

2023 Annual Business Survey Content Cognitive Testing Findings & Recommendations

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The Census Bureau, Economic Reimbursable Surveys Division (ERD) & the National Center for Science and Engineering Statistics (NCSES) within the National Science Foundation

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Table of Contents

Table of Contents	2
Research Objectives	3
Research Methodology	4
Participants	5
Module One: Sustainability Management	6
Round 1	6
Round 2	8
Module Two: Innovation.....	10
Round 1	10
Round 2	11
Module Three: Technology Transfer.....	12
Round 1	12
Round 2	13
Module Four: Technology and Intellectual Property	15
Round 1	15
Round 2	16
Labor Related Questions & Miscellaneous	19
About the Data Collection Methodology and Research (DCMR) Branch.....	21
Appendix A: Round One Protocol	22
Appendix B: Sustainability Management Module (Round One).....	29
Appendix C: Innovation Module (Round One).....	40
Appendix D: Technology Transfer (Round One)	54
Appendix E: Technology and Intellectual Property Module (Round One).....	62
Appendix F: Round Two Protocol	75
Appendix G: Sustainability Management Module (Round Two)	83
Appendix H: Innovation Module (Round Two)	93
Appendix I: Technology Transfer (Round Two).....	109
Appendix J: Technology and Intellectual Property Module (Round Two)	117

Research Objectives

The Annual Business Survey (ABS) asks questions about the business owner(s) as well as various characteristics about the business. The 2023 ABS cognitive testing included new draft questions in five modules:

- **Sustainability Management** – addresses how the operation of a business is affected by demands from consumers, other businesses, and the government to meet the needs of present and future generations and the environment.
- **Technology and Intellectual Property** – collects information on intellectual property and technology use for the business.
- **Technology Transfer** – asks about the development, purchase, or exchange of technologies and /or intellectual properties.
- **Innovation** – asks if the business has introduced new or improved goods, services and business processes. These questions were previously tested during the 2019 ABS content cognitive testing. The current testing would focus on respondents; understanding of the time frame indicated in the questions.
- **Labor Related Questions** – seeks to determine opportunities for workers where there are unions vs non-unions and business owners experience with the unions.

These draft questions were discussed using cognitive interviewing. The objectives of these interviews were to learn how respondents:

- understand and interpret the data requests;
- understand the terminology used throughout the questions;
- keep records related to the data items; and,
- perceive the burden that would be associated with answering the questions.

Note: The two rounds of testing were conducted in close proximity, time-wise, from each other. Between the rounds of testing, some changes were made to the draft materials. This report will attempt to summarize findings from all interviews, but the primary focus will be on the findings from Round 2 of the interviews, and provides recommendations based on those draft questions.

Research Methodology

Between August and September 2022, researchers from the U.S. Census Bureau's Data Collection and Methodology Research Branch (DCRMB) conducted 28 cognitive interviews over two rounds of testing, regarding proposed new questions. Participants in the interviews were recruited from a list of recent respondents to the ABS.

Cognitive interviews were the testing methodology used for this project. Cognitive interviews are used to, '(a) understand the thought processes used to answer survey items, and (b) to use this knowledge to find better ways of constructing, formulating, and asking survey questions' (Forsyth and Lessler, 1991).¹ Cognitive interviews traditionally focus on the four steps of Tourangeau's (1984) cognitive response model: comprehension, retrieval, judgment, and communication/reporting.² Comprehension refers to the respondent's interpretation and understanding of the question's language, structure, and grammar. In order to answer the question, a respondent must understand what information is being requested on the survey. Retrieval is the step where relevant information is obtained, either from records or from memory. The next step, judgment, describes the respondent's evaluation of the completeness or relevance of the data obtained. It is here that estimates are made based on partial or incomplete data. The last step, communication or reporting, deals with mapping the response to the answer space provided and possibly altering the answer.

While Tourangeau's model is suitable for household and social surveys, the establishment survey setting presents additional factors that must be considered. First, instead of or in addition to a reliance on memory, establishment surveys rely heavily on records and the information contained within them. Second, organizations tend to have distributed knowledge. Some people are experts in one type of information, while others keep information about something else. Third, competing priorities, both for the organization and the individual(s) completing the questionnaire, mean that the survey sometimes does not receive the amount of attention that researchers and data collectors would like. Finally, organizations regularly authorize only a few individuals to release data. If the data provider is not authorized to release the data, an additional step must be added to the response process. Tourangeau's model was expanded by Sudman *et al* (2000) to account for these factors.³

In addition to moderated interviews, researchers conducted unmoderated testing, which ran concurrently with the interviews. The unmoderated testing was conducted via five web surveys. These five surveys corresponding to the five modules being tested. The web surveys consisted of the targeted draft questions, each of which were followed by multiple probes, some open-ended and some close-ended, selected and adapted from the moderated cognitive interview protocol.

¹ Forsyth, B.H. and Lessler, J.T. (1991). 'Cognitive Laboratory Methods: A Taxonomy.' In Measurement Errors in Surveys, P.P. Biemer, R.M. Groves, L.E. Lyberg, N.A. Mathiowitz, S. Sudman (eds). New York: John Wiley & Sons, Inc.

² Tourangeau, R. (1984). 'Cognitive Sciences and Survey Methods.' In Cognitive Aspects of Survey Methodology, T.B. Jabine, M.L. Straf, J.M. Tanur, and R. Tourangeau (eds). Washington, DC: National Academy Press.

³ Sudman, S., Willimack, D.K., Nichols, E., and Mesenbourg, T.L. (2000). 'Exploratory Research at the U.S. Census Bureau on the Survey Response Process in Large Companies.' Paper prepared for presentation at the Second International Conference on Establishment Surveys, Buffalo, NY.

Participants

Participants included sample members from the ABS who responded yes to one or more of the existing innovation or technology questions. Businesses were recruited from across the nation and include a range of sizes based on employee count and covered a variety of industries.

Table 1. Count of businesses by employee count and round for cognitive interviews.

	Rd 1	Rd 2	Total
1 to 19 employees	4	6	10
20 to 99 employees	3	7	10
100 to 2,499 employees	5	3	8
Total	12	16	28

Table 2. Count of businesses by employee count and round for unmoderated testing.

	Sustainability	Innovation	Technology Transfer	Technology and Intellectual Property	Labor Related Questions	Total
1 to 19 employees	19	15	15	3	25	75
20 to 99 employees	3	3	18	14	10	48
100 to 2,499 employees	4	3	3	11	3	24
Missing						5
Total	26	21	37	29	39	152

Module One: Sustainability Management

Round 1

There was a total of six interviews completed in round one for the Sustainability Management Module. After reading the introduction to this module, most respondents thought of ‘environmentally friendly’ or ‘climate change.’ Some respondents felt that this module was describing activities that they ‘should’ be doing, not just what they might be doing. Some of these respondents expressed some embarrassment that their companies were not doing the activities described in the questions, even when the activities were not particularly applicable to their business. Some respondent said they ‘felt bad’ or asked if they were ‘going to be cancelled’ after completing this module. Most respondents felt that this section would be quick to answer since most of the questions did not apply to them.

For round two, the sentence “All responses are anonymized and will only be used for statistical purposes.” was added to the end of the introduction to reassure respondents that the information they provided would not be used for enforcement purposes.

Question 1

Most respondents understood this question. Overall, respondents interpreted ‘business priority’ as an ‘overarching drive for decision making.’ Some respondents suggested other priorities that they may specify in other, including:

- Cyber security
- Automation
- Employee growth
- Market share

Question 2

Most respondents understood this question. A few respondents were confused about the difference between items A, “Attracting customers who make purchasing decisions based on sustainable business values,” and C, “Attracting customers who make purchasing decisions based on sustainable products.” For round two, these items were combined into a single item A, “Attracting customers who make purchasing decisions based on sustainable products or sustainable business values.”

Question 3

This question was not applicable to any respondents, but the respondents that read this question had no issues with it.

Question 4

Most respondents understood this question. Many respondents pointed out that they rent their buildings/offices and were unable to track items A, B, D, or E, even if they wanted to. Some were hesitant to choose ‘Source is not applicable,’ as they did use that source, but the information was inaccessible.

For round two, the fourth column of this grid was changed to include that the source of information was “inaccessible.”

Question 5

This question was not applicable to any respondents, but the respondents that read this question had no issues with it.

Question 6

This question was difficult for some respondents to understand. Many respondents read ‘value chain’ as ‘supply chain.’ However, respondents that read the italicized examples felt that they understood what was being asked. In fact, many respondents noted that the examples were helpful. In addition to the phrase ‘value chain,’ none of the respondents were familiar with the terms ‘scope 3’ or ‘carbon hotspots.’

For round two, the definition of value chain was incorporated into the question. The phrase ‘value chain’ was moved to the example.

Question 7

Most respondents understood this question. Some respondents stated that ‘lack of financial resources’ could be added to the answer choices. For round two, item D, “The company lacks financial resources.” was added to this question.

Question 8

This question was not applicable to any respondents, but the respondents that read this question had no issues with it.

Question 9

This question was not applicable to any respondents, but the respondents that read this question had no issues with it.

Question 10

Most respondents understood this question. However, most respondents found item D unclear. For round two the examples “providing funds for reforestation or capping abandoned oil wells” was added to item D.

Questions 11 – 12

These questions were not applicable to any respondents, but the respondents that read these questions had no issues with them.

Question 13

This question was not applicable to any respondents, but the respondents that read this question had no issues with it. One respondent suggested ‘not being able to procure materials that are no longer being made’ as a potential missing item.

Question 14

Most respondents understood this question. Some respondents wanted a ‘Not Applicable’ column as many of these investments were simply not possible or useful for all businesses. A few respondents had difficulty discerning the difference between items E and G. Most respondents did not understand item F.

These respondents thought that item F was referring to recycling were not familiar with the concept of 'circular economy.'

For round two, a 'Not Applicable' was added as a third column. Item G was moved to follow item E. Item F, now item G was unchanged, however, item H, "Recycling initiatives going beyond municipal mandates," was added to catch respondents that wanted to report recycling.

Question 15 – 16

These questions were not applicable to any respondents, but the respondents that read these questions had no issues with them.

Question 17

Most respondents were unfamiliar with specific environmental certifications or standards. One respondent asked if 'Conflict Mineral Statements' were applicable to this question.

Question 18 – 19

These questions were not applicable to any respondents, but the respondents that read these questions had no issues with them.

Question 20

Most respondents understood this question. Some respondents noted that their companies did make investments to mitigate risk, however, those risks were not weather related.

Question 21

This question was not applicable to any respondents, but the respondents that read this question had no issues with it.

Round 2

There was a total of eight interviews completed in round two for the Sustainability Management Module. Overall, respondents this round were less concerned about their answers being used for regulatory purposes. Fewer respondents seemed to feel guilty for their companies' lack of environmental initiatives.

Some respondents thought of sustainability and this module from a business standpoint as opposed to an environmental standpoint:

- "What are their priorities for the future, what problems they are preparing for, what they can do to improve..."
- "This is oriented toward keeping business sustainable, maintaining business under certain circumstances. At first, I was thinking ecological, environmentally sustainable."
- "Stuff about the environment, energy usage, alliances, investing in team members, tech investments."

Recommendation: none needed.

Question 1

Most respondents understood this question. Some respondents defined ‘business priority’ as:

- “Is the organization making a specific attempt to address this? Organizational strategies. Corporate initiative.”
- “Most important goal or aspect.”

Some respondent suggested adding these items:

- Reducing costs
- Training, hiring, developing talent
- Improvements to corporate culture

Recommendation: none needed.

Question 2

Most respondents understood this question.

Recommendation: none needed.

Question 3

Most respondents understood this question. Some respondents mentioned these potential missing items:

- Costs savings or reductions
- Profitability

One respondent defined ‘realized’ as “tangible results - revenues, new customers.”

Recommendation: none needed.

Question 4 – 5

Most respondents understood these questions.

Recommendation: none needed.

Question 6

Most respondents understood this question now that the wording has been rearranged. Respondents noted that the examples were helpful.

Recommendation: none needed.

Question 7 – 12

Most respondents understood these questions.

Recommendation: none needed.

Question 13

Most respondents understood this question. Some respondents mentioned the following potential missing items:

- Lack of competitiveness
- Difficulty with vendors/suppliers (kind of like reputation)
- Unseen costs/losses due to not improving

Recommendation: none needed.

Question 14

Most respondents understood this question. A few respondents were still unsure of the meaning of item G:

- “Either reusing items in production that have already been used, or buying secondhand? Never heard of circular economy.”
- “Take waste materials and reuse them in manufacturing, use for biproducts.”

Recommendation:

Emphasize product reuse/repurposing in item G.

Question 15 – 21

Most respondents understood these questions.

Recommendation: none needed.

Module Two: Innovation

Round 1

There was a total of six interviews completed in round one for the Innovation Module. A few respondents had a negative reaction to this module as they remembered answering this module when responding to the ABS. These respondents cited confusion over the definition of innovation and the difference between new to market and new to business. Overall, the respondents noticed the three year timeframe.

Question C1

Most respondents remembered and understood this question. One respondent asked if products that were purchased to be sold to customers counted as innovations.

Question C2

Most respondents remembered and understood this question. One respondent asked if improved service contracts counted as innovations.

Question C3

Most respondents remembered this question, but some had difficulty understanding the difference between ‘new to market’ and ‘new only to this business.’ When asked if combining question C3 with questions C1 and C2 would make the distinction clearer, most respondents said yes.

For round two, the answer choices for questions C1 and C2 were altered to incorporate question C3.

Questions C4 – C19

As this module has been tested in past years, these questions were largely skipped for time.

Question C20

Most respondents understood the intent of the question. Most respondents did note the similarity with the Sustainability Management Module, though some of these respondents noted that moving this question would mean that the definition of innovation would need to be repeated. However, if the Sustainability Management Module followed the innovation, it may not be necessary to repeat the innovation definition.

Some respondents were confused by the phrase ‘great deal,’ as the meaning could be subjective. Some of these respondents suggested using the word ‘significant.’ One respondent asked, “What if the company had been doing these activities to a small degree for a long period of time? What if they only increased the degree of which they were performing the activity?”

Question C21

Most respondents understood this question.

Round 2

There was a total of eight interviews completed in round two for the Innovation Module.

Question C1 – C2

Overall, respondents seemed to understand these questions and were able to differentiate between the two ‘yes’ categories: “I had to read through the ‘yes’ choices, the bolding helps. In general, it makes sense, it’s just wordy. Completely new to the market, or did you adapt something that already existed to be competitive.”

Respondents do seem to notice the three-year timeframe.

Recommendation:

Consider modifying the production survey with the tested revisions in the future.

Question C19 (formerly C20)

Most respondents understood this question. Some respondents gave examples of ‘extent:’

- “Noticeable cost savings/reduction, saving paper. Spending the time to make changes.”
- “Like the CEO is making public announcements that this is the direction vs. directives that might not be public info.”
- “Great extent is to the maximum/largest percentage.”

It was suggested to change ‘extent’ to ‘reduced’ for the items about reduction, i.e. ‘greatly reduced,’ ‘somewhat reduced,’ or ‘not reduced.’ This may work for items A, B, and C in part one and items A and B in part 2, but this would not work for all items.

A few respondents felt that this question better belonged in the Sustainability Management Module: “Maybe better in sustainability. Seems to go better with that because innovations are not a big part of the question.”

Recommendation:

- The question may better belong in the Sustainability Management Module. If the question is moved the sustainability module should follow the innovation module.
- The question could also be reworded slightly:
‘During the three years 2020 to 2022, did your enterprise introduce innovations to this business’ goods, services, or processes with any of the following environmental benefits, and, if yes, was the extent of that contribution a great deal or not?’

Module Three: Technology Transfer

Round 1

There was a total of six interviews completed in round one for the Technology Transfer Module. Most respondents noted that they would have to reach out to other within their companies about intellectual property (IP). This module was tested along with the Technology and Intellectual Property Module. Most respondents felt that having this module separate from the other technology module was appropriate.

Question 1

This question was mostly skipped for time. Respondents that did read this question understood it.

Question 2

Most respondents understood the question, however, it would be difficult for most respondents to provide an exact figure and would likely provide an estimated number.

Question 3

Most respondents understood the question. Most respondents did not use formal means of IP protection.

Question 4

Most respondents understood the question. Some respondents mentioned non-disclosure agreements. Some respondents felt that branding belonged in question 3.

Question 5 – 6

Most respondents understood the question.

Question 7

Most respondents understood the question. However, most respondents did not know what an ‘unaffiliated company’ was. Some respondents gave the following definitions of ‘unaffiliated companies:’

- “No financial ties, not customer or vendor.”
- “No relationship, don’t know who they are.”
- “Company outside of the business’s main industry”

Some respondents were not sure how to report patents held by an international subsidiary.

For round two, the term ‘unaffiliated companies’ was changed to ‘companies that are not affiliated.’

Question 8

Most respondents understood this question. One respondent asked: “Does it count if the collaborative activities are done through a professional association/society?”

Question 9 – 10

These questions were not applicable to most respondents, however, most respondents did understand the questions.

Question 11

Most respondents understood this question. One respondent asked: “Do donations to nonprofits count as collaboration?”

Round 2

There was a total of eight interviews completed in round two for the Technology Transfer Module. Some respondents noted that this module seemed to be more geared towards manufacturing companies.

Questions 1 – 2

These questions were largely skipped for time.

Question 3

Most respondents understood this question. Most respondents did not utilize formal means of IP protection. However, most respondents stated that the question was clear and straightforward. When asked if any categories were missing, some respondents mentioned non-disclosure agreements (NDAs). These respondents had not yet seen question 4. Some respondents mentioned that patents were too expensive to maintain. Other suggested IP protection:

- Warnings and disclosures
- USB dongle to protect software
- Disclaimer in employee manual not to steal IP

- Manufacturing agreements

Recommendation: See recommendation for Q4.

Question 4

Most respondents understood this question. Most respondents did use some form of informal IP protection. Respondents found the question itself to be clear and straightforward. Some respondents felt that NDAs were formal IP protection as they could be used in court. “NDAs should be formal, if violated you’re in trouble. We take them very seriously.”

Some respondents, particularly manufacturers, noted that they were sometimes made to sign NDAs when producing products for other companies. Some of these respondents were unsure if they should say ‘yes’ to NDAs if they signed them for other companies. Ultimately, most of these respondents answered ‘no.’ “Would say no to all. If we’re dealing with a customer, we may have an NDA because the customer does not want their info disclosed.”

A few respondents noted that their products were complex in design but were not designed purposely to obfuscate.

Recommendations:

- Combine Q3 and Q4.
- Drop the ‘Formal’ vs ‘Informal’ labels.

