

## Technical Information

### 2019 Annual Business Survey (ABS): Technology Characteristics of Businesses (TCB) Dataset Accessible via the Application Programming Interface (API)

Estimates are provided for firms (classifiable by sex, ethnicity, race and veteran status) of employer firms that responded to the characteristic(s) listed below.

- Extent of technology use (TECHUSE)
- Motivation for technology use (MOTUSETECH)
- Impact of technology use on workforce (IMPACTWF\_U)
- Impact of technology use on types of workers (IMPACTWK\_U)
- Factors adversely affecting technology use (FACTORS\_U)
- Technology production (TECHSELL)
- Motivation to produce technology (MOTPRODTECH)
- Impact of technology production (IMPACTWF\_P)
- Impact of technology production on types of workers (IMPACTWK\_P)
- Factors adversely affecting technology production (FACTORS\_P)

Characteristic data are tabulated by:

- Geography (U.S. and states)
- Industry sector (2-digit 2017 North American Industry Classification System code (NAICS2017) and meaning of code (NAICS2017\_LABEL)) [See <https://www.census.gov/naics/> for detailed information.]
- Number of employees (NSFSZFI)

The full list of variables can be found at <https://api.census.gov/data/2018/abstcb/variables.html>

#### Technical Notes:

For all firms classifiable by sex, ethnicity, race, and veteran status, the details are counted based on the person(s) owning 51 percent or more of the stock or equity in the business. These estimates are tabulated by single attribute (such as female-owned or male-owned) only. Separate estimates are counted, tabulated, and cross tabulated for firms equally owned (such as 50 percent female / 50 percent male).

Firms not classifiable by sex, ethnicity, race, and veteran status are counted and tabulated separately.

Percentages are based on total reporting within a sex, ethnicity, race, veteran status, and/or industry group, and are not recalculated when the dataset is resorted. Firms with more than one domestic establishment are counted in each industry in which they operate, but only once in the U.S. total for all sectors. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see the Methodology section at <https://www.census.gov/programs-surveys/abs/technical-documentation/methodology.html>

**Abbreviations and Symbols:**

Please note that symbols will show in the associated flag field for variables. The data value shown will be zero. The following abbreviations and symbols are used with these data:

- **D** – Withheld to avoid disclosing data for individual companies; data are included in higher level totals.
- **S** – Estimate does not meet publication standards because of high sampling variability, poor response quality, or other concerns about the estimate quality. Unpublished estimates derived from this table by subtraction are subject to these same limitations and should not be attributed to the U.S. Census Bureau. For a description of publication standards and the total quantity response rate, see link to program methodology [page](#).
- **N** – Not available or not comparable.
- **X** – Not applicable.

For the complete list of all economic programs symbols, see the Symbols Glossary at

<https://www.census.gov/programs-surveys/economic-census/technical-documentation/data-dictionary.html>.

## Valid Data Values

To build valid API queries, data users will need to refer to the following codes.

NSFSZFI represents the employment size categories of firms.

DATA FIELD	Valid codes	Meaning of code
NSFSZFI	001	All firms
	811	Firms with no employees
	815	Firms with 1 to 9 employees
	857	Firms with 10 employees or more

If any one **person** owned 10 percent or more of the business in 2018, the respondent was asked to provide the sex, ethnicity, race, and veteran status for up to four persons owning the largest percentage(s) of the business in 2018. Please refer to these questions and valid codes (listed alphabetically by DATA FIELD) for a better understanding of the information collected on the 2019 ABS survey, which resulted in the classification of majority business ownership. Please note that only the race question instructed the respondent to "**Select all that apply.**"

"What is the sex of *Owner 1 (2, 3, or 4)?*"

DATA FIELD	Valid codes	Meaning of code
SEX	001	Total
	002	Female
	003	Male
	004	Equally male-/female
	096	Classifiable
	098	Unclassifiable

"Has *Owner 1 (2, 3, or 4)* ever served in any branch of the U.S. military service, including the Coast Guard, the National Guard, or a Reserve component of any service branch?"

DATA FIELD	Valid codes	Meaning of code
VET_GROUP	001	Total
	002	Veteran
	003	Equally veteran/nonveteran
	004	Nonveteran
	096	Classifiable
	098	Unclassifiable

"Is *Owner 1 (2, 3, or 4)* of Hispanic, Latino, or Spanish origin?"

