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Adopting a digital transformation strategy to enhance business network commons regeneration: an explorative case study

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Abstract:

Purpose: This article aims to understand whether and how a digital transformation strategy (DTS) can strengthen the relationship between network organizations and the generation/regeneration of their business network commons (BNC). Further, it investigates the role of the DTS in managing the BNC, a critical source of business network success.
Design/Methodology/Approach: A two-year longitudinal case study of an Italian business network operating in the wine sector was conducted.
Findings: This study provides theoretical insights into the digital, sustainable shift of a business network. On combining a network's business strategy and its DTS, digital resources are a key driver to promote BNC regeneration. A DTS undertaken to manage, regenerate, and preserve the BNC can positively affect organizational variables, such as participatory architecture, and the network-level organizational integration, and can help in preventing opportunistic behaviors affecting the BNC. Moreover, the DTS supports quality and social responsibility.
Research limitations/implications: This study focuses on an Italian case and its findings are hence not generalizable. Would be interesting to study sustainable business networks' digital shift in different socioeconomic contexts as well as in different industry settings.
Practical implications: Network SMEs and other stakeholders (institutions, competitors, and consumers) can foster the transition from a "business-as-usual" strategy to a long-term strategy for digitalized management of common resources.
Originality/Value: The study is at the intersection of, and contributes to, several research streams. It contributes to the digital transformation literature by adding information on the positive externalities of digitalization in the social and economic environment. It also contributes to the early streams of organizational and managerial literature on the BNC.
Keywords: Digital transformation strategy, digital transformation, digital platform, business network, business network commons, sustainability.
Paper type: Case study

1. Introduction

In the context of commons preservation, the related literature underlines the ways in which business networks can play a pivotal role in facilitating positive environmental effects, in particular, concerning the protection and regeneration of the commons (Bonomi *et al.*, 2019; Bullini Orlandi *et al.*, 2019; Cantino *et al.*, 2017; Fjeldstad *et al.*, 2012; Ricciardi *et al.*, 2018; Rossignoli *et al.*, 2018). Cooperative behavior, such as actively contributing to the network and respecting the restraints on resource exploitation, is essential to (re)generate

the common resources provided by the system (Ostrom, 1990) and to prevent their loss – termed "the tragedy of the commons" (Hardin, 1968).

Referring to the network organizational configuration, a view of networks as commons-enabling institutions is emerging (Bonomi *et al.*, 2019; Bullini Orlandi *et al.*, 2019; Cantino *et al.*, 2017; Fjeldstad *et al.*, 2012; Lusch and Nambisan, 2015; Ricciardi *et al.*, 2018; Rossignoli *et al.*, 2018) and management scholars are attempting to identify the main organizational variables needed to preserve the commons (Ferraro *et al.*, 2015; Plummer & Armitage, 2007). To this end, in a seminal work, Ricciardi *et al.* (2018) underline that the use of highly participatory architecture, the integration of organizations at the network level, and the presence of mechanisms for opportunism prevention and resolution are the prerequisites for enhancing firm performance through developing and protecting the network commons.

Nowadays, many opportunities are offered by the fourth industrial revolution, and through new technologies, organizations can easily adopt highly participatory digital architectures or platforms to promote network agility and coordination (Constantinides *et al.*, 2018). Digital architectures or platforms are digital resources that enable value-creating interactions between external actors (Parker *et al.*, 2017) through rich information exchanges both inside and outside organizations, which can induce new forms of business strategies (Bharadwaj *et al.*, 2013). Indeed, participants in a value network can develop a so-called remediation strategy, which is a digital transformation strategy (DTS) that leverages digital technologies, such as digital platforms, and promotes close collaboration and coordination among participants, even within their supply chain (Andal-Ancion *et al.*, 2003; Klötzer and Pflaum, 2017; Vial, 2019).

In general, on considering the digital transformation phenomenon, attention is first paid to operational efficiency or process simplification (Belvedere *et al.*, 2018; Hess *et al.*, 2016). However, organizations may adopt new digital technologies to achieve more sustainable performance (Bag *et al.*, 2020a; Bressanelli *et al.*, 2018; Dhamija and Bag, 2020; Gupta *et al.*, 2020a; Hsu *et al.*, 2018; Jabbour *et al.*, 2018; Telukdarie *et al.*, 2018), even in the context of the commons (Bonomi *et al.*, 2019; Rossignoli *et al.* 2018). Thus, the issue of adopting digital technologies to promote more sustainable firm performance is relevant. Indeed, in an extensive review of the digital transformation literature, Vial (2019) calls for studies on digital issues related to environmental disruptions. There is a lack of contributions in this field, and in particular, few management studies consider the context of the business network commons (BNC).

In conclusion, to address this specific research gap regarding the BNC and the digital transformation phenomenon, this study leverages the literature on both. Hence, it focuses on the following research question: *How can a business network shape a digital transformation strategy to preserve its business network commons?* To answer the question, a case study is presented on an Italian business network that adopted a DTS by creating a network digital platform, to promote efficient management of its BNC.

The remainder of this paper is structured as follows. Section 2 presents the theoretical background related to digital transformation and environmental sustainability (in particular, regarding common goods) and provides a literature review on the BNC. Section 3 presents the case and the qualitative methods employed. Section 4 analyzes the results.

Section 5 discusses the study findings. Section 6 provides the conclusions and implications of this study, and Section 7 presents its limitations and further research opportunities.

2. Theoretical background

2.1 Digital transformation and sustainability

Digital transformation can play a crucial role in promoting organizational forms that enable value co-creation by adopting bridging information and communications technology (ICT) solutions, which can generate greater opportunities to trigger positive changes in the social and economic environment.

Vial (2019), in his inductive framework, summarizes the current knowledge about digital transformation and highlights that the literature on this topic mainly focuses on the expected positive impact of technologies in terms of organizational performance and efficiency in the short to medium period. Thus, attempts to develop new contributions to understand the long-term and higher-level effects of digital transformation on organizations are lacking.

Scholars have arrived at a consensus that the technological progress in the past years has radically improved organizational performance but has simultaneously created higher expectations about increasing the sustainability of business operations (Abdelaal *et al.*, 2018). In general, digital transformation needs to be linked with a fundamental shift in achieving superior performance based on a holistic approach (Abdelaal *et al.*, 2018; Vial, 2019). Although this issue is relevant, the literature lacks in-depth studies on the ways in which digital technologies could promote the sustainability of organizations, particularly of small and medium-sized enterprise (SME) networks.

