

# Complex Event Resilience of Small- and Medium-Sized Enterprises: Natural Disaster Planning During the COVID-19 Pandemic

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## Executive Summary

Researchers at NIST and NOAA launched a longitudinal effort to assess Complex Event Resilience of Small- and Medium-sized Enterprises (SMEs). As a first step, a national survey of SMEs was conducted to better understand their experiences with natural disasters in the context of COVID-19. This effort addresses the gap in research on the experiences of SMEs dealing with complex events generally and those that arise during a pandemic, specifically.

Initial findings from over 1300 SMEs indicate that:

- 29 % have already experienced a natural disaster during the pandemic.
- 76 % implemented some adaptation/coping strategies during the COVID-19 pandemic.
- 66 % implemented natural disaster resilience planning in the past (pre-COVID-19), of which 23 % note use of natural disaster resilience actions to address COVID-19.
- 72 % are concerned about future complex events in the context of COVID-19, of which 31 % identify their concern as arising from natural disaster(s) during a pandemic.

Four categories of resources and information are identified by respondents as areas that could help them address complex event risks arising from natural disasters during the COVID-19 pandemic:

1. Assistance navigating deep uncertainty,
2. Clear, detailed information and training,
3. Assistance with personal protective equipment (PPE) and other equipment, and
4. Access to financial assistance and financial information.

## Key words

Adaptation, climate, community resilience, complex event, coping, COVID-19, extreme weather events, natural disaster, hazard, mitigation, online survey, pandemic, resilience planning, recovery, risk mitigation, small- and medium-sized enterprise, small business, survey instrument.

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## Background and Motivation

Small- and medium sized enterprises (SMEs) make up 99.9 % of U.S. businesses and employed 59 million people in 2018 (SBA, 2019). COVID-19 (Coronavirus Disease 2019) has greatly impacted SMEs through safety measures that limit customer interactions and reduce employee availability, as well as through supply chain disruptions. Early predictions estimate that 30 million of the most vulnerable jobs are at an SME (Dua et al., 2020), with 7.5 million small businesses in danger of closing permanently (Powe and Wagner, 2020). SMEs in areas vulnerable to extreme weather and climate face potential complex events as they prepare for or react to natural disasters during the pandemic.

Researchers at NIST and NOAA have launched a longitudinal effort to assess SME Complex Event Resilience. As a first step, a survey of SMEs was conducted to better understand how SME management is planning for natural disasters while dealing with the impacts of the COVID-19 pandemic. This effort addresses the gap in research on the experiences of SMEs in dealing with complex events that arise during a pandemic. Of specific importance is SME resilience to natural disasters during a pandemic.<sup>1</sup> The online survey was open between July 8 and August 8, 2020 and addressed the following themes:

1. Past SME experience with natural disasters;
2. Current SME experience with COVID-19;
3. Current SME experience with natural disasters during the COVID-19 pandemic; and
4. Future plans to cope with COVID-19 and natural disasters.

## Methods

**The survey instrument.** The survey<sup>2</sup> asked respondents about how COVID-19 impacted their SME, and how the SME is adapting to these impacts; about the SME's experience with natural disasters and resilience planning; and the respondent's expectations about the future of the SME. In addition, the survey collected demographic information and background information about the SME. Respondents were asked to indicate if they would like to be contacted in the future and if they would like to be sent a report on survey findings. Invitations to complete the online survey reached SMEs through direct emails, at the invitation of partner networks, and through social media posts. A Spanish-language version of the survey was available. For more details on the survey development and to view the instrument, see Helgeson et al. (2020).

**Sampling.** The sample contacted through direct email was selected based on the following criteria:<sup>3</sup>

- Located in counties with natural disaster experience.<sup>4</sup> Within each county, SMEs were sampled at random to ensure heterogeneity in potential disaster experience;
- 100 employees or fewer at a single site;
- Construction, manufacturing, and retail industries were targeted.<sup>5</sup>

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<sup>1</sup> For this survey, a natural disaster is defined as arising from a geophysical, meteorological, climatological, or hydrological hazard and includes both extreme weather and climate events.

