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(Article begins on next page)

The Italian agrifood supply chain sustainability through technological heritage redesign and new relationships

by
Maria Rosaria Marcone*

1. Introduction

The research work presents the first results of a study on green management with reference to the most relevant strategic decisions on a wide range of evolutionary phenomena in the way of doing business and the concomitant design by management of new green business model, of new digital technological development, of the new sustainable supply chains (SC).

The core objective of this paper is empirically to observe and to test sustainable innovative supply chain projects through the interpretation of the most appropriate ways to carry out R&D activities by supply chain actors, and also the type of involvement of these in the supply chain technological heritage redesign. In this the relational perspective of the sustainable innovative processes analysis is intended to investigate the better quality outcomes generation of the single actors of the supply chain, and in final of the entire supply chain, such as export orientation, new product development (NPD), repositioning in the international supply chains, repositioning in business to business (BtB) markets. The focus of this contribution is mainly to highlight how new digital technologies, especially those implemented in production plants, in new material design and in new digital governance platforms within supply chains, represent the ideal prerequisite for allowing manufacturing companies and new innovative actors (farmers, research centres, start upper, etc.) to formulate the most appropriate sustainable strategies to successfully attack current competitive contexts.

The agricultural context lends itself to studies that show that farmers and agrifood firms are very interested to explore in terms of border line technologies because of the significance of the sector for the economies of countries, the role of efficiency and potential optimization within the agrifood sector, and the role that the sector plays in transitioning toward net zero targets. In this sense is important to promote research methodological approaches to analyse different uncertainty scenarios for the future such as business model design for a sustainable development, biotechnology innovations, digitization of technologies, inter-firm sustainable relationships, international development of Italian agrifood supply chain.

In strategic management studies, traditionally focused on the formulation of decisions, increasing importance to the analysis of how changes are generated and the evaluation of the effects they generate is recognized (Hock et al., 2015). These are new governance systems and new managerial structures, that emerge. In the current economic contexts, we are witnessing profound changes in the processes of structuring agrifood supply chains at an international level.

Building resource-based view (RBV) and network analysis the purpose of this contribution is to empirically explore the relationships among Italian firms belonging to diversified sub-sectors of the Italian agrifood (suppliers, packaging materials manufacturers, machinery manufacturers, biomethane producers) and inter-firm performance in a global context.

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About the methodology adopted in the research, still underway, the inductive method was used with empirical verification, to correctly interpret the management phenomena that emerged regarding supply relationship management. During the empirical survey, eight Italian firms belonging to various sub-sectors of Italian agrifood supply chain and located in Italy were taken into consideration. The analysis covered the period 2020-2022 and involved the industrial firms, the agricultural providers, the industrial clients, and other economic operators (start-up, incubators, innovation communities, etc.) in the Italian agrifood supply chain. Drawing on an explorative analysis of qualitative data, strategies to innovate each new “interstitial spaces” (or micro-segments) in international offer’s structure are investigated.

2. Theoretical framework

In order to effectively exploit resources, firms and economic operators must not only be able to leverage existing resources but also to develop new and dynamic capabilities to maintain competitive advantage in changing industry environments and competitive processes (Barney, 2012; Teece, 2010; Wernerfelt, 1984). As has been argued, dynamic capabilities are studied in the most current and therefore more advanced RBV research steps: they deal with situation specific changes and consider contingency characteristics (Eisenhardt, 2021). The multiple innovative context dynamism lead the enterprises to use relationships for competitive advantage by accessing, integrating, and leveraging external resources which prove relevant across a myriad of relationship forms, such as supply agreements, cross-sector partnerships, networks, and consortia. Specifically, one would like to deepen the relationship perspective that is based or could even be better developed with the network-level design of network-type relational structures. The network analysis allows the scholar to grasp two theoretical frameworks using the main international managerial literature, namely the RBV and the resource-based view. In agreement with the relational based view, the network perspective sees supply chain as business network, where business units or firms are represented by nodes, and long-term complex interactions between them are represented by links (Håkansson and Ford, 2002). From a resource-based perspective firms differ in their capability to shape and exploit networks, to extent that their capability to leverage networks has been identified as distinctive.

