technology (Alojairi *et al.*, 2019).

The complementarity between technology assimilation and BMI is essential for performance gains when introducing new technology (Smajlović *et al.*, 2019). Due to the interaction between these two activities and their joint outcome, we will label this overall as technological transformation[2] to express conceptually the introduction of a technology to a company as one process. Although the joint effect of technology assimilation and BMI on the successful introduction of technologies is acknowledged by previous studies (Baden-Fuller and Haefliger, 2013; Chesbrough, 2007), they are generally separate concepts in the literature (Baden-Fuller and Haefliger, 2013), resulting in a fragmented research field of technological transformation.

This fragmentation is reflected in the studies' foci and theoretical backgrounds. Studies on the SMEs' context are generally focusing on the technological side of technological transformation (Arayici *et al.*, 2011; Bruque and Moyano, 2007; Haseeb *et al.*, 2019), more specifically on the phase of technology adoption (i.e. the decision to introduce a technology) (Nguyen *et al.*, 2015), or BMI (e.g. Ibarra *et al.*, 2020; Moeuf *et al.*, 2018), without analysing the entire process. Moreover, the theoretical background of the studies typically employ BMI theories and/or technology innovation-related theories to explain technological transformation (e.g. Norris, 2020; Priyono *et al.*, 2020), and few studies provide strategies to guide SMEs related to the technological transformation process (Balocco *et al.*, 2012). In the context of agri-food SMEs, studies are also fragmented, and can be focused on phases of technology assimilation (e.g. Ibrahim *et al.*, 2017; Jain *et al.*, 2021), or business model innovation aspects (e.g. Bivona and Cruz, 2021; Dagevos and Lauwere, 2021). Therefore, existing studies are falling short of identifying strategies used by agri-food SMEs to accomplish innovation activities related to technological transformation.

The lack of integration in the technological transformation field represents a relevant limit for the current scientific knowledge on how to deal with the introduction of technology. Not surprisingly, studies have shown that SMEs struggled to benefit from technologies due to failures in technology assimilation (Nguyen *et al.*, 2015), and/or in BMI (O'Toole, 2003). These failures depicted from the fragmented perspective on the introduction of technology are identified as leading to serious consequences in SMEs' business performances (Liang *et al.*, 2007), given the inherent vulnerability due to scarcity of resources (Minarelli *et al.*, 2015; Voytovych *et al.*, 2020).

To support understanding the strategies for dealing with technological transformation in agri-food SMEs, we group the companies with common drivers and barriers. This study aims to support giving insights to agri-food SMEs that have similar paths for technological transformation, by providing insight into how other companies coped with technological transformation, by connecting drivers, barriers, and strategies. The next section presents the methodology of this study.

[1] The term technology assimilation is used for consistency purposes since the literature on technological innovation is highly fragmented, resulting in different terms to discuss similar concepts. The term was chosen due to its comprehensiveness, and, whenever the papers analyzed use terms, such as adoption, implementation, innovation, this work uses the term 'technology assimilation'.

[2] The term 'technological transformation' refers to the actions that the company needs to take to benefit from a new technology, which encompasses both technology assimilation and BMI, similarly to the term 'digital transformation' comprehensively (e.g. Singh *et al*., 2020; Warner and Wäger, 2019).

3. Methodology

3.1 Data collection

To obtain detailed insights concerning the drivers and barriers and the key strategies employed by agri-food SMEs when engaging in technological transformation, we conducted in-depth interviews with 14 SMEs. The companies' selection was carried out according to the sampling approach by Lincoln and Guba (1985). These companies operate in different stages of the supply chain in the food and beverages sector and have introduced technologies recently. They were selected due to (1) the fact that they have approached the process of technological transformation, (2) their characteristics (SMEs within the EU agri-food context), and (3) their willingness and commitment to share information. Considering these three criteria, 14 companies were considered suitable to provide information on the technological transformation of EU agri-food SMEs' due to their commitment, characteristics, and practical experience dealing with introducing new technology. Data were collected from December 2019 to March 2020 with owners and managers of these 14 companies using semi-structured interviews. The interview guide gathered detailed information through a set of guided open questions regarding (1) their current business models, (2) the drivers and barriers of technological transformation, and (3) the key strategies employed by SMEs to cope with technological transformation; (4) the main changes in their business environment, after the introduction of the technology.

3.2 Data analysis

For data analysis, we combined a deductive pattern-matching approach (i.e. the identified subject was categorized within the theoretical framework) with an inductive approach (useful for developing theoretical insight related to phenomena that are early in their scholarly inquiry). The interviews were transcribed and translated into English (when necessary), and the interviews' data were coded with the support of ATLAS.ti 8 software. The coding process includes two steps: in the first step we focus on the single organization context, and in the second step we group the companies according to similarities in terms of drivers, barriers, and strategies. To support understanding the strategies for dealing with technological transformation in agri-food SMEs, we group the companies with common drivers and barriers.

Drivers positively influence the decision for technological transformation, while barriers negatively influence the technological transformation process (Balocco *et al.*, 2012; Gatautis *et al.*, 2019). Then we derived the strategies used by companies, designed to achieve the objectives (related to drivers) and overcome the barriers (Priyono *et al.,* 2020).

4. Results

4.1 Description of the sample

The sample consists of nine micro-enterprises (companies 1, 3, 4, 6, 7, 8, 9, 10 and 11), four small enterprises (companies 5, 12, 13, and 14), and one medium enterprise (company 2). As regards the company's age, most of the companies exist for less than five years (companies 1, 4, 6, 8, 10, 11, 12); companies 3, 5, 7, and 9 exist from five to ten years; and companies 2 and 14 exist for more than ten years. The geographical distribution of the sample includes the Netherlands, Italy, Austria, Portugal, Spain, Greece, and Hungary. The information on the companies within the sample is summarized in Table 1.