<sup>2</sup> The survey "SME Recovery from a Pandemic in the Face of Natural Hazard Risks" is approved by the NIST IRB and under OMB CONTROL NO. 0693-0078 Expiration Date 07/31/2022.

<sup>3</sup> Contact information for direct email was obtained from UZBizData.com and verified independently.

<sup>4</sup> Determined using the SHELATUS database. Any county experiencing at least one natural disaster since 1960 was eligible.

<sup>5</sup> For which the six-number NAICS codes begin with 23, 31-33, and 44-45, respectively. Administrative and Support and Waste Management and Remediation Services sectors were also included to account for SMEs that support routine operations of other sectors.

The survey was also disseminated through partner networks. At the federal level, NOAA's Weather Ready Nation, Sea Grant, and the Regional Integrated Science and Assessment (RISA) Network, as well as the Minority Business Development Agency (MBDA), each distributed the survey to their stakeholders across the country. In addition, the National Chamber of Commerce Foundation, the NYC Department of Small Business Services, and various local Chambers of Commerce publicized the survey to their stakeholders.

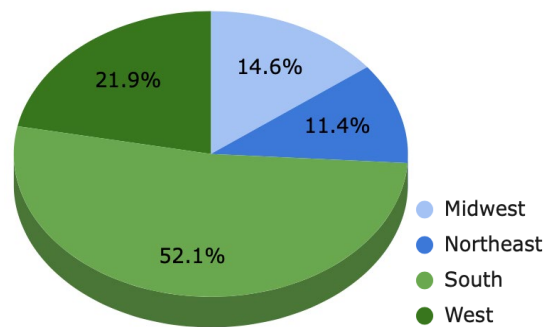


Figure 1. Respondents by Census region. n=1357.

## Descriptive Statistics

There were 1374 total survey responses. The location of the SME was provided by 1357 respondents: 52 % from the South Census Region, 22 % from the West, 15 % from the Midwest, and 11 % from the Northeast, as shown in Figure 1. Moreover, 1123 respondents identified their business as either essential or non-essential;<sup>6</sup> Figure 2 shows this

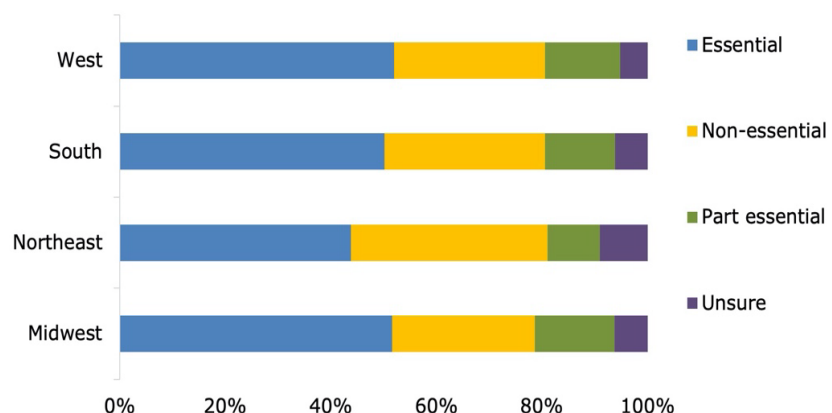


Figure 2. SME designation as essential/non-essential by Census region. n=1112.

distribution by Census Region. Of note, 50 % of respondents identified their business as essential, 31 % as non-essential, 13 % indicated that only some segment of their business is essential, while 6 % indicated that they are unsure about their SME's classification.

Of those providing sector information, 24 % are in the construction sector, 17% are in the health and medical services sector, 16 % are retail and wholesale businesses, 15 % are classified as accommodation, entertainment, recreation, and food services sector, 8 % are manufacturers, 5% are agriculture and food processing businesses, and 15 % are classified as "other."<sup>7</sup>

Respondents also reported SME demographics: 18 % identify as women-owned, while 12 % identify as minority-owned, and 5 % identify as Veteran-owned.

