
RESILIENCE OF TECH COMPANIES DURING THE COVID-19 CRISIS - CASE STUDIES' LEARNINGS

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Abstract

The COVID-19 pandemic caused significant changes in companies worldwide, and for organizations to survive, resilience was the key. Tech companies were no exception and faced unexpected challenges that were common to many industries, such as, lockdowns, remote work, and the change in market contexts.

This study aims to understand how tech companies, particularly SMEs, faced COVID-19 crisis and if they consider themselves more resilient after that, through a qualitative study with four Portuguese and Israeli technological small and medium enterprises (SME). Interviews were conducted with middle and top managers from both countries to understand three essential aspects: whether they were prepared to face the crisis, how they managed to avoid a more negative impact, and how they recovered from the shock.

Results show that, although most did not have any kind of previous plan to respond to such a challenge, they all managed to survive and even grow, despite the crisis. For that, they undertook a series of actions and challenges, as for example the search for new market segments, the management of remote work, and their business models' adaptation. The business model alterations observed are not temporary but created a foundation that prepared companies to react to future external shocks.

The results show the extraordinary dynamism and adaptability of the companies and their leaders in finding solutions to respond to the challenges they faced.

Keywords: Resilience, COVID-19, Business Model Dynamics, Lean, Agile leadership.

Resumo

A pandemia de COVID-19 causou alterações significativas nas empresas de todo o mundo, para que as organizações pudessem sobreviver, a resiliência foi a chave. As empresas tecnológicas não foram exceção e enfrentaram desafios inesperados, comuns a várias indústrias, como, confinamentos, trabalho remoto e alterações nos mercados.

O objetivo deste estudo é tentar perceber como é que as empresas tecnológicas, em particular as PME, enfrentaram a crise causada pela COVID-19 e se se consideram mais resilientes, através de um estudo qualitativo de quatro pequenas e médias empresas (PME) tecnológicas Portuguesas e Israelitas. Foram realizadas entrevistas com quadros médios-altos das empresas de ambos os países, para explorar três aspetos essenciais: se essas empresas estavam preparadas para enfrentar esta crise, como conseguiram evitar um impacto mais negativo, e como recuperaram deste choque.

Os resultados mostram que apesar de a maioria das empresas não ter nenhum tipo de plano prévio para responder a este desafio, todas as empresas conseguiram sobreviver e até crescer, apesar da crise. Para tal, desenvolveram uma série de ações e enfrentaram uma série de desafios, como por exemplo, a procura de novos segmentos de mercado, a gestão do trabalho remoto, e a adaptação do seu modelo de negócio. Estas alterações nos seus modelos de negócio não são apenas temporárias, mas criaram uma base que preparou as empresas para melhor reagir a futuros choques externos.

Estes resultados traduzem o extraordinário dinamismo e adaptabilidade destas empresas e dos seus líderes em encontrar soluções para responder aos desafios com que se depararam.

Palavras-chave: Resiliência, COVID-19, Dinâmica dos Modelos de Negócio, Lean, Liderança ágil

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1. Introduction

A series of phenomena, such as natural calamities, pandemic disease, terrorist strikes, economic decline, equipment malfunction and human error, can present both as a potentially unpredictable and serious risk to the continuity of an organization's operation (Bhamra, 2011).

The COVID-19 pandemic has reached almost every country in the world, leaving the national economies and business counting the costs, as governments struggled with lockdown measures and vaccination programs to stop the spread of the virus. The restrictions imposed by governments affected very severely the economy, hence countries where activities were limited for less time, and that were able to maintain some or all of their activities even during the lockdown, suffered then a different impact.

This research' starting point was the crisis caused by the COVID-19 pandemic that forced companies all over the world to adapt in numerous different extents. Restriction on movement decreed by governments created many supply chain disturbances, lack of resources and materials, deep modifications in the working environment and conditions, and changes in the supply-offer dynamic, among other constraints, which culminated in economic losses for the companies.

So, the ability to be resilient, meaning, the capacity to survive and thrive in the face of such an obstacle as the COVID-19 pandemic, can be shaped and dependent on many factors, that will be addressed. Also, it may be influenced by the context, geographical, economic and political for example, where these companies are inserted. In this manner two different contexts are explored: Portugal and Israel.

During the COVID-19 pandemic, technologies played a vital role in keeping society functional during lockdowns and quarantines. However, all sectors, including the technological companies (tech companies), had to adapt and evolve to survive. In fact, this crisis affected virtually all businesses, but special attention is given to the small and medium enterprises (SMEs), since they form the main entrepreneurial fabric of Portugal and Israel (OECD, 2020).

The author had the previous contact with the Portuguese and Israeli tech sectors for professional reasons. This experience and the related literature review allowed to identify the lack of available studies comparing Portugal and Israel in how technological SMEs reacted to the crisis caused by COVID-19. The tech companies' target was also reinforced by the author's Master's subject in Technological Entrepreneurship.

Israel is a well-known hub of innovative technological companies. Also, it had a special role worldwide in terms of vaccination and health measures during the COVID-19 crisis. Portugal, was the first country in the world to achieve the vaccination process goal (McBryde, 2021) of 85% of the population fully vaccinated against COVID-19 (Harlan, 2021), but suffered from very strict and prolonged lockdowns and restrictions that badly harmed the economy.

Hence, it is considered relevant to make the comparison between these two countries. Firstly, because even though both suffered the economic and social impact caused by the pandemic, the pandemic waves did not occur at the same time or with the same duration. And although the vaccination program was implemented effectively in both countries, in Israel a more rapid return to “normal” activity occurred. Secondly, in a time of great restrictions to movement of people and goods and to the economic activity, technology assumed a very important role; and Israel is known for being a "Start-up Nation" since the early 20th century, very much linked to technological companies; whereas Portugal, although with some advances in recent years (coinciding with hosting the Web-Summit since 2016), still has a long way to go in this field.

This study will then focus on Israeli and Portuguese small and medium technological companies to try to understand how different contexts (namely economic and political) and different resources and conditions, have influenced the way these organisations faced the COVID-19 crisis.

1.1. COVID-19 Context and Policies (2020)

To understand the context, the two countries faced in the first few months after the appearance of COVID-19, the most relevant events and decisions the two countries took to try to contain the pandemic were selected. It is also essential to assess the time intervals of the different COVID-19 waves in both countries to understand the relationship between these intervals and decisions taken by tech companies.

2020	Portugal	Israel	Worldwide
Milestones	Mar 2nd - First two Covid-19 cases Mar 16th - The first death in the country caused by Covid-19 May 1st - Portugal exceeds the barrier of one thousand deaths (1,007) and 25,351 infected	Feb 21st - First Covid-19 case Mar 20th - The first death in the country caused by Covid-19	Jan 7th - The disease was identified by Chinese authorities as a new type of coronavirus, novel coronavirus, or nCoV. Mar 11th - World Health Organization declares covid-19 a pandemic Mar 19th - WHO reported confirmed cases have passed 200,000 worldwide. Apr 10th - Deaths pass 100,000
Restrictions	Mar 9th - Access to some public services is closed or restricted. Schools and universities suspend classroom classes. Mar 18th - State of emergency declared for 15 days, including mandatory confinement and restrictions on circulation on public roads. May 2nd - The state of emergency expired	Mar 11th - Enforcing social distancing Mar 19th - The Government declared a national state of emergency. May 3rd - Schools reopened for first to third grade, and 11th to 12th grade	Feb 23rd - Two hotspot regions in Italy went into lockdown Apr 6th - WHO estimated almost 90% of students were affected by school closures.
Economy	Jun 4th - Government approved the Economic and Social Stabilization Program, as well as measures and social support and the hiring of more health professionals.	Mar 30th - The government announced an economic rescue package totalling 80 billion shekels (\$22 billion) Apr 1st - National unemployment rate had reached 24.4 percent	

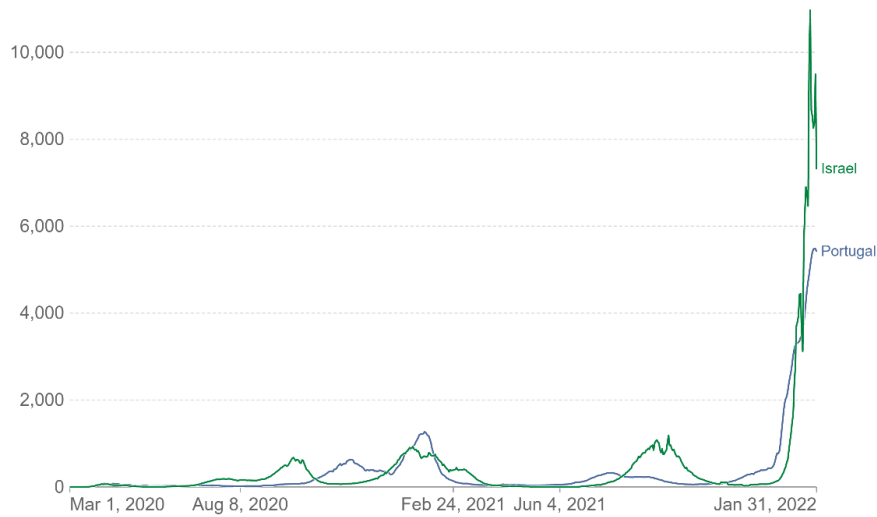
Figure 1 - COVID-19 events in 2020 - Source: The author based in: (OECD, 2021; Portugal.Gov.Pt, 2021; World Health Organization, 2021; Our World in Data, 2022)

The graph (Fig.2)(*Our World in Data*, 2022), shows the 5 waves of COVID-19 in Portugal and Israel, since the beginning of the pandemic in 2020, spread over months. It is interesting to note that some of the peaks are not coincident in time. Portugal was less affected than many other European countries during the initial wave of the COVID-19 outbreak, but succeeding waves hit the country hard, and Portugal had the highest rates of new infections and deaths globally in January 2021, as seen in Figure 2 (OECD, 2021b). The 5th wave that reached world records for infection, but occurred after the vaccination was almost completed including in Portugal and Israel, is also clearly visible on the chart (*Our World in Data*, 2022).

Daily new confirmed COVID-19 cases per million people

7-day rolling average. Due to limited testing, the number of confirmed cases is lower than the true number of infections.

Our World in Data



Source: Johns Hopkins University CSSE COVID-19 Data

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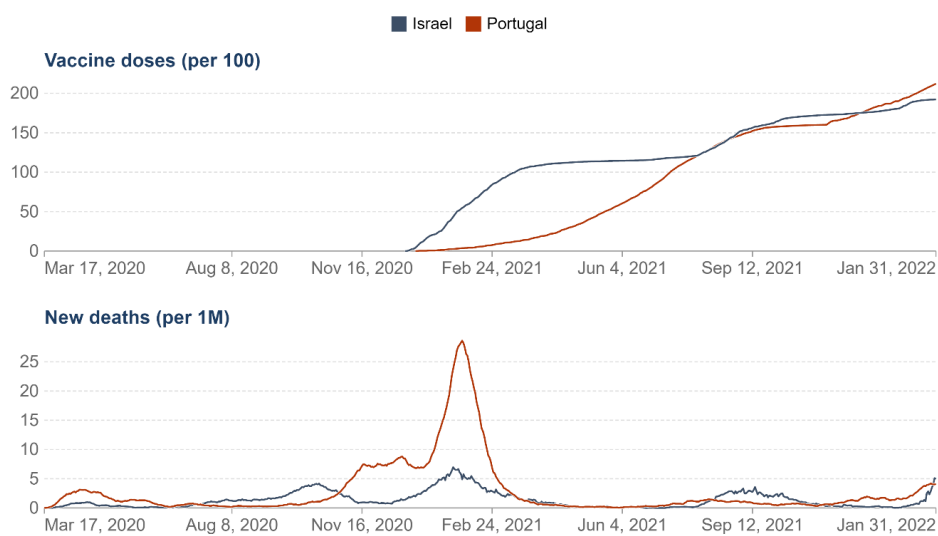
Figure 2 - Daily new confirmed COVID-19 cases (Our World in Data, 2022)

During the pandemic, Portugal assumed very strict isolation measures (a State of Emergency was declared on 18th March and strict lockdown measures were imposed from March - April 2020 and January - March 2021; the State of Emergency was renewed 15 times and terminated on 30th April 2021) and over these periods of lockdown restrictions have varied in intensity. It was crucial to join the efforts of the scientific community to find a vaccine to try to stop the pandemic and its effects.

COVID-19 vaccine doses and confirmed deaths

Due to limited testing and challenges in the attribution of the cause of death, confirmed deaths can be lower than the true number of deaths.