Questions 5 – 6

Most respondents understood these questions. Some respondents stated that they would likely reach out to someone else in their companies, such as an attorney, to obtain these numbers.

Recommendation: none needed.

Question 7

Most respondents understood this question. Most respondents did not report partaking in these activities. “Is this something where we’re paying for or something we’re trying to get paid for? Both ways?”

Most respondents still did not fully understand what was meant by ‘companies that are not affiliated.’ A few respondents did understand the phrase ‘companies that are not affiliated.’

- “It would be a company they have no relationship with. Not a parent or subsidiary.”
- We have some system integrators that sell our software. Do they count? You need to say something about ownership.”
- “Completely unrelated, separate. Affiliated would be subsidiary, parent, or sibling.”
- “No legal ownership connection or prior agreements, no real business relationship.”

One respondent asked, “Does item C include sharing technical drawings as part of a business agreement?”

Recommendation:

- Add definition of ‘unaffiliated companies’ beneath the question, not as a hyperlink.

Question 8

Most respondents understood this question. Only a few respondents reported collaborating with universities. Some respondents mentioned selling products to universities but did not consider that to be a collaboration activity. One respondent asked, “Does hiring an intern count?” Another respondent asked, “Does allowing the university to borrow equipment for an experiment count?”

Recommendation: none needed.

Question 9

Most respondents understood this question. Almost none of the respondents reported collaboration activities with government laboratories. One respondent asked, “Does producing items based on government IP for a government agency count as collaborating with a laboratory?” Some respondents mentioned selling products to the government but did not consider that to be a collaboration activity.

Recommendation: none needed.

Question 10

Most respondents understood this question. Almost none of the respondents reported collaboration activities with government laboratories, thus did not feel that this question was relevant.

Recommendation: none needed.

Question 11

Most respondents understood this question. None of the respondents reported collaboration activities with nonprofits. Donating to nonprofits did not come up in round 2 interviews.

Recommendation: none needed.

Module Four: Technology and Intellectual Property

Round 1

There was a total of six interviews completed in round one for the Technology and Intellectual Property Module. After reading the definitions, some respondents pointed out that robots have specialized software and that the overlap was confusing.

E3 Part One

Most respondents understood this question. Some respondent pointed out that there was no way to say a technology was both tested and put into practice.

E3 Part Two

Most respondents did not understand this question. Most respondents did not know what the denominator, or ‘total costs,’ should be.

E4, E8, E12, E16, or E20

Most respondents understood these questions. Most respondents felt that they could provide an approximate year, few felt they would need ranges.

E5, E9, E13, E17, or E21

Most respondents understood these questions. However, these questions were not applicable for most respondents.

E6, E10, E14, E18, or E22

Most respondents understood these questions.

E7, E11, E15, E19, or E23

Most respondents understood these questions. Some respondents noted that this question can difficult as there is high turnover for production workers in manufacturing. Most of these respondents would probably just state no change.

E24

Most respondents understood this question.

E25

Most respondents understood this question. Some respondents stated that this question seems out of place since it is asking about selling products.

Round 2

There was a total of eight interviews completed in round two for the Technology and Intellectual Property Module. Many respondents pointed out issues with the definitions of the various technologies, some examples include:

- Artificial Intelligence (AI):
 - “Pretty broad, people might not know they are using AI. Using google to search through photos is AI. It’s more helpful to have specific examples to keep from missing people that don’t know. It’s much more likely for software developers; they would better understand, not average people. If you know that what you are using is AI, you can answer.”
- Cloud Computing:
 - “All email is cloud -based, does that count? If not should exclude it.”
 - “Does webhosting for a website count?”
- Specialized Software:
 - “It’s weird to ask about software when the company does not do any software. Should have those questions separate so companies that have nothing to do with that can skip

them. There should be a fork for software and manufacturing companies. It feels hard to answer correctly when questions assume you do that.”

Many respondents had difficulty distinguishing between robots and specialized equipment.

- “I’m not sure if everyone would consider a programmable router as a robot. Specialized equipment does not use a computer to program the movements like special jigs. Robots are computer controlled. Specialized equipment’s “task-specific” is more clear.” This respondent also mentioned adding ‘CNC’ to the robotic definition as an example would make it clearer.
- “No robotics, we do have [specific task] machines. They’re not high tech enough to be specialized equipment. You may need to be more specific about what specialized means.”
- “Thought they were clear, but I got to robotics and specialized equipment. We have robotic [machine]; we program the position of the arm and other parameters that it uses. It’s not really multipurpose. It just [performs task] how it has been programmed. I’m not really sure if it’s a robot or specialized equipment, would probably go with specialized equipment.”
- In regard to specialized equipment: “I cannot visualize what that is besides robotics. It’s basically another definition of robotics ... We worked with an engineering company to create a machine to [perform specific task]. So which are they? I would say robots ... They are also re-programmable.”

Recommendations:

- Put emphasis on the difference between robotics and specialized equipment.
- Add examples to definitions.

E3 Part One:

Most respondents understood this question. One respondent pointed out that some companies may not know what technologies are applicable to their business: “It is hard to know if AI could be applicable. Like if you were a farmer, you might say ‘no,’ but they might not realize that some of their tractor functions are AI based on sensors. It’s so integrated. The farmer probably does not think of it as AI, or actively looks for it when purchasing equipment. More just looking at the functions, not what powers the functions. But a software, or tech-based company, might seek out AI specifically.” In regard to cloud-based computing: “Again, people may not realize they are using something cloud-based: Google docs, email, applications with subscriptions... The person filling out this survey should have a sense of that, but it’s pretty hard to differentiate between various subscriptions. Does it matter where you are digitally storing something? It might be of interest if something is wrong with the cloud.”

Recommendation: none needed.

E3 Part Two:

Most respondents had difficulty understanding this question. Particularly, respondents were unsure what was meant by ‘total costs.’

- “Would be hard to breakout. How much of the [product] cost is for the AI? Even a software company, is it a module, the cost of a module? If you are not paying directly for the

development, it is hard to pinpoint a cost. And you don't just go out and buy an AI box. You buy equipment that happens to have AI and how do you calculate that cost percentage? It does make it hard to take the survey seriously. Just out of left field."

- In regard to robotics: "Hard number to put finger on. Aside from the initial purchase, what is the actual yearly cost? Maintenance, parts? Maybe more informative to find out about depreciation. Do people understand the benefits they are accruing by using this equipment? What if you job out the project to an outside vendor that is using robotics? The survey does not capture this. We probably would know the vendor was using robotics because that's why we would choose the vendor. You outsource because you know the other person has the tech that you cannot justify purchasing."
- "Are you asking about total cost for the part, or total costs on income statement? Probably total costs on income statement."
- "Overall expenses. Are you looking for costs of goods sold or admin expenses? I would use both."
- "I'm not sure what that's asking. Percentage of total spend? Total business costs?"

Some respondents stated that they were not sure how to quantify the cost of the technology itself:

- "This would be hard for the total company. Would be looking at the cost of QuickBooks and the IT guy."
- "Probably for welders, I would gather up how much wire they use, and depreciation, compared to overall expenses."

Most respondents did not understand the point of choosing between low, medium, and high percentages. Some of these respondents pointed out that the answer should almost always be 'low' as that was the point of these technologies. Labors costs were always the highest.

Recommendation:

- Consider dropping the question as it is frustrating to the respondents and unlikely to yield meaningful results.

E4, E8, E12, E16, or E20:

Respondents understood these questions. Most respondents preferred choosing from the ranges.

Recommendation:

- Keep the ranges.

E5, E9, E13, E17, or E21:

Most respondents understood these questions. Some respondents provided suggestions for items:

- In regard to cloud computing: “...multi-user access is very important ... Distributed file sharing, editing, access, synchronous working, autosaving.”
- “Safety is another reason ... New business opportunity.”

Asking why respondents had adopted or used a technology during the 2020 – 2022 timeframe when the previous question establishes the year in which a technology was adopted was confusing to a few respondents. Regarding robotics: “Kind of confusing, you asked about when we first adopted, then the next question is why we adopted it in 2020 – 2022. We have added more since then, so was I thinking about later additions vs the first adoptions.”

Recommendation:

- Reconsider the timeframe of these questions. Would it make more sense to ask about why the respondents adopted and use the technology from the point of adoption?

E6, E10, E14, E18, or E22:

Respondents understood these questions. Nearly all respondents reported no change due to the use of specific technologies.

Recommendation: none needed.

E7, E11, E15, E19, or E23:

Respondents understood these questions. Nearly all respondents reported no change due to the use of specific technologies.

Recommendation: none needed.

E24:

Most respondents understood this question. Most respondents reported no change to their business’ automation. Most respondents reported making no changes in their automation due to the COVID-19 Pandemic, “This year’s survey was cumbersome, very time consuming. Felt repetitive and being this far from covid it’s harder to remember what was due to covid and what was due to government mandate. It didn’t feel like it gave an accurate picture.”

Recommendation: none needed.

Labor Related Questions

These questions were only tested with the unmoderated instrument. A total of 39 respondents completed the unmoderated testing for these questions.

Question 1

All respondents answered, 'No collective bargaining agreements present at your business.' Note that the majority of the respondents were from smaller companies. All of the respondents indicated that the question was easy to answer. None of the respondents had comments for this question.

Question 2

All respondents answered, 'No.' Note that the majority of the respondents were from smaller companies. All of the respondents indicated that the question was easy to answer. None of the respondents had comments for this question.

Question 3

All respondents answered, 'No.' Note that the majority of the respondents were from smaller companies. All of the respondents indicated that the question was easy to answer. None of the respondents had comments for this question.

Limitations:

This testing was conducted via online survey and was unmoderated. Most of the respondents that participated were from smaller companies. None of the respondents' companies had employees covered by a labor union. As such, there is no indication of level of burden a respondent would experience in estimating the percentage of employees covered by a union.

About the Data Collection Methodology and Research (DCMR) Branch

The Data Collection Methodology and Research (DCMR) Branch in the Economic Statistical Methods Division assists economic survey program areas and other governmental agencies with research associated with the behavioral aspects of survey response and data collection. The mission of DCMR is to improve data quality in surveys while reducing survey nonresponse and respondent burden. This mission is achieved by:

- Conducting expert reviews, cognitive pretesting, site visits and usability testing, along with post-collection evaluation methods, to assess the effectiveness and efficiency of the data collection instruments and associated materials;
- Conducting early stage scoping interviews to assist with the development of survey content (concepts, specifications, question wording and instructions, etc.) by getting early feedback on it from respondents;
- Assisting program areas with the development and use of nonresponse reduction methods and contact strategies;
- And conducting empirical research to help better understand behavioral aspects of survey response, with the aim of identifying areas for further improvement as well as evaluating the effectiveness of qualitative research.

For more information on how DCMR can assist your economic survey program area or agency, please visit the [DCMR intranet site](#) or contact the branch chief, [Amy Anderson Riemer](#).

Appendix A: Round One Protocol

2023 ABS Content Testing

Protocol

Aryn Hernandez

Krysten Mesner

General Research Questions:

- Do respondents understand what information they were asked to provide with this question?
- Do respondents understand the terminology used in the question?
- Are respondents able to answer the question that is being asked?
- Is the question layout clear and understandable?
- Is the requested information available in respondent's records?
- Are the lists/categories organized effectively?
- Are the instructions helpful to respondents?

Informed Consent: Respondents will be asked to complete a consent form electronically before the time of the interview.

Materials Needed:

- Electronically signed consent form
- Copy of questionnaire

Introduction

- Introduce everyone on the call
- Thank respondent for completing the survey
- Brief overview of why survey exists and role of NSF and Census
 - The Annual Business Survey (ABS) is conducted jointly by the U.S. Census Bureau and the National Center for Science and Engineering Statistics within the National Science Foundation. ABS provides information on selected economic and demographic characteristics for businesses and business owners. Additionally, the survey measures research and development, innovation and technology, as well as other business characteristics
- Tell respondent why we asked to speak with them
 - Suggestions for improvement
 - Refine questions and make them easier to answer

Recording the interview

- As mentioned in the consent form that you signed, we would like to record this interview so that we have an accurate record of your feedback. We plan to use your feedback to improve the

design and layout of the form for future data collections. Only staff involved in this data collection will have access to the recording. Would that be ok? If respondent says no, move on.

About the Respondent

- Can you tell us a little bit about your business -- what types of goods or services does this business provide?
- What is your role in the company? What kind of responsibilities do you have?

General probes that may be used for any question or module throughout the interview:

- In your own words, what is this question asking?
- Reflect back on respondent's answer: "you said..."
- How did you arrive at this number/answer this question?
- What records (if any) would you look at?
- Specifically, what would you include in this answer? What would you exclude?
- Would you consult other people to obtain this answer?
- How easy or difficult is it to answer this question?

Additional Probes Specific to Modules and Questions

Sustainability Management Module

Throughout this module, remain neutral on climate change, but note if the R has strong opinions or objections to these questions.

Intro:

- Please take a minute to read the introduction above the first question.
- What sort of questions are you expecting to see in this module?
- What does sustainability mean to you?
 - In relation to your company? Can you give me some examples?

Questions:

1. How would you define 'business priority' in the context of this question?
 - a. Do all of the items make sense, are there any you are unfamiliar with?
 - b. Would you put anything under other?
 - c. When thinking about how you would answer this question, were you thinking about the time frame from 2020 to 2022?
2. *Note how respondents react to item C, as it is similar to item A.*
 - a. How would you determine importance?
 - b. Do you have any thoughts about the answer categories/column headers?
 - c. Do all of the items make sense, are there any you are unfamiliar with?
 - d. Would you put anything under other?

3. What does ‘realized’ mean to you in the context of this question?
 - a. *If ‘realized’ is confusing:* is there another term or phrase that would make more sense here?
 - b. Do you think anything is missing with the response categories?
 - c. Do all of the items make sense, are any there any you are unfamiliar with?
 - d. Would you put anything under other?
4. *Note how respondents react to column headers and if there is any confusion. Note that item E is mainly relevant to manufacturing.*
 - a. *If R answers yes to any items:* Can you give me examples of what you track and how you track it?
 - b. Do you have any outside or consulting companies track these for you?
 - c. Do you have any thoughts about the answer categories/column headers?
 - d. Do all of the items make sense, are there any you are unfamiliar with?
 - i. Is the possible double counting of 4a. and 4b. with 4d. (HVAC) confusing?
5. *If R answers yes:* Can you give me examples or the name of the software you use?
6. *If R answers yes:* Can you give some examples of what your company tracks?
 - a. *If R answers limited tracking and estimates:* Can you tell me more about that?
 - i. Can you give me examples of the types of tracking or evaluation your company is doing?
 - b.
 - c. What does ‘value chain’ mean to you? Can you give me any examples that could be relevant to your company?
 - d. What about ‘major carbon hotspots’?
 - e. Are you familiar with the term ‘Scope 3’?
 - f. Do you find the text in parentheses and what is in italics helpful or unhelpful?
7. How do you define ‘value chains’?
 - a. What does this term mean to you in the context of this question?
 - b. Do all of the items make sense, are there any you are unfamiliar with?
 - c. Are there any other challenges that are missing from our list?
8. *If R answers yes:* can you tell me more about that? Can you give me any examples?
 - a. How do you define “develop a plan”?
9. *If R answers yes:* can you tell me more about that? Can you give me any examples?
10. Do all of the items make sense, are there any you are unfamiliar with?
 - a. Particularly, can you tell me what item D is asking in your own words?
 - b. Are there any other strategies that are missing from our list?
 - c. When answering this question, what time frame were you thinking about?
11. *Note if R has difficulty in choosing an answer category. Note if R asks if the target date pertains to only Scope 1 & 2 or to Scope 1, 2 & 3.*
 - a. Do these answer categories make sense to you, or are they confusing?
12. *Note if R mentions negative carbon emissions (highly unlikely). Note if R asks if the target goal pertains to only Scope 1 & 2 or to Scope 1, 2 & 3.*
 - a. Do these answer categories make sense to you, or are they confusing?

13. Do all of the items make sense, are there any you are unfamiliar with?
 - a. Are there any other effects that are missing from our list?
 14. *If R answers yes to any items, ask for examples.*
 - a. Do all of the items make sense, are there any you are unfamiliar with?
 - b. Are there any other activities that are missing from our list?
 15. *Starting from question 15, the questions may be redundant, note if R mentions it.*
 - a. What do 'strategic objectives' mean to you in context of this question?
 - b. *If R answers yes:* Can you give me any examples?
 16. General probes
 17. *If R answers yes to any items, ask for examples.*
 18. *If R answers yes:* can you give me any examples?
 - a. When answering this question, what time period were you thinking of?
 19. Were the includes helpful or unhelpful?
 - a. *If R answers yes:* can you give me any examples?
 - b. When answering this question, what time period were you thinking of?
 20. *If R answers yes:* can you give me any examples?
 - a. When answering this question, what time period were you thinking of?
 21. *After general probes, and if it was not obvious:* When answering this question, what time period were you thinking of?
- Having gone through this entire section, about how long do you think it would take you to complete?
 - Would you be able fill out this section, or would you need help from someone else in your company fill it out?

Innovation Module

We are primarily interested in how Rs handle the 3 year reference period.

C1 - C2:

- *Note if R notices the three year time period, if not:* When answering this question, what time period were you thinking of?
- How easy or difficult is it to recall innovations made in the last three years?
- Is this a question you would refer to records or another person to answer, or would you answer from memory?
- Would you answer the questions differently if you were only asked about one year?

C3: General probes

C4: *Note if R notices the change of reference period to 1 year.*

- When answering this question, what time period were you thinking of?

C5: *Note if R has any difficulty with the reference period and date mentioned.*

- Do the answer choices make sense, or are there any you are unfamiliar with?

C6: Do the answer choices make sense, or are there any you are unfamiliar with?

C7: Make sure R's response is consistent with C4.

- What good and service were you thinking about when answering this question?
- What makes that the 'most important?'
- *Make note of any difficulty choosing the most important. Find out if it because there are two things that are equally important or if something else is making it difficult.*

C8 – C9: Note any issues with the reference period shift as well as any difficulty in providing a percentage on C8? Did the R struggle calculate it?

Also, did R need any clarification on the response categories on C9?

C10: General probes

C11:

- Please read this question and answer items A and D.
- *If the R answers yes to either:* Could you give me some examples?
- *Show R the definition for R&D from section D of the ABS form.*
- *After reading this definition:* does your company perform any R&D based on this definition?
- After reading this definition, would you change your answers to items A and D from the previous question?

C12: Do all of the items make sense, are there any you are unfamiliar with? If R answers yes: can you give me any examples?

C13: Do you have any thoughts about the answer categories/column headers?

