



THE UNIVERSITY
of ADELAIDE



**2020.59 MODELLING BUSINESS CLUSTERS' READINESS AND
RESILIENCE IN MANAGING AND RESPONDING TO COVID-19**

Progress report June 2021

Research supported by the Local Government Association of South Australia
Research and Development Fund.

Contents

Section 1: Research method.....	1
1.1 Introduction	1
1.2 Research methodology	1
1.2.1 Sample selection	1
1.2.2 Survey topics.....	2
1.2.3 Businesses that contacted researchers	3
Section 2: Descriptive analysis.....	4
2.1. Introduction	4
2.2 Understanding business demographics	4
2.2.1 Industry divisions	4
2.2.2 Business size.....	4
2.2.3 Business age	5
2.2.4 Business ownership.....	5
2.2.5 Business resilience and crisis response.....	5
2.2.6 Internal factors and external support for recovery	6
2.2.7 Organisational processes and supply chain characteristics.....	6
2.2.8 Business innovation and collaboration.....	6
2.2.9 Business practices during the crisis	7
2.2.10 Suggestions for the local council to help businesses overcome the crisis	8
Section 3: Cluster analysis.....	9
3.1 Introduction	9
3.2 Methodology.....	9
3.3 Results of the cluster analysis.....	10
3.3.1 Results for resilience (resil) in combination with people	10
3.3.2 Results for resilience (resil) in combination with process.....	11
3.3.3 Results for resilience (resil) in combination with tooling	12
Section 4: Summary and future analysis	14
References.....	15
Appendix A.....	16
Appendix B	22

List of tables

Table 1. Sample selection criteria	2
Table 2. Reasons for participants who contacted researchers	3
Table 3. Business by industries.....	4
Table 4. Importance of sources of support for recovery	6
Table 5. Innovation by years.....	7
Table 6. Use of digital technologies	8
Table 7. Type of local government support for businesses.....	8
Table 8. Clustering variables for resilience and people	10
Table 9. Results and clusters for resilience and people.....	11
Table 10. Clustering variables for resilience and process	11
Table 11. Results and clusters for resilience and process.....	12
Table 12. Clustering variables for resilience and tooling.....	12
Table 13. Results and clusters for resilience and tooling	13

List of figures

Figure 1. Business size	4
Figure 2. Business age.....	5
Figure 3. Family business.....	5
Figure 4. Foreign ownership.....	5
Figure 5. Resilience processes.....	6
Figure 6. Types of innovation.....	7
Figure 7. Dendogram for resil and people.....	11
Figure 8. Dendogram for resil and process.....	12
Figure 9. Dendogram for resil and tooling	13

Executive Summary – Progress Report 2

This report outlines the research method employed for this project and presents an analysis of the current situation with regard to the COVID-19 crisis. The previous report presented the literature review and laid the theoretical foundations for organising the data collection and analysis.

Key messages

- A total of 619 survey responses were received; after accounting for missing data and impartial completions, the final number of usable responses was 584.
- Most surveyed businesses are family businesses, and only a few have foreign shareholders.
- More than three quarters of businesses reported that they had the ability to survive, adapt and recover after the COVID-19 crisis.
- Almost half of respondents considered support from local government and community organisations as not important at all for recovery.
- Throughout all of the innovation categories, at least one third of businesses reported innovations in 2020 and 2021.
- The use of digital technologies increased from pre-crisis to crisis levels.
- More than one quarter of businesses are not expecting any help from the local government in the immediate future, while more than one fifth noted that financial support would be most helpful.
- “People”, “process” and “tooling” mechanisms were analysed together with resilience and recovery in a cluster analysis to find similar groups of businesses.
- Two clusters of businesses were found when analysing each dimension (“people”, “process” and “tooling”) with resilience and recovery: Cluster 1 and Cluster 2.
- Businesses that implemented “people”, “process” or “tooling” mechanisms more efficiently were resilient and recovered better from the COVID-19 pandemic.
- Businesses in Cluster 1 are finding it more difficult to determine and implement the mechanisms that will best allow them to recover from the crisis, and this group might benefit of external support.
- Businesses in Cluster 2 have better implemented mechanisms that are allowing them to recover from the crisis and they are more prepared than businesses in Cluster 1.

Associate Professor Graciela Corral de Zubielqui - Lead Researcher

Dr Laura Marquez-Ramos

Peter Guckenbiehl

Section 1: Research method

1.1 Introduction

The purpose of this section is to present the research methodology that was used to identify the best ways to support local businesses' recovery and growth after the COVID-19 crisis. As well as the research methodology, this section also outlines the sample selection; it introduces the survey instrument used to collect data, explains the data collection procedures and provides information about the variables used for our research purpose.

1.2 Research methodology

Based on a quantitative and inductive analysis, this research used a cross-sectional design, which involved studying the survey population at a particular time. Because it is not viable to reach the whole population of all businesses in South Australia, a sample of businesses in a single location at a single point in time were studied. To achieve this, a self-completion questionnaire was administered to businesses via the internet to collect data (see Appendix A for the survey instrument). The main purpose of this applied research was to gain information about real-life problems connected to the COVID-19 crisis and how local governments can better support businesses in their local areas.

We followed standard University procedures to maintain the integrity of the research process. We completed the ethics requirements for the University's research procedures to confirm that the research complied with the national guidelines. The ethics application was reviewed by the Low Risk Human Research Ethics Review Group (Faculty of Arts and Faculty of the Professions) and was deemed to meet the requirements of the National Statement on Ethical Conduct in Human Research 2007 (Updated 2018) involving no more than a low risk for research participants. The project was given the ethics approval number H-2021-008. This process guarantees that survey responses are confidential, that all data will be de-identified (including names, locations, and workplaces) and that participants will not be identifiable within any research published as a result of this study. This information, along with other information required to obtain the ethics approval, was presented to participants in a cover letter and a participant information sheet. For example, the process for questions and complaints along with contact details of the main researcher and the Human Research Ethics Committee's Secretariat were provided. Participants were also informed that by submitting their survey responses they were consenting to participating in the study, and they had read and understood the presented information.

1.2.1 Sample selection

As it is not viable to obtain information from the whole population of all businesses in South Australia that met the criteria presented in Table 1 below, techniques were used to reduce this population to a representative sample selection. This study was given the support of the Local Government

Association, and the Federal Government supplied the dataset to select the sample. It used the Australian Business Register (ABR), which is the dataset developed by the Australian Taxation Office (ATO) of all the businesses registered in Australia. The ABR dataset was from 2021.

The population of our study are companies in South Australia (SA). Several steps of inclusion and exclusion criteria were applied to focus our data collection. We started by focusing on companies that included location postcodes between 5000 and 5999. The database contained three types of entities: Companies, individuals and partnerships. Only companies were included, and all other entities were excluded. Furthermore, only businesses with an active Australian Business Number (ABN), which is necessary for regular commercial transactions, were included. Businesses listed with inactive ABNs were excluded. Applying these criteria reduced companies in the database to 72,874 companies.

In Australia, businesses with an annual turnover of less than \$75,000 are not required to register for GST. To eliminate a group of businesses with little or no economic activity, entities that were not registered for GST were removed as a next step. This further reduced the number of businesses to 42,467. Because the survey was to be administered electronically, we further restricted the dataset to companies with emails, eliminating those without emails or with emails only for tax purposes. The number of businesses was reduced further to 41,793. Due to this project's focus on how businesses can be best supported, Strata, Community plan, ACN and trust companies were excluded, bringing down the number of businesses to 41,110.

We next focused the dataset on certain ANZSIC codes to allow the later clustering to only include businesses on which local government support can be focused. The following codes were considered: Agriculture, forestry and fishing; Mining; Manufacturing; Electricity, gas, water and waste services; Construction; Education (training and social assistance); Wholesale trade; Retail trade; Accommodation and food services; Non-depository financing and financial asset Investing; Rental, hiring and real estate services; Arts and recreation services; Professional, scientific and technical services; and administrative and support services, thereby taking the total number of businesses to 35,489.

As a last step before administering the survey, duplicate and redundant data was removed. This refers to entries in the database with the same ABN numbers, businesses registered in more than one location in SA, and businesses where the contact details included the email address of the company accountant. Only three businesses were randomly chosen when an accountant in the database represented four or more different businesses in the database. This reduced the number of businesses to which the survey was administered to 29,848.