<sup>6</sup> The survey did not define "essential" for respondents. Guidance issued by the Department of Homeland Security's Cybersecurity and Infrastructure Security Agency ("CISA Guidance") identified 16 industry sectors considered "essential critical workforce infrastructure" and declared the personnel that work in those industry sectors to have special responsibility to maintain their normal work schedules. This initial list of "Essential Critical Infrastructure Workers" was intended to help State and local officials as they work to protect their communities and decide upon local essential designations. See: <https://www.cisa.gov/sites/default/files/publications/CISA-Guidance-on-Essential-Critical-Infrastructure-Workers-1-20-508c.pdf>

<sup>7</sup> Other categories include: transportation and warehousing, finance and insurance, information and technology, real estate, technical and scientific services, natural resource management, fuel production, and fishing and aquaculture. n=930 for this question.

The median SME length of time in business is 51 years. This is consistent across regions.<sup>8</sup>

Finally, 55% of SMEs represent a microbusiness, with ten or fewer employees; 31% represent a small business, with 1-100 employees, and 14% represent a medium-sized business, with over 100 people.

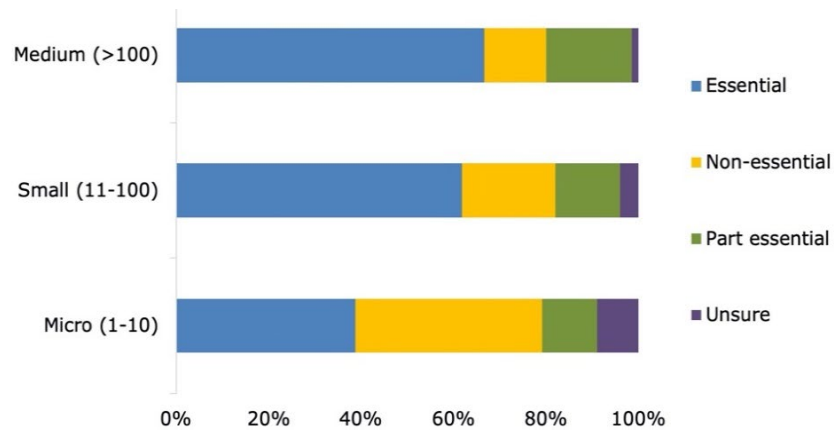


Figure 3. SME designation as essential/non-essential by employee number. n=1120.

Figure 3 shows the proportion of essential and non-essential businesses by employee number.

## Observations

Key initial findings from analysis of quantitative and qualitative survey data are presented in this section.

**1. Past SME natural disaster experience.** The majority of survey respondents in each region indicated that their SME has been affected by some natural disaster in the past ten years, as shown in Figure 4. Past experience with natural disasters is divided between chronic (13%) and acute (18%) events; 57% report having experienced both types in the past ten years (pre-COVID-19).<sup>9</sup>

### 2. Current SME experience

**with COVID-19.** The survey asked respondents if actions taken to prepare for natural disasters in the past helped the SME prepare for or cope with the impacts of COVID-19: 24% indicated that disaster preparedness has helped them with COVID-19, while 56% said it has not, and 20% report being “unsure.”<sup>10</sup> Table 1 presents the distribution of these responses by whether or

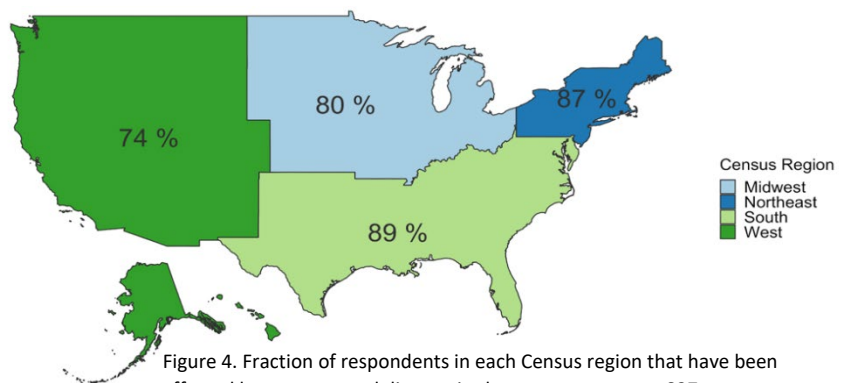


Figure 4. Fraction of respondents in each Census region that have been affected by some natural disaster in the past ten years. n=837.

not the SME had past disaster experience. It is worth noting that 11% of respondents that had not

experienced any type of natural disaster still found natural disaster preparedness helped reduce the impacts of COVID-19.