- Do all of the items make sense, are there any you are unfamiliar with?
- What would you include in 'public sector?'

C14 – C19: Skip

C20: Do you have any thoughts about the answer categories/column headers?

- What does a 'great deal' mean to you?
- Do all of the items make sense, are there any you are unfamiliar with?
- Can you think of any items missing from our list?
- *If testing with the sustainability module within the same interview, note any reactions or questions that might be informative for the sustainability module.*

C21: Skip

- Having gone through this entire section, about how long do you think it would take you to complete?
- Would you fill out this section, or would someone else in your company fill it out?

Technology Transfer Module:

1. Are the includes helpful or unhelpful?
 - a. Do all of the items make sense, are there any you are unfamiliar with?
 - b. Are there other R&D activities that we are missing from this list?

2. General probes
 - a. How easy or difficult would it be to provide this dollar amount?
 3. Does your company have any intellectual property? Can you give me any examples?
 - a. Do all of the items make sense, are there any you are unfamiliar with?
 - b. Are there other formal IP protections that we are missing from this list?
 4. Do all of the items make sense, are there any you are unfamiliar with?
 - a. Are there other informal IP protections that we are missing from this list?
 5. General probes
 6. General probes
 7. Do all of the items make sense, are there any you are unfamiliar with?
 - a. What does 'unaffiliated 'company mean' to you?
 - b. Are there other mechanisms of transfer that we are missing from this list?
 8. Do all of the items make sense, are there any you are unfamiliar with?
 - a. Are there other collaborative activities or agreements that we are missing from this list?
 9. Do all of the items make sense, are there any you are unfamiliar with?
 - a. Are there other collaborative activities or agreements that we are missing from this list?
 - b. Is it always clear if the organizations you work with are federal government laboratories?
 10. Note that this question has the same title, and this may confuse R (this will be changed).
 - a. If you work with federal government laboratories, is it obvious which parent agency the lab operates under? How would you go about answering this question if it was not obvious?
 11. Do all of the items make sense, are there any you are unfamiliar with?
 - a. Are there other collaborative activities or agreements that we are missing from this list?
 - b. Is it always clear if the organizations you work nonprofits?
- Having gone through this entire section, about how long do you think it would take you to complete?
 - Would you fill out this section, or would someone else in your company fill it out?

Technology and Intellectual Property Module

Note if R mentions that the tech transfer module has similarities to this one. You can prob on if the R feels that they should be in the same module or not.

Take a moment to read the definitions at the beginning of this section.

- Explain that the section is about these 5 technologies
- Does your company use any of these technologies, can you give me any examples?
- Do our definitions make sense? Do they match the way you think of these technologies, or do they differ?

E3: *This question is lengthy, note if R comments on it and note that it sets the stage for the remaining questions.*

- First part of question:
 - Do the answer choices make sense, are there any you are unfamiliar with?
 - Are we missing any categories?
- Second part of question:
 - What total costs were you thinking about when answering this question? How did you determine which percentage to choose?
 - How would you distinguish between, low, medium and high? Would another scale work better? What about actual percentages?

If they answered yes to any of the five sections in E.3 ask the following questions:

- Artificial Intelligence: go to Question E.4
- Cloud-based Computing Systems and Applications: go to Question E.8
- Specialized Software (excluding Artificial Intelligence: go to Question E.12
- Robotics: go to Question E.16
- Specialized Equipment (excluding Robotics): go to Question E.20

E4: How easy or difficult is it to provide a year?

- Would it be easier or more difficult to select a range of years?

E5: Do the categories make sense, are there any that are confusing?

- Are there any categories missing?
- *Ask how their answer could differ for each Tech they said they use in question E3.*

E6: *Note if R notices 3 year time period*

- How do you determine if skill level changed?
- Are you able to differentiate the STEM skills specifically?
- Would you consult any records when answering this question?

E7: How would you determine your answer to this question?

- Is it clear or unclear what is meant by ratio?
- Are you able to easily differentiate production vs non-production workers? Is this distinction in your records?
- Would it more clear or less clear to ask if the number of production workers to non-production workers increased or decreased?
- Are supervisory and non-supervisory workers distinct categories to you?

These questions repeat for every one of the technologies listed in the beginning, do you feel like this set of questions would be more difficult for any of the technologies?

Let's skip to question 24.

E24: How would you answer this question?

- Is the definition of automation provided clear or unclear?
- *However R answers:* can you tell me more about that or give me some examples?

E25: Can skip for time, otherwise, general probes.

- Having gone through this entire section, about how long do you think it would take you to complete?
- Would you fill out this section, or would someone else in your company fill it out?

Labor Related Questions

These questions will only be tested online via Qualtrics.

1: General Probes

- How would you determine your answer to this question?
- Are supervisory and non-supervisory workers distinct categories to you?

2: General Probes

3: General Probes

- What does 'certified' mean to you in the context of this question?

Wrap up

- Overall, which questions did you feel like were the most time consuming or difficult to complete?
- Do you have any other comments or additional feedback?

Thank you for your time!

Appendix B: Sustainability Management Module (Round One)

Draft of Sustainability Management Module (05/12/22)

2023 Annual Business Survey

Sustainability management addresses how the operation of your business is affected by demands from consumers, other businesses, and the government to meet the needs of present and future generations and the environment. These questions collect information on what your business is doing in response to or in anticipation of these demands.

1. BUSINESS PRIORITY

Over the past 3 years, from 2020 through 2022, have any of the following been this business's priority?
Select one for each row.

	Yes	No
a. Improving profitability	<input type="checkbox"/>	<input type="checkbox"/>
b. Increasing revenue	<input type="checkbox"/>	<input type="checkbox"/>
c. Accelerating digital transformation activities	<input type="checkbox"/>	<input type="checkbox"/>
d. Implementing or maturing sustainability initiatives	<input type="checkbox"/>	<input type="checkbox"/>
e. Improving the customer experience	<input type="checkbox"/>	<input type="checkbox"/>
f. Improving resilience to competitive pressures	<input type="checkbox"/>	<input type="checkbox"/>
g. Other (Specify)	<input type="checkbox"/>	<input type="checkbox"/>

If you reported 'Yes' for item d. '**Implementing or maturing sustainability initiatives**', continue to '**2. Sustainability Prioritization**'.

All others **skip to '4. Energy or Carbon Emissions Tracking'**.

2. SUSTAINABILITY PRIORITIZATION

How important to this business were each of the following factors for prioritizing sustainability?

	Very Important	Somewhat Important	Not Important
a. Attracting customers who make purchasing decisions based on sustainable business values	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Integrating sustainable value proposition into the company's brand	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Attracting customers who make purchasing decisions based on sustainable products	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Addressing stakeholder demand for climate risk disclosures and better sustainability management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Employee recruitment/retention tied to sustainable business values	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Green procurement requiring life-cycle assessment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Some other (Specify)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. SUSTAINABILITY OBJECTIVES

Has this business realized any of the following benefits from pursuing its sustainability goals? **Select one for each row.**

	Yes	No
a. Improved efficiency	<input type="checkbox"/>	<input type="checkbox"/>
b. Improved regulatory compliance	<input type="checkbox"/>	<input type="checkbox"/>
c. Improved employee recruitment and/or retention	<input type="checkbox"/>	<input type="checkbox"/>
d. Reduced waste	<input type="checkbox"/>	<input type="checkbox"/>
e. Improved brand reputation	<input type="checkbox"/>	<input type="checkbox"/>
f. Decreased costs	<input type="checkbox"/>	<input type="checkbox"/>
g. Improved customer acquisition and/or loyalty	<input type="checkbox"/>	<input type="checkbox"/>
h. Increased revenue	<input type="checkbox"/>	<input type="checkbox"/>
i. Other (Specify)	<input type="checkbox"/>	<input type="checkbox"/>

4. ENERGY OR CARBON EMISSIONS TRACKING

Does this business track energy use or carbon emissions from the following sources?

	No, does not track either	Yes, tracks Energy Expenditures	Yes, tracks Carbon Emissions	Source is not applicable to this business
a. Heating of buildings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Cooling of buildings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Fleet transportation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Electricity (used for lighting, computing, HVAC, production, etc.)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- | | | | | |
|---|--------------------------|--------------------------|--------------------------|--------------------------|
| e. Thermal energy in production (for example, from natural gas, petroleum, coal, biomass, etc.) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|---|--------------------------|--------------------------|--------------------------|--------------------------|

5. CARBON EMISSIONS SOFTWARE USE

Does this business use any carbon emissions reporting software?

- ☐ Yes
- ☐ No
- ☐ Don't Know

6. INDIRECT CARBON EMISSIONS TRACKING

Does this business track indirect carbon emissions in its value chain (Emissions in the value chain are a consequence of the activities of the business but from assets not owned or controlled by the business. Also called Scope 3 emissions.)? *For example, emissions from employee commuting, transportation and distribution, use of sold products, etc.*

- ☐ No, does not track - **Skip to '8. Carbon Emissions Reduction Plan'**
- ☐ Not yet, but some evaluation of major carbon hotspots
- ☐ Yes, major carbon hotspots tracked

7. INDIRECT CARBON EMISSIONS POTENTIAL CHALLENGES

Does this business expect to face any of the following challenges to measuring indirect carbon emission in its value chain (Scope 3)? **Select one for each row.**

	Yes	No
a. The company is not aligned internally on what to track and how.	<input type="checkbox"/>	<input type="checkbox"/>
b. The company lacks data from suppliers or end users.	<input type="checkbox"/>	<input type="checkbox"/>
c. The company lacks in-house expertise.	<input type="checkbox"/>	<input type="checkbox"/>

8. CARBON EMISSIONS REDUCTION PLAN

Has this business developed plans for reducing carbon emissions?

- ☐ Yes - **Skip to '10. Carbon Emissions Strategies'**
- ☐ No

9. FUTURE PLANS FOR CARBON EMISSIONS

Is this business considering developing plans in the future for reducing carbon emissions?

- ☐ Yes
- ☐ No - **Skip to '13. Sustainability Alternatives'**

10. CARBON EMISSIONS STRATEGIES

Will this business implement any of the following strategies to reduce carbon emissions? **Select one for each row.**

	Yes	No
a. Eliminating products or activities reliant on fossil fuel use by changing the company's product or service mix	<input type="checkbox"/>	<input type="checkbox"/>
b. Replacing fossil fuel using activities with zero or low emissions alternatives (for example, adding electric vehicles to the company's fleet)	<input type="checkbox"/>	<input type="checkbox"/>
c. Reducing carbon emissions by increasing the efficiency of activities using fossil fuels	<input type="checkbox"/>	<input type="checkbox"/>
d. Offsetting carbon emissions that cannot be abated by supporting projects that reduce carbon emissions elsewhere	<input type="checkbox"/>	<input type="checkbox"/>

11. CARBON EMISSIONS REDUCTION GOAL DATE

What is the target date for achieving this business's carbon emissions reduction goals?

- ☐ No target date set
- ☐ No later than 2030
- ☐ No later than 2040
- ☐ No later than 2050
- ☐ After 2050

12. CARBON EMISSIONS REDUCTION GOAL OBJECTIVE

How much of a reduction carbon emissions is this business planning?

- ☐ No reduction goal set
- ☐ Less than 25% reduction
- ☐ 25-50% reduction
- ☐ More than 50%, but less than 100% reduction
- ☐ 100% reduction

13. SUSTAINABILITY ALTERNATIVES

If this business is not successful at improving sustainability, does the business foresee any of the following effects? **Select one for each row.**

	Yes	No
a. Fines for lack of compliance with regulations	<input type="checkbox"/>	<input type="checkbox"/>
b. Inability to raise capital or secure credit	<input type="checkbox"/>	<input type="checkbox"/>
c. A loss of customer trust	<input type="checkbox"/>	<input type="checkbox"/>
d. A loss of brand reputation	<input type="checkbox"/>	<input type="checkbox"/>
e. Hiring difficulties or lower employee retention	<input type="checkbox"/>	<input type="checkbox"/>
f. Financial risks associated with future policy changes such as a carbon tax	<input type="checkbox"/>	<input type="checkbox"/>
g. Lost sales due to inability to provide emissions or other environmental information to potential customers	<input type="checkbox"/>	<input type="checkbox"/>

14. SUSTAINABILITY INVESTMENTS

Is this business making any of the following investments to improve sustainability? **Select one for each row.**

	Yes	No
a. Purchase power agreements for renewable energy	<input type="checkbox"/>	<input type="checkbox"/>
b. Renewable energy generation on-site (e.g., solar, wind, geothermal)	<input type="checkbox"/>	<input type="checkbox"/>
c. Battery storage or other means of saving renewable energy generation for later use	<input type="checkbox"/>	<input type="checkbox"/>
d. Improved energy efficiency and management	<input type="checkbox"/>	<input type="checkbox"/>
e. Engineering innovation to improve sustainability of our materials (e.g., innovating to produce goods with lower CO2 content)	<input type="checkbox"/>	<input type="checkbox"/>
f. Elimination of waste through circular economy or design for re-use strategies	<input type="checkbox"/>	<input type="checkbox"/>
g. Redesigning processes to make similar products with less environmental impacts	<input type="checkbox"/>	<input type="checkbox"/>

15. STRATEGIC OBJECTIVES AND THE ENVIRONMENT

Does this business have strategic objectives that mention environmental or climate change issues?

- ☐ Yes
- ☐ No
- ☐ Don't Know

16. ENVIRONMENTAL MANAGER

Does this business have a manager responsible for environmental and climate change issues?

- ☐ Yes
- ☐ No
- ☐ Don't Know

17. ENVIRONMENTAL CERTIFICATIONS

Do any of this business's customers require environmental certifications or adherence to certain environmental standards as a condition to do business with them?

- ☐ Yes
- ☐ No
- ☐ Don't Know

18. CO2 EMISSIONS MONITORING

Over the last 3 years, from 2020 through 2022, has this business monitored CO2 emissions along its supply chain?

- ☐ Yes
- ☐ No
- ☐ Don't Know

19. EXTREME WEATHER EVENTS AND IMPACT

Over the last 3 years, from 2020 through 2022, has this business experienced monetary losses due to extreme weather events? *For example, hurricanes, floods, droughts, or heat waves.*

Include:

- *Incurred costs*

- *Losses of sales or assets.*

- ☐ Yes
- ☐ No
- ☐ Don't Know

20. INVESTMENTS TO MITIGATE RISK

Over the last 3 years, from 2020 through 2022, has this business undertaken investments to reduce the risk of damages caused by extreme weather events? *For example, hurricanes, floods, droughts, wildfires, or heat waves.*

- ☐ Yes
- ☐ No
- ☐ Don't Know

21. FUTURE IMPACTS DUE TO EXTREME WEATHER

Over the next decade, how likely is this business to experience negative impacts from extreme weather events?

For example, hurricanes, floods, droughts, wildfires, or heat waves.

- ☐ Not at all likely
- ☐ A little likely
- ☐ Somewhat likely
- ☐ Very likely
- ☐ Extremely likely

Appendix C: Innovation Module (Round One)

DRAFT INNOVATION MODULE FOR ABS 2023 (Year 6)

GOODS, SERVICES, AND BUSINESS PROCESSES

The following section collects information on this business's introduction of new or improved goods, services, or business processes that differed significantly from this business's previous goods, services, or processes.

The goods, services, or business processes must have characteristics or intended uses that are new or improved, and which differ significantly from what was previously used or sold by this business. However, they can fail or take time to prove themselves.

The goods, services, or business processes need only be new or improved for this business. They could have

been originally developed or used by other businesses or organizations.

The following section asks about the 2020 to 2022 time period, instead of one year as in other sections of this survey.

C.1 NEW OR IMPROVED GOODS

During the three years 2020 to 2022, did this business introduce to the market any new or improved goods that differed significantly from this business's previous goods?

This includes the addition of new functions or improvements to existing functions or user utility.

- o Functions include the following: quality, technical specifications, reliability, durability, economic efficiency during use, affordability, convenience, usability, and user friendliness.
- o User utility includes attributes such as affordability and financial convenience.

Goods: usually a tangible object such as a smartphone, furniture, or packaged software, but also includes digital goods such as downloadable software, music and film. (Exclude the simple resale of new goods or changes of a solely aesthetic nature.)

- ☐ Yes
- ☐ No

C.2 NEW OR IMPROVED SERVICES

During the three years 2020 to 2022, did this business introduce to the market any new or improved services that differed significantly from this business's previous services?

This includes the addition of new functions or improvements to existing functions or user utility.

- ☐ Functions include quality, technical specifications, reliability, durability, economic efficiency during use, affordability, convenience, usability, and user friendliness.
- ☐ User utility includes attributes such as affordability and financial convenience.

Services: intangible activities, such as retailing, insurance, educational courses, air travel, consulting, etc., also includes digital services. (Exclude the simple resale of new services.)

- ☐ Yes
- ☐ No

If "No" is selected for 'C.1 New or Improved Goods' and "No" is selected for 'C.2 New or Improved Services,' skip to 'C.9 New or Improved Business Processes'.

C.3 NOVELTY OF NEW OR IMPROVED GOODS OR SERVICES

During the three years 2020 to 2022, did this business introduce any new or improved goods or services that

differ significantly from goods or services previously offered by this business that were:

Select one for each row. Yes No

a. New to the market? This business introduced a new or improved good or service that was not previously offered by any of your competitors (it may have already been available in other markets)

b. New only to this business? This business introduced a new or improved good or service that was identical or very similar to products already offered by your competitors

If no is selected for a. and b., skip to 'C.5 – Expectations'.

If you reported \$0 for 'A.11 – Domestic Sales and Revenues', skip to 'C.5 – Expectations'.

C.4 NEW OR IMPROVED GOODS OR SERVICES AS PERCENT OF TOTAL SALES

In 2022, what percentage of this business's 'A.11 DOMESTIC SALES AND REVENUES' on page tk in domestic sales and revenues were attributable to or originated from domestic operations in the following categories?

Details must sum to 100% of total dollar amount of 'A.11 Domestic Sales and Revenues'.

Estimates are acceptable.

a. New or improved goods or services introduced during 2020 to 2022 that were. %
new to your market.

b. New or improved goods or services introduced during 2020 to 2022 that were %
new only to this business.

- c. Goods or services that were unchanged or only marginally modified during 2020 to 2022 (include the resale of new goods or services purchased from other companies). %

Total sales in 2022 = 100%

C.5 EXPECTATIONS

Did the new or improved goods or services introduced during 2020 to 2022 meet this business's expectations, such as market share, sales or profits as of December 2022?