Since little is known on this topic, a few works have attempted to fill this gap by studying the relationship between Industry 4.0 and the circular economy. In particular, Bressanelli *et al.* (2018) and Jabbour *et al.* (2018) investigate how technologies (e.g., the Internet of Things, Big Data, and analytics) support the implementation of the circular economy paradigm in businesses. Moreover, Gupta *et al.* (2020a) study the relationship between Cloud ERP and the sustainable performance of small, medium, and large companies in Northern India. In addition, Hsu *et al.* (2018) focus on non–ICT oriented organizations and reveal that ICT applications are necessary for enabling and supporting sustainability practices and for enhancing the position of the information technology (IT) department in the organizational hierarchy.

Further, to benefit from emerging trends associated with digitalization and sustainability, network-level transformations are needed because the network represents a pivotal dimension that can promote value co-creation with partners and maximize sustainability benefits (Parida and Wincent, 2019). In particular, in the context of value networks, digital technologies can enable these networks to be redefined, allowing organizations to collaborate closely with their value chain partners and to strengthen the existing and new relationships with suppliers/producers, distributors and customers (Andal-Ancion *et al.*, 2003). From this perspective, Bonomi *et al.* (2019) present a case study that highlights the way ICTs can be used to manage a collaborative network using a

sustainable business model regarding commons preservation (better quality of life and public health). The research by Bonomi *et al.* (2019) underlines the close relationship that exists between the collaborative network, environmental sustainability, and digitalization.

Moreover, because digital technologies enable close collaboration and coordination among participants, the relationships between the participants in a value network can be reinforced by using a platform to coordinate exchanges within a supply chain (Klötzer and Pflaum, 2017). Digital architectures can stimulate expertise distribution, facilitate better stakeholder coordination (Dhanaraj and Parkhe, 2006), and generate an abundance of data on consumer behavior, orders, sales, and location of physical and digital objects (Constantinides *et al.*, 2018), therefore allowing managers to make smarter decisions (McAfee *et al.*, 2012).

Regarding digital architectures such as platforms, Rossignoli *et al.* (2018) study a group of ethically engaged volunteers who acted as a social entrepreneur group (herein understood as an "informal network") and adopted a bridging ICT solution (i.e., a "web-based and mobile solution") to foster transparency, accountability, and interaction among the participants of this "informal network," thus minimizing the room for opportunistic behavior related to a commons.

2.2 Organizational variables affecting regeneration of business network commons

Scholars are paying particular attention to the so-called grand challenges in terms of sustainability issues (Ansari *et al.*, 2013; Ferraro *et al.*, 2015), particularly regarding the management of fragile place-based common goods and environmental resources (Cantino *et al.*, 2017; Shrivastava and Kennelly, 2013). Nobel-winning scholar Elinor Ostrom (1990) shows that owing to their collective nature, common environmental resources are vulnerable to free-riding, inaction, opportunism, disorganization, ignorance, and over-exploitation; therefore, the "tragedy of the commons," meaning their destruction, may occur in many cases (Hardin, 1968).

Although in classical economic theory the government is expected to take care of such resources, an increasing number of published cases of emergent commons-enabling organizational forms suggest that other social players, such as collaborative networks, business networks, associations, and communities, can play a crucial role in transforming common resources into generators of sustainable growth (Bonomi *et al.*, 2019; Bullini Orlandi *et al.*, 2019; Cantino *et al.*, 2017; Fjeldstad *et al.*, 2012; Ricciardi *et al.*, 2018; Rossignoli *et al.*, 2018).

Among network forms of organizing, some can be considered commons-enabling architectures since they rely on a common good that cannot be regenerated and protected unless all network firms behave fairly (Fjeldstad *et al.*, 2012; Ricciardi *et al.*, 2018). The present study adopts the BNC definition conceptualized by Ricciardi *et al.* (2018, p. 328): "resources that are available for the partnering firms' collective use, but that also requires the partnering firms' collective engagement and collaboration to be acknowledged, protected, and/or (re)generated." This view of networks as organizations that enable, protect, and develop their key common resources is emerging in the literature (Bonomi *et al.*, 2019; Bullini Orlandi *et al.*, 2019; Cantino *et al.*, 2017; Fjeldstad *et al.*, 2012; Lusch and Nambisan, 2015; Ricciardi *et al.*, 2018; Rossignoli *et al.*, 2018) but the organization and

management literature on the main organizational variables needed to preserve the commons is still in its infancy (Ferraro *et al*. 2015; Plummer & Armitage, 2007; Ricciardi *et al*., 2018).

Moreover, Ricciardi *et al*. (2018) investigate the relationship between the network-level organizational configurations that enable firm success and the network capability to protect and develop its BNC. They identify three organizational variables that are the most effective in allowing network organizations to protect and develop their network's key common resources: (1) participatory architecture, (2) network-level organizational integration, and (3) specific mechanisms for opportunism prevention and resolution. According to the authors, participatory architectures in the context of commons regeneration rely on concepts such as clear, effective procedures for changing network arrangements, or for entering/exiting the network; common values within the network; shared network decision-making processes; effective communication; and trust among the participants. Further, network-level organizational integration relates to clarity in terms of firms' expected contribution, recognized leadership providing vision and coordination, a shared network-level business plan, and key resources sharing. Finally, to prevent opportunism, clear, easily applicable sanctions must be established to address the unfair behaviors of partnering firms.

3. Methodology

Based on the contributions summarized in the previous section, this study identifies the need to provide extensive insights into the BNC field and to answer the research question by presenting a case of an institutional context characterized by a systemic digital strategy that addresses BNC preservation. The next subsection presents the case study in detail.

3.1 Case presentation

Omega is an agricultural business network established in 2016 and is located in Italy in a specific territory of Verona, Valpolicella, which is characterized by its famed winemaking industrial district. The business network activity focuses on grape production and consists of a leading company and 27 SMEs, most of which are distributed in the Valpolicella area. The business network is led by a social entrepreneur and a manager who facilitate the horizontal coordination in the network. The Omega network has always pledged, in its business strategy, to be "significantly committed to socially and environmentally responsible innovation" (Bullini Orlandi *et al*., 2019, p. 6) and in particular, has also obtained the rigorous "Equalitas" certification, which certifies that the whole value chain enforces high economic, social, and environmental sustainability standards together with high transparency standards. Thus, the case study aims to show how the selected "business network can be considered both an elective tool in the protection and sustainable use of common goods and a tool that allows the development of the commons." (Bullini Orlandi *et al*., 2019, p. 1).