Table 1. Sample selection criteria

Condition	Variable	Included	Excluded
Only in South Australia	Postcodes	Postcodes from 5000 to 5999	All the rest
Only active Businesses	ABN active	ABN active	ABN not active
Private sector only	Entity types	Companies (A private Australian company is not listed on the stock exchange and is not included in the description of an Australian public company or cooperative)	All the rest
Subtotal number of organisations 72,874			
GST Registration	Turnover > 75,000	Registered organisations	Cancelled or never registered
Subtotal number of organisations 42,467			
Emails	Email address	Registered email address	No registered email or email with reference to ATO
Subtotal number of organisations 41,793			
Companies except for exclusions		All the rest	Strata, community plan, ACN, and trust companies
Subtotal number of organisations 41,110			
Certain Sectors	ANZSIC sectors	Agriculture, forestry and fishing; Mining; Manufacturing; Electricity, gas, water and waste services; Construction; Education (training and social assistance); Wholesale trade; Retail trade; Accommodation and food services; Non-depository financing and financial asset; Investing; Rental, hiring and real estate services; Arts and recreation services; Professional, scientific and technical services; Administrative and support services.	Public administration and safety; Education (primary and high schools); Other services (police, ambulance, hospitals, zoos and museums); Clubs (Hospitality); Transport postal and warehousing; Information media and telecommunications; Finance and insurance services (except for non-depository financing and financial asset Investing)
Subtotal number of organisations 35,489			
Redundant data	Repetitions: Only three companies were randomly selected even if they use the same accountant email or similar contact details. Repeated ABN numbers	Only one registration	Double registration / Same business in multiple locations
Subtotal number of organisations 29,848			
Distribution problems	Spam / failed and bounced emails		
The final number of organisations 26,506			

This, however, was not the final number of businesses that were reached. Emails that bounced, where the address was incorrect, or that were identified as spam, further reduced the businesses that were reached to 26,506; 6.3 per cent of those businesses started the survey. From those businesses a total of 619 responses was recorded, representing 37% of all businesses that started the survey.

To summarise, primary data was gathered during April and May 2021 using an online self-administered survey among a sample of SA businesses. The businesses in the final sample were sent two emails, an invitation email, and a reminder. The whole process followed University ethics approved procedures, and participant anonymity and confidentiality were guaranteed. After accounting for missing data and

impartial completions, the final number of usable responses was 584.

1.2.2 Survey topics

The survey (for the full survey, please see Appendix A) covered a total of 9 different topics across 19 questions as presented below:

- General information about the business
- Business resilience during COVID-19
- Responses to face the crisis
- Importance of internal factors and external support for recovery
- Organisational processes and supply chain characteristics

- Business innovation and collaboration
- Business practices during the crisis
- Business performance
- Suggestions for the local council to help businesses overcome the crisis

Based on those topics, derived from the literature review that was presented in the first project report, we created a purpose-designed self-administered questionnaire conducted via the internet to collect primary data for this project. The survey consisted of 19 questions, covering different topics of interest, using open-ended questions, multiple-choice format, and Likert-type questions. The first section of questions enquired about the business's demographics, such as the number of employees, years in operation, and ownership information.

The following questions examined the businesses' resilience during the COVID-19 pandemic, specifically concerning adaptation, recovery, response, incident planning, business continuity, and risk management.

The third group of questions investigated the business's responses to the crisis, such as cost-saving measures, new practices due to the COVID-19 pandemic, and the role of information sharing and awareness.

Next, the survey sought to identify the importance of external support from various sources, such as family, friends, or the Government, for recovery. It then proceeded to internal factors aiding recovery, such as top management support and trust among supply chain partners.

Then, respondents were asked to identify specific organisational processes (e.g., lean practices) and the supply chain characteristics (e.g., responsiveness) of their business. They were also asked to answer questions investigating business innovation and collaboration with different organisations for innovation purposes.

Respondents were also asked to indicate the extent to which business practices were used during the crisis, such as risk management practices and financial reserves management. Moreover, they were asked to compare digital resources for communication from pre-COVID levels to during the pandemic.

Finally, business performance in the COVID-19 pandemic was compared to business performance before the pandemic. Then, for the last question, respondents were asked to suggest how local councils could help businesses overcome crises.

1.2.3 Businesses that contacted researchers

During the data collection phase, the main researcher was contacted by multiple businesses that were enquiring about information, had questions, or were not willing or able to answer the survey. A total of 115 calls and emails were recorded. The different reasons for making contact were coded by the researcher as shown in Table 2.

Table 2. Reasons for participants who contacted researchers

Reason	Frequency	Percentage
Unsubscribe, delete, or out of office	38	33%
Business nonexistent / retired	22	19%
Wrong location	11	10%
Enquiry about the source of data, legitimacy, voluntariness, reason for the survey	11	10%
Business not appropriate/suitable	10	9%
Problems or could not complete survey	4	3%
Accountant who does not represent the client anymore	3	3%
Individual not at the company anymore	3	3%
Lack of time	2	2%
Other reasons	11	10%
Total number of comments	115	100% (*)

(*) after removing rounding errors

From a total of 115 calls and emails, 33% requested to be unsubscribed, deleted, or were out of office for the data collection period; 19% reported that their business did not exist anymore or that they had retired, and 10% reported that the business location was incorrect. Another 10% enquired about the source of data, the legitimacy of the survey, voluntariness of participation or reasons for the survey. A further 9% reported that their business was not suitable for the survey, 3% reported having problems or not being able to complete the survey, another 3% were accountants that did not represent their client anymore, and another 3% were individuals that had left the business. 2% reported lack of time to participate in a survey, and the remaining 10% reported other reasons that did not fit any of the categories above.

1.3 Summary

To conduct the quantitative data collection for this research project, University guidelines and ethics procedures were followed. A questionnaire was developed to be administered to a sample of SA businesses. This sample was selected from the ABR by applying a range of inclusion and exclusion criteria. 26,506 businesses received the survey electronically, resulting in a total of 619 responses that were recorded. After accounting for missing data and impartial completions, the final number of usable responses was 584.

Section 2: Descriptive analysis

2.1. Introduction

The data analysis was subdivided into two parts. First, we undertook a descriptive analysis using Stata, version 15. In this section, we introduce a descriptive analysis presented through frequencies and percentages.

2.2 Understanding business demographics

2.2.1 Industry divisions

To understand how representative the businesses that answered the survey are of the total population, a comparison of industry codes was conducted, presented below in Table 3.

Table 3. Business by industries

Industry Division	Full dataset		Respondents		Dif
	Freq.	%	Freq.	%	
Accommodation and Food Services	3,131	4.5%	38	6.5%	-2.00%
Administrative and Support Services	2,365	3.4%	33	5.7%	-2.3%
Agriculture, Forestry and Fishing	1,840	2.7%	23	3.9%	-1.2%
Arts and Recreation Services (*)	2,204	3.2%	15	2.6%	0.60%
Construction	7,296	10.5%	42	7.2%	3.30%
Education and Training (*)	1,616	2.3%	17	2.9%	-0.6%
Electricity, Gas, Water and Waste Services	892	1.3%	8	1.4%	-0.1%
Financial and Insurance Services (*)	10,903	15.7%	30	5.1%	10.6%
Health Care and Social Assistance (*)	3,248	4.7%	40	6.9%	-2.2%
Manufacturing	3,344	4.8%	43	7.4%	-2.6%
Other Services and not classified	6,739	9.7%	68	11.6%	-1.9%
Professional, Scientific and Technical Services	8,661	12.5%	127	21.8%	-9.3%
Rental, Hiring and Real Estate Services	9,457	13.6%	34	5.8%	7.8%
Retail Trade	4,116	5.9%	33	5.7%	0.2%
Wholesale Trade	3,718	5.4%	33	5.7%	-0.30%
Total	69,530	100.0% (**)	584	100.0% (**)	

(*) partially included

(**) after removing rounding errors

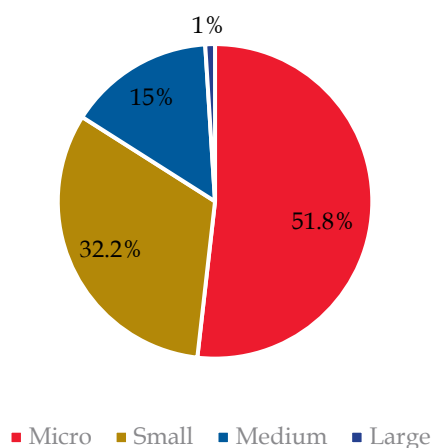
Major differences were found in three industry divisions: In the initial full dataset, Financial and insurance services represented the biggest industry division, with 15% of businesses included in this code, but only 5.1% of respondents from this industry division. Further major differences were recognised in Professional, Scientific and Technical Services, with 21.8% of respondents being from this industry division, while their share in the total population accounted for only 12.5%. The final major difference between the sample and the total population when analysing industry divisions was evident in Rental, Hiring and Real Estate Services, with only 5.8% of businesses in the sample belonging to this industry division, 7.8% less than the weight of this industry division in the total population. In the remaining industry divisions, difference between population and sample ranged between -2.6% and 3.3%.

Table 3 shows that there is a good representation of the whole population in the sample of responders in general. The significant difference is in financial and insurance services, as explained before, was a reduction in the number of businesses which received the survey as we dropped some of the ANZSIC codes in this sector in the survey. However, some bias could be present in the other two groups with over-representation (Professional, Scientific and Technical services and Rental, Hiring and Real Estate Services).