DATA FIELD	Valid codes	Meaning of code
ETH_GROUP	001	Total
	020	Hispanic
	028	Equally Hispanic/non-Hispanic
	029	Non-Hispanic
	096	Classifiable
	098	Unclassifiable

"What is Owner 1 (2, 3, or 4)'s race? **Select all that apply.** (For this survey, Hispanic origins are not races.)"

DATA FIELD	Valid codes	Meaning of code
RACE_GROUP	00	Total
	30	White
	40	Black or African American
	50	American Indian and Alaska Native
	60	Asian
	70	Native Hawaiian and Other Pacific Islander
	90	Minority
	91	Equally minority/nonminority
	92	Nonminority
	96	Classifiable
	98	Unclassifiable

Please refer to the following business questions and valid codes (listed alphabetically by DATA FIELD) for the technology information collected on the 2019 ABS questionnaire.

“During the three years 2016 to 2018, indicate which factors adversely affected the production of the following technologies or goods or services that included the technology. **Select all that apply for each technology.**”

DATA FIELD	Valid codes	Meaning of code
FACTORS_P	T1E36R01	Artificial Intelligence: Technology was too expensive
	T1E36R02	Artificial Intelligence: Technology was not mature
	T1E36R03	Artificial Intelligence: Lacked access to required data
	T1E36R04	Artificial Intelligence: Required data not reliable
	T1E36R05	Artificial Intelligence: Lacked access to required human capital and talent
	T1E36R06	Artificial Intelligence: Laws and regulations
	T1E36R07	Artificial Intelligence: Concerns regarding safety and security (physical security and/or cyber security)
	T1E36R08	Artificial Intelligence: Lacked access to capital
	T1E36R09	Artificial Intelligence: Technology not applicable to this business
	T1E36R10	Artificial Intelligence: No factors adversely affected the adoption of this technology
	T1E36R99	Artificial Intelligence: Total Reporting
	T2E36R01	Cloud-Based: Technology was too expensive
	T2E36R02	Cloud-Based: Technology was not mature
	T2E36R03	Cloud-Based: Lacked access to required data
	T2E36R04	Cloud-Based: Required data not reliable
	T2E36R05	Cloud-Based: Lacked access to required human capital and talent
	T2E36R06	Cloud-Based: Laws and regulations
	T2E36R07	Cloud-Based: Concerns regarding safety and security (physical security and/or cyber security)
	T2E36R08	Cloud-Based: Lacked access to capital
	T2E36R09	Cloud-Based: Technology not applicable to this business
	T2E36R10	Cloud-Based: No factors adversely affected the adoption of this technology
	T2E36R99	Cloud-Based: Total Reporting
	T3E36R01	Specialized Software: Technology was too expensive
	T3E36R02	Specialized Software: Technology was not mature
	T3E36R03	Specialized Software: Lacked access to required data
	T3E36R04	Specialized Software: Required data not reliable
	T3E36R05	Specialized Software: Lacked access to required human capital and talent
	T3E36R06	Specialized Software: Laws and regulations
	T3E36R07	Specialized Software: Concerns regarding safety and security (physical security and/or cyber security)
	T3E36R08	Specialized Software: Lacked access to capital
	T3E36R09	Specialized Software: Technology not applicable to this business
	T3E36R10	Specialized Software: No factors adversely affected the adoption of this technology
	T3E36R99	Specialized Software: Total Reporting
	T4E36R01	Robotics: Technology was too expensive
	T4E36R02	Robotics: Technology was not mature
	T4E36R03	Robotics: Lacked access to required data
	T4E36R04	Robotics: Required data not reliable
	T4E36R05	Robotics: Lacked access to required human capital and talent
	T4E36R06	Robotics: Laws and regulations
	T4E36R07	Robotics: Concerns regarding safety and security (physical security and/or cyber security)
T4E36R08	Robotics: Lacked access to capital	
T4E36R09	Robotics: Technology not applicable to this business	
T4E36R10	Robotics: No factors adversely affected the adoption of this technology	