4.2 Drivers

The analysis of the interviews reveals seven main drivers for engaging in technological transformation, which are summarized in Table 2. The companies of the first group employed the technology to obtain products with different levels of quality: companies 6, 9, and 14 looked for premium quality, while companies 2 and 13 aimed at extending the shelf life of the product, and, thus, extending the time window to sell the products

Table 1. Description of the sample.

n	Years	No. of employees	Size	Country	Technology	Supply chain stage
1	3 years	5 employees	Micro	NL	High technology for tailor-played sports nutrition and dietary supplements	Production and processing
2	40-50 years	60 producers (cooperative)	Medium	PT	Smart preserving systems based on cold treatment	Production, storage, and packaging
3	9 years	6 to 8 employees	Micro	NL	Innovative model to grow mushrooms from organic materials and their aim is to create 50% vegetarian meat from the fungal protein	Production, processing and distribution
4	less than 1 year	2 employees	Micro	NL	Mild and scalable process, which can recover unique compounds from natural micro-organisms such as baker's and brewer's yeast and micro-algae	Production and processing
5	6 year	17 employees	Small	NL	An innovative model that allows consumers to buy a share of one of the high-welfare animals by using a web platform	Processing, packaging and distribution
6	3 years	2 to 3 employees	Micro	AT	Hydroponic system recycling water from aquaculture (circular system) + recycling fishes processing waste for producing pet food	Production
7	5 Years	2 employees	Micro	NL	Stabilizing spirulina algae with a special oven	Production, processing and distribution
8	2 years	3 full-time + two entrants	Micro	NL	New alcoholic drink honey-based	Production, processing and distribution
9	6 years	6 employees	Micro	IT	High-Pressure Processing technology for cold-pressed juices	Processing
10	less than 1 year	2 employees	Micro	NL	Innovative process for producing innovative products (dairy-based healthy shot made of extra virgin olive oil)	Processing
11	3 years	2 fixed + 2 seasonal	Micro	IT	Recycling pruning waste and machinery for producing wood chips	Processing
12	2 years	30 employees (cooperative)	Small	ES	Innovative business platform for commercializing handicrafts (from the producer to consumers without intermediators)	Processing and distribution
13	8 years	20 employees	Small	GR	Very innovative pressure plant and equipment for energy self-sufficiency (Circular systems) – solar energy + geothermal	Processing
14	12 years	13-15 employees	Small	HU	Innovative technology for reducing the energy consumption of sheep and livestock	Production and processing

Table 2. Summary of the technological transformation drivers.

Drivers	Description	Companies
Improve the quality	Improve the quality of products in terms of shelf-life extension and preserving the organoleptic characteristics or produce a premium quality product	2, 6, 9, 13, 14
Identification of market trends and opportunities	Identification of innovative market opportunities in food production and consumption	3, 4, 5, 7, 8, 10, 11
Previous experiences/ knowledge of food innovation	Using the knowledge or previous experience in a similar field to develop an innovative idea for a new business	3, 4, 5, 7, 8, 10,11
Sustainable orientation	Sustainable-oriented innovation to reduce the environmental impact of food production with less waste	3, 5, 8, 14
Resources optimization to reduce the costs	Optimization of the resource use for achieving economic sustainability by reducing the costs	6, 13
Expand the market	Acquiring new customers and achieving international market	2, 12
Customers' demand	Customers request products that need a new processing procedure	1

given their perishability. For example, company 2 works with fresh fruits and vegetables and they apply cold treatment to maintain the quality of the products and extend the commercialization calendar for around 6 months. Company 9 produces juices and uses cold-press treatment to preserve the vitamins and all the organoleptic compounds of fresh fruit obtaining premium quality products.

Other companies identified future trends in the food industry (companies 3, 4, 5, 7, 8, 10, and 11), which can be addressed by using new technologies. For instance, with the increase in the vegetarian food market, company 4 produces protein-based food products from microalgae. Another example is company 11 which offers a solution for pruning waste, anticipating the urgency to answer the new regulation on waste management in the field.

The identification of market opportunities is driven by the previous knowledge (academic) and experience (empirical) of the owner-managers of SMEs. Companies 3 and 10 bring the know-how from different companies' countries and adapt it to their own countries by developing new concepts of the food chain. The founders of companies 4, 5, 8, and 11 have developed new related business ideas based on their previous research experiences with food innovation.

In the case of start-ups and micro-enterprises (companies 4, 7, 8, 10, 11) the knowledge of innovation's market opportunities is derived from the research developed during the academic thesis work developed by the owners. When companies operate in niche markets, it is easier to identify market opportunities related to innovation, especially when the identification process is supported by universities and research institutes (as in the case of company 7).

Regarding sustainable orientation, companies 3, 5, and 14 aim to reduce the environmental pressure (greenhouse gas (GHG) emissions) of food production by reducing food waste or by substituting plant-based protein. The sustainable orientation can be a result of new regulations for achieving sustainable development goals. For instance, Company 5 develops a new idea of meat chains by slaughtering the animals only when the cuts are fully pre-sold online (through a newly introduced technology i.e., a customer's platform). Company 8 aimed at creating a community network around bees protection and increasing the consumers' awareness of these topics.

Two companies used new systems to optimize the resources and reduce costs: company 6 employs a circular production system (aquaponic system) based on recovering the wastewater from the fish as fertilizer for the plants. Additionally, in this case (company 6), the decision to adopt the innovation was due also to the increase in the quality of the final product, which is an attribute that has a significant impact on consumers' preferences and, in turn, influences their purchasing decisions, and increases the premium price. Company 13 uses pressure plants and equipment for energy self-sufficiency (solar energy and geothermal systems).

Two companies aim at reaching international markets: while company 2 employs a product with an extended calendar, company 12 uses a platform to bring together handcraft producers and consumers. Finally, innovation can be driven by customers' demand, as in the case of company 1 which was requested to develop a sports drink product with new milk protein from Dutch cows, resulting in a new production process.

4.3 Barriers

The authors identify nine main barriers which are summarized in Table 3. One of the most common barriers perceived by the companies interviewed is the lack of internal financial resources and the difficulty of accessing external capital (companies 2, 3, 5, 9, 14). The insufficient capital, lack of internal funds, and difficulties in raising additional financial resources to adopt new technologies (companies 2 and 9) are particularly relevant for micro and small companies. Companies 2 and 9 used expensive technologies which they needed to outsource: in company 2, the investments in outsourcing the technology were also considered high. Companies 5 and 14 face a constant lack of internal financial resources and company 3 experiences difficulties in having access to credit lines, due to bank criteria (turnover, profit, etc).