- ☐ Yes, expectations were exceeded
- ☐ Yes, expectations were met
- ☐ No, Expectations were not met
- ☐ Too early to tell

C.6 SOURCES OF NEW OR IMPROVED GOODS OR SERVICES

Who developed these new or improved goods or services? Select all that apply

- ☐ This business by itself
- ☐ This business together with other businesses, universities, research institutes, nonprofits, or other organizations
- ☐ This business by adapting or modifying goods or services originally developed by other businesses or organizations
- ☐ Other businesses or organizations

C.7 MOST IMPORTANT INNOVATION

Thinking about the most important good or service this business introduced during 2020 to 2022, was that good or service new to the market or new only to this business?

- ☐ New to the market - This business introduced a new or improved good or service that was not previously offered by any of your competitors (it may have already been available in other markets)
- ☐ New only to this business - This business introduced a new or improved good or service that was identical or very similar to goods or services already offered by your competitors

If you reported \$0 for 'A.11 – Domestic Sales and Revenues', skip to 'C.9 – New or Improved Business Processes'.

C.8 MOST IMPORTANT INNOVATION AND SALES

In 2022, what percentage of this business's 'A.11 DOMESTIC SALES AND REVENUES' in domestic sales and revenues were attributed to this business's most important innovation? Estimates are acceptable.

%

C.9 NEW OR IMPROVED BUSINESS PROCESSES

During the three years 2020 to 2022, did this business introduce any of the following types of new or improved business processes that differed significantly (e.g. greater efficacy, resource efficiency, reliability and resilience, affordability, convenience and usability) from your previous business processes? Select one for each row.

Yes No

- a. Methods for producing goods or providing services (including methods related to engineering and related technical testing, analysis and certification)
- b. Logistics, delivery or distribution methods
- c. Marketing methods for promotion, packaging, pricing, product placement or after sales services
- d. Information and communication systems (including hardware, software and data processing)
- e. Administration and management activities (including decision-making, human resource management, and methods for accounting or other administrative operations)
- f. Product and business process development activities (including activities to identify, develop, or adapt products or processes, or adopting new methodologies for developing products and processes)

If no is selected for a. – f., skip to 'C.11 Goods, Services, or Business Process Activities'.

C.10 IMPROVED BUSINESS PROCESS DEVELOPERS

Who developed these new or improved business processes? Select all that apply.

- ☐ This business by itself
- ☐ This business together with other businesses, universities, research institutes, nonprofits, or other organizations
- ☐ This business by adapting or modifying business processes originally developed by other businesses or organizations
- ☐ Other businesses or organizations

C.11 GOODS, SERVICES, OR BUSINESS PROCESS ACTIVITIES

During the three years 2020 to 2022, did this business have any of the following types of innovation activities?

- ☐ Include all developmental, financial, and commercial activities that were intended to result in a new or improved good, service or business process that differed significantly from your previous goods, services, or business processes.
- ☐ Similar activities that were not intended to result in a new or improved good, service or business process should not be reported here. (e.g., employee training intended for general maintenance of skills are not considered "innovation activities")
- ☐ Simple replacement of machinery without enhanced capabilities are not considered "innovation activities"

Select one for each row.

Yes No

- a. Research and development: creative and systematic work undertaken in order to increase the stock of knowledge and to devise new applications of available knowledge
- b. Engineering and design activities: planning of technical specifications, testing, evaluation, setup and pre-production for goods, services, processes or systems; installing equipment, tooling- up, testing, trials and user demonstrations; and activities to extract knowledge or design information from existing products or process equipment. Also include activities to develop a new or modified function, form or appearance for goods, services, or processes
- c. Marketing and brand equity activities: include market research, market testing, methods for pricing, product placement and product promotion; product advertising, the promotion of products at trade fairs or exhibitions, and the development of marketing strategies

- d. Intellectual Property (IP) related activities: protection or exploitation of knowledge, often created through R&D, software development, and engineering, design and other creative work, including all related administrative and legal work
- e. Employee training: activities that are paid for or subsidized by the firm to develop knowledge and skills required for the specific trade, occupation or vocation of a firm's employees
- f. Software development and database activities: in-house development and purchase of computer software; collection and analysis of data in proprietary computer databases and data obtained from publicly-available reports or the Internet; and activities to upgrade or expand the functions of IT systems, including computer program and databases
- g. Acquisition of machinery, equipment and other tangible assets
- h. Management related to innovation: Activities to plan, govern and control internal and external resources

C.12 COOPERATION ON INNOVATION (CIS question 3.11).

During the three years 2020 to 2022, did your enterprise co-operate with other enterprises or organizations?

Cooperation occurs when two or more participants agree to take responsibility for a task or series of tasks and information is shared between the parties to facilitate the agreement.

Yes No

- a) On R&D
- b) On other innovation activities (excluding R&D)
- c) On any other business activities

If C.12 b equals yes ask C.13 else go to skip pattern before C.14

C.13 COOPERATION PARTNER LOCATION (CIS question 3.12)

Please indicate the type of innovation co-operation partner by location

Type of innovation co-operation partner:	USA	Canada/ Mexico	Rest of World
--	-----	-------------------	------------------

- a) Business enterprises outside your enterprise group
 - a.1 Consultants, commercial labs, or private research institutes
 - a.2 Suppliers of equipment, materials, components, or software
 - a.3 Enterprises that are your clients or customers
 - a.4 Enterprises that are your competitors
 - a.5 Other enterprises
- b) Enterprises within your enterprise group
- c) Universities or other higher education institutions
- d) Government or public research institutes
- e) Clients or customers from the public sector*
- f) Non-profit

*The public sector includes government owned organizations such as local, regional and national administrations and agencies, schools, hospitals, and government providers of services such as security, transport, housing, energy, etc.

C.14 is asked only of respondents who say no to all of C.11

C.14 REASONS FOR NO INNOVATION ACTIVITIES

Which of the following best describes why your enterprise had no innovation activities during the three years from 2020 to 2022:

Select one:

A lack of resources prevented us from innovating. (e.g. lack of finance, qualified personnel, material).

We decided not to innovate due to other reasons than a lack of resources. (e.g. strategic reasons; not the right time to innovate; other priorities; risks too high; low expected returns)

We had no innovation activities because there was no need for innovation.

SKIP to question C.18 Government Support – should the skip go to C.18 or C.19

C.15 is asked only of respondents who say yes to one part of C.11

C.15 RESULTS OF INNOVATION ACTIVITIES

During the three years 2020 to 2022, did this business have any innovation activities that did not result in a goods, services, or business process innovation because the activities were: Select one for each row.

Yes No

a. Abandoned or suspended before completion

b. Still ongoing at the end of 2022

C.16 ACTIVITY COSTS

In 2022, how much did this business spend on the innovation activities selected in the activities question and listed below? Note that this question refers only to the year 2022 and not the three-year period, 2017 – 2022. Estimates are acceptable.

- a. Research and development
- b. Engineering and design activities
- c. Marketing and brand equity activities
- d. Intellectual Property (IP) related activities
- e. Employee training
- f. Software development and database activities
- g. Acquisition of machinery, equipment and other tangible assets
- h. Management related to innovation

\$Mil. Thou. Dol.

i. TOTAL ,000

If yes is selected for from 'C.11 – Goods, Services, or Business Process Activities' and Total Number of W-2 Paid Employees or Employee/Owners from 'A.8 Number of W-2 Paid Employees or Employee/Owners' is greater than or equal to 10 and response to 'C.16 – Activity Costs' does not equal zero, continue to 'C.17 - R&D for Activity Costs'.

All else skip to 'C.18 – Government Support'.

C.17 R&D FOR ACTIVITY COSTS

Of the 'C.15 ACTIVITY COSTS' reported, how much was for research and development (creative and systematic work undertaken in order to increase the stock of knowledge and to devise new applications of available knowledge) in 2022?

\$Mil. Thou. Dol.

,000

C.18 GOVERNMENT SUPPORT

During the three years 2020 to 2022, did this business use any of the following types of government programs (federal, state, or local) to aid innovation activities?

Select one for each row.

Yes No

- a. Government tax incentive or tax credit programs: Include programs intended to support innovation activities such as research and development or capital expenditures
- b. Government grants and contributions programs: Include programs intended to support innovation activities such as research and development, business development or commercialization of intellectual property
- c. Government training and hiring programs: Include programs intended to support innovation activities such as hiring and training of researchers, interns or other personnel
- d. Government procurement: Include programs intended to support innovation such as the procurement of new or improved goods, services or businesses processes
- e. Other government programs: Include programs and activities to support innovation not included elsewhere such as access to facilities, export incentives, technical assistance, market information or loans

C.19 BARRIERS OF INNOVATION

During the three years 2020 to 2022, how, if at all, were each of the following factors in discouraging this business to conduct innovation activities:

Select one for each row.

Very

discouraging Somewhat

discouraging A little

discouraging Not at all

discouraging

- a. Lack of internal finance for innovation
- b. Lack of credit or private equity
- c. Difficulties in obtaining public grants or subsidies
- d. Costs too high
- e. Lack of skilled employees within this business
- f. Lack of collaboration partners
- g. Lack of access to external knowledge
- h. Uncertain market demand for your ideas
- i. Too much competition in your market
- j. Different priorities within this business
- k. Government Regulations

Everyone receives this question regardless of whether they are an innovator and whether they have innovation activities, but I don't know if that is correct. Should someone who is not an innovator and has no innovation activities be asked this question

C.20 INNOVATION AND THE ENVIRONMENT

Environmental benefits obtained within your enterprise

- a. Reduced material or water use per unit of output
- b. Reduced energy use or CO₂ 'footprint' (i.e. reduced total CO₂ emission)
- c. Reduced soil, noise, water or air pollution
- d. Replaced a share of materials with less polluting or hazardous substitutes
- e. Replaced a share of fossil energy with renewable energy
- f. Recycled waste, water, or materials for own use or sale

great deal No Yes, a great deal Yes, but not a great deal

- The Census Bureau has reviewed this data product for unauthorized disclosure of confidential information and has approved the disclosure avoidance practices applied to this release (Approval ID: CBDRB-FY23-ESMD010-008)

C.21 BUSINESS STRATEGIES

During 2020 to 2022, to what extent did the business focus on the following business strategies?

Select one for each row

- a. Improve existing goods or services
- b. Introduce new goods or services
- c. Reduce prices for goods or services
- d. Increase the quality of goods or services
- e. Develop a broad range of products
- f. Develop one or a small number of key products
- g. Satisfy established customers
- h. Reach out to new customers
- i. Develop standardized goods or services (e.g., goods or services are the same regardless of market or customer type)
- j. Develop customer-specific solutions (e.g., customized goods or services)

Appendix D: Technology Transfer (Round One)

2023 ABS Technology Transfer Module

ABS 2023 (Year 6) - DRAFT

Research and Development

[Note: Skip Questions 1 and 2 for businesses with W-2 employment between 1 and 9.]

What is Research and Development (R&D)?

Research and development (R&D) comprise creative and systematic work undertaken in order to increase the stock of knowledge and to devise new applications of available knowledge.

The term R&D does NOT include expenditures for:

- Costs for routine product testing, quality control, and technical services unless they are an integral part of an R&D project
- Market research
- Efficiency surveys or management studies
- Literary, artistic, or historical projects, such as films, music, or books and other publications
- Prospecting or exploration for natural resources

R&D activity in software INCLUDES:

- Software development or improvement activities that expand scientific or technological knowledge
- Construction of new theories and algorithms in the field of computer science

R&D activity in software EXCLUDES:

- Software development that does not depend on a scientific or technological advance, such as
- supporting or adapting existing systems
- adding functionality to existing application programs, and
- routine debugging of existing systems and software
- Creation of new software based on known methods and applications
- Conversion or translation of existing software and software languages
- Adaptation of a product to a specific client, unless knowledge that significantly improved the base program was added in that process

Reporting unit

The reporting unit is this business, including all subsidiaries and divisions. Include subsidiary companies where there is more than 50 percent ownership.

Reporting period

Report data for the calendar year 2022, if possible, or for this business's fiscal year ending between April 2022 and March 2023.

Estimates are acceptable.

Report all items to the best of your ability.

1. R&D ACTIVITIES

During 2022, did this business do any of the following R&D activities? Include activities that:

- This business performed
- Others paid this business to do
- This business paid others to do

Select one for each row.

Yes No

a. Conducted activities aimed at acquiring new knowledge or understanding without specific immediate commercial applications or uses

☐ ☐

b. Conducted activities aimed at acquiring new knowledge for solving a specific problem or meeting a specific commercial objective

☐ ☐

c. Conducted systematic work, drawing on research and practical experience and resulting in additional knowledge, which is directed to producing new products or processes or to improving existing products or processes

☐ ☐

d. Developed and tested goods, services, or processes that were derived from scientific research or technical findings

☐ ☐

e. Developed software that advanced scientific or technological knowledge

☐ ☐

f. Produced findings that could be published in academic journals or presented at scientific conferences

☐ ☐

g. Applied scientific or technical knowledge in a way that has never been done before

☐ ☐

h. Created new scientific or technical solutions that can be generalized to other situations.

☐ ☐

i. Conducted work to discover previously unknown technological facts, structures, or relationships

☐ ☐

j. Conducted work to extend the understanding of scientific facts, relationships, or principles in ways that could be useful to others ☐ ☐

If “No” is selected for a. – j., skip to ‘3’ on page XX.

2. R&D COSTS

What was the total cost (both direct and indirect) in 2021 for all the R&D activities reported as “Yes” in the ‘1. R&D Activities’ question? Your best estimate is acceptable. Report dollar amount in thousands. If none, report zero.

Include:

- Salaries, wages, fringe benefits
- Plant, machinery, and equipment, except that which was capitalized because it had an alternative future use
- Materials, supplies, software
- Rent, utilities
- Consultants, contractors
- Depreciation expense from plant, machinery, and equipment that was capitalized because it had an alternative future use

Exclude:

- Costs for routine product testing, quality control, and technical services unless they are an integral part of an R&D project
- Market research
- Efficiency surveys or management studies

- Literary, artistic, or historical projects, such as films, music, or books and other publications
- Prospecting or exploration for natural resources
- Capital expenditures (i.e., costs for construction or renovation of facilities)
- Payments/funds in excess of the actual cost of the research work performed (e.g., profits or fees)

\$Mil. | Thou.

Total costs for 'R&D Activities' reported in the '1 R&D Activities' question for 2021

\$ _____

3. Formal Intellectual Property Protection

Does this business use the following methods to protect intellectual property?

Yes No

- Utility patents (patents for inventions, applied for or awarded)
- Design patents (patents for appearance, applied for or awarded)
- Copyright
- Trademarks

4. Informal Intellectual Property Protection

Does this business use the following less formal means of protecting intellectual property?

Yes No

- Design complexity

- b. Nondisclosure agreements or non-compete clauses
- c. Branding and product image
- d. Trade secrets

5. Patents Pending

How many U.S. patent applications, if any, did this business have pending as of the end of 2022? If none, report zero.

6. Patents Owned

How many U.S. patents did this business own as of the end of 2022? If none, enter zero.

7. Intellectual Property Activities

During the three years 2020 to 2022, did your company exchange intellectual property (IP) rights, including patents, copyrights, and trademarks that give ownership, exclusion rights or rights to use technical knowledge using any of the following mechanisms. Select one for each row.

- | Yes | No |
|-----|---|
| a. | Licensed or purchased IP from unaffiliated companies |
| b. | Licensed or sold intellectual property (IP) to unaffiliated companies |
| c. | Transferred intellectual property (IP) to unaffiliated companies through participation in technical assistance or "know how" agreements |

- d. Received IP from unaffiliated companies through participation in technical assistance or "know how" agreements
- e. Participated in cross-licensing agreements with unaffiliated companies
- f. Acquired or merged with unaffiliated company to acquire their IP
- g. Transferred IP to a spin-off or spin-out of your company
- h. Received IP from a parent company as part of a spin-off or spin-out
- i. Allowed free use of patents or other IP owned by this company (for example, allowing free use of software patents by the open-source community)
- j. Made use of open-source patents or other freely available IP not owned by this company

8. Collaboration with Universities

During the three years 2020 to 2022, did this business engage in any of the following collaborative activities with universities? Select one for each row.

- | Yes | No |
|-----|---|
| a. | Performed collaborative research between company and university researchers |
| b. | Funded university research |
| c. | Funded PhD students and postdoctoral researchers at universities |
| d. | Licensed or purchased IP from a university |
| e. | Signed non-disclosure agreements, material transfer agreements, or other agreements with universities governing usage of IP |
| f. | Hired science and engineering graduates |
| g. | Engaged in formal or informal personnel exchanges with universities |

9. Collaboration with Government Laboratories

During the three years 2020 to 2022, did this business engage in any of the following collaborative activities with federal laboratories including Federally Funded Research and Development Centers? Select one for each row.

Yes No

- a. Conducted collaborative research using agreements such as Cooperative Research and Development Agreements, Space Act Agreements, Material Transfer Agreements, Confidential Disclosure Agreements, or other transaction authorities
- b. Conducted research at government user facilities
- c. Funded research at government laboratory
- d. Licensed IP from government laboratory
- e. Engaged in formal or informal personnel exchanges with government laboratories
- f. Attended workshops or seminars located at or sponsored by government laboratories

10. Collaboration with Government Laboratories

During the three years 2020 to 2022, did this business engage collaborative activities with federal laboratories in the following departments? Select one for each row.

- 1. Department of Agriculture
- 2. Department of Commerce
- 3. Department of Defense
- 4. Department of Energy
- 5. Department of Health and Human Services
- 6. Department of Homeland Security
- 7. Department of Transportation
- 8. Department of Veteran Affairs
- 9. National Aeronautics and Space Administration

10. Other federal department

11. Collaboration with Nonprofits

During the three years 2020 to 2022, did this business engage in any of the following collaborative activities with nonprofit organizations? Select one for each row.

Yes	No
a.	Performed collaborative research between company and nonprofit researchers
b.	Funded research at nonprofit organizations
c.	Licensed or purchased IP from a nonprofit organization
d.	Signed non-disclosure agreements, material transfer agreements, or other agreements with nonprofit organizations governing usage of IP
e.	Engaged in formal or informal personnel exchanges with nonprofit research organizations

Appendix E: Technology and Intellectual Property Module (Round One)

SECTION E: TECHNOLOGY AND INTELLECTUAL PROPERTY

The following section collects information on intellectual property and technology use for the business. Technology related questions in this section asks about the following technologies:

Artificial Intelligence: Artificial intelligence is a branch of computer science and engineering devoted to making machines intelligent. Intelligence is that quality that enables an entity to perceive, analyze, determine response and act appropriately in its environment.

Cloud-based Computing Systems and Applications: Cloud systems and applications are computing resources available on-demand via the internet.

