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# Survey among Italian firms on resilience and sustainability

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# Executive summary

This report introduces an analysis conducted to examine how Italian companies navigate crises and respond to environmental jolts, with a specific emphasis on company resilience. The investigation focused on eight core dimensions through a questionnaire, namely resilience capabilities, outcomes, sustainability, crisis and supply chain disruptions, company flexibility and agility, workforce talent and skills, end-to-end solutions, and management control.

The primary objective of this report is to provide an overview of the research framework employed in designing the survey. Firstly, it presents an overview of crises and their characteristics to contextualize the business environment. Secondly, the adopted research framework is outlined, elucidating the complexities and potential interconnections among the eight areas under investigation. Thirdly, a brief description of the questionnaire is provided, highlighting its core sections. Finally, each of the eight core dimensions is discussed in separate sections, drawing upon relevant scientific literature. This report serves as a theoretical introduction to the themes explored in the questionnaire. A subsequent report will delve into methodological details concerning questionnaire administration and data analysis, slated for future presentation.

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# 1. Introduction

The COVID-19 pandemic is one among the adversities and crises that have affected organizations' operations and performances during the last years. More in detail, disruptions can arise from supply chain disruptions, technological changes, natural disasters, climate change, geopolitical tensions, etc. Therefore, firms need to develop resilience, i.e. the capability of responding to shocks and crises and even thriving in periods of crisis (Duchek, 2020; Rietze et al., 2022).

This report illustrates the rationale and structure of a survey aimed at investigating how Italian firms reacted to crises and external shocks. The survey is aligned with the main objectives declared by the PNRR GRINS project - Spoke 1 - WP2, which deals with improving firms' resilience to external shocks and environmental jolts. The questionnaire further investigates and complements the issues covered by Target #1, focused on value chains' reaction to COVID-19, while widening the scope of the analysis.

The questionnaire is designed to investigate firms' resilience from different yet interrelated perspectives: sustainability and sustainable practices; organizational agility and flexibility; talented and skilled workforce; end-to-end solutions; supply chain relations; management control systems.

The research question (RQ) the survey aims at answering is: (how) do organizational capabilities and processes, inter-organizational and intra-organization relations, technology and sustainability orientation improve firms' resilience and resilience outcomes?

The report is organized as follows: first, we will outline the research context; second, the research framework explaining the rationale of the survey will be presented; third, we will illustrate the questionnaire design and the main areas investigated through the survey. Fourth, five sections will focus on the areas of investigation. The questionnaire is reported in the appendix.

## 2. Context of the research

According to Lawrence et al. (2023), humanity is facing a 'perfect storm' of crises due to the rapid successions of events such as war, extreme weather, energy scarcity, inflations, and pandemics. The literature lacks a general consensus about how to intend crisis (Perry and Quantarelli, 2005; Wu et al., 2021). To be comprehensive, more crisis definitions commonly adopted in literature to catch possible different perspectives on how scholars deal with crises are here provided. One of the most common definitions cited in the literature is the one proposed by Pearson and Clair (1998, p. 60), which defines crisis by applying an organizational perspective. In this sense, a crisis must be intended as *"a low-probability, high-impact event that threatens the viability of the organisation and is characterized by ambiguity of cause, effect, and means of resolution, as well as by a belief that decisions must be made swiftly"*. However, crisis may have broad impacts that exiting the organization boundaries. Clark (1995) expanded the definition of crisis impacts by characterizing a crisis as an unforeseen occurrence capable of resulting in fatalities or severe injuries to staff, clients, or the public. Such events can lead to business closure, operational disturbances, physical or environmental harm, or jeopardize the financial stability and reputation of the organization.

Miklian and Hoelscher (2022, p. 180) referred to exogenous shock when referring to a crisis with broader impacts whose causes must be considered external to an investigated system. Indeed, they defined exogenous shock as *"an unpredictable and/or unexpected event not initiated by a given market, community or country that carries a significant negative impact upon that market, community or country"*. In contrast, some scholars interpret crises as a process with broad effects. Rosenthal et al. (1989, p. 10) referred to the crisis by intending it as a "threat" that may increase in severity during the time and uncertain conditions. They stated a crisis is *"a serious threat to the basic structures or the fundamental values and norms of a system, which under time pressure and highly uncertain circumstances necessitates making critical decisions"*.

Despite various possible definitions, the last decades have been characterized by successive crises that appear to trigger or exacerbate one another, resulting in a state of polycrisis. Lawrence et al. (2022, p. 9) define global polycrisis as *"the causal entanglement of crises in*

*multiple global systems that significantly degrade humanity's prospects*". Polycrisis context denotes a situation where multiple extremely harmful emergencies subsequently occur (Lawrence et al., 2023) increasing the perception of organizations to live in permacrisis condition.

Such a situation constantly contributes to highly volatile and uncertain environment characterized by extreme events posing new challenges to organizations that strike for their survival. Understanding how to efficiently, and effectively address uncertainties and challenges is therefore of paramount importance for organizations survival (e.g. Duchek, 2020). The aim of the survey is to collect information on how companies coping with crises and resilience, to gain knowledge, sharing best-practices and potentially reduce mistakes or uncertainties. In particular, eight core dimensions were investigated through the questionnaire, namely resilience capabilities, resilience outcome, sustainability, crisis and supply chain disruptions, flexibility and agility of companies, talented and skilled workforce, end-to-end solutions, and management control.



### 3. Research framework

Within a polycrisis context (see section 2) characterized by extreme environmental turbulence and systemic crises (e.g., supply chain disruptions, climate change) firms need to become resilient and sustainable. The research investigates crises and resilience in combination as *“the notions of resilience and crisis are necessarily intertwined”* (Darkow, 2019, p. 150). Indeed, the organizational response to adversities depends on several contextual factors (e.g., the history of the organization, the type of industry, the social capital of the entrepreneur; Duchek, 2020; Williams et al., 2017) as well as on the type of shock threatening the operations.

Resilience can be considered from two different perspectives (Darkow, 2019; Duchek, 2020):

1. Resilience as a process;
2. Resilience as an outcome.

As outlined in paragraph 5.2, resilience can be intended as a process that unfolds over time (e.g. Burnard and Bhamra, 2011). Using different labels, scholars identify three main resilience stages or phases (e.g., Williams et al., 2017; Duchek, 2020; Raetze et al., 2022): anticipation/proactive resilience; coping/reaction/response; adaptation/feedback (a more detailed description of the three stages is outlined in paragraphs 5.2.1, 5.2.3, 5.3.4). If the starting point of the process depends on the framework adopted - e.g., Raetze et al. (2022)'s perspective differs from Burnard and Bhamra's (2011) one -, the shock that threatens the organization represents a turning point of paramount importance. A clear divide between the pre-shock period (in which resilience was an unexpressed potential) and the “critical phase” (Burnard and Bhamra, 2011) following the shock or the environmental jolt can be easily identified. During the activation phase, an organization reacts to the shock: agility and flexibility must be pragmatically used to reconfigure existing and novel resources and restore normal functionality and adapt to the changed context.

The response implemented by the organization may turn out to be successful or not (Burnard and Bhamra, 2011). However, the outcome is only part of the story, which includes adjusting and learning (see paragraph 5.2.3) and involves capabilities embedded in people and routines (paragraph 5.3 and 5.4). Nonetheless, including the outcome in the research framework is useful to assess the effectiveness of the processes activated by the organization (paragraph 6.8).

Consistently, the report builds on a research framework that conceptualizes resilience as the result of organizational capabilities and processes (Duchek, 2020; Burnard and Bhamra, 2011; Burnard, Dani and Bhamra, 2011; Raetze et al., 2022). Adopting a sequential approach, capabilities and processes can be grouped as follows:

- Organizational processes and capabilities related to the pre-shock(s) period (i.e. resilience's antecedents; Burnard and Bhamra, 2011; Vogus and Sutcliffe, 2007);
- Organizational capabilities that support the response to shocks: organizational flexibility and agility, effective orchestration of external networks (Verreynne et al., 2023);
- Resilience outcomes (time to recovery, crisis' severity; Darkow, 2019; Ayyub, 2014), i.e. the (nuanced, McConnell, 2011) effects of the organizational response to the crisis.

Moreover, the research framework includes further areas of investigation to study the interplay between resilience capabilities (focusing on the agility and flexibility of companies as well as on talented and skilled workforce, paragraphs 5.3 and 5.4) with sustainability (section 6), supply chains' disruption (section 7), end-to-end solutions (section 8), and management control systems (section 9). The questionnaire design – outlined in the next paragraph – reflects the rationale of the framework.

## 4. Questionnaire design

In compliance with target established in the field of the GRINS project, a questionnaire was produced aiming at collecting data for a sample of 1000 companies.

The aim of the questionnaire was to understand how companies react to environmental jolts and develop resilience while addressing crises. Based on project objectives, eight core areas of investigation were identified as relevant to gain information about the resilience level of companies: resilience capabilities, resilience outcome, sustainability, crisis and supply chain disruptions, flexibility and agility of companies, talented and skilled workforce, end-to-end solutions, and organizational controls.

The main goal of the survey is to understand to what extent these core dimensions can contribute to improving firms' resilience and resilience outcomes in context of crises.

On an overall level, 35 questions were produced to measure the key dimensions. Table 1 reports the correspondence between the areas of investigation and the associated questions of the questionnaire (Appendix 1). In the following sections, core dimensions investigated are presented and the survey introduced.

Table 1 Areas of research and associated questions

Areas of investigation	Question(s)
Resilience Capabilities	B21; B22
Resilience Outcome	B1; B8; B9; B10; B11
Flexibility and Agility of Companies	B21; B22
Talented and Skilled Workforce	B2; B3
Sustainability	B15; B16
Crisis and Supply Chain Disruptions	B7; B8; B13
End-to-end Solutions	B23; B24
Management Control	C1; C2; C3; C4; C5

More details about methods used for collecting data, technical and methodological insights for the data collection process will be presented in the future through a separate and dedicated report provided by each University group involved in the WP.

## 5. Resilience

Within a context of global downturns, climatic and natural catastrophes, industrial accidents, IT breaches, terrorist attacks, firms must prepare for and respond to threats and adversities, in order to prevent decline or failure and preserve their performance (Williams et al., 2017). Resilience enables organizations to respond to threats, mitigate adversities before they arise, achieve positive outcomes and even thrive in face of adversities (Duchek, 2020; Raetze et al., 2022; Williams et al., 2017).

