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KEEPING UP WITH THE TIMES: DIGITAL TOOLS TO NURTURE SMALLER COMPANIES CONTRIBUTION TOWARDS A BRIGHTER FUTURE

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Disclosure statement

This PhD Thesis is a collection of papers. Therefore, since most of these bodies of work have been published or is about to be published, I have contacted all of my co-authors and I have received their permission to use these bodies of work within my PhD Thesis.

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Abstract

Purpose: The now global economy in which companies operate forces them to pursue constant evolution and change so to meet today's expectations and requirements from both an environmental and digital prospective. Governmental entities are formulating legislations and norms to highlight the importance of sustainability endeavors. This is because stakeholders perceive sustainability and sustainable production to be central to the pursue of a greener future hence preserving scarce resources, foster sustainable economic growth, minimize waste and pollutants, as well as improve the human condition. Furthermore, due to governmental policies, incentives and educational and awareness raising programs, consumers and investors are increasingly more demanding that companies make real efforts to reduce their environmental impact and prioritize sustainability practices. Nonetheless, companies must pursue digital transformation, alongside sustainability practices, since digital tools have become central to companies' survival and growth potential. Digital transformation has changed the market and the way in which companies operate. Thus, companies must implement various digital tools within their strategy formulation and processes to maintain, capture and develop a competitive advantage and thrive in today's challenging market. Consequently, it is appropriate to identify the two above mentioned dimensions, sustainability, and digital transformation, to be central to today's companies experience and aim.

Small and medium enterprises (SMEs) have received a great deal of interest from various stakeholders since they constitute the backbone of various economies all over the globe. Therefore, governmental institutions have directed most of their efforts and resources towards expanding the population of SMEs which adopt sustainable practices, as well as to adopt digital tools which can help support a sustainable future. In fact, the new industrial aim of multiple economies and governments is to promote SMEs adoption of strategies which nurture sustainability through grants and public procurement contracts which promote digital transformation and digital technologies integration within SMEs. Companies' need to pursue an intertwined and simultaneous digital and green transition has been coined as the "twin transition" notion. The concept of twin transition lets companies operate under the assumption that digital tools can help offset their environmental impact. However, it is worth noting that the empirical evidence surrounding twin transition within SMEs is scant and additional studies are needed to fully comprehend to what extent digital tools can contribute to companies' sustainability endeavors. Moreover, it is worth noting that twin transition operates under the assumption that SMEs can successfully implement various digital tools within their strategy formulation and core processes to nurture their sustainable endeavors. However,

digital transformation is challenging for smaller entities since it requires both tangible and intangible resources. SMEs must possess the necessary financial and human resources (tangible), as well as the attitudes and strategic orientation (intangibles) to approach digital advancements. However, SMEs' context must be considered when evaluating their ability to digitize since their smallness, industrial sector and digital maturity does affect their ability to digitize.

In conclusion, the twin transition notion builds upon the assumption that SMEs are sufficiently equipped to deal with digital transformation and that those tools available to them can meaningfully impact companies' environmental endeavors. Hence, there is a growing need to further the current scholarly body surrounding the notion of twin transition within SMEs context, as well as establish whether SMEs do possess the necessary resources to pursue digitalization, as well as gather empirical evidence which indicates what practices can potentially nurture SMEs digital and environmental endeavors thus fostering twin transition.

Thus, the present collection of studies strives to gather empirical evidence to further our current understanding of twin transition and digital transformation by investigating various dimensions of the two above mentioned concepts within SMEs context. Moreover, we seek to discover practices that can help SMEs pursue twin transition.

Design/methodology/approach: The first contribution explores whether the twin transition notion can enhance a company's green-based competitive advantage. To do so, this study employs a PLS-SEM analysis to investigate 459 responses obtained from SMEs selected from purposive sampling technique. A regression analysis is then used to further analyze the obtained empirical data. This study adopts green work climate perception as a moderator and technological innovation as a mediator.

The second contribution is based on a qualitative approach which explores the perspective of micro and small entities whose digital readiness is limited so to investigate potential barriers and challenges that micro and small firms just starting to approach digital endeavors might face in an attempt to transform their business strategy and processes. This empirical body of work employs a multiple case study methodology with purposeful sampling. The sample is composed of micro and small companies operating in Italy.

Finally, the third contribution seek to explore the role of partnerships and external stakeholder engagement as potential avenues to overcome SMEs' constraints and foster ambitions. This study employs a qualitative approach by gathering empirical data from 9 SMEs operating within the Italian

context. The above-mentioned SMEs engage in a partnership powered by a digital platform which acts as an online digital sales channel for the companies involved in the partnership.

Findings: The obtained empirical findings from the first study support the literature strand which suggests that internet of things, green human resource management and investment in environmental management strategies are directly linked with SMEs' green competitive advantage. Thus, this study's empirical results further support the notion of twin transition since the obtained data suggests that digital tools, such as internet of things, and technological innovation can positively strengthen the relationship between SMEs' technological innovation and green competitive advantage. Furthermore, the second contribution included within this collection critically explores and challenges the notion of the Covid-19 pandemic being perceived as a catalyst for entities digital transformation and technological adoption. In fact, the obtained empirical findings suggest that the above-mentioned effects of Covid-19 did not apply to smaller entities with low degrees of digital readiness. Thus, this study contributes to the scholarly literature by helping determine a series of barriers micro and small entities experience in starting their digital journey. The barriers identified are as follow: economic constraints, lack of know-how, cultural predisposition and management resistance to innovation and change towards digital tools. Finally, the third contribution's empirical findings reveal that cooperative activities allow SMEs to improve their competitive advantage and overcome constraints normally associated with their limited size and resources. In fact, through cooperative activities, SMEs are able to generate new revenues streams, gain access to digital platforms and finance their sustainability and technological innovation endeavors with their newly financial and shared human resources. The obtained empirical findings prove useful in underlining the importance of external stakeholders' engagement to SMEs which can leverage off of collaborative activities to gain new resources, access digital tools and external knowledge.

Originality/value: The manuscript included within this collection of papers address research gaps highlighted by both scholars and practitioners; hence, these articles research questions and aim are original and relevant to address today's challenges and contexts. The first article addresses the reported research gaps that exists between digital technologies such as Internet of Things and companies' green competitive advantage. Moreover, it broadens the investigation of the factors influencing green competitive advantage, technological innovation and green management practices. Finally, this article originality stems from scholars and practitioners' efforts to gather and explore the twin transition notion.

The second manuscript proposes an original question which seeks to address the Covid-19 impact on smaller companies' digital transformation. Furthermore, this article originality stems from its efforts to explore the potential barriers that smaller entities encounter when seeking to digitize.

The third and final manuscript originality stems from its selection of external entities as businesses to include within collaborative efforts and partnerships. Most of the literature has focused its endeavors on customers and internal stakeholders; hence, our empirical findings further highlight how external actors can be seen as key partners and collaborators. Hence more, this article contributes to the exploration of digital platforms as tools to promote collaborative activities. The foregoing element is another original contribution of this paper since it highlights the role that digital platform might have in engaging with companies operating within the same industry sector.

Theoretical implications: Each of the three contributions find their positioning within the digital transformation literature and it contributes to the discourse which ties digital tools, sustainability endeavors within SMEs context. Therefore, the above-mentioned papers included within this collection seek to advance the current body of knowledge on digital tools and their potential contribution to the environmental protection agenda. Additionally, this collection seeks to focus specifically on SMEs due to their central role in many economies.

The first manuscript contributes to the literature as follows. First, it answers the research gap highlighted by previous scholars concerning the notion of twin transition by supporting the scholarly body which argues that technologies and digitalization have a positive impact on a firm's sustainability. Moreover, this study contributes to the discourse on how engagement with various green techniques and stakeholders can be utilized to promote companies green CA. Finally, this study contributes to the discourse surrounding twin transition since the obtained findings further reinforce the validity and achievability of the foregoing mentioned notion developed by the EU.

The second manuscript highlights and analyses the other side of digital transformation and the reasons why it might not be implemented within smaller entities. Furthermore, this study challenges the literature strand which reports empirical findings indicating that the Covid-19 pandemic served as a catalyst to companies' digitalization.

Finally, the third manuscript contributes to the understanding of stakeholder engagement practices within the context of SMEs partnerships. The obtained empirical findings contribute to the three dimensions of the stakeholder engagement theory, as well as the literature strand which argues that today's economy is a relational economy. Additionally, the third article further emphasizes the

importance that digital platforms have in nurturing external stakeholders engagement and co creation activities.

Managerial implications: Each of the three contributions included within this collection position itself within the digital transformation and SMEs realm and it contributes to furthering practitioners' discourse and knowledge surrounding those two main thematic areas. Consequently, the three manuscripts included within this collection have the following managerial implications.

The first manuscript clarifies to managers and policy makers that investments towards technologies and digitalization can help dimmish companies' environmental impact, as well as improve firms' green competitive advantage. Specifically, this study underlines the role of internet of things has in nurturing companies' green competitive advantage.

The second manuscript included within the present collection of paper makes the following practical contributions. First, it highlights barriers and limitations that smaller entities face when seeking to digitize. In doing so, this study seeks to promote managers, legislators and policy makers to develop new strategies and policies which could help smaller companies overcome said barriers so to nurture their future success and growth potential. Second, this study highlights the necessity to establish both educational and financial aid initiatives to help companies obtain both tangible and intangible resources necessary to implement digitalization within their strategy and processes.

The third and final manuscript has the following managerial contributions. SMEs must address their organizational capabilities and resources to perceive/understand their limitations and pursue collaborative efforts through partnerships in an attempt to engage with relevant stakeholders which can help overcome their limitations and constraints. The study also highlights how partnerships with businesses which operate in a similar sector allows for synergies and it creates the opportunity to co-develop new products while also optimizing firms' resource utilization and allocation. Finally, it presents empirical findings which underline partnerships as potentially beneficial to smaller entities seeking to access external knowledge.

Keywords: digital transformation, SMEs, twin transition, barriers, partnerships

Chapter 1

Digitalization, Twin Transition and SMEs' Central Role for a Better Future

1.Introduction

The effects of digital transformation are becoming ever more apparent, and businesses of all sizes are forced to pursue digital transformation if they seek to remain competitive (Klein and Todesco, 2021). In fact, the environment in which organizations operate is defined as a VUCA world where continuous technological evolution and disruptive technologies, constant uncertainty caused by global crisis and political conflicts force businesses to pursue technological advancements in an attempt to remain relevant and competitive (Bertei et al, 2015). In fact, some believe digital tools and technologies are often a solution to the above-mentioned challenges which characterize today's business world (Paolini et al, 2021).

Given the importance and relevancy that digital tools have assumed in the past years, academics and practitioners have directed their efforts towards the investigation and exploration of digital transformation and its multifaceted effects on various aspects and performance of organizations (Klein and Todesco, 2021). Literature streams on digital transformation discuss topics such as twin transition (Kraus et al, 2020), its effect of companies' business model (Marchini et al, 2019), barriers to implementing digital tools (Broccardo et al, 2017), how to gain access to digital technologies (Kujala et al, 2022) and more. Within those literature streams, academics and practitioners have put a great deal of efforts towards the investigation of small and medium enterprises (SMEs) due to their central role within many countries' economies, employment rate and innovation capabilities (Paul et al, 2017). Therefore, this collection of papers will focus its efforts on the exploration of SMEs reality in conjunction with digital technologies and digital tools.

1.1 Digital Tools and Sustainability: the Twin Transition Notion

Organizations all over the globe are being pressured by various stakeholders to reduce their environmental impact in an attempt to dimmish the damages caused by human and industrial activities (Kraus et al, 2020). Therefore, today's stakeholders demand entities to adhere to an ever-increasing number of policies aimed at safeguarding the environment and reduce pollutants

emissions (Davenport et al, 2019). Consequently, a great deal of efforts has been directed towards the exploration of new tools and practices which could help companies improve their sustainability endeavors and reduce their resources consumption, as well as their resource degradation (Bresciani et al, 2022). In an attempt to promote companies' efforts towards sustainability, the European Commission has set the objective to employ digital tools as promoters of companies' greener performance through systematic transformations by introducing the concept of twin transitions (Declaration, 2021). Twin transition refers to the simultaneous transformation of green and digital transition to offset companies' pollutants and environmental impact (El Hilali et al, 2020). Therefore, this led to the notion of digital tools help sustainability efforts (El Hilali et al, 2020). However, limited empirical evidence supports the above-mentioned statement. Consequently, the first study included in this collection seeks to expand the current understanding concerning twin transition. To do so, the study explores whether SMEs can achieve a green competitive advantage through internet of things (IoT) and technological innovation.

IoT is a tool which falls within the broader scope of the industry 4.0 (Jermsittiparsert et al, 2020). IoT is employed by companies to maintain high speed connections amongst people, machines, and production lines (Li and Li, 2017). IoT plays a central role within different business activities since it allows entities to pursue objectives such as data sensing, gathering, monitoring, communication, and identification (Dadkhah et al, 2019). IoT falls within the digitalization concept, and it has been selected since it has become crucial for companies' success and pursue of business agility (Capik, 2017). Moreover, IoT played a central role during the Covid-19 pandemic in which companies had to rely on technological tools to continuously carry out their production activities (Rehman et al, 2021). Several studies have found that digitalization and tools traditionally associated with the industry 4.0 dimension do positively impact on firms' environmental performance (Gadekar et al, 2022; Jermsittiparsert et al, 2020). The manuscript included within chapter 2 of this collection of papers does further corroborate this notion by furthering our current understanding on IoT and technological innovation contributions towards reduced emissions and resource depletion. Investments in IoT and technological innovations, which fall within the digitalization and industry 4.0 notion, can positively contribute towards SMEs sustainability goals.

1.2 Digital Transformation in SMEs

Digital transformation is a phenomenon which is inherently different within various contexts; thus, industry sector, region, legislation, resources, companies' degree of digital readiness and firms' size deeply affect the organizations process of digitalization (Truant et al, 2021). Digital transformation is heavily contextual and different scenarios could lead to different consequences for various forms of entities (Li, 2021). Therefore, it is necessary for researchers and practitioners to investigate and explore multiple organizations (Marcysiak and PLeskacz, 2021). Consequently, this collection of studies seeks to answer the call for research which demands additional empirical evidence concerning SMEs (Baig et al, 2020). Despite their limited size, SMEs are considered to be extremely relevant to the discourse surrounding digitalization due to the numerical dominance and essential role within many countries economy, employment rate and innovation capabilities (Truant et al, 2021). Despite their essential role to many nations' growth and survival, SMEs may encounter specific barriers and challenges when seeking to digitize (Broccardo et al, 2017). Digital transformation is not as simple as implementing some brand-new technologies within SMEs' infrastructure. Instead, digital transformation requires all-round changes of SMEs strategic, organizational, and business nature (Alfiero et al, 2018; Marchini et al, 2019). SMEs' owners must be prepared to deeply change their business if they seek to evolve and digitize.

SMEs pursue of digitalization often comes with its set of specific challenges and barriers due to the inherent nature of SMEs' smallness and resource constraints (Broccardo et al, 2017). SMEs' barriers to digital transformation are usually indicated as: lack of a clear vision, goal and practical approach, and financial and human resource constraints (Bican and Brem, 2020). This is where the contextual nature of digital transformation plays a crucial role in SMEs' journey towards digitalization since the above-mentioned constraints might significantly change and affect SMEs transformation in comparison to the journey that larger entities must undertake to digitize (Lombardi et al, 2021).

In recent years, several publications have investigated and explored the factors that could potentially foster and drive digital transformation within SMEs. Digital readiness emerges as one of the most relevant factors since organizations with significant levels of predisposition towards digital tools are more likely to digitize and remain up to date with technological advancements (Bican and Brem, 2020) and through them, achieve or maintain a competitive position within the market in which they operate in. Scholarly evidence suggests that SMEs' owners have a central role in driving their organization towards a culture which nurtures digital tools integration; thus, promoting their company digital readiness and proactive approach to innovation and technological advancements (Bican and Brem, 2020). Therefore, managers and owners support towards digitalization is crucial

since cultural barriers deeply affect the digital readiness of SMEs. Accurate planning, preparation, a clear strategic vision and a culture which nurtures change, and digitalization can greatly contribute towards SMEs ability to overcome their constraints of smallness and digitize (Dallasega et al, 2018). Finally, as previously mentioned, smaller entities limited resources greatly challenge their ability to pursue digitalization endeavors. This is particularly evident during the Covid-19 pandemic in which SMEs had to focus their limited resources towards survival rather than innovation (Klein and Todesco, 2021). The economic crisis caused by the Covid-19 pandemic jeopardized SMEs survival; hence, additional investments in digital tools were out of the picture since the already limited human and financial resources where funneled by SMEs towards overcoming the hardships caused by the pandemic to ensure employees health safety and production continuity (Klein and Todesco, 2021).

1.3 Partnerships to Overcome SMEs' Constraints and Fuel their Ambitions

Market uncertainty forces companies to pursue digitalization and innovation so to remain competitive in an ever-changing world (Pantano et al, 2020). Nonetheless, as identified in chapter 3, SMEs face unique barriers due to their limited size and resources constraints; thus, it becomes challenging to conduct innovative activities aimed at implementing digital tools and expanding beyond national boundaries (Pantano et al, 2020). Gaining additional financial resources and knowledge is especially difficult for smaller entities since their size limits their investment capabilities, as well as their ability to attract the required human capital (Grama-Vigouroux et al, 2020). Hence, the foregoing constraints must be addressed to improve SMEs competitiveness, stability and, consequently, ability to pursue changes aimed at improving their digitalization and sustainability practices (Paul et al, 2017). However, governmental institutions often fail to address the challenges that SMEs encounters; thus, companies must pursue new avenues to overcome their constraints and limitations (De Marco et al, 2020).

SMEs can engage in mutual working relationships with external stakeholders in an attempt to lessen their constraints (Chesbrough and Schwartz, 2007). Collaborative efforts with external stakeholders grant firms access to resources that they might not be able to procure nor obtain on their own (Schneider and Sachs, 2017). For example, digital tools such as online digital sales platforms are extremely difficult to implement and run. Engaging with external stakeholders is believed to hold the potential to establish positive relationships which can help SMEs nurture their innovation strategies and development processes (Ommen et al, 2016). In fact, stakeholder engagement is

regarded as essential for SMEs seeking to access additional resources and knowledge (Liu, 2021). Furthermore, empirical evidence should be directed towards the investigation of the effects that partnerships have on SMEs' competitiveness (Hessels and Parker, 2013). This is of relevance since today's economy is considered to be a relational economy in which links between organizations and stakeholders need to be understood and explored in an attempt to better comprehend the importance and potential impact that cooperative and collaborative relationships have (Freeman et al, 2017; Kujala et al, 2022).SMEs might seek to engage with external stakeholder in order to gain access to digital platforms since those digital tools might prove useful to SMEs seeking to overcome their liability of smallness and resources constraints to achieve digitalization and innovate their processes and company's reach (Constantinides et al, 2018). SMEs might find it useful to engage with external stakeholders to gain access to digital tools since developing and managing a digital platform requires technical knowledge and financial resources which might not be obtainable by most SMEs, especially if they operate in traditional sectors (Giotopoulos et al, 2017).

Conclusively, the current goal of both academic and practitioners is to investigate and better comprehend the importance and potential impact that cooperative activities can have on SMEs (Kujala et al, 2022).

1.4 Conclusion

This collection of manuscripts is structured as follows. Chapter 2 discusses the topic of digital tools and sustainability through the lens of twin transition via the analyses of responses obtained from SMEs operating within various industry sectors. This study highlights the importance of digital tools such as internet of things to improve companies' green competitive advantage; thus, further corroborating the concept of digital technologies as promotors of sustainable performances of smaller entities. Chapter 3 explores smaller entities so to identify whether the Covid-19 pandemic acted as a catalyst for small and micro firms' digital transformation. Additionally, chapter 3 identifies smaller companies' constraints and barriers preventing their digitalization so to further our current understanding of what challenges their ability to remain up to date with industry trends and technological advancements. Chapter 4 builds upon the barriers identified in chapter 3 and it seeks to understand whether external stakeholder engagement through partnerships and collaborative activities can help SMEs overcome their smallness and lack of resources. Moreover, chapter 4 highlights the importance of external stakeholders engagement in accessing digital tools which can

help SMEs foster their market reach, revenue streams and nurture their resources which can then be employed to pursue technological and environmental investments. Finally, chapter 5 contains this collection of papers concluding remarks, as well as suggestions for future research avenues which build upon the three manuscript empirical findings.

Chapter 2

Twin Transition and Industry 4.0: Unpacking the relationship between digital and green factors to determine green competitive advantage

2.1 Introduction

Academics, practitioners, and policymakers have overlooked the environmental impact of organisations and other human activities because they believed that production lines' environmental impact was limited (Kraus et al, 2020). Kraus et al (2018) argue that organisations have not concentrated on their environmental performance because their main concern was to increase profitability and sales. Nonetheless, the ever-increasing depletion of the world's natural resources has become a central issue for many companies, institutions, and governments. Pressure has been put on companies to decrease the environmental damage that is caused by their processes in an attempt to promote a greener future and mindset (Gerli et al, 2022). Firms are being pressured by stakeholders to reduce their polluting emissions in an attempt to stop the damage caused by the consumption of goods and services, and by the polluting practices of industry (Kraus et al, 2020). Furthermore, today's stakeholders require companies to adhere to an ever-increasing number of environmental policies (Davenport et al, 2019). Hence, it is necessary to finance sustainable practices in an attempt to improve a company's environmental and social performance, while also satisfying the stakeholders' demands, and improving the company's competitive advantage (CA) and public image (Bresciani et al, 2022).

In an attempt to promote a sustainable future, the European Commission (EU) has set the objective to utilise digital technologies to pursue a green future through systematic transformations by introducing the concept of twin transitions (European Union Declaration, 2021), which refers to an intertwined and simultaneous green and digital transition to offset companies' carbon footprint. Therefore, companies operate under the assumption that digital technologies can help their sustainability efforts (El Hilali et al, 2020). Technological innovation and green factors are crucial to an organisation's success (Zhai and An, 2021). Thus, managers are forced to pursue both environmental and technological innovation (Wang et al, 2021). Finally, the COVID-19 pandemic has further underlined the importance that technology and sustainability have in today's business world, thus pressuring entities and organisations to maximise their efforts and achieve a twin transition (Alraja et al, 2022).

The pursuit of technological innovation has led to the Industry 4.0 revolution, which is linked to a variety of modern technical advances, such as the Internet-of-Things (IoT), cyber-physical systems, digitalisation, cloud computing, artificial intelligence, automation and robotics, and additive manufacturing processes (Reiman et al, 2021; Roijko, 2017). With the advent of these tools, organisations have had to drastically change their ways (Bresciani et al, 2022; Brescani, Dabic, Bertello, 2022) because of the commercialisation and diffusion of new technologies (Nizetc et al, 2020; Pal et al, 2021).

Thanks to technological advances, manufacturing processes have become more complex, and demand new kinds of practices and processes (Neumann et al, 2021). Nonetheless, Industry 4.0 has become increasingly relevant because its tools are driving the manufacturing system to new performance heights thanks to its improved levels of digital, automated, and intelligent platforms (Oztemel and Gursev, 2020). Manufacturing businesses with higher technological aptitude can utilise these technological developments to enlarge their market share (Bertello et al, 2021; Wang et al, 2021) and improve their competitiveness through innovation, cost reduction, and productivity (Bresciani et al, 2022; Coskun-Setirek and Tanrikulu, 2021; Stief et al, 2016). Hence, IT investments and organisational resources such as IoT are necessary to ensure the long term success of a business (Rehman et al, 2021). In addition, IoT has to be taken into account if managers want to promote organisational success (Tang et al, 2018), determine innovation performance (Rehman et al, 2021), manage their supply chain (Zelbst et al, 2019), and organisational ambidexterity (Bresciani et al, 2018). Finally, the ability to exploit and integrate digital solutions within a firm's existing business strategies has become vital to ensure their survival and ability to cope with unprecedented events (Coskun-Setiirek and Tanrikulu, 2021; Gupta et al, 2022; Ozdemir et al, 2022). For example, during the COVID-19 pandemic, technologies held a significant role within firms' capabilities to ensure their survival (Akram et al, 2022; Alraja et al, 2022).

