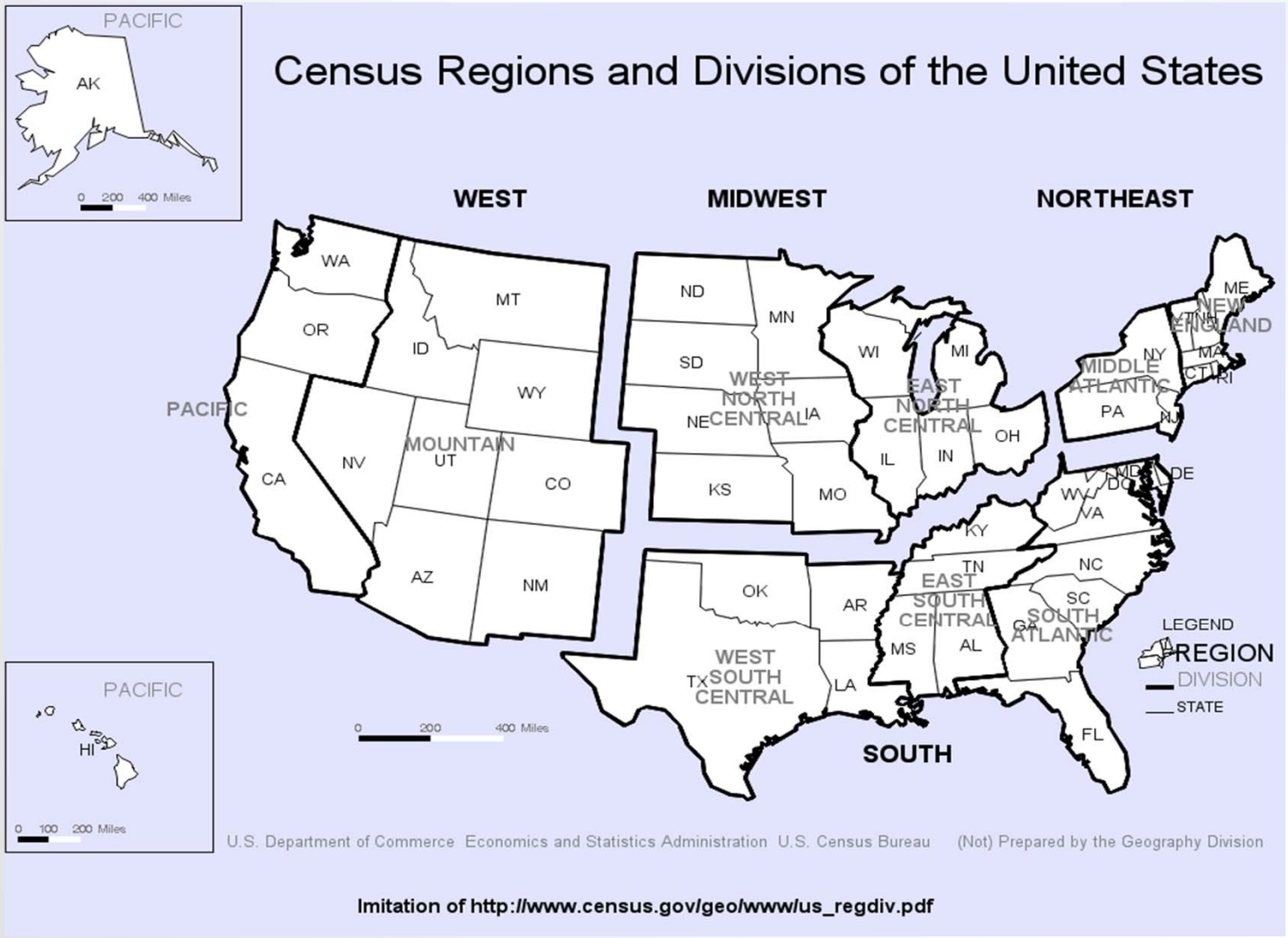
ACEC RESEARCH INSTITUTE

ACEC COVID-19 BUSINESS IMPACT SURVEY - WAVE 2

March 26, 2020

TABLE OF CONTENTS

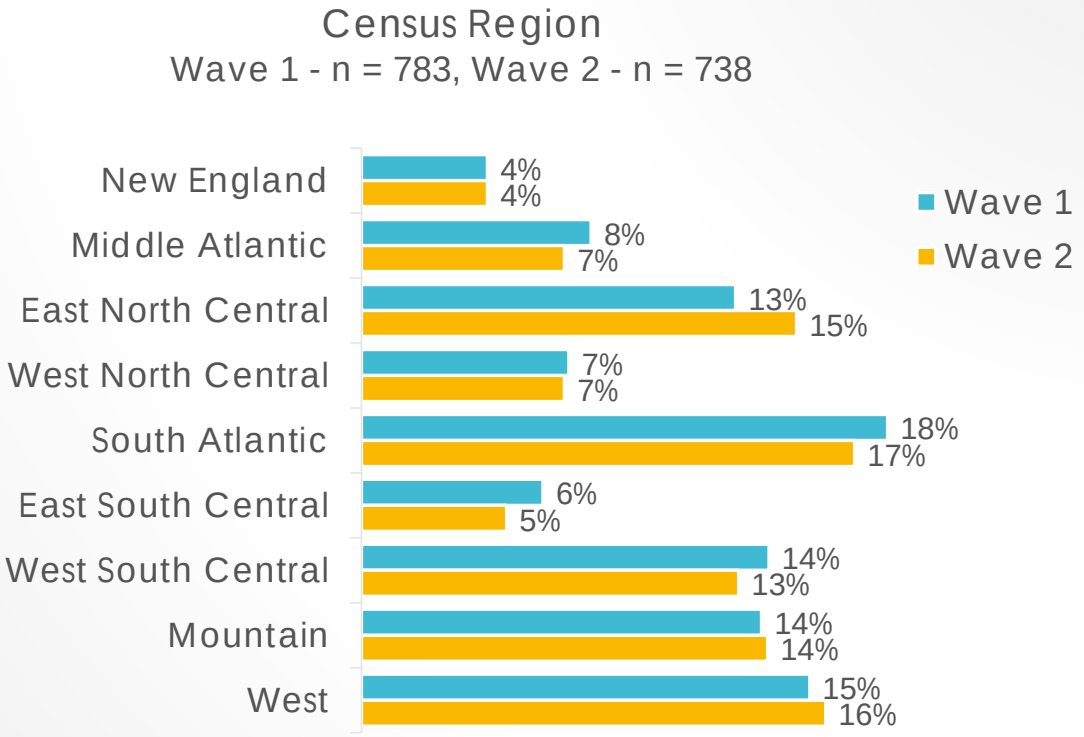
DEMOGRAPHICS



Imitation of http://www.census.gov/geo/www/us_regdiv.pdf

THE GEOGRAPHIC LOCATION OF RESPONDENTS' ORGANIZATIONS ARE STATISTICALLY THE SAME BETWEEN WAVE 1 AND WAVE 2.