### 5.1 Defining the concept

Rooted in the latin word “resilio”, which means “to rebound”, resilience originally refers to the property of a material or substance to go back to the pre-shock shape after being bent, stretched or pressed (Bevilacqua et al., 2017). Resilience has been explored from multiple perspectives in a variety of areas of inquiry (e.g. psychology, ecology; Raetze et al., 2022; Williams et al. 2017). In organizational and management studies, resilience is a multi-faced (Burnard and Bhamra, 2011) and multi-stage (Williams et al., 2017) concept that encompasses many issues of organizations’ life (e.g., human resources management, Lengnick-Hall et al., 2011; organizational design, Verreyne et al., 2023). Organizational resilience has been studied in diverse contexts (e.g., High Reliability Organizations, Weick at al., 1999; small and middle enterprises, Sullivan-Taylor and Branicki, 2011) and reviewed in different studies (e.g., Raetze et al., 2022; Duchek, 2020; Bhamra et al., 2011; Linnenluecke, 2017).

Not surprisingly, many definitions of resilience coexist (see Bhamra et al., 2011; Verreyne et al., 2023). For instance, Lengnick-Hall et al. (2011) defines resilience as a *“firm’s ability to effectively absorb, develop situation-specific responses to, and ultimately engage in transformative activities to capitalize on disruptive surprises that potentially threaten organization survival”* (p. 244). Vogus and Sutcliffe (2007) focus on the adjustment and define resilience as *“the maintenance of positive adjustment under challenging conditions such that the organization emerges from those conditions strengthened and more resourceful”* (p. 3418). Williams et al. (2017) embrace a resilience-as-a-process view: resilience is *“the process by which an actor (i.e.,*

*individual, organization, or community) builds and uses its capability endowments to interact with the environment in a way that positively adjusts and maintains functioning prior to, during, and following adversity” (p. 742). The common idea is that resilient organizations are capable of “retaining shape and maintaining core functionality” in face of adversities (Verreynne et al., 2023, p.1342). Overall, organizational resilience can be intended as the capability to bounce back from a threat or a disruption, the ability to absorb a shock and to adapt to changes, reacting to adversities or disasters (Sheffi and Rice, 2005; Des Jardine et al., 2019; Lengnick-Hall et al., 2011; Duchek, 2020). For sake of clarity and synthesis, two central attributes of resilience are common to all conceptualizations: some form of adversity and some form of positive functioning (Raetze et al., 2022).*

Importantly, resilience can be viewed as a desired outcome (Darkow, 2019; Bevilacqua et al., 2017; Ayyub, 2014; Ilseven and Puranam, 2021) or as a process leading to the positive outcome (Burnard and Bhamra, 2011). The process successfully unfolds thanks to a mix of organization capabilities and characteristics, such as the agility and flexibility of organizations and the skills of their human resources (Duchek, 2020; Verreynne et al., 2023; Legninck-Hall et al., 2011).

The section devoted to organization capabilities is organized as follows. First, we will outline the resilience-as-a-process approach. Second, the following paragraphs (5.2.1, 5.2.3, 5.2.4) will illustrate the three stages of resilience - anticipation, coping, adaptation (Duchek, 2020). Paragraph 5.3 will focus on the organization design principles (agility and flexibility) that enhance organizational resilience. After analyzing how individual cognitive skills, behavioral abilities, and their interplay contribute to the resilience of organizations (paragraph 5.4) from a micro-level perspective, paragraph 5.5 outlines the resilience-as-an-outcome approach, to integrate the former discussion.

## 5.2 Resilience capabilities

In facing crises and adversities, organizations interact with the environment in a dynamic way (Williams et al., 2017) following a process trajectory (Darkow, 2019). Resilience can be built over time; *“resilience means to effectively respond to adverse events, not only after events, but before, during, and after as well”* (Duchek, 2020: 223). As suggested by Duchek (2020), each

stage relies on a unique blend of organizational capabilities and routines, which are “highly complex, socially embedded, and path-dependent” (Duchek, 2020, p. 238).

During the process of resilience, the organization anticipates, react to and learn from crisis in an intricate and multi-level way. Indeed, cognition, behaviors and emotions interact (Weick, 1988; Duchek, 2020; Williams et al., 2017) at the individual (e.g., Lengnick-Hall et al., 2011), group and organizational levels (e.g., Duchek, 2020) with relevant implications for human resource management and organization design (Weick, 1993; Douglas, 2021). For instance, resilience is enhanced by the (possibly micro-level) action of bricoleurs who “routinely act in chaotic conditions” (Weick, 1993, p. 639) and (at a macro and meso level) by proper organizational structure and role design (Weick, 1993; Weick, 1988).

## 5.2.1 Anticipation

The anticipation stage refers to the preparation for future threats and critical developments. This stage represents the foundation on which responses to threats and adversities are implemented (Duchek, 2020; Williams et al., 2017). Anticipation capabilities decrease the vulnerability of the organization and helps it in identifying threats (Williams et al., 2017).

The anticipation resilience stage includes the preventive aspect of resilience which concern the pre-shock phase (Duchek, 2020). Also called “proactive resilience” (Raetze et al., 2022). This form of resilience is not realized nor evident before the occurrence of the threat (Duchek, 2020). Proactive organizations anticipate future threats avoiding a “wait and see strategy” approach. Rather, they devote resources to observe the internal and external environments, identify threats, and plan for adversity (Duchek, 2020; Verreynne et al., 2023; Raetze et al., 2022).

First, environmental scanning is a critical step to detect the threat and quickly activate the response (Burnard and Bhamra, 2011). It can be performed in different ways, from deliberate gathering of data to casual exposure to relevant information (Duchek, 2020).

Second, recognizing that an event is indeed a threat for the organizations is a crucial step to activate the response process. Being aware of the vulnerabilities of the organization help in promptly detecting the problems (Burnard and Bhamra, 2011).

Third, planning for adversity is based on risk-management practices and emergency planning. It can be conducted via training and simulations (Duchek, 2020; Williams et al. 2017).

However, planning for adversity is limited by the fact that often crises are unforeseeable: planning for the unexpected is impossible (Duchek, 2020). Therefore, coping capabilities are necessary to respond to crises and disruptions.

## 5.2.2 Coping

The coping stage is the offensive response to the threat that generates the critical situation; it chronologically refers to the phase that follows the threat (Duchek, 2020). During this phase, organizations must exploit the coping capabilities to pragmatically realize the resilience potential accumulated in the anticipation stage (Duchek, 2020; Raetze et al., 2022).

Many challenges are critical during the coping stage (Burnard and Bhamra, 2011; Duchek, 2020). First, as a threat occurs, an organization is challenged from a cognitive perspective (Williams et al., 2017): reality and the accident must be accepted and a quick understanding of the critical situation is necessary (Duchek, 2020). Information can be easily understood in an inappropriate manner. Importantly, when a threat is detected, an organization should avoid simplistic interpretations; rather, a triangulation of different perspectives may help in better understanding the problem and its implications (Burnard and Bhamra, 2011). Therefore, the organizational knowledge base is paramount to detect and correctly frame the problem and its cause-effect relationships (Williams et al., 2017; Duchek, 2020).

Second, a variety of possible responses must be developed (Burnard and Bhamra, 2011; Duchek, 2020). Solutions may derive from the combination of extant and new resources, combined in a novel original manner (e.g., through bricolage, Baker and Nelson, 2005). Third, response actions must be promptly implemented. Coping behaviors may include: role shifting, reorganizing routines, reassembling work activities, changing habits, developing specific tactics, blending bureaucratic structure with improvisation and ad-hoc actions, role enactment, identification and mobilization of resources, emergent communication and coordination (Williams et al., 2017). The coping stage is followed by the adaptation phase.

## 5.2.3 Adaptation

During the adaptation stage, an organization adapts its organizational functioning to the changed environment and, by adjusting, learns after critical situations (Duchek, 2020). The adaptation stage includes two types of capabilities: (1) reflection and learning; and (2) organizational change capabilities (Duchek, 2020; Raetze et al., 2022).



First, reflection and learning are necessary to transform experience in new knowledge. Stepping back from the crisis to infer meaning from the events enables the organization to get new insights about threats and adversities. Problems should be articulated, analyzed, explained via the formulation of a theory, which can lead future action (Daudelin, 1997). Learning may occur thanks to formal meetings and problem-solving sessions as well as through informal conversation. However, learning can be vicarious too, i.e. based on failures and crises experienced by similar organizations (Williams et al., 2017; Ducheck, 2020).

Reflection and learning nurture the endowments that influence organizational resilience (Williams et al., 2017). More specifically, the knowledge base can be viewed as the cognitive aspect of organizational endowments: the sum of the expertise and training of organizational actors (Williams et al., 2017). It enables the acquisition of information, its transformation in new knowledge, the encoding of knowledge in organizational routines (Williams et al., 2017). Extant knowledge facilitates the interpretation and sensemaking of the contextual information during a crisis (Ducheck, 2020). Also, scanning and monitoring activities are restricted to the areas which are familiar and proximate to the knowledge base the organization is endowed with (Ducheck, 2020). Learning processes activate the enhancement of all the stages of resilience, including the anticipation and the coping ones.

The knowledge base is the very foundation for the anticipation, coping, adaptation stages (Ducheck, 2020): on the one side, the knowledge base is the result of the three resilience processes; on the other side, it nurtures them and make them evolve. In fact, knowledge is useful “to anticipate both internal and external change, even if this knowledge is far away from the organization’s core business” (Ducheck, 2020; p. 234). Knowledge about previous crises and successful past experience is useful to generate multiple solutions to solve crises and select the most suitable path of reactions (Ducheck, 2020). The knowledge base reflects the diversity of skills, personalities, perspectives, experiences (Ducheck, 2020), which are related with critical thinking and creativity (Williams et al., 2017). These are paramount to better frame disruptions, via the triangulation of the interpretations, and to generate multiple potential responses (Burnard and Bhamra, 2011). The knowledge base should trigger a deeper analysis of crisis and prevent organizations to explaining failures.

Lessons learned must be translated into new mental models and new behavioral routines (Williams et al., 2017; Ducheck, 2020). Therefore, the adaptation phase involves both the cognitive

and the behavioral dimension of the organizations. Furthermore, learning and change concern all the organizations levels – micro, meso, macro.

Organizations effectively cope with adversities and adapt to new environmental conditions if they are agile and flexible and if they leverage workforce's skills. The next paragraphs illustrate how an organization may reconfigure in coping with and adjusting to adversities (paragraph 5.3) and how resilience derive from workforce's capabilities (paragraph 5.4).

## 5.3 Agility and flexibility of companies

During crisis, organizations need to transform their structures and change products and services (Duchek, 2020; Linnenluecke, 2017). Agility and flexibility are the key resilience capabilities that enable organizations to reconfigure resources promptly in face of changes (Iftikhar et al., 2021; Verreyne et al., 2023; Weber and Tarba, 2014). Flexible organizations can “bend without breaking” (Peck, 2005), design a new course of action quickly and reconfigure the resources in response to threat (Iftikhar et al., 2021).