<sup>8</sup> By region, the median age is 52 years for SMEs located in the Midwest, 48 years for those located in the Northeast, 54 for SMEs located in the South, and 47.5 years for businesses located in the West. The minimum is 1 and the maximum is 72.

<sup>9</sup> A chronic risk is one that is recurring, can often be expected, and for which an SME may plan for regularly. Chronic natural disaster risks include drought, extreme cold, heat waves, winter storms, flooding. Acute risks are associated with less predictability and are often defined by low-probability and high-impact. Acute natural disaster risks include hurricanes, storm surge, earthquakes, tsunamis, tornadoes, and wildfires.

<sup>10</sup> In addition, 156 respondents indicated that this the question did not apply to them and 338 did not answer the question.

The survey asks respondents' perception of how long it will be before the SME returns to its pre-COVID-19 business capacity. Of the 992 responses, 20 % think that it will be less than 12 months. 19 % estimate that it will be 12-18 months, 23 % indicate more than 18 months. Finally, 19 % indicate that their SME is unlikely to ever resume operations at the same level. For example, some respondents are considering early retirement. It is likely that perceived recovery timeframes will impact the types of coping and adaptation measures employed.

Table 1. Respondents indicating whether natural disaster preparedness helped their SME prepare for or cope with COVID-19 impacts. n=880

Actions to address natural disasters in the past helped address COVID-19 impacts	Natural disaster experience reported	
	YES	NO
YES	89 %	11 %
NO	84 %	16 %
Unsure	89 %	11 %

Essential businesses do not appear to have been better prepared than their non-essential counterparts for a pandemic. For example, essential and non-essential businesses across SME size informally report reductions in employee productivity, whether they are on-site or working remotely. For example, one respondent noted that they *"closed [their] showroom to the public, but continue to ship. [Salespeople] worked from home. Their effectiveness is diminished without in-person visits."* Figure 5 presents commonly reported issues related to customers, employees, and supply chains.

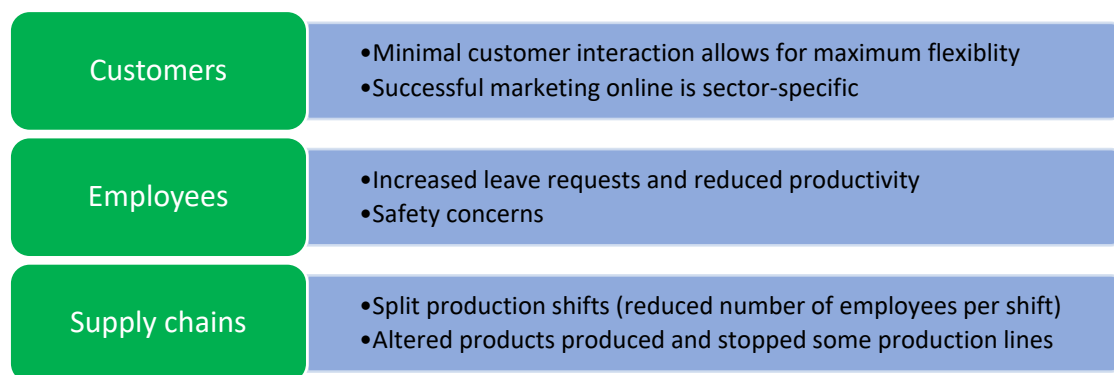


Figure 5. Commonly reported issues and opportunities arising from COVID-19 across both essential and non-essential SMEs.

Financial difficulties arising from a number of direct and indirect COVID-19 specific impacts were frequently discussed. Many micro-sized enterprises expressed concerns over continuing to fund employee health insurance as financial margins tighten. Those in the services sector, especially those seasonal in their functions, experienced delays from the consumer-side that supersede past delays from natural disaster impacts. This is largely accounted for by deep uncertainty facing consumers. In turn, this left these respondents with less of a financial safety net.