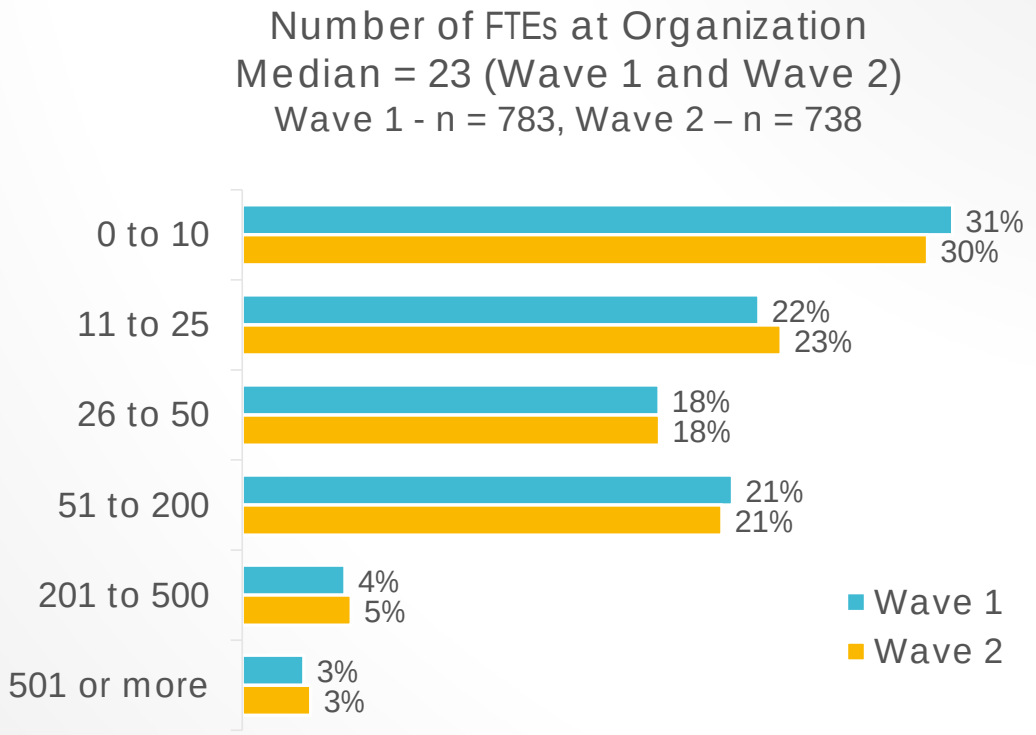
- For an analysis of trends by region, please refer to the report for Wave 1.



Q13. In which state is your organization headquartered?

CONSISTENT WITH WAVE 1, MORE THAN HALF (53%) OF RESPONDENTS INDICATE THERE ARE 25 OR FEWER FULL-TIME EQUIVALENTS AT THEIR ORGANIZATION. THE MEDIAN FIRM SIZE IS ALSO IDENTICAL BETWEEN THE TWO TIME SERIES.

- The largest organization in Wave 1 reported 11,000 FTEs compared to 10,000 in Wave 2.
- Although the *average* number of FTEs in Wave 2 (124) is larger than in Wave 1 (107), the *median* is the exact same (23), indicating that some very large firms are skewing the average size. Therefore, the median is a more helpful metric to use in this analysis.
- Throughout this report meaningful, statistically significant differences between firm size are noted.



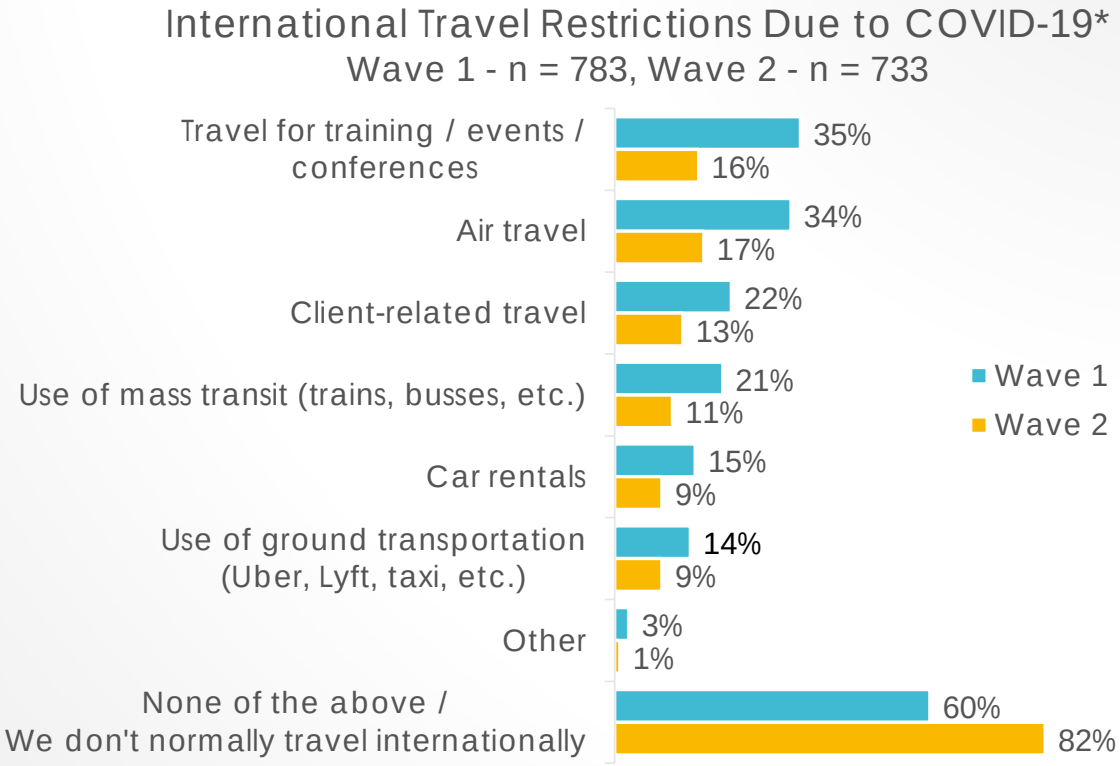
Q14. How many full-time equivalent employees (FTEs) do you have? If you are not sure, please provide your best estimate.

TRAVEL RESTRICTIONS

ALTHOUGH 82% OF FIRMS INDICATED THEY DO NOT NORMALLY TRAVEL INTERNATIONALLY, AMONG THOSE THAT DO, NEARLY ALL HAVE RESTRICTED TRAVEL FOR TRAINING / EVENTS / CONFERENCES AND AIR TRAVEL.

* NOTE: Although the same question was asked in Wave 1 and Wave 2, two response options were displayed slightly differently between the two waves, likely causing the differences shown in the graph. In Wave 1, “None of the above” and “ We don’t normally travel internationally” were combined as one option while in Wave 2 they were separated. Despite this change, the trend is the same in terms of the top restrictions imposed.

- As detailed on the following slide there are some statistically significant differences by firm size.
  - Generally speaking, the larger the firm size, the more likely employees are to travel internationally, and therefore, are more likely to report restricting all forms of international travel.



Q2. As a result of COVID-19, which of the following, if any, has your company restricted or prohibited regarding international travel? Select All That Apply

INTERNATIONAL TRAVEL RESTRICTIONS DUE TO COVID-19 BY FIRM SIZE (FTE)

	Total		0 to 10	11 to 25	26 to 50	51 to 200	201 to 500	501 or more
Air travel	17%		**9%**	13%	15%	**23%**	**50%**	**57%**
Travel for training / events / conferences	16%		**8%**	13%	16%	**21%**	**38%**	**57%**
Client-related travel	13%		**7%**	11%	14%	14%	**38%**	**29%**
Use of mass transit (trains, busses, etc.)	11%		**6%**	9%	10%	12%	**29%**	**29%**
Car rentals	9%		**5%**	9%	10%	10%	**24%**	**24%**
Use of ground transportation (Uber, Lyft, taxi, etc.)	9%		7%	8%	8%	10%	**24%**	**24%**
Other	1%		0%	1%	3%	1%	0%	0%
None of the above / We don't normally travel internationally	82%		**91%**	**86%**	83%	**76%**	**50%**	**43%**