Companies 4, 7, 8, 10, and 11 endure technical difficulties in employing the technology. For instance, relatively new companies (such as 4, 8, and 10) have strong innovative ideas but they encounter difficulties in operationalizing the idea into food products with acceptable attributes (e.g. products' texture, taste,

Table 3. Summary of the main barriers.

Barriers	Description	Companies
Financial	The financial barrier can be related to the cost of technology or the investments for running the production activities	4, 2, 3, 5, 8, 9, 14
Technical	Difficulties in achieving stable production or managing the new chain	4, 5, 7, 8, 10, 11
Selling the food products at a premium price for the quality due to the technology used	Difficulties in making consumers aware of the premium quality and the added value of the technologies used	6, 9
Entering markets with high competition	Difficulties in entering markets (especially when they are well-established)	1, 13
Inadequacy of regulations	Lack of regulation for certain technologies and absence of standards for specific products and/or processes	9, 11, 7
Hiring people with specific skills	Difficulty in hiring people with specific skills needed to deal with the production requirements	5, 7, 11, 13, 14
Lack of demand or acceptance of customers	Difficulties in acquiring new customers (sometimes due to their lack of trust in the new product formulation/offered services)	8, 9, 11, 7, 14
Technologies require time to provide the benefits	Companies that do not outsource experience a gradual process of technology assimilation and it takes time for benefiting from technology	6, 7, 11,13

stability), such as company 4 struggling with the production of plant-based hamburgers and sausages. Companies 5 and 11 face challenges in managing the new supply chains (especially the logistics) created after the introduction of the innovation.

The absence of workers with specific skills, who are needed to deal with the production and technical requirements at the SME level, represents another obstacle for companies 5, 7, 11, 13, and 14. These companies observed a lack of expertise in the technology environment due to the immature nature of technological innovation. Company 7, in particular, experiences a lack of operators with a medium level of education, since it is a novel product.

Another common barrier is related to marketing the product at a premium price for its higher quality. To reach a premium price, one of the challenges for SMEs is related to improve the communication/promotion of the innovation's benefits/effects of the innovation (e.g. on products' characteristics) because consumers are more interested in the stated technology benefits than the technology treatments itself (Song *et al.*, 2022). Moreover, the customers do not show a willingness to pay a premium price, although the products are treated with innovative technologies, especially if the new technologies do not have established regulations. Obtaining certifications and green labels can support agri-food SMEs in translating the value of new products to customers. The inadequacy of regulation for specific products and services obtained with the new technologies leads consumers to be reluctant about the novelty resulting in a lack of consumers' acceptance and a decrease in the probability of purchases by new customers or consumers.

Company 11 faces difficulties in convincing customers about the benefits of its pruning waste management solution. Other companies (Companies 7, 14) experienced unstable and uncertain demand for specific food items and difficulties in acquiring new customers (as in the case of Company 14). For companies 1 and 13, the main barrier relates to gaining a market share from competitors in a saturated market.

4.4 Understanding strategies when introducing the technologies through drivers and barriers

To draw the paths of the technological transformation process for the agri-food SMEs, the authors grouped the companies according to similarities in terms of drivers, barriers, and strategies. Considering that barriers and strategies are shaped according to the objectives to introduce the technology, the categorization of the companies in different groups first considers the analogous drivers, then the common barriers associated with the specific drivers.

Potentially a company can have multiple drivers and multiple barriers and this combination is assumed to shape the strategies that each group of SMEs adopts to cope with the technological transformation. Seven main groups were identified and reported in Table 4.

- *Group 1: Improving quality and reducing costs*

The first group includes the companies that want to achieve quality improvement and a reduction of costs at the same time (6, 13). The common barrier for them is maintaining their competitive advantages. More specifically, company 6 wants to place on the market premium quality products but has difficulties in marketing these products at a higher price. In this context, the managers developed two main strategies: first, they invest in target communication via media coverage; second, they empower the production line which implies a reduction of costs and an increment of the margins (economies of scale).

Company 13 achieves quality improvement by extending the shelf life of the product (longer keeping quality), and for the manager, the main impediment is to find new customers and enter new markets. Unlike company 6 which is a relatively new business, company 13 is a well-established enterprise possessing well-functioning production activities, therefore the strategy adopted by this company is building collaborations with key business partners, as facilitators for entering new markets and consequently increasing its competitiveness.

Table 4. Summary of the main strategies.

Strategies	Description	Companies
Collaboration with business partners (BPs)	Finding key BPs to enter new markets [13] Building on alliances with BPs for searching for funding [2, 3, 5, 8] Building a community around the offered products[8] Collaborate with big companies to develop the formulation of the product and scale up the innovation [4,10] Collaborating with technology providers to scale up the technology [6,13] Partnership to find new customers [1, 14] Partnership with different countries who promote the products [2] Collaborating with a research centre and university [4, 5,7, 8, 11] Collaborating with the association of producers [2, 7]	1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14
Investing in target communication	Target communication: - media coverage [6] - infographics [9] - organizing seminars, workshops, and demonstration events inviting other customers who already experienced the product and who can offer their testimony [8]	6, 8, 9
Outsourcing	To afford the high-costs (using third-party technologies) To have access to manufacturing expertise	1, 2, 3, 4, 8, 9, 10
Shortening the supply chain	To increase the margins To create environmental value	3, 5, 6, 14
Go bigger to get cheaper (economy of scale)	Increasing production and reducing costs	6
Cooperative business model	Division of technical skills and commercialization skills (producers can be completely focused on the production since there are responsible for the marketing activities)	12
Market knowledge	Good knowledge concerning the market of raw materials that allows taking advantage of price fluctuation and being competitive with the price	1
Discontinue the use of the technology	Inabilities to find new customers willing to pay a premium price for the innovative product Low margins	9

The second common obstacle for both is related to the technology assimilation process: technology requires time for learning and time to return the outcomes, and more specifically the learning process regards how to reduce the costs by using the new systems. The process of technology assimilation is facilitated through the support of the technology providers, which allows them to speed up the innovation scaling up, by acquiring crucial information and best practices to deal with the technologies.