The empirical evidence presented within the literature suggests that the relevance of Industry 4.0 is not limited to the enhancement of the efficiency and responsiveness of the manufacturing system through technologies (Jermsittiparsert et al, 2020). Companies' sustainable performance can also positively benefit from Industry 4.0 (Gadekar et al, 2022) and its various tools (e.g., IoT) because they have a central role (Jermsittiparsert et al, 2020). Organisational investments towards the environment can positively affect a company's CA within a given industry's marketplace (Bresciani

et al, 2022). Technological innovation assists firms to use their limited resources to foster their CA (Ferraris et al, 2019) and improve their sustainable performance (El-Haddade, 2020). The empirical evidence suggests that Industry 4.0 tools can positively influence a company's green process innovation (Wei and Sun, 2021) and supply chain management (Fallahpour et al, 2021; Sarkis et al, 2021). Additionally, IoT plays a crucial role in examining organisational performance and determining competitive advantage (Bresciani et al, 2022). Due to the centrality of IoT to Industry 4.0 and the digitalisation of companies, it is possible to assume that IoT should positively enhance green CA. However, despite its centrality and potential positive effects on a firm's green CA, the relationship between IoT and a company's green CA is yet to be fully understood (Al-Khatib, 2022; Polas et al, 2022). Finally, the current research is mainly theoretical and focuses on specific contexts, such as China, Germany and the United States (Broccardo et al, 2023). Hence, additional empirical evidence is necessary to expand our knowledge concerning this topic.

In addition to IoT, firms can resort to a number of techniques in an attempt to better their environmental performance. First, the empirical findings indicate that manufacturing companies seeking to improve their sustainability can also engage in green human resource management (HRM) techniques (Rehman et al, 2021; Yong et al, 2019). In particular, by implementing green HRM, companies can better their management of the environment (Bombiak and Marciniuk, 2018). Moreover, the adoption of green HRM practices can be important in influencing competitive advantage (Tang et al, 2018). Firms proactive engagement in green issues can lead to organisational benefits, such as higher degrees of productivity and competitive advantage (Muisyo et al, 2021). However, the incorrect or limited implementation of a comprehensive framework of green HRM can lead to negative effects for a company's performance, thus underlining the necessity for organisations to fully understand the relationship between green HRM and green CA (Renwick et al, 2016). Prior researchers have investigated the influence of green HRM on the employees' green behaviour (Chaudhary, 2020) or environmental performance [41] but have paid less attention to how green HRM can impact green CA (Muisyo et al, 2021). The literature suggests that green HRM practices are necessary to make sustainable changes in the manufacturing industry (Yong et al, 2020). Despite its reported relevance, researchers have recognised that additional empirical studies are necessary to investigate whether green HRM practices can determine green competitive advantage (Hameed et al, 2022; Muisyo et al, 2021). Second, companies who seek to enhance their organisational performance can do so by investing in environmental management (IEM), which

allows them to also direct resources to environmentally-friendly behaviours (Power et al, 2015). Prior researchers have used IEM to examine green process innovation (Awan et al, 2021) and green performance (Bresciani et al, 2022) but they paid scant concentration to determining green CA through IEM. Therefore, to better understand IEM effects on green CA, additional empirical evidence is necessary.

Finally, companies who pursue sustainability through investment and other initiatives also affect different dimensions of their organisations. For example, firms who pursue green-related initiatives foster green work climate perception (GWCP), which promotes and supports employees' green behaviour (Bresciani et al, 2022). Thus, GWCP can shape the employees' views of their organisation's behavioural norms associated with green sustainability (Norton et al, 2014). In addition, the employees' green behaviour and management may promote the development of sustainable resources, hence furthering the organisation's sustainability efforts (Khanra et al, 2022). Nonetheless, additional efforts are to be directed towards the exploration of GWCP and its effect on green CA (Khanra et al, 2022). Hence, it is unclear to what extent GWCP can moderate the relationship between technological innovation and green CA (Aric and Uysal, 2022; Hameed et al, 2022). In conclusion, despite the effects that these elements might have on a company's sustainability and greenness, prior researchers have paid scant attention to IoT, green HRM, IEM, technological innovation, and GWCP, and their effect and relationship with green CA (Bresciani et al, 2018; Zhai and An, 2021; Zhang et al, 2020).

Based on these gaps and due to the complex nature of technological innovation and green CA, further empirical studies are necessary to explore which elements positively affect these factors. To fill the reported gaps, authors have attempted to investigate whether IoT, green HRM and IEM affects firms' green competitive advantage through the theoretical lens of natural resource based view (RBV) theory ()Hart, 1995). Hence, this work aims to further the current literature by building upon the work of Tang et al (2018) by broadening the investigation of the factors influencing green CA to green HRM, IEM, tecnological innovation, and green WCP. This is important because it presents evidence to guide and promote a company's resource investments. It can also direct institutional efforts towards the promotion of tools and management techniques that support twin transition's path. This paper aims to identify some means by which companies can improve or moderate their green CA. Consequently, the following research questions have been formulated:

RQ1: Do IoT, green HRM, and IEM affect green CA?

RQ2: Does technological innovation significantly mediate the relationship between IoT, HRM, IEM, and green CA?

RQ3: Does GWCP significantly moderate technological innovation and green CA?

The purposive sampling technique allows us to collect data from the Textiles, Plastic & PVC, Chemicals, Leather, and Automobile industries of Pakistan. A total of 459 questionnaires were used to conduct the analysis, which is done with SmartPLS, WarpPLS, and SPSS. The findings reveal that IoT, green HRM, and IEM wield a direct and indirect influence on green CA. Technological innovation has a positive influence on green CA. Finally, GWCP significantly moderates technological innovation and green CA. From a practical perspective, Pakistani organisations that operate in these industries should focus on IoT, green HRM, IEM, technological innovation, and green work climate perception when decisions concerning green CA must be taken.

This article is structured as follows. Section 2 reviews the literature and develops the hypotheses. Section 3 describes the methodology, while Section 4 presents a regression model test. Section 5 gives the discussion and conclusion, theoretical implications, practical implications, as well as the paper's limitations and future research avenues.

2.2 Literature Review and Hypotheses Development

2.2.1 Natural Resource-based View Theory

The RBV theory postulates that organisational resources and capabilities can play a significant role in determining sustainable performance and competitive advantage (Barney, 1991). However, RBV theory omits the interaction between organisations and the environment (Hart, 1995). A few decades ago, this omission was bearable but now organisations cannot ignore environmental issues if they want to achieve a competitive advantage (Bresciani et al, 2022). Researchers have recognised that environmental resources and capabilities can enhance a firm's profitability and curtail pollution (Hart and Dowell, 2011). A firm's capabilities, pollution prevention strategies, and natural resources can enhance green CA (Hart and Dowell, 2011). Natural RBV theory and green issues have attracted a large number of studies concerning these research topics (Bresciani et al, 2022; Khan et al, 2021; Kraus et al, 2020; Latan et al, 2018). Hence, natural RBV theory is deemed to be relevant to our

research because the present article tackles several environmental and technological dimensions and tools (Hart, 1995; Hart and Dowell, 2011).

IoT is considered to be a proven strategy, emerging trend, and innovative technology for organisations (Tang et aal, 2018). This study extends natural RBV theory by adding IoT to determine green CA. This is of particular relevance because IoT plays a significant role in determining environmental performance (Jermsittiparsert et al, 2020). In addition, researchers have confirmed that the adoption and execution of industry 4.0 are important to achieve social, economic, and environmental progress (Nara et al, 2021). Green HRM is deemed to be a natural resource and can assist sustainable performance (Malik et al, 2020). Researchers have recognised that organisations who are proactive in green issues can enjoy the benefits of higher productivity and competitive advantage (Muisyo et al, 2021). The environmental training aspect of green HRM may significantly improve a firm's green performance (Singh et al, 2020). The employees' awareness of the environment assists management in achieving green objectives (Bombiak and Marciniuk-Kluska, 2018). Prior researchers have used social exchange theory and ability-motivation-opportunity (Bhatti et al, 2021), and RBV theory (Afum et al, 2021) to measure environmental performance through green HRM. Therefore, the authors of this paper build upon previous studies and deem natural RBV to be a useful theoretical lens for investigating green HRM. Green CA is measured through green HRM by using the ability-motivation-opportunity theory (Muisyo et al, 2021). Additionally, IEM is reported to significantly improve companies' performance (Pagel et al, 2007).

Prior researchers used natural RBV theory to determine green performance (Bresciani et al, 2022). GWCP is an environmental resource and can help to solve environmental issues (Brescian et al, 2022). Firms cannot overlook environmental factors to determine sustainable performance (Rehman et al, 2020). Finally, technological innovation assists in successfully using limited resources to attain a CA (El-Haddadeh, 2020). Natural RBV theory postulated that environmental resources (i.e., green HRM, IEM, and GWCP) and technologies factors (i.e., IoT and technological innovation) can help to determine green CA (Hart, 1995). Dynamic capabilities theory is not utilised because it would be difficult to measure the underlying operational processes, and the relationship between organisational performance and dynamic capabilities empirically (Easterby-Smith et al, 2009).

2.2.2 Industry 4.0

The term industry 4.0 was used for the first time in 2011 and originated in Germany. Industry 4.0 is triggered by advances in technology, and information and communication technologies (ICT) (Rojko, 2017). Industry 4.0 is still in its infancy but its concept has gained a lot of traction and is considered to be relevant to today's businesses, despite its complexity and difficulty to define [70]. Industry 4.0 provides new capabilities by integrating and communicating information technologies to improve production methods (Bresciani et al, 2022; Xu et al, 2018) [14, 71]. Additionally, empirical evidence suggests that Industry 4.0 can be utilised to overcome social and environmental issues that exist in technologies and industrial methods to provide a more sustainable future (Morrar et al, 2017). Tools such as IoT, artificial intelligence, robotics, automation, cloud computing, additive manufacturing process, cyber-physical systems and digitalisation are considered to fall within the scope and definition of industry 4.0 (Reiman et al, 2021; Rojko, 2017). From the manufacturing perspective, industry 4.0 transforms manufacturing plants into well-functioning automized systems that are linked to vertical and horizontal procedures (Reiman et al, 2021). Hence, industry 4.0 and its tools are extremely relevant to manufacturing companies. Thus, this study seeks to further understand the effects that IoT has on these firms.

2.2.3 Internet-of-Things (IoT)

IoT is a key aspect of industry 4.0 and is significant for business success (Jermsittiparsert et al, 2020). IoT is necessary to ensure fast connections amongst people, machines, and products (Ehret and Wirtz, 2017; Li and Li, 2017). IoT is employed to maintain interconnections amongst different activities with different objectives, such as data sensing, identification, gathering and communication of data and other forms of information (Dadkhah et al, 2019). Moreover, IoT plays a central role in monitoring processes, measuring outcomes, and driving efficiency gains (Ehret and Wirtz, 2017). IoT is made possible by the emergence of a global information network, which enables the communication and data sharing that are necessary for IoT to exist (Schroeder et al, 2019). IoT utilises self-configurated and smart elements that are configured through the dynamic network subculture (Capik, 2017).

Technologies such as IoT have recently become necessary tools to ensure a company's success and agility (Rehman et al, 2021). Furthermore, IoT has solidified its relevance, even during periods of distress such as the COVID-19 pandemic in which companies had to rely on technological tools such as IoT to carry out their activities (Rehman et al, 2021). Hence, many firms are directing their

spending and resources towards innovative strategies, which include the use of tools, such as IoT, in an attempt to enhance their long term performance and resilience (Tang et al, 2018). Previous studies have reported the benefits that IoT has to supply chain management (Zelbst et al, 2019), innovation performance (Rehman et al, 2021), and organisational ambidexterity (Bresciani et al, 2018).

Investment in digital tools and technology must align with sustainability goals to provide for a better future. Hence, many studies have investigated the relationship between industry 4.0, digitalisation, and a firm's sustainability performance (Broccardo et al, 2023; Fallahpour et al, 2021; Sarkis et al, 2021). Several studies have found that industry 4.0, digitalisation, and its various tools seem to have a positive effect on a firm's environmental performance (Gdekar et al, 2022; Jermsittiparsert et al, 2020). Therefore, companies seeking to achieve improved sustainability do not have to shy away from investments targeted towards the implementation and integration of industry 4.0 and IoT (Jermsittiparsert et al, 2020). The empirical findings presented within the literature report that industry 4.0 can positively influence a company's green process innovation (Wei and Sun, 2021) and supply chain management (Fallahpour et al, 2021; Sarkis et al, 2021). However, despite the reported effects that technological innovation has on a company's sustainability, there is limited evidence of the effects and potentially positive relationships between IoT and a company's green CA (Al-Khatib, 2022; Polas et al, 2022). Moreover, most of the published studies have investigated companies and organisations within Germany, China, and the United States (Broccardo et al, 2023). Thus, our current understanding of this phenomenon is limited to those countries. Considering the effects that industry 4.0 and IoT have on an organisation's ability to tackle and innovate their processes and business model, it is possible to assume that IoT should positively enhance the green CA of manufacturing companies. Hence, the following hypotheses are developed:

H1: IoT is positively related to green CA.

H2: IoT is positively related to technological innovation.

2.2.4 Green Human Resource Management

The term green HRM emerged over the last three decades (Rehman et al, 2021). Green HRM is defined as HRM attributes that lead to desired environmental outcomes based on the proper and minimised use of finite resources (Kramar, 2014). This is particularly relevant for manufacturing firms who seek to enhance their environmental efforts (Rehman et al, 2021; Yong et al, 2019). Green HRM

grants the opportunity for organisations to better their management of the environment (Bombiak and Marciniuk, 2018), and it can be important when seeking to achieve and influence their competitive advantage (Tang et al, 2018). Higher degrees of productivity and a stronger competitive advantage are some of the organisational benefits that are normally associated with green HRM (Muisyo et al, 2021). Nonetheless, it is necessary to consider that the incorrect or limited implementation of a comprehensive approach to green HRM can negatively affect a company's performance (Renwick et al, 2016). However, it is important to underline that sustainable and ecological awareness is necessary to reap the benefits that are normally connected with green HRM activities (Bombiak and Marciniuk, 2018). If employees are not involved within such practices, then companies might fail to fully implement and promote ecological activities and practices [79].

The literature concerning green HRM is still in its nascent stage of development (Bombiak and Marciniuk, 2018). Previous literature has explored the effects that green HRM has on the employees' green behaviour (Chaudhary, 2020) and overall environmental performance (Rehman et al, 2021). Nonetheless, despite its reported benefits on a company's sustainability, it is not clear whether green HRM can foster their green CA (Muisyo et al, 2021). Therefore, additional empirical findings are necessary to better understand the relationship between green HRM practices and green CA (Muisyo et al, 2021). Many researchers believe that green HRM practices are necessary to make sustainable changes within the manufacturing industry.

Research underlines the importance of green HRM and its influence on innovation (Rehman et al, 2021). A few researchers have recommended that HRM does guide product and technological innovation (Verburg et al, 2007; Wei et al, 2011). However, additional empirical evidence is necessary to further understand the relationship between green HRM and technological innovation (Rehman et al, 2021; Verburg et al, 2007; Wei et al, 2011). Hence, this study seeks to establish such a relationship. This relationship is argued by natural RBV theory, which contends that natural resources combined with technological innovation leads to sustainable competitive advantage (Hart, 1995).

Based on these research gaps, the following hypothesis are developed:
H3: Green HRM is positively related to green CA.
H4: Green HRM is positively related to technological innovation.

2.2.5 Investment in Environmental Management

The stronger focus on environmental issues from stakeholders has forced many companies to reduce the pollutants derived from the products and services (Kraus et al, 2020). To do so, companies seek to innovate their processes and business activities in an attempt to reduce their emissions and energy consumption (Awan, 2019). However, the implementation of such innovations and practices is often considered to be costly and possibly negative for the short term profitability of companies (Bresciani et al, 2022). To enhance their organisational performance, organisations can engage in IEM, which funnels resources into the development of environmentally-friendly behaviours (Power et al, 2015). In addition, IEM gives confidence and supports managers to pursue clean production through improved efficiency (Ortaas et al, 2013). However, IEM often results in high degrees of investment targeted towards technology in an attempt to reduce waste associated with production, and can improve a firm's processes (Klassen and Vachon, 2003). Previous studies concerning IEM have explored its effect on an organisation's green process innovation (Awan et al, 2021) and green performance (Bresciani et al, 2022), which suggests its potential positive relationship with an organisation's green CA. However, despite its reported positive effects on companies' efforts towards sustainability and its achievement through the implementation of new technologies, the relationship between IEM and green CA remains unclear. Moreover, IEM is often achieved through the implementation of new technologies. Nonetheless, it effect on companies technological innovation remains to be fully understood (Klassen and Vachon, 2003).

Therefore, to better understand IEM's effects on green CA and technological innovation, the following hypothesis are developed:

H5: IEM is positively related to green CA.

H6: IEM is positively related to technological innovation.

2.2.6 Technological Innovation and Green Competitive Advantage

Technological innovation is crucial to businesses survival and success (Zhai and An, 2021). Improved performance can be achieved through technology because companies can better their profit margins, while also improving their product or service offerings (Lee et al, 2014). However, few studies have investigated technological innovation and a company's CA (Chiou et al, 2011; Ferraris et al, 2019). Therefore, technological innovation is deemed to be a key factor for a firm's

competitiveness (Walker et al, 2015). It is believed that technological innovation can assists companies with limited resources to attain a CA (El-Haddadeh, 2020).

Organisations also have the opportunity to implement new tools and technologies that can also enhance their environmental performances while also improving their growth potential [89]. However, the link between technological innovation and a firm's sustainable performance is complex and is dependent on a number of factors (Alraja et al, 2022). The empirical findings suggest that technological innovation leads to improved performance and it reduces waste, thus enhancing the sustainability performance of companies (Wang et al, 2021). Hence, prior research has utilised technological innovation to assess a company's environmental performance (Kraus et al, 2020), as well as operational and financial performance (Khan et al, 2022; Wang, 2019). Despite these positive effects that technological innovation can have on a company's CA and environmental performance, there is limited evidence for the relationship between technological innovations and an organisation's green CA. Hence, this study tries to explore this relationship. The natural RBV theory postulates that organisations investing in technological innovation will enjoy sustainable performance and CA (Hart, 1995). With this in mind the following hypothesis is articulated:
H7: Technological innovation is positively related to green CA.

2.2.7 The Mediating role of Technological Innovation

Technological innovation is used as a mediating variable. This study used organisational resources—specifically IoT, green HRM, and IEM—to determine green CA. A few studies have confirmed that IoT significantly enhances green performance (Jermsittiparsert et al, 2020) or innovation performance [24]. However, the relationship between IoT and organisational performance is still unclear (Tang et al, 2018). Nonetheless, green HRM practices are reported to have a significant positive effect on environmental performance (Afum et al, 2021) or attainment of green CA (Muisyo et al, 2021. There is empirical evidence which suggests that green HRM practices do not help environmental performance (Rehman et al, 2021). Consequently, the relationship between green HRM and the attainment of green CA still needs to be further investigated and understood.

Empirical findings report that investments directed towards environmental issues also have a beneficial effect on a company's green performance but other studies suggest that investments towards environmental issues do not necessarily result in enhanced organisational performance

(Rehman et al, 2021). Therefore, the relationship between IoT, green HRM practices, IEM, and green performance is not clearly understood or even agreed upon, and therefore needs further analysis. Organisational capabilities can help us to clarify the association between a firm's environmental resources and its green CA (Hart, 1995). This study uses IoT, green HRM, and IEM as independent variables, while green CA is used as the dependent variable. The relevant hypotheses for this argument follow:

H8: Technological innovation mediates between IoT and green CA.

H9: Technological innovation mediates between green HRM and green CA.

H10: Technological innovation mediates between IEM and green CA.

2.2.8 Green Work Climate Perception (GWCP)

Organisations' green initiatives build what is known as a GWCP, which gives confidence to the employees' green behaviours and actions (Bresciani et al, 2022). GWCP fosters employee engagement in the firm's environmental activities because they are motivated and inspired to take part in the actions taken by their organization (Norton et al, 2015). Therefore, GWCP can be used to shape the employees' views of their organisation's behaviours and the norms associated with green sustainability (Norton et al, 2014). Empirical research suggests that GWCP can promote pro-environmental behaviour, which can guide environmentally-friendly workforce performance [94]. GWCP promotes the development of sustainable resources and it furthers the efforts directed towards lowered emission levels (Khanra et al, 2022). However, GWCP can act as a catalyst but is not crucial to determine a firm's sustainability performance (Rehman et al, 2021). Nonetheless, organisations should not ignore its importance because it can play a vital role in shaping a company's green culture and performance (Kraus et al, 2020). This argument is further supported by empirical findings which report that GWCP strongly affects the employees' green views, norms, and behaviours, which are necessary to promote sustainability (Norton et al, 2014). Additionally, GWCP has a significant moderating role on senior management support of green performance (Bresciani et al, 2022). Consequently, it is necessary for researchers to further investigate and clarify the effects and relationship that GWCP has on a company's green performance and innovation (Kahnraa et al, 2022). Hence, the present study seeks to explore and clarify the extent to which GWCP can influence a company's green CA, and also address the moderating role that GWCP has on technological innovation and a firm's green CA (Arici and Uysal, 2022; Hameed et al, 2022). Therefore, the following hypotheses were developed, while Figure 1 below displays the research model:

H11: GWCP is positively related to green CA.

H12: GWCP significantly moderates between technological innovation and green CA.

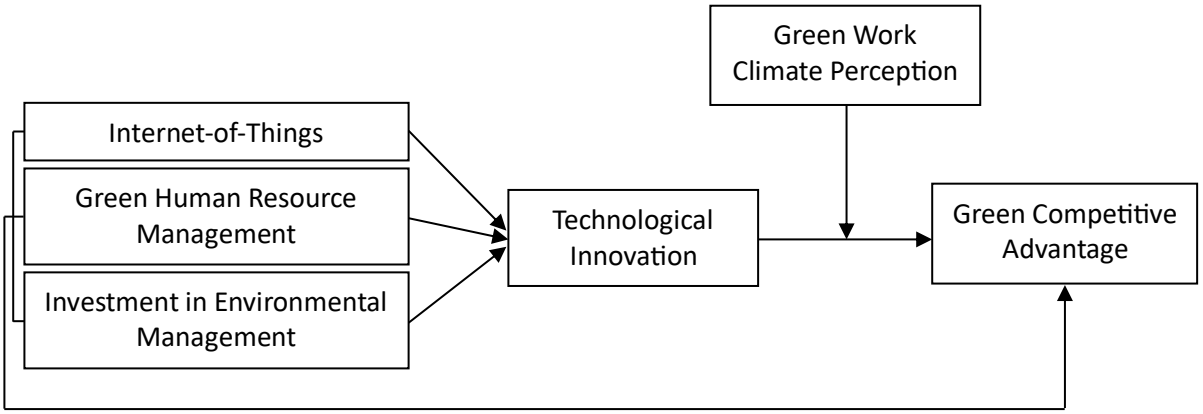


Figure 1 Research Framework

2.3 Methodology

2.3.1 Measures

This study will cover IoT, green HRM, investment in environmental management, technological innovation, green work climate perception, and green competitive advantage. IoT incorporates the five items that were devised by Zelbst et al (2019). Green HRM includes six dimensions with 15 items from Jabbour (2011). Analysis and description of job position consists of three items, recruitment includes two items, training consists of three items, the selection includes two items, performance assessment has three items, and rewards includes two items. Investment in environmental management comprises four items from Pagell et al (2007). Technological innovation contains two dimensions that incorporate seven items from Saleem et al (2020). Product innovation consists of three items while process innovation includes four items. GWCP includes four items from Norton et al (2014). Green competitive advantage includes four items that are based on the work of Chen and Chang (2013).

2.3.2 Population and Sampling

The data was collected from organisations listed by the Lahore Chamber of Commerce & Industry. Table 1 depicts the data information. Lahore is the second largest financial hub of Pakistan (Bresciani et al, 2022). The purposive sampling technique (Akram et al, 2022) is used to collect data from the Textiles, Plastic & PVC, Chemicals, Leather, and Automobile industries. This is a suitable technique to access a particular subset of the population. A pre-test was conducted to ensure construct validity (Rehman et al, 2021) and the questionnaire was checked for coherence, validity, and clarity. A total of six persons were selected for the pre-test: three academic experts and three having industry experience. Feedback from these six persons was used to refine the questionnaire's content. In SmartPLS, the content validity is computed through cross-loadings. In total, 1500 questionnaires were distributed and the data were collected from May 2022 to June 2022. Due to time constraints, some managers did not fill out the questionnaire and only 465 questionnaires were returned. Out of 465 questionnaires returned, 459 were used for the final analysis. A five-point Likert scale is used to measure constructs because prior studies used this scale and they got better results in terms of response rate (Alnaimi et al, 2022; Bresciani et al, 2022; Song et al, 2022).