Agility and flexibility depend on organizational design. From an organizational design perspective, flexibility and agility refer to the capability of reshaping and adjusting the structure (management and roles) to make material and immaterial resources available across the organization. In fact, in flexible organizations, inter-department barriers are permeable, employees can easily switch jobs, generalists may occupy key positions, leaders can be substituted. Also, agility derives from the information flow thought the organizational structure, as the fragmentation of information hinder the understanding of problems and the capability to react (Williams et al., 2017; Weick, 1988, 1993). The principles for organizing for resilience are: decentralization, self-organization, shared decision-making processes (Duchek, 2020; Verreyne et al., 2023; Williams et al., 2017). Modularity can increase agility, too (Weber and Tarba, 2014). Opposite, rigid organizations based on hierarchy, bureaucracy and mechanistic structures are less capable to absorb shocks (Duchek et al., 2020). As suggested by Weick (1988, p. 312): *“the person in authority is not necessarily the most competent person to deal with a crisis”*. Overall, an organizational design based upon flexibility principles is characterized by low cost and reduced difficulties in adaptive coordination (Weber and Tarba, 2014), which enables

people with the right skills to be involved even in new teams or departments (Verreyne et al., 2023; Weick, 1988).

Relational capabilities increase agility and flexibility, too. Internal relationships must be characterized by trust and common knowledge, which underpin the switch of jobs and substantiality of leaders (Williams et al., 2017; Verreyne et al., 2023). Social ties facilitate information sharing, resource exchange, and collaboration across functions and hierarchical levels (Duchek, 2020; Lengnick-Hall et al., 2011).

## 5.4 Talented and skilled workforce

Resilience organizational capabilities derive from the skills and talents of an organization's human resources (HR, Lengnick-Hall et al., 2011). Organizational resilience capabilities can be understood as the aggregation of the individual capabilities of organizational members (Douglas, 2021). Indeed, resilience organizational capabilities result from individual-level knowledge, cognitive and behavioral skills. Importantly these, canalized through motivation, lead the sense-making process and the response to the threat (Weick, 1988; Douglas, 2021).

More specifically, at the individual level, decisiveness and risk-assessment capabilities, commitment in face of adversities, and persistence are important resilience-related characteristics (Lengnick-Hall et al., 2011). For instance, as reported by Delfino and van der Kolk (2021), during the covid-19 pandemic, organizational resilience derived from the individual skills in working autonomously.

From a procedural perspective (see paragraph 6.2), during the coping phase, the organizational response to the shock depends on individual responses to adversities (Burnard and Bhamra, 2011): for example, employees can improvise a solution with the resources that they have at hand (Coutu, 2002) demonstrating ingenuity and bricolage skills. In the adaptation stage, organization change is successfully realized when all organizational members contribute to the organization's destiny, finding solutions, selecting and adopting behaviors that fit the new context.

Emphasizing the role of human resources, Lengnick-Hall et al. (2011) illustrate some HR principles that can increase the flexibility and agility of organizations leveraging the skills of workforce: *"localize decision making power, (...) create fluid team-based work and job design, (...) minimize*

*rules and procedures, (...) use both formal and informal social integration mechanisms*" (Lengnick-Hall et al., 2011, p. 250). These principles have direct implications on a micro (i.e., individual) level: organizational members should have the right skills to apply discretion in decision making and to take actions respecting the overarching goals (Lengnick-Hall et al., 2011). Cognitive skills and capabilities play a crucial role (Williams et al., 2017) in shaping how human resources change, innovate, improvise, generate viable alternatives, avoiding the collapse of sense-making (Weick, 1993). Qualified and skilled workforce can effectively assimilate information, direct attention (Williams et al., 2017), and detect threats (Linnenluecke, 2017). Skilled organizational members can combine knowledge and reaction repertoires to solve problems, enhance making sense of the dynamic environment, critically question the context, have flexible and creative approach to the dynamic context (Williams et al., 2017, p. 744).

The cognitive aspect interacts with the behavioral one at the individual level (Weick, 1988). On the one hand, crises require sensemaking processes, i.e. a cognitive process of interpretations. On the other hand, "people think by acting" (Weick, 1988, p. 305) with unclear outcomes: *"understanding is facilitated by action, but action affects events and can make things worse"* (Weick, 1988, p. 306).

To increase the skills and talents of workforce, some practices have been suggested by Lengnick-Hall (2011): *"hire to ensure a range of different experiences, perspectives, paradigms, and competencies are available in the workforce, (...) place a high value on pluralism and individual differences, (...) invest in human capital"* (p. 250). Other factors that can increase resilience via individual-level skills and endowments are (Douglas, 2021): 1) focus on curiosity, collaboration, creativity, and empathy to make employees reskill and reinvent fast; 2) passion to solve unseen future problems combined with the traditional focus on workforce's short-term needs; 3) motivation to make an impact and contribute to the organizational outcome; 4) exploitation of learning through experience; 5) design the performance management system so that people are incentivized to learn and adapt.

Workforce commitment must be carefully monitored during crises (Lengnick-Hall et al., 2011; Douglas, 2021): *"the dark side of commitment is that it produces blind spots. Once a person becomes committed to an action, and then builds an explanation that justifies that action, the explanation tends to persist and become transformed into an assumption that is taken for granted"* (Weick, 1988, p. 310).

Overall, a crucial factor making organizations more resilient is training and development of the workforce. Training should be addressed to the employees in a flexible and targeted manner to involve them and make interventions effective (Douglas, 2021).

## 5.5 Resilience outcome

Focusing on the outcome of the processes, which leverage organizations' agility and flexibility (paragraph 5.3) and human resources' skills (paragraph 5.4), resilience is intended as the ability to rebound from crisis promptly and return to the pre-shock state (Darkow, 2019). Interacting with the context and the organizational endowments (Williams et al., 2017; Lengnick-Hall et al., 2011), the capabilities enacted during the resilience stages lead to an outcome, i.e. a response that can be either successful or not (Burnard and Bhamra, 2011) or "something in-between" (McConnell, 2011).

Conceptualizing resilience as an outcome, first, it is necessary to define the pre-shock state, i.e. the "*status quo that needs to be rebuilt*" (Darkow, 2019, p. 151). Second, the variable that is usually used is the time needed for the organization to restore the normal level of functioning or performance (Linnenluecke, 2017).

The outcome can be outlined as a triangle (Bevilacqua et al., 2017) that visualizes the impact of the disruption in terms of functionality loss. It focuses on the magnitude of the impact on performance (vertical axis) and the time needed to recover (horizontal axis). This conceptualization was developed in the case of single-event crisis, e.g. an earthquake or a flood, to measure the resilience of infrastructures (Darkow, 2019; Bevilacqua et al., 2017). The same rationale can be adopted to conceptualize organizational resilience; it is suitable to describe events that have a clear beginning (Darkow, 2019).

However, a limitation of the resilience-as-an-outcome approach is that those organizations that are excellent in anticipation resist to environmental shocks or buffer against them. Therefore, the trajectory of recovery is smoothed because of the proactive and anticipatory capabilities of the organization (Linnenluecke, 2017; Raetze et al., 2022). In addition, the pre-shock state is not easily definable, as organizations are evolving and complex systems (Darkow, 2019). New environmental conditions require adaptation and adjustment as well as the restoration of former processes (Darkow, 2019): this is reflected by the procedural view (Williams

et al., 2017), that intends the desired outcome as possibly changing over time (Darkow, 2019). Consequently, resilience is better understood when combining the resilience-as-an-outcome approach with the resilience-as-a-process perspective (see paragraph 6.2).

## 5.6 Reference to the questionnaire

As anticipated in Table 1, the questions concerning the topics presented in section 6 are the following ones: B21, B22 (resilience capabilities, notably, agility and flexibility). Questions B1, B8, B9, B10, B11, and B12 aim at assessing resilience outcome. Questions B2 and B3 (as well as some items of questions B21 and B22) measure the skills of the workforce.

# 6. Sustainability

## 6.1 Sustainability conceptualization

The Oxford Dictionary defines sustainability as "the use of natural products and energy in a way that does not harm the environment." This definition is rooted in one of the earliest formulations of sustainability, crafted in 1987 by the United Nations Brundtland Commission: "Meeting the needs of the present without compromising the ability of future generations to meet their own needs." Since then, academic research in sustainability has flourished, yielding a plethora of definitions, approaches, and perspectives across various research domains (Shrivastava and Berger, 2010). There are three commonly accepted dimensions of sustainability: social, environmental, and economic (Hahn et al., 2015), all stemming from the concept of the Triple Bottom Line introduced by Elkington in 1994 (Elkington, 1994; De Giovanni, 2012).

Social sustainability concerns ensuring the well-being of people and communities. It encompasses fair profit distribution within the supply chain, ensuring adequate wages and fair prices for suppliers, combating child labor, upholding workers' rights, and engaging in social initiatives within communities (Shrivastava and Berger, 2010). Environmental sustainability involves preserving the natural environment in which businesses operate and includes managing energy use efficiently, promoting renewable energy sources, implementing waste management strategies to limit waste production and encourage recycling, reducing harmful emissions, responsibly using natural resources, and restoring the environment post-utilization (Hahn et al., 2015). Finally, the economic sustainability focuses on an organization's ability to create economic value while considering both positive and negative externalities generated by its activities. It goes beyond traditional accounting profit to encompass broader economic impacts within the ecosystem (Elkington, 2018).

Supply chain sustainability research has largely focused on environmental aspects, neglecting social dimensions (Fahimnia and Jabbarzadeh, 2016). However, social sustainability, encompassing issues like human rights and fair trading, remains a crucial yet underexplored area (Jabbarzadeh et al., 2018). Integrating economic, social, and environmental dimensions is challenging due to potential tensions among them (Hahn et al., 2015).

In recent years, there has been a surge in interest in the relationship between sustainability and resilience. Studies have begun exploring synergies, trade-offs, and other links between these concepts, highlighting the interconnectedness of resilience and sustainability in addressing contemporary challenges (Negri et al., 2021; Silva et al., 2023).

## 6.2 Synergies between resilience and sustainability

According to proponents of synergies, resilience and sustainability are deeply intertwined, and it results to be impossible achieving resilience without considering sustainability. Some studies support the idea that resilience promotes sustainability by enhancing a company's ability to cope with environmental disruptions (Ciasullo et al., 2023). Additionally, resilience is a critical element in addressing the new challenges that sustainability leaves to organizations (Liang and Li, 2023). However, if resilience is not pursued thoughtfully, it could lead to unsustainable practices, such as overexploitation of resources to achieve redundancy (Ciasullo et al., 2023). Therefore, resilience must be pursued in conjunction with sustainability.

Other studies view the synergistic relationship between resilience and sustainability from the opposite perspective, believing that sustainability fosters resilience. Sustainable companies create significant value for society while minimizing risks and vulnerabilities, thereby enhancing their resilience (Winnard et al., 2014). Practices that enable companies to become more sustainable mitigate long-term threats by enhancing resilience (Ortiz-De-Mandojana and Bansal, 2016). Moreover, sustainable companies exhibit lower financial volatility because sustainability efforts enable them to withstand shocks better and recover more quickly. Additionally, sustainable companies tend to grow more rapidly in the long run by capturing a larger market share. Sustainable companies have a greater chance of survival by demonstrating greater resilience while creating sustainable supply chains reduces long-term risks and enhances resilience (Ivanov, 2018).