To fulfill the needs of coordination, cooperation, knowledge sharing, and preservation of Omega's BNC, considerable financial investments had been made to promote the adoption of a digital platform for network governance. Thus, investments were made for implementing a cloud solution to promote business network process integration and an integrated IT security solution to protect data. Moreover, by the end of 2018, a specific IT strategy was designed: a project was developed to implement the digital platform, and a task force was created to spread digital transformation in the network. Economic resources to develop this project were obtained from the National Project of digitalization of SMEs, which derived from the National Plan for Industry 4.0. [1]

Over the previous three years, the digital platform became a key instrument for Omega, which gradually shaped a DTS by building and employing its digital architecture. The digital platform soon became the tool through which the business network activities are run, and the commons are managed systemically. In fact, gradually, all the processes were reengineered and digitalized; therefore, the business process management and the data of all the production phases, from planting a vineyard to grape picking and the commercialization process, were handled on the digital platform. Further, the digital platform is not only essential for network activities, but also for supporting the participation and coordination of all the network companies (Dhanaraj and Parkhe, 2006; Klötzer and Pflaum, 2017). Network firms can access the portal and, for example, upload and download relevant documents, program treatments for their vineyard, share tools and equipment, and manage the logistic processes.

The platform also manages the recruiting procedure of new network members: firms can join the network by following a strict procedure, involving a selection process that considers whether they comply with certain quality standards. Apart from quality standards, firms desiring to join the network are characterized by a set of shared values regarding the sustainable use of the commons. Eventually, when selected, the company becomes a part of the network by signing a medium-term, extendable contract (six years). Thanks to the digital platform, many activities that were previously conducted "in an analog way" to ensure BNC regeneration, are digitalized at present and therefore can be run systemically throughout the network, ensuring a more effective approach to BNC regeneration. For example, the digital platform makes it possible for Omega to check at any time the state of health of all the vineyards and to monitor whether periodical medical examinations or pruning activities have been completed, which allows Omega to perform more efficient systemic management of the natural assets of the network.

The presented business network case is characterized by an authentic socially and environmentally responsible business strategy that drives its choices (Ciasullo and Troisi, 2013), and owing to the data and analytics provided by the platform's dashboards, the digital infrastructure increases transparency (Klötzer and Pflaum, 2017), increase the coordination between firms (Dhanaraj and Parkhe, 2006), supports the decision-making process (McAfee *et al.*, 2012), and therefore improves the definition of network business strategy (Gupta *et al.*, 2020b). Indeed, it can be said that to more efficiently fulfill its business strategy, the network leverages digital technologies to accomplish its vision (Mithas *et al.*, 2013) by aligning its IT strategy with its business strategy (Akter *et al.*, 2016).

Therefore, by combining its business strategy and its DTS successfully (Matt *et al.*, 2015; Yeow *et al.*, 2018), the network allows the sustainable management of its commons.

Since the research design entails the identification of a case in which a DTS has been profitably applied to protect and develop a fragile commons, the Omega case can be considered an appropriate research context to address the research question.

3.2 Data structure and digitalization project

This qualitative study seeks to understand *how* a business network can shape a DTS to preserve its BNC, *what* is its blueprint in this process, and what are the *organizational variables* leveraged by digitalization that influence the protection of the network commons. In line with Eisenhardt (1989) and Yin (1984) who advocate the use of case studies in the early phases of theory development, since research in the selected context is limited, an explorative case study is conducted to analyze the phenomena of digitalization, taking into consideration the BNC.

Two of the authors of this study were actively involved in the definition of Omega's DTS from 2018 to 2020. Therefore, the case study methodology was selected since they had privileged access to relevant information. Data were collected during the whole process, at several points of time, and a blueprint was developed (see Figure 1) for the digital transformation project, which involved the following phases: (1) digital transformation project creation, (2) business process reengineering for implementing a digital platform, and (3) digital culture alignment in the business network. Such collaboration orientates researchers' interests to "real-life" problems and challenges them to ensure the managerial relevance of knowledge production (Amabile *et al.*, 2001). Therefore, to collect all the empirical data, the academic-practitioners interacted closely with the representatives of the focal companies involved in the process.

Figure 1. Data collection process and project development. Source: Authors' elaboration.

The majority of the data were gathered not only through participant observation, personal interviews, and focus groups (see Table 1), but also by collecting written material, both online and offline (e.g., published official documents, internal documents, articles, and company brochures).

Table 1. Data collection. Source: Authors' elaboration.

Collected Data	Number	Note
Phase 1: Creation of the digital transformation project		
Focus group	1	At the beginning of the research period (November 2018), a focus group on digital transformation was conducted, in which Omega's manager, leader, and IT manager participated.
Interviews	3	During Phase 1, three interviews were conducted. The interviews comprised one informal interview and two in-depth, structured interviews regarding the strategic purpose of digital transformation, the investments made in digitalization, and a digital maturity assessment. All the interviews were digitally recorded and then transcribed.
Phase 2: Business Process Reengineering for implementing a digital platform		
Focus group	1	A focus group on the theme of Business Process Management was conducted. The participants were Omega's manager, leader, IT manager, enologist, an employee, in-house software developers, and researchers.
Interviews	4	During Phase 2, four interviews were performed. The interviews comprised two informal interviews, and two in-depth, structured interviews regarding the network's digital transformation blueprint and future steps. All the interviews were digitally recorded and then transcribed.
Direct observation	4	During direct observations, the researchers participated in several meetings of the task force and of the in-house software developers of the digital platform, and in meetings held for the business process analysis of inefficiencies. The researchers supervised business process mapping activities and also participated in testing the software in this phase.
Online internal document	1	A document on the innovative project was published by the network to participate in a national contest on digital innovation
Phase 3: Digital culture alignment		
Interviews	2	One informal interview and one structured interview was conducted on the topic of Digital Culture.
Internal document	1	An internal report on the Digital Transformation Strategy and Digitalization Project was written by Omega.
Notes from direct observations	50 pages	Several notes were taken during all the phases of the Project. Official documents, internal documents, articles, and company brochures were consulted.

Data collection was divided into three phases related to the phases of the digital transformation blueprint. During phase 1, data were collected through three interviews and a focus group on digital transformation. After conducting this focus group, Omega applied for funds to the National Project of digitalization of SMEs, which derived from the National Plan for Industry 4.0. During phase 2, data were collected through a focus group, four interviews and direct observation and from one official document published by Omega. Lastly, during phase 3, data were collected through two interviews concerning digital culture alignment and from a report published by Omega on the digital transformation project.