■ *Group 2: Sustainability-orientation based on consumers' expectations*

This group entails companies (companies 3, 5, and 8) that develop sustainable products to address the new trend of consumers (e.g. vegetarian, less meat consumption). Therefore sustainable-oriented innovation is also driven by consumers' expectations since an increasing number of people are more sensitive to sustainability

issues. Company 3 is using organic waste to grow mushrooms in a circular system, and from that, the company creates a product with a 50% of plant-based burgers. This value proposition wants to address the needs of a rising percentage of vegetarian consumers. Company 5 aims at reducing the GHG impacts of meat products by reducing meat waste (optimizing the meat chain by shortening it) with positive benefits to animal welfare. Company 8 aims at boosting biodiversity and providing habitat for bees, also donating a percentage of the final price to bees protection initiatives. Through these initiatives, this company wants to create a community network around bee protection and increase the consumers' awareness of these topics.

The common barrier for this group is financial: switching to sustainability-oriented innovation, implies a product innovation (as in the case of company 8) or a new supply chain concept (as for companies 3 and 5). Both require new investments, as well as new assets (especially financial capital), and consequently, the companies, are constantly experiencing a lack of financial resources. The financial issue becomes more pressing for social enterprises (company 3) to whom banks show hesitation in ensuring the line of credit. All the companies react to this barrier by building networks and constantly looking for key business partners (including investors) to improve the technology and buy new machinery, as well as employ extra human resources. Moreover, as company 8 is introducing a novel alcoholic drink, which competes in the market with traditional drinks (e.g. wine and beer), thus the new product needed to be accepted by consumers. Therefore, the company decided to invest in target communication by organizing:

testing events with target consumers, conveying the product's features by way of its benefits, and telling a story of how that product will impact customers' lives;

demonstration events inviting other customers who already experienced the product and who can offer their testimony, to slowly raise the trust of those sceptical customers.

- *Group 3: Sustainability-orientation driven by internal motivation*

This group includes only company 14 in which the sustainable orientation is driven by internal motivation: the company is placing on the market a premium quality product produced with low impacts (reduction of pesticides, ensuring animal welfare and the freshness of the production (selling the product with a short-chain).

The main barrier encountered by this company is financial due to a lack of demand. Differently from the previous group, this company does not own previous experience and it does not look at market trends. The company is trying to re-organize its assets but the lack of demand does not ensure fair revenues and this creates some difficulties in making the right investments to attain the changes. Moreover, the production of high-quality food may require qualified employees that sometimes are scarce for special sectors. For instance, the company experiences a shortage of specific skills to produce high-quality meat due to the scarcity of highly educated workers, especially in the area where the company is placed, which is a village far from the capital. The lack of specific skills is also related to the scarcity of workers that share a common sustainability-oriented vision and the alignment of goals and expectations (workers that believe in sustainability issues).

In this business environment, the company reacts by adopting two main strategies: (1) shortening the value chain to increase the margins, and (2) joining a community to find new customers.

- *Group 4: Identification of market opportunities driven by previous experience*

This group incorporates micro-enterprises (companies 4, 7, 10, 11) with previous academic or empirical knowledge of innovation, which guides them in identifying new market opportunities. In fact, in the case of companies 4, 7, and 11, the innovation's knowledge and the related market opportunities are derived from the research developed during the academic thesis work. Company 4 produces protein-based food products from microalgae; Company 11 offers a solution for pruning waste management, anticipating the urgency to answer the new regulation on waste management in the field; Company 7 is specialized in developing

innovation in the microalgae sector. In the case of the microalgae micro-enterprise, when companies operate in niche markets, it is easier to identify market opportunities related to innovation. Company 10 brings the know-how from a different country and adapts it to its own country by developing innovative products with nutraceutical benefits.

The relatively new micro-enterprises, with innovative ideas, experienced difficulties in operationalizing the idea (technical barrier). For instance, obtaining acceptable attributes (e.g. products' texture, taste, stability) for companies 4 and 10 represents the main obstacles. Therefore, they needed reliable food manufacturing partners for developing the novel product and this often require financial support (the companies are not able to afford the investment with their financial resources) guaranteed by investors interested in the innovative ideas.

Unlike the other companies that outsource the production, companies 7 and 11 (that are both technology users and providers) implement the technology within the company, and for them, the main technical issue is related to the inconsistent regulations and standardization of novel processes that result in a lag of innovation scaling-up. For instance, company 7 is tailoring the innovation according to the specific needs of the customers by improving existing technologies, therefore since the process requires time to achieve the main benefits and the customers want to see the outcomes in the short-term, the company decided to implement the technology outside the real environment and scale-up it once the required performances were achieved. As companies 7 and 11 are innovation pioneers, they train employees internally, involving them in the adoption process, which requires extra time and costs for being successful and accepted in the markets (meeting the needs of the customers). Company 11 had the capability to set up all the processes by carrying out several piloting tests with their workers, to gradually achieve the highest productivity. In this case, the size of the company (micro-enterprise) and the relationships based on trust lead to a better analysis of critical issues within the production and to finding the best solutions for time and cost optimization.

Collaboration or partnerships with research institutions, universities, and microalgae associations (as in the case of company 7) are crucial strategies adopted by the companies, to develop competencies and acquire new knowledge for accelerating the technology learning process and assimilating the market trends knowledge.

- *Group 5: Market expansion driven*

In this group, both companies are producers' cooperatives that share the same driver, although they experience different barriers due to different technologies used and different products offered.

Regarding technology, organization 2 uses cold treatment while organization 12 operates a web platform to connect producers and consumers. The main barrier for organization 2 is the costs of the technology, while for organization 12 is related to the type of products offered (artisanal), and more specifically to keep the quality characteristics the same as well as achieving a premium price justified by the typicity of the produce.

The common strategy used by both companies intends to build alliances with key business partners to provide venture capital (as in the case of organization 2) or to find associates to promote the product in different countries (as in the case of organization 12). Moreover, in both organizations, the division of technical and commercialization skills are separated. This allows producers (associated with the cooperative) to be completely focused on the production (achieving the best quality) since the marketing activities (i.e. finding new customers, searching for the best promotion strategy, and building alliances) are under the responsibility of the cooperative.

■ *Group 6: Quality improvement driven*

This group incorporates company 9 in which the consumers' acceptance of the innovation was not checked at an early stage of technology adoption, therefore the company did not reach the expected competitive advantage from the innovation. In detail, the company follows the new technology trend and decided to invest in innovative products, in this case, cold-pressed juices obtained by High-Pressure Processing. Nevertheless, the Italian market was not ready for this innovation: the innovative product does not achieve the acceptance of consumers that associate the cold-pressed treatment with an artificial attribute. This is mostly related to the inconsistent regulation of specific products obtained with the new technology that leads consumers reluctant about the quality and peculiarity of products.