The approach that inspires the theoretical framework used in this study could be somewhat equated to the open innovation ecosystem literature that has emphasized how interorganizational collaborations among innovation actors plays a key role in the process of innovation generation (Kapoor and Lee, 2013; Adner, 2017; Falco et al., 2017; Robaczewska et al., 2019). However, in this study some theoretical and empirical research frames are not analyzed, although there is aware about the great importance both in the strategic-managerial and in the theoretical sense, as the process of development of new products in the era of open innovation (Frattini et al., 2013) and the design of the process of diffusion of innovation in the supply chain (Xiong et al., 2022).

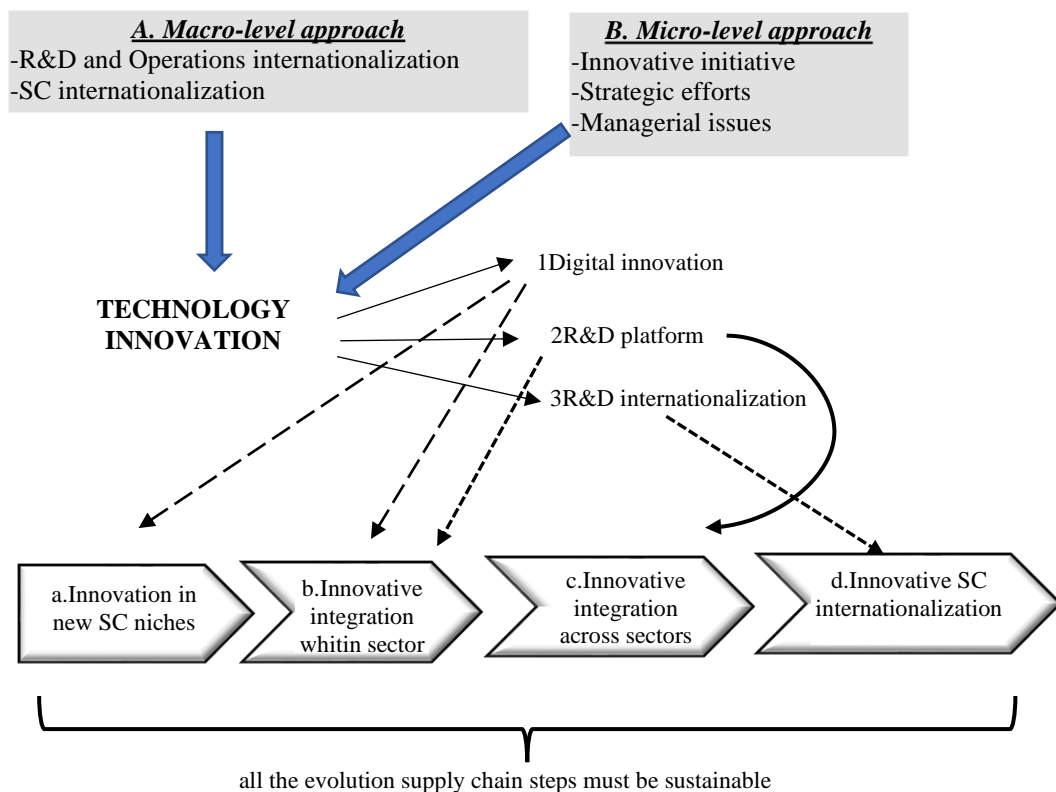
Factors including rapid technological development, the advent of innovative openness processes involving sub-sectors belonging to diversified supply chains, shorter product life cycles, more diversified and customized demand, and fierce marketing competition, make today's business model increasingly unpredictable and risky. In this new phase of economic transitions, complex technologies interactions across sectors have become particularly accentuated in many and diversified sectors (Markard et al., 2020; Mäktie et al., 2022). Hence, there is a need to investigate more thoroughly into the multi-sectoral and multi-technological features of innovation supply chain processes (Andersen and Markard, 2020; Rosenbloom, 2020).