Specialized Software (excluding Artificial Intelligence): Specialized software is software dedicated to performing a particular business function.

Robotics: Robotic equipment (or robots) are automatically controlled, reprogrammable, and multipurpose machines used in automated operations in industrial and service environments.

Specialized Equipment (excluding Robotics): Specialized equipment is equipment capable of automatically carrying out pre-specified task(s).

E.3 PRODUCTION TECHNOLOGY FOR GOODS AND SERVICES

During the three years 2020 to 2022, did this business adopt/use the following technologies?

Artificial Intelligence

- ☐ This technology is not applicable to this business
- ☐ Applicable, but did not test or use
- ☐ Tested, but did not use as part of the processes or methods
- ☐ Used as part of the processes or methods
- ☐ Don't know

If this business used Artificial Intelligence, what percentage of the total costs were associated with the processes and methods that use Artificial Intelligence?

- ☐ Low percentage
- ☐ Medium percentage
- ☐ High percentage

Cloud-based Computing Systems and Applications

- ☐ This technology is not applicable to this business
- ☐ Applicable, but did not test or use
- ☐ Tested, but did not use as part of the processes or methods
- ☐ Used as part of the processes or methods
- ☐ Don't know

If this business used Cloud-based Computing Systems and Applications, what percentage of the total costs were associated with the processes and methods that use Cloud-based Computing Systems and Applications?

- ☐ Low percentage
- ☐ Medium percentage
- ☐ High percentage

Specialized Software

- ☐ This technology is not applicable to this business
- ☐ Applicable, but did not test or use
- ☐ Tested, but did not use as part of the processes or methods
- ☐ Used as part of the processes or methods
- ☐ Don't know

If this business used Specialized Software, what percentage of the total costs were associated with the processes and methods that use Specialized Software?

- ☐ Low percentage
- ☐ Medium percentage
- ☐ High percentage

Robotics

- ☐ This technology is not applicable to this business
- ☐ Applicable, but did not test or use
- ☐ Tested, but did not use as part of the processes or methods
- ☐ Used as part of the processes or methods
- ☐ Don't know

If this business used Robotics, what percentage of the total costs were associated with the processes and methods that use Robotics?

- ☐ Low percentage
- ☐ Medium percentage
- ☐ High percentage

Specialized Equipment

- ☐ This technology is not applicable to this business
- ☐ Applicable, but did not test or use
- ☐ Tested, but did not use as part of the processes or methods
- ☐ Used as part of the processes or methods
- ☐ Don't know

If this business used Specialized Equipment, what percentage of the total costs were associated with the processes and methods that use Specialized Equipment?

- ☐ Low percentage
- ☐ Medium percentage
- ☐ High percentage

If all answers to E.3 are “This technology is not applicable to this business”, “Applicable, but did not test or use”, “Tested, but did not use in production or service”, or “Don’t know” then proceed to E.24 –
IMPACT OF THE PANDEMIC ON VIEWS TOWARDS AUTOMATION

E.4 TIMING OF ADOPTION FOR ARTIFICIAL INTELLIGENCE TECHNOLOGY – PROCESSES AND METHODS

Approximately what year did this business first adopt or use Artificial Intelligence in processes and methods? Please enter the year to the best of your knowledge (even if approximate).

_ _ _ _

☐ Don’t know the year

E.5 MOTIVATION FOR ARTIFICIAL INTELLIGENCE TECHNOLOGY ADOPTION AND UTILIZATION – PROCESSES AND METHODS

During the three years 2020 to 2022, why did this business adopt or use Artificial Intelligence? Select all that apply.

- ☐ To automate tasks performed by labor
- ☐ To replace or upgrade already existing automated processes or methods
- ☐ To improve quality or reliability of processes or methods
- ☐ To improve quality or reliability of goods or services
- ☐ To expand the range of goods or services
- ☐ To adopt standards and accreditation
- ☐ Some other reason

E.6 IMPACT OF ARTIFICIAL INTELLIGENCE TECHNOLOGY ON WORKFORCE – PROCESSES AND METHODS

During the three years 2020 to 2022, what were the effects of adopting or using Artificial Intelligence on the following?

A. The number of workers employed by this business

- ☐ Increased
- ☐ Decreased

☐ Did not change

B. The skill level of workers employed by this business

☐ Increased overall

☐ Decreased overall

☐ Did not change overall

C. The scientific, technological, engineering, and mathematical skills of workers employed by this business

☐ Increased overall

☐ Decreased overall

☐ Did not change overall

☐ Not applicable, we did not employ workers with scientific, technological, engineering and mathematical skills

E.7 IMPACT OF ARTIFICIAL INTELLIGENCE TECHNOLOGY ON WORKER TYPES – PROCESSES AND METHODS

Indicate what effect Artificial Intelligence had on the following types of workers employed by this business during the three years 2020 to 2022.

A. The ratio of production workers to non-production workers

☐ Increased

☐ Decreased

☐ Did not change

☐ Not applicable, we did not employ production workers

☐ Not applicable, we did not employ non-production workers

B. The ratio of non-supervisory workers to supervisory workers

☐ Increased

☐ Decreased

☐ Did not change

☐ Not applicable, we did not employ supervisory workers

☐ Not applicable, we did not employ non-supervisory workers

E.8 TIMING OF ADOPTION FOR CLOUD-BASED COMPUTING SYSTEMS AND APPLICATIONS TECHNOLOGY
– PROCESSES AND METHODS

Approximately what year did this business first adopt or use Cloud-based Computing Systems and Applications in processes and methods? Please enter the year to the best of your knowledge (even if approximate).

_ _ _ _

☐ Don't know the year

E.9 MOTIVATION FOR CLOUD-BASED COMPUTING SYSTEMS AND APPLICATIONS TECHNOLOGY
ADOPTION AND UTILIZATION – PROCESSES AND METHODS

During the three years 2020 to 2022, why did this business adopt or use Cloud-based Computing Systems and Applications? Select all that apply.

- ☐ To automate tasks performed by labor
- ☐ To replace or upgrade already existing automated processes
- ☐ To improve quality or reliability of processes or methods
- ☐ To improve quality or reliability of goods or services
- ☐ To expand the range of goods or services
- ☐ To adopt standards and accreditation
- ☐ Some other reason

E.10 IMPACT OF CLOUD-BASED COMPUTING SYSTEMS AND APPLICATIONS TECHNOLOGY ON
WORKFORCE – PROCESSES AND METHODS

During the three years 2020 to 2022, what were the effects of adopting or using Cloud-based Computing Systems and Applications on the following?

A. The number of workers employed by this business

- ☐ Increased
- ☐ Decreased
- ☐ Did not change

B. The skill level of workers employed by this business

- ☐ Increased overall
- ☐ Decreased overall
- ☐ Did not change overall

C. The scientific, technological, engineering, and mathematical skills of workers employed by this business

☐ Increased overall

☐ Decreased overall

☐ Did not change overall

☐ Not applicable, we did not employ workers with scientific, technological, engineering and mathematical skills

E.11 IMPACT OF CLOUD-BASED COMPUTING SYSTEMS AND APPLICATIONS TECHNOLOGY ON WORKER TYPES – PROCESSES AND METHODS

Indicate what effect Cloud-based Computing Systems and Applications had on the following types of workers employed by this business during the three years 2020 to 2022.

A. The ratio of production workers to non-production workers

☐ Increased

☐ Decreased

☐ Did not change

☐ Not applicable, we did not employ production workers

☐ Not applicable, we did not employ non-production workers

B. The ratio of non-supervisory workers to supervisory workers

☐ Increased

☐ Decreased

☐ Did not change

☐ Not applicable, we did not employ supervisory workers

☐ Not applicable, we did not employ non-supervisory workers

E.12 TIMING OF ADOPTION FOR SPECIALIZED SOFTWARE TECHNOLOGY – PROCESSES AND METHODS

Approximately what year did this business first adopt or use Specialized Software Technology in processes and methods? Please enter the year to the best of your knowledge (even if approximate).

_ _ _ _

☐ Don't know the year

E.13 MOTIVATION FOR SPECIALIZED SOFTWARE TECHNOLOGY ADOPTION AND UTILIZATION – PROCESSES AND METHODS

During the three years 2020 to 2022, why did this business adopt or use Specialized Software? Select all that apply.

- ☐ To automate tasks performed by labor
- ☐ To replace or upgrade already existing automated processes
- ☐ To improve quality or reliability of processes or methods
- ☐ To improve quality or reliability of goods or services
- ☐ To expand the range of goods or services
- ☐ To adopt standards and accreditation
- ☐ Some other reason

E.14 IMPACT OF SPECIALIZED SOFTWARE TECHNOLOGY ON WORKFORCE – PROCESSES AND METHODS

During the three years 2020 to 2022, what were the effects of adopting or using Specialized Software on the following?

A. The number of workers employed by this business

- ☐ Increased
- ☐ Decreased
- ☐ Did not change

B. The skill level of workers employed by this business

- ☐ Increased overall
- ☐ Decreased overall
- ☐ Did not change overall

C. The scientific, technological, engineering, and mathematical skills of workers employed by this business

- ☐ Increased overall
- ☐ Decreased overall
- ☐ Did not change overall
- ☐ Not applicable, we did not employ workers with scientific, technological, engineering and mathematical skills

E.15 IMPACT OF SPECIALIZED SOFTWARE TECHNOLOGY ON WORKER TYPES – PROCESSES AND METHODS

Indicate what effect Specialized Software had on the following types of workers employed by this business during the three years 2020 to 2022.

A. The ratio of production workers to non-production workers

- ☐ Increased
- ☐ Decreased
- ☐ Did not change
- ☐ Not applicable, we did not employ production workers
- ☐ Not applicable, we did not employ non-production workers

B. The ratio of non-supervisory workers to supervisory workers

- ☐ Increased
- ☐ Decreased
- ☐ Did not change
- ☐ Not applicable, we did not employ supervisory workers
- ☐ Not applicable, we did not employ non-supervisory workers

E.16 TIMING OF ADOPTION FOR ROBOTICS TECHNOLOGY – PROCESSES AND METHODS

Approximately what year did this business first adopt or use Robotics in processes and methods? Please enter the year.

_ _ _ _

☐ Don't know the year

E.17 MOTIVATION FOR ROBOTICS TECHNOLOGY ADOPTION AND UTILIZATION – PROCESSES AND METHODS

During the three years 2020 to 2022, why did this business adopt or use Robotics? Select all that apply.

- ☐ To automate tasks performed by labor
- ☐ To replace or upgrade already existing automated processes
- ☐ To improve quality or reliability of processes or methods
- ☐ To improve quality or reliability of goods or services
- ☐ To expand the range of goods or services
- ☐ To adopt standards and accreditation
- ☐ Some other reason

E.18 IMPACT OF ROBOTICS TECHNOLOGY ON WORKFORCE – PROCESSES AND METHODS

During the three years 2020 to 2022, what were the effects of adopting or using Robotics on the following?

A. The number of workers employed by this business

☐ Increased

☐ Decreased

☐ Did not change

B. The skill level of workers employed by this business

☐ Increased overall

☐ Decreased overall

☐ Did not change overall

C. The scientific, technological, engineering, and mathematical skills of workers employed by this business

☐ Increased overall

☐ Decreased overall

☐ Did not change overall

☐ Not applicable, we did not employ workers with scientific, technological, engineering and mathematical skills

E.19 IMPACT OF ROBOTICS TECHNOLOGY ON WORKER TYPES – PROCESSES AND METHODS

Indicate what effect Robotics had on the following types of workers employed by this business during the three years 2020 to 2022.

A. The ratio of production workers to non-production workers

☐ Increased

☐ Decreased

☐ Did not change

☐ Not applicable, we did not employ production workers

☐ Not applicable, we did not employ non-production workers

B. The ratio of non-supervisory workers to supervisory workers

☐ Increased

- ☐ Decreased
- ☐ Did not change
- ☐ Not applicable, we did not employ supervisory workers
- ☐ Not applicable, we did not employ non-supervisory workers

E.20 TIMING OF ADOPTION FOR SPECIALIZED EQUIPMENT – PROCESSES AND METHODS

Approximately what year did this business first adopt or use Specialized Equipment in processes and methods? Please enter the year to the best of your knowledge (even if approximate).

_ _ _ _

☐ Don't know the year

E.21 MOTIVATION FOR SPECIALIZED EQUIPMENT TECHNOLOGY ADOPTION AND UTILIZATION – PROCESSES AND METHODS

During the three years 2020 to 2022, why did this business adopt or use Specialized Equipment? Select all that apply.

- ☐ To automate tasks performed by labor
- ☐ To replace or upgrade already existing automated processes
- ☐ To improve quality or reliability of processes or methods
- ☐ To improve quality or reliability of goods or services
- ☐ To expand the range of goods or services
- ☐ To adopt standards and accreditation
- ☐ Some other reason

E.22 IMPACT OF SPECIALIZED EQUIPMENT TECHNOLOGY ON WORKFORCE – PROCESSES AND METHODS

During the three years 2020 to 2022, what were the effects of adopting or using Specialized Equipment on the following?

A. The number of workers employed by this business

- ☐ Increased
- ☐ Decreased
- ☐ Did not change

B. The skill level of workers employed by this business

- ☐ Increased overall

☐ Decreased overall

☐ Did not change overall

C. The scientific, technological, engineering, and mathematical skills of workers employed by this business

☐ Increased overall

☐ Decreased overall

☐ Did not change overall

☐ Not applicable, we did not employ workers with scientific, technological, engineering and mathematical skills

E.23 IMPACT OF SPECIALIZED EQUIPMENT TECHNOLOGY ON WORKER TYPES – PROCESSES AND METHODS

Indicate what effect Specialized Equipment had on the following types of workers employed by this business during the three years 2020 to 2022.

A. The ratio of production workers to non-production workers

☐ Increased

☐ Decreased

☐ Did not change

☐ Not applicable, we did not employ production workers

☐ Not applicable, we did not employ non-production workers

B. The ratio of non-supervisory workers to supervisory workers

☐ Increased

☐ Decreased

☐ Did not change

☐ Not applicable, we did not employ supervisory workers

☐ Not applicable, we did not employ non-supervisory workers

E.24 IMPACT OF THE COVID-19 PANDEMIC ON AUTOMATION

During the period 2020-2022, did the COVID-19 pandemic specifically affect automation of tasks performed by labor in this business?

(Automation refers to automatically controlled operation of an apparatus, process, or system by mechanical or electronic devices or software that take the place of human labor)

- ☐ Yes, increased automation of tasks performed by labor
- ☐ Yes, decreased automation of tasks performed by labor
- ☐ No, did not change automation of tasks performed by labor
- ☐ Not applicable, this business did not have any tasks performed by labor that could be automated

E.25 TECHNOLOGY BASED GOODS AND SERVICES

During the three years 2020 to 2022, did this business sell the following technologies or provide goods or services that included the following technologies?

Artificial Intelligence

- ☐ Yes
- ☐ No
- ☐ Don't know

Cloud-based Computing Systems and Applications

- ☐ Yes
- ☐ No
- ☐ Don't know

Specialized Software

- ☐ Yes
- ☐ No
- ☐ Don't know

Robotics

- ☐ Yes
- ☐ No
- ☐ Don't know

Specialized Equipment

- ☐ Yes
- ☐ No
- ☐ Don't know

Appendix F: Round Two Protocol

2023 ABS Content Testing

Protocol

Aryn Hernandez

Krysten Mesner

General Research Questions:

- Do respondents understand what information they were asked to provide with this question?
- Do respondents understand the terminology used in the question?
- Are respondents able to answer the question that is being asked?
- Is the question layout clear and understandable?
- Is the requested information available in respondent's records?
- Are the lists/categories organized effectively?
- Are the instructions helpful to respondents?

Informed Consent: Respondents will be asked to complete a consent form electronically before the time of the interview.

Materials Needed:

- Electronically signed consent form
- Copy of questionnaire

Introduction

- Introduce everyone on the call
- Thank respondent for completing the survey
- Brief overview of why survey exists and role of NSF and Census
 - The Annual Business Survey (ABS) is conducted jointly by the U.S. Census Bureau and the National Center for Science and Engineering Statistics within the National Science Foundation. ABS provides information on selected economic and demographic characteristics for businesses and business owners. Additionally, the survey measures research and development, innovation and technology, as well as other business characteristics
- Tell respondent why we asked to speak with them
 - Suggestions for improvement
 - Refine questions and make them easier to answer

Recording the interview

- As mentioned in the consent form that you signed, we would like to record this interview so that we have an accurate record of your feedback. We plan to use your feedback to improve the design and layout of the form for future data collections. Only staff involved in this data collection will have access to the recording. Would that be ok? If respondent says no, move on.

About the Respondent

- Can you tell us a little bit about your business -- what types of goods or services does this business provide?
- What is your role in the company? What kind of responsibilities do you have?

General probes that may be used for any question or module throughout the interview:

- In your own words, what is this question asking?
- Reflect back on respondent's answer: "you said..."
- How did you arrive at this number/answer this question?
- What records (if any) would you look at?
- Specifically, what would you include in this answer? What would you exclude?
- Would you consult other people to obtain this answer?
- How easy or difficult is it to answer this question?

Additional Probes Specific to Modules and Questions

Sustainability Management Module

Throughout this module, remain neutral on climate change, but note if the R has strong opinions or objections to these questions.

Intro:

- Please take a minute to read the introduction above the first question.
- What sort of questions are you expecting to see in this module?
- What does sustainability mean to you?
 - In relation to your company? Can you give me some examples?

Questions:

22. How would you define 'business priority' in the context of this question?
 - a. Do all of the items make sense, are there any you are unfamiliar with?
 - b. Would you put anything under other?
 - c. When thinking about how you would answer this question, were you thinking about the time frame from 2020 to 2022?
23. *Note how respondents react to item C, as it is similar to item A.*
 - a. How would you determine importance?
 - b. Do you have any thoughts about the answer categories/column headers?
 - c. Do all of the items make sense, are there any you are unfamiliar with?
 - d. Would you put anything under other?
24. What does 'realized' mean to you in the context of this question?
 - a. *If 'realized' is confusing:* is there another term or phrase that would make more sense here?
 - b. Do you think anything is missing with the response categories?
 - c. Do all of the items make sense, are any there any you are unfamiliar with?
 - d. Would you put anything under other?
25. *Note how respondents react to column headers and if there is any confusion. Note that item E is mainly relevant to manufacturing.*
 - a. *If R answers yes to any items:* Can you give me examples of what you track and how you track it?
 - b. Do you have any outside or consulting companies track these for you?
 - c. Do you have any thoughts about the answer categories/column headers?
 - d. Do all of the items make sense, are there any you are unfamiliar with?
 - i. Is the possible double counting of 4a. and 4b. with 4d. (HVAC) confusing?
26. *If R answers yes:* Can you give me examples or the name of the software you use?
27. *If R answers yes:* Can you give some examples of what your company tracks?
 - a. *If R answers limited tracking and estimates:* Can you tell me more about that?
 - i. Can you give me examples of the types of tracking or evaluation your company is doing?