The first attempt of the company was to improve the promotion with infographics; then considering the low margins (the main customers were retailers that were not willing to pay a premium price for the premium quality), the company decided to discontinue the use of the technology. Finally, the company changed the value proposition targeting the final consumers by selling fresh juices (real-time pressed) and increasing the margins.

■ *Group 7: Customer's driven*

This group includes company 1 which developed the innovation in response to customers' requests. This company identified the main barrier to the competition: earning a market share from competitors in a saturated market. To cope with competitors, the company acquired a good knowledge concerning the market of raw materials and takes advantage of price fluctuation by buying the product when the price is low, therefore they can be competitive with the price of the final products. Moreover, collaboration with the branch companies is a further strategy adopted by this company to ensure the acquisition of new customers.

5. Discussion and conclusions

The results reveal that companies can have one or a combination of drivers (Gatautis *et al.*, 2019; Müller *et al.*, 2018; Rozmi *et al.*, 2020). The combination of drivers together with the identification of the common barriers and strategies guided the authors to group the companies. Therefore, the groups illustrate the different paths that companies studied follow when engaging in technological transformation. In fact, the decision to follow a transformation path is idiosyncratic for each SME (Priyono *et al.*, 2020) and depends on different aspects such as the technology type, food product type, motivations to use the technology, target consumers, etc. We identified generic strategies from the idiosyncratic paths followed by the 14 agri-food SMEs studied (Table 5), similar to the study of Pryiono *et al.* (2020). However, for the idiosyncratic reasons aforementioned, the paths suggested cannot necessarily be extended for agri-food SMEs with different characteristics. Nonetheless, this study provides insight into general strategies used by the SMEs in the agri-food sector to cope with drivers and barriers of technological transformation, which can be adapted by other agri-food SMEs.

The analysis highlights the importance of understanding the specific business context of the companies and the corresponding process of change, as suggested by a previous study that analyses paths for technological transformation in SMEs (Priyono *et al.*, 2020). By exploring the business environment, possible strategies can be tailor-made to overcome specific technical limitations and achieve their objectives.

From the analysis, we identified 7 groups of companies, and we present the drivers, barriers, and strategies when dealing with technological transformation. For instance, within group 1 '*Improving quality and reducing costs*', the companies that pursue quality improvement and a reduction of costs required time to learn how to benefit from the technology with more efficient use of resources and cost reduction. Quality-driven innovation is expected to produce a positive effect on companies' performances and competitiveness as well as contribute to improving the company's reputation and value which in turn affects the acquisition

Table 5. Groups of the companies.

Groups	Companies	Drivers	Barriers	Strategies
Improving quality and reducing costs	6, 13	• Quality improvement • Resources optimization	• Maintaining the competitive strategy • Technology requires time to provide benefits (learn how to reduce the costs by using the technology)	• Technology providers support • Go bigger to get cheaper (economy of scale) [6] • Investing in target communication [6] • Finding key business partners to be competitive [13]
Sustainability orientation based on consumers' expectation	3, 5, 8	• Sustainability orientation • Identification of new markets • Previous knowledge or experience	• Financial (find capital to invest) • Technical: - new chains to build [3, 5] - new products [8]	• Finding investors • Building a network with key business partners • Investing in target communication [8] • Building a community around the offered product [8]
Sustainability orientation is driven by internal motivation	14	• Sustainability orientation • Quality improvement	• Financial (placing the products on market) • Lack of demand (rural area) • Hiring people with specific skills	• Shortening the supply chain • Partnership to find new customers • Enter new markets
Identification of market opportunities driven by previous experience	4, 7, 10, 11	• Identification of new market • Previous experience or knowledge	• Technical: - Reaching the quality attributes - New processing system to set-up • Lack of regulations and standardization of the new processes [7, 11] • Hiring people with specific skills	• Collaboration with key business partners: - Big companies to develop the formulation of the product and scale up the innovation [4, 10] - Research center and university [7, 11] - Association of producers [7]
Market expansion driven	2, 12	• Acquiring new markets (international)	• Financial (technological costs) [2] • Technical (maintaining the characteristics of the product) [12] • Selling the food product at a premium price [12]	• Building on alliances: - for searching for funding [2] - partners in different countries who promote the products • Cooperative business model
Quality improvement driven	9	• Quality improvement	• Financial (technological cost); • Selling the food product at a premium price; Inadequate regulations; • Lack of acceptance from customers	• Invest in target communication; • Outsourcing; • Discontinued the use
Customers' driven	1	• Customer demand	• Competition	• Market knowledge • Collaboration with sister company

of new customers. Besides the selection of quality, the companies build a collaboration with key business partners, to mainly find new customers and successful paths to contact and sell through to increase their competitiveness. Moreover, to accelerate the learning and assimilation processes, especially on how to reduce costs, these companies required the support of the technology providers

In group 2 '*Sustainable orientation based on consumers' expectations*' the companies that improve the quality by following a market trend on sustainability and exploiting the previous knowledge on sustainability-oriented innovation need to build a network with key business partners, especially investors that support the innovation and find new investors that ensure venture capital and step up the scaling-up phase, in return for multiples of the initial investment. When companies deal with new product formulations, they might need to enhance the consumers' acceptance, this is realized by building a community of potentially interested consumers in which to develop promotion initiatives.

Sustainable innovation could also be internally motivated and combined with quality improvement as in the case of the third group '*Sustainable orientation driven by internal motivation*'. Here the company's sustainability orientation refers to adjusting the organization's vision and values, as well as the processes, practices, and final product to answer the goals of social and environmental value creation with economic returns (Adams *et al.*, 2016). Therefore, the strategy adopted is shortening the value chain to create environmental value and increase the margins, as well as building partnerships to find new customers and enter new markets.