2.2.2 Business size

Information about business size was retrieved by asking businesses to report the number of employees. The detailed question from the questionnaire can be found in Appendix A. In our sample, as displayed in Figure 1 below, the majority of businesses (51.8%) reported having less than five employees, thereby being classified as micro businesses. The second largest group of businesses were small businesses (32.2%) with 5 to 19 employees. 15% of businesses were of medium size with between 20 and 199 employees, and the remaining 1% were considered large businesses with more than 199 employees.

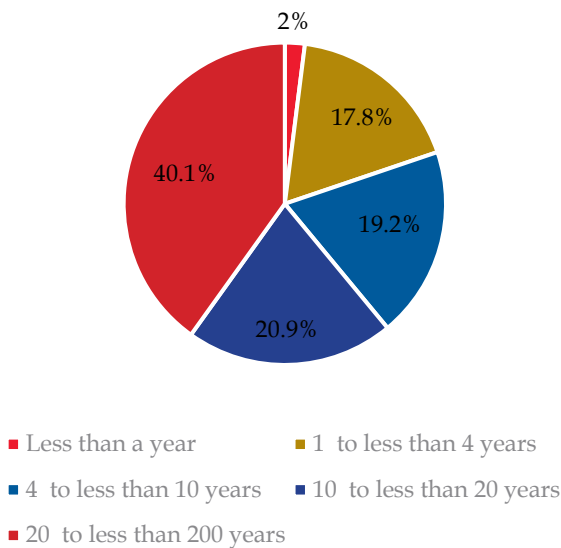
Figure 1. Business size



2.2.3 Business age

The survey also gathered information about the business's age. Respondents were asked how long their business had been in operations without considering changes in ownership (for the full question, see Appendix A). In our sample, as displayed in Figure 2, only 2% of businesses reported having started less than a year ago, during the pandemic. 17% of businesses are between 1 and 4 years old, 19.2% reported being in operation between 4 and 10 years, 20.9% had been operating between 10 and 20 years, and the remaining 40.1% of businesses had been in operation for more than 20 years.

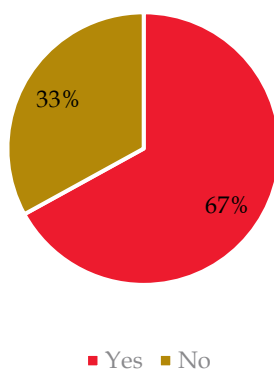
Figure 2. Business age



2.2.4 Business ownership

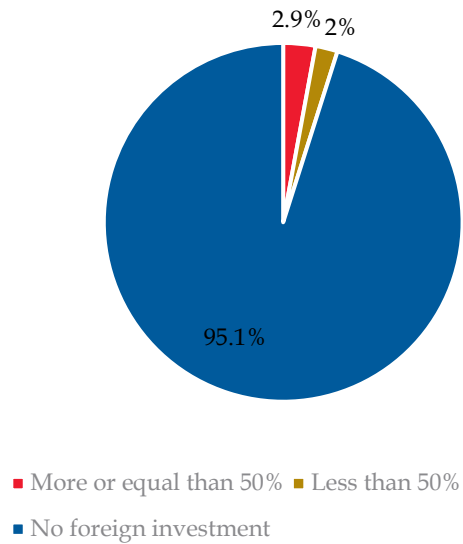
Two questions in the survey (see Appendix A) collected information about business ownership. Firstly, respondents were asked to indicate whether their business is considered a family business (meaning that family members held at least 50% of shares in 2020). More than two-thirds of businesses, 67%, reported being a family business, while the remaining 33% were not.

Figure 3. Family business



The second question about business ownership asked respondents to indicate the amount of foreign ownership in their business; 2.9% of businesses reported a foreign ownership of more than 50%, while 2% reported having foreign ownership, but below 50%, and the remaining 95.1% of businesses did not report any foreign ownership.

Figure 4. Foreign ownership



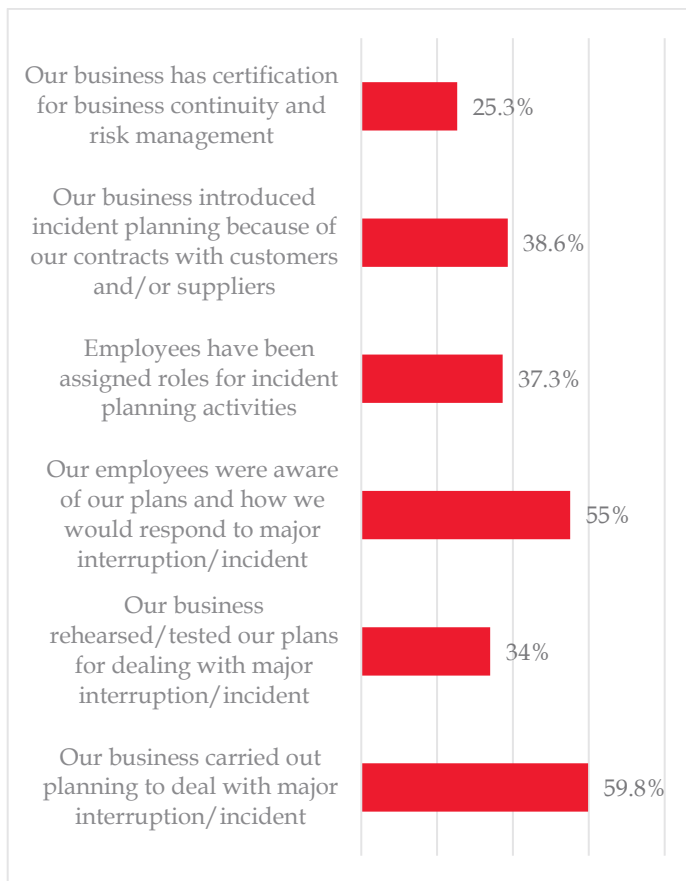
2.2.5 Business resilience and crisis response

Businesses reported showing resilience during the last 12 months (2020/21), with 75.2% of the companies disclosing that they had the ability to survive, adapt and recover after the COVID-19 crisis and return to the previous state of perceived normality. At the same time, 64.6% of businesses reported recovering and growing (bouncing forward) after the COVID-19 crisis. Furthermore, the majority of businesses (66.4%) reported having the ability to reduce the impact of the crisis as they had the required level of readiness and recovery ability. However, only a little more than half of the businesses (57.9%) reported that they were able to cope with supply chain disruptions. Even less were able to easily adapt to supply chain disruptions (54.9%), and only 53.5% were able to provide a quick response to supply chain disruptions.

We also asked if businesses had formalised their resilience processes during the last 12 months (2020/21), an overview of answers to these questions is provided in Figure 5. Overall, 59.8% of businesses carried out planning to deal with major interruptions and incidents. However, only a little more than one third of businesses (34%) rehearsed or tested their plans to deal with major interruptions or incidents. More than half of the respondents (55.1%) reported that their employees were aware of their plans and how they would respond to major interruptions or incidents. In contrast, only 37.3% of businesses reported that employees had been assigned roles for incident planning activities, while 38.6% introduced incident planning because of their contracts with customers and/or suppliers. Only a

quarter of businesses (25.3%) have certification for business continuity and risk management.

Figure 5. Resilience processes



When facing crises, responses taken by businesses need to be considered when analysing how to best support them. The survey identified the extent to which businesses used certain mechanisms during the last 12 months to face the crisis (2020/21). The share of businesses that answered using these mechanisms to a large or very large extent revealed differences in mechanisms used: changes in operations to incorporate social distancing and hygiene measures was implemented by almost two-thirds (64.2%), while less than half of businesses (44.4%) reported new practices in knowledge sharing and learning within the organisation. Approximately one third of businesses each reported increased business liquidity, including taking advantage of government measures (33.3%), implementing cost-saving measures such as reducing fixed costs, or controlled shutdown (33.1%), and implementing critical aspects review (32.9%).

2.2.6 Internal factors and external support for recovery

Both internal factors and external support influence the recovery of businesses. We thus asked respondents about the importance of information sharing and awareness to face the crisis. Overall, for each subquestion more than two-thirds of

businesses indicated the importance of information sharing and awareness; 66% of the businesses shared information within the organisation to be proactive. At the same time, 73.2% promoted awareness about responding to COVID-19 proactively, while 69% reported that they had learned from the COVID-19 experience, which could be exploited to build resilience.

The importance of external sources of support varied considerably as depicted in Table 4: Almost half of the respondents considered support from local government (47.7%) and community organisations (47%) as not important at all for recovery, and more than one third (38.5%) rated support from other private organisations as not important at all. On the other hand, support from family and friends (72.6%) and from state and/or federal government (81.4%) was commonly seen as being important.