**3. SME experience with natural disasters during the COVID-19 Pandemic.** The survey asked respondents if their SME had experienced a natural disaster event since March 13th, 2020,<sup>11</sup> and 29 % indicated that they had experienced such an event.<sup>12</sup> This is illustrated in Figure 6, which further indicates whether those SMEs felt their response to the natural disaster was impacted by COVID-19. Of these

<sup>11</sup> Date of the Federal Emergency Declaration. See: "Proclamation on Declaring a National Emergency Concerning the Novel Coronavirus Disease (COVID-19) Outbreak." <https://www.whitehouse.gov/presidential-actions/proclamation-declaring-national-emergency-concerning-novel-coronavirus-disease-covid-19-outbreak/>

<sup>12</sup> The period March 13-August 8, 2020. Natural disaster seasonality should be taken into account. Given the number of Presidentially declared natural disasters in August-September 2020, this value may underestimate disaster experience during the pandemic. n=1038

responses, 13 % reported that their organizational response to the occurrence of natural disasters at their location had been affected by COVID-19.

SMEs' capacity to respond to natural disasters is limited by current COVID-19 associated changes. Even respondents who indicated no direct impact from COVID-19 on their natural disaster response indicated that they were actually indirectly affected by decisions the business had previously made to address COVID-19.

For example, in sectors where there has been a significant shift towards teleworking to address COVID-19 already, it was easier to telework as a response to the natural disaster. Some businesses reporting minimal negative effects from COVID-19 indicated that experiencing a natural disaster during the pandemic disturbed what had become *new normal* operating procedures. Across sectors and designation of SMEs as essential (or not), liquidity was a major issue. For example, there was concern around ability to meet the criteria for SBA Paycheck Protection Program (PPP) loans when money earmarked for employee retention was used to address natural disaster recovery during this period.

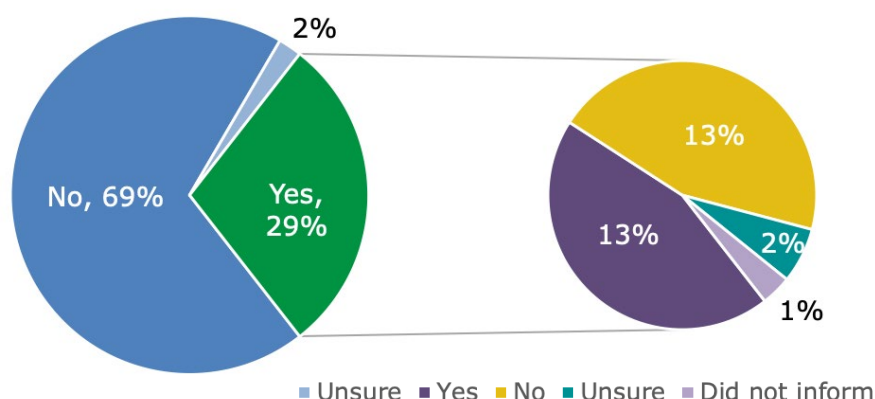


Figure 6. SMEs affected by a natural disaster during COVID-19, left. n=1038. Of those affected, whether the response to the disaster event was affected by COVID-19, right. n=300.

#### 4. Future plans to cope with COVID-19 and natural disasters

**Complex Event Concerns.** Looking forward,<sup>13</sup> the survey asked respondents about their concerns regarding continued COVID-19 impacts on the recovery process. Of the 1006 responses to the question, 99 % expressed concern over the risk of one or more complex event(s); see Table 2 for complex event types. Notably, those who have experienced or have prepared for natural disasters more readily expressed concern over a complex event. Out of the 99 % of SMEs that expressed any concern, 31 % reported specific concern over complex events related to occurrence of a natural disaster during the COVID-19 pandemic. Figure 7 presents the fraction of respondents in each region that have such a concern.

Table 2. Percent of respondents indicating a complex event type as a top concern, grouped by Census region and experience with a recent natural disaster. n=938.