Our World in Data



Source: Official data collated by Our World in Data, Johns Hopkins University CSSE COVID-19 Data

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Figure 3 - COVID-19 vaccines doses and confirmed deaths - Portugal vs Israel (Our World in Data, 2022)

The graph above (figure 3) shows the vaccination rate and the death rate due to COVID-19, in both countries. Israel was the first country in the world to start the vaccination process (Rosen, 2021), inclusively, it was a case-study for the pharmaceutical companies and the scientific world. Regarding the vaccination rate, it is clear that in Israel the process was also very quick, the campaign has started on the 20th of December 2020, and ten days after, on the 1st of January 2021, 10% of the population had already one vaccine shot. By contrast, according to Our World in Data, at the same time, less than 1% of the population of the United States and only a few European countries received a vaccine dose. In fact, “as of the end of 2020, Israel’s vaccination campaign had achieved a great deal – both in absolute terms and relative to other countries.” (Rosen, 2021, p. 3).

In Portugal, the first vaccine shot was give on the 27th December 2020 (*Portugal.Gov.Pt*, 2020). After a slowdown in the pace, possibly waiting for a third booster dose, Israel started to move fast again with the third and fourth dose. Nevertheless, even though Portugal is only on the third dose (the fourth in the elderly), it has already surpassed Israel's vaccination rate (*Our World in Data*, 2022).

Although the vaccination campaign started slowly, however, Portugal was clearly a case of success since it was one of the first countries in the world to reach 85% of the population with the inoculation completed on the 9th October 2021 (*Portugal.Gov.Pt*, 2021).

1.2. Evolution of Economic Indicators during the pandemic

In order to understand the evolution and economic dynamics of Portugal and Israel during the pandemic, two indicators will be analysed, the change (in percentage) of the of the Gross Domestic Product (GDP) and the change (in percentage) of the unemployment rate during 2020 and 2021, according to data from the Organization for Economic Co-operation and Development (OECD).

Table 1 - Gross Domestic Product (GDP) - Portugal vs Israel (*OECD Data*, 2022)

GDP, volume – annual	Q1	Q2	Q3	Q4	Q1	Q2	Q3
growth rates %	2020	2020	2020	2020	2021	2021	2021
Portugal	-4.4	-15.2	14.7	0.3	-3.3	4.4	2.9
Israel	-1.2	-9.1	8.7	2.6	-0.4	3.4	0.7

Although indicators of macro-financial stability indicate Portugal's economy is more resilient than in past major crises, Portuguese firms are in relatively large proportions very small and undercapitalised, and thus more vulnerable to crisis. In fact, Portugal was among the OECD economies most strongly affected by the pandemic (OECD, 2021). Portugal's economy contracted strongly in 2020 as the spread of the COVID-19 pandemic took a heavy toll on all aspects of social and business activities, with an especially heavy impact on the country's large hospitality sector. Indeed, Portugal's economy has been particularly sensitive to the pandemic due to its high reliance on international tourism, which has been one of the most severely affected sectors, with a 58% decline in travel and tourism exports in 2020 (OECD, 2021). According to the World Travel and Tourism Council (WTTC), direct, indirect and induced impacts of tourism amounted for 19.8% to the GDP (Costa, 2021).

Quarterly rates closely followed the evolution of the pandemic and the consequent introduction of restrictions, as seen in Table 1, that shows that Portugal began to feel the negative economic effects very strongly in the first quarter of 2020, with the fall of the GDP of 4.4% compared to the previous period. However, the worst was yet to come, and in the second quarter the Portuguese economy fell by 15.2%, registering the biggest fall in GDP in Portugal ever, due to the economic downturn activity during the first emergency state declared by the government (between 19th March and 2nd May 2020). In other words, in 6 months, the Portuguese economy lost almost 20% of its national wealth.

The recovery has been uneven, as the blow was particularly strong in the tourism, hospitality and transport sectors that have a relatively big weight in the economy. As the health situation improved, restrictions were lifted and the activity in the services sector has gained momentum. So, the third quarter saw a strong recovery. The gradual reopening as well as increased exportation and domestic consumption also significantly contributed to this (Goncalves, Sergio Azevedo, 2021). But, the partial lockdown and geographically targeted containment measures introduced in response up to mid-January 2021 were not sufficient to slow the spread of the virus. Hence, in the first quarter of 2021, with the record (to date) in the number of deaths and infections due to the Delta variant, the economy lost wealth again. The number of infections declined with the introduction of a second lockdown on 15th January. The new economic growth observed in the second half of 2021 was due to the easing of restrictions and the European Union recovery plan (Goncalves, Sergio Azevedo, 2021). In 2020 the Portuguese GDP fell 7.6%, this was one of the biggest falls ever recorded according to National Statistics Institute (INE). However, it is projected that the GDP

will strongly rebound in 2022 following the termination of restriction measures and the rollout of vaccination.

According to the Bank of Israel, Israel's first lockdown began in March 2020, costing the economy “5.4 billion shekels each week, as economic activity decreased by a fifth on average over the month” (Rosenberg, 2022, p. 1). Hence, the most significant impact on the economy was also felt in the second quarter of 2020, with very tight restrictions, however, it was not as expressive as in Portugal, as seen in Table 1. The next lockdown in September saw economic activity decline by a more modest value, and the cost ran to 3.2 billion shekels a week. The last lockdown, in December 2020-January 2021, cost just “3 billion shekels a week, according to Bank of Israel estimates” (Rosenberg, 2022, p. 1). In this next quarter, and like Portugal, Israel also almost fully recovered its losses. In January 2021, Israel was also affected by the Delta variant, causing the economy to lose 0.4%. In the third quarter of 2021, Israel was affected by the fourth wave, with a more significant impact between August and September, causing the economy to grow only 0.7%. As can be seen, in Israel, the real cost of the three lockdowns the government ordered in 2020 and 2021 was a lot smaller and diminished each time a new one was called. This declining cost is due to a combination of factors: for once, more and more workers started working from home, and also due to lockdown fatigue since people and businesses have grown tired of abiding by the rules and have learned how to bypass them.

Although it had three “internal” lockdowns and it almost completely closed to the “external” world (with very severe travel restrictions for a long period of time for example) (Kremer & Pasca-Raz, 2020), the lockdowns never struck the big blow to the Israeli economy as feared, since they were able to adjust very quickly (Rosenberg, 2022). The high-tech sector accounts for about half of all services exports, and the downturn in exports has been slightly more mild in the first half of 2020, thanks to the industry's resiliency (OECD, 2021). In fact, the COVID-19 pandemic caused a 2.4% contraction in Israel's economy in 2020, but it was a smaller fall than expected amid this strong high-tech exports and solid consumer spending despite high unemployment (Scheer, 2021).

Also, recovery came quickly since already in the second half of 2020, GDP grew sharply. For 2021, the Bank of Israel estimates that GDP grew 6.5 percent and will continue expanding at a pace of 5 percent or more annually in 2022 and 2023 (Rosenberg, 2022).

Table 2 - Unemployment Rate % - Portugal vs Israel (*OECD Stat, 2022*)

Unemployment Rate %	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021
Portugal	6.6	6.6	8.1	7.2	6.8	6.9	6.4	6.2
Israel	3.6	4.1	4.7	4.8	5.1	5.3	5.0	4.5

As for the unemployment rate (Table 2), as a reflection of the economic and social lockdowns due to COVID-19, it increased in both countries, especially during the end of 2020.

In Portugal, where the situation was already precarious, the crisis hit notably sectors with ample seasonal, temporary and low-paid jobs, such as hospitality and tourism, and people with pre-existing financial difficulties (OECD, 2021)).

In Israel, where before pandemic, the economy had low unemployment and living standards had moved up close to the OECD average (OECD, 2021), unemployment increased but not as much as in Portugal, in part due to fewer lockdowns and restrictions, and because the economy rapidly recovered after a brisk vaccine rollout.

1.3. The effect of the COVID-19 crisis on the technological companies

Initially, following the outbreak of COVID-19, globally speaking, one of the most affected sectors was the tech industry, with the reduction of investment, mass layoffs and a reduction in levels of innovation seen prior to COVID-19 (Ballard, 2020). In fact, PricewaterhouseCoopers (PwC) released data from the first half of 2020 showing massive declines in the value and number of large tech acquisitions (Potter, 2021). However, thanks to their well-known innovative and adaptative ability, the digital transformation observed and consequently the new business opportunities that emerged, many tech companies were able to adapt and even grow during the crisis.

In fact, tech organisations demonstrated a notable flexibility in the face of this situation. A survey demonstrated that most respondents (84%) rated the overall tech performance in response to COVID-19 as good or very good. It also states that three quarters of the organisations took less than three days to effectively start working from home when the lockdowns started, concluding that “these statistics show that the investments in IT infrastructure and efforts to migrate to the

cloud resulted in an effective response to the immediate business continuity needs from COVID-19” (*Public Sector Survey Report*, n.d., sec. 3).

The biggest worldwide tech company, Apple, responded to the pandemic in various fronts. On the 17th February 2020, Apple warned investors that probably would fail its revenues goals between 63 and 67 billion dollars. To respond to the health crisis, besides donations to healthcare institutions, the company attempted to do whatever was possible inside their products and technology scope. For example, the virtual assistant “Siri” was updated to guide the users through a questionnaire to help to answer the question “Do I have Coronavirus?”, and to keep adults and children occupied during isolation periods, Apple upgraded the Books store in the United States, offering a collection of free books and audiobooks for the users (Evans, 2020).

On another hand, Facebook (Meta) quickly began contributing socially on the 30th January 2020 by deciding to remove misinformation about the pandemic posted on the social media platform. In May 2020, the company introduced the *Support Small Business* sticker and *Business Nearby* tool to help people to support businesses that were strongly affected by the pandemic, among other monetary donations for vaccination campaigns and support for small businesses (*Responding to COVID-19 | Meta*, 2022).

Amazon, the e-commerce giant, saw its sales soar since the first weeks of 2020 and recruited more than 175 000 new warehouse and delivery workers between March and April to be able to react to the customer’s demand. Jeff Bezos, Amazon’s CEO, said in April 2020 that “the current crisis is demonstrating the adaptability and durability of Amazon’s business as never before, but it’s also the hardest time we’ve ever faced” (Palmer, 2020b, sec. 2). Amazon also collaborated with the World Health Organization in supply advanced cloud technologies and technical knowhow to track the coronavirus, and understand the outbreak and tendencies for better contain the outbreak (Palmer, 2020a).

As for the Israeli innovation ecosystem, following the outbreak of the COVID-19 global pandemic, it was forced to re-think the course of its operations and make the necessary adaptations to respond to the demands and circumstances of this new reality. The Israeli high-tech showed qualities such as “agility, multidisciplinary approach and out of the box thinking”, and it allowed many high-tech companies and startups to adjust their technologies, developments and products in order to satisfy the needs imposed by the new global situation (*Innovation in the Age of Corona Pandemic | Israel Innovation*, n.d., sec. 1).

In Portugal, according to the study “Impact of COVID-19 on the national startups ecosystem” conducted by Startup Portugal, Ernest and Young EY and SAP; 57% of the companies inquired claimed that this situation significantly affected their activity, such as the sales volume, the delay or postponement of projects and the deferment of investments. Nevertheless, around 40% of the companies inquired claimed that they had new business opportunities during the pandemic. For example, Barkyn, DefinedCrowd and Replai secured investments during this time (Cerdeira, 2021). Also, Portugal joined the group of “Strong Innovators” at the European Innovation Scoreboard 2020, and for the second consecutive year, was a leader in innovation in small and medium-sized companies (The European Commission, 2020).

Bearing the previous facts in mind, it was considered that a study investigating how technological small and medium enterprises reacted to the COVID-19, in these two different contexts- Portugal and Israel, would be interesting. The aim is to explore the factors and actions that did (or did not) lead the businesses through these times of hardship, and allowed (or did not allow) them to become more resilient. After a literature review of the concept of resilience and its contributors and components, a framework for business resilience is presented. Based on that, the results of interviews with Portuguese and Israeli tech companies are presented and discussed.

2. Literature review

In the face of disruptive scenarios, such as the COVID-19 pandemic the world has been facing, resilience emerges as a critical ability for entrepreneurs, influencing their capacity to incorporate, create, and rearrange resources (Schepers, 2021).

Although resilience has many dimensions, the business/organisational and the management viewpoints, potentially present as one the most relevant aspects of the enterprises' resilience.

This literature review will explore the topic of resilience from an organisational and management perspective. The topic of the resources essential for resilience will also be addressed, as well as, the practical response companies can have in disruptive moments such as this.

2.1. Resilience Overview

The world is becoming more and more uncertain and unstable, conveying a series of unforeseen and complex situations that companies must be able to respond to. And so, resilience can be used as a tool to help to solve these challenges (Schaffer, 2021).