Disruptive technologies, though studied in manufacturing systems and services, have long been associated with the agrifood sector, introducing novel operational practices, and optimizing inbound

and outbound innovative information creation flows (Spanaki et al., 2022). Some agritech research have been mainly dominated by conceptual studies and lacks empirical investigations to validate the initial theorizations in the field. Existing theories on technology adoption and implementation do not fully capture the unique specificities and challenges of the agritech sector and are not fully adapted to the revolutionary self-learning capabilities of machine learning algorithms. While the adoption and implementation effects of several emerging technologies on agritech firms have been explored, the impacts of digital-driven technologies and systems are yet to be examined (Wolfert et al., 2017). Also referred to as e-agriculture, digital farming, or smart farming, the agrifood field, more and more agritech field, is an interesting area of research that attracts significant interest from a multitude of institutional actors, including practitioners, governmental actors, and societal constituencies (Issa et al., 2022). This study addresses these gaps developing digital technology readiness and approaching framework that better fits the emerging needs of agritech firms and the ongoing evolution of digital-driven technologies and systems.

Therefore, to contend with the pressure to constantly innovate, firms formulate many strategic decisions (even simultaneously) that generate firm’s technological heritage diversification. In practice, these strategies determine the choice of different ways of doing R&D and the adoption of internal or external research structures different from the past (innovation community, open innovation activities, supply side relationships, etc.). Besides the diffusion of innovation theory (Taherdoost, 2018) has emerged as a key theory for explaining the effects of technological characteristics on technology adoption (see figure 1 and text table 1).

Figure 1: Theoretical approach



Source: our elaboration

Text table 1 – Theoretical highlights about a framework figure 1

Strategic sustainability choices can be effectively formulated if the analysis distinguishes the macro-level approach (see A in figure 1), useful in grasping how much sustainability is different following the internationalization processes of the operations and of the R&D activities of both of the focal company and of the firms at the various supply chain levels, from the micro-level analysis approach (see B in figure 1), which is instead focused on ‘micro -processes’, such as innovative processes, firm strategies, managerial practices (Wilhelm et al., 2016).

(a, b, points in figure 1) SC innovation has become a critical research topic in strategic management studies (Lee et al., 2011; Wong and Ngai, 2022). It seems important to place the emphasis from niche innovations in single sectors to more integrated innovations, within and across sectors (Andersen and Markard, 2020; Musiolik et al., 2020).

Supply chain innovation is regarded as a complex construct that is strengthened by cooperative ties and joint product development between buyers and suppliers. SC stakeholders are becoming increasingly involved in the innovation process, particularly in the innovative SC. Scholars have used RBV to describe how firms can increase their competitive advantage and enhance their capabilities through collaboration. From the RBV perspective, also external stakeholders are resources that can provide valuable knowledge for firm. A key component of SC innovation in this context is the management of inter-organizational relationships among partners: SC integration refers to strategic collaboration with key SC partners to achieve the efficient and effective management of inter and intra firm activities involving decision processes and the flow of information services and products. If in some studies the objective of the integration SC is considered the reduction of the costs and the offer of greater value, in this study the key aspects of SC innovation as a basis for conceptualizing and making the construct operational are investigated: companies can obtain complementary capabilities and resources from their partners to support innovation (Shou et al., 2018; Zimmermann et al., 2018).

(c point in figure 1 - SC diversification) In Italy in recent years there have been developed companies belonging to the supply chains of agrochemicals, nutraceuticals, agritech, etc.

Case studies have been chosen that highlight how the companies belonging to the Italian agrifood sectors have rethought and re-imagined the traditional mechanisms and processes that shape technology adoption within the agritech sector. Agritech sector suggests that technology adoption and implementation face several prevailing challenges, including the need for sustainable, organic, and environment-friendly products, emission-cutting production mechanisms, natural resource optimizing systems, and the strive to exploit the potential of disruptive technologies, enabling new possibilities for firms in the agrifood sector. In this respect, agritech firm’s strategies in agri-food supply chains, the focus of this contribution, has recently gained significant scholarly attention (Lezoche et al., 2020), considering its potential to unlock some of the most prevailing global societal and economic problems (Bowen and Morris, 2019).