DATA FIELD	Valid codes	Meaning of code
FACTORS_P (cont.)	T4E36R99	Robotics: Total Reporting
	T5E36R01	Specialized Equipment: Technology was too expensive
	T5E36R02	Specialized Equipment: Technology was not mature
	T5E36R03	Specialized Equipment: Lacked access to required data
	T5E36R04	Specialized Equipment: Required data not reliable
	T5E36R05	Specialized Equipment: Lacked access to required human capital and talent
	T5E36R06	Specialized Equipment: Laws and regulations
	T5E36R07	Specialized Equipment: Concerns regarding safety and security (physical security and/or cyber security)
	T5E36R08	Specialized Equipment: Lacked access to capital
	T5E36R09	Specialized Equipment: Technology not applicable to this business
	T5E36R10	Specialized Equipment: No factors adversely affected the adoption of this technology
	T5E36R99	Specialized Equipment: Total Reporting

“During the three years 2016 to 2018, indicate which factors adversely affected the adoption or utilization of the following technologies to produce goods or services. **Select all that apply for each technology.**”

DATA FIELD	Valid codes	Meaning of code
FACTORS_U	T1E19Q01	Artificial Intelligence: Technology was too expensive
	T1E19Q02	Artificial Intelligence: Technology was not mature
	T1E19Q03	Artificial Intelligence: Lacked access to required data
	T1E19Q04	Artificial Intelligence: Required data not reliable
	T1E19Q05	Artificial Intelligence: Lacked access to required human capital and talent
	T1E19Q06	Artificial Intelligence: Laws and regulations
	T1E19Q07	Artificial Intelligence: Concerns regarding safety and security (physical security and/or cyber security)
	T1E19Q08	Artificial Intelligence: Lacked access to capital
	T1E19Q09	Artificial Intelligence: Technology not applicable to this business
	T1E19Q10	Artificial Intelligence: No factors adversely affected the adoption of this technology
	T1E19Q99	Artificial Intelligence: Total Reporting
	T2E19Q01	Cloud-Based: Technology was too expensive
	T2E19Q02	Cloud-Based: Technology was not mature
	T2E19Q03	Cloud-Based: Lacked access to required data
	T2E19Q04	Cloud-Based: Required data not reliable
	T2E19Q05	Cloud-Based: Lacked access to required human capital and talent
	T2E19Q06	Cloud-Based: Laws and regulations
	T2E19Q07	Cloud-Based: Concerns regarding safety and security (physical security and/or cyber security)
	T2E19Q08	Cloud-Based: Lacked access to capital
	T2E19Q09	Cloud-Based: Technology not applicable to this business
	T2E19Q10	Cloud-Based: No factors adversely affected the adoption of this technology
	T2E19Q99	Cloud-Based: Total Reporting
	T3E19Q01	Specialized Software: Technology was too expensive
	T3E19Q02	Specialized Software: Technology was not mature
	T3E19Q03	Specialized Software: Lacked access to required data
	T3E19Q04	Specialized Software: Required data not reliable
	T3E19Q05	Specialized Software: Lacked access to required human capital and talent
	T3E19Q06	Specialized Software: Laws and regulations
	T3E19Q07	Specialized Software: Concerns regarding safety and security (physical security and/or cyber security)
	T3E19Q08	Specialized Software: Lacked access to capital
	T3E19Q09	Specialized Software: Technology not applicable to this business

DATA FIELD	Valid codes	Meaning of code
FACTORS_U (cont.)	T3E19Q10	Specialized Software: No factors adversely affected the adoption of this technology
	T3E19Q99	Specialized Software: Total Reporting
	T4E19Q01	Robotics: Technology was too expensive
	T4E19Q02	Robotics: Technology was not mature
	T4E19Q03	Robotics: Lacked access to required data
	T4E19Q04	Robotics: Required data not reliable
	T4E19Q05	Robotics: Lacked access to required human capital and talent
	T4E19Q06	Robotics: Laws and regulations
	T4E19Q07	Robotics: Concerns regarding safety and security (physical security and/or cyber security)
	T4E19Q08	Robotics: Lacked access to capital
	T4E19Q09	Robotics: Technology not applicable to this business
	T4E19Q10	Robotics: No factors adversely affected the adoption of this technology
	T4E19Q99	Robotics: Total Reporting
	T5E19Q01	Specialized Equipment: Technology was too expensive
	T5E19Q02	Specialized Equipment: Technology was not mature
	T5E19Q03	Specialized Equipment: Lacked access to required data
	T5E19Q04	Specialized Equipment: Required data not reliable
	T5E19Q05	Specialized Equipment: Lacked access to required human capital and talent
	T5E19Q06	Specialized Equipment: Laws and regulations
	T5E19Q07	Specialized Equipment: Concerns regarding safety and security (physical security and/or cyber security)
	T5E19Q08	Specialized Equipment: Lacked access to capital
	T5E19Q09	Specialized Equipment: Technology not applicable to this business
T5E19Q10	Specialized Equipment: No factors adversely affected the adoption of this technology	
T5E19Q99	Specialized Equipment: Total Reporting	