Table 1 summarises the demographic profile and SPSS software calculated percentages of the constructs. In the sample, there were 451 males (or 98.25%) and only 8 females (or 1.75%). Studies about the manufacturing sector in Pakistan show that few women work in management when compared to men (Bresciani et al, 2022; Rehman et al, 2021). This will not affect the data because females are generally in management positions in Pakistan. Hierarchically, junior managers numbered 81 (or 17.65%), and senior managers amounted to 378 (or 82.35%). From an organisation-type perspective, most firms were textiles, which equates to 211 firms (or 45.97%). Plastic and PVC companies were 75 (or 16.34%), 46 chemical firms (or 10.03%), 45 leather firms (or 9.80%), and 82 automobile firms (or 17.86%). In total, 129 (or 28.10%) of the respondents have a Bachelor's degree, 308 (or 67.10%) have a Master's degree, and only 22 were from the other category. From an organisational strength perspective, the majority of firms had 101 to 500 employees (207 or 45.10%). Meanwhile, 111 firms (or 24.18%) have up to 100 personnel, 109 firms (or 23.75%) have between 501 to 1000 employees, and 32 firms (or 6.97%) have more than 1000 staff.

Table 1 Demographics

Demographics	Frequency	Percentage
Gender		

Male	451	98.25
Female	8	1.75
Hierarchy Level		
Junior Manager	81	17.65
Senior Manager	378	82.35
Organisation Type		
Textiles	211	45.97
Plastic and PVC	75	16.34
Chemical	46	10.03
Leather	45	9.80
Automobile	82	17.86
Education Level		
Bachelor	129	28.10
Masters	308	67.10
Others	22	4.80
Firm Workforce		
Up to 100 workers	111	24.18
101 to 500 workers	207	45.10
501 to 1000 workers	109	23.75
More than 1000 workers	32	6.97

2.3.3 Common Method Bias (CMB)

When data is collected regarding endogenous and exogenous constructs through a questionnaire simultaneously, there is a chance that a CMB issue might occur (Kraus et al, 2020; Rehman et al, 2021). CMB is deemed to be a rigorous issue that is found in self-survey reports (Podsakoff et al, 2003; Rehman et al, 2021). However, few researchers recognise that CMB usually happens in behavioural studies (Bresciani et al, 2022; Sun et al, 2022; Rehman et al, 2022). The influence of CMB can be minimised by following procedural and statistical techniques. Procedurally, researchers can guarantee respondents that their information is safe and cannot leak without their permission (Podsakoff et al, 2003). Moreover, the researchers motivated the respondents to think that the questionnaire is free of errors and its language is easy to follow (Podsakoff et al, 2003). Statistically, this study used two methods for CMB, which are full-collinearity and Herman's single-factor method.

If the full-collinearity is below 3.3, then there is no issue regarding CMB (Kock, 2015). This study also used Herman's single-factor method, and Table 2 shows that a single factor explains 44.778% of total variance, which is less than 50%. Hence, there is no issue with CMB.

Table 2 Common Method Variance

Component	Initial Eigen values			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cum %	Total	% of Variance	Cum %
1	2.687	44.778	44.778	2.687	44.778	44.778
2	1.148	19.128	63.906	1.148	19.128	63.906
3	1.083	16.552	80.458	1.083	16.552	80.458
4	.557	9.285	89.743	.557	9.285	89.743
5	.400	6.673	96.416	.400	6.673	96.416
6	.215	3.584	100.000	.215	3.584	100.000

2.3.4 Model Estimation

The PLS-SEM technique is used because this is appropriate for every framework (Rehman et al, 2021). A total of six reflective constructs are used and only green HRM and technological innovation have dimensions. Table 3 shows that the lower loading is 0.655 and the upper loading is 0.952, which is >0.50 (Hair et al, 2016). Internal consistency is computed through composite reliability (CR) and CR should be at least 0.70 (Chin, 2010; Hair et al, 2016). This study has no issue regarding CR. To compute convergent validity, average variance extracted (AVE) is used and the researchers confirmed that AVE should be at least 0.50 (Hair et al, 2016). This study has no issue regarding AVE. For full-collinearity, this study followed WarpPLS7.0 because SmartPLS cannot measure full-collinearity. Full-collinearity should be below 3.3 (Kock and Lynn, 2012). This study subsequently has no CMB issue. Figure 2 depicts the measurement model in first-order.

Table 3 Convergent Validity

First-Order Variables	Items	Factor Loading	AVE	CR	Full-collinearity
Internet-of-Things	Our firm uses IoT technology to more rapidly bring new green products to market.	0.751	0.509	0.838	2.973

	Our firm uses IoT technology to more dynamically respond to changing product demands.	0.699			
	Our firm uses IoT technology to optimise manufacturing in real-time production and supply chains by networking equipment, sensors, controls, and business systems.	0.767			
	Our firm uses IoT technology to collect far more environmental data from an increasing number of sensors.	0.690			
	Our firm uses IoT technology to monitor, collect, analyse, and instantly act on information automatically.	0.655			
Analysis and Description of Job Position	Enable involvement in managing environmental activities.	0.914	0.848	0.944	3.156
	Enable acquiring knowledge about environmental management.	0.929			
	Demand knowledge about environmental management.	0.919			
Recruitment	The environmental performance of my company attracts new employees.	0.824	0.729	0.843	2.616
	The company prefers to hire employees who have environmental knowledge.	0.883			
Selection	Employee selection takes environmental motivation into account.	0.824	0.721	0.838	1.712
	All selection steps consider environmental questions.	0.874			
Training	Environmental training is continuous.	0.840	0.751	0.900	2.120
	Environmental training is a priority.	0.876			
	Environmental training is an important investment.	0.884			
Reward	Cash rewards are provided to recognise environmental performance.	0.921	0.877	0.935	1.334
	Environmental performance is recognised publicly.	0.952			

Performance Assessment	Every employee has specific environmental goals to achieve.	0.833	0.636	0.839	1.945
	Contributions to environmental management are assessed.	0.792			
	Individual performance assessment results are recorded.	0.765			
Investment in Environmental Management	Investment in workplace health and safety.	0.740	0.630	0.872	2.797
	Investment in recycling of materials.	0.830			
	Investment in training of employees (pollution prevention).	0.842			
	Investment in waste reduction.	0.858			
Product Innovation	The level of newness (novelty) of new products is high compared to our competitors.	0.858	0.674	0.861	3.120
	The use of the latest technological innovations in new product development is high compared to our major competitors.	0.779			
	The speed of new product development is high compared to our major competitors.	0.823			
Process Innovation	The technological competitiveness of our processes is high compared to our major competitors.	0.746	0.691	0.899	3.024
	The up-datedness or novelty of technology used in our processes is high compared to our major competitors.	0.884			
	The speed of adoption of the latest technological innovations in our processes is high compared to our major competitors.	0.850			
	The rate of change in processes, techniques, and technology is high compared to our major competitors.	0.839			

Green Work Climate Perception	Our company is interested in supporting environmental causes.	0.816	0.668	0.858	3.261
	Our company believes it is important to protect the environment.	Delete			
	Our company is concerned with becoming more environmentally friendly.	0.865			
	In our company, employees pay attention to environmental issues.	0.768			
Green Competitive Advantage	The company has the competitive advantage of low cost about environmental management or green innovation compared to its major competitors.	0.719	0.580	0.846	3.268
	The quality of the green products or services that the company offers is better than that of its competitors'.	0.838			
	The company is better at environmental R&D and green innovation than its major competitors.	0.806			
	The company is better at environmental management than its major competitors.	0.671			

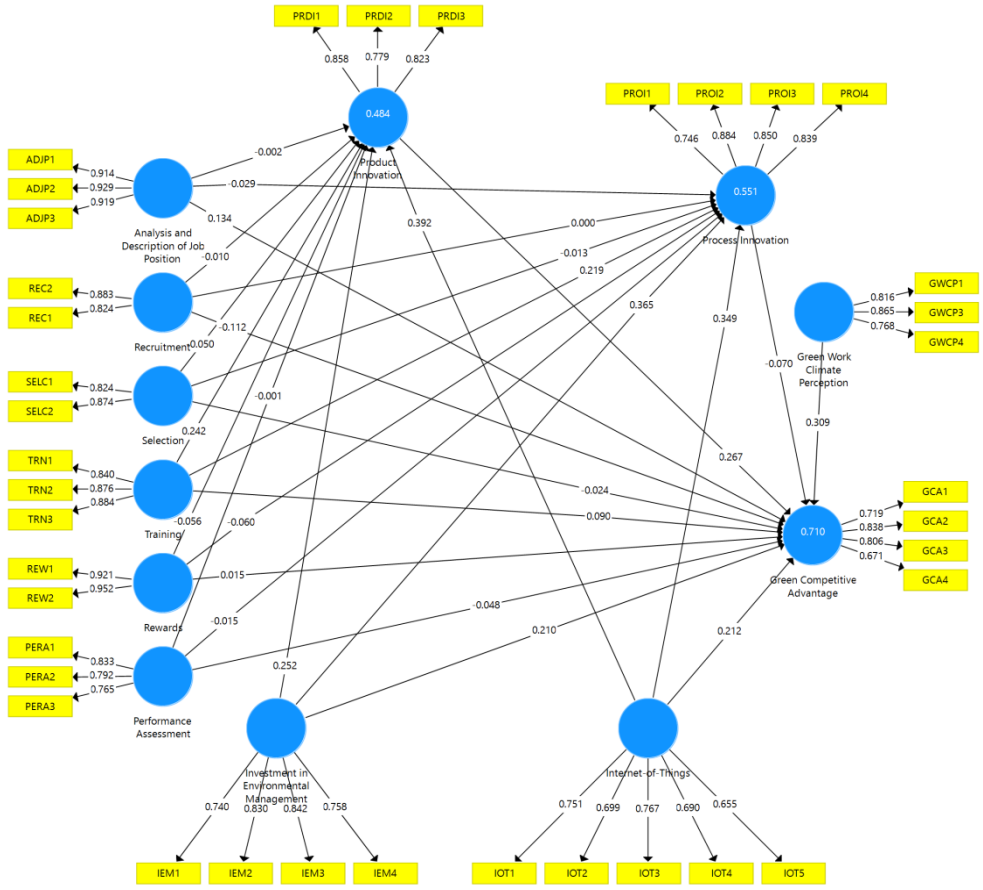


Figure 2: Measurement Model (At first-order)

Table 4 Cross-loadings

Items	ADJP	GCA	GWCP	IEM	IoT	PERA	PRDI	PROI	REC	REW	SELC	TRN
ADJP1	0.914	0.398	0.387	0.335	0.241	0.463	0.254	0.274	0.327	0.320	0.358	0.546
ADJP2	0.929	0.361	0.370	0.364	0.241	0.519	0.282	0.295	0.494	0.436	0.400	0.608
ADJP3	0.919	0.349	0.335	0.349	0.250	0.559	0.280	0.287	0.208	0.493	0.395	0.553
GCA1	0.274	0.719	0.436	0.348	0.238	0.144	0.550	0.481	0.289	0.180	0.111	0.319
GCA2	0.329	0.838	0.685	0.554	0.488	0.192	0.564	0.342	0.354	0.200	0.176	0.425

GCA3	0.271	0.806	0.541	0.492	0.562	0.113	0.525	0.586	0.340	0.154	0.127	0.364
GCA4	0.349	0.671	0.613	0.492	0.407	0.216	0.429	0.315	0.303	0.104	0.115	0.181
GWCP1	0.236	0.560	0.816	0.539	0.397	0.205	0.347	0.380	0.454	0.109	0.221	0.290
GWCP3	0.331	0.691	0.865	0.564	0.483	0.185	0.451	0.303	0.389	0.159	0.188	0.423
GWCP4	0.400	0.577	0.768	0.511	0.403	0.216	0.506	0.461	0.372	0.092	0.132	0.188
IEM1	0.202	0.650	0.429	0.740	0.340	0.087	0.459	0.400	0.223	0.163	0.049	0.250
IEM2	0.233	0.556	0.671	0.830	0.430	0.222	0.387	0.538	0.453	0.152	0.222	0.289
IEM3	0.211	0.500	0.550	0.842	0.242	0.206	0.242	0.455	0.371	0.085	0.191	0.277
IEM4	0.190	0.442	0.344	0.858	0.358	0.166	0.440	0.402	0.276	0.110	0.150	0.234
IOT1	0.407	0.563	0.627	0.479	0.751	0.276	0.546	0.527	0.460	0.140	0.223	0.264
IOT2	0.216	0.443	0.395	0.693	0.699	0.170	0.454	0.416	0.286	0.101	0.132	0.244
IOT3	0.247	0.632	0.472	0.673	0.767	0.089	0.578	0.520	0.278	0.155	0.068	0.287
IOT4	0.226	0.440	0.459	0.444	0.690	0.153	0.390	0.432	0.273	0.168	0.089	0.219
IOT5	0.236	0.441	0.366	0.368	0.655	0.190	0.389	0.361	0.277	0.209	0.139	0.243
PERA1	0.454	0.184	0.206	0.173	0.163	0.833	0.147	0.115	0.281	0.201	0.533	0.234
PERA2	0.409	0.113	0.157	0.128	0.101	0.792	0.098	0.093	0.203	0.205	0.508	0.174

	0.45	0.19		0.24	0.21	0.76	0.16	0.19	0.33	0.41	0.40	0.39
PERA3	3	8	0.208	6	2	5	5	4	2	6	0	0
	0.26	0.63		0.53	0.53	0.13	0.85	0.69	0.31	0.16	0.13	0.38
PRDI1	8	9	0.254	3	3	2	8	2	3	8	5	8
	0.24	0.58		0.53	0.44	0.16	0.77	0.65	0.31	0.08	0.08	0.24
PRDI2	4	7	0.348	2	3	6	9	7	1	2	8	9
	0.24	0.58		0.51	0.50	0.14	0.82	0.64	0.31	0.12	0.12	0.38
PRDI3	9	0	0.365	5	8	8	3	4	2	3	8	3
	0.24	0.58		0.57	0.50	0.16	0.65	0.74	0.37	0.06	0.14	0.31
PROI1	4	2	0.489	0	3	7	2	6	8	2	6	3
	0.22	0.53		0.55	0.62	0.14	0.64	0.88	0.29	0.11	0.15	0.31
PROI2	8	6	0.215	5	5	2	4	4	8	0	7	9
	0.25	0.52		0.53	0.62	0.17	0.62	0.85	0.32	0.14	0.13	0.34
PROI3	1	9	0.178	1	2	0	0	0	4	5	4	9
	0.25	0.61		0.57	0.50	0.12	0.46	0.83	0.30	0.15	0.12	0.38
PROI4	7	2	0.262	5	3	1	7	9	0	3	2	6
REC1	0.76	0.34		0.41	0.25	0.37	0.28	0.27	0.82	0.32	0.29	0.49
	2	9	0.365	7	2	1	8	8	4	9	9	6
REC2	0.46	0.37		0.35	0.44	0.25	0.37	0.36	0.88	0.21	0.26	0.52
	3	4	0.468	3	7	3	4	4	3	7	6	7
	0.38	0.17		0.20	0.14	0.34	0.11	0.12	0.24	0.92	0.16	0.31
REW1	2	0	0.123	1	4	8	6	7	7	1	1	5
	0.45	0.22		0.20	0.16	0.34	0.14	0.15	0.33	0.95	0.18	0.42
REW2	7	1	0.154	1	1	7	7	7	0	2	5	6
	0.37	0.12		0.15	0.18	0.60	0.14	0.11	0.23	0.17	0.82	0.25
SELC1	8	0	0.176	9	0	7	4	9	6	8	4	4
	0.33	0.17		0.15	0.14	0.41	0.14	0.12	0.31	0.14	0.87	0.36
SELC2	5	5	0.196	2	7	6	3	5	6	1	4	2
	0.46	0.33		0.28	0.31	0.30	0.35	0.38	0.48	0.28	0.30	0.84
TRN1	2	2	0.289	2	7	2	8	6	4	7	8	0
	0.55	0.35		0.32	0.28	0.28	0.36	0.31	0.53	0.39	0.31	0.87
TRN2	2	8	0.302	1	4	2	9	3	7	9	6	6

	0.59	0.42		0.31	0.26	0.34	0.34	0.38	0.53	0.35	0.32	0.88
TRN3	0	1	0.381	8	6	8	6	0	5	9	9	4

Heterotrait-monotrait or HTMT is used for discriminant validity (Henseler er al, 2015) because it is more appropriate when loadings have smaller differences. The value of HTMT should be 0.90 for similar LVs and 0.85 for conceptually different constructs. Table 5 shows that the HTMT criterion is fulfilled.

Table 5 HTMT for first-order

Variables	ADJP	GCA	GWCP	IOT	IEM	PERA	PROI	PRDI	REC	REW	SELC	TRN
ADJP												
	0.48											
GCA	6											
	0.47	0.79										
GWCP	7	9										
	0.44	0.73										
IOT	8	4	0.758									
	0.30	0.77		0.75								
IEM	8	3	0.818	1								
	0.67	0.27		0.30	0.26							
PERA	0	8	0.323	7	0							
	0.33	0.85		0.82	0.81							
PROI	6	0	0.721	1	2	0.217						
	0.37	0.76		0.83	0.76		0.80					
PRDI	3	9	0.799	3	4	0.226	9					
	0.74	0.61		0.64	0.57		0.52	0.54				
REC	4	3	0.712	1	1	0.509	9	4				
	0.50	0.25		0.27	0.19		0.16	0.18	0.42			
REW	6	7	0.180	0	2	0.433	3	6	6			
	0.56	0.25		0.26	0.27		0.23	0.20	0.52	0.25		
SELC	0	3	0.323	7	6	0.809	3	9	5	6		

TRN	0.708	0.533	0.462	0.442	0.405	0.423	0.490	0.520	0.824	0.466	0.506

Two second-order constructs (i.e., green HRM and technological innovation) and four first-order constructs (i.e., IoT, IEM, green work climate perception, and green CA) were used. Tables 6 and 7 demonstrate that loadings, CR, AVE, full-collinearity, and discriminant validity criterion are met. Figure 3 portrays the measurement model at second-order.

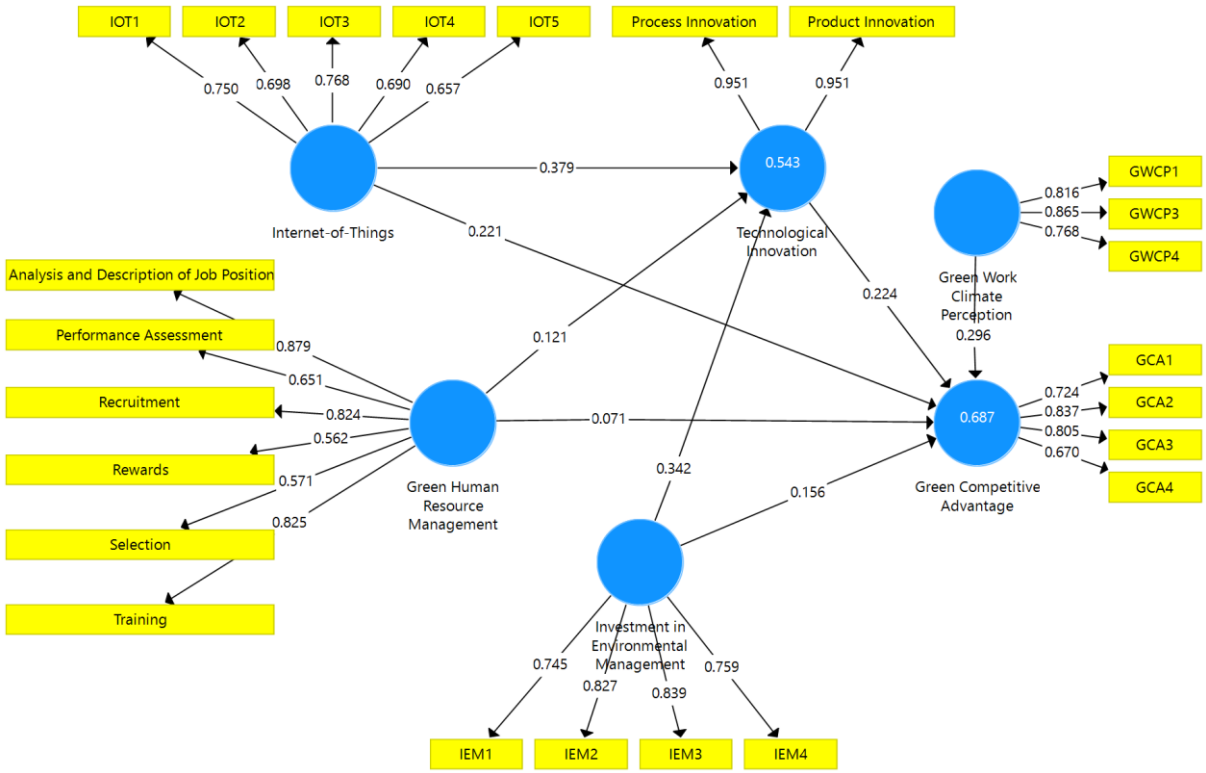


Figure 3: Measurement Model (At Second-order)

Table 6 Convergent Validity (Second-order)

First-Order	Second-Order	Items	Factor Loading	AVE	CR	R2	Full-collinearity
	Green HRM	Analysis and Description of Job Position	0.879	0.533	0.869		1.315
		Recruitment	0.824				
		Selection	0.571				

		Training	0.825				
		Rewards	0.562				
		Performance Assessment	0.651				
Internet-of-Things		IOT1	0.751	0.509	0.838		2.914
		IOT2	0.699				
		IOT3	0.767				
		IOT4	0.690				
		IOT5	0.655				
IEM		IEM1	0.740	0.630	0.872		2.555
		IEM2	0.830				
		IEM3	0.842				
		IEM4	0.858				
	Technological Innovation	Product Innovation	0.951	0.905	0.949	0.543	3.285
		Process Innovation	0.951				
Green Work Climate Perception		GWCP1	0.816	0.668	0.858		3.207
		GWCP3	0.865				
		GWCP4	0.768				
Green Competitive Advantage		GCA1	0.719	0.580	0.846	0.687	3.021
		GCA2	0.838				
		GCA3	0.806				
		GCA4	0.671				

Table 7 HTMT for second-order

Variables	ADJP	GCA	GWCP	IOT	IEM	PERA
Green Competitive Advantage						
Green Human Resource Management	0.536					
Green Work Climate Perception	0.790	0.542				

Internet-of-Things	0.734	0.521	0.758		
Investment in Environmental Management	0.773	0.442	0.818	0.751	
Technological Innovation	0.804	0.442	0.824	0.823	0.785

2.4 Regression Model Test

Figure 4 portrays the structural model. From this figure, it can be seen that IoT significantly increases green CA (beta=0.210 and t=4.974) and technological innovation (beta=0.379 and t=5.234) so H1 and H2 are accepted. Green HRM increases green CA (beta=0.062 and t=2.290) and technological innovation (beta=0.121 and t=3.183), which means that H3 and H4 are supported. Investment in environmental management is positively related to green CA (beta=0.151 and t=4.833) and technological innovation (beta=0.342 and t=5.306), which means that H5 and H6 are viable. Technological innovation increases green CA (beta=0.244 and t=5.551) and H8 is accepted. In addition, technological innovation significantly mediates between IoT (beta=0.093 and t=5.841), green HRM (beta=0.030 and t=2.770), and investment in environmental management (beta=0.084and t=3.349). This means that H8, H9, and H10 are all supported. Green work climate perception increases green CA (beta=0.309 and t=5.088) and leads to the acceptance of H11. Finally, green work climate perception strengthens the relationship between technological innovation and green CA (beta=0.042 and t=2.299), and so H12 is supported. Figure 5 shows that green work climate perception strengthens the relationship between technological innovation and green CA.