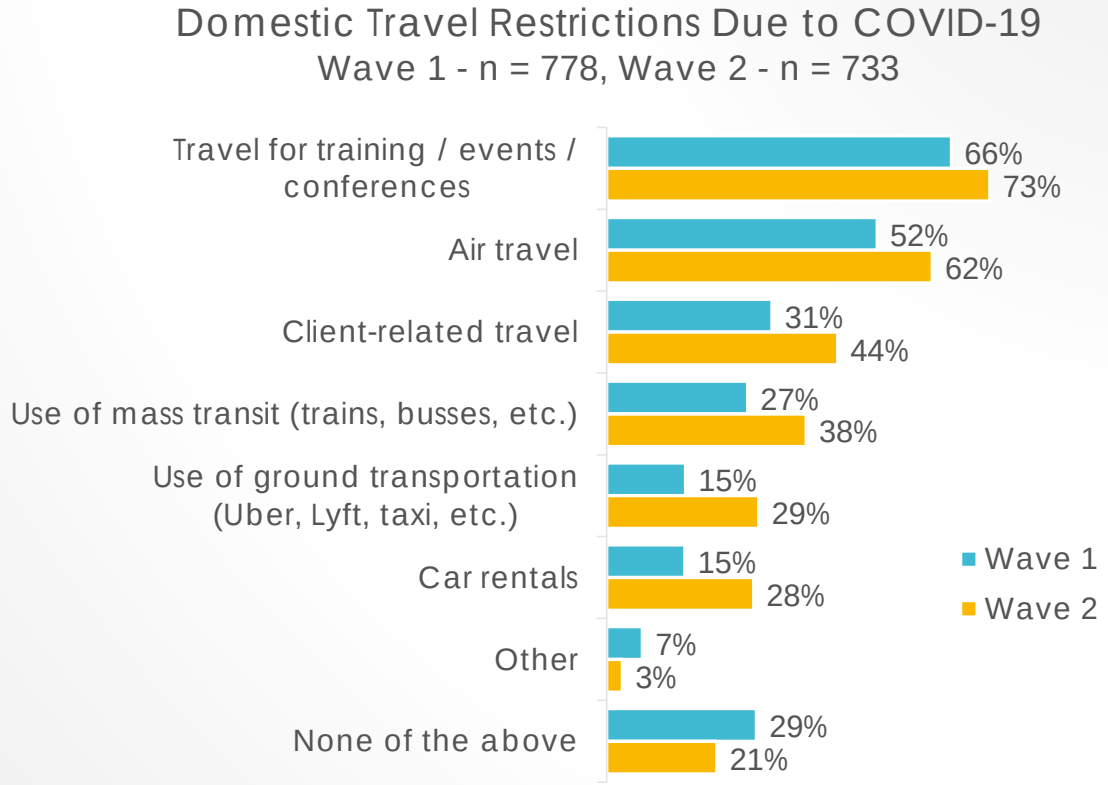
Indicates significantly higher percentage

Indicates significantly lower percentage

Q2. As a result of COVID-19, which of the following, if any, has your company restricted or prohibited regarding international travel? Select All That Apply

COMPARED TO WAVE 1, MORE FIRMS HAVE IMPLEMENTED SOME TYPE OF DOMESTIC TRAVEL RESTRICTIONS (79% UP FROM 71%). THIS HAS LED TO AN INCREASE IN RESTRICTIONS OF ALL TYPES OF TRAVEL.

- As detailed on the following slide there are some statistically significant differences by firm size.
  - The larger the firm size, the more likely an organization has restricted travel for training / events / conferences, air travel and use of mass transit.
  - Smaller firms are more likely to have restricted use of ground transportation compared to larger firms.



Q3. As a result of COVID-19, which of the following, if any, has your company restricted or prohibited regarding domestic travel? Select All That Apply

DOMESTIC TRAVEL RESTRICTIONS DUE TO COVID-19 BY FIRM SIZE (FTE)

	Total		0 to 10	11 to 25	26 to 50	51 to 200	201 to 500	501 or more
Travel for training / events / conferences	73%		**62%**	71%	**79%**	**80%**	**94%**	**95%**
Air travel	62%		**52%**	**56%**	**70%**	**69%**	**80%**	**95%**
Client-related travel	44%		41%	42%	**48%**	**49%**	**40%**	**33%**
Use of mass transit (trains, busses, etc.)	38%		39%	39%	36%	**33%**	**46%**	**52%**
Use of ground transportation (Uber, Lyft, taxi, etc.)	29%		32%	**34%**	29%	**23%**	**23%**	**14%**
Car rentals	28%		31%	27%	32%	25%	26%	**10%**
Other	3%		2%	3%	3%	3%	6%	5%
None of the above	21%		**31%**	**26%**	**14%**	**14%**	**6%**	**5%**

Indicates significantly higher percentage

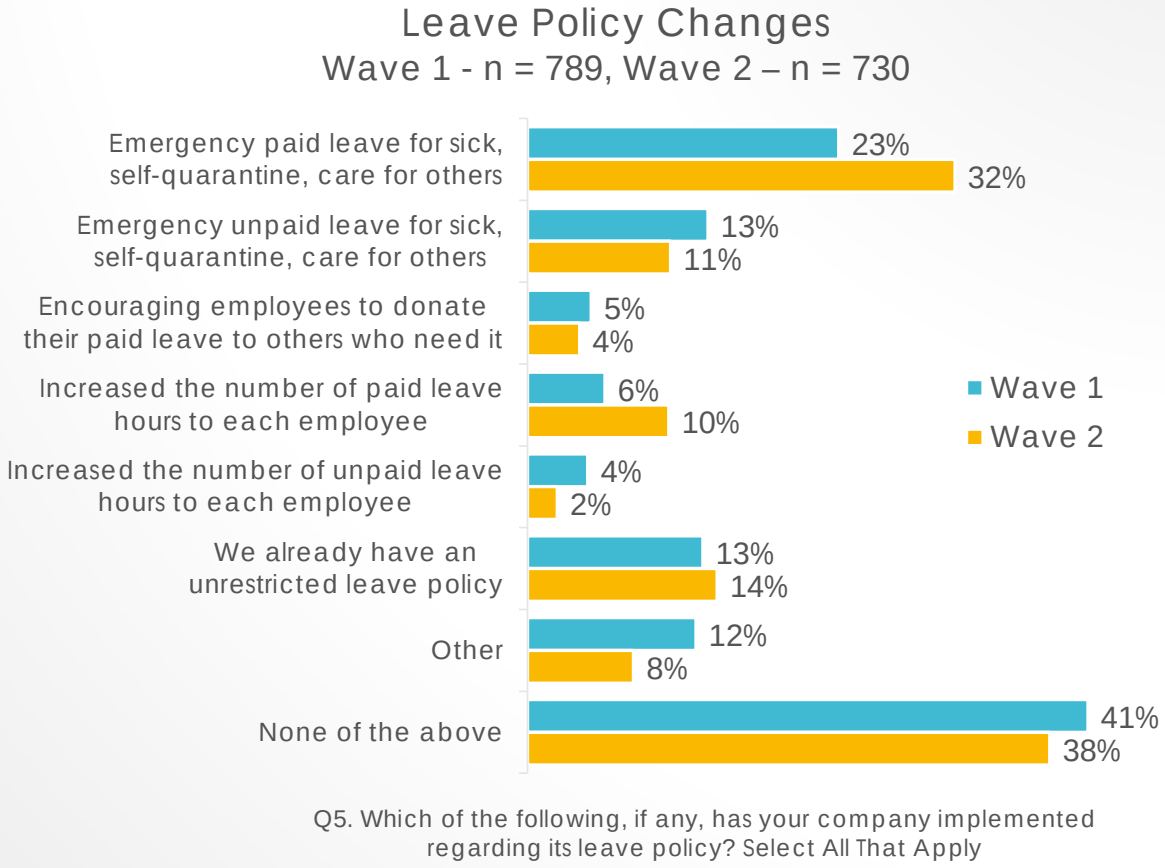
Indicates significantly lower percentage

Q3. As a result of COVID-19, which of the following, if any, has your company restricted or prohibited regarding domestic travel? Select All That Apply

WORKSTYLE IMPACTS

ALTHOUGH THE PERCENTAGE OF FIRMS THAT HAVE CHANGED THEIR LEAVE POLICY IS NEARLY THE SAME (48% VERSUS 46% IN WAVE 1), THERE HAS BEEN A SHIFT TOWARDS PROVIDING VARIOUS TYPES OF PAID LEAVE INSTEAD OF UNPAID LEAVE.