The fourth group '*Identification of market opportunities driven by previous experience*' includes microenterprises that utilize previous knowledge of innovation to develop an innovative idea for a new business and to search for market opportunities. Several authors recognized the search for market opportunities as a driver of technology adoption (Cosenz and Bivona, 2021; Fanelli, 2021). In this case, market-driven innovation implies the understanding of the needs of the sector, as well as the preferences of customers and the market condition, and it contributes to improving value creation and delivery, especially for SMEs with a large market adaptation. In some companies, market research is essential for strategic decisions to innovate the processes, the services, and the BMs. Research institutions and universities, industry associations, and policymakers contribute to helping SMEs in exploring new business opportunities and receive targeted information, access to funds, partner networks, potential customers, and cross-industry /cross-regional expertise.

The main strategy for the companies of the fourth group is to collaborate with (1) big manufacturing (or suppliers) for technical support in developing and testing the first food applications; (2) research organizations as 'catalysers' of the technological transformation process, that transfer the knowledge, solutions, and results from the food sector; (3) association of producers to find potential clients.

The companies seeking to expand into new international markets, in group five '*Market expansion driven*' need to build alliances for acquiring financial capital to afford the costs of servicing the market, as well as new partners in different countries, to promote the products.

Consumers' acceptance of the innovation can be checked early on, which is essential to avoid the risks of failure and loss of investments. Indeed, the company in the sixth group '*Quality improvement driven*' decided to disclose the use of technology for low consumer demand. In this case, the scarce acceptance is also caused by the inconsistent regulation of specific products leads consumers incapable of evaluating the quality and peculiarity of products, decreasing their commercial value, and dwindling the niche of customers able to catch the real characteristics of the production. Within this context, institutions and governments are called to provide a supportive environment for SMEs to boost their innovation potential and rebalance the market of these specific products. The main strategy for the company in which the innovation is driven by customers' demand (within group 7 '*Customer's driven'*) is to collaborate with the sister company (suppliers). In this case, the collaboration seeks to complement the different competencies thus preventing the two organizations compete for the same market segments. To develop or re-organize a unique and innovative business model after the technology introduction, each company needs specific strategies aligned with the business scenario

(Priyono *et al.*, 2020). Nevertheless, the analysis reveals a common and crucial strategy adopted by all the companies: partnerships and collaboration that mainly allow them to successfully enter and maintain the markets, by creating true win-win scenarios.

The collaboration/partnerships may concern:

1. The provision of financial resources to cope with the new business.
2. Stakeholders from governmental institutions, chambers of commerce, regional development agencies, research institutes, and universities to boost a joint innovation funding scheme.
3. The co-working with the technology and service providers to acquire technical information required for the technology implementation in the real environment.
4. Producers association or non-competitor companies to find new customers and market opportunities.
5. Research institutions and universities to develop competencies and acquire new knowledge and skills to accelerate the technologies assimilation process and improve the companies' flexibility to the changes determined by this.
6. With final consumers to enhance the promotional initiative and create a community around the products and the sustainability issues connected to it.

The comprehensive analysis of drivers, barriers, and strategies denotes the complexity of the technological transformation, especially for SMEs that are characterized by a simpler structure with fewer human, financial, and material resources.

This research contributes to fill in the gap in the literature on technology transformation related to the agri-food sector, by proving insights into how EU agri-food SMEs cope with this process. Moreover, the study provides a general framework that encompasses the understanding of technological transformation requirements (Figure 1).

This framework, useful for the companies engaging in the technological transformation process, includes the following steps:

1. Understanding the technology's requirements by exploring the technological and organizational context. Specifically, it is crucial to explore the main internal motivations that bring the SMEs to introduce the technology, as it details the direction that these companies should pursue in achieving

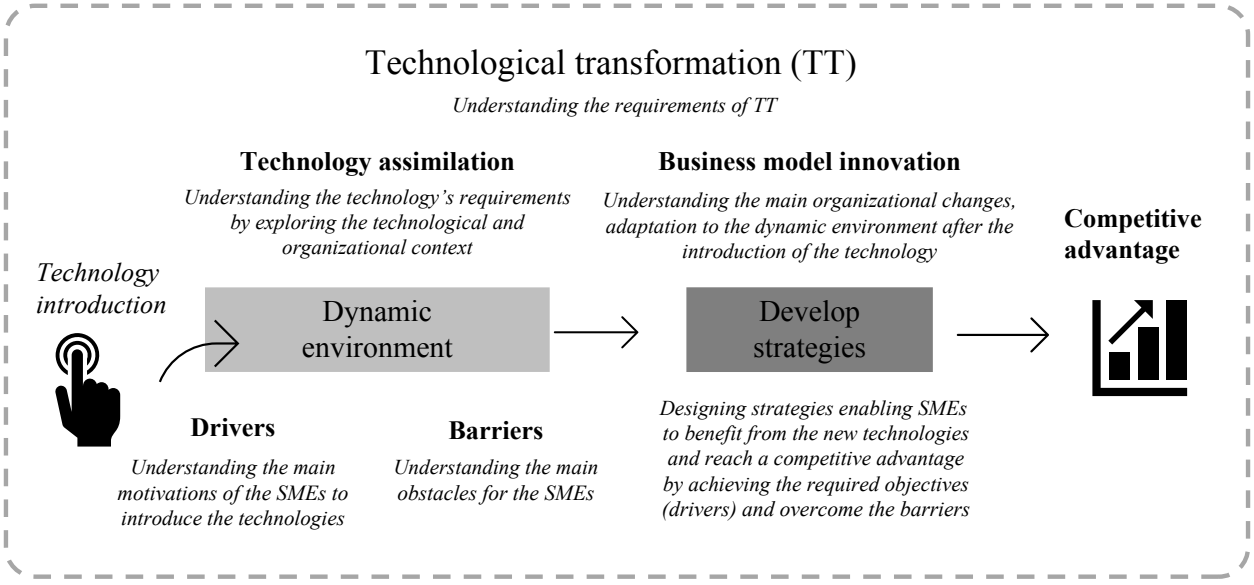

Figure 1. General framework of technological transformation.

their technology goals (drivers). The analysis of the barriers is also essential since they could negatively influence the success of technology assimilation and then technological transformation.

2. Understanding the main organizational changes, and adaptation to the dynamic environment after the introduction of the technology, given the resources scarcity. In detail, the emerging strategies developed on specific technology's drivers (goals that the companies aim to achieve), and barriers encountered in the process, provide detailed insights on how the companies should adapt to the dynamic environment. In this positive view, strategies play a central role as enabling factors for benefitting from the new technology (BMI) and achieving a competitive advantage.