For the analysis, this study employed a two-step mixed inductive–deductive coding approach (Fereday and Muir-Cochrane, 2006). The first step was performing a deductive

theory-driven coding in which a literature review about the commons was employed to ascertain the main "initial" categories (Yin, 2015) of the organizational variables of business networks that influence the preservation of their commons (Ricciardi *et al.*, 2018). In detail, this study employed the following categories: participatory architecture, network-level organizational integration, and the presence of mechanisms for opportunism prevention and resolution. In this phase, the previously mentioned three categories were considered axial codes. Next, after having coded all the empirical material by employing those categories, the second phase of coding was implemented in which the residual empirical material was coded based on an inductive approach, starting from the data, and two other axial codes were identified: quality and social responsibility. A table summarizing the codes emerged from this analytical process is available in Appendix A.

4. Results

4.1 Digitalization and participatory architecture for BNC regeneration

Agricultural business network organizations can be viewed as communities that must protect and develop their critical commons to survive (Cantino *et al.*, 2019); the literature highlights that rigid architectures are not suitable to achieve this goal (Dietz *et al.*, 2003). Conversely, participatory architectures are needed to foster effective communication between participants as well as a shared decision-making process (Ricciardi *et al.*, 2018).

To this end, the Omega network started a process of digital transition that was actively shared among firms, as explained by the network manager:

> Only if we all think it [: the digital portal] is useful within the company, we carry out the portal. We must not burden the company with something new that people do not perceive but do things gradually in everyone's interest. I strongly believe that business networks in agriculture are the future.

Moreover, since transparency is essential to encourage commons-enabling behaviors (Ostrom, 1990), digital tools were addressed to foster transparency (Constantinides *et al.*, 2018) in the network. The network leader affirmed:

> The strength of the portal is that it is a flexible tool and, above all, it operates all the information transparently: it is an architecture for the network governance, but it can also be used as a driver of control by network firms or from a third party to verify the leading company behavior. This is, in my opinion, the more transparent way to set up a company.

Further, according to the network manager, the adoption process was shared with employees as well as the SME owners of the network:

> When it was necessary to build the digital business portal, it was necessary to translate all the network processes into its architecture, after having fixed them. To do this business process reengineering, we discussed with employees and the network's firms, examining each process and listening to the criticisms of the users.

Despite this shared-process of digitalization, when the adoption process commenced, the SME owners exhibited a certain degree of hostility to the introduction of a new

technology, which was overcome by increasing the digital culture (Cobelli and Chiarini, 2020). In fact, as shared by the network manager:

> When the digital portal was then implemented, ad hoc training was done, first, for the employees of the leading company, and then, for the network's firms. In the beginning, there was a bit of hostility, but with time, everyone started to use it correctly. I strongly believe that the territory improves only if the culture of the territory is improved.

Despite typical complaints about the inability to use digital tools correctly in the initial stage of the adoption process, the digital transition occurred as a result of a participative learning process owing to Omega's strong orientation toward knowledge sharing (Bullini Orlandi *et al.*, 2019). Participants shared their expertise, as underlined by the network leader:

> At the beginning, for me and the IT manager of the project it was difficult to communicate since we had very different backgrounds; then, thanks to the help of the network manager, we understood how to communicate. I realized that digitalization is a tailor-made process. I digitalize what I need for the company and the people who work there. So, digitization allows for greater customization; it becomes a tailor-made dress that facilitates the work of all stakeholders. The know-how to produce the portal comes partly from our knowledge of the business network and partly from experience we accumulated on this path of digital transformation, and I have to say that I'm a bit jealous of the result we obtained.

Eventually, when discussing commons-enabling participatory architectures within a network, effective communication is fundamental. In this regard, digital platforms promote rich information exchanges inside and outside organizations (Bharadwaj *et al.*, 2013; Dhamija and Bag, 2020) and can therefore provide quick, clear knowledge transfer, as the network manager stated:

> The Omega digital platform manages the land registries of all the network firms, it maintains accounts of the expenses that are prepaid by the leader during the agrarian year, and it maintains the country notebooks (a regulatory obligation) and the distribution of grapes. The digital project ensures transparency and information sharing. The digital platform is a cloud solution; therefore, everyone can have access to the information. The information on the platform is objective for everyone. If I, as a leader, have to fulfill an obligation, everyone can see when the deadline is and whether I have done it or not. Besides, the control body can see transparently whether that information is available.

4.2 Digitalization and network-level organizational integration toward BNC regeneration

Adaptive co-management systems, such as the Omega business network, foster collaboration among participants, highlighting their role as bridge organizations (Crona and Parker, 2012) in the management of common goods, such as knowledge and environmental resources (Bullini Orlandi *et al.*, 2019).

Omega used this adaptive co-management approach to create the digital infrastructure it required to manage its own BNC. Within the platform, agricultural expertise had to be integrated with managerial and IT knowledge, as stated by the network leader:

> The development of the digital portal requires not only the skills of the agronomist but also that of the digital ones. It took an IT manager with both economic and digital skills to integrate all the different software and make them talk to each other. The IT manager and I worked side by side for one year to convert agricultural production processes in digital terms and implement the digital platform.

This collaborative approach was adopted in a shared platform architecture's design, allowing stakeholders of the platform ecosystem to better govern their relationships (Baldwin and Clark, 2000), processes and operations (Bag *et al.*, 2020b; Constantinides *et al.*, 2018). On this the network manager, argued:

> We have re-designed Omega's processes from the pruning and production of grapes to the management of the harvest, and all this has been inserted into the digital portal. To do this, I had to translate agricultural knowledge and explain it to a computer scientist in order to set up an ad hoc digital structure.

It is interesting to note that:

> The work on the digital platform has been carried out thanks to a task force established for the digitization project and was composed of the network leader, the production manager, agronomists, the administrative manager, and the IT manager. (network manager).

Indeed, the composition of the recognized leading group committed to the governance of the network coincides with the composition of the *task force* in charge of developing the digital strategy. Therefore, the task force provided vision and coordination (i.e., organizational integration) during the whole digital transformation process.

The variables expected to influence the network's capability to protect and develop its own BNC include clarity regarding the expected contribution of the network firms, the shared network-level business plan, and the sharing of key resources (Ricciardi *et al.*, 2018). In this regard, the digital platform enables all these aspects since it provides data and information sharing as well as customized digital processes that exert horizontal control on each participant's behavior (Constantinides *et al.*, 2018). According to the network manager:

> The cultivation plan (or business plan) is shared and managed through the digital portal that also manages all the land registries of all the firms, the country notebooks (regulatory requirement), and the delivery of grapes at the end of the production cycle.