The literature categorizes practices that enhance sustainability and resilience into four main domains: supply, demand, product, and information (Negri et al., 2021). On the supply side, effective practices include managing long-term supplier relationships, sharing information across the supply chain, engaging sustainable suppliers, and adopting multi-sourcing



strategies with multiple sustainable suppliers. Demand-side strategies encompass customer relationship management and demand flow management while product-related practices involve product repairability, modularity, interchangeability, and pricing strategies. Finally, information-related practices encompass training, education, information sharing, and security measures.

Specific capabilities within each supply chain domain support the simultaneous pursuit of sustainability and resilience. For instance, infrastructure improvements from a sustainable perspective yield benefits in both areas (Ivanov, 2018). Flexibility and collaboration, essential for resilience, also enhance social sustainability efforts (Shen and Sun, 2023). In dynamic environments like wineries, resilience strategies include product and process innovation, changes in corporate governance, capability development, and building connections, all of which unexpectedly contribute to sustainability (Golicic et al., 2017). Similarly, other strategies may have a dual positive effect on resilience and sustainability.

## 6.3 The trade-off between resilience and sustainability

The pursuit of sustainability can challenge a company's ability to remain resilient and respond swiftly to unforeseen disruptions. One of the key contradictions between sustainability and resilience revolves around redundancy. While redundancy enhances resilience by ensuring system reliability in the face of unexpected events like machinery failures can be viewed negatively from a sustainable standpoint due to potential resource waste and the maintenance of unused production capacity (Tan et al., 2019).

Moreover, sustainability inherently adopts a long-term perspective, considering future generations and aiming for continuous operations without being constrained by environmental degradation (Priyadarshini et al., 2023). Conversely, resilience focuses on short-term goals, seeking to safeguard immediate outcomes (Priyadarshini et al., 2023). Despite the widely acknowledged trade-off posed by redundancy, some studies surprisingly suggest that redundancy can enhance both sustainability and resilience (Shin and Park, 2019).

Another trade-off arises from the need to engage sustainable suppliers, which may limit collaboration options. While partnering with sustainable suppliers enhances a company's sustainability, it diminishes resilience against disruptive events that could impede the suppliers' ability to provide raw materials (Ivanov, 2018). Furthermore, the pursuit of sustainable warehouse management, involving reduced storage facilities and fewer idle raw materials, can increase the risk of production shutdowns during disruptive events due to insufficient inventory (Ivanov, 2018).

During disruptive events like the COVID-19 pandemic, companies often prioritize maintaining financial performance over sustainability goals, temporarily suspending sustainability initiatives to address immediate challenges (Sajko et al., 2021). In some cases, social sustainability initiatives take precedence over environmental sustainability efforts (Sauer et al., 2022).

Lastly, sustainability and resilience exhibit differing time perspectives. Resilience typically focuses on short-term responses to urgent and probable disruptions, whereas sustainability emphasizes long-term actions aimed at ensuring the company's endurance without harming the surrounding ecosystem. However, studying sustainability and resilience requires considering both short and long-term perspectives (Winnard et al., 2014).

## 6.4 Other relationships between resilience and sustainability

Some studies explore alternative relationships between sustainability and resilience. In certain instances, resilience and sustainability are closely associated but not directly correlated, meaning strategies aimed at enhancing one may not necessarily impact the other positively or negatively (Negri et al., 2021). On the contrary, other research identifies a more diverse relationship between resilience and sustainability, pinpointing six synergies and four trade-offs (Silva et al., 2023). Additionally, Higgins et al. (2010) propose that resilience falls under the broader umbrella of sustainability, viewing resilience as one component of sustainable firms. In this context, there is neither a synergy nor a trade-off; rather, resilience is regarded as a subset of sustainability, one of several conditions necessary for sustainability.

In conclusion, the relationship between sustainability and resilience remains somewhat ambiguous (Negri et al., 2021). While a connection between the two concepts is evident, conflicting findings persist. It remains uncertain whether sustainability and resilience mutually reinforce each other, if trade-offs exist necessitating a balance between efforts to be resilient and sustainable, or if the relationship takes a different form, such as a combination of synergies or trade-offs, no relationship at all, or one concept being subsumed within the other.

## 6.5 Reference to the questionnaire

As anticipated in Table 1, the questionnaire concerning the topics presented in section 6 are the following ones: B15; B16.

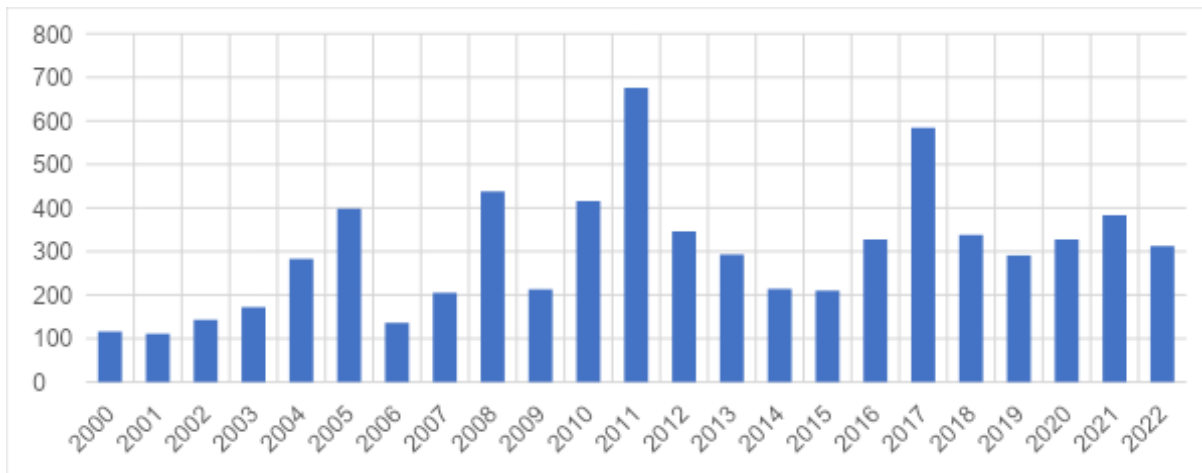
# 7. Crisis and Supply Chain Disruptions

## 7.1 Crisis and Supply Chain Disruptions: Context

In recent years, the global economy has faced a barrage of formidable challenges, including natural disasters, pandemics, and geopolitical shifts. These crises have caused profound disruptions to supply chains, highlighting the critical need for effective supply chain management during such disruptions (Al Naimi et al., 2022). Crises are characterized as unforeseen and unintentional situations that pose significant risks to the supply chain, resulting in exceptional and widespread disruptions (Gunessee et al., 2018).

Numerous examples illustrate how crises lead to supply chain disruptions. Natural disasters, such as floods, hurricanes, earthquakes, and tsunamis, arising from Earth's natural processes, can have devastating effects on supply chains (Baharmand et al., 2019). For instance, the 1999 earthquake in Taiwan and the subsequent tsunami and earthquake in Japan in 2011 had profound impacts on global supply chains. The Taiwan earthquake disrupted operations for PC manufacturers like Dell and Apple, while the Japanese tsunami affected various industries, including automotive and electronics (Hosseini & Ivanov, 2019). These events caused extensive damage to critical infrastructure, including manufacturing facilities and transportation networks, resulting in significant production and distribution delays. The ripple effect of these disruptions reverberated throughout the supply chain, highlighting the interconnectedness and vulnerability of global manufacturing networks. However, these events were not isolated incidents. The economic fallout from natural disasters has been substantial, with the global economic loss attributed to such events reaching approximately 313 billion U.S. dollars in 2022 alone (Statista, 2024, see Figure 1).

Figure 1. Global economic losses from natural disasters 2000–2022 (in billion U.S. Dollars)



Source: Statista (2024)<sup>1</sup>

Moreover, epidemics and health crises have profoundly impacted global supply chains. Events such as the outbreaks of diseases like mad cow disease in 2001, SARS in 2003, and most notably, the COVID-19 pandemic in late 2019, have underscored the vulnerability of supply chains to public health emergencies (Ghobakhloo et al., 2023). Lockdowns and restrictions aimed at containing the spread of disease led to widespread factory closures, labor shortages, and disruptions in transportation and logistics networks. The COVID-19 pandemic, in particular, generated several vulnerabilities in supply chains worldwide, from shortages of critical medical supplies to disruptions in the production and distribution of consumer goods and electronics. The uneven impact of the pandemic on consumer demand further complicated supply chain management, resulting in fluctuations in production and distribution patterns.

Regarding geopolitical shifts and man-made disasters, events such as terrorist attacks, trade disputes, and geopolitical tensions have also contributed to supply chain disruptions (Meyer, 1982; Weick, 1988; Raetz et al., 2021; Rice & Caniato, 2003). For example, longshoreman strikes at US ports in 2002 and tariffs imposed on billions of products due to trade conflicts have disrupted global trade flows and supply chain operations. Moreover, geopolitical uncertainties and trade

<sup>1</sup>

tensions have led to increased costs, necessitated supply chain reconfigurations, and disrupted sourcing strategies. A prime example of this is the Brexit referendum in 2016, and subsequent negotiations have heightened concerns regarding border delays and regulatory changes, further complicating supply chain management for companies operating in Europe.

## 7.2 Crisis and Supply Chain Disruptions – Perceived and Real Impact

Even when confronting identical disruptions or crises, companies may experience divergent impacts due to their unique internal strengths (Ambulkar et al., 2015). For instance, let's consider two companies within the same industry grappling with a sudden tariff hike resulting from a trade dispute between two nations. Despite encountering the same external disruption, their internal capabilities and strategic positions could lead to markedly different outcomes. Company A, equipped with diversified suppliers and agile sourcing strategies, could swiftly adapt to tariff changes by relocating production to alternative regions or renegotiating contracts with existing suppliers. Conversely, Company B, heavily reliant on a single source of raw materials and lacking flexible sourcing options, might struggle to mitigate tariff impacts, facing escalated production costs and supply chain bottlenecks.