Table 4. Importance of sources of support for recovery

	Family and friends	Community organisations	Other private organisations	State and/or federal government	Local Government
Not at all important	27.4%	47.0%	38.5%	18.6%	47.7%
Somewhat important	15.8%	16.3%	17.6%	11.0%	11.4%
Moderately Important	15.4%	14.0%	19.1%	11.4%	11.4%
Important	22.2%	14.4%	17.9%	21.6%	14.4%
Extremely important	19.2%	8.3%	6.9%	37.5%	15.2%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

2.2.7 Organisational processes and supply chain characteristics

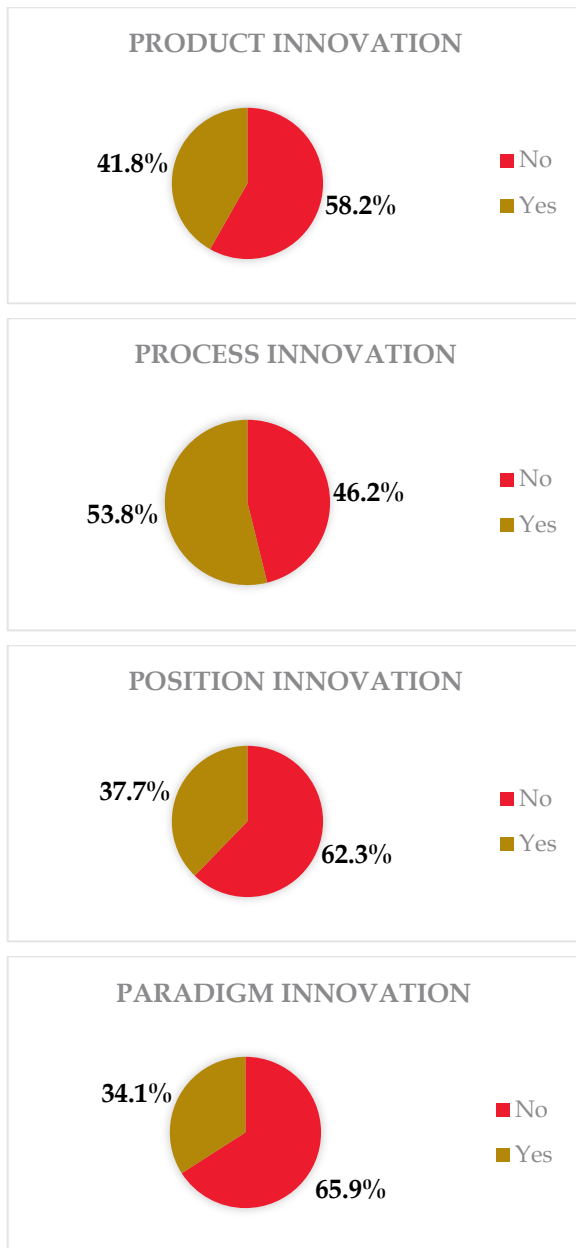
To better understand local businesses, the survey also included questions about organisational processes and characteristics of supply chains. Overall, the majority of businesses indicated having processes or policies that at least meet standards or are above standards in many areas: 88.7% have organisational processes for creating products or services, 86.7% have strategies to build operational resilience, 90.5% have lean practices for providing a means for improvement, and 93.3% indicated having policies and processes for reducing levels of bureaucracy and extending the chain of administration.

2.2.8 Business innovation and collaboration

Innovation is considered as a means for businesses to better deal with crises. Innovation data was gathered and analysed in four categories: product innovation, process innovation, position innovation, and paradigm innovation. Throughout all innovation categories, at least one third of businesses reported innovations in 2020 and 2021 as shown in Figure 6.

While only 34.1% of businesses achieved paradigm innovations and 37.7% achieved position innovations, more businesses were able to innovate products and processes: 41.8% of businesses reported product innovations, and 53.8% reported process innovations.

Figure 6. Types of innovation



Further analysing innovation per timeframe reveals interesting patterns as depicted in Table 5. Of the 41.8% of the businesses that innovated, 21.1% only innovated in 2020 or 2021, while 20.7% innovated across both years. The same pattern appears for the other innovations, such as process innovation, where 27.3% of the businesses reported having innovated in one year (2020 or 2021), while 26.5% innovated in both years. With regard to position innovation, 22.4% of the businesses reported having innovated in 2020 or 2021, while 15% innovated in both years. Finally, paradigm

innovation showed that 19% of the businesses innovated in 2020 or 2021 and 15.1% innovated in both years.

Although there has been a reduction of innovation outputs between 2020 and 2021, the second year is not comparable as it only includes the first 4 months; in fact, results in the first quarter of 2021 show similar results as the previous year in just one-third of the time.

Table 5. Innovation by years

Category	No	Yes, 2020	Yes, 2021 (*)	Yes, 2020 and 2021
Product Innovation	58.2%	12.7%	8.4%	20.7%
Process Innovation	46.2%	19.2%	8.1%	26.5%
Position Innovation	62.3%	13.2%	9.2%	15.4%
Paradigm Innovation	65.9%	9.9%	9.1%	15.1%

(*) only 4 months

Business collaboration for innovation purpose also varied substantially depending on the actors involved. The extent (considering responses between sometimes and always) that the business collaborates in the last 12 months for an innovative purpose varied depending on the actors involved. The highest levels of collaboration were associated with clients or customers (82.8%), with suppliers (59.6%) and with competitors or other businesses (51%). On the contrary, most businesses (60.9%) have never collaborated with universities or higher education institutions and private non-profit research institutions (66.7%). Only 43.3% of businesses collaborated with government agencies during the last 12 months.

2.2.9 Business practices during the crisis

The most common business practice utilised during the last 12 months (2020/2021) to survive the crisis was using effective financial reserves management (73.8%), followed by implementing proactive risk management practices (71.4%). Businesses also frequently responded that they had used resource management (66.4%), reactive risk mitigation practices (63.8%) and business continuity plans (68.9%) to survive the crisis. The least used practice was diversity and redundancy of suppliers (46.1%).

Another topic of interest was the use of digital technologies and whether this had changed during the COVID-19 crisis. Data was gathered regarding use of digital resources in 2019 and in 2020/2021 as shown in Table 6. There were no surprises regarding the use of digital technologies as the share of businesses using these technologies sometimes, often, or always, increased for each technology. The use of open data increased from 69.9% in 2019 to 77% in 2020/2021, the use of work from home technology increased considerably from 67% to 83%, and digital media were more frequently used as mediums to communicate with

employees (64.7% to 77.9%) and as mediums to communicate with other stakeholders (59.7% to 74.7%). The largest increase was recorded for the use of online meeting software such as Zoom and Teams, increasing from 42% in 2019 to 77.3% in 2020/2021. Other digital tools in the organisation also were used frequently (64.6% to 79.5%).

Table 6. Use of digital technologies

	2019	2020/2021
Use of open data	69.9%	77.0%
Work from home technology	67.0%	83.0%
Digital media as medium to communicate with employees	64.7%	77.9%
Digital media as a medium to communicate with other stakeholders	59.7%	74.7%
Online meeting software (Zoom and Team)	42.0%	77.3%
Other digital tools in the organisation	64.6%	79.5%

and collaborate with businesses (8.9%) and to reduce the amount of red tape and have faster processes implemented (8.2%). Less frequently, using local businesses as suppliers (4.4%), marketing support (4.4%), infrastructure support (3.2%), offering support regarding training, hiring, or consulting (2.5%), and providing crisis information (2.5%) were named as actions that local governments could take to help businesses overcome the crisis.

2.2.10 Suggestions for the local council to help businesses overcome the crisis

The final survey question asked businesses what type of actions the local government could undertake to help them overcome the crisis. 158 responses were received, which were codified by themes as depicted in Table 7.

Table 7. Type of local government support for businesses

Possible support	Frequency	%
Nothing	40	25.3%
Financial support	35	22.2%
Used field for suggestions to state/federal government	16	10.1%
Listen and collaborate	14	8.9%
Less red tape, faster processes	13	8.2%
Local businesses as suppliers	7	4.4%
Marketing support	7	4.4%
Infrastructure support	5	3.2%
Training, hiring, consulting	4	2.5%
Provide crisis information	4	2.5%
Others	13	8.2%
Total number of comments	158	100.0% (*)

(*) after removing rounding errors

More than one quarter (25.3%) of respondents were not expecting any help from the local government, while 22.2% noted that financial support would be most helpful. 10.1% of respondents used this field to make suggestions to state or federal governments, such as requesting a sooner opening of international borders. Other frequently mentioned types of support included for local governments to better listen to

Section 3: Cluster analysis

3.1 Introduction

This section presents the methodology and results of a clustering analysis that was undertaken using Stata, version 16. The main aim was to identify the number of clusters that differentiate whether businesses were resilient and recovered from the COVID-19 pandemic well. Businesses' responses from the survey presented in section 1 of this report were used for this analysis, specifically questions from four dimensions: resilience/recovery, people, process, and tooling.