According to Bhamra (2011) the term resilience is used in a great variety of contexts, including: ecology (Walker, 2002), metallurgy (Callister, 2003), individual and organisational psychology (Barnett and Pratt, 2000, Powley, 2009), supply chain management (Sheffi, 2005), strategic management (Hamel and Valikangas, 2003) and safety engineering (Hollnagel, 2006). Despite the terminology's context might be different across all of these fields, the notion of resilience is intimately related with the "capability and ability of an element to return to a stable state after a disruption" (Bhamra, 2011, p. 5376). In fact, in the 80's, the US Army College of War introduced the acronym "VUCA", that is usually used to define the Volatile, Uncertain, Complex and Ambiguous world. This term has been extensively used by society in general until today. However, in 2020 Jamais Cascio created a new acronym that represents better the world that we are living in nowadays- the "BANI" world (Grabmeier, 2020). On the one hand, today we live in a world susceptible to sudden and catastrophic failures that translate into volatility and fragility in all processes. The whole world witnessed in 2021 the boat stranded in the Suez Canal in Egypt which had a giant impact on the entire global supply chain, even a few months after the resolution, the economic and logistical impact was still being felt around the world (Stevens, 2021), this is the (new) **(B)**rittle world. The second letter (A) represents the pervasive **A**nxiety in which society lives today. We are constantly waiting for the next disaster, we are terrified of missing opportunities and

we prefer to be more passive, not taking ownership of the decision in order not to fail (Grabmeier, 2020). The third letter (N) means a **N**on-linear cause-effect where “ cause and consequence no longer are assessable”, and small decisions can have a disproportionate impact (Grabmeier, 2020, p. 1). Lastly, the third letter (I) refers to the **I**ncomprehensible world where often decisions seem to lack any kind of logic or purpose, despite the fact that today we have more information and data available (Grabmeier, 2020).

With many different dynamics and pressures that the economies face, these four words fit perfectly in the COVID-19 circumstances. So as Schepers explained, resilience is as "an ability to go on with life, or to continue living a purposeful life, after hardship or adversity", which is particularly pertinent nowadays (Schepers, 2021, p. 3).

When this concept is applied to organisations, this definition does not hugely change. Hence, resilience is deeply associated to the responses of an individual or organization, in the face of instability and disruption (Bhamra, 2011). And, in a systems perspective, as stated by Aldianto, resilience is "the ability to maintain the functionality of a system when disrupted or the ability to retain the elements needed to update or rearrange if an interruption changes the structure of a system's function" (Aldianto, 2021, p. 3).

Resilience from the organisational perspective

According to Rose, static economic resilience can be defined as “the ability of an entity or system to maintain function (e.g., continue producing) when shocked”(Rose, 2009, p. 9). And resilience can take place at three different levels, reflecting the social system: microeconomic (individual); mesoeconomic (sector, market, or cooperative group); and macroeconomic (all individual units and markets combined) (Rose, 2004). The organisational resilience, as stated by Aldianto (2021), can then be defined as "the ability to deal with challenging conditions by ensuring the existence and prosperity of the organization" (Aldianto, 2021, p. 2). David Denyer in 2017, stated that “organisational resilience is the ability of an organization to anticipate, prepare for, respond and adapt to incremental change and sudden disruptions in order to survive and prosper” (Denyer, 2017, p. 5). In order to do so, the organisational resilience literature describes three key factors: (i) "foresight" - the ability to predict that something negative will happen: (ii) "coping"- the ability to prevent this adverse event from turning into an even worse one; and (iii) "recovery"- the ability to recover from a negative occurrence (Westrum, 2012). In fact, the ultimate intention of resilience is to build an organization able to rapidly change and evolve, without negative effects to the

company (Hamel & Välikangas, 2003). It therefore entails a continuous ability to innovate. This capacity is grounded on an analysis of strengths, weaknesses, opportunities and the ability to generate new methods or using its assets in a different manner, in order to survive (Mansour, 2021). In such a way, if a company wants to possess a significant advantage, it has to be quicker at generating options and reorganizing resources than its competition (Ponomarov & Holcomb, 2009). And in this sense, innovation is assumed to bring multiple benefits to an organization, helping the company to achieve competitive advantage (Baer & Frese, 2003).

For several years now, technological (tech) companies, that can be defined as a “business that provides a digital technical service/product/platform/hardware, or heavily relies on it, as its primary revenue source” (*Tech Nation*, 2022, sec. 1), have been on the front line of modernization and have been constantly adapting to new developments and creations. And as is well known, the COVID-19 crisis created a peculiar economy that benefited some industries, including technology, since people and businesses had even greater demand for what these companies were selling. As the pandemic shut down the physical world, the digital world stepped in and filled the void. Hence, during the pandemic these companies helped reduce the spread of the coronavirus while helping businesses to stay open, confirming that technology can help make society more resilient in the face of pandemic and other threats (Xiao, 2020). However, the way tech companies performed during this crisis, as in any other challenge, is also contextual, as it depends on the business and its offerings, but also on the economic and social ambience where these companies exist.

2.2. Drivers for Business Resilience

After reviewing the existing literature on resilience from a business perspective and the response of firms to external crises, which cause a drastic change in context, the drivers that may be influential in this response were drawn.

As represented in figure 3, when changes in context occur, as for example, the crises created by the COVID-19 pandemic, a company’s response and its ability to adapt and evolve depends on many factors. It depends on their ability to change and implement those changes quickly and effectively in order to maintain their operations, that is to say, the capacity to be resilient (Rose, 2004). Having a flexible manager that understands the business context change and reacts accordingly (as an agile leader) is also paramount (Aldianto, 2021; Parker, 2015). The organisational capabilities are likewise core factors that might allow the business to sustain its performance (Aldianto, 2021; Schepers, 2021). Ultimately, in response to this external trigger, companies may

have the need to “change and develop their business models to achieve sustained value creation through time” – Business Model Dynamics (Achtenhagen, 2013, p. 1), creating a new business model reflecting these adjustments (Peñarroya-Farell & Miralles, 2021).

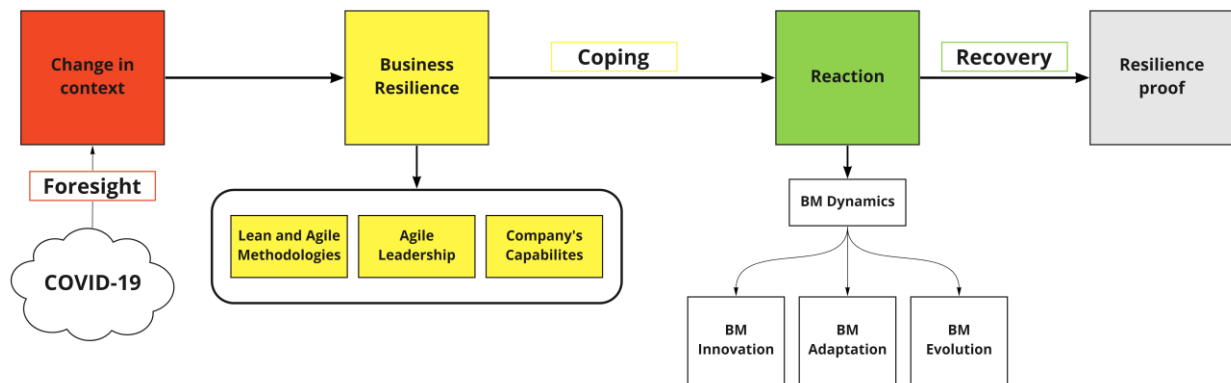


Figure 3 - Resilience Framework – Source: The author

The business context was affected by the COVID-19 pandemic in many dimensions (Hadjielias et al., 2022). Companies were forced to deal with lockdowns, restrictions on movement within countries and on travelling abroad, resulting in not only a health crisis, but also an economic and social crisis (OECD, 2021). The resilience of companies was put to the test. The agile, flexible methodology, with constant feedback from stakeholders, as well as a leadership that quickly adapts to new realities and contexts (Aldianto (2021), and obviously linked to the intrinsic capacities of the companies, were decisive in the reaction to the crisis caused by COVID-19 (Achtenhagen , 2013; Aldianto., 2021; Kronblad & Envall Pregmark, 2021). The practical form of this response and resilience of companies often involves changes to the Business Model, which in the event of success, translates into proof of resilience and overcoming the crisis (Buliga, 2016; Chanyasak, 2021; Peñarroya-Farell & Miralles, 2021).

Lean and Agile - Operationalizing change

Lean and Agile are development methodologies that are utilized in a variety of fields and organizations. They are both “flexible, quick and end-user-focused philosophies that help teams develop and produce high-quality products and services quickly and sustainably.” (Lynn, 2020, sec. 1). Lean and Agile methodologies are not new to technological companies, as most of these companies use several frameworks of these approaches.

Lean principles were developed in the 1950s and come from the history of Japanese manufacturing techniques that were applied to industries and organizations around the world. In their books “The Machine that Changed the World” (Womack, 1990) and “Lean Thinking” (Womack, 1996), Womack and Jones elaborated on the practices and principles of this kind of thinking. The Lean thinking prescription for the elimination of waste, *muda* in Japanese, involves a five-stage process that includes value definition, value streams analysis, flow deployment, pull system and search of perfection. Lean thinking is then a business philosophy that can be used in any type of organization, and its goal is to achieve better results as growth and success, as described in his book by Hines (2010): “Staying Lean - thriving, not just surviving”. It is a business methodology but also a mindset, as it is a means of thinking about business in a lean way, that is to say, in a way where value to the customer is given the most emphasis (Melović, 2016). Lean thinking is then a transformational framework whose purpose is to provide a new way of thinking about how to organize human activities in order to deliver more benefits to society and value to individuals, while eliminating waste along value chains (Womack, 1990; Womack, 1996) . In short, lean is a set of principles as well a way of thinking created for the goal of effective and efficient organization of the process of production (or services) and supply by the elimination of all activities that do not add value (Melović, 2016).

As for the Agile paradigm, seeds were planted in the 1980s and 90s in the software industry since at that time it was too expensive and time consuming to develop those specialized products, and there was a need to find a better way to plan, develop and release the software so that they could satisfy their market needs (Sutherland, 2014) . In 2001, modern Agile was then developed as a time-focused, iterative way of achieving continuous value delivery. Even though these principles were originally created for software development teams, the ideas backing them are suited to nearly all project-driven work. This concept of agility includes a set of management practices and values radically different from the previous 20th-century hierarchical bureaucracy, becoming a management breakthrough. In fact, according to Holbeche (2019) “the concept of agility has been systematized into a different kind of management with a different goal according to (delighting the customer), a different role for managers (enabling self- organizing teams), a different way of coordinating work (dynamic linking), different values (innovation, continuous improvement, and radical transparency) and different communications (lateral conversations)”(Holbeche, 2019, p. 669). Holbeche (2015) also states that “organisational agility or the ability to continuously adjust and adapt strategic direction in a core business, is increasingly considering the vital business success factor.”(Holbeche, 2015, p. 1). Hence, “an agile organization is one that can intelligently and

proactively seize opportunities and react to threats and make timely, effective, sustainable changes that generate competitive advantage and give them some leverage in the marketplace or in their ecosystem”(Holbeche, 2019, p. 669).

In the Agile paradigm the goal is to deliver work (software) as quickly as possible, in frequent product delivery (instead of large batches) allowing the team to rapidly use any feedback from customers when making alterations to upcoming work. This is very similar to the Lean principle of deliver fast, meaning that the quicker the team can deliver value to a client, the sooner they can learn from their feedback. The difference is that in Lean thinking teams increase speed by managing flow (limiting work in progress), while in Agile teams emphasize small batch sizes to deliver quickly (in sprints).

The book “The Lean Startup”, Ries (2011) advocates for a lean approach to business development. Startups used to spend years developing and refining a product before even displaying it to potential clients. Customers were frequently denied the opportunity to express their interest in the product, which resulted in failures. The solution presented from basic prototypes of products, as the MVP (minimum viable product) concept and this is done through the constant customer feedback (Paternoster , 2014). In such a manner, Ries (2011) has coined the term Lean Startup to describe a methodology that helps organizations to carry out experiments and iterate when searching for a viable business model. The aim of the Lean Startup methodology is to reduce product development cycles and quickly determine if the proposed business model is viable. In order to do so, it is necessary to adopt a combination of business-hypothesis-driven experimentation, iterative product releases, and validated learning; and this is strongly dependent on constant customer feedback and opinion (Blank, 2013).

Adaptability and transformation are then core values of these methodologies, and as stated before, if a company wants to acquire an important leverage or even to survive when faced with critical challenges, it has to be agile and swift at creating options and reorganizing assets.

Agile Leadership

A leader can be defined as a person whose primary goal and value is to inspire others, deemed followers, to willingly engage together to achieve a goal (Bass, 2019). In fact, Hines, pointed that leadership “it is really about inspiring people to want to change” (Buckley, 2017, p. 27). As stated by Aldianto (2021) flexible management and leadership can be a determining factor for resilience. In this sense, the agile management can be considered a key factor to resilience since it permits to

adapt to the dynamic contexts of companies since constant feedback, adaptation and collaboration between different departments are some of the basic rules of the agile methodology. According to Aldianto, “the development of higher levels of leadership agility is important for all organizational levels, including top executives and managers” (Aldianto, 2021, p. 5) . The agile leader’s job is “setting the direction, establishing the simple, generative rules of the system, and encouraging constant feedback, adaptation, and collaboration ” (Parker, 2015, p. 118). Hence, agile leadership, a term that describes the ability of a leader to be “quick, adaptable, and flexible in responding to unforeseen events in an unfamiliar circumstance” (Aldianto, 2021, p. 5), may be thought as a very relevant factor during the COVID- 19 crisis.