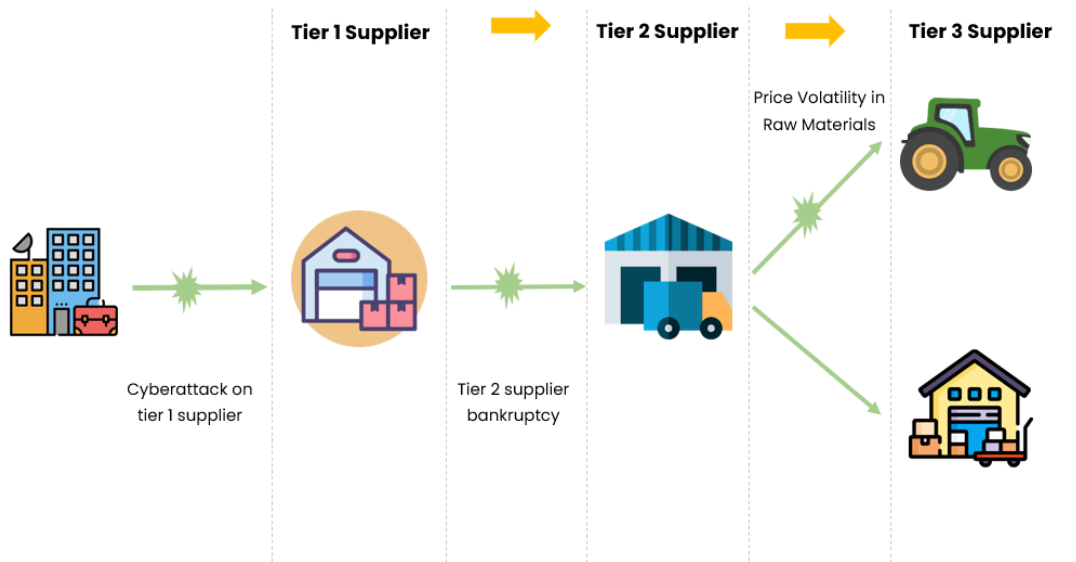
Despite facing the same disruption, the perceived and actual impact can significantly vary between these two companies. This phenomenon aligns with Attribution Theory, pioneered by Fritz Heider, which suggests that individuals interpret events based on their attributions or explanations for those events (Kelley & Michela, 1980). Furthermore, it supports Cognitive Bias Theory, proposed by Daniel Kahneman, Amos Tversky, and Richard Thaler, as cognitive biases can change individuals' perceptions and interpretations of crisis-related information, potentially leading to overestimation or underestimation of the threat posed by an event (Mata, 2012).

For this reason, a clear segregation is made between perceived impact and real impact. The perceived impact of disruptions in a company's operations encompasses a comprehensive assessment of threats from various aspects of the competitive environment in which it operates. This includes considerations such as increases in the cost of materials, services, or labor, legislative changes, the potential loss of crucial customers or suppliers, as well as emerging competition (Craighead et al., 2007).

The perceived impact is influenced by several critical factors. One key determinant is the severity of the disruption and its direct implications on the company's operations, playing a significant role in shaping perception (Craighead et al., 2007). Disruptions that directly affect production or distribution channels may be perceived as more severe compared to those with indirect consequences. Moreover, the geography and industry in which the company operates can significantly influence its perception of the impact of disruptions. Industries with complex and interconnected supply chains, such as automotive or electronics, may perceive disruptions more acutely due to the ripple effects across multiple tiers of suppliers and customers (Han et al., 2020). This phenomenon, often referred to as the "bullwhip effect," illustrates how small disturbances at the upstream end of the supply chain can amplify as they propagate downstream leading disruptions to be felt more acutely due to their ability to cascade throughout the interconnected network of suppliers and customers (Dolgui et al., 2020).

For example, let's consider the scenario depicted in Figure 2, where a major manufacturer, Company X (tier 1 supplier), falls victim to a cyber-attack, compromising its production processes and sensitive data. As a result, one of its tier 2 suppliers, Company Y, which produces critical components for Company X, faces financial turmoil and ultimately declares bankruptcy. This event not only disrupts Company X's operations but also affects its tier 3 suppliers, such as Company Z (tier 3 supplier), which provides raw materials to Company Y. With Company Y no longer operational, Company Z experiences a sudden decline in demand for its raw materials, leading to price volatility in the market. The ripple effect of these disruptions extends beyond individual companies, impacting the entire industry as manufacturers struggle to source components, face production delays, and navigate price fluctuations.

Figure 2. Crisis and Disruption Effect on Multi-tier Supply Chain



Source: Adapted from Oracle<sup>2</sup> (2024)

To gain deeper insights into perceived threats faced by companies, we included questions in our survey to Italian firms, focusing on their experiences with perceived threats in the competitive environment over the past two years. This will help us gauge the extent to which these businesses have been impacted by events related to their competitive landscape.

Shifting our attention to the tangible impact of crises and supply chain disruptions, the literature suggests that the magnitude of these effects varies significantly depending on multiple factors and differs with each occurrence. Companies often struggle to quantify the effects of supply chain disruptions, and empirical evidence remains limited (Wagner and Neshat, 2012).

In broad terms, the repercussions of supply chain disruptions may encompass a decline in sales and/or an increase in costs (Ponomarov and Holcomb, 2009), from which many companies struggle to fully recover (Wagner and Neshat, 2012). Sales decreases may result from an inability

2



to meet customer demand, leading to customer dissatisfaction, tarnished image and brand reputation, and customer attrition (Dolgui et al., 2018). For example, the 2000 plant fire at Philips microchip in New Mexico caused a chip shortage in the market, resulting in approximately \$400 million in lost sales for cell phone producer Ericsson (Dolgui et al., 2018).

Conversely, increased costs may stem from utilizing alternative transportation methods, entering into premium supplier contracts, rescheduling production, shutting down production, and facing penalties for contract breaches or non-compliance with legal requirements (Jabbarzadeh et al., 2018; Wagner and Neshat, 2012). Overall, declining sales and escalating costs ultimately lead to reduced turnover and a decrease in the company's value (Ivanov, 2017). When evaluating the impact of crises and supply chain disruptions, it is crucial to consider both perceived and actual impacts. This comprehensive approach enables stakeholders to gain nuanced insights into the nature and severity of risks, empowering them to develop proactive measures and response strategies to effectively mitigate and manage crises and disruptions (Ali et al., 2023). Hence, we have incorporated questions in our survey, focusing on changes in company turnover due to crises and supply chain disruptions over the past two years, particularly in the competitive environment.

## 7.3 Crisis and Supply Chain Disruptions – Categorization

The type of crises and disruptions in supply chains play a critical role in their perceived and actual impacts. Academic research has extensively classified and defined these disruptions from various perspectives. For instance, Ivanov et al. (2019) categorized disruptions based on the phase they affect, such as production, procurement, or transportation. Tang and Tomlin (2008) further classified disruptions based on their frequency, differentiating between minor disruptions occurring regularly (linked to procurement, processes, and demand volatility) and major crises occurring less frequently but with more significant impact (such as pandemics or wars). Additionally, Katsaliaki et al. (2022) classified disruptions according to their primary causes, such as natural events or those caused by humans, demand forecasting errors, or supply interruptions.

Our report builds upon the framework proposed by Katsaliaki et al. (2022), categorizing disruptions into five distinct categories based on their cause, detailed in Table 1: Catastrophic events/Macro level risks; Demand-side events; Supply-side events; Logistics–Transportation events; and Production–Infrastructural events. We further enhance the proposed framework to incorporate recent references, offering a comprehensive understanding of the sources of supply chain disruptions.

Table 2 presents the main outputs. Each category of supply chain disruptions is supported by indicative references, providing insights into the scholarly literature addressing these critical aspects of supply chain disruption management. This classification framework enables companies to identify potential risks and develop targeted strategies to mitigate the impact of disruptions on their operations. This table served as the foundation for questions in the survey, where each disruption type is indicated to provide insights into the sources of disruption.

The first category, Catastrophic events/Macro level risks, encompasses natural disasters, political instability, trade disputes and tariffs, and diseases or epidemics. These external factors are beyond a company's control and can have far-reaching consequences, disrupting supply chains on a global scale (see Freund et al.; 2018; Gunessee et al., 2018; Ivanov, 2020; Sheffi, 2001). For instance, natural disasters like earthquakes or hurricanes can damage infrastructure and disrupt transportation networks, while political instability and trade disputes can lead to regulatory changes and border delays. Similarly, outbreaks of diseases or epidemics, such as the COVID-19 pandemic, can cause widespread disruptions by affecting workforce availability and disrupting international trade. In the questionnaire, this category is represented by the impact of disruptive challenges resulting from trade disputes and tariffs.

Demand-side events focus on disruptions related to customer behavior and market dynamics (see Baghalian et al., 2013; Kanike, 2023; Lee et al., 1997; Yang and Fan, 2016). These events can include unanticipated or volatile customer demand, which may lead to shortages of raw materials and production delays. Additionally, insufficient or distorted information from customers can contribute to coordination and sourcing constraints, making it challenging for companies to manage their supply chains effectively. For instance, the sudden surge in demand for personal protective equipment during the COVID-19 pandemic led to shortages and supply chain disruptions for healthcare providers. In the questionnaire, this category is represented by

the impact of disruptive challenges resulting from the shortage of raw materials, for not meeting the demand.

Supply-side events involve disruptions originating from suppliers, emphasizing the importance of supplier relationships and risk management strategies (see Atadeniz and Sridharan, 2019; Ni et al., 2016; Sarkar and Kumar, 2015). These disruptions can include supplier bankruptcy, financial instability, product quality issues, and sourcing constraints. Companies reliant on a single source of supply are particularly vulnerable to these events, as they may struggle to find alternative suppliers or quickly adapt to changing market conditions. An example of this was the bankruptcy of Hanjin Shipping in 2016, which disrupted global shipping networks, stranding cargo on ships and causing delivery delays. In the questionnaire, this category is represented by the impact of disruptive challenges resulting from supplier bankruptcy or financial instability and delocalization or reshoring of suppliers (i.e., re-localization of suppliers through the procurement of raw materials, semi-finished products, etc., from suppliers located in closer territories/countries).

Logistics-Transportation events encompass disruptions related to poor logistics performance and transportation interruptions (see Dupont et al., 2018; Fan et al., 2017; Maiyar and Thakkar, 2019). Issues such as delays in transportation or poor logistics coordination can lead to inventory shortages and production delays. Similarly, disruptions in transportation networks, such as port closures or labour strikes, can significantly impact supply chain operations, particularly for companies with global supply chains. For instance, the grounding of flights during the COVID-19 pandemic disrupted air cargo networks, leading to delays in delivering high-value and time-sensitive goods. In the questionnaire, this category is represented by the impact of disruptive challenges resulting from transport interruptions.

Finally, Production-Infrastructural events cover disruptions within a company's operations, emphasizing the importance of internal risk management and contingency planning (see Ghadge et al., 2019; Khakzad, 2015; Yang et al., 2017). These events can include the loss of production capacity due to technical reasons, unplanned IT or telecommunications outages, cyber-attacks and data breaches, and quality control issues. Companies must invest in robust infrastructure and technology systems to minimize the risk of these disruptions and ensure

business continuity. In the questionnaire, this category is represented by the impact of disruptive challenges resulting from quality control issues.