Moreover, the digital platform makes available explicit information about the expected contributions of each participant based on specific estimations made from the business plan. As explained by the network manager:

> We put the rule of equivalence on our business network contract. It means that as much economic resources the leader of the network contributes to the other firms in their production cycle, the equivalent value in grapes has to be given later to the leader. The portal can estimate and predict the expenses at the start of the year; therefore, every firm can be updated in real time and in a transparent way.

In addition, the network manager explained that the digital platform:

> has been able to simplify the business network management compared with that in previous years and to improve the management of the agricultural vehicles and tools that are often exchanged between the firms. Compared with the past, agricultural equipment

> is now under control and we know exactly where all the network tools and country products are.

Lastly, one of the most interesting and innovative aspects of the digital strategy concerning organizational integration is that the digital architecture is also integrated with the processes of external key stakeholders, and according to the network leader, positive externalities arose owing to this feature in terms of the supply chain performance, which is attributable to the connectivity and the information-sharing feature offered by the digital platform (Gunasekaran *et al.*, 2017). The network leader explained:

> We manage the harvest through the digital portal by integrating it with the center for grapes drying at Valpolicella managed by the company Beta. The strength of the network portal was to be able to improve the management of the harvest: the grapes were monitored and removed from the vineyards only when ripe, maximizing revenues for each firm. Moreover, by integrating our portal with that of Beta we improved our logistic management, and delays didn't occur. Finally, this integration produced analytical accounting in advance, and we obtained the data on the contribution of each firm in a much faster and accurate way. So, we were able to pay the firms of our network almost three months in advance of our competitors.

4.3 Digitalization and opportunism prevention in business networks for BNC regeneration

Governance and incentive structures can be successfully implemented using digital platforms to coordinate the behavior of different stakeholders (Constantinides *et al.*, 2018). As Omega's network manager said, to prevent network firms from jeopardizing the environmental network commons by under-investing in the maintenance of the necessary elements:

> the leading firm of the business network forecasts and provides in advance the economic resources needed to complete the necessary soil tillage to guarantee the integrity of the vineyards for all the firms of the network.

Moreover, in line with the view that opportunism mainly occurs because of a lack of accountability or transparency (Ostrom, 1990), in this specific context, the digital platform enhances the transparency and accountability in the network governance and establishes mechanisms that appropriately bound opportunistic behaviors (Constantinides *et al.*, 2018) As network manager declares:

> Through the digital platform, every firm discusses at the beginning of the year with the agronomist about the operations [of maintenance]. We have never verified selfish behaviors because the firms can't afford to pay all the necessary maintenances in advance; therefore, they have an interest in helping the leader in regenerating the vineyards. Also, all information about the soil tillage is transparent and shared in advance at the beginning of the year.

4.4 Digitalization and quality as regards BNC regeneration

Since the Omega network is located in a territory essential to its own success, it can be viewed as a place-based enterprise (Shrivastava and Kennelly, 2013) that pays considerable attention to sustainability and adopts innovative solutions aimed at (re)generating its

common good (environment), which have a significant impact on quality. In this regard, apart from avoiding chemical products in favor of natural processes (Bullini Orlandi *et al.*, 2019), Omega adopts ICTs to promote sustainable standards. In this sense, the use of technology to support improved quality performance is termed "Quality 4.0" (Sony *et al.*, 2020) and, as underlined by the network manager:

> Omega's network leader installs in the vineyards weather stations with cameras that monitor the weather, and if, for example, it does not rain, they do not treat the plant. So, you can calibrate the treatments concerning the season because our priority is respect for the environment.

Omega's adherence to high quality standards needs to be proved by strict auditing controls, and to this end, the digital infrastructure provides centralized data processing that results in speed and transparency during quality assessments (Dimitris and Ekaterini, 2016). This fact is confirmed by the network leader, who recognizes the importance of the digital platform:

> If there is control by a third party, all data are available to demonstrate that all firms in the network respect the parameters and that this is the more transparent way to set up and to govern a company.

Because of the network's digital platform, the process innovation in quality management confers on Omega a technological and market advantage (Sahoo, 2019) over other agricultural organizations in the territory. Indeed, network manager declares:

> The auditing body was surprised by the speed with which we can provide the certifications issued by the quality control authority regarding the application of the environmental and security standards for the entire business network thanks to our platform. They asked us if it's possible to extend the same technology to all the agricultural organizations of Valpolicella.

Digitalization allows speed in the process of quality certification of the entire value chain. Moreover, Omega obtained the important certification "Equalitas" owing to the error-removal tactics to improve quality (Agrawal, 2019) applied during the process mapping activities performed to build the digital architecture.

The network leader eventually declared that Omega will soon adopt advanced technologies, such as blockchain, to manage quality certification:

> This technology [blockchain] has relevance for the traceability of products. Besides, consumers are increasingly attentive to the product, and the processing techniques and treatments carried out on the vineyard.

Indeed, in the wine sector, blockchain technology allows firms in the value chain to obtain certifications regarding the origin of the raw materials and their product and process quality. This technology allows firms to adapt to the customer needs and new perceptions about quality and environmental aspects (Shah *et al.*, 2019), and thus align their processes with stakeholder requirements to achieve effective quality management (Kuhn *et al.*, 2018).

4.5 Digitalization and social responsibility for BNC regeneration

Along with its environmental commitment, Omega's leader fosters culture spread in the business network and has a strong orientation toward knowledge sharing and skills development to stimulate learning (Bullini Orlandi *et al.*, 2019). In this way, a network composed of micro and small firms can share their experience and practices and benefit from the increased information (Sinha and Conti, 2010). Further, the network leader highlights this distinctive feature regarding e-skills development that can lead small organizations to gain new competencies:

> In the beginning, among the companies of the network, perhaps only 50% were able to enter the portal with the password. Although our Trade Association doesn't promote a good digital alphabetization, even though it should be the one to spread digital culture, we have transmitted by ourselves e-skills within the network. Now, network companies can access the portal and manage their firm in a more advanced way.

Moreover, the centralized data processing allows the network leader to support the social sustainability of the network. Indeed, analytics allow risk management across the network in terms of protecting small firms from the extreme weather events that characterize agricultural businesses. In this regard, the network leader clarified:

> If, in a given area, grapes are destroyed by a hailstorm, we can cover that firm's losses thanks to the network's strength. We were able to see this thanks to the centralized data processing of the digital platform. In this way, the platform also becomes a tool to attract new firms and transmit a message, such as "Come into my network, you will have greater protection".

Therefore, analytics allows the small firms in the network to rival the production and service capabilities of large firms through more efficient coordination of distributed resources and participants (Constantinides *et al.*, 2018), and this network behavior, in turn, may affect long-term profits positively because of the highly motivated, loyal firms belonging to the network (Weckenmann *et al.*, 2015).