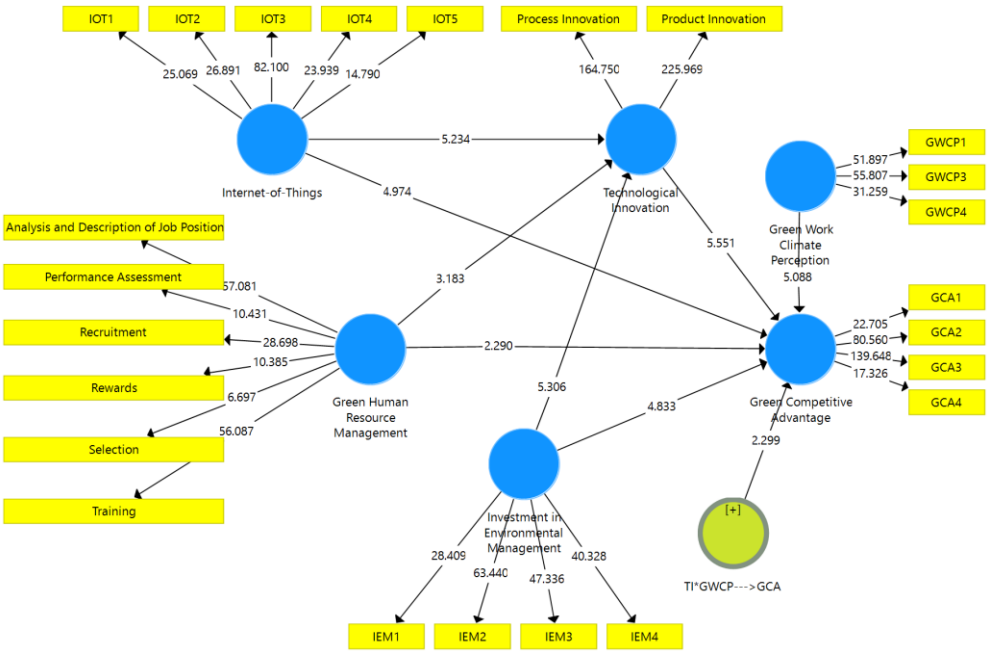


Figure 4 Structural Model

Table 8 Testing for Direct and Indirect Effects

Hypotheses	Paths	Beta-Value	T-values	P-values	BCI LL	BCI UL	f2	Remarks
H1	IoT-->GCA	0.210	4.974	0.002	0.146	0.277	0.055	Yes
H2	IoT-->TI	0.379	5.234	0.001	0.279	0.454	0.127	Yes
H3	GHRM-->GCA	0.062	2.290	0.028	0.008	0.065	0.022	Yes
H4	GHRM-->TI	0.121	3.183	0.015	0.061	0.120	0.026	Yes
H5	IEM-->GCA	0.151	4.833	0.002	0.081	0.147	0.030	Yes
H6	IEM-->TI	0.342	5.306	0.001	0.212	0.383	0.110	Yes
H7	TI-->GCA	0.244	5.551	0.001	0.182	0.265	0.051	Yes
H8	IoT-->TI-->GCA	0.093	5.841	0.001	0.065	0.106	---	Yes
H9	GHRM-->TI-->GCA	0.030	2.770	0.028	0.012	0.037	---	Yes
H10	IEM-->TI-->GCA	0.084	3.349	0.012	0.045	0.095	---	Yes
H11	GWCP-->GCA	0.309	5.088	0.001	0.203	0.382	0.095	Yes
H12	TI*GWCP-->GCA	0.042	2.299	0.027	0.014	0.071	---	Yes

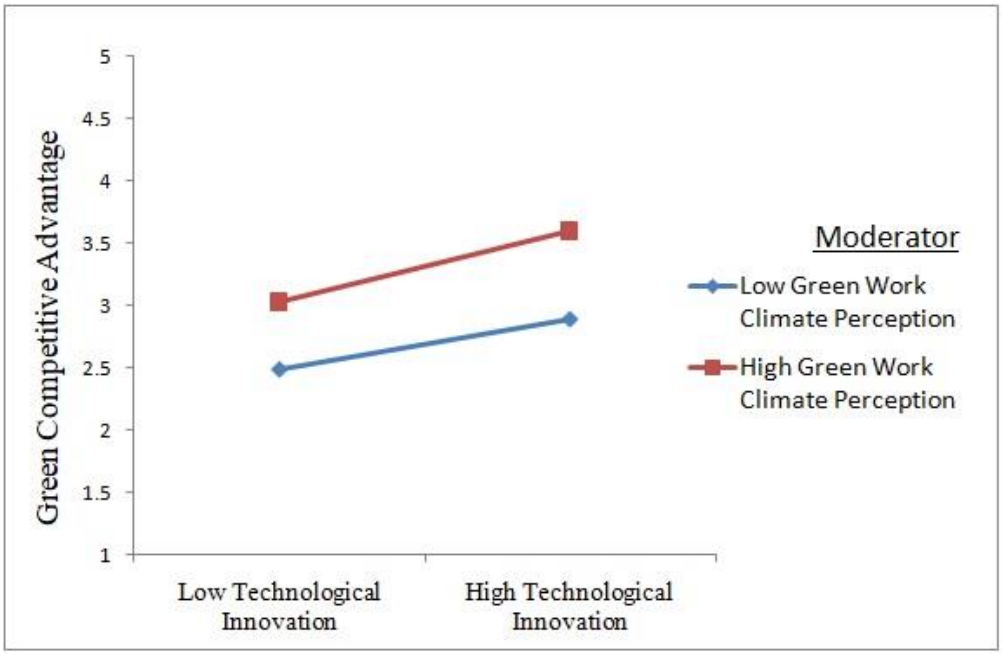


Figure 5 GWCP moderates between technological innovation and green CA

There are three categories of f-square (f2), which are high (f2>=0.35), medium (f2>=0.15), and smaller (f2>=0.02) as proposed by Cohen (1988). Table 8 shows that all the exogenous constructs have a medium effect on endogenous constructs.

Table 9 Predictive relevance of the study model

	SSO	SSE	Q^2 (=1-SSE/SSO)
Green Competitive Advantage	1836	1120.384	0.390
Technological Innovation	918	473.487	0.484

This study used two techniques to assess the predictive relevance of research frameworks (i.e., R2 and Q2). The researchers recognised that R2 should be at least 10% (Falk and Miller, 1992). Table 5 demonstrates that the R2 value of technological innovation is 0.543 and the green CA is 0.687, which is more than 0.10. In SmartPLS, the value of Q2 is calculated to run the blindfolding technique. The Q2 value must be greater than zero, as suggested by Geisser (1974). Table 9 shows that the Q2 value of green CA and technological innovation is more than zero, and so the predictive relevance criterion is fulfilled.

2.5 Discussion

The answers to the hypotheses that were developed in the previous sections follow.

H1 & H2: First, this study finds evidence suggesting that IoT (Tang et al, 2018) has a positive influence on green CA. IoT tools can be utilised to improve a company's green CA. For example, previous studies highlighted similar findings for a positive relationship between IoT and environmental performance in a different geographical context (Xu et al, 2018). Therefore, the current literature seems to suggest that managers should focus their efforts on the correct use of IoT technology because it allows them to enhance their environmental performance, and in this way achieve a twin transition (Xu et al, 2018). IoT can be grouped within the industry 4.0 set of instruments. Our results indicate that investments in IoT have a positive relationship with the technological innovation carried out in an organisation. Other studies have reported findings suggesting that innovation capabilities can be determined through internet usage (Karahoca et al, 2018). Consequently, our findings support the idea presented within the literature that IoT serves as an enabling technology to achieve twin transitions (Ortega-Gras et al, 2021; Pan et al, 2022; Reiman et al, 2021). IoT is reported to be one of the top five technologies—together with robotics, big data, AI, and AM—that are great enablers to achieving twin transitions in comparison to the other technologies (Ortega-Gras et al, 2021). Industry 4.0 and digital transformation processes and tools can lead to the integration of sustainability (Strandhagen et al, 2017) within a company's business model and activities, thus furthering its sustainability (Broccardo et al, 2023). Hence, our obtained results support the importance of digital tools in favouring greener process optimisation, reduce transactional costs [123], supply chain management, and enhance operational optimization (Lardo et al, 2020; Watanabe et al, 2018). The positive effects that technologies may have on a company's environmental performance are not limited to larger technology companies or Western countries because our empirical findings align with previous bodies of work that underline positive effects for beverage companies (Tiscini et al, 2020), car manufacturers (Bohnsack et al, 2014) and other forms of firms (Jocevski, 2020).

Part of the literature concerning industry 4.0 and other digital tools presents empirical evidence that companies pursuing these technologies might increase their environmental impact due to higher energy and resource consumption (Muller and Voigt, 2018). However, this study supports the literature which argues that technologies and digital tools such as IoT create opportunities for firms to improve their sustainability and garner a green CA (Broccardo et al, 2023). Nonetheless, there are

many bodies of work which suggest that the difference in findings might be caused by the phase at which companies are in their digitalisation and innovation process (Cezarno et al, 2021; Lardo et al, 2020; Muller and Voigt, 2018). Thus, future research should investigate the relationship among industry 4.0 tools and sustainability within different micro, macro, and time phases to better comprehend the implications under which twin transition can be achieved.

H3 & H4: Second, there is evidence for the existence of a positive relationship between green HRM and green CA. Other studies reported the existence of a positive relationship between green HRM and sustainable performance, such as Malik et al (2020). Our findings align with previous bodies of work which indicate that green HRM influences employees' green behaviour thus promoting companies' sustainability and workers' engagement with its new practices and environmental goals (Kim et al, 2019). This is also supported by multiple studies which report a positive association between green HRM and companies sustainability performances (Hart, 1995; Hart and Dowell, 2011). Hence, the development and management of human resources internal to companies is essential to companies seeking achieve improved sustainability (Cassells and Lewis, 2017; Singh et al, 2019).

The obtained findings highlight the effects that green HRM can have on the technological innovation of entities, consequently supporting hypothesis four. This result relates to the existing literature. For example, Rehman et al (2021) asserted that green HRM practices can lead to green innovation, especially when associated with product and process innovation. Their study notes that if management seeks to achieve higher levels of technological innovation, then the company's decision-makers can utilise green HRM practices to do this (Hess et al, 2020). Thus, managerial and entrepreneurial activities are crucial to the development of companies, both from an environmental standpoint and from a technological aspect, so as to obtain a twin transition (Anderson, 2012; Husain et al, 2022). Adapting the business to the challenges associated with technology and sustainability is crucial to achieving a competitive advantage (Fitcher and Tiemann, 2018; Hornuf et al, 2021), thus confirming our findings which highlight an improved green CA for companies. Moreover, our findings are consistent with RBV theory because a stronger perception of a company's green behaviours strengthens the relationship between green HRM and employees' creativity, thus fostering innovation and green innovation (Hameed et al, 2022; Pinzone et al, 2019).

H5 & H6: Third, the results indicate that IEM assists companies in achieving higher degrees of green CA. Our results are supported by Bresciani et al (2022). In their study, the authors found that IEM does increase the green performance of manufacturing firms. Therefore, a potential avenue for managers to pursue green CA is to focus on IEM. This statement is further supported by the natural RBV theory, which postulates that environmental practices such as IEM can assist in achieving higher sustainable performance (Hart, 1995). Here, the literature makes it clear that organisational and managerial capabilities, such as making proper IEM, are necessary to achieve twin transitions (Reiman et al, 2021). Another publication that supports the proposed findings is the work of Klassen and Vachon (2003), who state that IEM leads to a higher degree of investment in technological and environmental aspects of the business, which consequently improves product and process innovation. Several researchers have underlined the importance of IEM through leadership, top management commitment, environmental strategy, and organisational culture (Chen et al, 2015; Dubey et al, 2017; Singh et al, 2019) to improve a firm's sustainability. Some publications argue that IEM are essential in fostering firms environmental performance and green CA (Kim et al, 2019). Thus, our study further supports the literature which suggests the linkage between IEM and environmental management and performance (Guerci et al, 2013 Singh et al, 2019). Finally, the utilisation of RBV when exploring this hypothesis allows the researchers to maintain a macro-level view, which allows for an investigation that considers an alignment between IEM and a company's attitudes, aims and practices (Singh et al, 2019).

H7, H8, H9 & H10: Fourth, our results indicate that technological innovation increases green CA so H7 is supported by our empirical results. Similar claims can be identified in the study by El-Haddadeh (2020), in which it is revealed that technological innovation assists in utilising limited resources as best as possible to attain a CA. Our study further expands current understanding by highlighting the need for managers to focus the company's technological innovation on the pursuit of twin transition goals. The natural RBV supports this claim because it indicates that capabilities lead to sustainable CA (Hart, 1995). It is possible to find studies supporting the idea that technological innovation and technological advancement can address the sustainable challenges of today's societies, and environmental and ethical targets such as sustainable development goals (Popkova et al, 2022). Technological innovation significantly mediates between IoT, green HRM, IEM, and green CA, thus supporting H8, H9, and H10. The present study supports the literature which believes that technological advancements and digitalisation supports the sustainability performance of

companies, hence allowing them to achieve twin transitions (Broccardo et al, 2023; Strandhagen et al, 2017). This is possible because digitalisation can affect a firm's business model to shift into sustainable business models (Broccardo et al, 2023). Moreover, technology tools can help companies to reduce their production waste and improve their operations (Lardo et al, 2020).

H11 & H12: Fifth, this study presents evidence to support the idea that GWCP moderates the relationship between technological innovation and green CA. In addition, GWCP increases a company's green CA. Norton et al (2014) document evidence that GWCP can form employees' views of the organisational behavioural norms associated with green sustainability. This creates the possibility for employees to engage in the company's environmental norms and programmes. Finally, different stakeholders' involvement is not only necessary but also desirable to ensure improved performance in achieving twin transitions (Almansour, 2022; Reiman et al, 2021) [12, 144]. Hence, the present study further supports the view that both internal and external stakeholder involvement is desirable when seeking to improve the effects of investments targeted towards sustainability and technological innovation.

2.5.1 Conclusion

The pursuit of twin transitions has received attention because it enables the achievement of technological innovation, while also improving a company's sustainability. Institutions such as the EU have set objectives targeting the pursuit of a green future by using digital technologies. Tools such as IoT, big data analytics, high-capacity broadband, and artificial intelligence are instruments that could be scrutinised and analysed to better understand whether they can help companies and entities achieve a greener future. However, more research is required to understand the relationships that might exist between different technologies and management practices and a company's environmental performance and green CA. There is also a lack of studies investigating and positioning technology such as IoT as a tool of twin transitions, which consequently brings together IoT, technological innovation, and green CA/sustainability. Therefore, the authors of this paper believe that these gaps in our knowledge need immediate attention.

The present study attempted to investigate some visible gaps that may contribute to uncovering more clearly the relationship between technological innovation and green CA. Specifically, this study pursued the following objectives: (a) uncover the existence of a potential positive relationship

between technological innovation and green CA; (b) whether GHRM, IoT, and IEM might play mediating roles or positive relationships with technological innovation/green CA; and (c) whether GWCP is associated with green CA or if it can moderate the relationship between technological innovation and green CA.

This study analysed the quantitative data that were obtained from 459 respondents' answers to questionnaires. To analyse the gathered data, the PLS-SEM technique is deemed to be appropriate to handle similar frameworks (Rehman et al, 2021). Six reflective constructs are utilised. However, green HRM and technological innovation are the only two to have dimensions. When conducting this study, the authors have not identified any issue collated with the CR. Moreover, to compute convergent validity, AVE has been utilised to ensure that it would interfere with the results obtained. A regression model test has been utilised to test the study hypothesis. The authors have obtained the following results: objective (a) a positive relationship exists between technological innovation and a company's green CA; and for objective (c) GWCP does strengthen the relationship between technological innovation and green CA while also improving a company's green CA. Referring to objective (b), the authors have been able to establish the following finding: IoT green HRM does significantly increase green CA and technological innovation, whereas investment in environmental management practices is positively related to technological innovation.

Overall, the findings suggest that while pursuing technological innovation, companies are still capable of improving their green CA, which consequently leads to a twin transition as defined by the EU. While this study offered newer insights into the relationships of technological innovation and green CA in the context of twin transitions, it has confirmed some of previous findings presented in the literature, such as IoT positively affects environmental performance, according to Jermsittiparsert et al (2020). Green HRM capabilities significantly improve sustainable performance within Pakistani entities, according to Malik et al (2020), while IEM has a positive association with green CA in the work by Klassen and Vachon (2003). GWCP forms employees' views of organisations' behavioural norms associated with green sustainability based on research by Norton et al (2014). This study offers tangible theoretical and practical implications, which are discussed in the following sections.

2.5.2 Theoretical Implications

This study makes the following theoretical contributions. First, it answers the calls for more research to deepen the current understanding of twin transitions. This study supports the literature which believes that digitalisation and technology can have a positive impact on a firm's sustainability (Broccardo et al, 2023; Strandhagen et al, 2017). However, there are studies which believe that digitalisation does increase a firm's consumption of energy and resources, thus worsening their sustainability performances (Muller and Voigt, 2018). Thus, based on our obtained finding, this study suggests that research on twin transition can be expanded and used to further investigate and clarify the relationships amongst technology and sustainability within different phases of a firm's implementation.

Second, this study sheds light on how engagement with multiple green techniques and stakeholders can be utilised to promote sustainability and green CA. Our findings indicate that IoT, green HRM, and IEM have a positive relationship with the green CA of companies. Hence, this study suggests that managerial behaviours and a company's strategies research can be expanded to examine how they are now seeking to achieve twin transitions as defined by the EU. Moreover, it highlights the importance for GWCP because it can mediate the positive relationship between technological innovation and sustainability of companies. This study sets the basis for future researchers to examine multiple different contexts and how the promotion of knowledge transfer can lead to the achievement of twin transitions (Ortega-Gras et al, 2021).

Third, this study presents a detailed view of the recent literature on IoT, green HRM, IEM, technological innovation, and GWCP. This study uncovers the limitedness of the findings, lack of studies focused on the twin transitions aspects, lack of geographical variety, and narrowness of the methodological approaches in the investigation of the phenomenon of twin transitions as defined by the EU. This can serve as a basis to guide future studies on this topic. Moreover, this study offers a relevant set of hypotheses that can help future researchers investigate the effect that new technologies have on the sustainability of companies. Finally, this study expands the existing literature on RBV-guided green innovation through digitalisation and other forms of technological resources to achieve a firm's green CA.

2.5.3 Managerial Implications

This study has important managerial implications for supporting twin transitions. First, this study deepens our current understanding of which tools can be utilised by companies to achieve both digitalisation and improved business sustainability (Broccardo et al, 2023). Moreover, it supports the literature stream which argues that technological innovation and sustainability can be achieved through twin transition (Lardo et al, 2020; Watanabe et al, 2018). The empirical findings obtained suggest that the positive effects that technology can have on an organisation's environmental performance and green CA are not limited to Western countries and larger cap technology companies (Jocevski, 2020; Tiscini et al, 2020). Hence, institutional and managerial efforts can be directed towards the promotion and pursuit of technologies such as IoT within multiple contexts and business sectors.

Second, the presented results underline the importance for companies to engage with their employees and green HRM because it is necessary to engage and promote green behaviours within the business context (Kim et al, 2019). The development and management of internal human resources is essential when seeking to achieve sustainability (Cassells and Lewis, 2017; Singh et al, 2019). However, the present study highlights the importance of both internal and external stakeholders when trying to ensure desirable performance and achieve twin transition (Almansour, 2022; Reman et al, 2021) [12, 144] because companies have to engage in GWCP, green HRM and IEM.

2.5.4 Limitations and Future Research

First, the data that were analysed within our study is drawn from companies operating in Pakistan. Therefore, the presented findings are not generalisable to other contexts, such as developed countries. Future studies can gather supplementary evidence from larger corporations or larger capital markets to present more data concerning how the studied relationships influence green CA and a company's technological innovation. Second, a study that focuses on the investigation of the longitudinal effects that IoT, green HRM, IEM, and technological innovation have on green CA should be carried out to further explore how and to what extent the stakeholders' needs might shape the variables investigated, as well as to reveal the moderating role of green work in climate perception.

Furthermore, because the present study has detected positive relationships between technological innovation and green CA, it is recommended that future researchers should focus their efforts on

the exploration of how institutions can foster a company's research and development activities to promote investment in digital tools that enhance the transitions of corporations to a circular economy (Ortega-Gras et al, 2021). Moreover, as far as the authors are concerned, many gaps exist within the technological and knowledge transfer literature. Thus, the authors believe that additional findings in relation to this topic will help us to better understand how to promote the spread of knowledge in relation to the green CA benefits of technologies such as IoT (Ortega-Gras et al, 2021). Future studies could attempt to further investigate the concept of twin transitions by adopting theoretical frameworks such as dynamic capabilities. Furthermore, future research should investigate within one company the different phases of technological innovation and their effects on the sustainability performances of this company in an attempt to better understand the micro, macro, and time implications necessary to achieve twin transition.

Chapter 3

Digital Transformation: Is Covid-19 a catalyst for micro and small enterprises first steps toward innovation?

3.1 Introduction

The current Covid-19 pandemic has dramatically affected many economies all around the world. Multiple different countries have utilised lockdowns to reduce the spread of Covid-19. Those lockdowns are now causing a global recession which is affecting all types of companies (Klein, Todesco, 2021). Despite them playing a major role in several world's economies (Truant et al., 2021), small and micro enterprises are believed to be in a more vulnerable position due to their lack of resources and necessary know-how to endure times of distress such as the current pandemic (Klein, Todesco, 2021). The size of companies has been previously seen as a liability when it comes to the management of external and internal events that threatens the business (Broccardo et al., 2017).

On the other hand, the pandemic has caused changes in customers behaviour, supply chain and markets (Ceylan et al., 2020). The Covid-19 pandemic has highlighted the differences between companies which have embraced digital transformation and those who have not (DT) (Truant et al., 2021; Giannetti et al., 2021). The ability to adapt to an ever-changing competitive scenario is essential to long term survival (Bertei et al., 2015; Del Gobbo, 2013). While multiple definitions of DT exist, the general consensus defines it as the use of information and communication technologies (ICT) to change business processes and models, in order to gain a competitive advantage (Bharadwaj et al., 2013). However, while Covid-19 pandemic has accelerated the adoption of digital technologies (Baig et al., 2020), the current literature on DT adoption fails to address multiple research gaps in relations to its implication for SMEs.

In fact, further research should be conducted to assess the impact Covid-19 has had on the DT of small and micro enterprises operating in different geographical areas to promote the collection of empirical evidence (Li, 2021). In fact, as suggested by Li (2021), the effects of DT differ from country to country and, as such, empirical research is necessary to get a better understanding of this complex phenomenon. Similar sentiments are echoed in several other publications as well (Marcysiak, Pleskacz, 2021; Truant et al., 2021).

Consequently, the goal of this research is to investigate the effect Covid-19 has had on micro and small enterprises by focusing on how the pandemic impacted the very first steps towards their digital transformation journey. Furthermore, the research explores the barriers that are preventing small and micro businesses 'digitalisation. Drawing on Truant et al. (2021), we have identified micro and small companies that can be considered at their earliest possible stage of DT. In other words, we purposefully looked for companies with a limited degree of digitalisation. Therefore, our research strives to find an answer to the following research question:

RQ: How is the Covid-19 pandemic impacting the digital transformation of Italian micro and small companies at the earliest stage of DT?

To achieve our research goal, we adopted an inductive qualitative approach while engaging in purposeful sampling, in-depth interviews and a multi staged coding process. We focused on a selected sample of micro and small enterprises at a very early stage of DT (Truant et al., 2021). Our qualitative approach, grounded in coding techniques and aided with secondary data triangulation, deeply explores the very nature of said barriers, as we shed light on the impact Covid-19 had on DT in small and micro enterprises with a limited degree of digitalisation.

From a theoretical perspective, this research adds insights to the discussion of how the pandemic has impacted the barriers to SMEs implementation of DT. We build upon a literature review which focuses on SMEs' DT and its related concepts such as the barriers to DT and the impact that the Covid-19 pandemic has on SMEs' digitalization. Meanwhile, from a more practical perspective, we gather empirical evidence to investigate the impact Covid-19 has had on the DT journey of a selected sample of micro and small enterprises. Moreover, we identify and present the four main barriers that micro and small enterprises face when starting their DT journey during the pandemic. By doing so, practitioners and policy makers should have a better understanding of the necessary tools which need to be implemented to promote DT within small and medium sized businesses.