Table 2. Categorization of the disruptions

Categories	References
<p>Catastrophic events/Macro level risks</p> <p>Natural disasters</p> <p>Political instability</p> <p>Trade disputes and tariffs</p> <p>Diseases or epidemics</p>	<p>Freund <i>et al.</i> (2018), Gunessee <i>et al.</i> (2018), Ivanov (2020), Sheffi (2001)</p>
<p>Demand-side events</p> <p>Unanticipated or highly volatile customer demand, rush orders that leads to shortage of raw materials</p> <p>Insufficient or distorted information from customers about orders or demand quantities, delivery, coordination and sourcing constraints (bullwhip effect)</p>	<p>Baghalian <i>et al.</i> (2013), Kanike (2023), Lee <i>et al.</i> (1997), Yang and Fan (2016).</p>
<p>Supply-side events</p> <p>Supplier bankruptcy or financial instability</p> <p>Delocalization or reshoring of suppliers</p> <p>Supplier product quality problems</p> <p>Sourcing constraints</p>	<p>Atadeniz and Sridharan (2019), Ni <i>et al.</i> (2016), Sarkar and Kumar (2015)</p>

Categories	References
<p>Logistics–Transportation events                      Poor logistics performance of suppliers                      Poor logistics performance of logistics service providers (LSP)                      Transport interruptions</p> <p>Production-Infrastructural events                      Loss of own production capacity due to technical reasons                      Unplanned IT or telecommunications outage                      Cyber-attack and data breach                      Quality control issues</p>	<p>Dupont <i>et al.</i> (2018), Fan <i>et al.</i> (2017) Maiyar and Thakkar (2019)</p> <p>Ghadge <i>et al.</i> (2019), Khakzad (2015), Yang <i>et al.</i> (2017)</p>

Source: Adapted from Katsaliaki *et al.* (2022)

## 7.4 Reference to the questionnaire

As anticipated in Table 1, the questionnaire concerning the topics presented in section 7 are the following ones: B7; B8; B13.

## 8. End-to-end solutions

### 8.1 Introduction to the Core Concepts

The integration of Industry 4.0 technologies (I4.0T) offers a pathway for SMEs to develop end-to-end solutions (E2ES), crucial for enhancing organizational resilience and sustainability (Margherita & Braccini, 2020). In turn, E2ES provide a tool to understand sustainability as a mechanism of transmission of firms' survivability. Amidst the COVID 19 crisis, the push towards innovative supply chain solutions represented an unvaluable asset, fostering social, environmental and thus economic sustainability and firm's resilience.

### 8.2 Conceptual Framework and Scale Construction

This section of studies on the E2ES topic within the GRINS project, grounded in dual-process theory (Kahneman, 2013), investigates the cognitive dynamics underpinning technological adoption, emphasizing the role of intuitive and rational decision-making in shaping strategic approaches to companies' innovation, resilience and sustainability. The conceptual framework stems by the growing recognition of the importance of networking capabilities, continuous innovation, and knowledge-sharing for the survival and growth of companies (Bogers et al., 2017; Chesbrough, 2020). Employing scales related to the survey's questions B23 and B24 (see Appendix), the research measures the extent of I4.0T' integration and assesses managerial perceptions towards their benefits and challenges, reflecting on the intricate decision-making processes involved. The E2ES, resulting from the synergy of Big Data analytics, the Internet of Things, Artificial Intelligence, and other I4.0Ts, can be jointly thought of as a group of driving forces, allowing firms to bypass third-party solutions, focusing on comprehensive client-focused chains. As a result of the adoption of E2ES solutions, the firm's economic considerations merge with the regulatory needs sprouting from the social and natural environment, driving up the necessity to adhere to new value chain solutions. A crucial question related to how sustainability and survivability interact stems from the interaction of E2ES and its underlying fundamentals

(relevant I4.0T, B23) together with the main driving factors justifying the adoption of innovative technologies (B.24).

## 8.3 Relevance of Variables and Concepts

To explore the linkage between survivability and sustainability, questions B.23 and B.24 would initially accommodate four paradigms: willingness of adopting the technology; impact evaluation of the effects of I4.0Ts on the development of sustainable practices; evaluation of perceived net advantages of I4.0Ts adoption; evaluation of perceived risks stemming from I4.0Ts practices.

Conditional on the overall objectives of the Spoke II WP 2 survey, the first paradigm, adoption rate intention, was translated by question B.23 into real perceived intensity of utilization, as the respondent was asked about its firm's investment choices in I4.0T during the last 2 years, adopting a Likert-like scale approach to measure intensity.

Considering the revealed utilization response from question B.23, the paradigm of willingness of adoption was instead embodied in B.24 as it would just represent an intentional prerequisite to the actual adoption of the technology. The third and fourth paradigms, following again a Likert scale ordering, were condensed into question B.24, to consider and evaluate jointly pros and cons of the adoption. The insights from B.24 and the literature employed to develop the scale show how each aspect of technological perception shapes the integration and efficacy of E2ES within SMEs. Echoing the findings of Pandya & Kumar (2023), technological tools, such as AI and Big Data Analytics, are instrumental in enhancing operational efficiency. The emphasis on fostering internal and external relationships highlights the role of Industry 4.0 in promoting collaboration and knowledge-sharing (Marzi, Manesh, Caputo, Pellegrini, & Vlačić, 2023). Furthermore, the capacity of these technologies could expand access to market insights and foster inter-business collaboration (Pappas, Caputo, Pellegrini, Marzi, & Michopoulou, 2021), underscoring the strategic value of technological adoption in driving innovation and market expansion. Challenges related to technology integration and organizational support should be also acknowledged, reflecting concerns about aligning new technologies with existing business models. Financial considerations and regulatory uncertainties also emerge as factors influencing the adoption process, requiring clear policies to mitigate risks and optimize the

benefits of technological investments. This comprehensive scale, grounded in the previous research (Marzi et al., 2023; Pandya & Kumar, 2023; Pappas et al., 2021), underlines the intricate interplay between technological capabilities, managerial perceptions and organizational strategies, highlighting the role of I4.0T in fostering sustainable end-to-end solutions for SMEs dealing with turbulent times.

Exploring the determinants of E2ES (question B.23) would ultimately allow for an analysis of firm survivability and resilience through sustainability. In this context, an exogenous shock, such as the COVID 19 crisis, would provide additional insight into the relationships among E2ES, survivability and sustainability, an area not fully explored in literature (Beltrami, Orzes, Sarkis, & Sartor, 2021). Demonstrating these relationships empirically would offer valuable managerial policies for firms seeking stable growth, highlighting the significance of leveraging I4.0T for operational enhancement, pointing towards a strategic alignment that fosters resilience and sustainable innovation. It would highlight the significance of cognitive approaches in managerial decisions, critical for navigating the adoption landscape of I4.0T and enhancing organizational practices for sustainability.

This research trajectory aims to shed light on the pivotal role of cognitive underpinnings in the SME's decisions towards I4.0T, contributing to the discourse on technological adoption and organizational strategy. The intended research path will delve into the dynamic relationship between technology, integrated solutions, and sustainable business practices, understanding how technological advancements can strategically enhance organizational survival, resilience and E2ES.

## 8.4 Reference to the questionnaire

As anticipated in Table 1, and explained throughout paragraphs 8.1, 8.2 and 8.3, the questions concerning end-to-end solutions (and their interplay with sustainability and resilience) are the following ones: B23, B24 .



# 9. Management controls, crisis and resilience

## 9.1 Management controls in context of crises

Merchant and van der Stede (2007, p. 5) defined management control as activities and mechanisms that increase the probability that the organization's objectives will be achieved. When severe or abrupt crises (e.g. financial crises, natural crises, the covid-19 pandemic) occur, environmental uncertainty and hostility can increase implying rapid adaptation by organizations, real-time solutions, and adjustments. However, different issues such as lack of information, weak collaborations of employees due to a poor understanding for required action, communication problems and inflexible procedures may effectively hamper rapid and effective responses (Smart and Vertinsky, 1977; Parker, 2023). Some studies have investigated the role of accounting and management control in addressing different types of crises such as financial crisis (Becker et al., 2016; Rikhardsson et al., 2021), natural disaster (Lai et al., 2014), the Covid-19 pandemic (Delfino and van der Kolk, 2021).

Becker et al. (2016) studied how the 2008 financial crisis affected budget controls. They focused on three budget functions namely, planning, resource allocation, and performance evaluation. The research revealed that planning-related functions became more vital during the crisis, emphasizing continuous planning and forecasting. Conversely, performance evaluation with budget targets became less critical, and alternative metrics gained traction. While rewarding employees for achieving organizational targets continued, the significance of reaching them decreased as employees recognized the challenges of receiving bonuses amid an economic downturn. In summary, budgeting's importance declined during crises, especially in performance evaluation. Rikhardsson et al. (2021) investigated the impact of the 2008 financial crisis on the Icelandic financial system. Management control mechanisms were used to formalised policies and procedures of the organization for a twofold purpose: to compliance with new standards established by regulatory agencies and, to strengthen the transparency and behavioral rules to restore clients' and local community trust in the financial system.

Passetti et al. (2021), investigated the role of management control mechanisms within a food retail company during the Covid-19 pandemic. From the research emerged that management control played a crucial role in facilitating swift adaptation to new circumstances by orchestrating appropriate organizational responses to address the crisis and, by supporting managers in making timely decisions. More specifically, to effectively combat the spread of the virus, the company introduced measures aimed at pursuing employee well-being, safety, and customers concerns. These measures facilitated a cohesive and coordinated organizational reaction, enhancing internal safety and providing suppliers with clear safety guidelines to compliance with. Delfino and van der Kolk (2021) investigated the effects of the transition to remote work due to Covid-19 within professional service firms. Such a transition implied changes on management control in terms of more online meetings and monitoring employees from a distance. In response to this new work environment, on one side, employees experienced increased autonomy and greater motivation, on the other, they also perceived higher stress levels and lower sense of connection within organizations.

Lai et al. (2014), examined the role of accounting practices during emergency response to the 2010 extreme flood event in the north of Italy. Results suggested that accounting and calculative practices contributed to the recovery process of the affected area. In a first time, accounting enabled to authorities to gain data and information about the area estimating damages. In a second time, accounting was used to transfer economic aid and donations to municipalities affected by the flood based on equity and transparent criteria. In this sense, accounting practices provided a rigorous basis for taking decisions and communicating with key-actors by creating a common and clear language, which was supported the sharing of information. Additionally, calculative practices enabled controls for reimbursement requests, enhancing the credibility of the accounting process and building trust among key stakeholders. Similarly, Sargiacomo (2015) investigated the role of accounting for the recovery process after the 2009 earthquake in Abruzzo. Also, in this case, accounting proved to be pivotal to distribute resources to communities affected by the earthquake and have access to government funding.

All these studies proved that management control can effectively support organizations in coping with extreme events or crises in many ways. Indeed, management control mechanisms have a wide range of manoeuvre within organizations, and they can be implemented across

different levels to orient actions, results, personnel attitude, and culture towards the organization's objectives (Merchant and van der Stede, 2007). However, gaining more empirical evidence from different organizations that dealt with crises and resilience may be helpful to collect information about how management control operates in the attempt to avoiding unsuccessful transition, to balancing possible trade-off, to identifying possible side-effects.