“During the three years 2016 to 2018, what were the effects of producing [Artificial Intelligence, Cloud-based Computing Systems and Applications, Specialized Software, Robotics, Specialized Equipment] or producing goods or services that included [Artificial Intelligence, Cloud-based Computing Systems and Applications, Specialized Software, Robotics, Specialized Equipment] on the following?

The **number of workers** employed by this business

The **skill level of workers** employed by this business

The **scientific, technological, engineering, and mathematical skills of workers** employed by this business”

DATA FIELD	Valid codes	Meaning of code
IMPACTWF_P	T1E22L01	Artificial Intelligence: Increased number of workers employed by this business
	T1E22L02	Artificial Intelligence: Decreased number of workers employed by this business
	T1E22L03	Artificial Intelligence: Did not change number of workers employed by this business
	T1E22L04	Artificial Intelligence: Increased skill level of workers employed by this business
	T1E22L05	Artificial Intelligence: Decreased skill level of workers employed by this business
	T1E22L06	Artificial Intelligence: Did not change skill level of workers employed by this business
	T1E22L07	Artificial Intelligence: Increased STEM skills of workers employed by this business
	T1E22L08	Artificial Intelligence: Decreased STEM skills of workers employed by this business

DATA FIELD	Valid codes	Meaning of code
IMPACTWF_P (cont.)	T1E22L09	Artificial Intelligence: Did not change STEM skills of workers employed by this business
	T1E22L10	Artificial Intelligence: Not applicable, did not employ workers with STEM skills
	T1E22L99	Artificial Intelligence: Total Reporting
	T2E25L01	Cloud-Based: Increased number of workers employed by this business
	T2E25L02	Cloud-Based: Decreased number of workers employed by this business
	T2E25L03	Cloud-Based: Did not change number of workers employed by this business
	T2E25L04	Cloud-Based: Increased skill level of workers employed by this business
	T2E25L05	Cloud-Based: Decreased skill level of workers employed by this business
	T2E25L06	Cloud-Based: Did not change skill level of workers employed by this business
	T2E25L07	Cloud-Based: Increased STEM skills of workers employed by this business
	T2E25L08	Cloud-Based: Decreased STEM skills of workers employed by this business
	T2E25L09	Cloud-Based: Did not change STEM skills of workers employed by this business
	T2E25L10	Cloud-Based: Not applicable, did not employ workers with STEM skills
	T2E25L99	Cloud-Based: Total Reporting
	T3E28L01	Specialized Software: Increased number of workers employed by this business
	T3E28L02	Specialized Software: Decreased number of workers employed by this business
	T3E28L03	Specialized Software: Did not change number of workers employed by this business
	T3E28L04	Specialized Software: Increased skill level of workers employed by this business
	T3E28L05	Specialized Software: Decreased skill level of workers employed by this business
	T3E28L06	Specialized Software: Did not change skill level of workers employed by this business
	T3E28L07	Specialized Software: Increased STEM skills of workers employed by this business
	T3E28L08	Specialized Software: Decreased STEM skills of workers employed by this business
	T3E28L09	Specialized Software: Did not change STEM skills of workers employed by this business
	T3E28L10	Specialized Software: Not applicable, did not employ workers with STEM skills
	T3E28L99	Specialized Software: Total Reporting
	T4E31L01	Robotics: Increased number of workers employed by this business
	T4E31L02	Robotics: Decreased number of workers employed by this business
	T4E31L03	Robotics: Did not change number of workers employed by this business
	T4E31L04	Robotics: Increased skill level of workers employed by this business
	T4E31L05	Robotics: Decreased skill level of workers employed by this business
	T4E31L06	Robotics: Did not change skill level of workers employed by this business
	T4E31L07	Robotics: Increased STEM skills of workers employed by this business
	T4E31L08	Robotics: Decreased STEM skills of workers employed by this business
	T4E31L09	Robotics: Did not change STEM skills of workers employed by this business
	T4E31L10	Robotics: Not applicable, did not employ workers with STEM skills
	T4E31L99	Robotics: Total Reporting
	T5E34L01	Specialized Equipment: Increased number of workers employed by this business
	T5E34L02	Specialized Equipment: Decreased number of workers employed by this business
	T5E34L03	Specialized Equipment: Did not change number of workers employed by this business
	T5E34L04	Specialized Equipment: Increased skill level of workers employed by this business
	T5E34L05	Specialized Equipment: Decreased skill level of workers employed by this business