(d point in figure 1 - SC internationalization) On the other hand, agrifood supply chains, even those that characterize Made in Italy, are internationalized (Arregle et al., 2009; Wu and Jia, 2018). It should be noted that such complex internationalization processes are different for the technology/country combination adopted. At the more observations about supply chain micro-level, in up-stream sense, the role played by the first-tier supplier as double agent role is particularly important. As showed by Wilhelm et al. (2016) first-tier suppliers take on a double agency role that sees them acting as agents for their lead firms implementing the sustainability requirements in their own operations and acting as agents to make their suppliers implement the sustainability requirements imposed. In this sense the transformation of business models thanks to the opportunities offered by digital technology is not a new theme. With recent technological advancements, empowered by new digital technology frontiers

have become more salient for solving specific types of business problems and for redesign in innovative sense and at international level the supply chain configuration, even when this is internationalized, and that is replicated with cutting-edge technological standards. This saliency is in fact important for firms operating in the agrifood sector, where the impacts of digital-driven technologies and systems create new opportunities and challenges.

(Point 1 in figure 1 - Digital innovation) The technological evolutions guide agri-food companies through the process of transforming their traditional physical processes into digital or industrialized ones (Schallmo et al., 2017); digital technologies currently play a prominent role in transforming firms' relations both in traditional and in newly sectors (Agrawal et al., 2017; Bienhaus and Haddud, 2017; Keding, 2020). The perceived role of digital transformation-driven systems in newly developed agrifood firms has received little scholarly attention (Spanaki et al., 2022). Furthermore, extant research on the adoption and implementation of new technologies in business has overlooked the emerging sector of agritech (Keding, 2020). Some authors studied the effect of emerging digital technologies on the operations management through co-creation and found positive impact on efficiency, safety, and ecological sustainability (Baroroh et al, 2021; Didden et al., 2021; Felsberger et al., 2022; Mittal et al., 2018). The automation of manufacturing processes coupled with the renewal product-production engineering capabilities may result in radical improvement in efficiency (cost-reduction) and accuracy. Industrial digitization technologies, such as the internet of things, big data or artificial intelligence, aim to increase productivity and efficiency through intelligent and remote management. These technologies will create new potential for firms changing strategic management, which may lead to improved sustainable competitiveness (Lehay and Neary, 2007; Didden et al., 2021). To migrate to a 4.0 business model, you need to go beyond the logic of keeping up with the competition.

(Point 2 in figure 1 - R&D platform) From the resource-based theory perspective, there is a growing emphasis on platform research within open innovation ecosystems because of digital firms becoming more involved in the crowds to leverage on external resources (Lavie, 2006). A platform can be represented as an evolving technological support of interdependent supply chain companies. In this way, a platform acts as a supply chain hub within an open innovation system (Thomas et al., 2014; Appleyard and Chesbrough, 2017; Chesbrough et al., 2018). Open innovation considered as the disruptive element that moves a plurality of innovative business processes, Institutions, organizations well lend itself to interpret the role that the strategies of the innovative platforms they have in the feeding the innovative and competitive processes of entire supply chain. The need to evolve value-producing enterprises by transforming raw materials and components into intermediate and final products into 'platform enterprises' has been under discussion for some time: the analysis has unfolded companies capable of intermediating demand with an increasingly wide and diversified supply of products. For this to happen, pipelines or supply chain structures had to adapt their offer, even on a global scale, by implementing technology far superior to that needed to keep up with the competition. In addition, the focus is mainly on supply side relationships (upstream direction), some of which arise from little studied but already widespread, forms of crowdsourcing (Afuah and Tucci2013).

(Point 3 in figure 1 - R&D internationalization) From the first observation of the cases, it seems to be found that the R&D activities are internationalized i.e. replicated on an international scale, developing the research content based on the specific needs of the country, by those enterprises that create supply chains to produce and distribute a product or deliver an agronomy service in emerging economies. The processes of supply chain internationalization seem to appear, to a first observation, like complex, but still more different in the various Country as a result of the technology/Country adopted choices.