## 9.2 Management controls and resilience

If, on one side, literature is populated by different studies that explore the role of management control in addressing crises, research on relation between management control and resilience still appear less developed. However, some first insights depicted a positive relation between management control and resilience.

Bracci and Tallaki (2021) investigated the role of management control mechanisms in developing anticipatory and coping capacities within a public sector organization. Results suggested that the organization developed both anticipatory capacities (e.g. business planning, budgeting monitoring, operations control, more flexible budget, and environmental awareness) and coping capacities (training and internal communication and collaboration). Thanks to the implementation of anticipatory capacity, the organization was able to plan its activities both on short and long term, established operational objectives and monitoring activities and performance. In turn, control and monitoring enabled the company to be more flexible in reviewing budget and business plan whenever managers perceived the need to promote changes due to uncertainties and risks. At the same time, coping capacities encouraged the dialogue and the participation of people in the decision-making process, thereby spilling higher level of motivations. Therefore, according to the authors, management control may be intended as drivers for the organizational change and adaptation to new environmental conditions. Barbera et al. (2020) analysed how municipalities addressed austerity by means of accounting. Municipalities that before crisis had implemented long-term planning and control proved their ability of anticipating shocks. In addition, performing simulations to forecast future revenues and expenditures, enabled easier early budgetary approval process and encouraged the monitoring of revenues, expenditures, and quality of services. As result, such accounting practices promoting organizational change (e.g. the creation of a spending review unit)

Contrary, municipalities that based planning on short-term and mechanisms to increase budget flexibility were less prepared to anticipate shocks, however, they proved that accounting could be used for addressing the crisis. For example, accounting was used to coping with shocks through the implementation of short-term responses (e.g. creation of budgetary reserves).

In Parker's (2023) analysis of third-sector organizations coping with crises, organizational resilience was linked to organizational transformation. Management control through the monitoring (e.g. structural and cultural performance monitoring, environmental monitoring of key stakeholders) enabled organizations to collect high quality information. In turn, information systems and reporting were necessary to be bolster strategies for resilience fostering the sharing of the information and enhancing communication within and beyond the organization, networking, and collaboration. Additionally, traditional management control, based on financial information and guidelines, contributed to better management of financial and human resources, serving as anticipatory reserves in crisis management.

Kober and Thambar (2021) examined a charity to explore how accounting practices (e.g. budgeting, forecasting, performance reporting, accounting talk) were used to increase resilience. In particular, accounting talk facilitated both anticipatory and coping capacities within the organization. Through verbal discussions of accounting information, managers were able to customize information and discuss its implications. This discourse prompted considerations of potential future actions, enabling managers to collaboratively envision alternative organizational scenarios. Thus, accounting talk played a pivotal role in the organization's ability to anticipate and adapt to challenges. Moreover, results highlighted the significance of slack resources in building financial resilience. Financial reserves served as an organizational shock absorber, allowing managers the flexibility to implement necessary accounting practices. These reserves provided the time and space for accounting to evolve towards emphasizing learning, dialogue, and idea generation.

Lambert and Paterson (2024) investigated the measures implemented by charities to improve the resilience while they were facing Covid-19. Two contrasting approaches to addressing the crisis were observed: pragmatic resilience and strategic resilience. Results generated demonstrated that pragmatic resilience was focused on maintaining existing services and adopting a firefighting approach to income generation to ensure survival, with little emphasis on growth. Financial fluctuations were managed with limited growth achieved over time. In

contrast, charities applying strategic resilience, proactively encouraged growth opportunities and strategically managed crises with a forward-looking approach. In turn, the financial performance consistently improved, demonstrating adaptive capacity and learning.

All studies identified the role of management control mechanisms as pivotal for enhancing organizational resilience, strengthening the adaptation of organizations to new environmental conditions. In particular, management control mechanisms can improve the anticipatory capacity of organization to absorb shock (e.g. by implementing monitoring and associated information systems; generating slack resources) enabling organizations to rationalize environmental uncertainties to facilitate the decision-making process. In addition, all studies recognized the role of management control in advancing the organizational resilience when both short- and long-term perspectives were considered in planning. Although these first findings seem to suggest a connection between management control and resilience, the understanding of how and to what extent management control can contribute to improve the organizational resilience is still subjected to an open debate (Tillemma et al., 2022). For these reasons, advancing the research may be helpful to further explore the potentialities of management control mechanisms in improving resilience and contributing to organizations survival, especially in terms of anticipatory capacities and learning.

### 9.3 Reference to the questionnaire

The questions concerning management control and its interplay with resilience are presented in the section C of the Appendix.

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# 11. Appendix – Questionnaire

## 11.1 Section A – Company Profile

### **A1. Could you first tell me what your role is within the company?**

1. Owner/Entrepreneur
2. Partner/Shareholder
3. Administration Manager/CFO
4. CEO/Managing Director/Chief Executive Officer/President
5. Other
6. I prefer not to answer

### **A2. Excluding yourself, approximately how many employees and/or collaborators work in your company/business?**

1. 0 – only me
2. 1 to 9
3. 10 to 49
4. 50 to 249
5. 250 or more

### **A3. In which of the following sectors does your company/business operate?**

1. A: Agriculture and Food
2. B: Mining and Quarrying
3. C: Manufacturing
4. D: Supply of Electricity, Gas, Steam, and Air Conditioning
5. E: Water Supply, Sewerage, Waste Management, and Remediation Activities
6. F: Construction
7. G: Wholesale and Retail Trade, Repair of Motor Vehicles and Motorcycles
8. H: Transportation and Storage
9. I: Accommodation and Food Service Activities
10. J: Information and Communication Services
11. K: Financial and Insurance Activities
12. L: Real Estate Activities
13. M: Professional, Scientific, and Technical Activities
14. N: Rental, Travel Agencies, Business Support Services
15. P: Education
16. Q: Health and Social Work
17. R: Arts, Entertainment, and Recreation Activities
18. S: Other Service Activities

### **A4. In which Region and Province is the company headquartered? In case of multiple locations, please indicate the main one.**

- A. Region
- B. Province

### **A5. For how many years have you held this role within your company?**

1. Less than 1 year
2. 2–3 years
3. 5–10 years
4. More than 10 years

**A6. And could you kindly tell me your educational qualification?**

1. Elementary/No degree
2. Lower secondary school
3. Upper secondary school in progress
4. Professional institute diploma (3 years)
5. High school diploma (5 years)
6. University in progress/no degree obtained
7. University diploma/short degree
8. First-level three-year degree
9. Specialist/master's degree or 4–5 year degree
10. Master's degree/postgraduate specialization school
11. PhD

## 11.2 Section B – Companies facing crises

**B.1 From an economic standpoint, what are the prospects for your business in 2024 compared to 2023?**

1. Growth
2. Stability
3. Contraction
4. We have closed / we are considering closure

**B.2 Could you roughly tell what percentage of the company's employees have a degree?**

**B.3 Are there employees in your company with an educational qualification higher than a degree, such as a doctorate or a master's?**

Yes  
No

**B.4 And approximately what percentage of women work in the company?**

### COMPANIES FACING CRISES

**B.5 On a scale from 1 (strongly disagree) to 5 (strongly agree), how much do you agree with the following statements regarding external dynamics related to your company:**

1. Our customers' preferences change frequently over time.
2. We operate in a highly turbulent market.
3. Technology in our industry changes rapidly.

**B.6 Thinking about the past 2 years, how much would you say your company has been threatened by systemic crises (e.g., health emergencies, climate change, extreme weather events, wars, geopolitical tensions between countries)?**

1. Not at all
2. A little
3. Fairly
4. A lot
5. Very much

**B.7 And still thinking about the past 2 years, how much would you say your company has been threatened by events related to the competitive environment in which you operate, such as increases in the cost of materials, services, or labor; legislative changes; loss of significant customers or suppliers, new competitors, etc.?**

1. Not at all
2. A little
3. Fairly
4. A lot
5. Very much

**B.8 Thinking about the systemic crises/events related to the competitive environment that have threatened your company, to what extent has the company's turnover changed due to these events?**

1. Increased
2. Remained stable
3. Reduced by up to 10%
4. Reduced by between 10% and 20%
5. Reduced by between 20% and 40%
6. Reduced by between 40% and 60%
7. Reduced by between 60% and 80%
8. Reduced by more than 80%
9. Prefer not to answer

**B.9 For how long has the company experienced negative performance due to systemic crises/events related to the competitive environment?**

1. Very little time (between 1 and 3 months)
2. Up to 6 months
3. From 6 months to 1 year
4. Between 1 and 2 years
5. Performance is still negative

**B.10 And how long did it take for the company to fully recover from the effects of these events?**

1. Very little time, the recovery was immediate
2. Up to 6 months
3. From 6 months to 1 year
4. Between 1 and 2 years
5. We have not yet recovered

**B.11 During the occurrence of systemic crises (e.g., pandemics and other particularly complex external events), on a scale from 1 to 5 (1 = well below average; 3 = average; 5 = well above average), how is your company's performance generally compared to competitors in terms of:**

1. Return on investment
2. Gross margin
3. Customer satisfaction
4. Market share
5. Product/service quality
6. Employee productivity

**B.12 Now think about your company and how people can draw "lessons" from the crisis. Please indicate on a scale from 1 (strongly disagree) to 5 (strongly agree) how much you agree with the following statements:**

1. We discuss and analyze mistakes and failures.
2. We develop or update tools (manuals, databases, files, archives, organizational routines, etc.) to use the "lessons learned" when we encounter difficulties in the future.
3. Crises have changed people's mindset in our company: we are more attentive to threats and crisis signals.