DATA FIELD	Valid codes	Meaning of code
IMPACTWF_P (cont.)	T5E34L06	Specialized Equipment: Did not change skill level of workers employed by this business
	T5E34L07	Specialized Equipment: Increased STEM skills of workers employed by this business
	T5E34L08	Specialized Equipment: Decreased STEM skills of workers employed by this business
	T5E34L09	Specialized Equipment: Did not change STEM skills of workers employed by this business
	T5E34L10	Specialized Equipment: Not applicable, did not employ workers with STEM skills
	T5E34L99	Specialized Equipment: Total Reporting

“During the three years 2016 to 2018, what were the effects of adopting or using [Artificial Intelligence, Cloud-based Computing Systems and Applications, Specialized Software, Robotics, Specialized Equipment] on the following?

The **number of workers** employed by this business

The **skill level of workers** employed by this business

The **scientific, technological, engineering, and mathematical skills of workers** employed by this business”

DATA FIELD	Valid codes	Meaning of code
IMPACTWF_U	T1E05D01	Artificial Intelligence: Increased number of workers employed by this business
	T1E05D02	Artificial Intelligence: Decreased number of workers employed by this business
	T1E05D03	Artificial Intelligence: Did not change number of workers employed by this business
	T1E05D04	Artificial Intelligence: Increased skill level of workers employed by this business
	T1E05D05	Artificial Intelligence: Decreased skill level of workers employed by this business
	T1E05D06	Artificial Intelligence: Did not change skill level of workers employed by this business
	T1E05D07	Artificial Intelligence: Increased STEM skills of workers employed by this business
	T1E05D08	Artificial Intelligence: Decreased STEM skills of workers employed by this business
	T1E05D09	Artificial Intelligence: Did not change STEM skills of workers employed by this business
	T1E05D10	Artificial Intelligence: Not applicable, did not employ workers with STEM skills
	T1E05D99	Artificial Intelligence: Total Reporting
	T2E08D01	Cloud-Based: Increased number of workers employed by this business
	T2E08D02	Cloud-Based: Decreased number of workers employed by this business
	T2E08D03	Cloud-Based: Did not change number of workers employed by this business
	T2E08D04	Cloud-Based: Increased skill level of workers employed by this business
	T2E08D05	Cloud-Based: Decreased skill level of workers employed by this business
	T2E08D06	Cloud-Based: Did not change skill level of workers employed by this business
	T2E08D07	Cloud-Based: Increased STEM skills of workers employed by this business
	T2E08D08	Cloud-Based: Decreased STEM skills of workers employed by this business
	T2E08D09	Cloud-Based: Did not change STEM skills of workers employed by this business
	T2E08D10	Cloud-Based: Not applicable, did not employ workers with STEM skills
	T2E08D99	Cloud-Based: Total Reporting
	T3E11D01	Specialized Software: Increased number of workers employed by this business
	T3E11D02	Specialized Software: Decreased number of workers employed by this business
	T3E11D03	Specialized Software: Did not change number of workers employed by this business
	T3E11D04	Specialized Software: Increased skill level of workers employed by this business