This was particularly relevant in the face of the necessity to change the work environment during the pandemic.

Remote Work – The new Normal

Due to the COVID-19 pandemic various challenges were presented to organisations across the world, which resulted in a huge shift from office-based working to remote working (Chakraborty & Kar, 2021).

Remote working can be defined as “a flexible work arrangement whereby workers work in locations, remote from their central offices or production facilities, the worker has no personal contact with co-workers there, but is able to communicate with them using technology” (Di Martino & Wirth, 1990 p. 530). Prior to the COVID-19 crisis, most workers did not have much remote working experience and companies were not prepared for supporting this practice, despite the fact that its use has grown the past several decades. However, with the outbreak of the COVID-19 crisis, millions of workers all over the world were forced to remote work and, in fact, remote work may be considered the “new normal” nowadays and it happened almost overnight (Wang, 2021).

This was only possible due to the new communication technologies that have been created, that were hence paramount during the pandemic, when most of the world was forced to stay at home. Applied to the workplaces, they have given rise to a new business practice, one in which a team, spatially dispersed, uses predominantly computer-mediated communication. High tech companies were in general better equipped to adapt to this new workstyle, and many now favor this type of work. But, despite the fact that remote work has allowed to adapt and effectively be able to work during a time of lockdown, it may also have some implications (Lal (2021); Prochazka (2020); Wang

(2021)), presenting a particular set of challenges the team leaders, like influencing other team members while trusting on this computer-based communication (Purvanova & Bono, 2009).

Company's Capabilities

The extent of a companies' resilience will also rely upon their capability and resource availability (Bhamra, 2011). As a result, "an organization's capability portfolio ideally comprises both operating capabilities and dynamic capabilities that should allow an entrepreneurial firm to be resilient and respond to threats" (Schepers, 2021, p. 3).

The literature distinguishes between these two definitions as: operational capabilities - "how you earn your living" and dynamic capabilities - "how you change your operational routines" (Cepeda & Vera, 2007; Helfat & Peteraf, 2003; Winter, 2003). It follows that "Operating capabilities require a certain amount of routinization and enable the firm to execute its main operating activities such as making and selling products or delivering services" (Schepers, 2021, p. 4). However, when facing an exogenous shock, like the COVID-19 pandemic, such routinization can eventually become the source of apathy, market irrelevance, and eventually failure (Teece, 1997). On the other hand, dynamic capabilities can counterbalance this effect since they allow the company to readjust their operating capabilities (Newey & Zahra, 2009; Zahra, 2006). As a result, strategic decision making can be viewed as a dynamic capability, as entrepreneurs pool their commercial, functional, and personal knowledge to make decisions that reflect the firm's strategic actions (K. M. Eisenhardt, 1989; Kathleen M. Eisenhardt & Martin, 2000). Following that line of thought, also Teece in 1997 had stated that dynamic capabilities are "how firms achieve and sustain competitive advantage" as well as "sources of wealth creation and capture by firms" (Teece, 1997, p. 1). And according to Helfat & Peteraf (2009) dynamic capability is "the capacity of organisations to intentionally create, expand, or modify their resource base, and, thus, achieve higher economic value than their competitors" (Aldianto, 2021, p. 4). Schepers (2021) added a new dimension to the capacity of the companies, the operational capacity, and defined the objectives of each one of them in this way: "dynamic capabilities are necessary to adapt and change while operating capabilities are needed for stability" (Schepers, 2021, p. 4).

As a result, while a firm's operational capacity is generally defined by daily routines that allow it to continue its routine operation, dynamic capacity is defined as the ability to reconfigure operational capabilities and therefore allow the organization to evolve and grow (Schepers, 2021). So,

“especially in times of an economic crisis, entrepreneurial resilience is highly dependent on the dynamic capabilities of a firm as firms need to adapt and evolve” (Schepers, 2021, p. 4).

Resilience through Business Model

A business model (BM) describes how a corporation creates and distributes value to its consumers while retaining a portion of the value in order to remain financially viable (Teece, 2010a). And the business model reflects management's assumptions about what the consumer wants and how the organization can best organize to create, deliver, and acquire that value (Doz & Kosonen, 2010; Foss & Saebi, 2017; Teece, 2010b; Tikkanen, 2005). The logic of the business model is exposed to the market test once it has been created, and it must then be adjusted when faced with dynamic environmental conditions. (Teece, 2010b). It follows that, “far from being static, business models need to be in a continuous flux, responding to opportunities and threats in the firm’s external environment” (Saebi, 2015, p. 1).

Companies that are successful, specially those that have enjoyed a somewhat benign environment, find it quite difficult to reinvent their business model (Hamel & Välikangas, 2003). Nevertheless, companies and entrepreneurs that are resilient in difficult economic times often find an alternative through business model innovation. In fact, as stated by Buliga (2016) “the aim of business model innovation, as a strategic measure, is to ensure company survival in times of environmental change and turbulence” (Buliga, 2016, p. 650). The link between resilience and business model dynamics may not be immediate, however Buliga (2016) stated that business model dynamics can be a tool to build organisational resilience since “with their numerous types and variations, business model innovations are viewed as a powerful source of performance and growth, and hence as a prerequisite for organisational survival” (Buliga, 2016, p. 650). Furthermore, in his study Schaffer (2021) states that “organisational resilience is a central ability to strive through these challenges”; and that “business model innovation can be a tool to build organisational resilience” (Schaffer, 2021, p. 1). Likewise, according to Magretta (2022) when a firm starts to operate, its initial business model, including economic and motivational concerns, is constantly dependent on market test and validation. Hence, the capacity to adapt its business model dynamically effectively drives the success of a company. The entrepreneur’s constant function is, thus, to maintain a sustainable long-term business model (Teece, 2010). In fact, in the past, executives had the luxury of considering that business models were somewhat immortal. But nowadays for all companies continued success no longer depends on momentum, but it relies on resilience- on the capacity to dynamically and

continually reinvent business models and strategies, in the face of constantly changing circumstances (Hamel & Välikangas, 2003). So, as can be deduced, business model changes can also be related, and can rely upon, methods that allow the constant evolution and adaptation that permit companies to maintain their operations even in the face of change, and thus, to be resilient.

Husin (2021) further explains the need for companies to understand the business model dynamic process in order to be able to develop a new business model that is flexible and adaptable in such troubled times as we are now experiencing. Peñarroya-Farell & Miralles (2021) develop this topic comprehensively and thoroughly, defining four different concepts often misinterpreted or misused in literature: (i) business model dynamic, (ii) business model adaptation, (iii) business model innovation, and (iv) business model evolution. They define business model dynamics (BMD) as "how companies change and develop their business models to achieve sustained value creation through time" (Peñarroya-Farell & Miralles, 2021, p. 6). However, this can be done in different ways, such as: Business Model Adaptation (BMA), Business Model Innovation (BMI) or Business Model Evolution (BME).

In this sense, when companies are seeking to answer to an external disruption or a change in the environment and intend to pursue the alignment of their current model with the new competitive environment, an approach based on BMA would be better suited. BMA is then "related to encompassing strategic settings to external effects with the main goal guaranteeing economic sustainability of the firm" (Peñarroya-Farell & Miralles, 2021, p. 3). Thus BMA can be defined as the "process by which management actively aligns the internal and/or external system of activities and relations of the business model to a changing environment" (Saebi, 2015, p. 149). Of note is the fact that "while novelty might be a likely outcome of business model adaptation, it does not constitute a necessary requirement" (Saebi, 2015, p. 150).

But if instead the firm pretends to disrupt the market conditions or the ecosystem status quo with a start-up approach, a path based on BMI would be a better fit. BMI "refers to radically reconfiguring the firm's competencies to respond to the external effects" (Peñarroya-Farell & Miralles (2021). So, BMI can be defined as "the process by which management actively innovates the internal and/ or external dimensions of the business model to disrupt market conditions" (Saebi, 2015, p. 149). In fact, while BME and BMA always imply changes to the existing business models, BMI may or may not result in the creation of a different business model for a separate unit, or it can entail changes to an existing business model. Regularly, BMI is likely to involve various components of the business model at the same time and requires reconfiguration and/or creation of new core activities and processes within the business model (Saebi, 2015).

Finally, if an incremental and continuous innovation is necessary, BME would be the best approach. BME is “an incremental reconfiguration of some components of the business model to face the strategic challenges derived from the external effects” (Peñarroya-Farell & Miralles, 2021, p. 3). This type of business model change refers to the “effective standardization, replication, implementation, and maintenance of the existing business model, manifested in the fine tuning process involving voluntary and emergent changes in and between permanently linked core components” (Saebi, 2015, p. 148). In this model,” the scope of change is limited to a few areas at a time and does not significantly alter core-repeated standard processes of the firm’s business model.” (Saebi, 2015, p. 150).

All things considered it can be said that BME and BMA are similar in the sense that they require organisational processes that bring about alterations and adjustments (as opposed to disruptions) to the business models. They are different in the way that way that "evolutionary change processes occur more naturally and incrementally over the lifespan of the firm’s business model, while business model adaptation reflects purposeful changes made in response to changing environmental conditions” (Saebi, 2015, p. 151).

So, in these ever-changing and fast-moving environments that we live in nowadays, if a company wants do have a sustained superior performance it depends on its ability to arrange and re-arrange superior strategic assets, such as the companies’ business model, in order for them to be suitable and adapted for those environments (Peñarroya-Farell & Miralles, 2021).

In this sense, not only, but also through different changes in its business model dynamics, a company might be able to adapt, innovate or evolve. Consequently, strategic resilience is not only responding to a single crisis or surviving a setback. It is about relentlessly anticipating and adjusting to changes that can permanently affect the business. In the end, it is about having the ability to change before the need for change becomes dangerously obvious (Hamel & Välikangas, 2003).

Hence, as explained, big pandemic disasters, as well as small uncertainties or deviations did before, cause challenges to enterprises and can pose as threats to organisations, since these disruptions can influence the organisations’ ability to get finished goods into a market and provide critical services (Bhamra, 2011). The aim of resilience is to survive and thrive through it all. Tech companies are well known for being innovative, adaptative businesses, and had a very important role during the pandemic. But in order to do so, as other organisations, they had to adapt and evolve.

After reviewing the existing literature about resilience, as showed in the table below, and the response of technological companies to times of extreme disruption, it is found that there is a gap

in two directions: the first is the lack of studies on the practical impact of COVID-19 on technological companies, the other gap is the lack of comparative studies between two countries (Portugal and Israel), i.e. two different contexts that have been impacted differently by the COVID-19 pandemic.

Table 3 - Literature Review - Screened Papers (Source: The author)

<i>Subject</i>	<i>Title</i>	<i>Author (Year)</i>
Resilience	<i>Defining and measuring economic resilience to disasters</i>	Rose (2004)
Resilience	<i>Economic Resilience to Disasters</i>	Rose (2009)
Resilience	<i>The impact of the covid-19 crisis on growth-oriented smes: Building entrepreneurial resilience</i>	Schepers (2021)
Resilience	<i>Resilience: The concept, a literature review and future directions</i>	Bhamra (2011)
Resilience	<i>The Quest for Resilience by Gary Hamel and Liisa Välikangas</i>	Hamel & Välikangas (2003)
Crisis Management	<i>COVID-19 and public policy and entrepreneurship: future research directions</i>	Ratten (2021)
Lean	<i>Lean thinking: banish waste and create wealth in your corporation</i>	Womack (1996)
Agile Leadership	<i>Improving productivity with self-organised teams and agile leadership</i>	Parker (2015)
Company's Capabilities and Agile Leadership	<i>Toward a business resilience framework for startups</i>	Aldianto (2021)
Business Model Dynamics	<i>Evolution, Adaptation, or Innovation?</i>	Saebi (2015)
Business Model Dynamics	<i>Business Model Dynamics from Interaction with Open Innovation</i>	Peñarroya-Farell & Miralles (2021)
Business Model Dynamics	<i>How Business Model Innovation fosters Organizational Resilience during COVID-19</i>	Schaffer (2021)
Business Model Dynamics	<i>Business model innovation and organizational resilience: towards an integrated conceptual framework</i>	Buliga (2016)

3. Methodology

This chapter presents the research design and methodology justification for the qualitative study.

Firstly, a gap in the literature was identified, originating the research question. Then the units of analysis and study procedures were created and the selection of cases was done, as explained further on. Data collection and analysis procedures are also presented.

The aim of this study is to add value to the literature and provide resilience lessons through the analysis of actions and decisions that enabled companies to react in the best way to an unprecedented crisis, so that one can learn. Also, they can serve as future reference in the event of another extreme crisis, such as the one we experienced in 2020.

3.1. Research design

Yin (2018) defined research design as “*a logical plan from getting from here to there, where here may be defined as the set of questions to be addressed, and there is some set of conclusions about these questions*” (Yin, 2018, p. 26). Plus, Nachmias & Nachmias (2014) defined research design as a “*logical model of proof*”.