The paper is structured as follows. First, we present a review of the available literature on DT, its implications for Covid-19, as well as an overview of the barriers to DT encountered by micro and small companies. Then in section 3, we highlight the methodology applied in our research, with a strong focus on sampling techniques and interviews protocol. Subsequently, section 4 shows the results obtained through the coding process and it illustrates the key quotes gathered from the qualitative interviews. Finally, section 5 discusses the findings in relation to the available literature. The paper culminates with one section devoted to implications, limitations, and avenues for further research.

3.2 Literature review

3.2.1. The Advent of Digital Transformation in small and micro enterprises

The Covid-19 pandemic has forced SMEs, corporations, and public institutions to change the way in which they operate (Paoloni et al., 2021). The different policies utilised by governments all over the globe to respond to the pandemic have impacted the volatility, complexity, and uncertainty of many businesses (Fletcher, Griffiths, 2020). Companies which are digitally mature have been able to quickly adapt, reducing disruptions caused by the Covid-19 pandemic (Jones et al., 2021). However, empirical evidence reveals significant digital adoption gaps when it comes to small businesses (Soto-Acosta, 2020). For instance, many countries are still lagging when it comes to DT in SMEs. In countries like Greece, Hungary, Poland, Portugal and Turkey, the median share of employees with connected computers in small firms remains at or below 40%, while larger firms in frontier countries (Denmark, Finland, Sweden at about 80% or above) have shown substantial progress over the last decade (OECD, 2020). Despite various difficulties, SMEs worldwide have intensified the use of digital technologies in response to the Covid-19 pandemic. Data from PayPal (2020) revealed that 72% of online small business owners interviewed in Canada believed ecommerce to be a necessity. Furthermore, 75% of the United Kingdom SMEs have moved to remote working during the pandemic and, as a result, had invested in digital technologies to run their business remotely (Riom, Valero, 2020).

Organizations fronted the effects of DT well before the Covid-19 pandemic (Chen et al., 2016). In fact, DT has been explored at length over the course of the last two decades (Besson, Rowe, 2012). DT has been described as a complex process which includes a wide range of changes, including changes to business models, organizational culture, work habits, processes, delivery, and customer services, just to name a few (Marchini et al., 2019; Alfiero et al., 2018; Marchi, Paolini, 2018). One of the most comprehensive definitions of DT describes it as "… the profound transformation of business and organizational activities, processes, competencies, and models to fully leverage the changes and opportunities of a mix of digital technologies and their accelerating impact across society in a strategic and prioritized way, with present and future shifts in mind" (Digital Transformation: Online Guide to Digital Transformation, 2021).

DT has significantly increased its scope and relevance under Covid-19 (Gavrila Gavrila, De Lucas Ancillo, 2021). For starters, companies were able to implement remote working on a much broader scale (Wade, Shan, 2020). Consequently, they were able to get in touch with new and existing customers, as well as deliver their own products and services (Guenzi, Nijssen, 2021). In Italy, just as much as in the rest of the globe, the adoption of digital solutions under Covid-19 has increased exponentially (Galindo-Martín et al., 2019). They served as a tool to respond and lessen the effects of potential economic losses resulting from the ongoing crisis (Crupi et al., 2020). Furthermore, it is safe to assume that the digital economy is and will characterize the post-pandemic landscape (Gavrila Gavrila, De Lucas Ancillo, 2021). For instance, SMEs owners will be using digital platforms to sell and promote their products (Min, Kim, 2021). Broadly speaking, SMEs will be venturing into the new landscape powered by DT to expand upon the possibilities that were previously seen as necessities under Covid-19. DT represents a new frontier for business development and growth (Matarazzo et al., 2021).

Amid Covid-19 times, DT is becoming an increasingly popular topic in literature and research. Nonetheless, the implications for SMEs are yet to be fully understood. This is partially due to the multi-faceted nature of DT and the need for domain specific approaches to it. Implementation strategies and empirical research are hard to universalise (Korachi, Bounabat, 2020). On the other hand, the Covid-19 pandemic has inadvertently made DT more relevant within SMEs, as more and more small businesses were forced to implement digital solutions to overcome the limitations of restrictions and regional lockdowns (Hai, 2021).

More specifically, when it comes to small and micro businesses, research is still somewhat scant in terms of DT and its applications. Townsend et al. (2014) has pointed out that micro enterprises could benefit from an online presence. This could lead to an enhanced network, which in return could improve the company's visibility and sales. Moreover, Domazet et al. (2018) believe that DT can be a significant competitive advantage to micro and small businesses. However, several authors have stressed the importance of further research on the topic of DT. Especially when it comes to less explored point of view, such as the one of micro and small businesses (Marcysiak, Pleskacz, 2021; Truant et al., 2021).

3.2.2. Barriers to the Implementation of Digital Transformation in small and micro enterprises

DT has barriers that need to be overcome (Alrawadieh et al., 2020). To make a smooth transition into the digital era, SMEs need a clear understanding of their digital strategy to make sure that every resource at their disposal, whether tangible or intangible, will come together in shaping their digital future (Ellström et al., 2021; Lombardi et al., 2021). A strong digital mindset is required from SMEs owners and management since they must be willing to approach DT with an open mind. Moreover, they must not get discouraged by the complexity of the new tools powered by Internet 2.0 (Eden et al., 2019). "Digital Readiness" is a literature trend which has recently gained traction. It is meant to analyse the level of preparedness of SMEs when faced by the implications of DT (Bican, Brem, 2020). The aforementioned elements, along with the need to adapt the existing business model to a new technological environment, are amid the toughest challenges of small and micro companies, as they approach the digital era. It is up to the enterprise to turn DT into significant competitive advantages, rather than being hindered by its complexity (Galindo-Martín et al., 2019). Governments from all around the world are taking unprecedented steps to promote DT and make sure that SMEs are getting ready to tackle the challenges arising from the digital age (Fleischer, Carstens, 2021), especially amid Covid-19 times (Klein, Todesco, 2021).

Barriers to DT prevent the adoption of digital technologies and can present themselves in a variety of ways (Tijan et al., 2021). Firstly, a lack of awareness on how digital transformation affects the organization might lead to insufficient investments in SMEs' technological infrastructures (Ullah et al., 2021). Furthermore, organisational barriers include a lack of management trust in innovation and DT adoption (Broccardo et al., 2019; Santoro et al, 2016). Previous research has investigated how events such as the global financial crisis affect small companies' barriers to innovation (Ausloos et al., 2017; Bartolacci et al., 2016). Although, DT research has mainly focused on large sized companies (Olanipekun et al., 2021). Nonetheless, DT barriers do also apply to small and micro enterprises. Their limited size and resources often exacerbate DT barriers (Ramírez-Durán et al., 2021). In addition, empirical studies seem to suggest that limited degrees of digital maturity, which are commonly found in small and micro enterprises compared to larger ones (Truant et al., 2021), intensify the barriers to DT adoption (Masood et al., 2020; Ramírez-Durán et al., 2021).

Furthermore, Marcysiak, Pleskacz (2021) have pointed out that micro enterprises suffer from chronic lack of human resources, which consequently leads to poor performance in terms of financing, planning, control, training, and the adaptation of their information systems. The micro and small perspective has received limited attention throughout the years (Domazet et al., 2018), despite them being a massive portion of today's economy (ISTAT, 2020). Therefore, several research gaps remain.

More specifically, further research should focus on the importance of digital maturity when it comes to the barriers to DT adoption during Covid-19 (Truant et al., 2021). Fletcher, Griffiths (2020) work suggests how Covid-19 has made DT obligatory for businesses of all sizes and sectors. However, empirical studies on small and micro businesses with a limited degrees of digital maturity are limited, as most of the academic discourse has been developed around digitally mature SMEs (Domazet et al., 2018; Jones et al., 2021).

3.3. Methodology

3.3.1. Background and Research Design

The researchers adopted the Truant et al. (2021) definition of degree of digitalisation. Therefore, the authors purposely looked for SMEs at the earliest stage of DT, which can be defined as the "unknown phase", since they are at the very beginning of their DT process and are not aware of what DT is and which benefits it could bring to the company. Drawing on this theoretical framework was meaningful as it allowed us to find common traits within our sample of micro and small enterprises. The theoretical framework allowed the researchers to determine which companies could or could not be considered at an early stage of DT.

We adopted an inductive multiple case study approach and engaged in purposeful sampling to select information-rich cases that met these criteria (Gerring, 2007). Purposeful sampling has allowed us to gather empirical data on a specific set of SMEs with the same level of digital readiness, while excluding those at a very advanced stage of DT. The researchers were able to investigate and highlight the existing barriers of DT that are holding back those SMEs. To answer our research question, we adopted a qualitative interpretive methodology (Cunningham et al. 2016). Ù

3.3.2. Research Sample

The research focuses on micro and small companies at a very early stage of their DT journey. Additionally, the selected businesses are struggling to overcome the barriers associated with the implementation of technology. The sampled enterprises operate within different sectors from one

another. To find our sample, we focused on Piedmont, Italy, whose economy is dominated by SMEs (Fasano, Deloof, 2021; Ferraris et al., 2017). We focus our attention on small and micro enterprises (ISTAT 2020). Using data from the companies' websites alongside the AIDA Italian company information and business intelligence database, we were able to identify businesses that could fit in the micro and small definition provided by the European standards. More specifically, our inclusion criteria evaluated companies' size and yearly profits. In other words, companies had to feature less than 50 employees and a turnover of less than 10 million euros. Furthermore, we have performed several checks on their level of digital maturity to filter out those at an advanced level of DT implementation. More specifically, we made use of our theoretical framework to identify companies at the earliest degree of digital maturity possible (Truant et al., 2021): enterprises had a very barebone website or no website at all, nor an e-commerce website; they did not have an actively maintained social media presence and they did not use IT tools in their daily business activities, such as computers or tablets. We verified this aspect both externally, by monitoring and reviewing their internet presence, and internally, by asking specific questions during the screening phase which will be further discussed in the following paragraphs. In addition to the aforementioned criteria, companies had to have experimented with DT as a response to the pandemic. In other words, we were interested in companies that were forced to step foot into DT due to the pandemic, either by setting up a website they never had before, by switching to smart working in some capacity due to lockdowns, or by intensifying their social media presence to make up for the lack of physical visitors, and much more (Catturi, 2021).

The above-mentioned sampling approach helped us identify 117 potential SMEs that could take part in our investigation. Out of the initial 117 potential SMEs, only 29 of them showed interest in taking part to the research. We then approached those 29 companies in an attempt to garner a more in-depth understanding of them. During this phase, we gained access to more information, which allowed us to apply a further level of screening. Additionally, the researchers were able to filter out those companies that did not fit the specified criteria, even thought, at first glance, they looked as if they belonged to an early stage of DT and had intensified their efforts in response to the pandemic. Ultimately, we were left with 11 cases available for close examination.

3.3.3. Data Analysis

Every company in our final sample fell within either the micro or the small category. Overall, the sample was deemed representative of Italian's landscape, as roughly 80% of Italian enterprises are considered micro (9 or less employees) and, out of the remaining enterprises, 18% are to be considered small by the standards set by the European commission (ISTAT, 2020). We began by contacting and interviewing these ventures' entrepreneurial team members. Interviews were held in-person. The researchers aim is to detect common factors that might highlight the different nature of DT barriers (Palinkas et al., 2013), and to enable heterogeneity between cases, we applied maximum variation sampling. Maximum variation sampling, also known as heterogeneous sampling, has allowed us to set up a varied sample (Creswell et al., 2006). To accomplish this goal, we iteratively added cases by monitoring several characteristics of companies, including overall size in terms of revenues and employees, the sector they operate in, and the age and gender of the owner.

Researchers tried to create a heterogeneous sample while still maintaining the aforementioned inclusion criteria. The iterative process ended when researchers deemed theoretical saturation had been reached (Creswell et al., 2006). In other words, based on the data that had been collected and analysed hitherto, further data collection and analysis was deemed unnecessary (Saunders, 2017).

The interviews were conducted with the following protocol. When possible, we have interviewed employees as well as owners, in an attempt to gather as much information as possible. Interviews were carried from July 2021 to October 2021. Most interviewees were spoken to multiple times, for a grand total of 49 interviews, off a sample size of 21 unique individuals. The interviews were conducted one-on-one by a researcher and lasted from fifteen minutes to sixty, for an average of twenty-five minutes per interview. Interviews were semi-structured with open ended questions, as we delved deeper into the concepts of DT, barriers to digitalisation, the struggles of Covid-19 and the post pandemic road to recovery. Table 1 displays the sample in detail.

To facilitate qualitative data analysis and the coding process, the interviews were fully transcribed (Miles et al. 2014). The transcripts were analysed in a multi-step iterative process, involving both interviewers and co-authors who were not engaged in conducting interviews. The coding process operated as an interplay between theoretical preconceptions influencing the analysis and inductive reasoning influencing conceptual development (Markusen 2003; Miles et al. 2014). To optimise validity via critical verification techniques (Morse et al. 2008), the coders cross-checked and enriched each other's interpretation of the data. More specifically, qualitative data collected through in-depth semi structured interviews was analysed through the guidance of the Gioia method (Gioia et al., 2012). The approach relies on researchers settling on a well-specified research question, which in

our case consisted in determining the pandemic's impact on smaller companies at an early stage of DT.

Table 1 - Sample characteristics

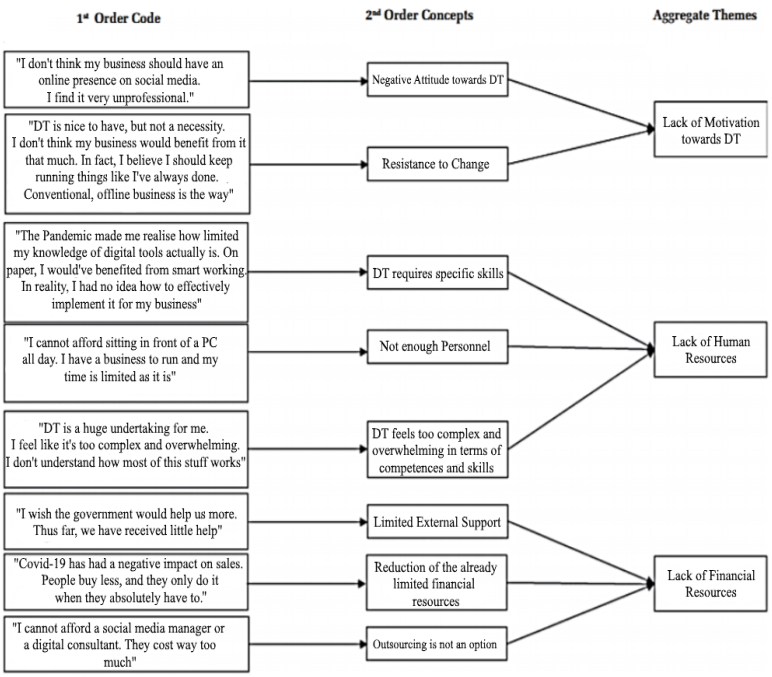
Coding Reference	Business Sector	Personnel Interviewed	Company Size	Age Group	Gender
#01a, #01b	Manufacturing	Owner, Accountant	Small	48–63, 26-47	F, M
#02a, #02b	Food, Beverage	Owner, Assistant	Micro	48–63, 26-47	M, F
#03a, #03b	Manufacturing	Owner, Accountant	Small	26-47, 26-47	M, M
#04a, #04b, #04c	Manufacturing	Owner, Accountant, Assistant	Small	26-47, 26-47, 18-25	F, F, F
#05	Food, Beverage	Owner	Micro	26-47	M
#06	Food, Beverage	Owner	Small	26-47	M
#07a, #07b	Manufacturing	Owner, Assistant	Micro	26-47, 18-25	F, F
#08a, #08b	Manufacturing	Owner, Accountant	Small	26-47, 26-47	F, M

#09a, #09b, #09c	Manufacturing	Owner, Accountant, Assistant	Small	48–63, 48–63, 18-25	F, F, F
#10a, #10b	Manufacturing	Owner	Micro	48–63, 26-47	M
#11	Service Provider	Owner	Micro	26-47	M

The Gioia approach relies on interview protocols and informant quotes as a means to make sense of the data being collected, on the basis of similarities and differences between the categories. The first round of coding, also known as the open coding phase, was conducted by going back and forth between the empirical observations and grouping together codes deemed similar by the researchers. We then moved to a more abstract level of coding, also referred to as axial coding, in an attempt to conceptualize the codes found in the first phase and group them in several themes. This phase, which resulted in the second-order concepts, saw the authors discuss and review their understanding of the codes several times over, until an unanimous consensus was reached. Throughout the analysis, the authors iterated back and forth between data and the relevant literature to see whether the findings had precedents and how the emergent themes aligned with or diverged from previous work. More specifically, authors made use of DT literature to make sense and group the codes into distinct categories, while cross-referencing the results with previous works mentioning the role played by the pandemic when it comes to DT (Truant et al., 2021; Fletcher, Griffiths, 2020). This work ultimately led to the final round of coding, which consisted of the theorization of three distinct themes, also known as aggregate themes. Figure 1 features the data structure obtained from coding, while Table 2 features representative quotes from the sample (Gioia et al., 2012).

Figure 1 - Data structure (Gioia et al., 2012)

FIGURE 1
Data Structure



Source: Authors own elaboration

Table 2 - Representative Quotations

Negative Attitude towards DT	"I believe social media presence to be unprofessional and childish. It is not meant for companies and businesses. I do not understand what the fuzz is about" (#09a) "I dislike how everything is hyper connected these days. I do not want my business to turn into some sort of Amazon, in which customers coldly buy products with no human elements involved in the transaction whatsoever" (#01a)
Resistance to Change	"My business has survived several financial crises. I would say I will stick with my conventional way of doing business, rather than following trends" (#02a)

	"I am proud of the way I do business. I want to be able to travel to my customers, show them my product and talk to them. I do not want to do all of that through a computer, pandemic or not" (#08a)
DT Requires Specific Skills	"Covid-19 made me realize I am simply obsolete when it comes to digital skills. I see everyone around me use computers like it is nothing. Meanwhile, I'm struggling for even the most basic things" (#02a) "DT for a manufacturing company is not that straightforward. We are talking about automation, robots, and advanced IT systems. Sounds great on paper, but who's going to take care of it? Not me, for sure. I know nothing about any of that" (#04c)
Not enough Personnel	"I am understaffed, to put it bluntly. I already work long hours as it is. The pandemic made things even worse in a way, as I am forced to keep an eye out on several safety standards that weren't there before. I do not have the time to worry about anything else" (#09b)
DT feels too complex	"When I think of DT, I feel overwhelmed. It is not just a matter of competencies. As a process, it requires a huge commitment to it, along with long term vision and planning, both things we don't possess in the slightest" (#06) "I feel like DT is more than just opening and managing a website, or a social media page. People around me do not always get it, but DT is going to affect every single aspect of a company, not just the online presence. As such, it is far from being an easy task to achieve" (#05)

Limited external support	"I wish we had more support from the government throughout the pandemic. I got 600 euros a month from them, yet I had to completely shut down production. Do you believe it was enough to break even?" (#10a) "I have heard there are incentives, but the procedure is far too convoluted for me to consider it a viable option. By the time I get the funds, the pandemic will be over for sure. I guarantee you that." (#04c)
Reduction of financial resources	"We were already barely scraping by. Covid-19 hit us hard and hurt the already limited resources we had. I genuinely cannot even consider the option of investing in anything, right now." (#01a) "I feel like I have been stuck in a financial crisis since the dawn of time. Covid-19 did not help either. All I can think of is my day-to-day survival." (#02b)
Outsourcing is not an option	"I have asked for someone to make me a new fancy website. I felt like it could help draw new customers in. The prices, however, were simply absurd and I had to decline" (#02a) "Hiring external help is simply not a viable option. They cost too much, and we cannot afford it" (#10a)

3.4. Findings

In the interviews, SMEs owners and managers discussed at length the barriers they have collided against when trying to digitise their company, amid Covid-19. Based on the analysis of the interviews, secondary data and the extensive, iterative, and multi-step process of coding, several sub themes emerged concerning the impact of Covid-19 in terms of the exacerbation of barriers towards DT for smaller enterprises. The themes will be discussed in the following sections.

3.4.1. Lack of motivation and positive attitude towards Digital Transformation

SMEs owners see DT as a “nice to have”, rather than something essential. This includes social media presence, which comes off as unnecessary or even unprofessional by some. “Having a Facebook page is silly. This is a business company. I’m not an influencer, nor a Youtuber” (#09a), when asked on why his company had no social media presence whatsoever. “Our customers are always the same and we go way back with most of them.” (#01b) That was the reply when we pointed out that social media along with company websites are actively being used by SMEs all over the world to get in touch with new potential customers. “I know how Facebook works. But I don’t think anyone would ever reach out for us through Facebook. I think it’s not very professional for both parties (#03a)”. Younger interviewees displayed a more positive attitude towards social media; however, they are still not quite convinced when it comes to its actual effectiveness. “Every company has a social media page nowadays; I see them all the time. But I don’t think we would get a lot of traffic from it. The way I see it, it’s not worth the hustle.” (#04c).

Some owners reject DT out of a mixture of spite towards the new generation of entrepreneurs and pride in the old ways of going about it. “Call me old fashioned, but a website will never be a viable option to me. Face to face conversation is mandatory. I cannot see myself ever selling a product on the Internet to an anonymous buyer. I want them to come here where I manufacture my goods, I want to know specifically what they want so that I can manufacture my products to meet my clients’ demands. This is something that I’m sure some will appreciate” (#08a). This type of cultural barrier turns the tables on the concept of DT itself. Instead of DT being “out of reach” due to internal limitations, entrepreneurs willingly reject it and reclaim the traditional way of handling business as their adopted approach.

3.4.2. Not enough human resources to handle Digital Transformation

The second theme arising from our investigation is the lack of Human Resources needed to handle the digital side of the businesses. The interviewed SMEs showed signs of understaffing.

Consequently, businesses could not devote a single individual to the management of a company's website nor social media presence.

"It's just me in the office. I work almost 10 hours a day and 5 on Saturdays. Where can I find the time to sit there and learn how a CRM works? That stuff takes time. Time that I personally don't have." (#02a). This sentiment is echoed in most of the contributions we have collected. Small and micro companies featured in our sample felt overwhelmed when it came to DT, as the whole ordeal felt too complex to handle properly.

In addition to the lack of time, small businesses owners claim there's a severe lack of competences needed to fully implement DT in their everyday business processes. "Making use of IT tools is not simple. Personally, I wouldn't be able to manage an online marketing campaign through social media. I'd have no idea where to start" (#04c). Lack of Human Resources is not to be intended purely in terms of employees and time spent educating themselves on DT. Instead, as mentioned several times in DT literature, digital technologies require specific skill sets to get the most out of them, which is something not many small businesses have, nor have the possibility to get access to.

3.4.3. Lack of Financial Resources

The lack of financial resources from an economic perspective is a significant barrier which emerged from our qualitative research. An interviewee said "I don't have enough money for that. We are already in massive debt and barely scraping by. I can't see myself spending even more money on websites, social media promotion and IT infrastructure (#04b)". Furthermore, another owner claimed her company barely allowed her to get a salary for herself and her two collaborators. "Every single bit of money I invest in technology is something I put out of my own pocket, pretty much. I simply cannot afford it. And it's not like I'm living a fancy lifestyle either. More often than not, I earn less than my collaborators because I try to pay them first and only if there's enough money for them, I get my own check" (#06). The contributions from the rest of the sample were more or less along the same lines. DT is seen as something expensive and complex, while most of the interviewed small and micro companies struggle to simply keep their business afloat and, for that reason, can't see themselves spending more money on it.

When confronted with the option of outsourcing their online presence to third parties professionals, participants showed a negative sentiment. "I barely have the money to pay my employees. And I

consider myself lucky. In fact, most of my competitors had to shut down during Covid-19 pandemic. We survived somehow, but the money is a problem just like it was a problem prior to this whole pandemic" (#10a). While the company's website features somewhat accessible price points, outsourcing DT doesn't appear to be a viable option overall due to limitations in economic resources. This point of view ties with previous dimension, as small business owners featured in our sample claim they are not able to afford external support on digital knowledge due to their limited financial resources.