- b. Do you find the text in parentheses and what is in italics helpful or unhelpful?
- 28. How do you define 'value chains'?
 - a. What does this term mean to you in the context of this question?
 - b. Do all of the items make sense, are there any you are unfamiliar with?
 - c. Are there any other challenges that are missing from our list?
- 29. *If R answers yes:* can you tell me more about that? Can you give me any examples?
 - a. How do you define "develop a plan"?
- 30. *If R answers yes:* can you tell me more about that? Can you give me any examples?
- 31. Do all of the items make sense, are there any you are unfamiliar with?
 - a. Particularly, can you tell me what item D is asking in your own words?
 - b. Are there any other strategies that are missing from our list?
 - c. When answering this question, what time frame were you thinking about?
- 32. *Note if R has difficulty in choosing an answer category. Note if R asks if the target date pertains to only Scope 1 & 2 or to Scope 1, 2 & 3.*
 - a. Do these answer categories make sense to you, or are they confusing?
- 33. *Note if R mentions negative carbon emissions (highly unlikely). Note if R asks if the target goal pertains to only Scope 1 & 2 or to Scope 1, 2 & 3.*
 - a. Do these answer categories make sense to you, or are they confusing?
- 34. Do all of the items make sense, are there any you are unfamiliar with?
 - a. Are there any other effects that are missing from our list?
- 35. *If R answers yes to any items, ask for examples.*
 - a. Do all of the items make sense, are there any you are unfamiliar with?
 - i. In your own words, what is the difference between items E and F?
 - ii. We're particularly interested in Item G, can you tell me what Item G means to you in your own words? *Note if R includes recycling.*
 - b. Are there any other activities that are missing from our list?
- 36. *Starting from question 15, the questions may be redundant, note if R mentions it.*
 - a. What do 'strategic objectives' mean to you in context of this question?
 - b. *If R answers yes:* Can you give me any examples?
- 37. General probes
- 38. *If R answers yes to any items, ask for examples.*
- 39. *If R answers yes:* can you give me any examples?
 - a. When answering this question, what time period were you thinking of?
- 40. Were the includes helpful or unhelpful?
 - a. *If R answers yes:* can you give me any examples?
 - b. When answering this question, what time period were you thinking of?
- 41. *If R answers yes:* can you give me any examples?
 - a. When answering this question, what time period were you thinking of?
- 42. *After general probes, and if it was not obvious:* When answering this question, what time period were you thinking of?

- Having gone through this entire section, about how long do you think it would take you to complete?
- Would you be able fill out this section, or would you need help from someone else in your company fill it out?

Innovation Module

We are primarily interested in how Rs handle the 3 year reference period.

C1 - C2:

- *Note if R notices the three year time period, if not:* When answering this question, what time period were you thinking of?
- How easy or difficult is it to recall innovations made in the last three years?
- Is this a question you would refer to records or another person to answer, or would you answer from memory?
- Would you answer the questions differently if you were only asked about one year?

C3: *Note if R notices the change of reference period to 1 year.*

- When answering this question, what time period were you thinking of?

C4 – C18: *Skip for time*

C19: Do you have any thoughts about the answer categories/column headers?

- What does a 'great extent' mean to you?
- Do all of the items make sense, are there any you are unfamiliar with?
- Can you think of any items missing from our list?
- *If testing with the sustainability module within the same interview, note any reactions or questions that might be informative for the sustainability module.*

C20: *General Probes, or skip for time.*

- Having gone through this entire section, about how long do you think it would take you to complete?
- Would you fill out this section, or would someone else in your company fill it out?

Technology Transfer Module:

12. Are the includes helpful or unhelpful?
 - a. Do all of the items make sense, are there any you are unfamiliar with?
 - b. Are there other R&D activities that we are missing from this list?
13. General probes
 - a. How easy or difficult would it be to provide this dollar amount?
14. Does your company have any intellectual property? Can you give me any examples?

- a. Do all of the items make sense, are there any you are unfamiliar with?
 - b. Are there other formal IP protections that we are missing from this list?
 - 15. Do all of the items make sense, are there any you are unfamiliar with?
 - a. Are there other informal IP protections that we are missing from this list?
 - 16. General probes
 - 17. General probes
 - 18. Do all of the items make sense, are there any you are unfamiliar with?
 - a. What does a 'companies that are not affiliated' mean to you?
 - b. Are there other mechanisms of transfer that we are missing from this list?
 - 19. Do all of the items make sense, are there any you are unfamiliar with?
 - a. Are there other collaborative activities or agreements that we are missing from this list?
 - 20. Do all of the items make sense, are there any you are unfamiliar with?
 - a. Are there other collaborative activities or agreements that we are missing from this list?
 - b. Is it always clear if the organizations you work with are federal government laboratories?
 - 21. Note that this question has the same title, and this may confuse R (this will be changed).
 - a. If you work with federal government laboratories, is it obvious which parent agency the lab operates under? How would you go about answering this question if it was not obvious?
 - 22. *If R answers yes to any item, ask for examples. Note if R includes charitable donations in any item.*
 - a. Do all of the items make sense, are there any you are unfamiliar with?
 - b. Are there other collaborative activities or agreements that we are missing from this list?
 - c. Is it always clear if the organizations you work nonprofits?
- Having gone through this entire section, about how long do you think it would take you to complete?
 - Would you fill out this section, or would someone else in your company fill it out?

Technology and Intellectual Property Module

Note if R mentions that the tech transfer module has similarities to this one. You can prob on if the R feels that they should be in the same module or not.

Take a moment to read the definitions at the beginning of this section.

- Explain that the section is about these 5 technologies
- Does your company use any of these technologies, can you give me any examples?
- Do our definitions make sense? Do they match the way you think of these technologies, or do they differ?

E3: *This question is lengthy, note if R comments on it and note that it sets the stage for the remaining questions.*

- First part of question:
 - Do the answer choices make sense, are there any you are unfamiliar with?
 - Are we missing any categories?
- Second part of question:
 - What total costs were you thinking about when answering this question? How did you determine which percentage to choose?
 - How would you distinguish between, low, medium and high? Would another scale work better? What about about actual percentages?

If they answered yes to any of the five sections in E.3 ask the following questions:

- Artificial Intelligence: go to Question E.4
- Cloud-based Computing Systems and Applications: go to Question E.8
- Specialized Software (excluding Artificial Intelligence: go to Question E.12
- Robotics: go to Question E.16
- Specialized Equipment (excluding Robotics): go to Question E.20

E4: How easy or difficult is it to provide a year?

- Would it be easier or more difficult to write in an estimated year?

E5: Do the categories make sense, are there any that are confusing?

- Are there any categories missing?
- *Ask how their answer could differ for each Tech they said they use in question E3.*

E6: *Note if R notices 3 year time period*

- How do you determine if skill level changed?
- Are you able to differentiate the STEM skills specifically?
- Would you consult any records when answering this question?

E7: How would you determine your answer to this question?

- Is it clear or unclear what is meant by ratio?
- Are you able to easily differentiate production vs non-production workers? Is this distinction in your records?
- Would it more clear or less clear to ask if the number of production workers to non-production workers increased or decreased?
- Are supervisory and non-supervisory workers distinct categories to you?

These questions repeat for every one of the technologies listed in the beginning, do you feel like this set of questions would be more difficult for any of the technologies?

Let's skip to question 24.

E24: How would you answer this question?

- Is the definition of automation provided clear or unclear?
- *However R answers:* can you tell me more about that or give me some examples?

E25: Can skip for time, otherwise, general probes.

- Having gone through this entire section, about how long do you think it would take you to complete?
- Would you fill out this section, or would someone else in your company fill it out?

Labor Related Questions

These questions will only be tested online via Qualtrics.

1: General Probes

- How would you determine your answer to this question?
- Are supervisory and non-supervisory workers distinct categories to you?

2: General Probes

3: General Probes

- What does 'certified' mean to you in the context of this question?

Wrap up

- Overall, which questions did you feel like were the most time consuming or difficult to complete?
- Do you have any other comments or additional feedback?

Thank you for your time!

Appendix G: Sustainability Management Module (Round Two)

Draft of Sustainability Management Module (09/06/2022)

2023 Annual Business Survey

Sustainability management addresses how the operation of your business is affected by demands from consumers, other businesses, and the government to meet the needs of present and future generations and the environment. These questions collect information on what your business is doing in response to or in anticipation of these demands. All responses are anonymized and will only be used for statistical purposes.

1. BUSINESS PRIORITY

Over the past 3 years, from 2020 through 2022, have any of the following been this business's priority?
Select one for each row.

	Yes	No
a. Improving profitability	<input type="checkbox"/>	<input type="checkbox"/>
b. Increasing revenue	<input type="checkbox"/>	<input type="checkbox"/>
c. Accelerating digital transformation activities/improving cybersecurity	<input type="checkbox"/>	<input type="checkbox"/>
d. Implementing or maturing sustainability initiatives	<input type="checkbox"/>	<input type="checkbox"/>
e. Improving the customer experience	<input type="checkbox"/>	<input type="checkbox"/>
f. Improving resilience to competitive pressures	<input type="checkbox"/>	<input type="checkbox"/>
g. Other (Specify)		
_____	<input type="checkbox"/>	<input type="checkbox"/>

If you reported 'Yes' for item d. 'Implementing or maturing sustainability initiatives', continue to '2. Sustainability Prioritization'.

All others skip to '4. Energy or Carbon Emissions Tracking'.

2. SUSTAINABILITY PRIORITIZATION

How important to this business were each of the following factors for prioritizing sustainability?

	Very Important	Somewhat Important	Not Important
a. Attracting customers who make purchasing decisions based on sustainable products or sustainable business values	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Integrating sustainable value proposition into the company's brand	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Addressing stakeholder demand for climate risk disclosures and better sustainability management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Employee recruitment/retention tied to sustainable business values	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Green procurement requiring life-cycle assessment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Some other (Specify)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

3. SUSTAINABILITY OBJECTIVES

Has this business realized any of the following benefits from pursuing its sustainability goals? Select one for each row.

	Yes	No
a. Improved efficiency	<input type="checkbox"/>	<input type="checkbox"/>
b. Improved regulatory compliance	<input type="checkbox"/>	<input type="checkbox"/>
c. Improved employee recruitment and/or retention	<input type="checkbox"/>	<input type="checkbox"/>
d. Reduced waste	<input type="checkbox"/>	<input type="checkbox"/>
e. Improved brand reputation	<input type="checkbox"/>	<input type="checkbox"/>
f. Decreased costs	<input type="checkbox"/>	<input type="checkbox"/>
g. Improved customer acquisition and/or loyalty	<input type="checkbox"/>	<input type="checkbox"/>
h. Increased revenue	<input type="checkbox"/>	<input type="checkbox"/>
i. Other (Specify)	<input type="checkbox"/>	<input type="checkbox"/>
_____	<input type="checkbox"/>	<input type="checkbox"/>

4. ENERGY OR CARBON EMISSIONS TRACKING

Does this business track energy use or carbon emissions from the following sources?

	No, does not track either Source is not applicable to this business or is inaccessible	Yes, tracks Energy Expenditures	Yes, tracks Carbon Emissions
a. Heating of buildings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Cooling of buildings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Fleet transportation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- d. Electricity (used for lighting, computing, HVAC, production, etc.) ? ? ? ?
- e. Thermal energy in production (for example, from natural gas, petroleum, coal, biomass, etc.)
? ? ? ?

5. CARBON EMISSIONS SOFTWARE USE

Does this business use any carbon emissions reporting software?

- ☐ Yes
- ☐ No
- ☐ Don't Know

6. INDIRECT CARBON EMISSIONS TRACKING

Does this business track indirect carbon emissions that are a consequence of the activities of the business but from assets not owned or controlled by the business? For example, emissions from employee commuting, transportation and distribution, use of sold products, etc. Also known as 'value chain' or 'Scope 3.'

- ☐ No, does not track - Skip to '8. Carbon Emissions Reduction Plan'
- ☐ Not yet, but some evaluation of major carbon hotspots
- ☐ Yes, major carbon hotspots tracked

7. INDIRECT CARBON EMISSIONS POTENTIAL CHALLENGES

Does this business expect to face any of the following challenges to measuring indirect carbon emission in its value chain (Scope 3)? Select one for each row.

Yes No

- a. The company is not aligned internally on what to track and how. ? ?
- b. The company lacks data from suppliers or end users. ? ?

- c. The company lacks in-house expertise.
- d. The company lacks financial resources. ☐

☐ ☐

☐

8. CARBON EMISSIONS REDUCTION PLAN

Has this business developed plans for reducing carbon emissions?

- ☐ Yes - Skip to '10. Carbon Emissions Strategies'
- ☐ No

9. FUTURE PLANS FOR CARBON EMISSIONS

Is this business considering developing plans in the future for reducing carbon emissions?

- ☐ Yes
- ☐ No - Skip to '13. Sustainability Alternatives'

10. CARBON EMISSIONS STRATEGIES

Will this business implement any of the following strategies to reduce carbon emissions? Select one for each row.

Yes No

- a. Eliminating products or activities reliant on fossil fuel use by changing the company's product or service mix ☐ ☐
- b. Replacing fossil fuel using activities with zero or low emissions alternatives (for example, adding electric vehicles to the company's fleet) ☐ ☐
- c. Reducing carbon emissions by increasing the efficiency of activities using fossil fuels ☐ ☐

- d. Offsetting carbon emissions that cannot be abated by supporting projects that reduce carbon emissions elsewhere (e.g., providing funds for reforestation or capping abandoned oil wells) ☐
- ☐

11. CARBON EMISSIONS REDUCTION GOAL DATE

What is the target date for achieving this business's carbon emissions reduction goals?

- ☐ No target date set
- ☐ No later than 2030
- ☐ No later than 2040
- ☐ No later than 2050
- ☐ After 2050

12. CARBON EMISSIONS REDUCTION GOAL OBJECTIVE

How much of a reduction carbon emissions is this business planning?

- ☐ No reduction goal set
- ☐ Less than 25% reduction
- ☐ 25-50% reduction
- ☐ More than 50%, but less than 100% reduction
- ☐ 100% reduction

13. SUSTAINABILITY ALTERNATIVES

If this business is not successful at improving sustainability, does the business foresee any of the following effects? Select one for each row.

Yes No

- a. Fines for lack of compliance with regulations ☐ ☐

- b. Inability to raise capital or secure credit ☐ ☐
- c. A loss of customer trust ☐ ☐
- d. A loss of brand reputation ☐ ☐
- e. Hiring difficulties or lower employee retention ☐ ☐
- f. Financial risks associated with future policy changes such as a carbon tax ☐ ☐
- g. Lost sales due to inability to provide emissions or other environmental information to potential customers ☐ ☐

14. SUSTAINABILITY INVESTMENTS

Is this business making any of the following investments to improve sustainability? Select one for each row.

- | | Yes | No | Not applicable |
|---|--------------------------|--------------------------|--------------------------|
| a. Purchase power agreements for renewable energy | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| b. Renewable energy generation on-site (e.g., solar, wind, geothermal) | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| c. Battery storage or other means of saving renewable energy generation for later use | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| d. Improved energy efficiency and management | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| e. Engineering innovation to improve sustainability of our materials (e.g., innovating to produce goods with lower CO2 content) | | | |
| f. Redesigning processes to make similar products with less environmental impacts | | | <input type="checkbox"/> |

☐ ☐

☐ ☐

☐

g. Elimination of waste through circular economy or design for re-use strategies ☐ ☐
☐

h. Recycling initiatives going beyond municipal mandates ☐ ☐ ☐

15. STRATEGIC OBJECTIVES AND THE ENVIRONMENT

Does this business have strategic objectives that mention environmental or climate change issues?

- ☐ Yes
- ☐ No
- ☐ Don't Know

16. ENVIRONMENTAL MANAGER

Does this business have a manager responsible for environmental and climate change issues?

- ☐ Yes
- ☐ No
- ☐ Don't Know

17. ENVIRONMENTAL CERTIFICATIONS

Do any of this business's customers require environmental certifications or adherence to certain environmental standards as a condition to do business with them?

- ☐ Yes

- ☐ No
- ☐ Don't Know

18. CO2 EMISSIONS MONITORING

Over the last 3 years, from 2020 through 2022, has this business monitored CO2 emissions along its supply chain?

- ☐ Yes
- ☐ No
- ☐ Don't Know

19. EXTREME WEATHER EVENTS AND IMPACT

Over the last 3 years, from 2020 through 2022, has this business experienced monetary losses due to extreme weather events? For example, hurricanes, floods, droughts, or heat waves.

Include:

- Incurred costs
- Losses of sales or assets.
- ☐ Yes
- ☐ No
- ☐ Don't Know

20. INVESTMENTS TO MITIGATE RISK

Over the last 3 years, from 2020 through 2022, has this business undertaken investments to reduce the risk of damages caused by extreme weather events? For example, hurricanes, floods, droughts, wildfires, or heat waves.

- ☐ Yes
- ☐ No
- ☐ Don't Know

21. FUTURE IMPACTS DUE TO EXTREME WEATHER

Over the next decade, how likely is this business to experience negative impacts from extreme weather events?

For example, hurricanes, floods, droughts, wildfires, or heat waves.

- ☐ Not at all likely
- ☐ A little likely
- ☐ Somewhat likely
- ☐ Very likely
- ☐ Extremely likely

Appendix H: Innovation Module (Round Two)

DRAFT INNOVATION MODULE FOR ABS 2023 (Year 6)

GOODS, SERVICES, AND BUSINESS PROCESSES

The following section collects information on this business's introduction of new or improved goods, services, or business processes that differed significantly from this business's previous goods, services, or processes.

The goods, services, or business processes must have characteristics or intended uses that are new or improved, and which differ significantly from what was previously used or sold by this business. However, they can fail or take time to prove themselves.

The goods, services, or business processes need only be new or improved for this business. They could have

been originally developed or used by other businesses or organizations.

The following section asks about the 2020 to 2022 time period, instead of one year as in other sections of this

survey.

C.1 NEW OR IMPROVED GOODS

During the three years 2020 to 2022, did this business introduce to the market any new or improved goods that differed significantly from this business's previous goods?

This includes the addition of new functions or improvements to existing functions or user utility.

- Functions include the following: quality, technical specifications, reliability, durability, economic efficiency during use, affordability, convenience, usability, and user friendliness.
- User utility includes attributes such as affordability and financial convenience.