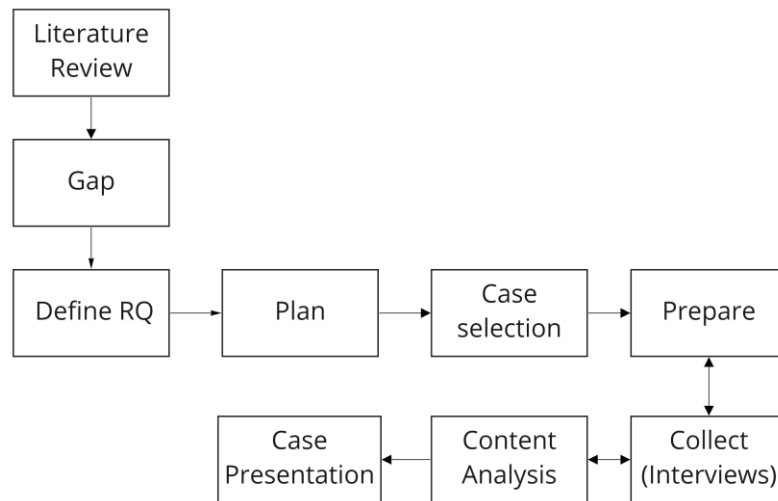


Figure 4 - Research Design - Source: The author (adapted from Yin, 2018)

As Yin (2018) recommended, the literature research was done in order to narrow the subject to a key topic or two, in accordance to the author’s interest. After that first research, that involved approximately 70 articles, 13 articles were selected and screened (table 3) closely with special attention to their future research and learnings. The other articles were used in order to reinforce the relevance and pertinence of the topic or to clarify a special subject. From this general overview,

a gap in the literature emerged: the lack of studies of how tech companies in the two countries (Portugal and Israel) dealt with the crisis caused by COVID-19. Thus, the research question was defined and a plan to answer it was created.

As stated in Yin (2018), “a case study is an empirical method that investigates a contemporary phenomenon (the “case”) in depth and within its real-world context, especially when the boundaries between phenomenon and context may not be clearly evident” (Yin, 2018, p. 15). According to this author, what characterizes a case study as a research method is that it does not require control over behavioral events, it focuses on contemporary events and the forms of the research questions that are most appropriate are “how” and “why”. Moreover, Schramm (1971), as emphasized by Yin (2018), states that “the essence of a case study, the central tendency among all types of case study, is that it tries to illuminate a decision or set of decisions: why they were taken, how they were implemented, and with what result”(Yin, 2018, p. 14). Also, “case studies can include both single and multiple case studies”(Yin, 2018, p. 17). Accordingly, it was decided to use the multiple case study methodology.

As for the case selection, Technological Portuguese and Israeli SMEs were selected, according to the criteria explained further on (3.1.2 Unit of analysis).

In the preparation phase, the interview script (Annex 2) was drawn up based on the fundamental themes needed to be explored, as the literature review suggested. Subsequently, the target companies were contacted, an overview of the objectives of this study, as well as the key concepts was given, and the online interviews were scheduled. In total, 8 online interviews were conducted with middle/top managers from Portuguese and Israeli tech companies. The online interviews were recorded and transcript. The evidences were individually analyzed and then a comparison analysis was made in order to understand the differences/similarities between the cases.

3.1.1 Research Question

This research intends to understand how technological companies in two different contexts (economy and culture) faced the COVID-19 crisis. There are several possible angles to analyze the effects of the pandemic on technological companies, however, this study aims to analyze the three categories of resilience: foresight, coping and recovery, as defined previously in the literature review.

RQ – How did tech companies face COVID-19 pandemic in order to become more resilient?

3.1.2 Unit of analysis

As the research main objective is to understand how tech companies in Portugal and in Israel faced the COVID-19 crisis, different small and medium enterprises (SMEs) tech companies in both countries were analyzed. According to the different case study designs (Yin, 2018), it is considered each company as an Unit of Analysis (UA).

There were several reasons for choosing these two countries. Firstly, due to the differences in health and social measures taken by both countries, as mentioned previously. Secondly, the author's professional career, that passes through both countries, which has already passed through these two countries, was also a determining factor.

For the case selection, the inclusion criteria were:

- Technological SMEs;
- The same number of Portuguese and Israeli Companies.
That were founded at least 3 years ago (2019) and didn't stop operating during the COVID-19 crisis

3.2. Data Collection

Data was collected through online semi-structured interviews that were conducted with middle/top managers of Portuguese and Israeli tech companies, after obtaining the informed consent.

The interviews were based on a script (Annex 2) that was developed according to the concepts and ideas included in the resilience framework presented in section 2.2 (figure 3), and in the literature review. In the first part of the interview, it was intended to understand how companies were or were not prepared for an extreme crisis such as the one caused by the COVID-19 pandemic. In a second part, whether the existence of a lean and agile methodology in the company impacted the processes during the pandemic and also leadership, especially through the impact of remote work; In the third part, the theme of the companies' capabilities and how they were affected and changed during the pandemic. The fourth and final part of the script aimed to understand how the companies' business models were impacted by the COVID-19 crisis and if the companies view themselves as more resilient nowadays.

Eight interviews were conducted, two per each company, each with a different middle/top manager from the same company, in order to be able to validate and compare the information. In

total four companies, two Portuguese and two Israeli were analysed. The interviews were conducted between the 13th and 23rd of May 2022, each one lasted an average of 30 minutes. Video and audio of the full interviews was recorded and transcript. The anonymity of data and all kind of information was guaranteed during the whole process.

3.3. Data Analysis

Of the total of four companies analysed (identified as A, B, C and D), two of them are from the advertising sector, one from infrastructure management and another linked to human resources and E-learning, all of which have a very strong technological component, as explained in Table 4.

Table 4 - Companies selected for the study (Source: The author)

<i>Company</i>	<i>Business Scope</i>		<i>Interviewees</i>	<i>Country</i>
A	Intelligent Management Platform	Maintenance	VP Operations & Strategy Head of People & Culture	Portugal
B	Advertising Services - Customer acquisition platform		CEO Chief of Staff	Portugal
C	Mobile ad platform		Client Growth Team Leader Senior Publisher Relations Manager	Israel
D	Online e-learning network - Pre-employment test preparation platform		Head of Product Development Test Developer Manager	Israel

3.3.1. Categories of analysis

The three key elements of resilience developed by Rangachari & Woods (2020) were used as a macro categories of analysis in order to systematise the information collected from the interviews, also based on the literature review presented. The three key elements of resilience, presented in Table 5 are: “(i) **foresight** (ability to predict something bad could happen), (ii) **coping** (ability to

prevent something bad from becoming worse), and (iii) **recovery** (ability to recover from a bad occurrence)” (Rangachari & Woods, 2020, p. 3).

Table 5 - Categories of analysis (Source: the author)

<i>Element</i>	<i>Category</i>
Foresight	<u>Crisis Response Plan</u> The existence of some kind of guidelines or plan to respond to a crisis, previously to the COVID-19 pandemic.
	<u>Response team</u> The existence of a specific team in the company to deal with the crisis
Coping	<u>Lean and Agile Methodologies</u> The practice of Lean and/or Agile principles in the company
	<u>Remote Work and Leadership</u> How did the Remote work affect the company, especially the leadership?
	<u>Agile Leadership</u> The leader’s ability to react, adapt and be flexible during the COVID-19 crisis.
	<u>Capabilities</u> The company’s investment in resources during the pandemic.
Recovery	<u>Business Model (BM) Dynamics</u> Effective changes in the Business Model due to the pandemic.
	<u>Resilience Proof</u> What the company learned from the crisis.

The strategy followed to analyze the data gathered from the interviews was the pattern-matching as recommended by Yin (2018). This technique consists in comparing the existing findings from each case-study with the predicted one, the data collected previously to the interviews (Trochim, 1989).

4. Discussion

In order to treat the information collected from the interviews of the four companies (Units of Analysis), a table was drawn up for each company studied, containing the above-mentioned categories of analysis as well as some important transcript evidence from the interviews.

4.1. Evidences: Company A

Company A was founded in 2015 (year of the end of Troika's 'control' in Portugal) and offers an intelligent maintenance management platform, it currently has around 150 employees. It has four offices between Porto (headquarters), Barcelona, London and Florianopolis in Brazil, which also correspond to the company's main markets: Portugal, Spain, United Kingdom and Brazil.

The table below contains the transcribed evidence from the two interviews, divided by the three categories of analysis previously explained.

Table 6- Data Analysis - Company A - Intelligent Maintenance Management Platform – Portugal (Source: The Author)

<i>Category</i>	<i>Sub-Category</i>	<i>Evidences</i>
Foresight	Crisis Response Plan	There was no response plan previously, it was created during the crisis - <i>"We didn't have one, we ended up having to create one adjusted to COVID-19, also because at some point it was something legally required. But we didn't have anything structured like that before."</i>
	Response team	There were no specific group for COVID-19 crisis. In another hand, it is defined by the company a group of people that in crisis moments or specific challenges get together. <i>"These people were not the specific committee for COVID-19, but they are the same people who already today unite in any crisis situation or any challenge they have (People and Culture, CEO, CTO, VP of Growth, VP of Strategy and Operations and Leadership Team)."</i>
Coping	Lean and Agile Methodologies	Yes, the company uses agile methodology - <i>"This for us helps us a lot to avoid prolonging mistakes for a long time, to learn faster from each other and to be constantly aligned."</i>
	Remote Work and Leadership	The interviewees affirmed that <i>"One to one meetings with the team, made it more impersonal on the one hand but more efficient on the other."</i>

<i>Category</i>	<i>Sub-Category</i>	<i>Evidences</i>
Recovery	Agile Leadership	The opinion of the two interviewees was unanimous, they affirmed and gave examples of agile leadership during all periods of the pandemic - <i>“Especially team leaders and top management. It had a lot to do with the speed of decision making.”</i>
	Capabilities	The company increased the investment during the pandemic at the infrastructure level (not directly related to the COVID-19), Human Resources <i>“we went into the pandemic with 40 people, we came out of the pandemic with twice as many”</i> and Technology <i>“we continued to invest in the systems that were needed for all the new projects.”</i>
		<i>“I believe that the transformations caused by the COVID-19 pandemic do not impact our vision, mission and goals.”</i>
		<i>“We have made strategic, operational changes, but we continue on the same path (goal) because we are obstinate.”</i>
	Business Model Dynamics	Both interviewees mentioned that the type of BM Dynamics that best suited what happened to the company in the external context change is Business Model Adaptation - <i>“The company has adapted its Business Model , especially sales and pricing strategy.”</i>
		There were some components in the BM that changed and there is no plan to revert them in a short term - <i>“In the short term we do not expect to reverse the decisions and core changes that have been made”</i>
	Resilience Proof	The company reacted in various fronts since the day 1 of the Coronavirus pandemic. Internal Reaction Adaptation to the remote work – <i>“There had to be an adaptation for us to continue to have the same level of communication. We started using a word that is "over communication."”</i>

<i>Category</i>	<i>Sub-Category</i>	<i>Evidences</i>
		Worker's well-being – <i>“Some staff were living alone and so psychologically it started to be very intense, so we (HR) created regular check-ins, we would not only go to these people but also talk to them on the phone or by teams.”</i> External Reaction Social Responsibility (Place Check up) – <i>“As we had the technological structure, in 2 or 3 days we built a platform that allowed people to check in where they were going. For example, I went into a café, I can go there (to the platform) and say if the café complies or not with the COVID-19 safety rules. That product still exists today. We made a free product; we made this pro bono platform serving small businesses and people. We have managed to productise it (platform) for larger institutions.”</i> Social Responsibility (Tech4Covid19) – <i>“The idea was, let's pool our knowledge, our human resources and let's put heads working on different projects. It was a very large national project, several start-ups, including us, who also led the organisation and the birth of this group. It resulted in a series of projects in all kinds of areas: security areas, volunteering, food reuse and localisation of services.”</i> Interaction with customers – <i>“We had personal conversations with customers, made some adjustments at the level of sales plan and framework. Things that would actually give them relief and allow them to survive and then come back and continue to use our platform in the future.”</i> Search for new Markets – <i>“Before the pandemic, one of the biggest sectors that we served with our technology platform was the hospitality and tourism sector, which was one of the most affected by the crisis. We started to explore new market segments, such as health, more technical and occupational safety-related services that we had not explored before.”</i>

<i>Category</i>	<i>Sub-Category</i>	<i>Evidences</i>
		Is the company more resilient today than it was before Covid-19? The VP of Operations and Strategy answered that - <i>“We are now more people thinking, we have more resources, more talent and we are definitely more resilient because we also learned a lot from that (COVID-19).”</i>

Both interviewees said that the initial "shock" caused by the news of COVID-19 and the first restrictions on movement did not last long, and that they quickly went through a process of reaction and adaptation: *“So initially there was a shock, but because of our type of culture, maybe because of our age, because of the company’s internal openness, it only lasted a few hours. Very quickly we realised: let’s unite and let’s realise what we can do for the company together, and for the world”*. Until this pandemic broke out, the company had no crisis response plan of any kind, but on the other hand it had defined a working group to respond to external "challenges" or problems: *“These people were not the specific committee for COVID-19, but they are the same people who already used to unite in any crisis situation or any challenge they have”*. This group of people was responsible (among other things) for drawing up a scenario matrix in the very first weeks of the pandemic, in which concrete goals and actions for various revenue and cost hypotheses were decided upon.