3.2 Methodology

A cluster analysis was performed to classify businesses into homogeneous groups with respect to indicators of how businesses have been resilient and recovered from COVID-19 pandemics, as well as the three different dimensions of responses taken to face the crisis: people, process and tooling.

Cluster analysis is a method for segmentation and identifies homogenous groups of businesses called clusters. The basic intuition is that businesses in a cluster should be as similar as possible to each other, but as distinct as possible from objects in other clusters (Mooi et al., 2018). In this research, two widely-used approaches in market research were used: hierarchical and partitioning clustering methods (and specifically, k-means). In k-means clustering, researchers specify the number of clusters to extract from the data prior to the analysis. Using this information as input, k-means assigns all the objects to the number of specified clusters. Otherwise, hierarchical clustering is characterised by a tree-like structure in which clusters are consecutively formed from objects or, in the context of this research, businesses. In this research project, the clustering started with each business representing an individual cluster; the businesses were then sequentially merged to form clusters of multiple businesses, starting with the two most similar businesses.¹ This clustering procedure continued until all the businesses were merged into one cluster.

Hierarchical clustering establishes a hierarchy of objects from the bottom (where each business represents a distinct cluster) to the top (where all businesses form one cluster). From this clustering, an answer on the number of clusters is visualised by plotting the distance level at which the mergers of businesses and clusters occur by using a dendrogram.² A combination of criteria can be used for determining the number of clusters in the analysis for hierarchical clustering.

¹ (Dis)similarity being measured as distance between businesses, i.e., businesses with smaller distances between one another are more similar.

² We read the dendrogram from the bottom to the top. The horizontal lines indicate the distances at which the objects were merged.

³ For example, in the case that the solution obtained is of three clusters, the null (H_0) and the alternative (H_A) hypotheses for each variable would be:

Following Mooi et al. (2018), in the present research, we used a combination of the Calinski and Harabasz's variance ratio criterion (VRC), the Duda-Hart index, and a modified version of this index called the pseudo T-squared. This is done by selecting the number of clusters that yields a large VRC, a large Duda-Hart index, and a small pseudo T-squared value. Also, in hierarchical clustering, researchers have to specify a linkage algorithm that defines the distance from a newly formed cluster to a certain business or other clusters. In this research, Ward's linkage algorithm was used, whose merger increases the homogeneity of clusters (Mooi et al., 2018). Finally, in both hierarchical and k-means clustering, researchers should choose a (dis)similarity measure between pairs of clusters or businesses. In this research, we used the most common type of distance for analysing metrics and ordinal variables, i.e., the Euclidean distance (Mooi et al., 2018).

To decide on the number of clusters, first we ran a hierarchical clustering. This information obtained about the number of clusters was then used in the second step, as a priori information for the k-means clustering. Third, consistency and robustness was checked across the two clustering methods to validate the cluster solution. Finally, we ran an analysis of variance (ANOVA) to test whether the clusters generated differ significantly.³ The number of clusters was then compared with a priori knowledge arising from the theory. During this analysis, we uncovered three main areas:

- Overall, businesses that implemented "people" mechanisms more efficiently to face the crisis have been more resilient and recovered better from the COVID-19 pandemic.
- Overall, businesses that implemented "process" mechanisms more efficiently to face the crisis have been more resilient and recovered better from the COVID-19 pandemic.
- Overall, businesses that implemented "tooling" mechanisms more efficiently to face the crisis have been more resilient and recovered better from the COVID-19 pandemic.

When running a cluster analysis, two additional issues require attention and are relevant in this research: multicollinearity and sample size. Accordingly, those variables with strong correlation were removed from the analysis. In addition, the analysis confirmed that the relationship between the number of businesses and the

$H_0: \mu_{\text{cluster}1} = \mu_{\text{cluster}2} = \mu_{\text{cluster}3}$ (μ , i.e. the population means, of all three clusters are equal)

H_A : At least two of $\mu_{\text{cluster}1}$, $\mu_{\text{cluster}2}$, and $\mu_{\text{cluster}3}$ are unequal.

ANOVA uses the F-test to determine whether the variability between group means is larger than the variability of the observations within the groups. If that ratio is sufficiently large, one can conclude that not all the means are equal (reject H_0).

clustering variables was reasonable.⁴ We analysed the three different dimensions of responses taken to face the crisis, i.e., people, process and tooling, separately. In particular, three sets of cluster analyses were run: first, for variables measuring businesses' resilience and recovery (or dimension resil) in combination with "people" variables (or dimension people), second, resil in combination with "process" variables (or dimension process), and finally, resil in combination with "tooling" variables (or dimension tooling). A final consideration was that, because there was a limited number of businesses in the dataset, results obtained using hierarchical cluster were preferred, and results from the k-means clustering were used to validate the hierarchical cluster solution.⁵

3.3 Results of the cluster analysis

Cluster analysis has been used to group businesses based on similarities in various areas, for example similarities in innovation indicators (Hollenstein, 2003) or supply chain characteristics (Kannan and Choon Tan, 2010). It has also been applied to group wineries with distinctive characteristics to investigate the relationship between cost structures and business typologies (Marone et al., 2017).

Table 8. Clustering variables for resilience and people

Dimension	Question and measurement	Variable name	Variable description
<i>resil</i>	Q5 In your opinion, has your business shown resilience during the last 12 months (2020/21)? Please assess the following statements regarding the COVID19 crisis. 1 denotes strongly disagree, 2 somewhat disagree, 3 neither agree nor disagree, 4 somewhat agree, 5 strongly agree	Q5ARETURN	Our business had the ability to survive, adapt and recover after the COVID19 crisis and return to the previous state of perceived normality
		Q5CREDUCEIMP	Our business had the ability to reduce the impact of the crisis; it had the required level of readiness and recovery ability
		Q5DCOPESUPPLYDISR	Our business had the ability cope with supply chain disruption
<i>people</i>	Q8 In your opinion, how relevant was information sharing and awareness during the last 12 months (2020/2021)? Please assess the following statements regarding the COVID19 crisis. 1 denotes strongly disagree, 2 somewhat disagree, 3 neither agree nor disagree, 4 somewhat agree, 5 strongly agree	Q8AWITHINORG	Our business shared information within the organisation in order to be proactive (taking actions by causing change and not only reacting to change when it happens)
		Q8CLEARNEDFROM	Our business has learned from the COVID19 experience and this could be exploited to build resilience in the future
	Q10 How important were the following dimensions within your business during the last 12 months (2020/2021) for the recovery from the COVID19 crisis? 1 denotes not at all important, 2 somewhat important, 3 moderately important, 4 important, 5 extremely important	Q10ATRUST	Trust (among supply chain partners)
		Q10BEMPLOYCOMM	Employee Commitment
		Q10CTOPMANAGSUP	Top management support
	Q10EWORKPLACESAT	Workplace satisfaction	

In the present research, the main aim was to identify the number of clusters that differentiated whether businesses were resilient and recovered from the COVID-19 pandemic well. The analysis proceeded as follows: first, the hierarchical clustering was applied, based on Euclidean distances, using the Ward's linkage algorithm; second, the results were then used as input for the k-means clustering. For each dimension considered (resil, people, process, tooling), Appendix B presents the clustering variables used in the analysis (after taking potential multicollinearity into account). The relevant dimensions of this table will be also reproduced in the main text in the corresponding analysis for each dimension.

3.3.1 Results for resilience (resil) in combination with people

The first area is the analysis of resilience and people together, and we addressed the following statement:

a) Overall, businesses that implemented "people" mechanisms more efficiently to face the crisis have been more resilient and recovered better from the COVID-19 pandemic.

Table 8 presents the clustering variables used in this analysis (after taking potential multicollinearity into account).

⁴ Between 10 and 30 times the number of clustering variables is the minimum recommended (see, e.g. Mooi et al. 2018).

⁵ *k-means* clustering is generally preferred for sample sizes above 500 (see, e.g. Mooi et al. 2018).

The cluster for resilience/recovery and people shows the existence of two clusters. Figure 7 displays the dendrogram.

Figure 7. Dendrogram for resil and people

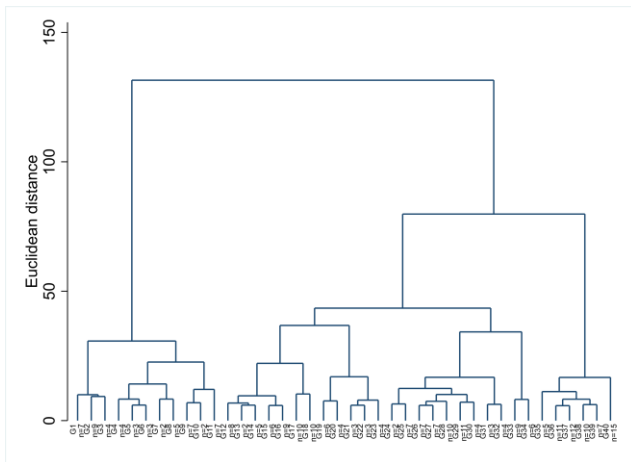


Table 9 shows the averages obtained for the variables in the two clusters. In cluster 1, there are 53 businesses, and in cluster 2, there are 200. Means of variables show that cluster 2 presents higher values for both resilience/recovery and people variables than cluster 1. The ANOVA confirms that differences in means for the two clusters are statistically significant at conventional significance levels.⁶ Thus, obtained results are in line with point a.