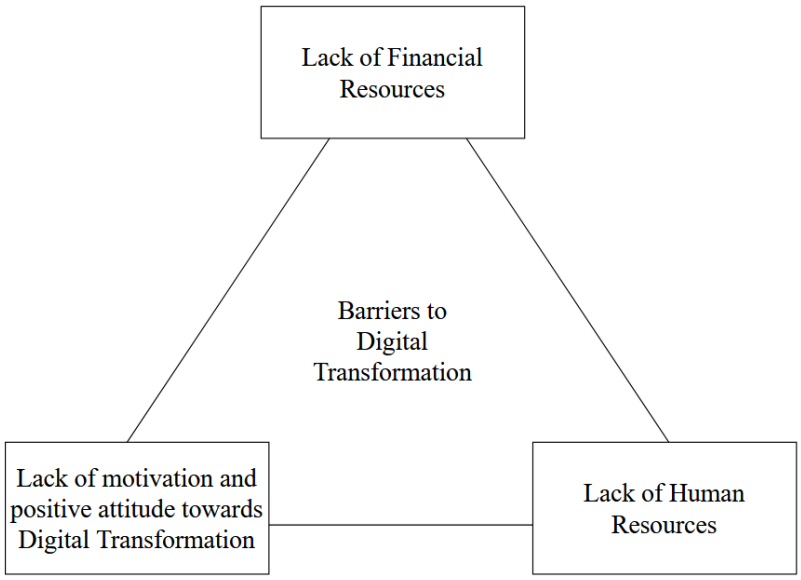
3.5. Discussion

The obtained empirical findings partially contradict the perception of Covid-19 being an accelerator of the DT process of micro and small companies (Gavrila Gavrila, De Lucas Ancillo, 2021). In fact, previous literature has generally referred to the impact of Covid-19 on DT as a driver of innovation (Subramaniam et al., 2021). DT must be evaluated on a case-by-case basis due to the uniqueness of companies (Kurniawati et al., 2021): what is true and relevant for digitally ready SMEs, may not apply to companies with a significantly smaller degree of digitalization (Truant et al., 2021). The gathered data shows how the pandemic has sharpened the effects of DT barriers, rather than breaking them down (Klein, Todesco, 2021). SMEs all over the world were forced to make use of digital technologies in response to the Covid-19 pandemic (Crupi et al., 2020). However, this study shows how the implementation of DT comes with specific challenges in terms of resources and knowledge. It is worth noting that in some cases, the pandemic has motivated SMEs to get around the DT obstacles to stay functional (Masood et al., 2020; Ramírez-Durán et al., 2021). However, the vast majority of the research sample suggests a different narrative. Those who saw Covid-19 as an opportunity to experiment with DT and discover new business horizons, generally showed a pre-existing digital friendly attitude towards innovation, as well as a strong awareness of the benefits brought by DT (Eden et al., 2019; Ellström et al., 2021). However, our sample sheds some light on a set of micro and small companies who still choose to run their business conventionally, regardless of the contextual factors brought out by the pandemic. The presented findings are in line with the study conducted by Kurniawati et al. (2021), who highlight the difficulties faced by less digitalised SMEs when trying to adapt to the disruptive changes brought by DT and the pandemic. Contrary to previous research which indicates the pandemic as a driver of DT (Subramaniam et al, 2021), we suggest that the Covid-

19 pandemic does not positively impact the DT of micro and small enterprises operating in the early stages of their digital journey. Figure 2 displays the identified barriers for small and micro businesses amid Covid-19.

The empirical evidence obtained within this research indicates how micro and small enterprises at an early stage of their DT journey (Truant et al., 2021), face multiple obstacles when approaching the DT of their businesses. Multiple entrepreneurs have indicated how the high costs and delayed return on investment (ROI) of implementing DT projects prevent them from adopting and executing digital technologies within their processes (Klein and Todesco, 2021; Kutnjak, 2021). The pandemic did not reduce the already existing need for knowledge constructs for DT (Kutnjak, 2021). The digital tools readily available to SMEs, such as social media and websites, often lack functionalities (Klein, Todesco, 2021) and are frequently perceived as redundant, unneeded, and irrelevant to SMEs success and/or survival. Due to the lack of knowledge and time, micro and small businesses' entrepreneurs often perceive digital media as additional adversities rather than new opportunities despite the potential benefits that these instruments carry (Pelletier, Cloutier, 2019). Ultimately, no evidence which indicates Covid-19 as a driving force of DT for micro and small enterprises who are at an early stage of digitalisation has been found.

Figure 2 - Barriers to Digital Transformation for small and micro businesses amid Covid-19



In their work on entrepreneurial stagnation, Brush et al. (2009) mention that while no manager ever willingly decides to stop growing, factors such as management, marketing and financial aid actively affect stagnation. DT literature agrees that in times of stagnating productivity and increasing competitive pressure, the digitization of value creation serves to achieve lasting competitive advantages (Dallasega et al., 2018). Our study synthesizes both statements by illustrating how a significant lack in financial and human resources, as well as an overall negative attitude towards digital change, leads to a state of digital stagnation, in which small and micro businesses can't keep up with their industry (Jones et al., 2021) and, instead, decide to run their companies conventionally with little to no regards towards long-term planning (Kurniawati et al., 2021).

As far as the age variable goes, the researchers have compared the gathered results to the ones previously discussed in the DT literature. Song et al. (2021) found that the Covid-19 pandemic accelerates the pace of digital technology utilisation but exacerbates the age-related digital divide. In our sample, we found older generations of entrepreneurs to be the ones showing a higher degree of resistance to change, despite the forced circumstances. In terms of gender divide, our empirical evidence does not highlight a significant correlation between gender identity and DT adoption (Grönlund, Öun, 2018; Rajahonka, Villman, 2019).

3.6. Conclusions

Even before the pandemic and the different lockdowns, DT has been imposing some challenges which are specific to SMEs (Klein, Todesco, 2021). Financial resources required to implement sophisticated IT systems often limit SMEs' ability to approach those technologies since it requires a conceived model with a satisfactory degree of fit resulting into a higher consumption of resources (Gianetti et al., 2021). The pandemic did not improve companies' financial stability. Consequently, the obtained data shows how the DT adoption has not increased in companies in which DT literacy was missing. Together with the lack of financial resources, micro and small enterprises often lack the necessary knowledge to implement DT. Some of the entrepreneurs that we have interviewed have shown a negative attitude towards the use of digital tools such as social media and websites (Metushi, Fradeani, 2018). Furthermore, the obtained empirical findings highlight how micro and small enterprises often lack the necessary personnel to correctly implement DT. The necessary knowledge required is often costly. Finally, the lack of time that can be invested into the process of

DT often affects smaller businesses, as they struggle to both handle technology themselves and ask for external help from professionals.

The research provides readers with both theoretical and practical implications. From a theoretical perspective, our research bridges a gap in the DT literature by analysing the other side of the DT spectrum and drawing theoretical conclusions on the reasons why it is not implemented in some micro and small enterprises. The study, which is exploratory in nature, draws from empirical data a theoretical perspective on DT barriers. Our investigation expands upon our understanding of the barriers and challenges to DT which need to be continuously investigated due to the unique setting in which SMEs operate (Kutnjak, 2021). More specifically, it allows multiple stakeholders to garner a deeper understanding on how the Covid-19 pandemic has affected SMEs' relationship with DT. Additionally, our study answers the call for future research posed by the theoretical framework of Truant et al. (2021), by shedding light on the effects of Covid-19 in terms of digital adoption, which was yet to be fully explored.

From a practical perspective, the research speaks to owners, managers, practitioners, experts, and policy makers to inform them as to what is happening within small and micro businesses. Therefore, the aforementioned stakeholders can allocate the right resources and tools necessary to foster the creation of context specific structures, elements and culture which promote DT. Furthermore, the research also strives to provide practical and empirical evidence to highlight a less known aspect of DT, which relates to companies who are not able to gain its benefits by implementing it. In this regard, the implications for policy makers are several, as they could consider addressing these barriers to DT to bridge the gap between small companies with limited degrees of digitalization and those with an already well-established DT. This can be done through both educational and financial initiatives, aimed at educating and providing companies with the necessary resources, knowledge, and tools to correctly implement DT. Moreover, micro and small enterprises' management have a better understanding of the steps required so to firstly approach DT. Additionally, the paper informs readers of the need to adapt the company and owners' culture before approaching DT. Hence, our research on DT barriers further explores said issue and provides insight to better understand the analysed context.

Our study comes with limitations related to its research design, sampling procedure and context. Firstly, the research is limited by the sample pool utilised to gather data, which restrains the generalisability of the findings. While our sample is representative of a significant portion of Italian micro and small enterprises (ISTAT, 2020), we expect the results to be fairly different within

enterprises with a higher degree of digital readiness. For example, the results obtained by Chamochumbi et al. (2021) suggests how Covid-19 can indeed act as a catalyst of DT in small companies with significant degree of digital readiness.

The study is also limited to the use of a qualitative interpretive methodology which prioritize the participants' experiences without quantifying the impact of every business choice. During said interviews we sought to gather qualitative data which would help us understand how the Covid-19 pandemic has impacted the DT within small and micro enterprises, as well as discuss how their barriers to the adoption of DT have changed during the pandemic. Consequently, the adopted approach has its own limitations.

Further research around these topics is needed to provide additional empirical evidence. Future works should consider the dynamics between digitally friendly attitudes of owners and managers of micro, small and medium sized businesses. Moreover, additional research with a larger research sample is required to garner quantitative data aimed at assessing the correlation between the Covid-19 pandemic and DT adoption rate.

Chapter 4

Food and Beverage SMEs Engagement with External Stakeholders: Partnerships as tool to foster ambitions and overcome constraints

4.1. Introduction

Today's dynamic business environment greatly challenges companies, especially small and medium enterprises (SMEs) due to their limited resources (Adomako and Ahsan, 2022). Dynamic markets force companies to remain open and pursue constant change and innovation to remain profitable (Pantano et al, 2020). SMEs resource constraints negatively impact their ability to pursue new actions, activities and obtain adequate resources which are deemed necessary to ensure businesses long-term profitability (Adomako and Ahsan, 2022). Despite their smallness and limited financial and human resources, SMEs are essential to the global economic growth and employment (Dabić et al, 2020). SMEs represent 99% of the EU's businesses (European Commission, 2022). Therefore, due to their central role, governments and ruling bodies create policies aimed at reducing the fiscal and administrative pressure put onto those institutions (Zahoor et al, 2021). However, the above-mentioned entities often fail to address the challenges associated with SMEs constraints, as well as marketplace opportunities (De Marco et al, 2020). Hence, SMEs must tackle their resources constraints and liability of smallness differently to address the challenges associated with today's dynamic business setting. Consequently, those organizations may seek alliances and partnerships with external stakeholders (Albats et al, 2020; Civera et al, 2018) in an attempt to access resources and knowledge that enables them to handle today's marketplace (Zahoor et al, 2020). A helpful tool that can be utilized by SMEs seeking to engage with external stakeholders are digital platforms (Cenamor et al, 2019; Cenamor et al, 2017; Constantinides et al, 2018). This is because empirical evidence indicates their usefulness in dealing with dynamic markets (Cenamor et al, 2019; Chan et al, 2019). This is because digital platforms allow companies to strengthen their competitive advantage and reach a greater pool of potential clients through foreign markets (Parker et al, 2016). Furtehrmore, SMEs may seek to gain access to the foregoing online tools in an attempt to establish positive relationships with external stakeholders and partially offset their resources and knowledge constraints (Cenamor et al, 2019; Cenamor et al, 2017; Constantinides et al, 2018). However, digital platforms require specific resources and knowledge to develop or implement (Giotopoulos et al,

2017); resources which are limited within most SMEs. Therefore, the need to engage in partnership and other forms of collaborative activities remains central to SMEs seeking to offset their smallness and resource and knowledge constraints.

By engaging and partnering with external stakeholders, SMEs can obtain the necessary resources and knowledge to strengthen their competitive advantage (Liu, 2021). This is possible when mutual trust, commitment and business understanding exists amongst the various stakeholders involved within a partnership (Lahiri and Kedia, 2009; Liu, 2021; Ku et al, 2016). High quality cooperative activities amongst firms can enhance their members' competitiveness as well as ensure cooperative continuity and additional support from stakeholders (Liu, 2021). Moreover, SMEs' partnerships can result in lower transaction costs and knowledge exchange while also enabling coordination amongst partners' complimentary activities thus enhancing the firms' ability to respond to customer needs (Dyer and Singh, 1998; Gardet and Mothe, 2012; Liu et al, 2013; Liu, 2021). Previous research present insights which concern collective efficiency and international market knowledge obtained by SMEs through cooperative activities (Stoian et al, 2017). Collective efficiency has been investigated to better understand how network engagement affects the ability of SMEs to absorb and exploit partners' knowledge (Ferreras-Méndez et al, 2019).

Finally, the limitations normally associated with SMEs often hinder their ability to exploit foreign markets thus challenging their internationalization (Hilmersson and Johanson, 2016). Therefore, SMEs often engage in partnerships and other forms of collaborative activities to improve their odds when internationalizing (Karami and Tang, 2019; Yata and Hurd, 2021; Zhang et al, 2016). Accessing foreign markets is crucial for SMEs seeking to strengthen their competitive advantage since it normally enables organizations to reap the following benefits: reduced costs through greater economies of scale, increased revenue streams and the acquisition of resources outside the domestic market (Ling-yee and Ogunmokun, 2001; Sadeghi et al, 2018; Wilson, 2006).

However, despite the relevancy that stakeholder engagement has within SMEs context, multiple research gaps remain. First, additional empirical studies should investigate the effects that stakeholder engagement has on firms' collaborative activities with external stakeholders (Pantano et al, 2020). Second, additional scholars' attention is required to further explore the effects that alliances and partnerships have on international diversification (Felzensztein et al, 2015; Zahoor et al, 2020) since there is scant evidence which suggests that collaborating with stakeholders, even creating alliances and partnerships, can play a crucial role in helping SMEs access foreign markets

(Love and Roper, 2015); thus, nurturing their competitiveness (Hessels and Parker, 2013; Zhou et al, 2007). Furthermore, empirical evidence suggests that digital platforms facilitate the interaction between stakeholders (Constantinides et al, 2018). Nonetheless, additional empirical research should focus on whether digital platforms enable firms' renovation and enhancement of performance by engaging with stakeholders and networks (Cenamor et al, 2019; Teece, 2018). Previously published articles have focused their efforts on the investigation and implementation of digital technologies within larger companies (Cenamor et al, 2019). Thus, there is a need for additional research which focuses on the collection of insights obtained from SMEs usage of digital platforms to enhance their stakeholder engagement, as well as strengthen their ability to access foreign markets (Mohd Salleh et al, 2017). Finally, Hennart (2020) underlines that alliances and partnerships amongst SMEs are unique and cannot be compared with larger multinational cooperative activities since they do not benefit from it in the same way larger firms do (Fassin et al, 2017; Hennart, 2020; Valentinov, 2022). Consequently, there is a need for additional research concerning SMEs cooperative activities such as alliances and partnerships (Sakhdari et al, 2020). Moreover, there is little research that focuses on SMEs that operate in non-high-tech organizations (Loureiro et al, 2020). Thus, the utilised context and sample aims to provide empirical findings to address the aforementioned theoretical and contextual gaps.

This study draws insights from the stakeholder engagement theory since it is the most appropriate theoretical lens. Therefore, the following research questions have been formulated:

RQ1: How does cooperating with external stakeholders on a digital platform help SMEs become more competitive?

RQ2: How does interacting with external stakeholders on a digital platform affect SMEs' ability to access foreign markets?

To answer these questions, data from 9 SMEs operating within the Italian food and beverage industry were collected. We conducted a qualitative study which relies on semi structured interviews conducted with multiple actors of the various firms involved within a partnership developed between a SME operating as an online digital sales platform and multiple SMEs operating within the production of food and beverages consumables. The gathered data has been utilized to further our

current understanding of the effects that partnerships amongst SMEs can have when it comes to their performance and their ability to access new markets.

Particular attention was given to the food and beverage SMEs within the Italian context for the following reasons. First, the Italian context is predominantly composed of SMEs (Perrini, 2006). Second, food and beverage SMEs are central to the Italian growth (Coldiretti, 2021). Moreover, by sampling SMEs operating within the food and beverage sector we hope to address the above mentioned gap which underlines the necessity to gather empirical findings from non-high-tech sectors (Loureiro et al, 2020).

Broadly speaking, the empirical findings presented within this study support the idea that stakeholder engagement plays a key role in supporting SMEs overcome their resources and knowledge constraints (Pantano et al, 2020). Thus, this study underlines the importance that stakeholder engagement has on the competitiveness of SMEs (Liu, 2021; Parker et al, 2016). Moreover, the present study sheds light on the benefits that digital platforms have when it comes down to SMEs ability to form positive relationships with external stakeholders, as well as obtain the necessary tools and knowledge to access foreign markets (Liu, 2021).

The present study contributes to the existing literature in several ways. First, it extends the current understanding of SMEs' partnerships. SMEs can engage in the foregoing collaborative activity to establish relationships with external stakeholders; hence, gain access to resources and knowledge necessary to overcome SMEs' constraints (Giotopoulos et al, 2017; Liu, 2021) and positively enhance firms' competitiveness (Emami et al, 2022). Second, this research underlines the importance of collaborative activities amongst businesses operating within the same industry sector to exploit potential synergies (Parker et al, 2016). Moreover, partnering with digital platforms allows SMEs to engage with additional external stakeholders. Finally, the paper further develops the stakeholder engagement literature by presenting evidence which suggests that cooperative efforts with stakeholders through a digital platform positively affect firms' competitive advantage, as well as their ability to expand in foreign markets.

The paper is structured as follows. Firstly, Section 2 contains a literature review, as well as the relevant theoretical developments. Secondly, Section 3 details the methodological approach and considerations. Within Section 4 the authors have presented the obtained findings obtained from

the gathered data. Section 5 contains the study's discussion. Finally, conclusion, contributions and recommendations for future studies conclude the paper with Section 6.

4.2. Theoretical background

4.2.1 Stakeholder engagement

The stakeholder engagement is formed by two essential terms that exist within the management literature: stakeholder and engagement (Kujala et al, 2022; Loureiro et al, 2020). First, the stakeholder theory provides fertile ground for the rise of the concept of stakeholder (Freeman, 1984). According to the stakeholder theory, firms' primary objective is to create value for their stakeholders (Frow and Payne, 2011). Second, engagement stems from previous empirical work investigating cooperative processes, service exchanges and interactions (Kujala et al, 2022; Kumar and Pansari, 2016; Mollen and WIlson, 2010). A lack of consensus exists within the current literature concerning the conceptualisation of engagement and its various dimensions (Loureiro et al, 2020). Nonetheless, two recurring principles exists (Loureiro et al, 2020). These two principles of engagement tie in with two assumptions pertaining to the stakeholder theory: the need for companies to recognise joint interests with its stakeholders and the rejection of a purely economic approach to firms' standpoint (Freeman, 2010). Organisations need to understand and recognise that stakeholders' interest can align with the firm's own interest thus providing fertile ground for collaborative activities between the two (Freeman, 2010). In fact, studies indicated that to achieve economic success, companies must cooperate with stakeholders and engage in long term relationships with them (Freeman, 2010). Therefore, stakeholder engagement theory promotes the mutual commitment of the company and its stakeholders in creating value and building positive relationships (Loureiro et al, 2020).

The construct of stakeholder engagement can be divided into the following three components. Firstly, the literature identifies the moral component of stakeholder engagement which entails recognition and respect, stakeholder empowerment and achieving good through reciprocal and voluntary relationships (Ghodsvali et al, 2019; Kujala et al, 2022; Todeschini et al, 2020). Oftentimes, the moral component is underlying within the stakeholder concept since it is believed to be an indicator of the understanding of business actions as morals actions (Kujala et al, 2022). Secondly,

stakeholder engagement entails the strategic component (Kujala et al, 2022). The above mentioned component focuses on the stakeholders' willingness to partake in cooperative activities to generate business value (Kujala et al, 2022). Typically, to achieve greater business value, stakeholders can engage with organisations through resource contribution in an attempt to improve their financial performance and competitive advantage (Gupta et al, 2020; Kujala et al, 2022). Finally, the third component of stakeholder engagement relates to pragmatism. This component concerns action and problem solving thus underlining the practical consequences of the actions aimed at promoting stakeholders' wealth (Freeman, 1994; Freeman et al, 2017; Kujala et al, 2022). Furthermore, the pragmatic component of stakeholder engagement highlights how stakeholder engagement acts in the natural and social environment thus underlining the activities that should be undertaken within specific contexts (Kujala et al, 2022; Sandberg and Tsoukas, 2011).

Most authors utilising the stakeholder engagement theory mainly focus on the moral dimension of it since it is necessary to identify the behaviours and actions that lead to morally positive stakeholder engagement (Kujala et al, 2022). According to the literature, morally positive stakeholder engagement behaviours and actions are firms' attentiveness to stakeholders' needs, capabilities and necessities (Todeschini et al, 2020), stakeholder empowerment (Ghodsvali et al, 2019) and stakeholder recognition which leads to respectful behaviours (Miska er al, 2014). Nonetheless, part of the literature argues that the strategic and pragmatic stakeholder engagement concepts are necessary since the theory originates from the strategic management (Freeman, 1984). Thus, businesses willingness to partake in value creation activities and strategies must be addressed with the strategic dimension of the stakeholder engagement theory (Kujala et al, 2022). Furthermore, the pragmatic concept is deemed necessary by some since it is an appropriate dimension to understand how stakeholders acts in social and natural environments; hence, examining which business activities are necessary within specific contexts (Sandberg and Tsoukas, 2011). The pragmatic dimension supports researchers seeking to address the problem-solving practices in which companies engage with within specific circumstances (Freeman, 1984).

Almost half of the literature utilizes a definition of stakeholder engagement which encompasses all three dimensions of the foregoing theory (Kujala et al, 2022). This is believed to provide a theoretical lens which permits researchers to investigate different aspects of stakeholder engagement practices, behaviors, ethical challenges and contexts (Mitchell et al, 2022). Therefore, considering the aim and

scope of this study, as well as the aforementioned considerations, the authors of the paper deemed relevant all three components of stakeholder engagement; hence, Kujala et al (2022) definition was adopted within the present study: "Stakeholder engagement refers to the aims, activities, and impacts of stakeholder relations in a moral, strategic, and/or pragmatic manner." (Kujala et al, 2022:1139). Moreover, the authors utilised Kujala's et al (2022) definition which contains all three dimensions of stakeholder engagement because it broadens previous definitions and constructs that have put too much emphasis on the business itself; thus, the adopted interpretation allow the authors to centre their efforts in the investigation of stakeholder engagement as a broader and more encompassing construct (Kujala et al, 2022).

Despite the growing interest of academic research to the stakeholder engagement (Kujala et al, 2022; Valentinov, 2022) most of the published studies focus on customers as key stakeholders (Pantano et al, 2020). Therefore, in an attempt to address this gap (Kujala et al, 2022; Pantano et al, 2020) our empirical research investigates the role of external stakeholders through the lens of the partnership which will be explained later in the article (see section 3.1). This is particularly relevant from both a theoretical and practical point of view since the engagement and involvement of stakeholders often plays a key role within SMEs' strategic management and performance (Freeman, 1984; Scuotto et al, 2020). In fact, there is empirical evidence which highlights that stakeholder engagement can positively support a firm's value creation (Audretsch et al, 2023a; Audretsch et al, 2023b; Gamble et al, 2021; Jones et al, 2018), improve their profitability and operational capabilities (Scuotto et al, 2020), as well as organizational knowledge (Katsoulakos and Katsoulacos, 2007). The stakeholder engagement approach becomes particularly relevant to SMEs seeking to develop or integrate new processes or products (Chesbrough, 2006). Therefore, SMEs can engage with stakeholders in an attempt to broaden their reach, overcome their limitations and access external stakeholders' resource and knowledge in an attempt to obtain the above mentioned benefits (Scuotto et al, 2020).

4.2.2 Stakeholder engagement practices to overcome smallness and resource constraints

Market uncertainty forces companies to pursue constant change and innovation to maintain business profitability and improve performance (Pantano et al, 2020). Nonetheless, SMEs' smallness and resource constraints limits their capabilities to conduct activities aimed at expanding and

innovating their business strategy and processes (Pantano et al, 2020). This is especially true within the food and beverage sector in which SMEs often lack the necessary resources to evolve and improve their competitiveness and profitability (Capitanio et al, 2010). Furthermore, SMEs' limited resources and knowledge negatively impact their ability to reach and expand beyond national boundaries (Hilmersson and Johanson, 2016). Accessing additional markets is essential for smaller companies because it allows them to diversify their revenue streams, strengthen their competitive advantage, gain access to resources that might not be available within their local market and benefit from economies of scale and scope (Ling-yee and Ogunmokun, 2001; Sadeghi et al, 2018; Wilson, 2006).