When asked about the company's use of Lean or Agile methodologies, both said gave examples and explaining how these same methodologies are adjusted to the company’s intrinsic culture of constant adaptation, short feedback cycles and experimentation. The (punctual) changes that occurred in the work teams, according to the interviewees, were mainly due to the new projects that the company embraced during the pandemic. As expected, the Head of People and Culture throughout the interview gave special emphasis to the work of Human Resources during the pandemic and the care they took in dealing with the issue of remote work. It was shared that some of the initiatives that used to take place in person when migrating to online did not go so well, such as Happy Hours; but others had a strong adhesion, such as a “hidden talents contest” of employees. It is also worth mentioning the concern of the company as a whole, but especially of Human Resources, with the mental health of its employees, especially those who lived alone during lockdowns. A very curious perspective raised by the VP of Product and Strategy was the fact that remote work and online meetings with clients have made relationships more impersonal but at the same time have greatly increased the company’s efficiency.

As far as Agile Leadership is concerned, the opinion of both was unanimous and, in a way, complementary. On the one hand, the Head of People and Culture said that the best example of the existence of the characteristics of an Agile leader was the speed of decision making its implementation. On the other hand, the VP of Product and Strategy (and also one of the four founders of the company) mentioned that an example of Agile Leadership in the company was the anticipation or quickness of reaction, for example when they took the initiative to go and talk to the customers in the main and most affected market (Hotels) offering flexibility and solutions to overcome that moment together.

Regarding the company's investment during the pandemic, both interviewees shared the opinion that it had increased at all levels. Perhaps the most impactful was the strong investment in new hires as the company has more than tripled its employees. This strong investment in Human Resources comes from the diversification and search for new market segments, such as the health area, which even after the first months of the pandemic continued to be segments with a strong invoicing volume.

Among the three possible types of changes in the Business Model, the one that both elected as being the one most related to the company's reality was "Adaptation" and both mentioned that the changes that were made are not expected to be reversed in the short term.

In the Business Model, the adaptation of the value proposition to the new market segments such as health and safety at work should be mentioned.

When answering the question "Is the company more resilient today than it was before COVID-19?" the VP of Operations and Strategy answered that: *"We are now more people thinking, we have more resources, more talent and we are definitely more resilient because we also learned a lot from that (COVID-19)."*

As shown in the table above (and confirmed with the documentation provided) the company also dedicated a large part of its time and resources to social responsibility projects, and was the only one of the four companies studied that demonstrably had the concern to contribute to society. One of these projects, the company even managed to monetize after a few months, selling the solution to large companies.

4.2. Evidences: Company B

Company B was founded in 2017 in Lisbon (Portugal) and its main product is a customer acquisition platform in the digital advertising market. It currently has 36 employees, and they are

still looking for new talent for the company. There are already 15 countries where this company sells its products, although the main markets are Portugal and Belgium.

The table below contains the transcribed evidence from the two interviews, divided by the 3 categories of analysis previously explained.

Table 7 – Company B – Customer acquisition platform – Portugal (Source: The Author)

<i>Category</i>	<i>Sub-Category</i>	<i>Evidences</i>
Foresight	Crisis Response Plan	Before the advent of COVID-19 there was no plan of any kind. When asked if any plan was created after the appearance of COVID-19 the CEO of the company stated that nothing was created, on the other hand the Chief of Staff stated that there is now a plan but it is not very well structured – <i>“I think that at this moment there is already something but it’s nothing very extensive, it’s just a group of listed processes.”</i>
	Response team	There was no team or set of people with the mission to respond to the challenges caused by COVID-19. <i>“There was no team with that kind of mission.”</i>
Coping	Lean and Agile Methodologies	Yes, the company uses an adapted Agile methodology – <i>“We use a bit of our own adaptation of agile. It’s derived from our previous experience in software development.”</i> <i>“We have a Scrum Master, and it’s very much because of COVID. That is, when we switched to remote, we started giving even more importance to Scrum ceremonies, so we could all be more aligned.”</i>
	Remote Work and Leadership	The CEO affirmed that it was difficult to adapt to remote in the first weeks because <i>“Leadership really wasn’t used to working remotely.”</i>
	Agile Leadership	The opinion of the two interviewees was unanimous, they affirmed and gave examples of agile leadership mainly in the first months of the pandemic.

<i>Category</i>	<i>Sub-Category</i>	<i>Evidences</i>
		<i>“We very quickly adapted the management structure of the company. We ended up very quickly changing the processes that we had at the time and which were a bit dependent and based on having an office and everyone being there.”</i> <i>“Improving documentation, for example. I think it is very important that we make a great effort to document the whole company and all the processes.”</i>
	Capabilities	Both interviewees referred that the company didn’t have enough resources when COVID-19 occurred – <i>“Even today we don’t have all the means we need to have, but it’s because we are growing so much.”</i> The resource investment had a significant increase (Human Resources, Infrastructures and Technology) but in their opinion it was because of the company’s growth and not so much related do the pandemic – <i>“Increased practically in everything, we tripled the team.”</i> <i>“It increased enormously, but it wasn’t because of the pandemic, it was because of the growth of the company.”</i>
Recovery	Business Model Dynamics	Both interviewees mentioned that the type of BM Dynamics that best suited what happened to the company in the external context change is Business Model Adaptation – <i>“There were some (BM) components that changed directly related to the COVID-19 pandemic”</i> There were some components in the BM that changed and there is no plan to revert them in a short term – <i>“Some of the components that have changed, are evolutions, they will no longer return to the initial state. Now, if it happened because of the pandemic or if it happened because of the growth, it is difficult to understand.”</i>

<i>Category</i>	<i>Sub-Category</i>	<i>Evidences</i>
	Resilience Proof	The CEO affirmed that the company's product didn't change because of the COVID-19 pandemic, meanwhile the Chief of Staff affirmed that – <i>“(The product) has changed because people have turned much more to online and we used to be very focused only on the end client. Because of COVID we now end up working with very big partners, with agencies which at the time was not something we even had in mind.”</i> Is the company more resilient today than it was before Covid-19? The CEO answered that <i>“Yes, and it is very much because of COVID that we set up a structure that is less dependent on geography. We grew in new markets, but the most significant changes were in terms of the company itself.”</i>

Before the pandemic, company B did not have any kind of plan or guideline for responding to crises. When asked whether or not a plan exists today, the CEO of the company stated that it does not, while the Chief of Staff stated that it does: *“I think that at this moment there is already something but it's nothing very extensive, it's just a group of listed processes”*.

With regard to the use of Lean or Agile methodologies, both interviewees stated that yes, they used them. The CEO shared that the methodology used by the company is an adaptation of these two “philosophies” after having had previous experiences in the area of software development. On the other hand, the Chief of Staff confided that the use of these methodologies was further strengthened after the emergence of COVID-19 and consequently remote working. For this, the company hired a Scrum Master (Agile Coach) to ensure the alignment between the teams and the ‘compliance’ with the Agile methodology bases. Both the CEO and the Chief of Staff stated that the company was not prepared for 100% remote work and that this was one of the biggest challenges that the pandemic brought. However, the positive side that came from remote work was that the search for talent could extend to the whole world and not only to Lisbon, for example, having hired (during the pandemic) a Product Manager who lives in London.

About Agile Leadership, the answer was once again unanimous, both recognised the existence of the characteristics of an Agile leader. The CEO gave special focus to the structure of the company and how it was quickly adjusted to respond to the challenges of remote work, also giving examples of the need that the company had to start documenting more and more of its processes. On the

other hand, the Chief of staff praised the importance of the feedback from all employees during the first months, which allowed to improve processes and make better decisions.

Regarding the investment that the company made during the pandemic, the CEO was categorical in stating that it increased in all aspects, however he does not hold the pandemic 100% responsible for this fact. He states that this is natural as the company is experiencing a strong growth, which was already occurring even before COVID-19: *“The company started at the end of 2017 and the company has been in natural growth since then. There’s a lot that came before and after COVID that’s not necessarily connected to COVID itself”*.

As far as the Business Model is concerned, both interviewees stated that the company has broadened segments (e.g. partners), but has not changed its value proposition. These changes are not expected to be reverted in the short term. As for revenues, both interviewees acknowledged a drop in the first quarter of 2020, but this was quickly overcome in the following quarters, and ended 2020 on positive ground. The turnover for the year 2022 is expected to double compared to 2021, from €2 million (2021) to €4 million at the end of 2022.

When asked if the company is more resilient today than before the advent of COVID-19, both had the opinion that yes – CEO: *“Yes, and very much because of COVID, we set up a structure that is less dependent on geography. We grew in new markets, but the most significant changes were even in terms of the company itself”*; Chief of Staff: *“For us the pandemic really taught us a lot. The year 2020 was a great learning experience for us, especially for all of us who were here before.”*.

4.3. Evidences: Company C

Company C is a mobile ad platform for advertising agencies and brands and was founded in Tel-Aviv (Israel) in 2012. It currently has around 80 employees spread between Israel and the United States. The company works with over 600 companies worldwide including Amazon, Facebook and Disney.

The transcribed material from the two interviews is organized in the table below by the three categories of analysis previously discussed.

Table 8 – Data Analysis – Company C – Mobile advertising platform – Israel (Source- The Author)

<i>Category</i>	<i>Sub-Category</i>	<i>Evidences</i>
Foresight	Crisis Response	Before the advent of COVID-19 there was no plan of any
	Plan	kind. <i>“No, (there was no plan) but people were agile enough to adjust</i>

<i>Category</i>	<i>Sub-Category</i>	<i>Evidences</i>
Coping		<i>quickly once the pandemic started. We didn't wait for the full shutdown, the government rules. We took steps before that."</i>
		Now, there is some kind of guideline or plan to respond to a crisis <i>"If there is something that will hit again like COVID 2.0, they have like a structure they built during the pandemic, and they adjust a little bit every time a new variant appears. It's kind of a plan."</i>
	Response team	The Human Resources department was the one responsible to define (internal) strategies to face COVID-19 pandemic. <i>"It was a part from HR – Just people from HR, like a Covid unit"</i>
	Lean and Agile Methodologies	The company does not follow a Lean or Agile methodology. Even so, the Client Growth Team leader affirmed that the company has a <i>"Lean Philosophy"</i> .
	Remote Work and Leadership	Both interviewees stated that Remote Work was actually a good change for the company <i>"I think they actually they improved, the work and the quality of the work. As a business, we perform better when everyone work from home."</i>
		Both interviewees affirmed that the leaders of the company reacted fast and also that there were changes comparing before and after the COVID-19 crisis regarding the remote work rules.
	Agile Leadership	<i>"Yes, I think it was quite agile the management. The examples like sending office equipment to their homes with taxis, just to make sure to provide them all the office supplies they need."</i>
		<i>"The mindset changed, that led to other decisions, and the management now is more flexible. They now don't care how many persons are in the office or at home (working)."</i>
	Capabilities	Both interviewees highlighted the investment in HR that, in their opinion, increased in terms of benefits due to the COVID-19.

<i>Category</i>	<i>Sub-Category</i>	<i>Evidences</i>
		<i>“In terms of HR, it increased. The company now is more interested in the people than was before. Increased in terms of benefits for the ones that already work in the company. They send the packages to our homes on holidays and things like that.”</i> <i>Regarding other departments I think there was not an investment increase”</i>
	Business Model Dynamics	Both interviewees mentioned that the type of BM Dynamics that best suited what happened to the company in the external context change is Business Model Adaptation – <i>“We needed to adapt to the new contextual circumstances, so there were some blocks in the BM that were affected.”</i> There were some components in the BM that changed and there is no plan to revert them in a short term – <i>“I think there were some changes that did not go back to what they were before.”</i>
Recovery	Resilience Proof	Both interviewees affirmed that the product didn’t change but the target segments changed and the company adapted to it – <i>“Some segments are changed with excitement, mostly because of the world-changing segments of advertising. Before we had some big clients in the beverage and food and drinks, these are no longer advertising. But payment companies, streaming, shopping online are now our segment focus.”</i> Is the company more resilient today than it was before Covid-19? <i>“Yes, the pandemic kind of shocked everything and now we are more prepared.”</i> <i>“There were no big changes done, but I think now we are more prepared.”</i> <i>“The revenue is growing, and of course it helps.”</i>

Company C did not have any kind of defined plan to respond to a crisis, however the Client Growth Team Leader underlined that even though, there was no outlined plan and that people *“were agile enough to adjust quickly once the pandemic started. We didn’t wait for the full shutdown, the government rules. We took steps before that.”* The same person when asked whether or not a plan currently exists stated: *“If there is something that will hit again like COVID 2.0, they have like a structure they built during the pandemic, and they adjust a little bit every time a new variant appears. It’s kind of a plan.”*. Regarding the existence of any specific team or committee to respond to the challenges of the crisis, both interviewees replied that it was a matter dealt with almost exclusively by Human Resources.