Complex Event Type	Midwest		Northeast		South		West	
	No	Yes	No	Yes	No	Yes	No	Yes
Natural Disaster	2 %	8 %	1 %	5 %	3 %	63 %	4 %	15 %
COVID-19 Specific	2 %	10 %	1 %	11 %	6 %	48 %	5 %	17 %
Financial / Market	2 %	10 %	1 %	9 %	6 %	49 %	6 %	16 %
Workforce Issues	2 %	11 %	1 %	9 %	6 %	51 %	5 %	16 %
Consumer Issues	3 %	10 %	1 %	9 %	8 %	48 %	6 %	15 %
Global Concerns	3 %	9 %	1 %	11 %	6 %	44 %	5 %	21 %

<sup>13</sup> This question was asked about the "future," opposed to events that may have already occurred. SMEs that experienced a natural disaster during the COVID-19 pandemic up until the point of taking this survey did not necessarily indicate concern about a natural disaster in this forward looking question.



SMEs that have prepared for natural disasters in the past tended to report greater concern for a complex event related to natural disasters during the COVID-19 pandemic. Although most SMEs were concerned about acute and chronic natural disaster risks at their location (61 %), the percent of SMEs with concerns specific to acute risks (23 %) is higher than those with concerns specific to chronic events (16 %). Figure 8 gives this breakdown by region.

Furthermore, the more general an SME's disaster preparedness and response plans are (i.e., widely applicable across event types), the more the respondent perceives that such planning has been applicable to the current pandemic and is flexible enough to address a complex event, should one occur in the near future. As one respondent put it: *"We have dealt with many weather emergencies in the past as well a bad flu pandemic, all of which prepared us for something like COVID-19, especially as it relates to teleworking. Our employees have been used to teleworking during emergencies."*

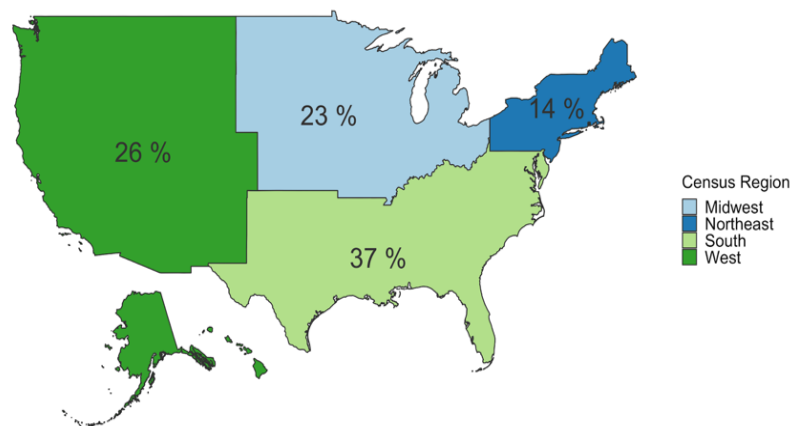


Figure 7. Fraction of respondents in each Census region that expressed concern over natural disaster risk in the context of recovery from COVID-19. n=983.

Respondents largely indicated that they were unsure (44 %) about how preparedness and response to future natural disasters will change as a consequence of COVID-19 experiences once the pandemic is over,<sup>14</sup> while 9 % of respondents indicated that their planning will change and 47 % believed that it will not.

However, SMEs largely are changing natural disaster responses during COVID-19 given current protocols they have in place. For example, in the case of natural disasters, many multi-location SMEs travel between locations or shift employees; however, during COVID-19 they reported not transferring

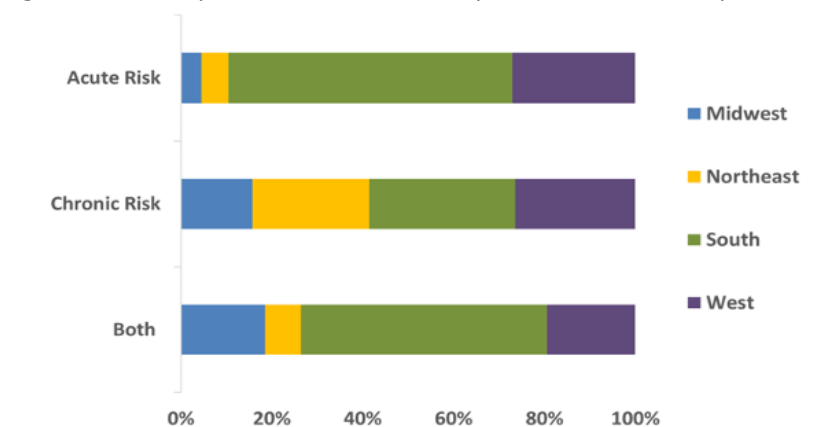


Figure 8. SMEs with top concerns about chronic risks and acute risks by Census region. n=859.