The current literature on technological transformation is fragmented, and BMI and technology assimilation are not covered by previous studies when analyzing the introduction of new technology. Moreover, to the best of the authors' knowledge, this is the first paper that presents strategies to cope with technological transformation in agri-food SMEs, by considering different technologies. By taking the transition perspective, we were interested in how agri-food SMEs deal with technological transformation challenges in practice.

This analysis intends to guide managers in understanding how other SMEs can be successful in their technology transformation journey, proving insights on what strategies need to develop for coping with the specific barriers encountered while maintaining alignment with their main drivers. More specifically, by learning from the experience of other companies, managers can find common patterns and design their strategies, based on their business environment and the conditions in which the technology has been introduced.

Policymakers can facilitate access to funding to support these companies in affording these technologies in the short term. They are also called to develop programs for professional education and knowledge transfer not only addressed to improve technological innovation but also aimed at enhancing their market opportunities (e.g. integrating the consumer and market analysis into the technological innovation process). Moreover, collaborative arrangements can be created, hence these companies can share structures and the costs in the technology transformation process. Finally, new government rules aligned with the technology needs should be designed to reduce the risk perception amongst company managers. Future studies could also extend the analysis of the agri-food SMEs' business environment to explore the main strategies adopted by the companies to re-organize the resources available (resources mix) and build dynamic capabilities, encompassing changes in a dynamic environment and achieving a competitive advantage (Figure 2).

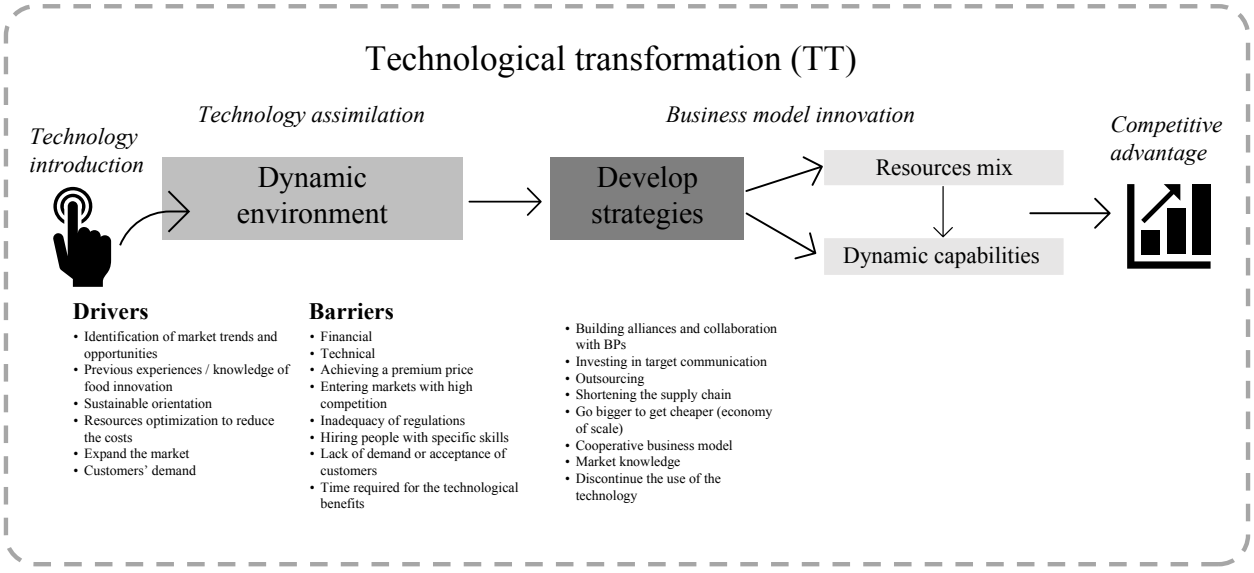

Figure 2. Technological transformation framework expanded with dynamic capabilities analysis.

The study of dynamic capabilities (Teece, 2007) and re-organization of resources can contribute to provide more insights for illustrating the different paths that companies can follow when engaging in technological transformation and benefitting from it.

Acknowledgements

This research has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 817936.

Conflict of interest

The authors declare no conflict of interest.

References

Abecassis, J., B. Cuq, J.L. Escudier, G. Garric, A. Kondjoyan, V. Planchot, J.M. Salmon and H. de Vries. 2018. Food chains; the cradle for scientific ideas and the target for technological innovations. *Innovative Food Science a Emerging Technology* 46: 7-17.

Alojairi, A., N. Akhtar, H.M. Ali and A.F. Basiouni. 2019. Assessing Canadian business IT capabilities for online selling adoption: a net-enabled business innovation cycle (NEBIC) perspective. *Sustainability* 11(13): 3662.

Arayici, Y., C.O. Egbu and S.P. Coates. 2012. Building information modelling (BIM) implementation and remote construction projects: issues, challenges, and critiques. *Journal of Information Technology in Construction* 17: 75-92.

Baden-Fuller, C. and S. Haefliger. 2013. Business models and technological innovation. *Long Range Planning* 46(6): 419-426.

Baird, A., E. Davidson and L. Mathiassen. 2017. Reflective technology assimilation: Facilitating electronic health record assimilation in small physician practices. *Journal of Management Information Systems* 34(3): 664-694.

Balocco, R., A. Cavallo, A. Ghezzi, and J. Berbegal-Mirabent. 2019. Lean business models change process in digital entrepreneurship. *Business Process Management Journal* 25(7): 1520-1542. https://doi.org/10.1108/BPMJ-07-2018-0194

Bivona, E., and M. Cruz. 2021. Can business model innovation help SMEs in the food and beverage industry to respond to crises? Findings from a Swiss brewery during COVID-19. *British Food Journal* 123(11): 3638-3660.

Bruque, S. and J. Moyano. 2007. Organisational determinants of information technology adoption and implementation in SMEs: The case of family and cooperative firms. *Technovation* 27(5): 241-253.

Chesbrough, H. 2007. Business model innovation: it's not just about technology anymore. *Strategy and Leadership* 35 (6): 12-17.

Casadesus-Masanell, R. and F. Zhu. 2013. Business model innovation and competitive imitation: The case of sponsor-based business models. *Strategic Management Journal* 34(4): 464-482.