- More firms are providing emergency paid leave compared to Wave 1 (32% versus 23%) and/or have increased the number of paid leave hours provided to employees (10% versus 6%).
- As detailed on the following slide there are some statistically significant differences by firm size.
  - The larger the firm size, the more likely the firm is to provide emergency paid leave and/or increase the number of paid leave hours for employees.
  - Firms with more than 200 employees are also more likely to encourage employees to donate their paid leave to others who need it.
- Many firms noted in the "other" comments that they are allowing employees to borrow leave or go into a negative leave balance.



Q5. Which of the following, if any, has your company implemented regarding its leave policy? Select All That Apply

LEAVE POLICY CHANGES BY FIRM SIZE (FTE)

	Total		0 to 10	11 to 25	26 to 50	51 to 200	201 to 500	501 or more
Emergency paid leave for those who become sick, must self-quarantine, or care for others	32%		**24%**	**25%**	**39%**	33%	**64%**	**55%**
Emergency unpaid leave for those who become sick, must self-quarantine, or care for others	11%		**7%**	12%	**7%**	**14%**	9%	**36%**
Encouraging employees to donate their paid leave to others who need it	4%		**1%**	**2%**	3%	3%	**18%**	**27%**
Increased the number of paid leave hours to each employee	10%		**3%**	9%	**13%**	**15%**	**18%**	**27%**
Increased the number of unpaid leave hours to each employee	2%		2%	2%	2%	1%	9%	5%
We already have an unrestricted leave policy	14%		**22%**	13%	**10%**	**11%**	**3%**	**5%**
Other	8%		**3%**	**5%**	**14%**	**11%**	12%	14%
None of the above	38%		**46%**	**46%**	**28%**	36%	**24%**	**9%**

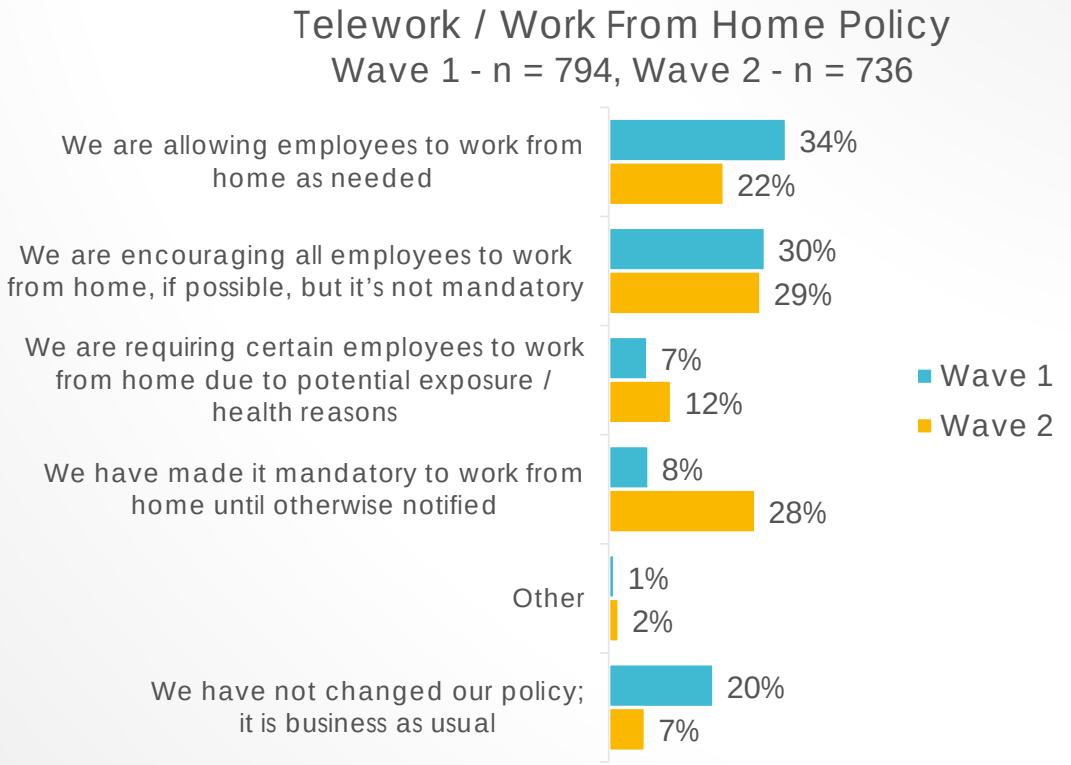
Indicates significantly higher percentage

Indicates significantly lower percentage

Q5. Which of the following, if any, has your company implemented regarding its leave policy? Select All That Apply

THERE HAS BEEN A SIGNIFICANT INCREASE IN THE PERCENTAGE OF FIRMS THAT HAVE IMPLEMENTED SOME TYPE OF TELEWORK POLICY (93% UP FROM 80% IN WAVE 1). AS A RESULT, THERE HAS BEEN A LARGE INCREASE IN FIRMS MANDATING EMPLOYEES WORK FROM HOME (28% UP FROM 8%).

- More firms are also requiring certain employees work from home due to potential exposure / health reasons (12% up from 7%).
- As detailed on the following slide there are some statistically significant differences by firm size.
  - Firms with between 51 and 500 FTEs are more likely to be mandating work from home, while smaller firms with 25 or fewer employees are more likely to be allowing employees to work from home as needed.
  - Firms with more than 200 FTEs are more likely to be encouraging all employees to work from home, if possible.



Q4. Which one of the following best describes your current telework / work from home policy?

TELEWORK / WORK FROM HOME POLICY BY FIRM SIZE (FTE)

	Total		0 to 10	11 to 25	26 to 50	51 to 200	201 to 500	501 or more
We are allowing employees to work from home as needed	22%		**27%**	**26%**	20%	**18%**	**9%**	**14%**
We are encouraging all employees to work from home, if possible, but it's not mandatory	29%		**20%**	30%	**37%**	30%	**40%**	**41%**
We are requiring certain employees to work from home due to potential exposure / health reasons	12%		10%	10%	13%	12%	11%	**23%**
We have made it mandatory to work from home until otherwise notified	28%		25%	25%	**23%**	**38%**	**34%**	**23%**
Other	2%		1%	1%	4%	2%	6%	0%
We have not changed our policy; it is business as usual	7%		**17%**	8%	**2%**	**1%**	**0%**	**0%**