Goods: usually a tangible object such as a smartphone, furniture, or packaged software, but also includes digital goods such as downloadable software, music and film. (Exclude the simple resale of new goods or changes of a solely aesthetic nature.)

- ☐ Yes, this business introduced a new or improved good that was new to the market, which was not previously offered by any of your competitors (it may have already been available in other markets)
- ☐ Yes, this business introduced a new or improved good that was new only to this business, which was identical or very similar to products already offered by your competitors
- ☐ No

C.2 NEW OR IMPROVED SERVICES

During the three years 2020 to 2022, did this business introduce to the market any new or improved services that differed significantly from this business's previous services?

This includes the addition of new functions or improvements to existing functions or user utility.

- Functions include quality, technical specifications, reliability, durability, economic efficiency during use, affordability, convenience, usability, and user friendliness.
- User utility includes attributes such as affordability and financial convenience.

Services: intangible activities, such as retailing, insurance, educational courses, air travel, consulting, etc., also includes digital services. (Exclude the simple resale of new services.)

- ☐ Yes, this business introduced a new or improved service that was new to the market, which was not previously offered by any of your competitors (it may have already been available in other markets)
- ☐ Yes, this business introduced a new or improved service that was new only to this business, which was identical or very similar to services already offered by your competitors
- ☐ No

If "No" is selected for 'C.1 New or Improved Goods' and "No" is selected for 'C.2 New or Improved Services,' skip to 'C.9 New or Improved Business Processes'.

C.3 NEW OR IMPROVED GOODS OR SERVICES AS PERCENT OF TOTAL SALES

In 2022, what percentage of this business's 'A.11 DOMESTIC SALES AND REVENUES' on page # in domestic sales and revenues were attributable to or originated from domestic operations in the following categories?

Details must sum to 100% of total dollar amount of 'A.11 Domestic Sales and Revenues'.

Estimates are acceptable.

- a. New or improved goods or services introduced during 2020 to 2022 that were. %
new to your market.
- b. New or improved goods or services introduced during 2020 to 2022 that were %
new only to this business.
- c. Goods or services that were unchanged or only marginally modified during
2020 to 2022 (include the resale of new goods or services purchased from
other companies). %

Total sales in 2022 = 100%

C.4 EXPECTATIONS

Did the new or improved goods or services introduced during 2020 to 2022 meet this business's expectations, such as market share, sales or profits as of December 2022?

- ☐ Yes, expectations were exceeded
- ☐ Yes, expectations were met
- ☐ No, Expectations were not met
- ☐ Too early to tell

C.5 SOURCES OF NEW OR IMPROVED GOODS OR SERVICES

Who developed these new or improved goods or services? Select all that apply

- o This business by itself
- o This business together with other businesses, universities, research institutes, nonprofits, or other organizations
- o This business by adapting or modifying goods or services originally developed by other businesses or organizations
- o Other businesses or organizations

C.6 MOST IMPORTANT INNOVATION

Thinking about the most important good or service this business introduced during 2020 to 2022, was that good or service new to the market or new only to this business?

- o New to the market - This business introduced a new or improved good or service that was not previously offered by any of your competitors (it may have already been available in other markets)
- o New only to this business - This business introduced a new or improved good or service that was identical or very similar to goods or services already offered by your competitors

If you reported \$0 for 'A.11 – Domestic Sales and Revenues', skip to 'C.9 – New or Improved Business Processes'.

C.7 MOST IMPORTANT INNOVATION AND SALES

In 2022, what percentage of this business's 'A.11 DOMESTIC SALES AND REVENUES' in domestic sales and revenues were attributed to this business's most important innovation? Estimates are acceptable.

%

C.8 NEW OR IMPROVED BUSINESS PROCESSES

During the three years 2020 to 2022, did this business introduce any of the following types of new or improved business processes that differed significantly (e.g. greater efficacy, resource efficiency, reliability and resilience, affordability, convenience and usability) from your previous business processes? Select one for each row.

Yes No

- a. Methods for producing goods or providing services (including methods related to engineering and related technical testing, analysis and certification)
- b. Logistics, delivery or distribution methods
- c. Marketing methods for promotion, packaging, pricing, product placement or after sales services
- d. Information and communication systems (including hardware, software and data processing)
- e. Administration and management activities (including decision-making, human resource management, and methods for accounting or other administrative operations)
- f. Product and business process development activities (including activities to identify, develop, or adapt products or processes, or adopting new methodologies for developing products and processes)

If no is selected for a. – f., skip to 'C.11 Goods, Services, or Business Process Activities'.

C.9 IMPROVED BUSINESS PROCESS DEVELOPERS

Who developed these new or improved business processes? Select all that apply.

- o This business by itself
- o This business together with other businesses, universities, research institutes, nonprofits, or other organizations
- o This business by adapting or modifying business processes originally developed by other businesses or organizations
- o Other businesses or organizations

C.10 GOODS, SERVICES, OR BUSINESS PROCESS ACTIVITIES

During the three years 2020 to 2022, did this business have any of the following types of innovation activities?

- Include all developmental, financial, and commercial activities that were intended to result in a new or improved good, service or business process that differed significantly from your previous goods, services, or business processes.
- Similar activities that were not intended to result in a new or improved good, service or business process should not be reported here. (e.g., employee training intended for general maintenance of skills are not considered “innovation activities”)
- Simple replacement of machinery without enhanced capabilities are not considered “innovation activities”

Select one for each row.

Yes No

a. Research and development: creative and systematic work undertaken in order to increase the stock of knowledge and to devise new applications of available knowledge

- b. Engineering and design activities: planning of technical specifications, testing, evaluation, setup and pre-production for goods, services, processes or systems; installing equipment, tooling- up, testing, trials and user demonstrations; and activities to extract knowledge or design information from existing products or process equipment. Also include activities to develop a new or modified function, form or appearance for goods, services, or processes
- c. Marketing and brand equity activities: include market research, market testing, methods for pricing, product placement and product promotion; product advertising, the promotion of products at trade fairs or exhibitions, and the development of marketing strategies
- d. Intellectual Property (IP) related activities: protection or exploitation of knowledge, often created through R&D, software development, and engineering, design and other creative work, including all related administrative and legal work
- e. Employee training: activities that are paid for or subsidized by the firm to develop knowledge and skills required for the specific trade, occupation or vocation of a firm's employees
- f. Software development and database activities: in-house development and purchase of computer software; collection and analysis of data in proprietary computer databases and data obtained from publicly-available reports or the Internet; and activities to upgrade or expand the functions of IT systems, including computer program and databases
- g. Acquisition of machinery, equipment and other tangible assets
- h. Management related to innovation: Activities to plan, govern and control internal and external resources

C.11 COOPERATION ON INNOVATION (CIS question 3.11).

During the three years 2020 to 2022, did your enterprise co-operate with other enterprises or organizations?

Cooperation occurs when two or more participants agree to take responsibility for a task or series of tasks and information is shared between the parties to facilitate the agreement.

Yes No

- a) On R&D
- b) On other innovation activities (excluding R&D)
- c) On any other business activities

If C.12 b equals yes ask C.13 else go to skip pattern before C.14

C.12 COOPERATION PARTNER LOCATION (CIS question 3.12)

Please indicate the type of innovation co-operation partner by location

Type of innovation co-operation partner:	USA	Canada/ Mexico	Rest of World
--	-----	-------------------	------------------

- a) Business enterprises outside your enterprise group
 - a.1 Consultants, commercial labs, or private research institutes
 - a.2 Suppliers of equipment, materials, components, or software
 - a.3 Enterprises that are your clients or customers
 - a.4 Enterprises that are your competitors
 - a.5 Other enterprises
- b) Enterprises within your enterprise group
- c) Universities or other higher education institutions
- d) Government or public research institutes
- e) Clients or customers from the public sector*
- f) Non-profit

*The public sector includes government owned organizations such as local, regional and national administrations and agencies, schools, hospitals, and government providers of services such as security, transport, housing, energy, etc.

C.14 is asked only of respondents who say no to all of C.11

C.13 REASONS FOR NO INNOVATION ACTIVITIES

Which of the following best describes why your enterprise had no innovation activities during the three years from 2020 to 2022:

Select one:

A lack of resources prevented us from innovating. (e.g. lack of finance, qualified personnel, material).

We decided not to innovate due to other reasons than a lack of resources. (e.g. strategic reasons; not the right time to innovate; other priorities; risks too high; low expected returns)

We had no innovation activities because there was no need for innovation.

SKIP to question C.18 Government Support – should the skip go to C.18 or C.19

C.15 is asked only of respondents who say yes to one part of C.11

C.14 RESULTS OF INNOVATION ACTIVITIES

During the three years 2020 to 2022, did this business have any innovation activities that did not result in a goods, services, or business process innovation because the activities were: Select one for each row.

Yes No

a. Abandoned or suspended before completion

b. Still ongoing at the end of 2022

C.15 ACTIVITY COSTS

In 2022, how much did this business spend on the innovation activities selected in the activities question and listed below? Note that this question refers only to the year 2022 and not the three-year period, 2017 – 2022. Estimates are acceptable.

- a. Research and development
- b. Engineering and design activities
- c. Marketing and brand equity activities
- d. Intellectual Property (IP) related activities
- e. Employee training
- f. Software development and database activities
- g. Acquisition of machinery, equipment and other tangible assets
- h. Management related to innovation

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i. TOTAL ,000

If yes is selected for from 'C.11 – Goods, Services, or Business Process Activities' and Total Number of W-2 Paid Employees or Employee/Owners from 'A.8 Number of W-2 Paid Employees or Employee/Owners' is greater than or equal to 10 and response to 'C.16 – Activity Costs' does not equal zero, continue to 'C.17 - R&D for Activity Costs'.

All else skip to 'C.18 – Government Support'.

C.16 R&D FOR ACTIVITY COSTS

Of the 'C.15 ACTIVITY COSTS' reported, how much was for research and development (creative and systematic work undertaken in order to increase the stock of knowledge and to devise new applications of available knowledge) in 2022?

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,000

C.17 GOVERNMENT SUPPORT

During the three years 2020 to 2022, did this business use any of the following types of government programs (federal, state, or local) to aid innovation activities?

Select one for each row.

Yes No

- a. Government tax incentive or tax credit programs: Include programs intended to support innovation activities such as research and development or capital expenditures
- b. Government grants and contributions programs: Include programs intended to support innovation activities such as research and development, business development or commercialization of intellectual property
- c. Government training and hiring programs: Include programs intended to support innovation activities such as hiring and training of researchers, interns or other personnel
- d. Government procurement: Include programs intended to support innovation such as the procurement of new or improved goods, services or businesses processes
- e. Other government programs: Include programs and activities to support innovation not included elsewhere such as access to facilities, export incentives, technical assistance, market information or loans

C.18 BARRIERS OF INNOVATION

During the three years 2020 to 2022, how, if at all, were each of the following factors in discouraging this business to conduct innovation activities:

Select one for each row.

Very

discouraging Somewhat

discouraging A little

discouraging Not at all

discouraging

- a. Lack of internal finance for innovation
- b. Lack of credit or private equity
- c. Difficulties in obtaining public grants or subsidies
- d. Costs too high
- e. Lack of skilled employees within this business
- f. Lack of collaboration partners
- g. Lack of access to external knowledge
- h. Uncertain market demand for your ideas
- i. Too much competition in your market
- j. Different priorities within this business
- k. Government Regulations

C.19 INNOVATION AND THE ENVIRONMENT

During the three years 2020 to 2022, did your enterprise introduce innovations with any of the following environmental benefits, and, if yes, was the extent of that contribution a great deal or not?

Environmental benefits obtained within your enterprise

	Yes, a great extent	Yes, but not a great extent	No
extent			

- a. Reduced material or water use per unit of output
- b. Reduced energy use or CO2 'footprint' (i.e. reduced total CO2 emission)
- c. Reduced soil, noise, water or air pollution
- d. Replaced a share of materials with less polluting or hazardous substitutes
- e. Replaced a share of fossil energy with renewable energy
- f. Recycled waste, water, or materials for own use or sale

Environmental benefits obtained during the consumption or use of a good or service by the end user

	Yes, a great extent	Yes, but not a great extent	No
extent			

- a. Reduced energy use or CO2 'footprint'
- b. Reduced air, water, soil or noise pollution
- c. Facilitated recycling of product after use
- d. Extended product life through longer-lasting, more durable, or

easier-to-repair products

C.20 BUSINESS STRATEGIES

During 2020 to 2022, to what extent did the business focus on the following business strategies?

Select one for each row

- a. Improve existing goods or services
- b. Introduce new goods or services
- c. Reduce prices for goods or services
- d. Increase the quality of goods or services
- e. Develop a broad range of products
- f. Develop one or a small number of key products
- g. Satisfy established customers
- h. Reach out to new customers
- i. Develop standardized goods or services (e.g., goods or services are the same regardless of market or customer type)
- j. Develop customer-specific solutions (e.g., customized goods or services)

Appendix I: Technology Transfer (Round Two)

2023 ABS Technology Transfer Module

ABS 2023 (Year 6) - DRAFT

Research and Development

[Note: Skip Questions 1 and 2 for businesses with W-2 employment between 1 and 9.]

What is Research and Development (R&D)?

Research and development (R&D) comprise creative and systematic work undertaken in order to increase the stock of knowledge and to devise new applications of available knowledge.

The term R&D does NOT include expenditures for:

- Costs for routine product testing, quality control, and technical services unless they are an integral part of an R&D project
- Market research
- Efficiency surveys or management studies
- Literary, artistic, or historical projects, such as films, music, or books and other publications
- Prospecting or exploration for natural resources

R&D activity in software INCLUDES:

- Software development or improvement activities that expand scientific or technological knowledge
- Construction of new theories and algorithms in the field of computer science

R&D activity in software EXCLUDES:

- Software development that does not depend on a scientific or technological advance, such as
- supporting or adapting existing systems
- adding functionality to existing application programs, and
- routine debugging of existing systems and software
- Creation of new software based on known methods and applications
- Conversion or translation of existing software and software languages
- Adaptation of a product to a specific client, unless knowledge that significantly improved the base program was added in that process

Reporting unit

The reporting unit is this business, including all subsidiaries and divisions. Include subsidiary companies where there is more than 50 percent ownership.

Reporting period

Report data for the calendar year 2022, if possible, or for this business's fiscal year ending between April 2022 and March 2023.

Estimates are acceptable.

Report all items to the best of your ability.

1. R&D ACTIVITIES

During 2022, did this business do any of the following R&D activities? Include activities that:

- This business performed
- Others paid this business to do
- This business paid others to do

Select one for each row.

Yes No

a. Conducted activities aimed at acquiring new knowledge or understanding without specific immediate commercial applications or uses

☐ ☐

b. Conducted activities aimed at acquiring new knowledge for solving a specific problem or meeting a specific commercial objective

☐ ☐

c. Conducted systematic work, drawing on research and practical experience and resulting in additional knowledge, which is directed to producing new products or processes or to improving existing products or processes

☐ ☐

d. Developed and tested goods, services, or processes that were derived from scientific research or technical findings

☐ ☐

e. Developed software that advanced scientific or technological knowledge

☐ ☐

f. Produced findings that could be published in academic journals or presented at scientific conferences

☐ ☐

g. Applied scientific or technical knowledge in a way that has never been done before

☐ ☐

h. Created new scientific or technical solutions that can be generalized to other situations.

☐ ☐

i. Conducted work to discover previously unknown technological facts, structures, or relationships

☐ ☐

j. Conducted work to extend the understanding of scientific facts, relationships, or principles in ways that could be useful to others ☐ ☐

If “No” is selected for a. – j., skip to ‘3’ on page XX.

2. R&D COSTS

What was the total cost (both direct and indirect) in 2021 for all the R&D activities reported as “Yes” in the ‘1. R&D Activities’ question? Your best estimate is acceptable. Report dollar amount in thousands. If none, report zero.

Include:

- Salaries, wages, fringe benefits
- Plant, machinery, and equipment, except that which was capitalized because it had an alternative future use
- Materials, supplies, software
- Rent, utilities
- Consultants, contractors
- Depreciation expense from plant, machinery, and equipment that was capitalized because it had an alternative future use

Exclude:

- Costs for routine product testing, quality control, and technical services unless they are an integral part of an R&D project
- Market research
- Efficiency surveys or management studies
- Literary, artistic, or historical projects, such as films, music, or books and other publications
- Prospecting or exploration for natural resources
- Capital expenditures (i.e., costs for construction or renovation of facilities)
- Payments/funds in excess of the actual cost of the research work performed (e.g., profits or fees)

\$Mil. | Thou.

Total costs for ‘R&D Activities’ reported in the ‘1 R&D Activities’ question for 2021

\$ _____

3. Formal Intellectual Property Protection

Does this business use the following methods to protect intellectual property?

Yes No

- a. Utility patents (patents for inventions, applied for or awarded)
- b. Design patents (patents for appearance, applied for or awarded)
- c. Copyright
- d. Trademarks

4. Informal Intellectual Property Protection

Does this business use the following less formal means of protecting intellectual property?

Yes No

- a. Design complexity
- b. Nondisclosure agreements or non-compete clauses
- c. Branding and product image
- d. Trade secrets

5. Patents Pending

How many U.S. patent applications, if any, did this business have pending as of the end of 2022? If none, report zero.

6. Patents Owned

How many U.S. patents did this business own as of the end of 2022? If none, enter zero.

7. Intellectual Property Activities

During the three years 2020 to 2022, did your company exchange intellectual property (IP) rights, including patents, copyrights, and trademarks that give ownership, exclusion rights or rights to use technical knowledge using any of the following mechanisms. Select one for each row.

- | Yes | No |
|-----|--|
| a. | Licensed or purchased IP from companies that are not affiliated |
| b. | Licensed or sold intellectual property (IP) to companies that are not affiliated |
| c. | Transferred intellectual property (IP) to companies that are not affiliated through participation in technical assistance or "know how" agreements |
| d. | Received IP from companies that are not affiliated through participation in technical assistance or "know how" agreements |
| e. | Participated in cross-licensing agreements with companies that are not affiliated |
| f. | Acquired or merged with companies that are not affiliated to acquire their IP |
| g. | Transferred IP to a spin-off or spin-out of your company |
| h. | Received IP from a parent company as part of a spin-off or spin-out |
| i. | Allowed free use of patents or other IP owned by this company (for example, allowing free use of software patents by the open-source community) |
| j. | Made use of open-source patents or other freely available IP not owned by this company |

8. Collaboration with Universities

During the three years 2020 to 2022, did this business engage in any of the following collaborative activities with universities? Select one for each row.