Nonetheless, gaining additional knowledge and resources is especially challenging for SMEs since their limited human and financial capital, as well as time constraints, negatively impact their ability to monitor and identify the essential information and resources necessary to thrive within the environment in which they operate in (Grama-Vigouroux et al, 2020). Consequently, companies can engage in cooperating activities with stakeholders to overcome the above mentioned resource and knowledge constraints (Pantano et al, 2020). Thus, the foregoing constraints must be addressed to improve SMEs competitiveness and stability, which, as previously discussed, is essential to the growth, innovativeness and employment rate of many contexts (e.g., European Union) (Paul et al, 2017). However, institutions and entities often fail to successfully address the constraints and limitations discussed (De Marco et al, 2020). Therefore, it becomes essential for those smaller enterprises to create positive relationships with stakeholders in an attempt to attain access to external knowledge and resources (Grama-Vigouroux et al, 2020).

SMEs should be able to somewhat lessen their constraints through the adoption of mutual working relationships with multiple stakeholders (Chesbrough and Schwartz, 2007). Collaborative efforts with external stakeholders grant firms with external resources that they could not procure nor obtain themselves, as well as the necessary tools to develop solutions to pressing issues (Schneider and Sachs, 2017).

Engaging with external stakeholders is important since it holds the potential to establish relationships aimed at fostering innovation strategies and development processes (Ommen et al, 2016; Pantano et al, 2020). The constitution of positive and ongoing relationships with relevant stakeholders can positively influence companies' financial returns and improve their competitive advantage (Kumar and Pansari, 2016; Verbeke and Tung, 2013). In fact, stakeholder engagement is

regarded as essential for SMEs seeking to access additional resources and knowledge (Liu, 2021). Nonetheless, additional scholars' attention is required to further explore the effects that alliances and partnerships have on SMEs' ability to achieve international diversification, as well as improve SMEs' financial and operational performance (Zahoor et al, 2020). Furthermore, empirical evidence should be directed towards the investigation of the effects that partnerships have on SMEs' competitiveness (Hessels and Parker, 2013). This is of relevance since today's economy is considered to be a relational economy in which links between organizations and stakeholders need to be understood and explored in an attempt to better comprehend the importance and potential impact that cooperative and collaborative relationships have (Freeman et al, 2017; Kujala et al, 2022).

There are tools available to SMEs which are deemed relevant for companies seeking to establish various forms of collaborative relationships with external stakeholders (Constantinides et al, 2018). Empirical evidence underlines the role digital platforms have on firms' engagement with external stakeholders (Cenamor et al, 2019; Cenamor et al, 2017; Constantinides et al, 2018). In fact, studies show that stakeholder engagement and co-creation activities and processes take place increasingly in digital environments (Loureiro et al, 2020; Prisco et al, 2022; Ruzante et al, 2022); hence, SMEs online stakeholder engagement can help nurture their external stakeholder engagement (Ruzante et al, 2022), as well as their innovation capabilities and accelerate their growth (Coviello et al, 2012; Loureiro et al, 2020; Roberts et al, 2014). Moreover, digital platforms might prove useful to SMEs seeking to engage with external stakeholders to overcome their liability of smallness and resources constraints (Constantinides et al, 2018). Furthermore, SMEs might seek to develop or gain access to digital platforms in an attempt to remain competitive through a dynamic and open approach to the business (Cenamor et al, 2019). Hence, digital platforms might prove extremely useful to SMEs seeking to engage with external stakeholders so to offset their resources and knowledge constraints (Cenamor et al, 2019; Cenamor et al, 2017; Constantinides et al, 2018) as well as remain dynamic to address today's market challenges and attempt to improve their competitiveness and customer diversification by expanding into foreign markets (Parker et al, 2016).

Nonetheless, developing and managing digital platforms requires technical knowledge and resources that might not be accessible to most SMEs (Giotopoulos et al, 2017) operating within a traditional sector such as the food sector. Therefore, smaller entities might seek to engage with external stakeholders to gain access to the foregoing digital tools. Nevertheless, additional research should focus its attention on the exploration of the effects that digital platforms have on firms'

competitiveness and stakeholder engagement of SMEs (Cenamor et al, 2019; Teece, 2018). This is because previously published article utilise samples composed of larger firms (Cenamor et al, 2019). Due to the unique nature and conditions under which SMEs operate previously published empirical findings cannot be applied and generalized to SMEs context (Hennart, 2020).

4.3. Research Design

The authors conducted a qualitative study of 9 Italian small and medium sized enterprises within the contexts of a partnership fostered and promoted by a local online digital sales platform.

4.3.1 Empirical Setting

The paper focuses on the investigation of a partnership which is composed of SMEs operating within the Piedmont region, Italy. The selected context is deemed of relevance because of SMEs central role within the EU, as well as the Italian economy (European Commission, 2022; Ministero delle Imprese e del Made in Italy, 2021). The partnership is composed of SMEs working within the food and beverage sector and one digital online retail platform (ITsGOOD). SMEs operating within the food and beverage sector generate a large portion of the Italian GDP (Coldiretti, 2021); hence, the foregoing information further delineates the relevancy of the selected empirical setting. ITsGOOD is the firm that encouraged and lead to the creation of a partnership whose aim is to promote local businesses and produce. The authors selected this specific context since it represents a partnership whose aim is to promote the growth of local businesses and contexts. This is deemed of relevance since the sustainable development goals (SDGs) emphasize the necessity to ensure local growth and the development of local communities, as well as to reduce the migration towards larger urban areas (United Nations, 2022).

Since its creation in 2016, ITsGOOD has established positive relationships with multiple local businesses. By cooperating with ITsGOOD, the SMEs involved would obtain access to ITsGOOD's online retail platform, product distribution service, inventory management, as well as their knowledge on online sales and other digital tools at favourable conditions. On the other hand, ITsGOOD would enlarge its catalogue of products available on its online platform while also promoting the territory and its locally produced foods and beverages.

Over the years a larger number of producers has joined the partnership with the online sale platform thus enlarging its network and portfolio. However, the mutual participation of SMEs that shared similar core values such as territorial focus, quality and sustainability, promotion of the local communities and traditions etc. have built relationships amongst themselves. The online platform acts as a catalyst for the formation of a partnership which includes all firms participating within the platform's network and suppliers. They were able to promote an environment in which all parties involved felt as key players of the project through continuous meetings and events at their offices. In doing so, they were able to connect owners and managers of the food and beverage SMEs. This is beneficial to all parties involved since the online platform needs local SMEs to ensure their offering to its clients. Whereas local SMEs need the platform to thrive and grow since it grants them access to new markets and customers that they could not reach before with their limited resources. Additionally, the platform collaborates with SMEs operating within the food and beverage sector if the following core values are met: focus on local traditions and processes while also pursuing innovation, sustainability and improvement of the local territory and communities, high quality standards, integrity and "piemontesità" ("Piemontesità" can be defined as a commitment to the region in which the companies operate in an attempt to promote and foster regional traditions, culture, as well as the economic growth and attractiveness of the Piedmont region.) which highlights the importance of the connection between SMEs and their local communities, territories and local ingredients. Thus, the aforementioned common values and directions to the management of businesses has also further enabled the creation of a partnership amongst the various SMEs involved with the online platform.

4.3.2 Data Collection

Data collection was carried out from January 2022 to mid-August 2022. The authors of the paper considered SMEs that are a part of the collaborative system developed between the online digital sales platform and the various firms foraging its benefits. The researchers opted for a qualitative approach since it would allow them to explore inputs provided by the various actors of the multiple SMEs involved in the collaboration with the digital online sale platform. The data were collected through in-depth interviews with owners, founders, controllers, and other key personnel of the various SMEs involved in the collaboration. The interviews were conducted in person and recorded.

All nine enterprises involved in the collaboration have participated in the empirical study. The following Table 1 shows the role and number of people from each enterprise.

Company	**Company's Size**	**People Interviewed**	**Type of Products**
#01	Medium	Founder Owner Controller Production Manager	Food and Beverage
#02	Medium	Owner Controller Production Technician	Food and Beverage
#03	Small	Owner	Food and Beverage
#04	Small	Owner Plant Manager	Beverage
#05	Small	Owner	Food and Beverage
#06	Medium	Owner Manager	Food
#07	Small	Owner	Food
#08	Medium	Owner Production Planner	Food and Beverage
#09	Medium	Owner Production Planner and Controller	Food and Beverage

Table 1 Sample Composition

4.3.3 Data Analysis

Firstly, the researchers have identified the types of input shared by the owners, managers and employees of the firms under investigation. A review of the literature on stakeholder engagement and collaborations amongst small and medium sized enterprises was utilised as a starting point so that the intelligence obtained could serve to confirm or disconfirm the gathered narratives and experiences. Furthermore, the authors focused their efforts on the identification of novel insights emerging from the collected data as an attempt to extend the existing literature by broadening our understanding of the relationships between SMEs collaborations and the stakeholders engagement theory. Thus, the analysis of interviews led to the codification and categorization of all emerging aspects associated with SMEs collaborations and the dynamics of stakeholder engagement. One author of the article analysed the interview transcripts through manual coding. Therefore, the open code obtained was divided and categorised into relevant concepts (Glaser & Strauss, 1967). The different categories obtained are utilised to represent the contributions associated with SMEs collaborations activities. The remaining authors focused their efforts to interpret the theoretical contributions associated with the key emerging dimensions and their links to the stakeholder engagement theory (Gioia, Corley & Hamilton, 2013). The authors identified categories of inputs shared by the interviewee. The following Table 2 presents the identified categories and their associated types of inputs.

Categories	**Definition**	**Examples**
Relationship Cultivation	Activities aimed at creating positive connections with stakeholders	Connections with local stakeholders, business to business promotion, support systems and so on.
Peer Engagement	Activities aimed at utilising jointly the company and others stakeholders' assets, knowledge or attractiveness	Exploit others' image to promote their business, product development, online branding and so on.
Financial Capabilities	Activities aimed at accessing and generating revenue streams	Additional revenue streams, gaining access to instruments that could

		improve profit margins and so on.
Operational Performance	Activities aimed at reducing companies' operational costs	Reduce operational costs, reduce expenditures related to projects and so on.
Competitive Advantage	Activities aimed at producing higher sales and higher profit margins compared to other industry players	Increased purchasing power through shared purchases, additional distribution channel, higher margins and so on.
Ecological Wellbeing	Activities aimed at reducing the environmental impact and CO2 emissions	Reduce fossil fuel consumption, lower pollutants produced by their machinery and products and so on.
Social Sustainability	Activities aimed at improving the wellbeing of employees and local communities	Higher salaries, improved contractual conditions, better appliances available to staff and so on.

Table 2 Categories definition

Thereafter, the researchers combined the previously identified categories into the general categories as shown in Figure 1.

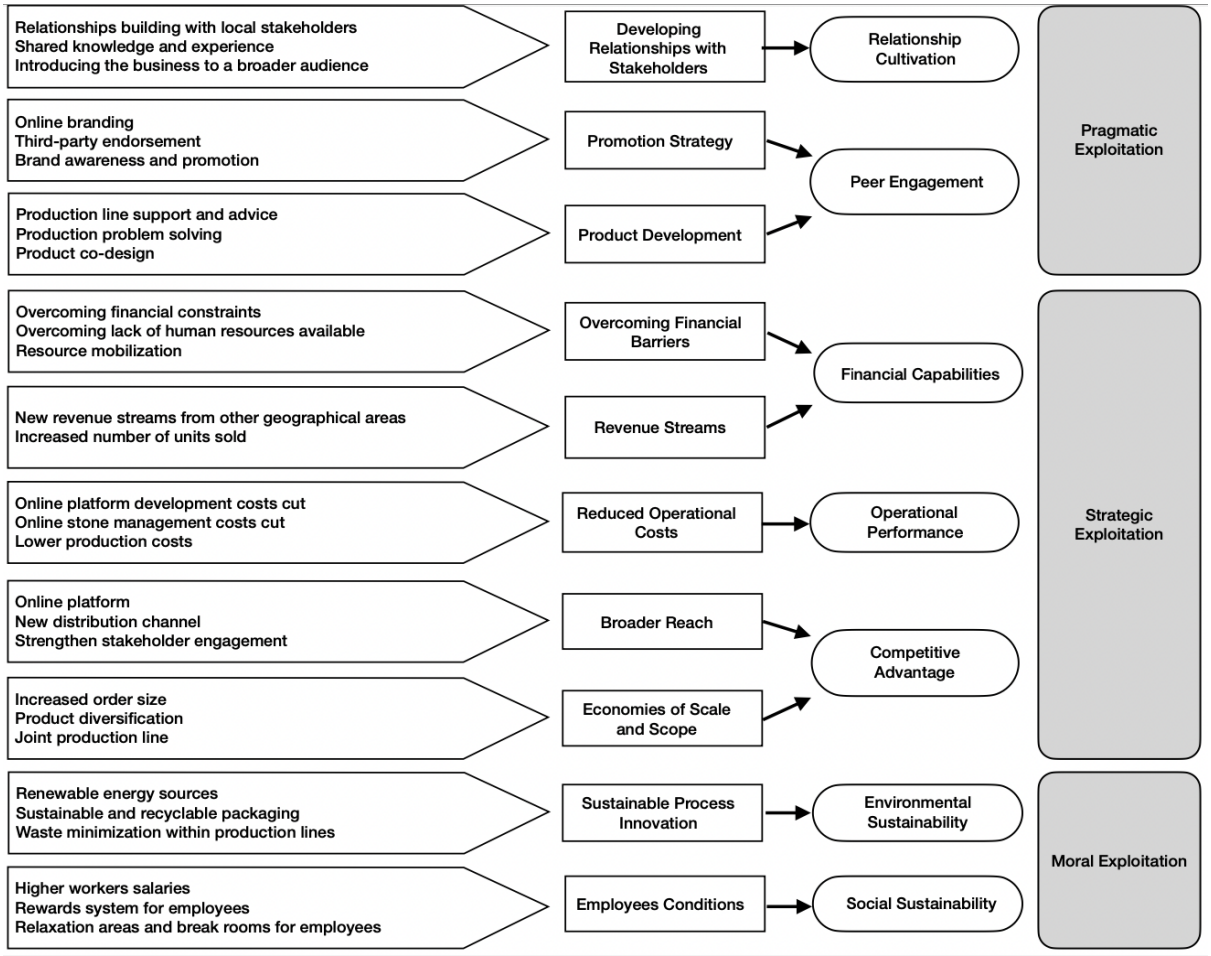


Figure 1 Research Framework

In Figure 1 the aggregate themes identified have been associated to the three elements of stakeholder engagement proposed by Kujala et al (2022). Furthermore, Table 3 below provides an overview of the empirical findings and their relation to the main thematic categories identified.

Emerging Themes	**Representative Quotes**
Relationship Cultivation	"#01 recommended me to another machinery supplier and we have both benefited from discounted prices from it. We also get to share some of our bad experiences with suppliers and their customer service [...] we sometimes avoid engaging with some sellers because of other businesses have had a terrible time with them " (#05). "It is a great deal of publicity for a small business like

	us because we get to benefit from visitors that might have been attracted to the platform by other more renowned brands" (#03).
Peer Engagement	"Now that I am familiar with the other businesses and owners I am always happy to talk about them with clients and suppliers" (#07). "It was possible due to the favourable conditions at which they landed us their machinery and production line. Besides, it is challenging for medium and small sized businesses to develop a new product. Our resources are limited and we have to be careful how we use them. By having these new "friends" we get to "divide" the risks associated with innovating and broadening our sources of income" (#01). "They have helped enlarge and improve our online presence. Their charter member has provided us with some useful tips on how to approach the various platform and website building tools. [...] he took over some of our goals and lended us his expertise for a lowered fee" (#01). "The collaboration has given us the opportunity to finally meet some other local and likeminded business owners. [...] we were able to create a new product by utilising our knowledge in combination with another business's physical assets [...]" (#01).
Financial Capabilities	"there are customers purchasing our products who live in regions of Italy that we could not have reached at our current state if it was not for them." (#09) "When developing our strategic approach to implementing an online store, we quickly realised that we would need to hire a lot of people to ensure the acquisition of the necessary knowledge. [...]. We could use some of our drivers to deliver the products but it would not be possible to expand beyond our county." (#06). "It is way too costly to hire staff, we could not do it." (#08). We did not have the resources to hire someone with an engineering background. We did not have the resources to hire a distribution channel specialist." (#01).

Operational Performance	"It is great seeing the benefit of selling online with little costs associated with it. For example, our store in [...] has a greater impact on our product's profit margin than the products sold through the online platform" (#02). "We started to work on how to develop an online store that would allow our customers to purchase our products outside our physical store in 2015. However, it was extremely difficult for us because it does cost a great deal of money to acquire the necessary knowledge, domain and tools necessary to build a functioning online store" (#01). "It was a money pit that I do not know for how long we would have been able to sustain" (#06).
Competitive Advantage	"We have experienced somewhat of an increase in the demand of our products thanks to the platform. But, together with #02, we can still benefit from economies of scale when purchasing our packaging components in bulk together" (#04). "there are customers purchasing our products who live in regions of Italy that we could not have reached at our current state if it was not for them." (#09) "the broadening of our product catalogue has allowed us to increase our sales at lower operating costs" (#01). "By having a larger market due to our reach, we have been able to improve our conditions with our bottle and jar suppliers." (#01).
Ecological Wellbeing	"Investment towards the use of more sustainable components for our packing have been made thanks to the new resources obtained through the collaboration" (#08). "[...] we have utilised the new resources to partially finance the implementation of solar panels on our buildings so to reduce our energy consumption from fossil fuels" (#01)
Social Sustainability	"We used it to add appliances and kitchenware to our employees lunchroom [...]" (#04). Furthermore, companies awarded their workers by "[...] financing new bonuses, such as vouchers and

	rewards, together with higher salaries and better contractual conditions" (#04)

Table 3 Emerging themes and representative quotes

4.4. Findings

In the interviews, SMEs owners and managers have discussed at length how the collaboration has positively affected their businesses' performance and competitiveness and geographical reach. Therefore, our findings reveal how collaborations amongst SMEs can contribute to the performance of small and medium sized businesses by providing expertise, network, financial and operational gains, as well as new resources for the pursuit of new goals. Based on the analysis of the interviews and multi-step coding process, the researchers have been able to identify several sub themes concerning how the collaboration has impacted the various businesses who partook in it.

4.4.1 Pragmatic Exploitation

The various SMEs who participate in the collaboration have the opportunity to exploit the online distribution channel to form new relationships with customers that they were unable to reach before due to the limitations of their physical stores, as well as lack of online distribution platforms. Moreover, the online distribution channel's network acts as a fertile ground for the various businesses who use it to form connections and establish partnerships with other businesses and other stakeholders. Therefore, the online distribution channel functions as a business ambassador as well as a marketing channel.

Firstly, the online platform behaves like a bridge between the small and medium enterprises and their consumers. "They [online distribution channel] provide us a digital platform which allows us to maintain as well as build new relationships with clients that want to consume our products. We are no longer limited by our physical presence" (#04). Entrepreneurs exploit the e-commerce platform to promote their business too: "It is beneficial to us to improve our online presence. The platform has a page in which the consumer can get to know us better by going over our story, principles and motives. Moreover, when scrolling through it they get to see all of our products available on the e-commerce platform. It is a great deal of publicity for a small business like us because we get to

benefit from visitors that might have been attracted to the platform by other more renowned brands" (#03). Therefore, the online platform has taken the form of an online branding strategy since it allows SMEs participating in the collaboration to expand their brand image, as well as, benefit from the attractiveness of other brands in order to become more visible to other stakeholders thus increasing the public brand awareness. In fact, "having multiple brands on one platform allows less popular or well known brands to catch some eyes through visitors brought over by larger and more established SMEs" (#08).

Additionally, SMEs collaborating with the e-commerce have the opportunity to benefit from the operational side by collaborating with businesses which provide complementary services and assets. "The collaboration has given us the opportunity to finally meet some other local and likeminded business owners. [...] we were able to create a new product by utilising our knowledge in combination with another business's physical assets [...]" (#01).
Thus, the e-commerce platform has also shared its knowledge and experience with digital tools. "They [the e-commerce platform which allowed the collaboration] have helped enlarge and improve our online presence. Their charter member [which specialises in digital services] has provided us with some useful tips on how to approach the various platform and website building tools. [...] he [charter member] took over some of our goals and lended us his expertise for a lowered fee" (#01). The new collaboration was possible thanks to the favourable conditions to obtain access to the knowledge and assets of the two businesses. "It [new product developed] was possible due to the favourable conditions at which they landed us their machinery and production line. Besides, it is challenging for medium and small sized businesses to develop a new product. Our resources are limited and we have to be careful how we use them. By having these new "friends" we get to "divide" the risks associated with innovating and broadening our sources of income" (#01).

Besides the previously reported elements, the collaboration is fertile ground for positive word of mouth between the various firms involved. "Now that I am familiar with the other businesses and owners I am always happy to talk about them with clients and suppliers" (#07). Furthermore, sharing positive and negative experiences with other businesses helps the various enterprises establish positively affirming relationships outside of their collaboration: "#01 recommended me to another machinery supplier and we have both benefited from discounted prices from it. We also get to share some of our bad experiences with suppliers and their customer service [...] we sometimes avoid

engaging with some sellers because of other businesses [involved in the collaboration] have had a terrible time with them " (#05). Additionally, firms involved in the collaboration share their expertise and offer support to others engaged with the partnership in an attempt to support their production lines and resolve issues associated with it. "They [#01] have helped us when we were having trouble managing a new machinery introduced in the production line by sharing their previous experience with it" (#08). "With the advent of new public funding, multiple firms within the group have supported and helped each other through the tedious process of accessing the funds and purchasing equipment which would fall within the categories set by the government" (#04).

4.4.2 Strategic Exploitation

The various SMEs participating in the collaboration no longer feel the need to invest their resources to create an online store of their own since they believe that the e-commerce business does represent them well while also maintaining sustainable fees and order management systems whose costs can be absorbed by small and medium sized companies. Thus, some companies have been able to reduce their operational costs while also improving their sales volumes by reaching a new audience of customers previously left untouched.

First of all, having a complete and functioning online digital platform is crucial for businesses of small and medium size since they no longer have to undertake the risks and expenses associated with developing one. "We were attending a food conference in Bologna and we have been able to speak to some businesses that have an online store. [...] Consequently, hearing their experience and seeing the economic benefits that it brought to them we immediately knew that it was something that we wanted to pursue [...]" (#01). Similar experiences are reported by other two entities (#03 & #06) involved in the collaboration. Therefore, some before than others, started to plan and undertake the project of an online presence. "We started to work on how to develop an online store that would allow our customers to purchase our products outside our physical store in 2015. However, it was extremely difficult for us because it does cost a great deal of money to acquire the necessary knowledge, domain and tools necessary to build a functioning online store" (#01). "It [the development of an online store] was a money pit that I [owner] do not know for how long we would have been able to sustain" (#06).

Additionally, the limited financial resources were not the only issue encountered by the sample. The need for new human resources became evident. “We have people working for us that might have had some useful knowledge but what was I supposed to do? Relocate them to a new project? Who would take the place that they would have to leave? We did not have the resources to hire someone with an engineering background. We did not have the resources to hire a distribution channel specialist.” (#01). Every single employee in small and medium sized firms is necessary for it to function. More often than not, employees do not have enough time to take over additional projects. Consequently, enterprises need additional human resources to add to their business. “When developing our strategic approach to implementing an online store, we quickly realised that we would need to hire a lot of people to ensure the acquisition of the necessary knowledge. [...]. We could use some of our drivers to deliver the products but it would not be possible to expand beyond our county.” (#06). “It is way too costly to hire staff, we could not do it.” (#08).