3. Methodology

About the methodology adopted in the research, still underway, we wish to clarify that the inductive method was used with empirical verification, to correctly interpret the management phenomena that emerged regarding supply relationship management. An interpretative, qualitative approach - utilizing selected multi-case study interviews (Yin, 2014) such as the primary data collection method - is chosen because it helps to navigate and understand the complex issues that are associated with the data quality concept, and its relation to the factors involving managerial practices to implement facilities in modern relationships within the international supply chain. Drawing on qualitative analysis, we investigate strategies and structural choices (way of doing research, redesign of supply side relations, digitization of the supply chain relationships, foreign development) in order to create new ‘interstitial spaces’ (or micro-segments) both in international offers structure and in international newly markets.

During the empirical survey, eight Italian firms belonging to various sub-sectors of Italian agrifood supply chain (see column 1 in table 2) and located in Italy were taken into consideration. The analysis covered the period 2020-2022 and involved the industrial firms, the agricultural providers, the industrial clients, and other economic operators (start-up, incubators, innovation community, etc.) in the Italian agrifood supply chain. ‘Oriented case studies’ investigate the issue within a real-life context, drawing on the reviews of several sources, and provides the means to review theory and practice iteratively (Ellram, 1996; Flynn et al., 2010; Hennenberg et al., 2010). Multiple cases ensure that common patterns are identified rather than generalized from what might be change occurrences (Eisenhardt, 2021).

The studied cases, particularly dynamic, highlight the importance, therefore the need to allocate resources, on different fronts, because the overabundance of technologies can trigger growth opportunities difficult to predict a priori. Some of the guiding principles in identifying and selecting case studies are listed below:

- companies with good competitive performance (turnover, export quota, production capacity, etc.) and well established in Italy;
- pioneer innovative firms in an unusual way compared to the tradition of the sector (open innovation, technological diversification, spillovers effects, internal R&D improvement);
- enterprises that have designed new production facilities with digital technologies in manufacturing activities;
- enterprises which have established international partnerships;
- firm export processes, quickly followed by internationalization processes that have affected the entire Italian agrifood supply chain (packaging manufacturers, Farmers, producers, Italian food machinery, agritech software suppliers, etc.);
- Italian food companies, that are excellent case studies in the Italian and foreign business schools.

It was first investigated how companies belonging to the agri-food supply chain design their research activities, to generate sustainable innovative processes (table 1), and then the reconfiguration of sustainable innovative supply chain (see table 2, second column) and sustainable strategic choices of supply chain companies (see table 2, third column).

Table 1 – R&D activity strategies aimed at sustainability

Cases	Innovative activities in sustainable agri-food supply chains
1	R&D in the various supply chain levels Diversification: multi-vertical supply chain integration

2	Joint R&D of cooperatives (that are competitors and located in regional areas near-Po Valley) Supply chain integration: down stream for foreign markets.
3	Internal R&D shared with suppliers (Supply side integration)
4	Internal R&D and strategic diversification (sector to which they belong) Internationalisation of R&D in Japan Merger of a foreign company with advanced know-how
5	Open Innovation Platform with farmers (supply side innovative supply chain integration)
6	New R&D in collaboration with cluster partners (Ferrara-Italy) operating in machinery, animal husbandry and poultry farming. New R&D in collaboration with a partner of Milano belonging at the sub-sector 'food supplements'.
7	R&D activities both in-house and in partnership with growers and study centres.
8	Open platform-project involving: -4 companies in agrifood chain (with well-known and established brands in the world); -200 Italian suppliers-agronomists; -7.000 hectares of crops have been digitized.

Source: our empirical investigation

4. Findings

In this study, the relevant phenomena that characterize the sustainable innovative chain path in the Italian agrifood sector reconfiguration phenomena emerge: the technological heritage redesign, the new way of doing research, the formation of relationships that are established in the sustainable supply chains that innovate and internationalize.