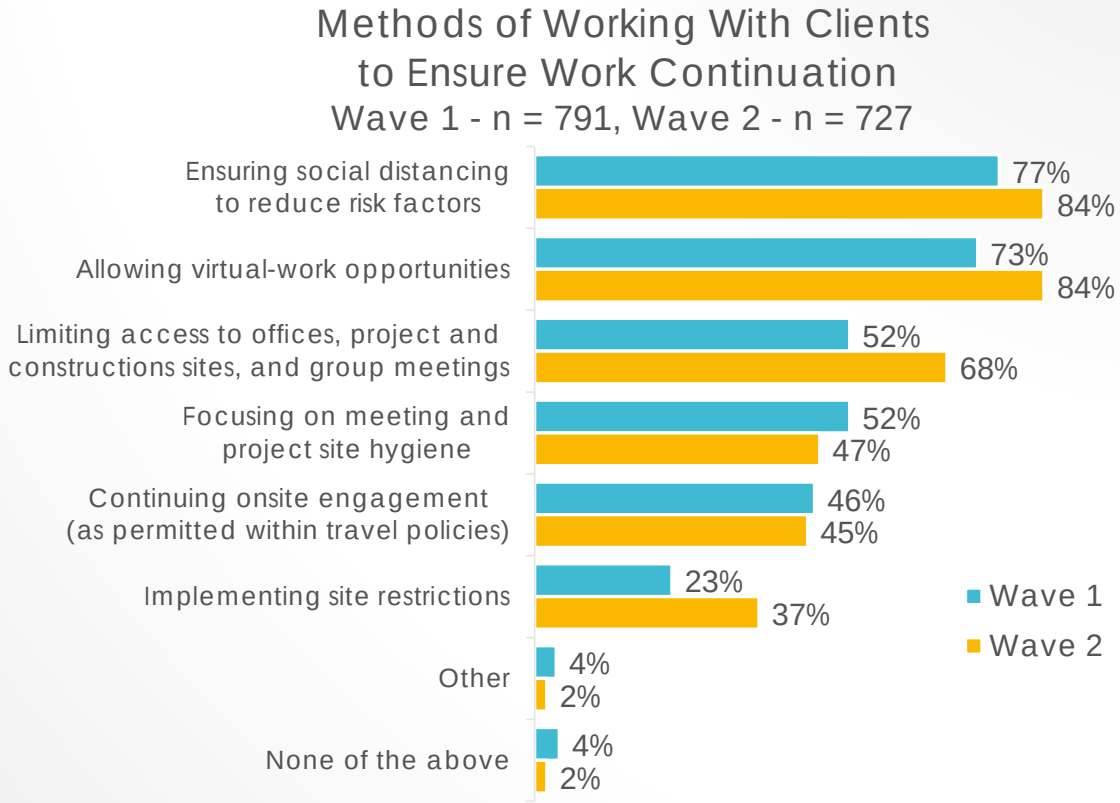
Indicates significantly higher percentage

Indicates significantly lower percentage

Q4. Which one of the following best describes your current telework / work from home policy?

COMPARED TO WAVE 1, MORE FIRMS HAVE IMPLEMENTED VARIOUS METHODS OF WORKING WITH CLIENTS TO ENSURE WORK CONTINUATION. SOCIAL DISTANCING (84% UP FROM 77%) AND ALLOWING VIRTUAL WORK (84% UP FROM 73%) STILL TOP THE LIST.

- More firms are also limiting access to offices, project/construction sites and group meetings (68% up from 52%), and implementing site restrictions (37% up from 23%).
- As detailed on the following slide there are some statistically significant differences by firm size.
  - Generally speaking, the larger the firm size, the more likely the firm has implemented all methods.



Q6. In which of the following ways, if any, are you working with your client counterparts to ensure projects can be executed and work can continue? Select All That Apply

METHODS OF WORKING WITH CLIENTS TO ENSURE WORK CONTINUATION BY FIRM SIZE (FTE)

	Total		0 to 10	11 to 25	26 to 50	51 to 200	201 to 500	501 or more
Allowing virtual-work opportunities	84%		**72%**	87%	**89%**	**88%**	**100%**	**100%**
Ensuring social distancing to reduce risk factors	84%		**76%**	81%	**91%**	**88%**	**91%**	**100%**
Limiting access to offices, project and constructions sites, and group meetings	68%		**57%**	67%	**76%**	**75%**	**73%**	**91%**
Focusing on meeting and project site hygiene	47%		**31%**	**42%**	**52%**	**58%**	**88%**	**91%**
Continuing onsite engagement (as permitted within travel policies)	45%		**33%**	43%	**51%**	**48%**	**76%**	**86%**
Implementing site restrictions	37%		**30%**	**33%**	**44%**	**43%**	**33%**	**68%**
Other	2%		1%	3%	2%	3%	6%	0%
None of the above	2%		5%	0%	0%	0%	0%	0%

Indicates significantly higher percentage

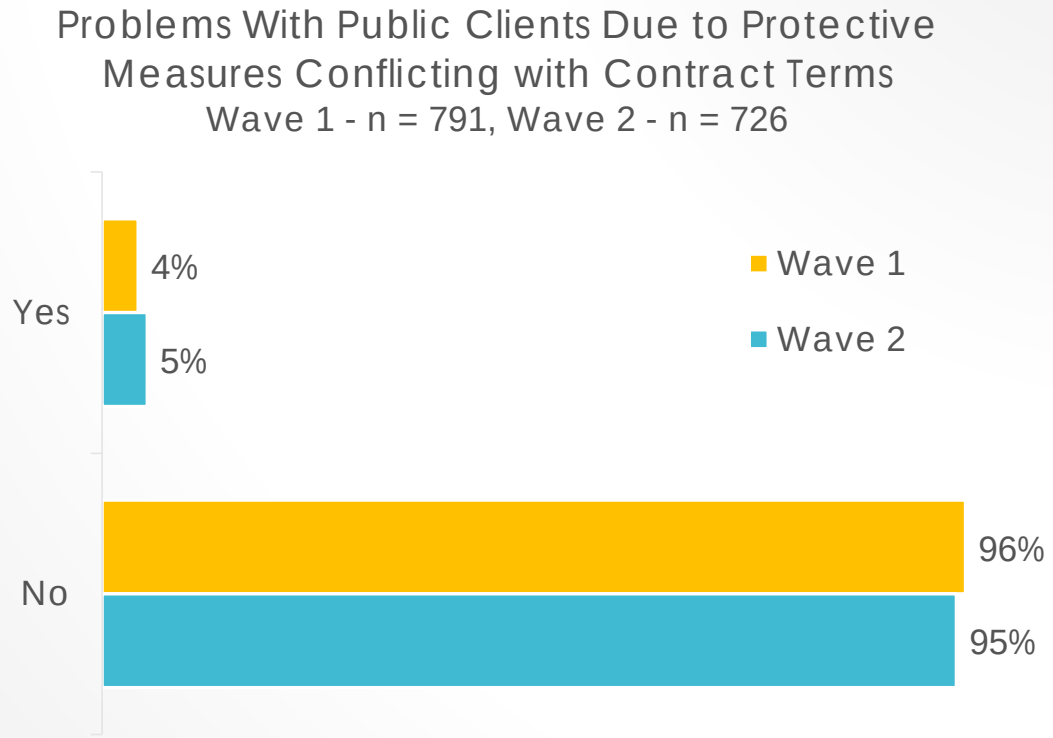
Indicates significantly lower percentage

Q6. In which of the following ways, if any, are you working with your client counterparts to ensure projects can be executed and work can continue? Select All That Apply

BUSINESS IMPACTS

SIMILAR TO WAVE 1, VERY FEW ORGANIZATIONS (5%) REPORT PROBLEMS WITH PUBLIC CLIENTS DUE TO PROTECTIVE MEASURES CONFLICTING WITH CONTRACT TERMS.