5. Discussion

By analyzing the way in which the Omega business network manages its commons based on a digital strategy, this study developed a data structure (Figure 2) that highlights how different levels of coding were connected during the analysis (see Appendix A). The main selective code identified concerns the DTS undertaken by the Omega business network to manage and preserve its network commons. The following five axial codes identified are linked with the theory of network organizational configuration enabling BNC (Ricciardi *et al.*, 2018) and with the contribution of Bullini Orlandi *et al.* (2019) concerning the Omega case study.

Among these axial codes, three emerged from the network's organizational configuration enabling commons regeneration fostered by digital transformation. Conversely, the residual two axial codes concerned specific aspects that emerged deductively from the case study conducted and thus represent important aspects related to the BNC literature and promoted by digital transformation. These axial codes emerged through the analysis of the open codes connected to the statements of the subjects

interviewed during the research (in Appendix A, 16 open codes are provided as an example).

The main selective codes relate to Omega's attempt to govern the BNC in a holistic way through a DTS. Indeed, Omega goes beyond merely digitalizing resources in a fragmented way, and its strategic behavior involves making structural changes, transforming key processes, identifying new value creation paths and, eventually, promoting a digital culture in the network (Hess *et al.*, 2016; Matt *et al.*, 2015; Vial, 2019). According to the existent literature on DTS, Omega conceived its DTS as a *blueprint* (Matt *et al.*, 2015) and provided support, insights, and advice to all the companies of the network in governing the transformations that arose owing to the integration of digital technologies, with the aim of providing advanced tools to promote BNC regeneration. Moreover, even though the digital platform became the tool through which the BNC was managed in a systemic way, Omega's DTS also considers the future operations *after* the transformation (Matt *et al.*, 2015). Omega is increasing the level of the digital culture in the network to implement blockchain technology in the supply chain, which will no longer focus simply on transparency aspects but also on the creation of increased customer value (Klötzer and Pflaum, 2017).

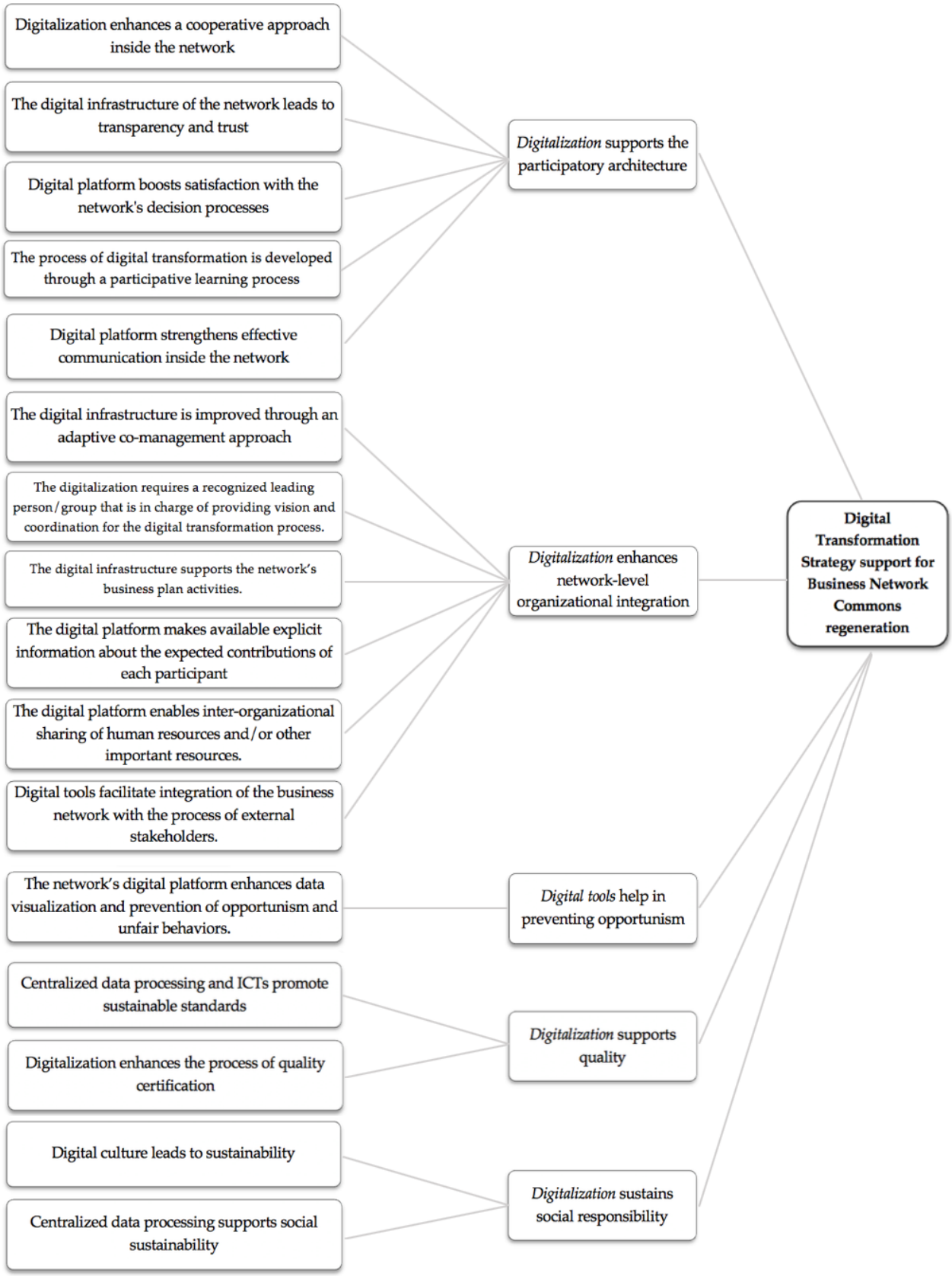

Figure 2. Data Structure. Source: Authors' elaboration.

The *first axial code* identified in this study is Omega's *DTS supporting participatory architecture*. In fact, in the network, the process of adopting the DTS to reach an advanced commons management was extensively shared with the firms. Moreover, the digital

infrastructure of the network leads to transparency and trust, which are, in turn, commons-enabling conditions (Ostrom, 1990). Then, the digital platform boosts the satisfaction with the network's decision process since it has been a participative, culture-enabling process characterized by a participative learning approach. Eventually, the digital platform strengthens effective internal and external network communication since it provides rapid, clear knowledge transfer.