At the conclusion of this contribution, the first cognitive results of which have been presented here, we would like to bring to the attention of the reader some observations. Firstly, to migrate to a digitized business model, you need to go beyond the logic of keeping up with the competition. Secondly the company's "proactivity" towards environmental and social issues positively orients the opinion of their stakeholders. And thirdly, the empirical findings make it possible to agree with those managerial studies which have highlighted how responsible management of the "supply chain" increases the company's reputation, which is one of the critical success factors to be leveraged in international competitive processes and in international business markets. Because transactions have evolved today: on the 'supply side' contractual relationships take place within a wide range of potential innovative relationships involving start-ups, innovation communities, young and competitive companies in new sectors, etc. it seems clear that transactional relationships are not to be considered as traditional ways of regulating supply chain relationships in supply chains characterized by consolidated or even mature technologies. Moreover, if a company competes mainly on product-service innovation, the type of relationship could depend on where the innovation is expected to emerge: many types of innovations (and therefore the technological assets) emerge outside the usual and close collaborations between suppliers and buyers. The need to involve suppliers in innovation processes, and in the design processes of new business models, as well as to acquire relevant information on the evolution of technologies and on the behavior of competitors, increases the need for coordination between companies in the supply chain, concretely achievable with the conclusion of long-term agreements, the establishment of more intense communication processes, the ability to manage joint decision-making processes and the development of relationships of trust.

Table 2- Strategic choices and sustainable strategic objectives

Sector/Industry niche	Innovative supply chain strategies	Some business information about strategic choices and sustainable strategic objectives
1.Dairy	Sustainable dairy supply chain internationalization	<i>Strategic choices:</i> by replicating the cooperative model (with Italian machinery producers, Italian packaging producers, etc.) on which the Italian company is based, an economic project has been successfully launched, sustainable over time, in one of the poorest areas of Tanzania. <i>Sustainable strategic objectives:</i> Africa Milk Project which allowed the construction of a dairy in Tanzania; company that allows small producers in rural communities to autonomously take charge of project activities.
2.Alliance of seven dairy cooperatives	New production plant NPD Export strategies in Cina	<i>Strategic choices:</i> - new common industrial plant to transform excess milk into high value derivatives; - milk powder production, in the future whey production too; -the Chinese market for milk powder is the most important and growing. China has concluded purchasing agreements in Europe and Italy. <i>Sustainable strategic objectives:</i> new plant: energy efficiency, technical process/product innovation, reduction of the environmental impact of production (water consumption, processing residues, etc.).
3.Italian food	NPD Supply innovative practices	<i>Strategic choices:</i> biscuit made entirely from soft wheat from sustainable agriculture: 500 Italian suppliers/ growers have joined the ‘Mulino agreement’, a specification written with the support of the WWF and two Italian universities. <i>Sustainable strategic objectives</i> which impose on wheat farmers: -the prohibition of glyphosate and bee-killing pesticides; the use of certified and non-GMO seeds; -crop rotation for soil fertility; obligation to allocate 3% of the area for common wheat to flower cultivation.
4.Agrochemical	NPD Production and retail activities internationalization	<i>Strategic choices:</i> -Know how increasing in partnerships with Japanese player; -to improve production skills and to acquire new geographic markets. <i>Sustainable strategic objectives:</i> design and engineering of synthesis’ production processes (NPD type); formulation and sale of active principles for the agricultural crops defense.
5.Agricultural medicine	Improvement of the management parameters of the sustainable farmland	<i>Strategic choices:</i> -innovation, the farmer evolves, in order to produce more, to increase profit, to optimize the use of scarce and expensive resources, to increase forecasting capacity, to reduce risks; -digitalisation, innovative processes about genetic studies and performance improvement (crop harvest). <i>Sustainable strategic objectives:</i> addressing the reduced availability of arable land, the need to preserve resources, the reduction of CO2 emissions.
6.Agritech	-Building Italian bioenergy supply chain -High tech agricultural supply chain internationalization	<i>Strategic choices:</i> production of sustainable energy from agricultural, food and livestock activities. <i>Sustainable strategic objectives:</i> - reuse of manure and food processing residues to produce energy (biomethane); -high tech agricultural supply chain internationalization.
7.Organic food	Development of organic farming Supply chain digitalization	<i>Strategic choices:</i> -cost reduction in purchasing and operations activities; -supply chain innovation; -supply chain resilience. <i>Sustainable strategic objectives:</i> - sustainable and organic food exclusively plant based; -organic healthy products with high nutritional profile.
8. Four Italian food firms	Agrifood supply chain digitalization	<i>Strategic choices:</i> innovative strategies and practices reconfiguration at the aim to simplify the data collection and the data processing. <i>Sustainable strategic objectives:</i> building climate indicators and forecasting models to have full control of agronomic management and a more understanding of the environmental footprint of the supply chain itself.