items or employees between locations, which impacts dealing with a potential complex event. Planning for complex events during the pandemic is trending towards use of capital to provide maximum flexibility. For example, many respondents indicated that they have preemptively set-up credit lines. Micro-sized enterprises frequently reported taking out personal loans and discuss letting their employees "know that they care;" however, they also reported that they do not feel that they have the capital to survive a

<sup>14</sup> n=629

complex event. Across the board, there are reported increases in cooperative actions with counterparts in the same industry and geographic location that would typically be market competition.

**Expressed Needs.** The survey asks respondents to indicate agreement with the statement: “COVID-19 posed the greatest risk yet to my organization’s survival.” Notably, 60 % of those respondents indicating that they strongly agree with the statement have past natural disaster experience. The survey goes on to ask respondents to indicate agreement with the statement that “the impacts of COVID-19 will leave my organization unable to cope with a natural disaster, should one occur, in the next year.” Notably, 90 % of those who responded that they strongly agree have previous experience with natural disasters.

Access to resources to protect against a complex event is an issue: 37 % of respondents reported that they do not have the resources needed to protect their SME against the complex events they identified as concerning. Many respondents indicated that deep uncertainty is the main source of concern; there is a desire for certainty in guidance and resources that will be made available to prepare for complex events.

In open-ended responses the term “crystal ball” appeared frequently; for example: *“[I need] a crystal ball to tell [if] a further shut down will occur, reactions, and...the economic impacts.”* Even those respondents who have seen an uptick in demand during COVID-19 hesitate to expand operations. Many respondents indicated that they are *unsure* about what resources they need to protect their SME: *“I’m not sure what resources I need or that they even exist.”*

Those respondents who provided information about resources to help them address complex risks in the future typically indicated that they need assistance that falls within the following categories: 1. Assistance navigating deep uncertainty, 2. Clear, detailed information and training, 3. Assistance with PPE and other equipment, and 4. Access to financial assistance and financial information.

In many cases, access to clear, detailed information came in the form of asking for better coordination and training programs (e.g., sales strategies in a telework environment, networking, use of social media). Best practices across industries were mentioned. Additionally, the desire for reliable health and safety information for the workplace was frequently mentioned. Finally, many SMEs would like *“to [see] the devastation to small business and the impacts to local communities better acknowledged”* in information that is made available by all levels of government, from local to federal (e.g., informational sheets).

Some respondents were concerned about continuing to access adequate supplies, masks, and cleaning products. Opinions as to whether the business or the employee bears the burden of maintaining these supplies was split. Some respondents representing the retail sector expressed concern over how to communicate with customers that may not want to wear PPE.

In facing potential complex events, SMEs acknowledged the need to be financially prepared ahead of time. However, strengthening SMEs in the current environment is perceived as tricky at best. As one respondent noted: *“The cost of preparedness reduces margin and we were already a low margin business.”* Some respondents hold business interruption insurance as a form of resilience planning for natural disasters. Many were unsuccessful when trying to file a claim for business interruption from a pandemic. These respondents are concerned about covering additional losses should a complex event occur. In considering finances, many SMEs are interested in the potential for low interest special loans to maintain businesses that are operating at reduced capacity already, while also needing to cover the cost of utilities, PPE, and salaries. There is also a desire to obtain training specific to financial resources, such as how to create better business relationships with financial institutions and lending personnel. Many respondents



expressed gratitude for SBA assistance, but desire a better understanding of how to apply for grants and other income support moving forward.

## Initial Findings: Summary

Operating in a multi-risk environment with acute and chronic shocks and stressors requires that SMEs address potential complex events that arise from compound and/or cascading risks in the context of COVID-19. This section presents a summary of key initial findings.