The *second axial code*, Omega's *digitalization that enhances network-level organizational integration*, in turn increases the network's capability to protect and develop its own BNC. The open coding process reveals the way in which the digital infrastructure development was coordinated with an adaptive co-management approach by a well-structured, skilled, recognized task force that included key network figures. From the organizational perspective, the digital platform also improved the efficient inter-organizational sharing of important resources, including human resources. Further, the digital platform helped in estimating the contributions of each participant by integrating the network's business plan into the digital infrastructure. Finally, digital tools also facilitated the external integration of the network with the processes of other key stakeholders, thus providing increased economic sustainability to its commons.

The *third axial code* is *digital tools help in preventing opportunism*. That is, the leading firm of the network provides economic resources to guarantee the natural regeneration of the network commons, whereas the network's digital platform enhances data visualization. In this way, transparent, shared pieces of evidence inhibit the opportunistic action of under-investment in maintenance and the unfair behavior of over-exploitation.

This study's analysis identifies two additional axial codes strongly linked with business commons preservation: *digitalization supports quality* and *digitalization sustains social responsibility*. Although high product quality in agriculture is the result of the quality of the environment (natural commons), the presence in Omega of a social entrepreneur who cares for the social welfare of its community underlines how the common goods are protected (Bullini Orlandi *et al.*, 2019). Moreover, as highlighted in the results section, these two residual axial codes are deeply linked with Omega's digitalization.

Therefore, the *fourth axial code* is the *digitalization supports quality*. Quality represents an important value for Omega, which employs centralized data processing and ICTs to allow speed and transparency during the compliance assessments. Further, Omega is perceived as a benchmark by the auditors for its innovative digital architecture that enables rapid quality control of the network territory. In addition, digitalization enhances the process of quality certification because whereas the extensive business process mapping performed to build the digital architecture was also used to obtain the "Equalitas" certification, Omega will also adopt advanced technologies, such as blockchain to manage quality certification.

Last, the *fifth axial code* identified is *digitalization sustains social responsibility.* When a business network consists of small firms and its institutions co-evolve with the actors' relationships, capabilities, technologies, and business models (Ricciardi *et al.*, 2018), it is important to share experience, knowledge, and practices to benefit from the increased information and thus enable network growth. The network leader believes in this approach of continuous learning for the benefit of all the network firms. Digital alphabetization is

fostered, which, in turn, offers the organizations the possibility to have innovative tools to manage their commons. Ultimately, centralized data processing supports the social sustainability of agricultural businesses that can benefit from greater protection from extreme weather events by more efficient management of the network risks.

6. Conclusion

The Omega case highlights the ways in which a clear vision in terms of digital transformation, well-integrated with the business network strategy and supported by an efficient digital architecture and a shared digital culture, can strongly support the network in preserving its commons. Technology can support the development and the protection of the environment by controlling the risks affecting the fragile commons, such as by monitoring its biodiversity levels or preventing opportunistic over-exploitation behaviors. The analysis results show that a DTS undertaken to manage, regenerate, and preserve the network's commons can positively influence organizational variables, such as participatory architecture and network-level organizational integration, and can help in preventing opportunistic behaviors affecting the BNC. Moreover, two other variables strongly linked to business commons regeneration were enhanced by the DTS implementation: quality and social responsibility.

This study argues that when the business strategy and the DTS of a business network are combined, digital resources represent a key driver to promote business commons regeneration in an innovative way and to improve the network's culture as well.

6.1 Theoretical implications

This study contributes by extending the managerial and organizational literature on business networks as commons-enabling institutions. The case study findings highlight the key role played by digital technologies in the context of BNC regeneration. The analysis results show how key variables that enable the BNC (i.e., participatory architecture, organizational integration, and mechanisms for opportunism prevention) can be strongly supported by adopting a systemic DTS. Moreover, the analysis highlights the support given by the DTS to quality improvement and social responsibility across the network, which, in turn, produce strong positive externalities that foster BNC regeneration.

The results show that not only does the network configuration play a critical role in enabling BNC preservation and regeneration, but also that an innovative digital strategy can strengthen the relationship between network organizations and their commons. This result also contributes to the literature on digital transformation, which still lacks adequate contributions linking digital transformation to long-term sustainability issues in the SME context and the higher-level effects of digital transformation on the social and economic environment.

6.2 Practical implications

The study shows the applicability and relevance of a DTS within a business network context. Omega represents a best practice of an environmentally and socially committed network that has developed a DTS to support BNC management and to enhance firm performance. Since the business network can be considered a useful organizational form for protecting, employing, and developing common goods in sustainable ways, the preservation of its commons requires flexible and dynamic architecture, centralized data processing, shared knowledge, complex activity redesign, and timely decision-making, which digital technologies are able to provide. To this extent, other network entrepreneurs are encouraged to develop digital skills and a digital culture to facilitate the creation of a DTS aimed at preserving and regenerating their critical resources and at limiting associated risks.

Other stakeholders, such as institutions, competitors, and consumers, can foster the transition from a "business-as-usual" strategy to a long-term strategy toward the digitalized management of common resources. From an empirical standpoint, this study encourages institutions to provide resources for digitalization, companies to cooperate with their partners to share data across corporate boundaries, and consumers to sensitize firms about environmental quality certification.

7. Limitations and future research opportunities

Given its exploratory nature, several limitations should be considered when interpreting the results of this case study, which can be considered further research opportunities. First, studies on different network types and in different socioeconomic contexts would enhance the generalizability of this study's outcomes. Moreover, data were collected from only one industry, and thus, evidence from different industry settings is required. In addition, the relationship between digitalization and commons-related issues should be investigated in detail in future studies.

Conflict of interest The authors declare that they have no conflict of interest.

Notes:
[1] The National Plan for Industry 4.0 supported a project for the digitalization of Italian SMEs by allocating specific resources to the Chambers of Trade. The relevant government decree of May 22, 2017 was published in the Official Gazette and is available at https://www.gazzettaufficiale.it/eli/id/2017/06/28/17A04352/sg.