Source: our elaboration based on empirical investigation

Following the obtained research results, it emerged that buyers and suppliers, relational skills, favour the profitable circulation of information, which is the basis of cooperation based on mutual trust. Supply chain integration is made possible by the ability of companies to cooperate with critical suppliers and customers.

In recent years there have been many companies that have modified the content of the international competitive strategies choosing to reconfigure the characteristics of their technological structure (R&D activities - e.g. 1, 7, 8 - , R&D localization - e.g. 1, 4, 5 - , R&D partnership - e.g. 3, 6; R&D internationalization - e.g. 1, 3, 6) in order to protect or even create new 'interstitial spaces' (or micro-segments) in international offer structure. Especially the innovative digital technologies that favours design platforms generate niches in the supply chain. Precisely their ability to identify in which sector-segment (or niche) to operate, revealed in particularly critical years, when the international supply system was re-engineered, was the element that allowed non-large companies to create differential assets in the competitive context.

The development of digital technologies creates competitive opportunities at the company's international supply chain repositioning (offer structure). Moreover, the new and more favourable competitive positioning in the international business markets (BtB) has been successfully achieved by those companies that have been able to change their position regarding the global supply chains too. In this paper, the idea that innovative digital technology triggers several fundamental changes that transform the prominent elements of the existing buyer-supplier supply chain relationships in agrifood and zootechnical processes in unprecedented ways emerge. New technology is not simply an implementation of existing digital technologies, but rather a substantive self-dependent game changer for innovative redesign agri-food chain: the adoption of the I 4.0 enablers and the analysis of the impact across all levels of the sustainable supply chain are critical for the successful implementation of digital transformation initiative. During the empirical survey, it was noted that, especially in recent years, small and medium-sized industrial firms belonging to an Italian agrifood supply chain formulate strategies that make them variously interdependent with different supply chain stages. Of the two distinct ways of managing open innovations in the supply chain platform, the collaborative and the transactional, it emerges that the collaborative mode is the one used and that the operators-enterprises to the various steps of the supply chain (the complementors of the innovation) pursue an objective centralized on the supply chain, rather than on the enterprise.

It emerges that the collaborative mode rather than the purely transactional mode, is the one used and that the operators-enterprises belonging to the various steps of the supply chain (the complementors of the innovation) pursue a common goal. These operators are the value-creator partners of the supply chain. As researchers have acknowledged, the companies involved show the need to move from business-centric platforms to open innovation. Using the 'micro-level' survey emerges from the empirical observation (e.g. 1, 2, 3, 6) that collaborative innovation processes, strategic efforts, management issues are simultaneously addressed by each phase of the supply chain, in that of belonging (innovation in new niches - point a in figure 1), in the new and innovative one (innovative integration - points b and c in figure 1), in that which is replicated abroad (supply chain internationalization – point c in figure 1).

The innovative coordination processes through platforms are also characterized by the following elements: the platform is not in all the case studies property of a lead company (except for case 2); the innovative actors create open innovative relationships with many other categories of innovators (public and private research institutions, enterprises, start-ups, venture capitalists, etc.), belonging to multiple and different supply chains (or sectors). In practice there are no 'platform owners', but focal firms (sometimes more than one in the supply chains analyzed) that manage the multilateral dependencies (internal to the supply chain and within other supply chains) by co-designing with