- 29 % have already experienced a natural disaster during the pandemic;
- 76 % implemented some adaptation/coping strategies during the COVID-19 pandemic.
- 66 % implemented natural disaster resilience planning in the past (pre-COVID-19), of which 23 % note use of natural disaster resilience actions to address COVID-19.
- 72 % are concerned about future complex events in the context of COVID-19, of which 31 % identify their concern as arising from natural disaster(s) during a pandemic.

Respondents indicated that four categories of resources and information would help them address complex event risks arising from natural disasters during the COVID-19 pandemic; see Figure 9.



Figure 9. Categories of expressed needs.

## Future Research

SMEs benefit their local communities by providing jobs, increasing the tax base, fostering community involvement, and providing diverse, locally sourced or made products and services. By the time that this survey was conducted, three months had passed since the National Emergency was declared. Thus, SMEs had time to start to adjust to pandemic circumstances, though continued deep uncertainty and dynamic circumstances make planning for natural disasters during a pandemic complicated. Since COVID-19 was declared a National Emergency there have been at least 18 natural disasters around the United States.<sup>15</sup> As COVID-19 is unprecedented, even existing pandemic recommendations for SMEs may not have been enough to prepare for this particular event (Agility Recovery, 2019; CDC, 2017). Businesses continue to adapt with new practices (e.g., moving retail online, changing to take-out dining), employee support (e.g., advanced pay, unemployment application support), and responding to shifting norms in their local communities (e.g., closing without government prompting to prevent spread)

<sup>15</sup> This value is based on Presidentially Declared Disasters March 13-September 14, 2020.

(Huddleston Jr., 2020; Levenson, 2020); but many have restrictions based on tangible and intangible barriers that prevent them from adapting adequately, e.g., value margins, size.

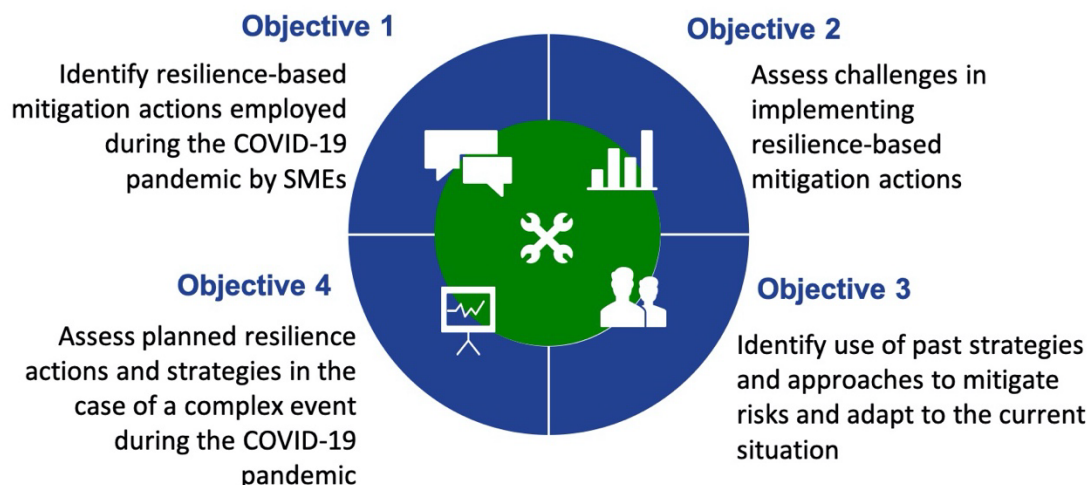


Figure 10. Four interconnected objectives of longitudinal effort.

This survey data collection is the first in a longitudinal effort to address SME Complex Event Resilience. There are four interconnected objectives for future data collection across the longitudinal effort, noted in Figure 10. This effort is aimed at providing relevant data to Federal partners and other entities in providing guidance to SMEs on: 1. mitigation planning for natural disasters during the pandemic and 2. disaster readiness strategies to cope with disruptions from the pandemic. As this longitudinal research effort continues, feedback and collaboration are welcome.

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