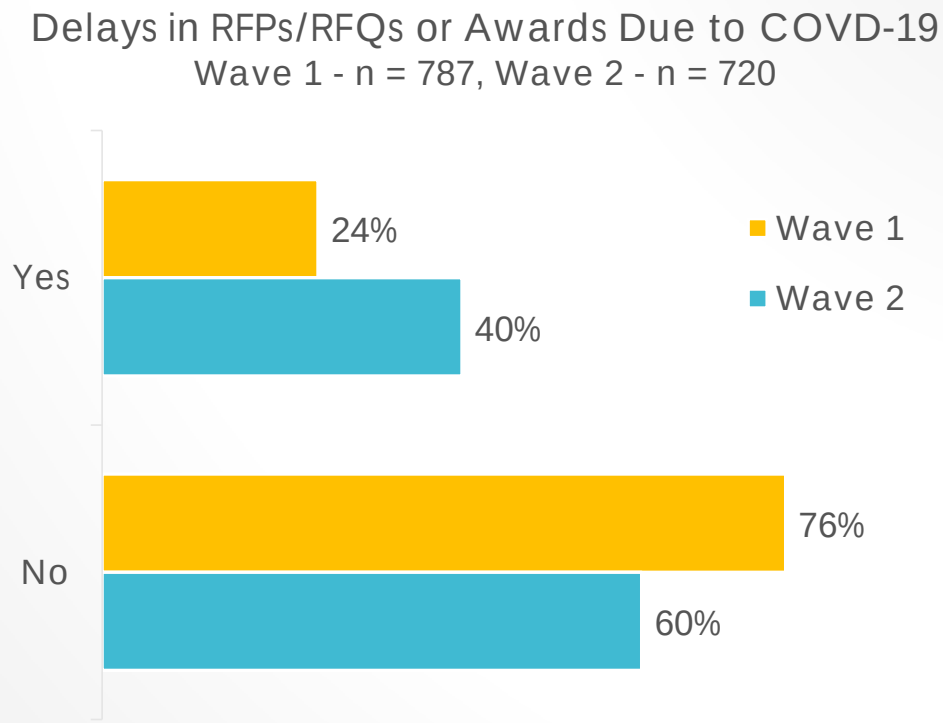
- Although percentages vary by firm size, the differences are not statistically significant:
  - 0 to 10 FTEs = 4% “Yes”
  - 11 to 25 FTEs = 5%
  - 26 to 50 FTEs = 4%
  - 51 to 200 FTEs = 8%
  - 201 to 500 FTEs = 0%
  - 501 or more FTEs = 5%



Q7. Has your company experienced problems with public clients when protective measures may conflict with contract terms?

BETWEEN WAVE 1 AND WAVE 2 THERE HAS BEEN A LARGE INCREASE IN THE PERCENTAGE OF FIRMS (24% UP TO 40%) REPORTING DELAYS IN RFPS/RFQS OR AWARDS DUE TO COVID-19.

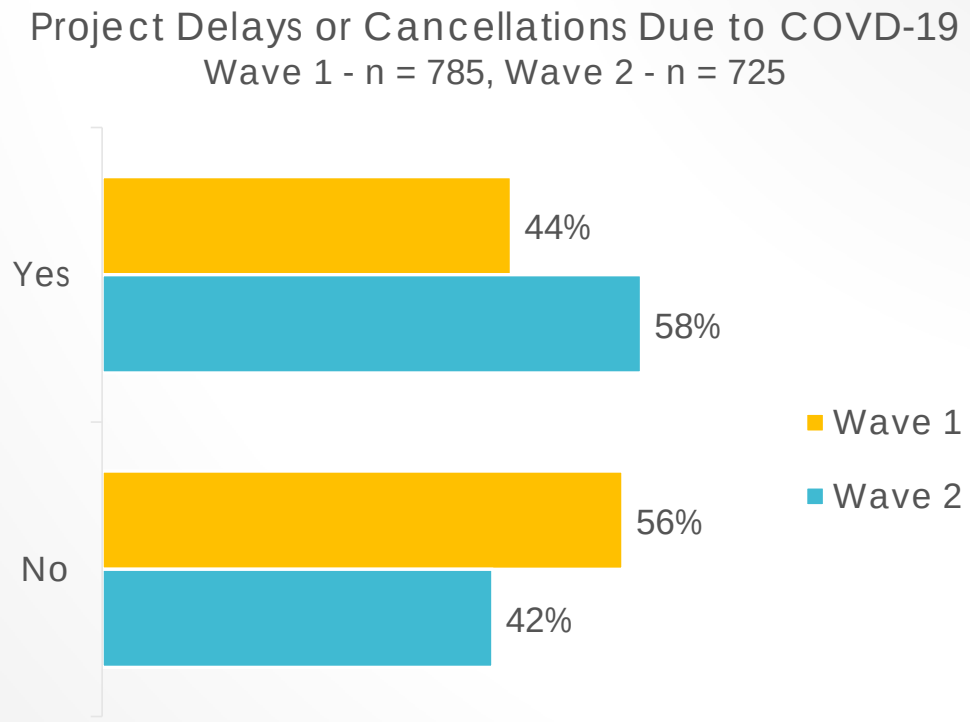
- As firm size increases, so too does the percentage of firms reporting delays:
  - 0 to 10 FTEs = 27% “Yes”
  - 11 to 25 FTEs = 36%
  - 26 to 50 FTEs = 45%
  - 51 to 200 FTEs = 48%
  - 201 to 500 FTEs = 61%
  - 501 or more FTEs = 73%
- The percentage of firms experiencing delays not only increased overall between the two waves, but also increased for each firm size group.



Q9. Is your firm experiencing delays in the issuance of RFPs/RFQs or awards as a result of COVID-19?

BETWEEN WAVE 1 AND WAVE 2 THERE HAS BEEN A LARGE INCREASE IN THE PERCENTAGE OF FIRMS (44% UP TO 58%) REPORTING PROJECT DELAYS OR CANCELLATIONS DUE TO COVID-19.

- As firm size increases, so too does the percentage of firms reporting delays/cancellations, with the exception of the largest firm size category:
  - 0 to 10 FTEs = 49% “Yes”
  - 11 to 25 FTEs = 55%
  - 26 to 50 FTEs = 59%
  - 51 to 200 FTEs = 67%
  - 201 to 500 FTEs = 91%
  - 501 or more FTEs = 68%
- The percentage of firms experiencing delays/cancellations not only increased overall between the two waves, but also increased for each firm size group, with the exception of the largest firm size category where it stayed about the same.



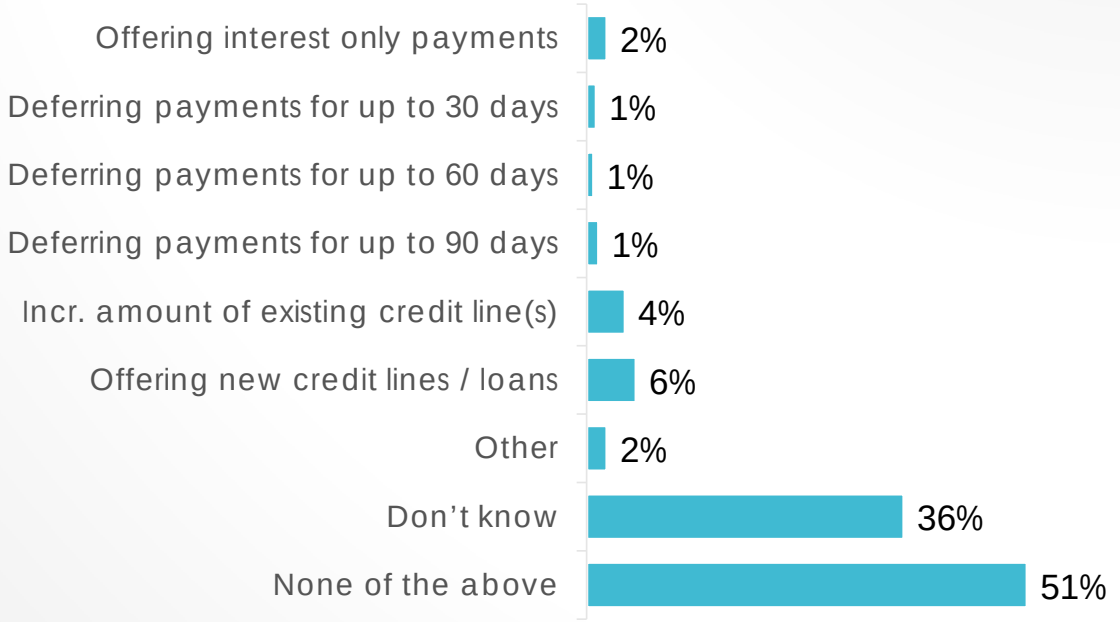
Q8. Is your firm experiencing project delays or cancellations as a result of COVID-19?