Table 10. Clustering variables for resilience and process

Dimension	Question and measurement	Variable name	Variable description
<i>resil</i>	Q5 In your opinion, has your business shown resilience during the last 12 months (2020/21)? Please assess the following statements regarding the COVID19 crisis. 1 denotes strongly disagree, 2 somewhat disagree, 3 neither agree nor disagree, 4 somewhat agree, 5 strongly agree	Q5ARETURN	Our business had the ability to survive, adapt and recover after the COVID19 crisis and return to the previous state of perceived normality
		Q5CREDUCEIMP	Our business had the ability to reduce the impact of the crisis; it had the required level of readiness and recovery ability
		Q5DCOPESUPPLYDISR	Our business had the ability cope with supply chain disruption
<i>process</i>	Q11 To what extent did your business have effective operational policies and processes (operating frontier) to survive the COVID19 crisis during the last 12 months (2020/2021)? 1 denotes far below standards, 2 below standards, 3 meets standards, 4 above standards, 5 far above standards	Q11AORGPROC	Organisational processes for creating products or services
		Q11CLEAN	Lean practices for providing a means for improvement
		Q11DREDBUROCRACY	Reduced levels of bureaucracy and extended chain of administration (to avoid long response times)
	Q12 To what extent did your supply chain have the following characteristics during the last 12 months (2020/2021)? 1 denotes to a very small extent, 2 to a small extent, 3 to a moderate extent, 4 to a large extent, 5 to a very large extent	Q12ARESPONSIVENESS	Responsiveness (speed at which your supply chain responds to disruptions) within the supply chain
		Q12BDIVERSITY	Diversity (the existence of multiple channels from which businesses can obtain their goods)

⁶ Excluding Q5DCOPESUPPLYDISR (*p-value* = 0.1312); however, the null hypothesis that the means of the variables in cluster 1 are equal to

Table 9. Results and clusters for resilience and people

Dimension	Variable name	Mean cluster 1	Mean cluster 2	F-statistic (ANOVA)
<i>resil</i>	Q5ARETURN	3.66	4.13	7.47
	Q5CREDUCEIMP	3.26	3.89	12.72
	Q5DCOPESUPPLYDISR	3.30	3.57	2.29
<i>people</i>	Q8AWITHINORG	2.98	4.07	55.96
	Q8CLEARNEDFROM	3.26	4.02	23.67
	Q10ATRUST	1.69	3.98	214.66
	Q10BEMPLOYCOMM	2.75	4.47	155.85
	Q10CTOPMANAGSUP	2.77	4.39	121.12
	Q10EWORKPLACESAT	2.67	4.29	140.69

3.3.2 Results for resilience (resil) in combination with process

The second area is the analysis of resilience and process together, and we addressed the following statement:

b) Overall, businesses that implemented “process” mechanisms more efficiently to face the crisis have been more resilient and recovered better from the COVID-19 pandemic.

Table 10 presents the clustering variables used in this analysis (after taking potential multicollinearity into account).

those in cluster 2 is rejected for all variables in the ANOVA for the *k-means* clustering.

The cluster for resilience/recovery and process shows the existence of two clusters. Figure 8 displays the dendrogram obtained.

Figure 8. Dendrogram for resil and process

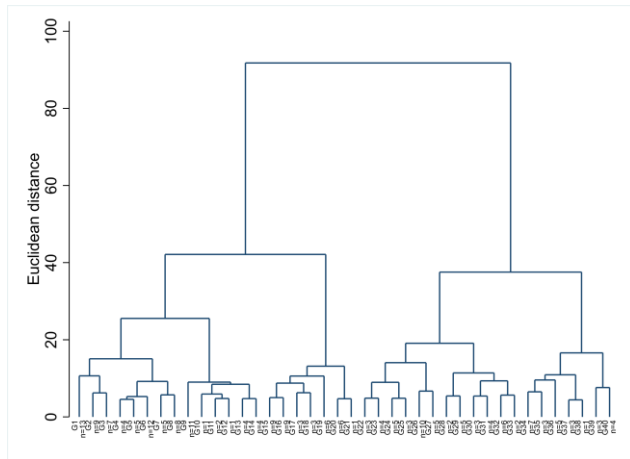


Table 11 shows the averages obtained for the variables in the two clusters. In cluster 1 there are 78 businesses, and in cluster 2 there are 123. Means of variables show that cluster 2 presents higher values for both resilience/recovery and process variables than cluster 1. The ANOVA confirms that differences in means for the two clusters are statistically significant at conventional significance levels. Thus, obtained results are in line with point b.

Table 11. Results and clusters for resilience and process

Dimension	Variable name	Mean cluster 1	Mean cluster 2	F-statistic (ANOVA)
<i>resil</i>	Q5ARETURN	3.20	4.50	88.32
	Q5CREDUCEIMP	2.91	4.21	87.80
	Q5DCOPESUPPLYDISR	2.85	3.86	45.07
<i>process</i>	Q11AORGPROC	3	3.39	9.96
	Q11CLEAN	3.05	3.55	17.81
	Q11DREDBUROCRACY	3.33	3.65	5.94
	Q12ARESPONSIVENESS	2.15	3.43	83.25
	Q12BDIVERSITY	2.11	3.34	72.25

3.3.3 Results for resilience (resil) in combination with tooling

The third area is the analysis of resilience and process together, and we addressed the following statement:

c) Overall, businesses that implemented “tooling” mechanisms more efficiently to face the crisis have been more resilient and recovered better from the COVID-19 pandemic.

Table 12 presents the clustering variables used in this analysis (after taking potential multicollinearity into account).

Table 12. Clustering variables for resilience and tooling

Dimension	Question and measurement	Variable name	Variable description
<i>resil</i>	Q5 In your opinion, has your business shown resilience during the last 12 months (2020/21)? Please assess the following statements regarding the COVID19 crisis. 1 denotes strongly disagree, 2 somewhat disagree, 3 neither agree nor disagree, 4 somewhat agree, 5 strongly agree	Q5ARETURN	Our business had the ability to survive, adapt and recover after the COVID19 crisis and return to the previous state of perceived normality
		Q5CREDUCEIMP	Our business had the ability to reduce the impact of the crisis; it had the required level of readiness and recovery ability
		Q5DCOPESUPPLYDISR	Our business had the ability cope with supply chain disruption
<i>tooling</i>	Q15 Please indicate to what extent did your business used the following practices during the last 12 months (2020/2021) to survive the crisis? 1 denotes never, 2 rarely, 3 sometimes, 4 often, 5 always	Q15ARESOURCEMANAG	Resource management (firm's ability to reconfigure, realign, restructure, and renew its resources in response to disruptions)
		Q15BRESERVEMANAG	Effective financial reserves management
		Q15CDIVERSSUPPLIERS	Diversity and redundancy of suppliers
		Q15EREACTRISKMANAG	Reactive risk mitigation practices
		Q15FBUSCONTPLAN	Business continuity plan (identification of key strategic vulnerabilities, priorities, critical resources and functions)

The cluster for resilience/recovery and tooling shows the existence of two groups/clusters. Figure 9 displays the dendrogram obtained.

Figure 9. Dendrogram for resil and tooling

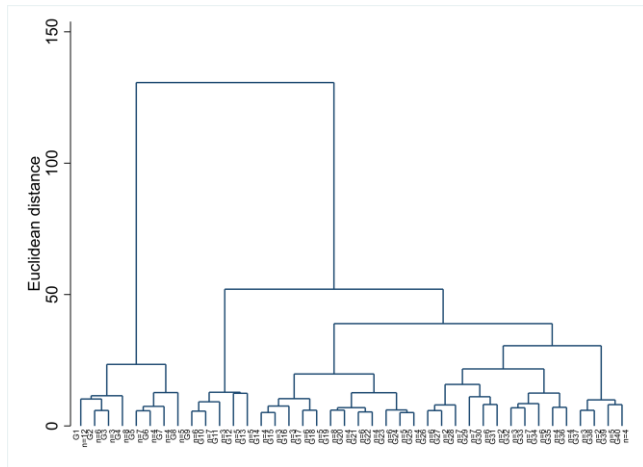


Table 13 shows the averages obtained for the variables in the two clusters. In cluster 1 there are 49 businesses, and in cluster 2 there are 152. Means of variables show that cluster 2 presents higher values for both resilience/recovery and tooling variables than cluster 1, excluding one variable (Q5DCOPESUPPLYDISR). However, the k-means clustering shows that all the means of the variables in cluster 1 are lower than those obtained in cluster 2, in line with theoretical predictions. The ANOVA confirms that differences in means for the two clusters are statistically significant at conventional significance levels (excluding Q5DCOPESUPPLYDISR, p-value = 0.3452). Thus, obtained results are in line with point c.