Cosenz, F. and E. Bivona. 2021. Fostering growth patterns of SMEs through business model innovation. A tailored dynamic business modelling approach. *Journal of Business Research* 130: 658-669. https://doi.org/10.1016/j.jbusres.2020.03.003

Dagevos, H. and C.D. Lauwere. 2021. Circular business models and circular agriculture: perceptions and practices of Dutch farmers. *Sustainability* 13(3): 1282.

De Velde, E.V. and D. Kretz. 2020. *Advanced technologies for industry. Sectoral watch. Technological trends in the agri-food industry*. European Commission Publications Office, Luxembourg, Luxembourg. Available at: https://ati.ec.europa.eu/reports/sectoral-watch/technological-trends-agri-food-industry

Fanelli, R.M. 2021. Barriers to adopting new technologies within rural small and medium enterprises (SMEs). *Social Sciences* 10: 430.

Gatautis, R., E. Vaiciukynaite and A. Tarute. 2019. Impact of business model innovations on SME's innovativeness and performance. *Baltic Journal of Management* 14 (4): 521-539. https://doi.org/10.1108/BJM-01-2018-0035

Haseeb, M., H.I. Hussain, B. Ślusarczyk and K. Jermsittiparsert, 2019. Industry 4.0: A solution towards technology challenges of sustainable business performance. *Social Sciences* 8(5): 154.

Ibarra, D., A.Z. Bigdeli, J.I. Igartua and J. Ganzarain. 2020. Business model innovation in established SMEs: A configurational approach. *Journal of Open Innovation: Technology, Market, and Complexity* 6(3): 76.

Ibrahim, A.M., M.S.H. Hassan and S. Yusuf. 2017. Factors influencing acceptance and use of ICT innovations by agribusinesses: a conceptual framework. In: *Driving agribusiness with technology innovations*. IGI Global, Pennsylvania, PA, USA, pp. 39-55.

Jain, V., T. Tavishi and G.B. Narayanan. 2021. Unlocking technology adoption for a robust food supply chain: Evidence from Indian food processing sector. *HSE Economic Journal* 25(1): 147-164.

Liang, H., N. Saraf, Q. Hu and Y. Xue. 2007. Assimilation of enterprise systems: the effect of institutional pressures and the mediating role of top management. *MIS Quarterly* 31 (1): 59-87.

Lincoln, Y. and E. Guba. 1985. *Naturalistic inquiry*. CA Sage, Beverly Hills, CA, USA.

Minarelli, F., M. Raggi and D. Viaggi. 2015. Innovation in European food SMEs: determinants and links between types. *Bio-based and Applied Economics* 4(1): 33-53.

Müller, J.M., O. Buliga and K.I. Voigt. 2018. Fortune favors the prepared: How SMEs approach business model innovations in Industry 4.0. *Technological Forecasting and Social Change* 132: 2-17.

Müller, J.M., O. Buliga and K.I. Voigt. 2021. The role of absorptive capacity and innovation strategy in the design of industry 4.0 business Models-A comparison between SMEs and large enterprises. *European Management Journal* 39(3): 333-343.

Moeuf, A., R. Pellerin, S. Lamouri, S. Tamayo-Giraldo and R. Barbaray. 2018. The industrial management of SMEs in the era of Industry 4.0. *International Journal of Production Research* 56(3): 1118-1136.

Nguyen, T.H., M. Newby and M.J. Macaulay. 2015. Information technology adoption in small business: Confirmation of a proposed framework. *Journal of Small Business Management* 53(1): 207-227.

Norris, L. 2020. The spatial implications of rural business digitalization: case studies from Wales. *Regional Studies, Regional Science* 7(1): 499-510.

O'Toole, T. 2003. E-relationships-emergence and the small firm. *Marketing Intelligence and Planning* 21: 115-122.

Popa, S., P. Soto-Acosta and D. Perez-Gonzalez. 2018. An investigation of the effect of electronic business on financial performance of Spanish manufacturing SMEs. *Technological Forecasting and Social Change* 136: 355-362.

Priyono, A., A. Moin and V.N.A.O. Putri. 2020. Identifying digital transformation paths in the business model of SMEs during the covid-19 pandemic. *Journal of Open Innovation: Technology, Market, and Complexity* 6 (4): 104.

Rozmi, A.N.A., P.N. Nohuddin, A. Hadi, A. Razak, A. Bakar, M. Izhar and A.I. Nordin. 2020. Factors affecting SME owners in adopting ICT in business using thematic analysis. *International Journal of Advanced Computer Science and Applications* 11 (7): 208-218.

Singh, A., P. Klarner and T. Hess. 2020. How do chief digital officers pursue digital transformation activities? The role of organization design parameters. *Long Range Planning* 53(3): 101890.

Smajlović, S., B. Umihanic and L. Turulja. 2019. The interplay of technological innovation and business model innovation toward company performance. *Management: Journal of Contemporary Management Issues* 24(2): 63-79.

Song, X., L. Bredahl, M. Diaz Navarro, P. Pendenza, I. Stojacic, S. Mincione, G. Pellegrini, O.K. Schlüter, E. Torrieri, R. Di Monaco and D. Giacalone. 2022. Factors affecting consumer choice of novel non-thermally processed fruit and vegetables products: Evidence from a 4-country study in Europe. *Food Research International* 153: 110975.

Teece, D.J. 2007. Explicating dynamic capabilities: the nature and micro foundations of (sustainable) enterprise performance. *Strategic Management Journal* 28: 1319-1350.

Ulvenblad, P., H. Barth, J.C. Björklund, M. Hoveskog, P.O. Ulvenblad and J. Ståhl. 2018. Barriers to business model innovation in the agri-food industry: A systematic literature review. *Outlook on Agriculture* 47(4): 308-314.

Voytovych, N., I. Smolynets and K. Hirniak. 2020. The role of technology innovation in food systems transformation. *Calitatea* 21(174): 128-134.

Warner, K.S. and M. Wäger. 2019. Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal. *Long Range Planning* 52(3): 326-349.

Yin, R. 2009. *Case study research: design and methods*, 4th ed. Sage Publications, Los Angeles, CA, USA.

Zhu, K., K.L. Kraemer and S. Xu. 2006. The process of innovation assimilation by firms in different countries: a technology diffusion perspective on e-business. *Management Science* 52(10): 1557-1576.