Appendix A: examples of coding. *Source: Authors' elaboration.*

SOURCE	QUOTE	OPEN CODING	AXIAL CODING	SELECTIVE CODING
Network Manager	"Only if we all think it [: the digital portal] is useful within the company, we carry out the portal. We must not burden the company with something new that people do not perceive but do things gradually in everyone's interest. I strongly believe that business networks in agriculture are the future."	Digitalization enhances a cooperative approach inside the network	*Digitalization* supports the participatory architecture	**Digital Transformation Strategy support for Business Network Commons Regeneration**
Network Leader	"The strength of the portal is that it is a flexible tool and, above all, it operates all the information transparently: it is an architecture for the network governance, but it can also be used as a driver of control by network firms or from a third party to verify the leading company behavior. This is, in my opinion, the more transparent way to set up a company."	The digital infrastructure of the network leads to transparency and trust		
Network Manager	"When it was necessary to build the digital business portal, it was necessary to translate all the network processes into its architecture, after having fixed them. To do this business process reengineering, we discussed with employees and network's firms, examining each process	Digital platform boosts satisfaction with the network's decision		

	and listening to the critics of the users." "When the digital portal was then implemented, ad-hoc training was done, first, for the employees of the leading company, and then, for the network's firms. In the beginning, there was a bit of hostility, but with time, everyone started to use it correctly. I strongly believe that the territory improves only if the culture of the territory is improved."	processes		
Network Leader	"At the beginning, for me and the IT manager of the project it was difficult to communicate since we had very different backgrounds; then, thanks to the help of the network manager, we understood how to communicate. I realized that digitalization is a tailor-made process. I digitalize what I need for the company and the people who work there. So, digitization allows for greater customization; it becomes a tailor-made dress that facilitates the work of all stakeholders. The know-how to produce the portal comes partly from our knowledge of the business network and partly from experience we accumulated on this path of digital transformation, and I have to say that I'm a bit jealous of the result we obtained."	The process of digital transformation is developed through a participative learning process		
Network Leader	"The Omega digital platform manages the land registries of all the network firms, it maintains accounts of the expenses that are prepaid by the leader during the agrarian year, and it maintains the country notebooks (a regulatory obligation) and the distribution of grapes. The digital project ensures transparency and information sharing. The digital platform is a cloud solution; therefore, everyone can have access to the information. The information on the platform is objective for everyone. If I, as a leader, have to fulfill an obligation, everyone can see when the deadline is and whether I have done it or not. Besides, the control body can see transparently whether that information is available."	Digital platform strengthens effective communication inside the network		
Network Leader	"The development of the digital portal requires not only the skills of the agronomist but also that of the digital ones. It took an IT manager with both economic and digital skills to integrate all the different software and make them talk to each other. The IT manager and I worked side by side for one year to convert agricultural production processes in digital terms and implement the digital platform."	The digital infrastructure is improved through an adaptive co-management approach	*Digitalization* enhances network-level organizational integration	
Network Manager	"We have re-designed Omega's processes from the pruning and production of grapes to the management of the harvest, and all this has been inserted into the digital portal. To do this, I had to translate agricultural knowledge and explain it to a computer scientist in order to set up an ad hoc digital structure."			
Network Manager	"The work on the digital platform has been carried out thanks to a task force established for the digitization project and was composed by the network leader, the production manager, agronomists, administrative manager, and IT-manager."	The digitalization requires a recognized leading person/group that is in charge of providing vision and coordination for the digital transformation process		
Network Manager	"The cultivation plan (or business plan) is shared and managed through the digital portal that also manages all the land registries of all the firms, the country notebooks (regulatory requirement), and the delivery of grapes at the end of the production cycle."	The digital infrastructure supports the network's business plan activities		
Network Manager	"We put the rule of equivalence on our business network contract. It means that as much economic resources the leader of the network contributes to the other firms in their production cycle, the equivalent value in grapes has to be given later to the leader. The portal can estimate and predict the expenses at the start of the year; therefore, every firm can be updated in real time and in a transparent way."	The digital platform makes available explicit information about the expected contributions of each participant		
Network Manager	"The digital platform has been able to simplify the business network management compared with that in previous years and to improve the management of the agricultural vehicles and tools that are often exchanged between the firms. Compared with the past, agricultural equipment is now under control and we know exactly where all the network tools and country products are."	The digital platform enables inter-organizational sharing of human resources and/or other important resources		
Network Leader	"We manage the harvest through the digital portal by integrating it with the center for grapes drying at Valpolicella managed by the company Beta. The strength of the network portal was to be able to improve the management of the harvest: the grapes were monitored and removed from the vineyards only when ripe, maximizing revenues for each firm. Moreover, by integrating our portal with that of Beta we improved our logistic management, and delays didn't occur. Finally, this integration produced analytical accounting in advance, and we obtained the data on the contribution of each firm in a much faster and accurate way. So, we were able to pay the firms of our network almost three months in advance of our competitors."	Digital tools facilitate the integration of the business network with the process of external stakeholders		
Network Manager	"The leading firm of the business network forecasts and provides in advance the economic resources needed to complete the necessary soil tillage to guarantee the integrity of the vineyards for all the firms of the network." "Through the digital platform, every firm discusses at the beginning of the year with the agronomist about the operations [of maintenance]. We have never verified selfish behaviors because the firms can't afford to pay all the necessary maintenances in advance; therefore, they have an interest in helping the leader in regenerating the vineyards. Also, all information about the soil tillage is transparent and shared in advance at the	The network's digital platform enhances data visualization and prevention of opportunism and unfair behaviors	*Digital tools* help in preventing opportunism	

	beginning of the year."			
Network Manager	"Omega's network leader, installs in the vineyards weather stations with cameras that monitor the weather, and if, for example, it does not rain, they do not treat the plant. So, you can calibrate the treatments concerning the season because our priority is respect for the environment."	Centralized data processing and ICTs promote sustainable standards	*Digitalization* supports quality	
Network Leader	"If there is a control by a third party, all data are available to demonstrate that all firms in the network respect the parameters and that is the more transparent way in order to set up and to govern a company."			
Network Manager	"The auditing body was surprised by the speed with which we can provide the certifications issued by the quality control authority regarding the application of the environmental and security standards for the entire business network thanks to our platform. They asked us if it's possible to extend the same technology to all the agricultural organizations of Valpolicella."			
Network Leader	"Because this technology [blockchain] has relevance to the traceability of products. Besides, consumers are increasingly attentive to the product, and to the processing techniques and treatments carried out on the vineyard."	Digitalization enhances the process of quality certification		
Network Leader	"In the beginning, among the companies of the network, perhaps only 50% were able to enter the portal with the password. Although our Trade Association doesn't promote a good digital alphabetization, even though it should be the one to spread digital culture, we have transmitted by ourselves e-skills within the network. Now, network companies can access the portal and manage their firm in a more advanced way."	Digital culture leads to sustainability	*Digitalization* sustains social responsibility	
Network Leader	"If, in a given area, grapes are destroyed by a hailstorm, we can cover that firm's losses thanks to the network's strength. We were able to see this thanks to the centralized data processing of the digital platform. In this way, the platform also becomes a tool to attract new firms and transmit a message, such as "Come into my network, you will have greater protection."	Centralized data processing supports social sustainability		

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