Table 9. Results and clusters for resilience and tooling

Dimension	Variable name	Mean cluster 1	Mean cluster 2	F-statistic (ANOVA)
<i>resil</i>	Q5ARETURN	3.73	4.10	3.96
	Q5CREDUCEIMP	3.46	3.81	3.11
	Q5DCOPESUPPLYDISR	3.63	3.45	0.90
<i>tooling</i>	Q15ARESOURCEMANAG	1.67	3.32	82.04
	Q15BRESERVEMANAG	1.65	3.84	182.65
	Q15CDIVERSSUPPLIERS	1.26	2.75	67.33
	Q15EREACTRISKMANAG	1.57	3.33	112.55
	Q15FBUSCONTPLAN	1.71	3.69	134.20

Overall, the three sets of cluster analyses found evidence in line with the three main statements tested. Specifically, it identified the existence of two clusters. On the one hand, those businesses that implemented more efficient mechanisms in any of the three dimensions analysed (people, process or tooling) seem to have been more resilient and recovered better from the COVID-19 pandemic. Indeed, this cluster, which we denote as Cluster 2, contains the

highest number of businesses. On the other hand, a second cluster includes those businesses that present lower values for all the dimensions taken on board. The interpretation is that businesses in this cluster seem to have implemented mechanisms less efficiently in any of the three dimensions analysed (people, process or tooling) and have been less resilient and recovered worse from the COVID-19 pandemics. We denote this cluster as Cluster 1. Importantly, although Cluster 1 includes a lower number of businesses, it is still a considerable number. Businesses in this cluster are, very likely, finding it difficult to implement the best mechanisms that will allow an optimal recovery from the crisis.

Section 4: Summary and future analysis

The COVID-19 pandemic has affected businesses throughout SA. To better understand the impact of the crisis, a survey was conducted among SA businesses. This report has provided information on the research methodology used, a descriptive analysis of survey data and a clustering analysis. It thereby provides an overview of how SA businesses were affected by the crisis, how they reacted to it, which internal and external factors are important to their future business operations and recovery, and which actions businesses would like to see from local governments.

The quantitative data collection for this research project considered the University's guidelines and followed ethics procedures. We developed a questionnaire and sent it to the selected sample of SA businesses. This sample was selected from the ABR by applying a range of inclusion and exclusion criteria. 26,506 businesses received the survey electronically, resulting in a total of 619 responses. After accounting for missing data and impartial completions, the final number of usable responses was 584.

We used frequencies and percentages to present the characteristics of the businesses that responded to the survey. Furthermore, we used a cluster analysis to identify the number of groups (or clusters) that differentiated whether businesses were resilient and recovered from the COVID-19 pandemic well. This analysis showed the existence of two groups of Businesses. Businesses in one of the groups are finding it more difficult to determine and implement the mechanisms that will best allow them to recover from the crisis, and this group might benefit of external support. As a consequence, local councils might consider what strategies they could implement to better support these businesses. A limitation of the present research is that the methodology followed, i.e., cluster analysis, does not allow us to study causal relationships between the clustering variables or the magnitude of the effects of any of the mechanisms implemented.

There are three main research questions left to address in the next stage of analysis:

- 1) *What are the demographic characteristics of the businesses in the two groups identified?*
- 2) *Did a more efficient implementation of "people", "process", or "tooling" mechanisms make businesses more resilient and, as a consequence, did they recover better from the COVID-19 pandemic crisis?*
- 3) *To what degree did each of the mechanisms contribute to the businesses' recovery?*

References

- Hollenstein H (2003) Innovation modes in the Swiss service sector: a cluster analysis based on firm-level data. *Research Policy* 32(5): 845-863.
- Kannan VR and Choon Tan K (2010) Supply chain integration: Cluster analysis of the impact of span of integration. *Supply Chain Management* 15(3): 207-215.
- Marone E, Bertocci M, Boncinelli F, et al. (2017) The cost of making wine: A Tuscan case study based on a full cost approach. *Wine Economics and Policy* 6(2): 88-97.
- Mooi E, Sarstedt M and Mooi-Reci I (2018) *Market Research The Process, Data, and Methods Using Stata* 1st ed. 2018. Singapore: Springer Singapore.

Appendix A

Questionnaire

Questions 1) How many employees were working for your business during the last pay period ending 31 January 2021?

Please include: a) persons paid a retainer, wage or salary b) working proprietors and partners c) full-time and part-time employees d) permanent, temporary and casual employees e) managerial and executive employees f) employees absent on paid or prepaid leave g) employees on work compensation who continue to be paid throughout the payroll

Please exclude: a) persons paid by commission only b) non-salaried directors c) self-employed persons such as consultants and contractors d) volunteers

Question 2) How many years has your business been in operation? (Without considering changes in ownership)

Question 3) Is your business a family business? (A business is considered a “family business” if a member of the same family held at least 50% of the company’s share in 2020)

Yes

No

Question 4) What is your business’s foreign ownership investment?

More or equal than 50%

Less than 50%

No foreign investment

Question 5) In your opinion, has your business shown resilience during the last 12 months (2020/21)? Please assess the following statements regarding the COVID19 crisis.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Our business had the ability to survive, adapt and recover after the COVID19 crisis and return to the previous state of perceived normality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Our business had the ability to recover and grow (bounce forward) after the COVID 19 crisis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Our business had the ability to reduce the impact of the crisis; it had the required level of readiness and recovery ability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Our business had the ability cope with supply chain disruption	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Our business was able to adapt to the supply chain disruption easily	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Our business was able to provide a quick response to the supply chain disruption	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other (please specify)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Question 6) In your opinion, has your business formalised its resilience process during the last 12 months (2020/21)? Please assess the following statements regarding the COVID19 crisis.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Our business carried out planning to deal with major interruption/incident	()	()	()	()	()
Our business rehearsed/tested our plans for dealing with major interruption/incident	()	()	()	()	()
Our employees were aware of our plans and how we would respond to major interruption/incident	()	()	()	()	()
Employees have been assigned roles for incident planning activities	()	()	()	()	()
Our business introduced incident planning because of our contracts with customers and/or suppliers	()	()	()	()	()
Our business has certification for business continuity and risk management	()	()	()	()	()
Other (please specify)	()	()	()	()	()

Question 7) To what extent did your business use the following mechanisms during the last 12 months to face the crisis (2020/21)?

	To a very small extent	To small extent	To a moderate extent	To a large extent	To a very large extent
Increase business liquidity (including taking advantage of government measures)	()	()	()	()	()
Implement cost saving measures (reduce fixed costs, including controlled shutdown)	()	()	()	()	()
Critical aspects review (activities and resources)	()	()	()	()	()
Changes in the way that your business operates to incorporate social distancing and hygiene measures	()	()	()	()	()
New practices in knowledge sharing and learning within the organisation	()	()	()	()	()
Other (please specify)	()	()	()	()	()

Question 8) In your opinion, how relevant was information sharing and awareness during the last 12 months (2020/2021)? Please assess the following statements regarding the COVID19 crisis.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
Our business shared information within the organisation in order to be proactive (taking actions by causing change and not only reacting to change when it happens)	()	()	()	()	()
Our business promoted awareness in order to proactively respond to COVID19	()	()	()	()	()
Our business has learned from the COVID19 experience and this could be exploited to build resilience in the future	()	()	()	()	()
Other (please specify)	()	()	()	()	()

Question 9) How important were the following sources of COVID19 specific support for your business recovery during the last 12 months (2020/2021)?

	No at all important	Somewhat important	Moderately important	Important	Extremely important
Support received from family and friends	()	()	()	()	()
Support offered by community organisations	()	()	()	()	()
Support received from other private organisations	()	()	()	()	()
Support received by the state and/or federal government	()	()	()	()	()
Support received by the local government	()	()	()	()	()
Other (please specify)	()	()	()	()	()

Question 10) How important were the following dimensions within your business during the last 12 months (2020/2021) for the recovery from the COVID19 crisis?

	No at all important	Somewhat important	Moderately important	Important	Extremely important
Trust (among supply chain partners)	()	()	()	()	()
Employee Commitment	()	()	()	()	()
Top management support	()	()	()	()	()
Personal attributes of the owners or top managers (adaptability, purposefulness, confidence and sociability)	()	()	()	()	()
Workplace satisfaction	()	()	()	()	()
Other (please specify)	()	()	()	()	()

Question 11) To what extent did your business have effective operational policies and processes (operating frontier) to survive the COVID19 crisis during the last 12 months (2020/2021)?