Regarding the use of Lean or Agile methodologies, the interviewees stated that there is no such practice in the company; however, the Client Growth Team Leader states that the company has a "Lean Philosophy" in the perspective of eliminating processes that do not add value to the company and especially to the client.

The remote work was also pointed out as having had a great impact, especially the adaptation in the first weeks. However, the Senior Publisher Relations Manager is of the opinion that the leadership was not affected by the challenge of remote work. On the other hand, the Client Growth Team Leader is of the opinion that: *“I think that actually they improved, the work and the quality of the work. As a business, we perform better when everyone works from home.”*

On Agile Leadership, both interviewees agree that the company's leadership was fast in decision making and flexible. Giving the example in the speed of decision and operation and putting the workers to work from home 100% (before the pandemic the employees only had that option of one time per month). Regarding the managers' mindset, the Client Growth Team Leader states that: *“The mindset changed, that led to other decisions, and the management now is more flexible.”*

The company's investment during the pandemic had a special focus on Human Resources according to the interviewees. The benefits offered to employees increased because *“The company now is more interested in the people than was before.”* as stated by the Senior Publisher Relations Manager; he also mentioned that the company sends gifts to employees' homes on special occasions.

The company's business model has also changed, for example the market segments have changed and this had to do directly with COVID-19 and lockdowns. These changes, according to the Senior Publisher Relations Manager, are not expected to be reverted in the short term. In what concerns Revenues, both interviewees shared that there was a decrease due to the freezing of the companies' advertising budgets in the first quarter, but afterwards the invoicing grew exponentially. The

turnover volume achieved between the end of 2020 and the year 2021 is expected to remain on par with the value achieved in 2022.

When asked whether they consider the company to be more resilient today than before the pandemic broke out, the answer was a unanimous yes: *“Yes, it is, because now after facing this challenge I think, the next challenge of the same size will be easier to handle because people are more prepared for this kind of situation.”*

Of note, at several points in the interview, both interviewees spoke of the pandemic and COVID-19 as something completely outdated and distant in time, representing the very own Israeli mindset of relativising problems.

4.4. Evidences: Company D

Company D helps people to achieve their academic and career goals through the use of their professional preparation materials and was founded in 1992 in Tel Aviv (Israel). It currently has around 100 employees and its main markets are the United States, the United Kingdom, Israel and Canada.

The transcribed data from the two interviews is grouped in the table below by the three categories of analysis previously discussed.

Table 9 - Data Analysis - Company D - Pre-employment test preparation platform – Israel (Source: The Author)

<i>Category</i>	<i>Sub-Category</i>	<i>Evidences</i>
Foresight	Crisis Response Plan	Both interviewees said that there wasn't any kind of crisis response plan or guideline previously to the COVID-19 pandemic - <i>“There was no plan or anything like that”</i>
	Response team	In order to respond to the crisis, the Head of Product Development said that <i>“Just the Management team”</i> was directly involved in the crisis management. On other hand, the Test Developer Manager said that there was no team or committee especially allocated to handle the crisis.
Coping	Lean and Agile Methodologies	When asked if the company uses a Lean or Agile methodologies, the Head of Product Development said that <i>“Yes, since the COVID-19, before that it took us months to create a</i>

Category	Sub-Category	Evidences
		<i>product. Now we've started to create products in a different way, more lean, more agile. We are creating products very quickly and very effectively, so the team knows how to work in an agile way.”, “The team knows how important is to fail fast and prototype early and frequently.”</i>
	Remote Work and Leadership	Both interviewees stated that the Remote work didn't impact in the Leadership <i>“I don't think so because it's a small company like a startup, so it's very tight leadership and the teams here are very close to one another.”</i> Regarding the remote work they also pointed that <i>“People like felt motivated to show that they are working from home and everything is ok and aligned”</i>
	Agile Leadership	Both interviewees consider that the leaders of the company were agile - <i>“I think that the company leaders were very agile and they're changing their focus all the time, they adapt to the different situations, for example they are always on top of the market trends.”</i>
	Capabilities	Regarding the company's investment in resources the Head of Product Development said that in the beginning - <i>“I think we decreased (investment). We try to be very agile in our resources as well as lean in our resources because we couldn't afford to have the same budgets, but I think that with the minimum resources we provided a lot of value for the company.”</i> But after the initial crisis shock, both interviewees said that the company's investment in different resources (HR and Technology) increased - <i>“The investment it's increasing of course, after the first months, the initial impact.”</i>
Recovery	Business Model Dynamics	Both interviewees mentioned that the type of BM Dynamics that best suited what happened to the company in the external context change is Business Model Adaptation – <i>“We made some changes that we needed in order to succeed in the market, due to the pandemic.”</i>

Category	Sub-Category	Evidences
		There were some components in the BM that changed and there is no plan to revert them in a short term - <i>"I feel like it's growing and it's not going back like before. It's keeping like renewing and adding more things that are more relevant."</i>
		Is the company more resilient today than it was before Covid-19? <i>"Yes, I think the best thing that the COVID gave us, is like a new perspective on how we can work, how we can be effective and efficient in our work in our daily life, in the procedures and in everything that we do."</i>
	Resilience Proof	The company revisited the product itself and its value to the customer - <i>"We provide a more accurate value proposition now and we provide something that is more precise in order to sell. Because people did not have money and we need it to be very accurate in order for them to buy our product."</i> The company also targeted new segments - <i>"We started to work more and more for retail companies that, at that time, were the ones that needed to hire more people. Before the crisis we didn't work with them."</i> In order to react and help the customers in the first months the company lowered the prices, but now the prices came back to what they were before the COVID-19 pandemic - <i>"We made some adjustment in the beginning, like we lowered our prices and we made it more affordable and people asked for more refunds, but now we are very stabilized and we got back to our original prices."</i>

The two interviewees mentioned that the company did not have any kind of crisis response plan in advance and still does not. Still on the topic of foresight, the Head of Product Development stated that only the management team was in charge of dealing with the crisis and the shock of the pandemic, while the Test Developer Manager stated that there was no special department with this mission.

About the use of Lean and Agile methodologies, the Head of Product Development stated that yes, and that this was a change related to COVID-19, giving the example that before the pandemic the products took longer than nowadays. She states that the increased speed of production comes from a lean methodology, which eliminates unnecessary processes, with constant feedback and is, therefore, more efficient. On the other hand, the Test Developer Manager states that yes, she also recognises Agile and Lean values now, and that the big change she sees are the short-term goals and the work by sprints. According to the Head of Product Development, this change in methodologies was a necessity for the company due to the reduced number of employees in the first months after the initial shock of the pandemic, as a result of some layoffs and sick leaves.

The two interviewees stated that the remote work had a positive impact on the company, on employee motivation; and according to the Head of Product Development, it did not affect the company's leadership because the company has a family and start-up environment, and these principles of proximity have not changed.

When asked whether they see the characteristics of agile leadership in the company and especially in its leaders, both of them said yes. The Test Developer Manager gave the example of the change in methodology that occurred since the beginning of the pandemic.

In the opinion of the Test Developer Manager, in what regards the company's investment during COVID-19, *"I think the company is increasing (investment)"*. On the other hand, the Head of Product Development thinks that during the pandemic and between lockdowns *"it decreased, like we tried to be very lean in our resources because we couldn't afford to have the same budgets, but I think that with the minimum resources we provided a lot of value for the company"*, however, she considers that the investment is currently growing again in areas such as Human Resources (new hirings) and also in new Technologies for their products.

The Business Model Dynamics model that the two interviewees identify more with (given the reality of the company) is the Business Model Adaptation. The Head of Product Development stated that: *"We made some changes that we needed in order to succeed in the market, due to the pandemic"*. Also, the Test Developer Manager considers that today the company has a better product, much because of COVID-19 which made the company reinvent itself, but also because of the increase in competition. In the same line of thought, in the opinion of the Head of Product Development, today the company has a *"more accurate value proposition"*. New functionalities were added to the platform but they are not sure that they are directly related to COVID-19. All changes, in the opinion of the interviewees, are not expected to be reversed in the short term.

When asked whether the company is more resilient today than it was before the advent of COVID-19, both said yes. The Head of Product Development commented: *"Yes, I think the best thing that the COVID gave us is like a new perspective on how we can work, how we can be effective and efficient in our work in our daily life, in the procedures and in everything that we do"*. The Test Developer Manager considers that if an external shock happened again, the company would know how to deal with it in a better way because it learned with this pandemic.

4.5. Case Studies’ Learnings

The COVID-19 pandemic changed the rules of the game. This public health, social and economic crisis had deep implications for all companies, and the tech space was no different. The good news is that these times of crisis offer challenges that oftentimes encompass learning opportunities. As Winston Churchill famously said in the 40’s: *“never let a good crisis go to waste”* (Gruère, 2019). And in fact, although in this new reality many firms struggled to survive and some were even forced into liquidation; others managed to adapt and even prosper. For that to be possible, they had to adjust, change and mature, they had to be resilient. It follows then that organisational resilience is a core ability necessary to navigate through these challenges.

Figure 5 summarizes the similar results observed in all four studied companies.

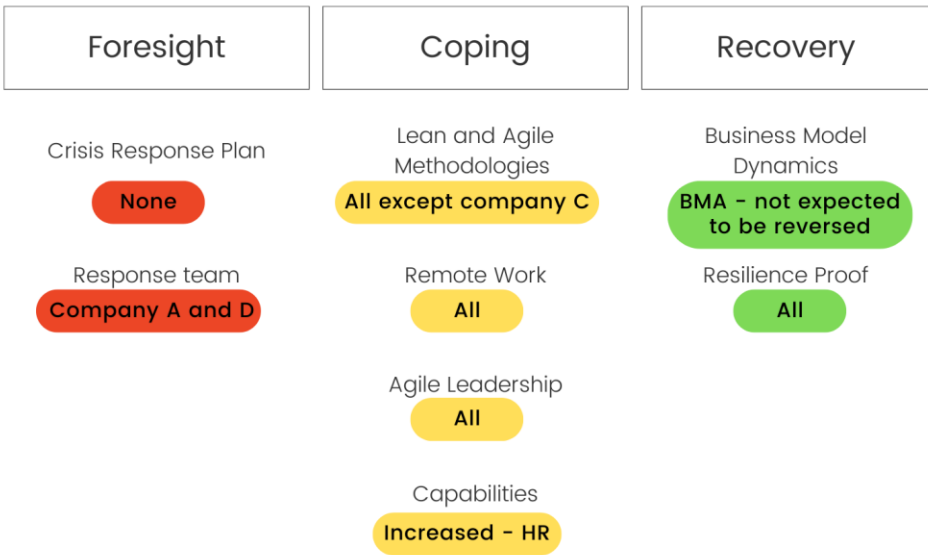


Figure 5 - Research Results - Similarities - Source: The author

Prior research has demonstrated that economic crises can aid companies to build organisational resilience (Bullough & Renko, 2013; Maritz, 2020). But to do so, resilience relies upon or depends on many variables and capacities, that correlate in an intricate matter, and whose ultimate goal is to make changes and adjustments in the company's way of working, allowing them to survive under hardship and sometimes even grow from these challenges, as proposed in the framework presented (please see Figure 3).

Following that line of thought, the objective of this study was to investigate how technological companies from two different settings faced the COVID-19 crisis and if eventually they consider they became more resilient.

In order to do so, four companies were interviewed, two from each country; investigating different phases of their response to this challenge: foresight, coping and recovery. In each of these categories, and as collected from the literature review, there are several factors that can influence the company's adaptation to changes in the external context.

In the chapter on anticipation of the crisis or external shock (foresight), all interviewees stated that there was no previous plan. However, when questioned about the existence of some plan made after the appearance of COVID-19, the answers were not always consensual. Even within the same organisation, on more than one occasion, one interviewee affirmed that yes, but another interviewee affirmed that it still does not exist. There may be two explanations for this. The first is that the concept of a crisis response plan or guideline is not consensual for all interviewees, and the second is the availability of such a plan and whether this plan is communicated to employees. Furthermore, it makes some sense that, since it is not expected that, in the so-called first world, "natural" disasters would happen nowadays, namely public health disasters that may severely affect companies; there are no action plans for these major crises. However, as defined in the literature review, resilience implies adaptation to a "crisis" or "shock" that can range from a small market change to a major economic or health crisis such as COVID-19 and, in this sense, the existence of a plan is also useful, and did not exist in any of these companies. Eventually, this is something that companies must be aware of, and that can be changed in order to prepare them for future events.

In the chapter of coping, questions about the use of agile and lean methodologies, agile leadership and capabilities (more specifically dynamic capabilities involving the company's investment in resources during the pandemic) were chosen.