However, the collaboration with the e-commerce has allowed companies to bypass the aforementioned challenges because another entity would take care of the management of the platform, collection and distribution of the products at lower costs in comparison to the expenses associated with the development of their own online store. “He [the owner of the e-commerce platform] knows very well the local economic fabric of our county. Therefore, when he showed to us how much it would cost to sell through him we immediately stopped any investment towards our online store project” (#01). “It is great seeing the benefit of selling online with little costs associated with it. For example, our store in [...] has a greater impact on our product’s profit margin than the products sold through the online platform” (#02). Consequently, the firms approaching the development of an online store on their own (#01, #03, #06) were able to cancel the project and eliminate the expenses associated with it. Therefore, the collaboration has allowed companies to overcome their financial constraints, as well as lack of human resources associated with the development of an inhouse online sales platform. Moreover, firms involved in the project would have the opportunity, once positive relationships are built between them, to share their human resources amongst them in an attempt to foster their newly found partners. “Something that I [owner and founder of the firm] find of particular importance is that, by joining it [online digital sales platform], we were able to form new friendships with local businesses. Thus, now, we sometimes mobilise our assets or human personal in an attempt to help each other overcome the barriers associated with out size and location” (#01). “For example, they [#09] have lended us their vehicles

for free. To return the favour and build a positive relationship, we [#01] have often sent our controller and line workers over to support them when needed" (#01). Consequently, positive relationships and a stronger stakeholder engagement has improved companies' competitive advantage.

Finally, the small and medium sized businesses involved in the collaboration had the opportunity to improve their financial performance by adding new revenue streams. The sales are no longer limited by their own and/or of their distribution partners physical presence. "It [the e-commerce platform] allows us to check some analytics detailing the orders processed through the platform. [...] there are customers purchasing our products who live in regions of Italy that we could not have reached at our current state if it was not for them [the e-commerce business]." (#09). Additionally, the platform provides firms the possibility to generate sales outside of the national boundaries. "They [the online platform] take care of our orders which are coming from foreign customers" (#07). Nonetheless, at the time of the study, only orders coming from within the EU boundaries are processed and accepted by the e-commerce platform. Nonetheless, despite the above mentioned limitation, the businesses involved in the collaboration have greatly enhanced their reach potential. Consequently, financial performance improved because companies are able to generate new revenue streams from geographical areas that could not be reached before, as well as, through the increased number of units sold. All actors involved report somewhat of an improvement to the aforementioned element.

Furthermore, "the broadening of our [one of the entities involved in the collaboration] product catalogue has allowed us to increase our sales at lower operating costs" (#01). Finally, knowing that they are able to reach a broader market, the companies involved have the opportunity to benefit from economies of scale since "By having a larger market due to our reach, we have been able to improve our purchasing conditions with our bottle and jar suppliers." (#01). Economies of scale can be achieved by the smaller entities who have not experienced large growth in their sales through the online platform since they are able to combine purchases with some other firms due to the similar industry sector in which all companies involved in the collaboration operate. "We have experienced somewhat of an increase in the demand of our products thanks to the platform. But, together with #02, we can still benefit from economies of scale when purchasing our packaging components in bulk together" (#04). Nonetheless, multiple companies have experienced economies of scale and scope due to the increase of order size obtained through the online sales platform, as

well as, diversification of products. “Our purchasing power has increased and we do benefit from it” (#05).

Additionally, the development of a joint production line and product has allowed a couple of companies to reduce the costs associated with each product by amortising their costs over multiple different outputs. “The new collaboration allows us to diversify our portfolio and improve our cost on output basis since we spread our costs amongst a larger pool” (#01).

4.4.3 Moral Exploitation

Since the collaboration has promoted the improvement of the financial and operational performance, as well as, the sharing of knowledge amongst businesses, it allows them to pursue new investments. The efforts made by companies are mainly aimed at improving their sustainability. “Investment towards the use of more sustainable components for our packing have been made thanks to the new resources obtained through the collaboration” (#08). However, those investment are not limited to the environmental impact of their products since “[...] we [one company involved in the collaboration] have utilised the new resources to partially finance the implementation of solar panels on our buildings so to reduce our energy consumption from fossil fuels” (#01). Moreover, “electric vehicles have been purchased in an attempt to reduce our carbon footprint associated with the distribution of our products in our various physical stores” (#09). Furthermore, companies involved have also assessed their production line seeking to improve it. “The purchase of our new machinery with its associated software has been possible thanks to the new sales volume coming from the e-commerce platform. By doing so, we were able to reduce the waste associated with said production” (#07).

Finally, the businesses who have experienced a lower level of growth in revenue generated through the platform have made smaller investments aimed at improving the working conditions of their employees. “We used it [the additional revenue from online sales] to add appliances and kitchenware to our employees lunchroom and relaxation area [...]” (#04). Furthermore, companies awarded their workers by “[...] financing new bonuses, such as vouchers and rewards, together with higher salaries and better contractual conditions” (#04) to improve the social wellbeing of their employees.

4.5. Discussion

First of all, it is important to note that the empirical setting analyzed further supports the literature which argues that smaller entities often engage in collaborative alliances and partnerships in an attempt to overcome constraints associated with their limited resources and knowledge (Liu, 2021). In fact, the presented findings indicate that within this empirical setting the resource constraints have somewhat fostered the creation of a partnership. By gaining access to the digital platform, companies are able to leverage off of their business strategy (Cenamor et al, 2019; Chan et al, 2019), further develop their competitive advantage (Parker et al, 2016), enhance their stakeholder engagement (Cenamor et al, 2019; Cenamor et al, 2017 ; Civera et al, 2018; Loureiro et al, 2020; Prisco et al, 2022) and exploit the digital platform's business specific capabilities and technologies (Giotopoulos et al, 2017). Hence, the obtained empirical findings align with previous bodies of work which would identify digital platforms (our study focuses on digital retail platforms) as useful tools that allow and enhance SMEs stakeholder engagement with external stakeholders (Cenamor et al, 2019; Cenamor et al, 2017; Loureiro et al, 2022; Prisco et al, 2022; Ruzante et al, 2022; Viglia et al, 2018). In fact, this manuscript empirical findings clearly outline the central role the digital retail platform has in enabling and nurturing the constitution of collaborative relationship with multiple external stakeholders; hence, fostering SMEs' co-creation and partnership dimension (Loureiro et al, 2020; Ruzante et al, 2022; Viglia et al, 2018). Additionally, our empirical results highlight the necessity for SMEs to engage with external stakeholders (Albats et al, 2020; Civera et al, 2018) to gain access to the foregoing platforms since SMEs constraints hinder their ability to acquire the necessary skills and resources to develop and implement their own online retail platform (Constantinides et al, 2018). Consequently, the obtained empirical findings further delineate the essential role that stakeholder engagement has on SMEs growth and accessibility of resources and knowledge (Liu, 2021) particularly for SMEs operating within the F&B sector (Gamble et al, 2021; Mamalis et al, 2020). Thus, this article's findings underline how necessary positive relationships with external stakeholders can be for smaller entities (Albats et al, 2020; Henisz et al, 2014; Ommen et al, 2016; Pantano et al, 2020) operating in the F&B sector (Gamble et al, 2021).

When it comes to the pragmatic dimension of stakeholder engagement, the obtained findings are supported by a multitude of publications within the stakeholder engagement literature. Firstly, it is important to underline that the partnership was nourished and enhanced by the fact that the companies involved in it had a similar background and shared a multitude of common values, norms

and objectives thus furthering the jointness of cooperative efforts (Audretsch et al, 2023a; Girard and Sobczak, 2012; Ku et al, 2016; Liu, 2021; Mitchell et al, 2022). In fact, there are scholars which report that geographical proximity does nurture SMEs innovation performance through collaborating strategies such as partnerships (Audretsch et al, 2023a). Additionally, once the partnership was set, the vision of the cooperative activity was clear and shared amongst all partners involved thus further increasing the likelihood of success (Viglia et al, 2018).

The partnership allows the sampled SMEs to further develop positive relationships with external stakeholders through continuous collaborative activities and knowledge sharing thus promoting trust amongst the stakeholders involved within the partnership (Davilla et al, 2018; Winkler et al, 2019). Moreover, companies taking part in the partnership are able to improve their reputation and image amongst multiple categories of stakeholders (Scruggs and Van Buren, 2016).

Some SMEs within our empirical setting were able to develop a new product by engaging with stakeholders involved in the cooperative activity. Therefore, the above mentioned empirical evidence further underlines the impact on innovation and strategic innovation that stakeholders might have (Bendell and Huvaj, 2020; Pucci et al, 2020). This becomes particularly true for SMEs operating within the food and beverage industry when they use locally sourced ingredients and local manufacturing (Pantano et al, 2020).

Within the strategic dimension of stakeholder engagement, it is possible to find multiple articles which support the empirical evidence obtained within the present study. By engaging with stakeholders, companies are able to reduce their transactional costs (Herremans et al, 2016; Liu et al, 2013; Liu, 2021), improve their effectiveness when utilising resources (Chen and Liu, 2020) and improve their overall financial and operational performance (Ayuso et al, 2014; Emami et al, 2022; Henisz et al, 2014) thus strengthening their overall business and competitive advantage (Kumar and Pansari, 2016; Scruggs and Van Buren, 2016; Verbeke and Tung, 2013). When engaging with stakeholders, our obtained findings further support the literature stream which argues that cooperative activities can result in larger revenues streams, as well as the ability to generate additional profit (Boakye et al, 2020); this does also apply to F&B SMEs as shown by our empirical findings which corroborate Gamble et al (2021) findings and propositions. Furthermore, companies are able to improve their revenue streams by accessing foreign markets and other customers that they were not able to reach previously due to their limited physical presence and lack of digital sales channels (Audretsch et al, 2023b; Hilmersson and Johanson, 2016). Thus, the obtained evidence

further supports the importance that collaborative activities, such as partnerships, have on SMEs capabilities to internationalise and access new markets (Audretsch et al, 2023b; Karami and Tang, 2019; Yata and Hurd, 2021; Zhang et al, 2016). The partnership allows SMEs to improve their competitive advantage while also achieving greater economies of scale and revenue diversification (Ling-yee and Ogunmokun, 2001; Sadeghi et al, 2018; Wilson, 2006).

When it comes to the moral dimension of stakeholder engagement, our empirical data further support the idea that by engaging with a variety of stakeholders companies can improve their social impact by strengthening societal well-being (Lindgreen and Swaen, 2010), fairness (Winkler et al, 2019) and goodwill (O'Riordan and Fairbrass, 2014). Additionally, by engaging with a partnership with the online platform, companies are able to nourish their brand image thus improving its legitimacy and credibility amongst a variety of stakeholders (Beelitz and Merkl-Davies, 2012; Gamble et al, 2021; Mamalis et al, 2020; O'Riordan and Fairbrass, 2014).
This study further supports existing literature since the obtained empirical findings suggest that companies were able to utilize the additional resources generated through the partnership and the business synergy amongst the various stakeholders to further develop their environmental efforts by reducing their resource waste and consumption, as well as by reducing their carbon footprint (Giacomarra et al, 2020; Pucci et al, 2020; Watson et al, 2018).

4.6. Conclusion

The present study has explored the effects that stakeholder engagement can have on the competitiveness and capability to access foreign markets of SMEs operating within the food and beverage sector by underlining the importance of partnerships as a key factor for overcoming financial and knowledge constraints normally associated with SMEs' smallness.

The obtained findings underline how stakeholder engagement through partnerships has the potential to impact all three components of the stakeholder engagement theory.
Firstly, this study underlines the importance for companies engaging in collaborative activities such as partnerships to align their values and expectations to further increase the likelihood to positively enhance their businesses, network, and stakeholder engagement capabilities (Audretsch et al, 2023a; Viglia et al, 2018). Through a broader network and partnerships, companies can engage in

collaborative activities such as co-development of products and enhance their brands' reach (Audretsch et al, 2023a; Audretsch et al, 2023b; Gamble et al, 2021; Pantano et al, 2020). Additionally, our findings contribute to the literature on stakeholder engagement and its positive effects to the financial and operational performance of companies (Chen and Liu, 2020; Emami et al, 2022; Gamble et al, 2021; Herremans et al, 2016; Liu et al, 2013; Liu, 2021). The gathered findings showcase the expansion of the company's market reach since, after the collaboration, the involved SMEs are no longer limited by their physical presence and shops. Therefore, they are able to access new markets and generate a greater deal of revenues, increased production volume and consequently benefit from economies of scale and scope (Hilmersson and Johanson, 2016; Yata and Hurd, 2021; Zhang et al, 2016). The partnership grants access to the necessary resources and tools (ITsGOOD platform as well as its inventory and distribution service alongside their knowledge and expertise) to SMEs. Thus, the selected SMEs are able to improve their competitiveness and international presence (Audretsch et al, 2023b; Karami and Tang, 2019; Yata and Hurd, 2021; Zhang et al, 2016).

Finally, the obtained findings underline the rise in investments to improve the companies' contribution to the environment and societal conditions through the deployment of the newly acquired resources and knowledge obtained from the partnership and its consequential benefits (Giacomarra et al, 2020; Pucci et al, 2020; Winkler et al, 2019).

4.6.1 Theoretical and managerial implications

This study contributes to the understanding of stakeholder engagement in the context of SMEs partnerships in several ways. First, the obtained findings show that stakeholder engagement has a significant positive effect on the competitiveness of SMEs (Ayosu et al, 2014; Emami et al, 2022; Herremans et al, 2016; Liu et al, 2013; Liu, 2021). Second, the obtained findings underline the necessity for SMEs to form positive relationships with external stakeholders; hence, smaller firms must operate under the assumption that today's economy is a relational economy (Freeman et al, 2017; Kujala et al, 2022). Third, our findings underline the role that stakeholder engagement has on SMEs seeking to acquire knowledge and resources necessary to overcome their constraints (Giotopoulos et al, 2017; Liu, 2021). Fourth, this manuscript further contributes to the literature stream which argues that digital platforms nurture external stakeholder engagement and co-creation endeavors (Loureiro et al, 2020; Viglia et al, 2018); Thus, the empirical results obtained

further strengthen the notion that SMEs utilize digital platforms as a means to connect with external entities and pursue collaborative activities (Cenamor et al, 2017; Cenamor et al, 2019; Loureiro et al, 2020; Prisco et al, 2022).
Finally, the obtained findings showcase the importance of a common vision, objective and norms in enhancing the capabilities of stakeholders engagement (Girard and Sobczak, 2012; Ku et al, 2016; Liu, 2021; Mitchell et al, 2022).

This study has the following managerial implications. SMEs must address their organizational capabilities and resources to perceive their limitations and seek collaborative efforts through partnerships. Creating a partnership with businesses which operate in the same sector allows for synergy and it creates the opportunity to co-develop new products while also optimizing companies' resource utilization (Parker et al, 2016). On the other hand, partnering with an online sales platform allows them to benefit from its knowledge and resources; thus expanding their brand and product reach outside of their local market (Liu, 2021).

4.6.2 Limitations and future research avenues

Although our study provides novel insights into the importance of stakeholder engagement and collaborative activities for SMEs survival and growth, it is subject to limitations that offer potential new avenues for future research. Firstly, the qualitative nature of our research and the nature of our empirical sample limits our body of work. Thus, future research might leverage quantitative methods to provide additional evidence on the potential relationship between collaborative activities and SMEs ability to engage with new markets. Secondly, the present study focuses on an empirical setting composed of SMEs operating within the Italian food and beverage sector. Therefore, the findings of our research are to be treated with cautions when it comes to its generalizability since this manuscript' findings are limited by its empirical setting. Consequently, future studies could investigate whether the obtained findings are relevant within various geographical, cultural and political contexts (Kujala et al, 2022).
Future scholarly bodies of work could further investigate how important common vision, objective, norms and companies' values are in partnering activities since the obtained findings seem to suggest that the above mentioned shared values and objectives did help nurture positive relationships amongst the entities involved within the partnership (Audretsch et al, 2023a). Furthermore, future

studies could explore to what extent partnerships affect SMEs' governance structure, as well as whether partnerships could prove useful to smaller entities seeking to cope and endure turbulent times. Finally, our research provides empirical evidence concerning SMEs engagement with external stakeholders. Thus, future research could focus its efforts on a broader variety of stakeholders and its effects on SMEs' ability to internationalize (Mohd Salleh et al, 2017; Sakhdari et al, 2020; Zahoor et al, 2020).

Chapter 5

Conclusion

5.1 Concluding remarks and implications for future research

This collection of manuscripts allows the formulation of several conclusions and both theoretical and practical implications which are listed and explicated below into distinct sections.

First, the main conclusion of this collection is that digital tools and digital transformation in itself is a complex phenomenon which bleeds into various aspects of business (XXX). First, it is generally believed that digital tools have exclusively positive effects on companies' digitalization. However, within this collection, empirical findings suggest that some digital tools can have a role in enhancing companies' green competitive advantage; thus, suggesting that digitalization can impact companies' environmental performance. Therefore, this collection further reinforces the concept of twin transition. Overall, the obtained findings concerning the first contribution indicate that SMEs pursuing technological innovation and digitalization are still able to improve their sustainability performance and their green competitive advantage. The above-mentioned results support the literature strand which argues that digitalization can help achieve the goal of a twin transition (Jermsittiparsertt et al, 2020). However, the collected responses from the analyzed SMEs further expand the current understanding of digital tools and their interplay with sustainability concerns since the first manuscript empirical evidence suggests that IoT positively affects environmental performance (Jermsittiparsertt et al, 2020). This leads to the following managerial and theoretical implications. From a theoretical perspective, this study expands the scholarly body concerning twin transition and it supports the strand of articles which argue that digital tools can help companies reduce their environmental impact. Second, this study highlights the importance of investments in multiple technologies and engagement with stakeholders in order to strengthen a company's green competitive advantage. Finally, this manuscript concerning twin transition provides readers with a structured presentation of published work concerning the notion of twin transition; thus, it can serve as a basis to guide future studies concerning this topic. From a managerial perspective, this collection might serve as useful informative tools to indicate to managers and policy makers that some technologies and digital tools can help promote the twin transition agenda, as well as, companies endeavors towards a greener future. Second, this study highlights the importance for companies to

engage with both external and internal stakeholders to promote a company culture and attitudes which nurture green competitive advantage and efforts directed towards sustainable practices.

The second main element that emerges from this collection of papers is that SMEs seeking to digitalize must overcome a series of barriers. First, the company size has certainly emerged as an important factor which determines an organization ability to implement digital tools within its processes. SMEs limited size often translates into limited human and financial resources which further reinforce potential barriers encountered by smaller entities seeking to achieve digitalization. The above-mentioned constraints might cause smaller companies to lag behind when it comes to technological advancements and digital tools usage. Secondly, the second manuscript of this collection highlights the importance that a company's culture can have in affecting digitalization and digital readiness (Kappelman et al, 2019). In fact, owners and managers that have attitudes and show signs of resistance towards digitalization and change, due to cultural barriers, lack of motivation or overall lack of a clear vision towards digital tools, might experience internal barriers and resistances towards digitalization. This contribution has both theoretical and managerial implications. First, this manuscript speaks to managers, owners and policy makers to inform them of what barriers and obstacles smaller entities must face in order to digitize. Therefore, the empirical findings can help owners and practitioners allocate their resources in an attempt to mitigate the barriers faced by smaller firms. Second, this paper should help institutional organizations and governments establish new policies to nurture smaller entities efforts towards the implementation of digital tools within their business model, strategy and processes. Finally, managers have a deeper understanding of the necessary steps to first approach digitalization.

The third and final manuscript underlines the importance for smaller companies to engage in collaborative efforts to overcome their limitations and increase the likelihood to enhance their business strategy, processes and operations (Viglia et al, 2018). Partnerships allow companies to connect and engage with external stakeholders' resources and digital tools so to nurture co-development activities (Pantano et al, 2020). By doing so, SMEs can utilize and take advantage from positive relationships which grant them access to tangible and intangible resources that they might have not been able to develop nor acquire by themselves. For instance, the third manuscript underlines how accessing a digital online sales platform for SMEs can help strengthen and expand their revenues streams. The additional resources can then be employed to pursue technological innovation and sustainability endeavors. However, it is important to note that the selected SMEs were able to invest in digital tools and sustainability practices because of owners and managers

tendencies and attitudes towards those two notions. The foregoing further corroborates previous findings of owners and managers attitudes being essential to the growth and evolution of SMEs.

This final article has both practical and managerial contributions. First, it expands the literature which underlines the importance of stakeholder engagement practices within SMEs context thus underlining the role that cooperative actions can have in overcoming barriers, obtain access to digital tools and promote resource acquisition to nurture innovation (Kujala et al, 2022). Second, it reinforces the strand of scholarly body which believes that today's economy is a relational economy (Freeman et al, 2017). Finally, this manuscript showcases the importance of owners and managers vison and strategic attitudes to pursue digital and environmental innovation.

While the foregoing conclusions are reported into three distinct sections, this collection seeks to highlight the red thread among the three bodies of work. A transversal conclusion is that SMEs operating in various sectors can benefit from digitalization since it allows them to strengthen their green competitive advantage. However, this collection highlights challenges which are inherent to SMEs. Thus, managers and owners must foster a culture which promotes the adoption of attitudes that can help digitalization flourish or at least, establish behaviors and managerial practices which reduce SMEs' constraints to innovation and digitalization. Another transversal conclusion of this collection of papers is that SMEs seeking to digitalize might find it useful to engage with both internal and external stakeholders. This is because evidence suggests that engaging with various stakeholders can help SMEs access digital tools, as well as overcome their barriers normally tied with their resource constraints, smallness and lack of human capital.

5.2 Future research avenues

The paper which tackles digitalization, and the twin transition notion makes the following suggestions for future research avenues. First, since a positive relationship between technological innovation and green competitive advantage has been found, future studies should direct their efforts towards the exploration of how governmental institutions can help foster a company's research and development activities to promote investments in digital tools, circular economy and overall adoption of technologies which enable organizations' twin transition (Ortega-Gras et al, 2021). Second, the manuscript identifies various gaps within the knowledge and technological transfer literature. Therefore, future studies should investigate practices and techniques which can help promote the widespread adoption of knowledge and technological tools concerning

companies' green competitive advantage development (Ortega-Gras et al, 2021). Third, the first manuscript highlights the importance for future studies to explore the notion of twin transition through the theoretical framework of the dynamic capabilities. Finally, future research avenues consist in the investigation of the micro, macro and time implications that twin transition inherently carries.

The second contribution which focuses on smaller entities and their digitalization barriers elaborates the following contributions. First, future studies should consider gathering additional empirical evidence concerning the dynamics between digitally friendly attitudes of owners and managers and smaller entities. Second, this study calls for additional research concerning smaller entities through quantitative methodologies so to further understand whether the observed phenomenon is applicable to a larger sample of small enterprises. Finally, future researchers should investigate whether governmental entities have been able to elaborate policies and grants which have shown to increase and nurture small companies' adoption and pursue of digitalization.

The third and final manuscript makes the following contributions concerning future research avenues. First, researchers should direct their efforts towards the investigation of other forms of external stakeholders so to better comprehend which potential actors have the biggest impact on companies' ability to obtain the necessary resources to digitize and innovate. Second, future studies should adopt a quantitative methodology to better comprehend whether the identified phenomenon is limited to the selected SMEs or whether the empirical findings are applicable to various contexts. Finally, this paper further connects the literature between digitalization and stakeholder engagement in an attempt to highlight potential techniques and avenues to overcome SMEs constraints.

Considering the above reported future research avenues we propose the following table which contains a future research agenda that proposes various research questions.

Research Gap	**Proposed Research Questions**	**Reference**
Lack of empirical studies exploring which technologies and governmental policies nurture firms' twin transition notion	• What digital tools foster companies' sustainability endeavors? • How can ruling bodies support the twin transition notion? • Does digital circular economy contribute to companies twin transition?	Ortega-Gras et al, 2021

	• Which practices promote the widespread adoption of knowledge and technological tools concerning companies' green competitive advantage?	
Lack of empirical studies which explore how managers attitudes affect smaller firms digital readiness	• How does managers and owners' digital attitudes affect their firms' digital readiness? • What are the key elements contributing to managers and owners' attitudes towards digital technologies?	Chamochumbi et al 2021
Lack of research on external stakeholders' role in companies collaborating activities	• How do various external stakeholders affect SMEs' ability to internationalize through collaborative endeavors? • What stakeholder engagement activities have the greatest impact on SMEs knowledge and resource acquisition?	Zahoor et al, 2020 Sakhadari et al, 2020
Lack of empirical studies on the elements which nurture relationships amongst the entities involved in a partnership	• How important are common vision, values and norms in nurturing partnerships? • Does a common vision provide fertile ground for collaborative activities between firms? • What dimension of stakeholder engagement has the biggest impact on external stakeholder engagement?	Audretsch et al, 2023a
Lack of empirical studies on collaborative efforts failure	• Are mutual trust and business understanding essential in partnering activities?	Liu, 2021

	• What are the elements causing collaborative efforts failure?	

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