coordinated actors (or complementors) the structure of collaboration, specifying managerial practices. In the Italian agrifood supply chain, above all if the sustainable platformers design is considered, it is evident as it happens both the outside-in open innovation that is aligned with the innovation generation emphasizing the role of the external knowledge sourcing and the inside-out path of the open innovation that resonates with the diffusion of the innovation placing the accent on the importance to diffuse the innovations in the supply chain, and sometimes in other closely connected. It is precisely the study of agrifood supply chains that makes it possible to break the preeminent firm-centric focus, primarily preferred by scholars who focused their attention on outside-in open innovation, with a new based on the supply chain relationships deepened recently by scholars who tend to recognize the paradigm inside-out of open innovation. In practice open innovation can, if considered in the two paradigmatic forms (outside-in and inside-out) place emphasis on the importance of spreading innovations to the outside world and supply chain relationships to provide returns to innovative economic actors (companies, research centres, start-up). Some of the analysed firms, those of the end-to-end multinational type (e.g., 1 and 6), create supply chains to produce and distribute a product or deliver an agronomy service in emerging economies. This process is considered supply chain internationalization: agri-food supply chain replicates itself in the disadvantaged markets/Countries of the African continent or of the sub-continent India, through the installation of modern farms and the design of plants to produce food goods, food packaging and sometimes machinery in those countries.

5. Some concluding reflections

The academic-scientific debate has been heavily focused in recent years on the issue of sustainability that has captured the attention of the economic and social disciplines. However, since this is a new economic model, the attention of scholars and economic operators (managers, institutions, etc.) must necessarily pay particular attention to business production systems and to new ways of managing these business systems and new opportunities such as relationships within supply chains. The research work presents the results of a study on green management with reference to the most relevant strategic decisions by companies, belonging in agrifood, and the concomitant design by management of new governance of relationships systems in supply chain (the one to which they belong, the new one different from the one to which they belong, the innovative sector that help to create). This contribution examines the critical yet underexplores role of innovation diffusion in sustaining digital innovation in business model strategies that belonging more and more at evolutionary supply chain systems. The study of the evolutionary view of disruptive innovation diffusion in the supply chain favours, in this research, the investigation of the roles played by case studies - distinct yet interconnected parties (agri-suppliers, food manufacturing systems, manufacturing firms, platforms or hub academies) - within innovation supply chain systems as well as the research opportunities it brings. More recent NPD strategies show challenges of managing suppliers in a buyer's innovative process. Firm's internal choices and relational choices inspired by 'environmental sustainability' are even more difficult to formulate if you consider that the Italian agrifood chains are at the same time subject to national and European regulations (legislation, social norms) and increasingly exposed to the global context, because of the business and production internationalization processes in the various sectors/Countries and in the various markets/Countries. But the green orientation is a strategic driver on which Italian companies can leverage critical factors of success: the improvement of competitive capacity that results generates concrete opportunities for growth in turnover, export quotas and employment, process productivity improvement and cost savings.

It is important to note that a significant number of companies in the agri-food sector are investing in the construction of the company's digital infrastructure: considering the importance of the necessary resources, which, in particular, are cultural and managerial for businesses in the sector, it is important, in the field of digital technology research, to focus on sectors that have proven to be consistent in terms of sustainable challenge (digital technology, R&D mode choices). Although innovation is the cornerstone of this contribution, which hypothetically affects business performance, our results theoretically contribute to new ways of doing business in modern supply chains by highlighting the importance of the platform, understood as formalized technological-operating procedures, and recognized by the operators (innovators, suppliers, buyer-firms, information services providers) of supply chain.

The attention to environmental sustainability now pervades economic operators and not, scholars of technological solutions and recipients of products and services and agriculture. As regards the strategic sustainability effectively formulated, it observes that the sustainability of multi-level supply chains must go far beyond the choices of the leading company and that arise from innovations coming even beyond the boundaries of the focal or leader supply chain firms and more precisely involving various tiers of the supply chain.

The paper presents modern and unusual innovative processes shedding new light on success factors in modern competitive contexts increasingly anchored to integrated relationships in sustainable supply chains. In the Italian agrifood supply chain, above all if the platformers are considered, it is evident as it happens both the outside-in open innovation that is aligned with the innovation generation emphasizing the role of the external knowledge sourcing and the inside-out path of the open innovation that resonates with the diffusion of the innovation placing the accent on the importance to diffuse the innovations in the supply chain, and sometimes in other closely connected.

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