Of the four companies studied, three currently use Lean or Agile methodologies and were already using them before the crisis. In none of them there were changes in methodology or previously

established working methods (before COVID-19) that are directly related to the COVID-19 pandemic. The two companies in Portugal mentioned that the principles included in these two methodologies helped overcome the impact of COVID-19, such as rapid and frequent prototyping, constant alignment between everyone and constant feedback - *“The team knows how important is to fail fast and prototype early and frequently.”* (Company A), which is in line with the literature. Company B also stated that they decided to hire a Scrum Master (Agile coach) due to COVID-19 and the remote work impact *“We have a Scrum Master, and it's very much because of COVID-19. That is, when we switched to remote, we started giving even more importance to Scrum ceremonies, so we could all be more aligned.”*. It is interesting to note that, in the face of this extreme situation, the need to adapt was paramount and essential to maintain the survival of companies, so these types of methodologies, which in most companies were already in use, were absolutely essential.

All eight interviewees stated that they recognise the characteristics of agile leadership in their companies. Among the characteristics identified, they recognised the leaders' decision-making speed and adaptability to contextual changes. However, company A mentioned that these characteristics can also be seen in many of their employees, whether they hold management positions or not, as they believe that the attributes of an "agile leader" may be essential at any level, especially during times of crisis.

Due to the specific characteristics of this pandemic, which demanded severe lockdowns and prohibited contact between people, in their coping process companies had to deal with a very particular aspect, and maybe even very characteristic of this pandemic, that was the adaptation of the workplaces, which became almost exclusively from home (remote work), if not forever, at least during the crisis. Therefore, remote work also implied a series of adaptations (logistic, human, social, etc.) and had a series of consequences that basically impacted almost all the activities of this type of tech companies. Although one company in each country had previously the option of remote work for its employees (Company A and C), in neither of them was remote work generally used by employees. The challenges were of several levels, for example, making all the necessary equipment for their functions quickly available at the employees' homes, as well as the need for a greater alignment (and control of that alignment) among all the employees, same level, top-down but inverse as well. The two Portuguese companies also underlined that the pandemic and consequently the remote work brought about the concern with information, more specifically the documentation of processes *“Concern to ensure that information was available to anyone who needed it at any time. Documentation of meetings, best practices, processes, projects, well centralised, well defined”* (Company A). Therefore, although this option was already available in some companies, it was not widely used

by employees, which reflects what literatures already described. With the obligation to work remotely, despite everything, and thanks to the very characteristics of tech companies, this change was quick and relatively easy. This might be a particular advantage of tech companies in this lockdown setting since, by definition, they were already accustomed to use different software and tech devices.

When confronted with this new reality, one of the things that many tech companies were forced to revise, if not alter, was their resources, namely, human resources, infrastructures and technology. This dynamic capability, the ability to perform changes and adapt, proved essential, as was already stated in previous studies. Hence, what was observed was that there was a bigger investment in resources, in all four companies. The reinforcement of human resources was the investment that all four companies mentioned as having been the main one, followed by technology and infrastructure. However, in this chapter it was difficult for some managers to differentiate the investment that was made due to COVID-19 and the challenges that it brought, from the investment that was made due to the natural growth of the company.

Another unanimous view among all interviewees was when confronted with the three types of changes in the business model (Business Model Dynamics), in the recovery chapter. They all referred that the one that best suited the situation of the companies is Business Model Adaptation. The changes that were made were purposeful changes in response to changing environmental conditions, happened only in some components of the Business Model, and are not expected to be reversed. This may be a clue for future studies, as we may have today a "new normal" for companies. Even in a few years' time, with the economic, social and public health situation stabilized, the companies will not go back to the way they were before the appearance of COVID-19. To prove this, all interviewees gave examples of how companies reacted and overcame the crisis. All the companies studied sought new markets, which prior to the pandemic was not in their plans, and which have now become another option in the market diversification strategy. Special note to Company A that besides seeking new markets played a very active role in society, seeking to use its tools, knowledge and platforms to help the population and small businesses, and that later on even managed to monetize that same product with public institutions and larger companies.

Of note is the fact that of the four companies, three of them stated (A, B, C) that it was difficult to be sure if the changes at the level of clients, invoicing and investment was totally imputed to the impact of COVID-19 or on the other hand if it was also caused by a natural component of the company's growth.

Finally, the interviewees were once again unanimous in stating that they think that today the company is much more resilient than before the appearance of COVID-19, considering that during this period the company learned to reinvent itself and that if in the future another external shock occurs, they will be much better prepared – “*If there is something that will hit again like COVID 2.0, they have like a structure they built during the pandemic, and they adjust a little bit every time a new variant appears. It's kind of a plan.*” (Company C).

Despite the fact that, for the stated reasons, Portugal and Israel are two different countries in what concerns economics and politics especially affecting tech companies; from our findings, conclusions could not be drawn in what could differentiate the two different settings regarding these diverse backgrounds. In fact, although perhaps it could be expected that Israeli companies would be quicker and more efficient to adapt to this new reality (Deloitte, n.d.; *Israel's High-Tech Economy*, 2022; *Israeli Tech for Covid-19 : How Israeli Tech Companies and Initiatives Are Responding to the Crisis*, 2020), the Portuguese companies studied showed also a good resilience capacity and were also able to adapt quite fast and well, and even thrive (Butcher, 2021). What lingers from the interviews that could perhaps be related to the said economic and political decisions taken during this health crisis, and also with the Israeli culture itself, is the mindset with which Israeli companies reacted. The well-known and characteristic Israeli *chutzpah* (meaning the amount of courage, mettle or ardour that an individual has) that allowed some sort of confidence and optimism when facing this challenge. This can be easily understood if one thinks about an environment where, facing these major health problems, actions were immediately taken and few and short lockdowns were needed. Although these two specific Portuguese tech companies are not the representation of all Portuguese companies (which was not obviously what was intended with this study), one could think that, based on the economic reports presented, Portuguese companies would have suffered more and for a longer time due to the extreme prohibitions observed during the pandemic, and also because of the somewhat more fragile economy and less government help and incentives that Portugal had when compared with the Israeli tech companies; that was not what was observed in these two examples. Hence, this could be a topic for investigation in more in-depth future research.

5. Conclusions

The COVID-19 pandemic presented as a global challenge for individuals, organisations, and societies. No one could have accounted for the fast-paced and unknown challenges that came with this global virus outbreak.

To cope with such an economic and social crisis, companies required organisational resilience. In fact, the way this situation was handled can be one of the keys to the company's continuity in the short and long term, where organisational resilience and the acquisition of new capabilities allowed to redesign the way of doing business. Tech companies, for their well-known innovative capacity and adaptability, were such an example.

This study aimed to understand how these companies faced COVID-19 and if they consider that they became more resilient, focusing on two different contexts and environments: Portugal and Israel.

In the foresight category, the results showed that none of the studied companies had a well-thought-out business continuity plan, but two of them developed some kind of special team during the crisis.

When coping with this crisis, agile leadership, lean and agile methodologies and dynamic capabilities such as new investment in resources, were paramount. New specific situations like remote work were also a challenge to overcome.

The role of entrepreneurs is to solve problems and make the best of existing opportunities. And so, to recover from these setbacks and for firms to remain competitive, they had to continuously evolve and adapt their strategic settings to capture value from their customer needs, making changes in their business models. This is indeed more important in today's competitive environment where the BANI conditions affect the companies' competitiveness and influence strategic decisions. The business model alterations observed are not temporary but created a foundation that prepared companies to react to future external shocks.

All companies consider that they became more resilient after this crisis.

In conclusion, an SME business survival during a crisis depends on entrepreneurial capacity to react and survive, and ideally to thrive, in short, to be resilient.

6. Limitations and Future Research

Having concluded this study and having fulfilled the objective of presenting insights on How did tech companies face COVID-19 pandemic in order to become more resilient? " (Research Question), time limitation was the major constraint of this research due to several factors. The number of companies studied could have been greater, however, even with this small number of interviewees, it was essential to conduct a second interview for each company to complement and validate the data, resulting in a study with a more substantiated and consistent output.

In what concerns future research directions, besides a larger sample of companies, it is considered pertinent the cultural analysis of these two countries, for example through the "Hofstede Cultural Dimensions" that may help to give a greater frame to the results.

The fact that the sample of companies is organised by clusters of size and sector of activity (within tech companies) may also be important to understand if there were any differences in response and performance depending on their dimension and sectors. A complementary study analysing the differences in performance and response between tech and non-tech companies could also be relevant.

In a few years' time, it will be interesting to analyse if changes such as the remote work and the business model of companies will be reversed in the long term or if there is a "new normal" after the pandemic.

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Annex

1. Glossary

Covid-19

“Coronavirus disease (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus. Most people infected with the virus will experience mild to moderate respiratory illness and recover without requiring special treatment. However, some will become seriously ill and require medical attention. Older people and those with underlying medical conditions like cardiovascular disease, diabetes, chronic respiratory disease, or cancer are more likely to develop serious illness. Anyone can get sick with COVID-19 and become seriously ill or die at any age.” (World Health Organization, 2021)

Pandemic

The International Epidemiology Association's Dictionary of Epidemiology defines a pandemic as "an epidemic occurring worldwide, or over a very wide area, crossing international boundaries and usually affecting a large number of people" (Singer et al., 2021).

Resilience

"The ability of a system or an organization to react to and recover from disturbances at an early stage, with minimal effect on the dynamic stability" (Hollnagel, 2006).

Tech Company

“A business that provides a digital technical service/product/platform/hardware, or heavily relies on it, as its primary revenue source” (*Tech Nation*, 2022)

Business Model Dynamics

"How companies change and develop their business models to achieve sustained value creation through time" (Peñarroya-Farell & Miralles, 2021).

2. Interview Script

Table 10 - Interview Script

Topic	1 st order Questions	2 nd Order Questions
Change in context	What significant changes did the company experience with the impact of the pandemic during the first half of 2020?	Internal and external changes
	On which business function does the COVID-19 crisis currently have the most impact? (Ex. HR, Finance, Operations, supply chain, Sales & Marketing, and other business functions)	
Business Resilience		Resilience can be defined as “the ability of an entity or system to maintain function (e.g., continue producing) when shocked”
		What do you consider to be the pillars of a company's resilience?
	Previously to the COVID-19 crisis, did the company have already any crisis response plan?	If no, does the company have it now?
	Anticipation and Response	Has the company created a team responsible for specifically managing the crisis caused by COVID-19?
<i>Lean and Agile Methodology</i>		Lean encourages teams to deliver fast by managing flow, limiting the amount of WIP (work-in-process) to reduce context switching

Topic	1 st order Questions	2 nd Order Questions
		and improve focus. Agile teams manage flow by working in cross-functional teams on delivering one iteration at a time.
	Is there in your company any practice similar to the above definitions applied to production, shipping and communication processes?	
	Was there a change in the methodology used by the organisation during the crisis as a response to the constraints caused by the crisis?	
<i>Agile Leadership</i>		Agile leadership is “the ability of a leader to be “quick, adaptable, and flexible in responding to unexpected events in an unfamiliar context”
	Having identified what agile leadership is, do you think there were similar aspects observed in the leaders of the organisation during the crisis? Please, give examples.	
	Has there been any kind of reconfiguration of the teams?	
	Did the company have remote work during COVID-19? If yes, how did COVID-19 and remote work impact the company’s leadership?	

Topic	1 st order Questions	2 nd Order Questions
<i>Capabilities</i>	Operational capability of companies is largely the daily routines that allow them to maintain their routine operation, they are the processes and assets that the firms use to perform its business. Dynamic capability is the ability to reconfigure operational capabilities and therefore allow the company to adapt and evolve.	
	How was the companies' investment in resources during the pandemic? Did it increase or decrease? How was the investment in Human Resources, Technology and Infrastructure?	
Reaction <i>BM Dynamics</i>	BM Adaptation is "the reaction to either an external disruption or a change in the environment, and seek to align the current model with the new competitive environment" BM Innovation "It's a radical reconfiguration of the firms competences to disrupt the market conditions or the ecosystem status-quo" BM Evolution "is an incremental reconfiguration of some business model components to face the strategic challenges derived from the external effects"	
	Of these 3 types of business model changes, do you consider that the company identifies with any of these?	
	In order to identify the key drivers of a Business Model, the literature divided the 9 blocks into four basic business model components – Offering (Value Proposition), Customers (Segments, Relations, Channels), Infrastructure (Partners, Resources, Activities), and Financial viability (Revenues and Costs).	

Topic	1 st order Questions	2 nd Order Questions
	Since the start of the pandemic, did the offering change due to the COVID-19 crisis?	If yes, what where these changes? Are the changes expected to be reversed in the short term?
	Since the start of the pandemic, did the Customers change due to the COVID-19 crisis?	If yes, what where these changes? Are the changes expected to be reversed in the short term?
	Since the start of the pandemic, did the infrastructure change due to the COVID-19 crisis?	If yes, what where these changes? Are the changes expected to be reversed in the short term?
	Since the start of the pandemic, did the Financial Viability change due to the COVID-19 crisis?	If yes, what where these changes? Are the changes expected to be reversed in the short term?
Resilience Proof	Do you consider that today the company is more resilient than before the appearance of COVID-19?	In financial terms, value proposition, or growth in new markets