DESIRED CONGRESSIONAL ACTIONS

NEARLY 9 OUT OF 10 FIRMS (87%) REPORT RECEIVING NO ASSISTANCE FROM CREDITORS AT THIS TIME, OR AT LEAST ARE NOT AWARE OF ANY.

- As detailed on the following slide there are some statistically significant differences by firm size.
  - Firms with more than 500 FTEs are more likely to report receiving assistance of any kind.
  - Firms with between 51 and 500 FTEs are also more likely to report receiving assistance regarding increasing amounts of existing credit lines and offers of new credit lines.

Creditor Assistance Managing Financial Challenges*
Wave 2 - n = 721



Q10. Which of the following, if any, are your creditors doing to assist your organization with managing the financial challenges related to COVID-19? Select All That Apply

* Not asked in Wave 1

CREDITOR ASSISTANCE MANAGING FINANCIAL CHALLENGES BY FIRM SIZE (FTE)

	Total		0 to 10	11 to 25	26 to 50	51 to 200	201 to 500	501 or more
Offering interest only payments	2%		0%	2%	3%	3%	3%	**14%**
Deferring payments for up to 30 days	1%		1%	0%	2%	1%	0%	**9%**
Deferring payments for up to 60 days	1%		0%	1%	1%	1%	0%	**5%**
Deferring payments for up to 90 days	1%		1%	1%	2%	1%	3%	**5%**
Increasing the amount of your existing credit line(s)	4%		**0%**	2%	5%	**9%**	**16%**	**18%**
Offering new credit lines / loans	6%		**3%**	4%	7%	**9%**	**13%**	**9%**
Other	2%		1%	1%	2%	3%	**9%**	**14%**
Don't know	36%		**43%**	34%	33%	39%	**19%**	**14%**
None of the above	51%		50%	**57%**	53%	**42%**	53%	50%

Indicates significantly higher percentage

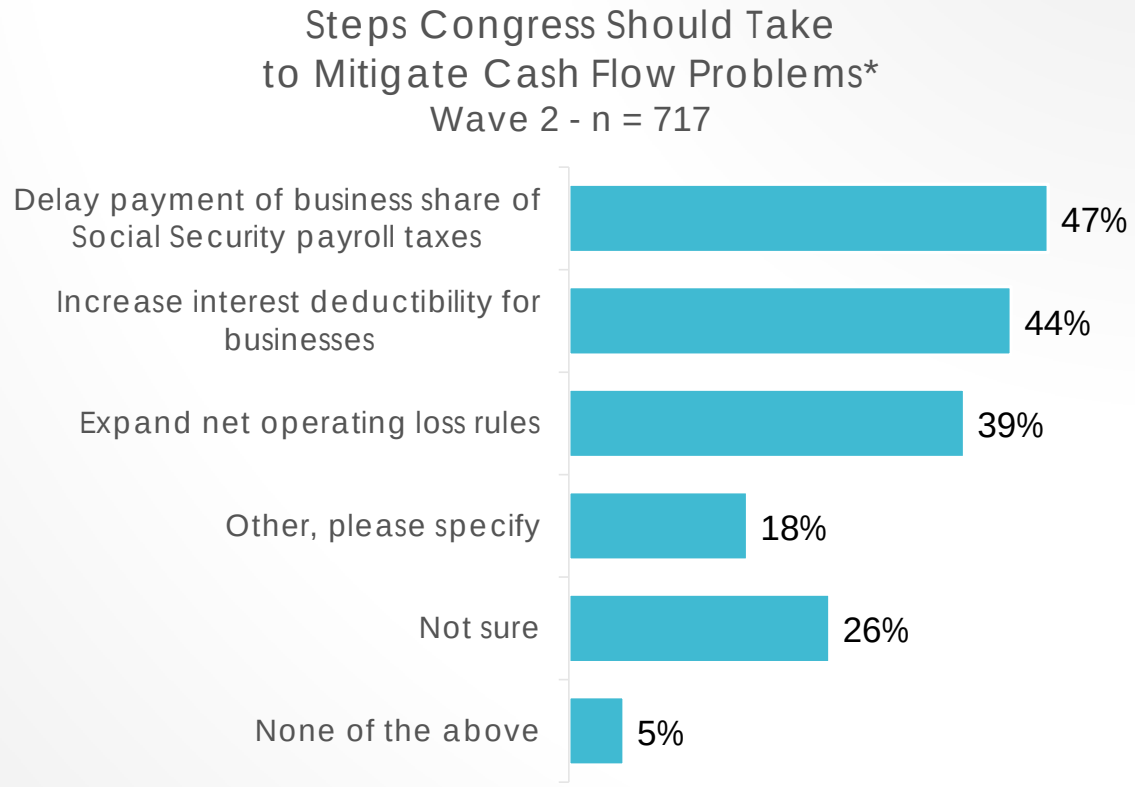
Indicates significantly lower percentage

Q10. Which of the following, if any, are your creditors doing to assist your organization with managing the financial challenges related to COVID-19? Select All That Apply

NEARLY HALF (47%) OF FIRMS BELIEVE CONGRESS SHOULD DELAY PAYMENT OF THE COMPANY'S SHARE OF SOCIAL SECURITY PAYROLL TAXES, WHILE NEARLY AS MANY FAVOR INCREASING INTEREST DEDUCTIBILITY FOR BUSINESSES (44%).

- As detailed on the following slide there are some statistically significant differences by firm size.
  - Firms that have between 51 and 200 FTEs and those with between 201 and 500 FTEs are more likely to favor all three options tested.
- There were a large number of "other" suggestions focused on the following areas (see next slide for a sample of verbatim comments):
  - No interest loans
  - Tax credits / deductions
  - Grants to cover payroll expenses
  - Direct payments / unemployment insurance for laid off employees

* Not asked in Wave 1



Q11. Congress has passed legislation to provide help to certain firms impacted by the costs of new family/medical leave requirements with refundable tax credits. What additional measures should Congress adopt to help mitigate against cash flow problems? Select All That Apply

SAMPLE VERBATIM COMMENTS REGARDING "OTHER" STEPS CONGRESS CAN TAKE TO MITIGATE CASH FLOW CHALLENGES:

No Interest Loans

"Zero to low interest loans for payroll purposes for small businesses that cannot absorb paid leave, sick, etc. for extended period of time and are having their projects put on hold because of the virus!."

"Provide interest free loans to small business to float for a year (30% of their revenue)."

Tax Credits/Deductions

"Allow deduction of salaries for employees in areas with mandatory shelter at home rules."

"Expand eligibility of refundable tax credits, as needed, with fewer restrictions."

Grants to Cover Payroll

"Make cash available immediately and easily to offset payroll and benefit costs to allow retention of staff."

"Provide grants to small businesses to continue paying staff."

Direct Payments / Unemployment to Employees

"Pay for employees if they get furloughed."

"Pay the affected staff directly."

"Make state unemployment insurance mandatory and immediate so we can furlough workers and not worry about them having some income."