**B.13 Thinking about your company in the last two years, on a scale from 1 (not at all) to 5 (very much), how much has the supply chain of your company faced disruptive challenges resulting from...**

1. Commercial disputes and tariffs
2. Supplier bankruptcy or financial instability
3. Transportation disruptions
4. Raw material shortages
5. Quality control issues
6. Supplier delocalization or reshoring (relocating suppliers by sourcing raw materials, semi-finished products, etc. from suppliers located in territories/countries closer)

**B.14 Thinking about your company in the last two years, how often and how intensely has your company collaborated with the following entities or organizations to overcome crises or adversities? Please respond on a scale (1=not at all, meaning we had no relationship with the actor or organization; 5=very much, meaning we had very intense and frequent relationships):**

1. Banks or other private financiers
2. Suppliers
3. Customers
4. Distributors or retailers
5. Business consultants (e.g., accountants)
6. Business networks or industry associations
7. Public or government entities (e.g., municipalities, regions, ministries)
8. Universities or other research institutions
9. Training entities

10. Non-governmental organizations/non-profit associations (e.g., related to environmental protection)

### SUSTAINABILITY INITIATIVES

**B.15 Now let's talk about sustainability and specifically about the achievements of your company in the last 2 years. On a scale from 1 (strongly disagree) to 5 (strongly agree), tell me how much you agree with the following statements about sustainability practices. "In the past two years, my company has been able to improve results in..."**

1. Reducing CO2 emissions
2. Reducing energy consumption
3. Reducing water consumption
4. Achieving gender parity
5. Reducing the number of workplace accidents and injuries
6. Offering services for work-life balance
7. Offering supplementary insurance services dedicated to employee health
8. Donations/contributions for the development of the territory and local communities

**B.16 And on a scale from 1=not at all to 5=very much, how much, in the last two years, has my company invested in:**

1. Using eco-friendly materials to reduce the environmental impact of the product/service
2. Adopting product/service design and development practices aimed at reducing its environmental impact throughout the entire lifecycle
3. Developing circular economy initiatives
4. Investment in renewable energies
5. Conversion of corporate fleets to hybrid or electric vehicles
6. Collaboration with non-profit organizations

### WORK AND TIME MANAGEMENT

**B.17 Now think about how activities and tasks are carried out in your company. Please indicate on a scale from 1 (strongly disagree) to 5 (strongly agree) how much you agree with the following statements regarding time management. "In my company:**

1. We have the same opinions on the need to meet deadlines.
2. We have similar ideas about the best way to use time.
3. We agree on how to allocate available time among different activities.
4. We have similar ideas about how much time is needed to perform tasks.
5. We encourage each other to finish tasks on time.
6. We remind each other of important intermediate milestones.
7. We support each other in keeping agreements.

**B.18 Think about when a task or project needs to be completed in the company. Please indicate on a scale from 1 (strongly disagree) to 5 (strongly agree) how much you agree with the following statements regarding time management.**

1. Generally, on average, people start performing a task as soon as possible to complete it well before the deadline.

2. Generally, on average, people work steadily, distributing activities evenly over the available time.

**B.19 The success (or failure) of my company is due, in part, to internal capabilities and resources (e.g., financial resources, organizational processes, human resources, and knowledge) and/or external factors (e.g., competitive pressure, regulatory framework, geographical location). To what extent does the success of your company depend on internal capabilities and resources?** Express a percentage value between 0% = not at all and 100% = completely.

**B.20 And in what percentage would you say that unsatisfactory performances are due to the lack of internal capabilities and resources of the company? Express a percentage value between 0% = not at all and 100% = completely.**

**B.21 Thinking about your company, please indicate on a scale from 1 (strongly disagree) to 5 (strongly agree) how much you agree with the following statements regarding agility/adaptability, flexibility, and proactivity:**

1. We have confidence in our ability to find practical solutions using the resources we already have.
2. We are able to react to adversity and crises while maintaining our role in the industry.
3. We are able to reorganize in the face of adversity and still provide value to the customer.
4. We are always able to find the manpower to dedicate to special projects.
5. We see changes in market conditions as opportunities to increase, improve, or change our capabilities.
6. In our company, people can quickly change their role to another that involves similar responsibilities to the previous one.
7. Agreements with partners allow us to easily change our product or service offering.
8. People in our organization are multidisciplinary and versatile.
9. Our company is capable of easily managing new vulnerabilities as soon as they are recognized.
10. We manage new challenges by applying a combination of existing resources and other resources we acquire at low cost.
11. When facing competitors, our company is often the first to introduce new products/services, new administrative techniques, new operational technologies.
12. When facing competitors, my company is typically the one to "make the first move."
13. Our organization has a history of turning threats into new opportunities.
14. We undertake more challenges compared to our competitors with similar resources.
15. We invest in building new capabilities when facing specific business challenges.
16. We reorganize aspects of our company to seize new emerging opportunities.
17. When facing specific threats, we develop organizational-level responses.
18. We adapt quickly to address changes in our environment or market.
19. Our company regularly recognizes new business opportunities resulting from changes in the market.

#### RESOURCE AND RELATIONSHIP MANAGEMENT

**B.22 Thinking about your company, please indicate on a scale from 1 (strongly disagree) to 5 (strongly agree) how much you agree with the following statements regarding resource and relationship management:**

1. Training is supported and encouraged beyond what is strictly required by roles.
2. When we face new challenges, we utilize available resources to find new feasible solutions.
3. Employees are rewarded when they think outside the box.
4. Our organization is quick to restore performance after a crisis or adversity.
5. Our organization modifies and communicates its priorities as soon as conditions change.
6. We keep a portion of equipment, infrastructure, and production capacity in reserve for use when needed.
7. Our organization has a reasonable amount of backup resources (e.g., human, financial, productive).
8. Not all available resources are engaged in the activities we currently perform.
9. We have ample financial resources available.
10. In carrying out their work, employees must tackle ambiguous tasks for which there are no predefined procedures.
11. Employees are encouraged to take risks when experimenting with new ideas.
12. Roles in our company require people to devise new ways of doing things.
13. We face new challenges with resources that were not originally intended to be used for this purpose.
14. In our company, there is freedom to experiment with new ways of doing things.
15. In combining our resources, we tackle a wide variety of new challenges.
16. We work closely with our external collaborators or network partners to limit our risks.
17. We conduct scenario planning exercises to test our assumptions about current plans.
18. We proactively monitor our sector to have early signs of emerging problems that could affect our business prospects.
19. We define ad-hoc plans with our clients on how to manage any delivery interruptions.
20. We define ad-hoc plans with our suppliers on how to manage any supply interruptions.

**B.23 In the last two years, how much has your company invested in terms of economic resources in the following advanced technologies? Please respond using a scale from 1=not at all to 5=very much, 6=the technology is not adopted in the company):**

1. Utilization of big data through big data analytics systems
2. Robotics
3. Internet of Things
4. Cybersecurity tools
5. Cloud computing and tools for cloud data management and storage
6. Additive manufacturing tools (e.g., 3D printers)
7. Augmented reality
8. Cyber-physical systems (cyber-physical integrated systems that constantly interact with the physical environment)
9. RFID - real-time tracking tools
10. Use of artificial intelligence
11. Use of automated vehicles (AGVs or LGVs)
12. Nanotechnologies and new materials



13. Development of the digital twin model of physical products
14. Blockchain technology

**B.24 Thinking about the technologies that your company has adopted, I will now ask you about your perception of the possible benefits or problems related to their use. On a scale from 1=not at all to 5=very much, how much do these technological tools:**

1. Improve the level of efficiency of the company
2. Foster relationships and organization within the company
3. Are an efficient means to collaborate with other companies
4. Allow greater access to market information and knowledge, as well as new business opportunities
5. Do not integrate well with the company's business and strategies
6. Their adoption is not supported by the company's organizational structure
7. Require a high and unbalanced investment in terms of costs compared to benefits
8. Face unclear regulatory frameworks for their use
9. Are not completely reliable in terms of use and relative security

## 11.3 Section C – Control functions

**INTRO - The following questions are aimed at assessing what financial and managerial resources companies have implemented during systemic crises or other particularly complex events. Typically, these are areas of expertise for the CFO or the Administrative Director. Do you think you would be able to answer?**

1. Accept and continue
2. No --> schedule an appointment to speak with the CFO

**C.1. During the occurrence of external systemic crises (e.g., pandemics and other particularly complex external events), to what extent do managers use management control systems for the following aspects? Please indicate on a scale from 1 (strongly disagree) to 5 (strongly agree) how much you agree with the following statements:**

1. Identification of critical performance variables to leverage in addressing the crisis
2. Definition of objectives for critical variables to leverage in addressing the crisis
3. Monitoring and control of results against critical and essential outcome objectives to address the crisis
4. Generation of information to correct deviations from established outcome objectives
5. Creation of a recurring and frequent agenda to guide strategic choices and activities
6. Creation of a recurring and frequent agenda capable of guiding operational choices and activities
7. Encouraging and facilitating dialogue on data/information and action plans with subordinates and peers/colleagues
8. Focusing attention on strategic uncertainties (e.g., factors that could invalidate the current strategy)

**C.2. During the occurrence of external systemic crises (e.g., pandemics and other particularly complex external events), to what extent were the following aspects related to performance measurement present? (1= not at all; 5= very much):**

1. Objectives and (un)achieved results were linked to the company's incentive system
2. Economic/financial objectives and results were measured and analyzed to understand whether they were realistic or not
3. Competitive objectives and results related to customers, personnel, operational processes, quality, and innovation were measured and analyzed to understand whether they were realistic or not
4. The company regularly uses a performance measurement system for results analysis
5. Achieved results are rarely communicated to employees (RI)

**C.3. During the occurrence of external systemic crises (e.g., pandemics and other particularly complex external events), to what extent were the following conditions related to employee behavior present? (1= very little; 5= very much):**

1. Employees continued to provide requested and voluntary feedback to each other
2. Company norms and values were rarely communicated to employees to guide their behaviors
3. Employees, mutually and autonomously, regularly monitored company activities
4. Employees knew how to behave by referencing the behavior of superiors
5. Managers trusted the decisions made by employees

**C.4. During the occurrence of external systemic crises (e.g., pandemics and other particularly complex external events), to what extent were the following conditions related to employee behavior present? (1= very little; 5= very much):**

1. Conformity and adherence to company plans and procedures were very important
2. Employees were rarely alerted and empowered regarding company plans and procedures
3. Work plans and division of labor systems were used to guide and control employee actions
4. Employees were held accountable for the activities performed

**C.5. Now think about how the management control system is designed in your company. Please indicate on a scale from 1 (strongly disagree) to 5 (strongly agree) how much you agree with the following statements:**

1. Control systems allow analyzing whether our current way of doing things is the most appropriate
2. Control systems foster new ways of doing things even in relation to unforeseen events and contingencies that may hinder the company's objectives
3. Control systems allow identifying areas for potential improvement
4. Control systems increase managers' knowledge of specific activities/critical areas to monitor
5. Control systems allow understanding the factors that generate costs and revenues
6. Control systems used have been explained and clarified to respective managers
7. Control systems increase managers' knowledge of how their business unit works overall

8. Control systems are designed to communicate the company's strategy to different organizational levels
9. Control systems make visible how individual organizational units are connected to the company's vision and overall/strategic objectives
10. Control systems generate a flow of information to think about new ways to carry out operations/activities/objectives
11. Control systems generate regular and frequent flows of information exchange and reporting between organizational levels/units
12. Manager suggestions are considered when the control system (objectives) is modified
13. New performance/result measurements can be added to the performance measurement system to meet specific work needs
14. In our company, continuous monitoring is carried out to assess whether the objectives of the various units are still realistic or need to be modified.
15. Control systems are designed in such a way that no deviation from achieving established objectives is tolerated
16. Control systems are designed to communicate to people in the company how they should behave
17. Control systems are designed with the goal of monitoring people regarding compliance with company procedures.