	Far below standards	Below standards	Meets standards	Above standards	Far above standards
Organisational processes for creating products or services	()	()	()	()	()
Strategies to build operational resilience	()	()	()	()	()
Lean practices for providing a means for improvement	()	()	()	()	()
Reduced levels of bureaucracy and extended chain of administration (to avoid long response times)	()	()	()	()	()
Other (please specify)	()	()	()	()	()

Question 12) To what extent did your supply chain have the following characteristics during the last 12 months (2020/2021)?

	To a very small extent	To small extent	To a moderate extent	To a large extent	To a very large extent
Responsiveness (speed at which your supply chain responds to disruptions) within the supply chain	()	()	()	()	()
Diversity (the existence of multiple channels from which businesses can obtain their goods)	()	()	()	()	()
Agility (the ability to adjust tactics and operations) in your supply chain operations	()	()	()	()	()
Structurally reliable (the degree of connectedness and number of healthy nodes in the supply chain networks during a disruptive event)	()	()	()	()	()

Question 13) During 2020, did your business introduce any new or significantly improved innovations in the following areas?

A product innovation is a new or improved good or service that differs significantly from the firm's previous goods or services and that has been introduced on the market. (OECD, 2018, Oslo Manual, 4th Edition; p.70)

A process innovation is a new or improved business process for one or more business functions that differs significantly from the firm's previous business processes and that has been brought into use in the firm. (OECD, 2018, Oslo Manual: 4th Edition; p.72)

Position innovation are changes in the context in which the products/services are introduced. (Tidd, J and Bessant, J, 2021; Integrating Technological, Market and Organizational Change, p.22)

Paradigm innovation are changes in the underlying mental models that frame what the organization does - such as changes in business models. (Tidd, J and Bessant, J, 2021; Integrating Technological, Market and Organizational Change, p.22)

	Innovation			2020				2021			
	No	Yes, 2020	Yes, 2021	Industry	State	Country	World	Industry	State	Country	World
Product innovation	()	()	()	()	()	()	()	()	()	()	()
Process innovation	()	()	()	()	()	()	()	()	()	()	()
Position innovation	()	()	()	()	()	()	()	()	()	()	()
Paradigm innovation	()	()	()	()	()	()	()	()	()	()	()

Question 14) If yes, please indicate to what extent your business collaborated with the following organisations for the purpose of innovation in the last 12 months (2020/2021).

	Never	Rarely	Sometimes	Often	Always
Suppliers of equipment, materials, components, or software	()	()	()	()	()
Clients or customers	()	()	()	()	()
Competitors and other businesses	()	()	()	()	()
Consultants	()	()	()	()	()
Universities or higher education institutions	()	()	()	()	()
Government agencies	()	()	()	()	()
Private non-profit research institutions	()	()	()	()	()
Other types of organisations. Please specify	()	()	()	()	()

Question 15) Please indicate to what extent did your business used the following practices during the last 12 months (2020/2021) to survive the crisis?

	Never	Rarely	Sometimes	Often	Always
Resource management (firm's ability to reconfigure, realign, restructure, and renew its resources in response to disruptions)	()	()	()	()	()
Effective financial reserves management	()	()	()	()	()
Diversity and redundancy of suppliers	()	()	()	()	()
Proactive risk management practices	()	()	()	()	()
Reactive risk mitigation practices	()	()	()	()	()
Business continuity plan (identification of key strategic vulnerabilities, priorities, critical resources, and functions)	()	()	()	()	()
Other. Please specify	()	()	()	()	()

Question 16) How often were digital resources used as a communication process before the crisis (2019), and then during the last 12 months (2020/2021)?

	In 2019					In 2020/2021				
	Always	Often	Sometimes	Rarely	Never	Always	Often	Sometimes	Rarely	Never
Use of open data	()	()	()	()	()	()	()	()	()	()
Work from home technology (internet and emails)	()	()	()	()	()	()	()	()	()	()
Digital media as medium to communicate with employees (WhatsApp messaging, blogs or employees newsletter)	()	()	()	()	()	()	()	()	()	()
Digital media as a medium to communicate with other stakeholders (WhatsApp messaging, blogs or employees newsletter)	()	()	()	()	()	()	()	()	()	()
Online meeting software (Zoom and Teams)	()	()	()	()	()	()	()	()	()	()
Other digital tools in the organisation	()	()	()	()	()	()	()	()	()	()
Other. Please specify	()	()	()	()	()	()	()	()	()	()

Question 17) Please indicate how the following performance aspects changed during the last 12 months (2020/2021) when compared to the 12 months prior (2019/2020).

	Decrease	Slightly decrease	Neither decrease or increase	Slightly increase	Increase
Productivity	()	()	()	()	()
Revenue	()	()	()	()	()
Operational costs	()	()	()	()	()
Market share	()	()	()	()	()
Responsiveness to consumers' needs	()	()	()	()	()
Exploit new ways to manage your business's supply chain	()	()	()	()	()
Market diversification (regional/national/local)	()	()	()	()	()
Other. Please specify	()	()	()	()	()

Question 18) Please evaluate your overall business performance in the last 12 months (2020/21) when compared to the 12 months prior (2019/2020).

	Decrease	Slightly decrease	Neither decrease or increase	Slightly increase	Increase
Sales level	()	()	()	()	()
Cash flow	()	()	()	()	()
Ability to fund business growth from profits	()	()	()	()	()
Profits	()	()	()	()	()
Number of FTE (full time employees)	()	()	()	()	()
Other. Please specify	()	()	()	()	()

Question 19) What actions could your local government council (s) undertake to help your business to overcome the crisis?

Appendix B

Dimension	Question and measurement	Variable name	Variable description
<i>resil</i>	Q5 In your opinion, has your business shown resilience during the last 12 months (2020/21)? Please assess the following statements regarding the COVID19 crisis. 1 denotes strongly disagree, 2 somewhat disagree, 3 neither agree nor disagree, 4 somewhat agree, 5 strongly agree	Q5ARETURN	Our business had the ability to survive, adapt and recover after the COVID19 crisis and return to the previous state of perceived normality
		Q5CREDUCEIMP	Our business had the ability to reduce the impact of the crisis; it had the required level of readiness and recovery ability
		Q5DCOPESUPPLYDISR	Our business had the ability cope with supply chain disruption
<i>people</i>	Q8 In your opinion, how relevant was information sharing and awareness during the last 12 months (2020/2021)? Please assess the following statements regarding the COVID19 crisis. 1 denotes strongly disagree, 2 somewhat disagree, 3 neither agree nor disagree, 4 somewhat agree, 5 strongly agree	Q8AWITHINORG	Our business shared information within the organisation in order to be proactive (taking actions by causing change and not only reacting to change when it happens)
		Q8CLEARNEDFROM	Our business has learned from the COVID19 experience and this could be exploited to build resilience in the future
	Q10 How important were the following dimensions within your business during the last 12 months (2020/2021) for the recovery from the COVID19 crisis? 1 denotes not at all important, 2 somewhat important, 3 moderately important, 4 important, 5 extremely important	Q10ATRUST	Trust (among supply chain partners)
		Q10BEMPLOYCOMM	Employee Commitment
<i>process</i>	Q11 To what extent did your business have effective operational policies and processes (operating frontier) to survive the COVID19 crisis during the last 12 months (2020/2021)? 1 denotes far below standards, 2 below standards, 3 meets standards, 4 above standards, 5 far above standards	Q10CTOPMANAGSUP	Top management support
		Q10EWORKPLACESAT	Workplace satisfaction
		Q11AORGPROC	Organisational processes for creating products or services
		Q11CLEAN	Lean practices for providing a means for improvement
		Q11DREDBUROCRACY	Reduced levels of bureaucracy and extended chain of administration (to avoid long response times)
	Q12 To what extent did your supply chain have the following characteristics during the last 12 months (2020/2021)? 1 denotes to a very small extent, 2 to a small extent, 3 to a moderate extent, 4 to a large extent, 5 to a very large extent	Q12ARESPONSIVENESS	Responsiveness (speed at which your supply chain responds to disruptions) within the supply chain
		Q12BDIVERSITY	Diversity (the existence of multiple channels from which businesses can obtain their goods)
<i>tooling</i>	Q15 Please indicate to what extent did your business used the following practices during the last 12 months (2020/2021) to survive the crisis? 1 denotes never, 2 rarely, 3 sometimes, 4 often, 5 always	Q15ARESOURCEMANAG	Resource management (firm's ability to reconfigure, realign, restructure, and renew its resources in response to disruptions)
		Q15BRESERVEMANAG	Effective financial reserves management
		Q15CDIVERSSUPPLIERS	Diversity and redundancy of suppliers
		Q15EREACTRISKMANAG	Reactive risk mitigation practices
		Q15FBUSCONTPLAN	Business continuity plan (identification of key strategic vulnerabilities, priorities, critical resources and functions)