DATA FIELD	Valid codes	Meaning of code
IMPACTWF_U (cont.)	T3E11D05	Specialized Software: Decreased skill level of workers employed by this business
	T3E11D06	Specialized Software: Did not change skill level of workers employed by this business
	T3E11D07	Specialized Software: Increased STEM skills of workers employed by this business
	T3E11D08	Specialized Software: Decreased STEM skills of workers employed by this business
	T3E11D09	Specialized Software: Did not change STEM skills of workers employed by this business
	T3E11D10	Specialized Software: Not applicable, did not employ workers with STEM skills
	T3E11D99	Specialized Software: Total Reporting
	T4E14D01	Robotics: Increased number of workers employed by this business
	T4E14D02	Robotics: Decreased number of workers employed by this business
	T4E14D03	Robotics: Did not change number of workers employed by this business
	T4E14D04	Robotics: Increased skill level of workers employed by this business
	T4E14D05	Robotics: Decreased skill level of workers employed by this business
	T4E14D06	Robotics: Did not change skill level of workers employed by this business
	T4E14D07	Robotics: Increased STEM skills of workers employed by this business
	T4E14D08	Robotics: Decreased STEM skills of workers employed by this business
	T4E14D09	Robotics: Did not change STEM skills of workers employed by this business
	T4E14D10	Robotics: Not applicable, did not employ workers with STEM skills
	T4E14D99	Robotics: Total Reporting
	T5E17D01	Specialized Equipment: Increased number of workers employed by this business
	T5E17D02	Specialized Equipment: Decreased number of workers employed by this business
	T5E17D03	Specialized Equipment: Did not change number of workers employed by this business
	T5E17D04	Specialized Equipment: Increased skill level of workers employed by this business
	T5E17D05	Specialized Equipment: Decreased skill level of workers employed by this business
	T5E17D06	Specialized Equipment: Did not change skill level of workers employed by this business
	T5E17D07	Specialized Equipment: Increased STEM skills of workers employed by this business
	T5E17D08	Specialized Equipment: Decreased STEM skills of workers employed by this business
	T5E17D09	Specialized Equipment: Did not change STEM skills of workers employed by this business
	T5E17D10	Specialized Equipment: Not applicable, did not employ workers with STEM skills
	T5E17D99	Specialized Equipment: Total Reporting

“Indicate what effect producing [Artificial Intelligence, Cloud-based Computing Systems and Applications, Specialized Software, Robotics, Specialized Equipment] or producing goods or services that included [Artificial Intelligence, Cloud-based Computing Systems and Applications, Specialized Software, Robotics, Specialized Equipment] had on the following types of workers employed by this business during the three years 2016 to 2018.

The number of **production workers**

The number of **nonproduction workers**

The number of **supervisory workers**

The number of nonsupervisory workers”

DATA FIELD	Valid codes	Meaning of code
IMPACTWK_P	T1E23M01	Artificial Intelligence: Increased number of production workers employed by this business
	T1E23M02	Artificial Intelligence: Decreased number of production workers employed by this business
	T1E23M03	Artificial Intelligence: Did not change number of production workers employed by this business
	T1E23M04	Artificial Intelligence: Not applicable, did not employ production workers
	T1E23N05	Artificial Intelligence: Increased number of nonproduction workers employed by this business
	T1E23N06	Artificial Intelligence: Decreased number of nonproduction workers employed by this business
	T1E23N07	Artificial Intelligence: Did not change number of nonproduction workers employed by this business
	T1E23N08	Artificial Intelligence: Not applicable, did not employ nonproduction workers
	T1E23O09	Artificial Intelligence: Increased number of supervisory workers employed by this business
	T1E23O10	Artificial Intelligence: Decreased number of supervisory workers employed by this business
	T1E23O11	Artificial Intelligence: Did not change number of supervisory workers employed by this business
	T1E23O12	Artificial Intelligence: Not applicable, did not employ supervisory workers
	T1E23P13	Artificial Intelligence: Increased number of nonsupervisory workers employed by this business
	T1E23P14	Artificial Intelligence: Decreased number of nonsupervisory workers employed by this business
	T1E23P15	Artificial Intelligence: Did not change number of nonsupervisory workers employed by this business
	T1E23P16	Artificial Intelligence: Not applicable, did not employ nonsupervisory workers
	T1E23P99	Artificial Intelligence: Total Reporting
	T2E26M01	Cloud-Based: Increased number of production workers employed by this business
	T2E26M02	Cloud-Based: Decreased number of production workers employed by this business
	T2E26M03	Cloud-Based: Did not change number of production workers employed by this business
	T2E26M04	Cloud-Based: Not applicable, did not employ production workers
	T2E26N05	Cloud-Based: Increased number of nonproduction workers employed by this business
	T2E26N06	Cloud-Based: Decreased number of nonproduction workers employed by this business
	T2E26N07	Cloud-Based: Did not change number of nonproduction workers employed by this business
	T2E26N08	Cloud-Based: Not applicable, did not employ nonproduction workers
	T2E26O09	Cloud-Based: Increased number of supervisory workers employed by this business
	T2E26O10	Cloud-Based: Decreased number of supervisory workers employed by this business
	T2E26O11	Cloud-Based: Did not change number of supervisory workers employed by this business
	T2E26O12	Cloud-Based: Not applicable, did not employ supervisory workers
	T2E26P13	Cloud-Based: Increased number of nonsupervisory workers employed by this business