Yes No

- a. Performed collaborative research between company and university researchers
- b. Funded university research
- c. Funded PhD students and postdoctoral researchers at universities
- d. Licensed or purchased IP from a university
- e. Signed non-disclosure agreements, material transfer agreements, or other agreements with universities governing usage of IP
- f. Hired science and engineering graduates
- g. Engaged in formal or informal personnel exchanges with universities

9. Collaboration with Government Laboratories

During the three years 2020 to 2022, did this business engage in any of the following collaborative activities with federal laboratories including Federally Funded Research and Development Centers? Select one for each row.

Yes No

- a. Conducted collaborative research using agreements such as Cooperative Research and Development Agreements, Space Act Agreements, Material Transfer Agreements, Confidential Disclosure Agreements, or other transaction authorities
- b. Conducted research at government user facilities
- c. Funded research at government laboratory
- d. Licensed IP from government laboratory
- e. Engaged in formal or informal personnel exchanges with government laboratories
- f. Attended workshops or seminars located at or sponsored by government laboratories

10. Collaboration with Government Laboratories

During the three years 2020 to 2022, did this business engage collaborative activities with federal laboratories in the following departments? Select one for each row.

1. Department of Agriculture
2. Department of Commerce
3. Department of Defense
4. Department of Energy
5. Department of Health and Human Services
6. Department of Homeland Security
7. Department of Transportation
8. Department of Veteran Affairs
9. National Aeronautics and Space Administration
10. Other federal department

11. Collaboration with Nonprofits

During the three years 2020 to 2022, did this business engage in any of the following collaborative activities with nonprofit organizations? Select one for each row.

- | Yes | No |
|-----|--|
| a. | Performed collaborative research between company and nonprofit researchers |
| b. | Funded research at nonprofit organizations |
| c. | Licensed or purchased IP from a nonprofit organization |
| d. | Signed non-disclosure agreements, material transfer agreements, or other agreements with nonprofit organizations governing usage of IP |
| e. | Engaged in formal or informal personnel exchanges with nonprofit research organizations |

Appendix J: Technology and Intellectual Property Module (Round Two)

SECTION E: TECHNOLOGY AND INTELLECTUAL PROPERTY

The following section collects information on intellectual property and technology use for the business. Technology related questions in this section asks about the following technologies:

Artificial Intelligence: Artificial intelligence is a branch of computer science and engineering devoted to making machines intelligent. Intelligence is that quality that enables an entity to perceive, analyze, determine response and act appropriately in its environment.

Cloud-based Computing Systems and Applications: Cloud systems and applications are computing resources available on-demand via the internet.

Specialized Software (excluding Artificial Intelligence): Specialized software is software dedicated to performing a particular business function.

Robotics: Robotic equipment (or robots) are automatically controlled, reprogrammable, and multipurpose machines used in automated operations in industrial and service environments.

Specialized Equipment (excluding Robotics): Specialized equipment is equipment capable of automatically carrying out pre-specified task(s).

E.3 PRODUCTION TECHNOLOGY FOR GOODS AND SERVICES

During the three years 2020 to 2022, did this business adopt/use the following technologies?

Artificial Intelligence

- ☐ This technology is not applicable to this business
- ☐ Applicable, but did not test or use
- ☐ Tested, but did not use as part of the processes or methods
- ☐ Used as part of the processes or methods

- o Don't know

If this business used Artificial Intelligence, what percentage of the total costs were associated with the processes and methods that use Artificial Intelligence?

- o Low percentage
- o Medium percentage
- o High percentage

Cloud-based Computing Systems and Applications

- o This technology is not applicable to this business
- o Applicable, but did not test or use
- o Tested, but did not use as part of the processes or methods
- o Used as part of the processes or methods
- o Don't know

If this business used Cloud-based Computing Systems and Applications, what percentage of the total costs were associated with the processes and methods that use Cloud-based Computing Systems and Applications?

- o Low percentage
- o Medium percentage
- o High percentage

Specialized Software

- o This technology is not applicable to this business
- o Applicable, but did not test or use

- o Tested, but did not use as part of the processes or methods
- o Used as part of the processes or methods
- o Don't know

If this business used Specialized Software, what percentage of the total costs were associated with the processes and methods that use Specialized Software?

- o Low percentage
- o Medium percentage
- o High percentage

Robotics

- o This technology is not applicable to this business
- o Applicable, but did not test or use
- o Tested, but did not use as part of the processes or methods
- o Used as part of the processes or methods
- o Don't know

If this business used Robotics, what percentage of the total costs were associated with the processes and methods that use Robotics?

- o Low percentage
- o Medium percentage
- o High percentage

Specialized Equipment

- o This technology is not applicable to this business
- o Applicable, but did not test or use

- o Tested, but did not use as part of the processes or methods
- o Used as part of the processes or methods
- o Don't know

If this business used Specialized Equipment, what percentage of the total costs were associated with the processes and methods that use Specialized Equipment?

- o Low percentage
- o Medium percentage
- o High percentage

If all answers to E.3 are "This technology is not applicable to this business", "Applicable, but did not test or use", "Tested, but did not use in production or service", or "Don't know" then proceed to E.24 –
IMPACT OF THE PANDEMIC ON VIEWS TOWARDS AUTOMATION

E.4 TIMING OF ADOPTION FOR ARTIFICIAL INTELLIGENCE TECHNOLOGY – PROCESSES AND METHODS

Approximately when did this business first adopt or use Artificial Intelligence in processes and methods?

- o Prior to 1990
- o 1991 - 1995
- o 1996 - 2000
- o 2001 - 2005
- o 2006 - 2010
- o 2011 - 2015
- o 2016 – 2020
- o 2021 - Present
- o Don't Know

E.5 MOTIVATION FOR ARTIFICIAL INTELLIGENCE TECHNOLOGY ADOPTION AND UTILIZATION – PROCESSES AND METHODS

During the three years 2020 to 2022, why did this business adopt or use Artificial Intelligence? Select all that apply.

- ☐ To automate tasks performed by labor
- ☐ To replace or upgrade already existing automated processes or methods
- ☐ To improve quality or reliability of processes or methods
- ☐ To improve quality or reliability of goods or services
- ☐ To expand the range of goods or services
- ☐ To adopt standards and accreditation
- ☐ Some other reason

E.6 IMPACT OF ARTIFICIAL INTELLIGENCE TECHNOLOGY ON WORKFORCE – PROCESSES AND METHODS

During the three years 2020 to 2022, what were the effects of adopting or using Artificial Intelligence on the following?

- A. The number of workers employed by this business
 - ☐ Increased
 - ☐ Decreased
 - ☐ Did not change

- B. The skill level of workers employed by this business
 - ☐ Increased overall
 - ☐ Decreased overall
 - ☐ Did not change overall

- C. The scientific, technological, engineering, and mathematical skills of workers employed by this business
 - ☐ Increased overall
 - ☐ Decreased overall

- o Did not change overall
- o Not applicable, we did not employ workers with scientific, technological, engineering and mathematical skills

E.7 IMPACT OF ARTIFICIAL INTELLIGENCE TECHNOLOGY ON WORKER TYPES – PROCESSES AND METHODS

Indicate what effect Artificial Intelligence had on the following types of workers employed by this business during the three years 2020 to 2022.

- A. The ratio of production workers to non-production workers
 - o Increased
 - o Decreased
 - o Did not change
 - o Not applicable, we did not employ production workers
 - o Not applicable, we did not employ non-production workers

- B. The ratio of non-supervisory workers to supervisory workers
- ☐ Increased
 - ☐ Decreased
 - ☐ Did not change
 - ☐ Not applicable, we did not employ supervisory workers
 - ☐ Not applicable, we did not employ non-supervisory workers

E.8 TIMING OF ADOPTION FOR CLOUD-BASED COMPUTING SYSTEMS AND APPLICATIONS TECHNOLOGY – PROCESSES AND METHODS

Approximately what year did this business first adopt or use Cloud-based Computing Systems and Applications in processes and methods?

- ☐ 2006 - 2010
- ☐ 2011 - 2015
- ☐ 2016 – 2020
- ☐ 2021 - Present
- ☐ Don't Know

E.9 MOTIVATION FOR CLOUD-BASED COMPUTING SYSTEMS AND APPLICATIONS TECHNOLOGY ADOPTION AND UTILIZATION – PROCESSES AND METHODS

During the three years 2020 to 2022, why did this business adopt or use Cloud-based Computing Systems and Applications? Select all that apply.

- ☐ To automate tasks performed by labor
- ☐ To replace or upgrade already existing automated processes
- ☐ To improve quality or reliability of processes or methods

- ☐ To improve quality or reliability of goods or services
- ☐ To expand the range of goods or services
- ☐ To adopt standards and accreditation
- ☐ Some other reason

E.10 IMPACT OF CLOUD-BASED COMPUTING SYSTEMS AND APPLICATIONS TECHNOLOGY ON WORKFORCE – PROCESSES AND METHODS

During the three years 2020 to 2022, what were the effects of adopting or using Cloud-based Computing Systems and Applications on the following?

A. The number of workers employed by this business

- ☐ Increased
- ☐ Decreased
- ☐ Did not change

B. The skill level of workers employed by this business

- ☐ Increased overall
- ☐ Decreased overall
- ☐ Did not change overall

C. The scientific, technological, engineering, and mathematical skills of workers employed by this business

- ☐ Increased overall

- ☐ Decreased overall
- ☐ Did not change overall
- ☐ Not applicable, we did not employ workers with scientific, technological, engineering and mathematical skills

E.11 IMPACT OF CLOUD-BASED COMPUTING SYSTEMS AND APPLICATIONS TECHNOLOGY ON WORKER TYPES – PROCESSES AND METHODS

Indicate what effect Cloud-based Computing Systems and Applications had on the following types of workers employed by this business during the three years 2020 to 2022.

A. The ratio of production workers to non-production workers

- ☐ Increased
- ☐ Decreased
- ☐ Did not change
- ☐ Not applicable, we did not employ production workers
- ☐ Not applicable, we did not employ non-production workers

B. The ratio of non-supervisory workers to supervisory workers

- ☐ Increased
- ☐ Decreased
- ☐ Did not change
- ☐ Not applicable, we did not employ supervisory workers
- ☐ Not applicable, we did not employ non-supervisory workers

E.12 TIMING OF ADOPTION FOR SPECIALIZED SOFTWARE TECHNOLOGY – PROCESSES AND METHODS

Approximately what year did this business first adopt or use Specialized Software Technology in processes and methods?

- ☐ Prior to 1990
- ☐ 1991 - 1995
- ☐ 1996 - 2000
- ☐ 2001 - 2005
- ☐ 2006 - 2010
- ☐ 2011 - 2015
- ☐ 2016 – 2020
- ☐ 2021 - Present
- ☐ Don't Know

E.13 MOTIVATION FOR SPECIALIZED SOFTWARE TECHNOLOGY ADOPTION AND UTILIZATION – PROCESSES AND METHODS

During the three years 2020 to 2022, why did this business adopt or use Specialized Software? Select all that apply.

- ☐ To automate tasks performed by labor
- ☐ To replace or upgrade already existing automated processes

- ☐ To improve quality or reliability of processes or methods
- ☐ To improve quality or reliability of goods or services
- ☐ To expand the range of goods or services
- ☐ To adopt standards and accreditation
- ☐ Some other reason

E.14 IMPACT OF SPECIALIZED SOFTWARE TECHNOLOGY ON WORKFORCE – PROCESSES AND METHODS

During the three years 2020 to 2022, what were the effects of adopting or using Specialized Software on the following?

- A. The number of workers employed by this business
 - ☐ Increased
 - ☐ Decreased
 - ☐ Did not change

- B. The skill level of workers employed by this business
 - ☐ Increased overall
 - ☐ Decreased overall
 - ☐ Did not change overall

- C. The scientific, technological, engineering, and mathematical skills of workers employed by this business
 - ☐ Increased overall
 - ☐ Decreased overall
 - ☐ Did not change overall
 - ☐ Not applicable, we did not employ workers with scientific, technological, engineering and mathematical skills

E.15 IMPACT OF SPECIALIZED SOFTWARE TECHNOLOGY ON WORKER TYPES – PROCESSES AND METHODS

Indicate what effect Specialized Software had on the following types of workers employed by this business during the three years 2020 to 2022.

A. The ratio of production workers to non-production workers

- ☐ Increased
- ☐ Decreased
- ☐ Did not change
- ☐ Not applicable, we did not employ production workers
- ☐ Not applicable, we did not employ non-production workers

B. The ratio of non-supervisory workers to supervisory workers

- ☐ Increased
- ☐ Decreased
- ☐ Did not change
- ☐ Not applicable, we did not employ supervisory workers
- ☐ Not applicable, we did not employ non-supervisory workers

E.16 TIMING OF ADOPTION FOR ROBOTICS TECHNOLOGY – PROCESSES AND METHODS

Approximately what year did this business first adopt or use Robotics in processes and methods?

- ☐ Prior to 1990
- ☐ 1991 - 1995
- ☐ 1996 - 2000
- ☐ 2001 - 2005
- ☐ 2006 - 2010
- ☐ 2011 - 2015
- ☐ 2016 – 2020
- ☐ 2021 - Present
- ☐ Don't Know

E.17 MOTIVATION FOR ROBOTICS TECHNOLOGY ADOPTION AND UTILIZATION – PROCESSES AND METHODS

During the three years 2020 to 2022, why did this business adopt or use Robotics? Select all that apply.

- ☐ To automate tasks performed by labor
- ☐ To replace or upgrade already existing automated processes
- ☐ To improve quality or reliability of processes or methods
- ☐ To improve quality or reliability of goods or services
- ☐ To expand the range of goods or services
- ☐ To adopt standards and accreditation
- ☐ Some other reason

E.18 IMPACT OF ROBOTICS TECHNOLOGY ON WORKFORCE – PROCESSES AND METHODS

During the three years 2020 to 2022, what were the effects of adopting or using Robotics on the following?

- A. The number of workers employed by this business
 - ☐ Increased
 - ☐ Decreased
 - ☐ Did not change

- B. The skill level of workers employed by this business
 - ☐ Increased overall
 - ☐ Decreased overall
 - ☐ Did not change overall

- C. The scientific, technological, engineering, and mathematical skills of workers employed by this business
 - ☐ Increased overall
 - ☐ Decreased overall
 - ☐ Did not change overall
 - ☐ Not applicable, we did not employ workers with scientific, technological, engineering and mathematical skills

E.19 IMPACT OF ROBOTICS TECHNOLOGY ON WORKER TYPES – PROCESSES AND METHODS

Indicate what effect Robotics had on the following types of workers employed by this business during the three years 2020 to 2022.

A. The ratio of production workers to non-production workers

- ☐ Increased
- ☐ Decreased
- ☐ Did not change
- ☐ Not applicable, we did not employ production workers
- ☐ Not applicable, we did not employ non-production workers

B. The ratio of non-supervisory workers to supervisory workers

- ☐ Increased
- ☐ Decreased
- ☐ Did not change
- ☐ Not applicable, we did not employ supervisory workers
- ☐ Not applicable, we did not employ non-supervisory workers

E.20 TIMING OF ADOPTION FOR SPECIALIZED EQUIPMENT – PROCESSES AND METHODS

Approximately what year did this business first adopt or use Specialized Equipment in processes and methods?

- ☐ Prior to 1990
- ☐ 1991 - 1995
- ☐ 1996 - 2000

- ☐ 2001 - 2005
- ☐ 2006 - 2010
- ☐ 2011 - 2015
- ☐ 2016 – 2020
- ☐ 2021 - Present
- ☐ Don't Know

E.21 MOTIVATION FOR SPECIALIZED EQUIPMENT TECHNOLOGY ADOPTION AND UTILIZATION – PROCESSES AND METHODS

During the three years 2020 to 2022, why did this business adopt or use Specialized Equipment? Select all that apply.

- ☐ To automate tasks performed by labor
- ☐ To replace or upgrade already existing automated processes
- ☐ To improve quality or reliability of processes or methods
- ☐ To improve quality or reliability of goods or services
- ☐ To expand the range of goods or services
- ☐ To adopt standards and accreditation
- ☐ Some other reason

E.22 IMPACT OF SPECIALIZED EQUIPMENT TECHNOLOGY ON WORKFORCE – PROCESSES AND METHODS

During the three years 2020 to 2022, what were the effects of adopting or using Specialized Equipment on the following?

- A. The number of workers employed by this business
 - ☐ Increased
 - ☐ Decreased
 - ☐ Did not change

B. The skill level of workers employed by this business

- ☐ Increased overall
- ☐ Decreased overall
- ☐ Did not change overall

C. The scientific, technological, engineering, and mathematical skills of workers employed by this business

- ☐ Increased overall
- ☐ Decreased overall
- ☐ Did not change overall
- ☐ Not applicable, we did not employ workers with scientific, technological, engineering and mathematical skills

E.23 IMPACT OF SPECIALIZED EQUIPMENT TECHNOLOGY ON WORKER TYPES – PROCESSES AND METHODS

Indicate what effect Specialized Equipment had on the following types of workers employed by this business during the three years 2020 to 2022.

A. The ratio of production workers to non-production workers

- ☐ Increased
- ☐ Decreased
- ☐ Did not change
- ☐ Not applicable, we did not employ production workers
- ☐ Not applicable, we did not employ non-production workers

B. The ratio of non-supervisory workers to supervisory workers

- ☐ Increased
- ☐ Decreased
- ☐ Did not change
- ☐ Not applicable, we did not employ supervisory workers
- ☐ Not applicable, we did not employ non-supervisory workers

E.24 IMPACT OF THE COVID-19 PANDEMIC ON AUTOMATION

During the period 2020-2022, did the COVID-19 pandemic specifically affect automation of tasks performed by labor in this business?

(Automation refers to automatically controlled operation of an apparatus, process, or system by mechanical or electronic devices or software that take the place of human labor)

- ☐ Yes, increased automation of tasks performed by labor
- ☐ Yes, decreased automation of tasks performed by labor
- ☐ No, did not change automation of tasks performed by labor
- ☐ Not applicable, this business did not have any tasks performed by labor that could be automated

E.25 TECHNOLOGY BASED GOODS AND SERVICES

During the three years 2020 to 2022, did this business sell the following technologies or provide goods or services that included the following technologies?

Artificial Intelligence

- ☐ Yes
- ☐ No
- ☐ Don't know

Cloud-based Computing Systems and Applications

- ☐ Yes
- ☐ No
- ☐ Don't know

Specialized Software

- ☐ Yes
- ☐ No
- ☐ Don't know

Robotics

- ☐ Yes
- ☐ No
- ☐ Don't know

Specialized Equipment

- ☐ Yes
- ☐ No
- ☐ Don't know