STEPS CONGRESS SHOULD TAKE TO MITIGATE CASH FLOW PROBLEMS BY FIRM SIZE (FTE)

	Total		0 to 10	11 to 25	26 to 50	51 to 200	201 to 500	501 or more
Allow businesses to delay payment of their share of Social Security payroll taxes	47%		**39%**	46%	48%	**54%**	**70%**	50%
Increase interest deductibility for businesses	44%		**39%**	40%	44%	**50%**	**58%**	45%
Expand net operating loss rules	39%		37%	39%	**34%**	**46%**	**48%**	**27%**
Other	18%		14%	**22%**	18%	15%	**24%**	**23%**
Not sure	26%		**32%**	24%	24%	24%	**12%**	**18%**
None of the above	5%		7%	6%	4%	4%	3%	5%

Indicates significantly higher percentage

Indicates significantly lower percentage

Q11. Congress has passed legislation to provide help to certain firms impacted by the costs of new family/medical leave requirements with refundable tax credits. What additional measures should Congress adopt to help mitigate against cash flow problems? Select All That Apply

OTHER IMPACTS

WHEN ASKED TO DESCRIBE ANY OTHER BUSINESS ISSUES THAT ORGANIZATIONS ARE EXPERIENCING RELATED TO COVID-19 RESPONDENTS ANSWERS FELL INTO SEVERAL MAIN CATEGORIES:

- Loss of productivity / efficiency due majority of staff working from home.
- Challenges related with staff having varied Internet speed / efficiency / access.
- Challenges with distracted staff.
- Many report that projects which weren't already underway are being delayed. Anxiety expressed regarding any future work.
- Banks are inundated with requests; firms are uncertain of response time.
- Many commented that cash flow challenges are top of mind. There is uncertainty that clients will pay in a timely manner.
- Concerns about the timing of government assistance - will it be in time before my firm runs out of cash; will the process be "impossible?"
- Anxiety and concern over the economy.

METHODOLOGY – WAVE 1

- The Institute for Association and Nonprofit Research (IFANR) invited individuals from among the database list of member companies provided by the American Council of Engineering Companies (ACEC) to participate in this survey. One invitation was sent per member company.
  - Data collection occurred on March 17 and 18, 2020.
  - A total of 3,456 invitations were emailed, although 294 bounced and 17 opted-out, resulting in a total of 3,145 potential respondents.
  - Individuals who did not respond to the first email were sent one follow-up reminder.
  - In all, 794 individuals responded to the email invitations for an overall **response rate of 25%**.
- Individuals could respond using a laptop/desktop computer, tablet or smartphone; 12% of respondents completed the survey using a mobile device.
- Throughout the report for Wave 1 meaningful, statistically significant differences are noted by geographic region.

METHODOLOGY – WAVE 2

- The Institute for Association and Nonprofit Research (IFANR) invited individuals from among the database list of member companies provided by the American Council of Engineering Companies (ACEC) to participate in this survey. One invitation was sent per member company.
  - Data collection occurred on March 24 and 25, 2020.
  - A total of 3,438 invitations were emailed, although 298 bounced and 20 opted-out, resulting in a total of 3,120 potential respondents.
  - Individuals who did not respond to the first email were sent one follow-up reminder.
  - In all, 738 individuals responded to the email invitations for an overall **response rate of 24%**.
- Individuals could respond using a laptop/desktop computer, tablet or smartphone; 11% of respondents completed the survey using a mobile device.
- Throughout this report meaningful, statistically significant differences are noted by number of FTEs.

STATISTICAL NOTES

- Statistically significant differences are evaluated at a 95% confidence interval (for a description of tests used, please see the Appendix).
- There is no margin of sampling error as this was a census of all individuals in the ACEC database.
- Although every effort was taken to minimize survey bias, there is no way to completely eliminate all sources of potential bias. Sources of potential bias include, but are not limited to, the following:
  - Non-response bias
  - Confounding bias
  - Question wording bias
  - Question order bias
  - Habituation
  - Sponsor bias
  - Confirmation bias

APPENDIX

TESTS OF SIGNIFICANCE FOR MEANS

F-test
When the mean is displayed for a row variable, MarketSight first runs an Analysis of Variance (ANOVA) using an F-test. Doing so tests the hypothesis that the means of multiple normally distributed populations, all having the same variance, are equal.

MarketSight tests whether or not the row variable's means are equal to one another for all columns in the crosstab. Rejecting the test hypothesis implies that at least one of the column means is significantly different from the others.

Fisher's Least Significant Difference (LSD) test
If the statistics option to "Correct for Type I errors in all comparisons" is disabled, MarketSight will run Fisher's LSD test for both Pairwise tests and Contrast tests of means. MarketSight only runs Fisher's LSD test if the ANOVA F-test first rejects the null hypothesis that all column means are equal to one another.

Fisher's LSD test is a relatively powerful test because it uses the pooled variance estimate from the F-test, thus taking advantage of the increased sample size of all columns in the crosstab. Pooling the variance is valid because MarketSight explicitly tests for equality of variance among all columns prior to running the associated F-test.

Although the test is more powerful than either the Tukey HSD or Scheffé tests, it is more susceptible to Type I error when running multiple simultaneous tests.

TESTS OF SIGNIFICANCE FOR MEANS (CONT)

Scheffé test
If the statistics option to "Correct for Type I errors in all comparisons" is enabled, MarketSight will run the Scheffé test for Contrast tests of means. MarketSight only runs the Scheffé test if the ANOVA F-test first rejects the null hypothesis that all column means are equal to one another.

The Scheffé test is a conservative test for running multiple Contrast tests of Means which controls the overall Type I error rate for all possible contrasts based on the selected Confidence Level.

Tukey-Kramer tests
MarketSight will run Tukey-Kramer test for Pairwise tests of means. MarketSight only runs Tukey-Kramer test if the ANOVA F-test first rejects the null hypothesis that all column means are equal to one another.

Tukey-Kramer test is a conservative test for running multiple Pairwise comparisons of Means. It controls the overall Type I error rate across a number of related Pairwise tests based on the selected Confidence Level.

TESTS OF SIGNIFICANCE FOR PROPORTIONS

Chi-squared
When a Row Variable displays the Column % or Count option for individual Values, MarketSight runs a Chi-squared test. This test examines whether there is a relationship between the Column Variable(s) and the Row Variable.

Chi-squared tests involve a comparison of "actual" cell counts to "expected" cell counts in a crosstab.

The expected count for each cell is derived from a Row Variable's actual counts as follows: multiply the cell's row total by its column total, then divide by the sum total of all observations.

If the actual cell counts for one or more cells differ materially from their expected counts, the Chi-squared test may produce a statistically significant result which implies there is a relationship between the Column Variable(s) and the Row Variable.

A modified version of a Chi-Squared test is run for Multiple Response Variables.

TESTS OF SIGNIFICANCE FOR PROPORTIONS (CONT)

Fisher's Exact

For 2x2 crosstabs with small sample sizes, the Chi-squared test may be unreliable. Therefore, MarketSight runs an alternate test, Fisher's Exact Test, if more than 20% of the cells in a 2x2 crosstab have an expected cell count less than 5, or if any cells in a 2x2 cross-tab have an expected cell count less than 1.

Fisher's Exact Test calculates the true probability of observing a particular set of actual cell counts in a 2 x 2 crosstab, assuming that row and column totals are held constant.

Fisher's Exact Test is not run for Multiple Response Variables.

z-test

MarketSight runs Z-tests for both Contrast and Pairwise tests of Column Proportions. A Z-test is used to test for a difference between two column proportions. The column proportions involved in the test are the cell counts divided by their respective column totals.

A Z-test is only run when the cells being compared have actual counts greater or equal to 5 and the column sample size minus the actual cell counts is greater than or equal to 5. If these data sufficiency conditions are not met, MarketSight runs Fisher's Exact Test instead.

A modified version of a Z-test is run for Multiple Response Variables.

THANK YOU!

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