DATA FIELD	Valid codes	Meaning of code
IMPACTWK_P (cont.)	T2E26P14	Cloud-Based: Decreased number of nonsupervisory workers employed by this business
	T2E26P15	Cloud-Based: Did not change number of nonsupervisory workers employed by this business
	T2E26P16	Cloud-Based: Not applicable, did not employ nonsupervisory workers
	T2E26P99	Cloud-Based: Total Reporting
	T3E29M01	Specialized Software: Increased number of production workers employed by this business
	T3E29M02	Specialized Software: Decreased number of production workers employed by this business
	T3E29M03	Specialized Software: Did not change number of production workers employed by this business
	T3E29M04	Specialized Software: Not applicable, did not employ production workers
	T3E29N05	Specialized Software: Increased number of nonproduction workers employed by this business
	T3E29N06	Specialized Software: Decreased number of nonproduction workers employed by this business
	T3E29N07	Specialized Software: Did not change number of nonproduction workers employed by this business
	T3E29N08	Specialized Software: Not applicable, did not employ nonproduction workers
	T3E29O09	Specialized Software: Increased number of supervisory workers employed by this business
	T3E29O10	Specialized Software: Decreased number of supervisory workers employed by this business
	T3E29O11	Specialized Software: Did not change number of supervisory workers employed by this business
	T3E29O12	Specialized Software: Not applicable, did not employ supervisory workers
	T3E29P13	Specialized Software: Increased number of nonsupervisory workers employed by this business
	T3E29P14	Specialized Software: Decreased number of nonsupervisory workers employed by this business
	T3E29P15	Specialized Software: Did not change number of nonsupervisory workers employed by this business
	T3E29P16	Specialized Software: Not applicable, did not employ nonsupervisory workers
	T3E29P99	Specialized Software: Total Reporting
	T4E32M01	Robotics: Increased number of production workers employed by this business
	T4E32M02	Robotics: Decreased number of production workers employed by this business
	T4E32M03	Robotics: Did not change number of production workers employed by this business
	T4E32M04	Robotics: Not applicable, did not employ production workers
	T4E32N05	Robotics: Increased number of nonproduction workers employed by this business
	T4E32N06	Robotics: Decreased number of nonproduction workers employed by this business
	T4E32N07	Robotics: Did not change number of nonproduction workers employed by this business
	T4E32N08	Robotics: Not applicable, did not employ nonproduction workers
	T4E32O09	Robotics: Increased number of supervisory workers employed by this business
	T4E32O10	Robotics: Decreased number of supervisory workers employed by this business
	T4E32O11	Robotics: Did not change number of supervisory workers employed by this business
T4E32O12	Robotics: Not applicable, did not employ supervisory workers	
T4E32P13	Robotics: Increased number of nonsupervisory workers employed by this business	

DATA FIELD	Valid codes	Meaning of code
IMPACTWK_P (cont.)	T4E32P14	Robotics: Decreased number of nonsupervisory workers employed by this business
	T4E32P15	Robotics: Did not change number of nonsupervisory workers employed by this business
	T4E32P16	Robotics: Not applicable, did not employ nonsupervisory workers
	T4E32P99	Robotics: Total Reporting
	T5E35M01	Specialized Equipment: Increased number of production workers employed by this business
	T5E35M02	Specialized Equipment: Decreased number of production workers employed by this business
	T5E35M03	Specialized Equipment: Did not change number of production workers employed by this business
	T5E35M04	Specialized Equipment: Not applicable, did not employ production workers
	T5E35N05	Specialized Equipment: Increased number of nonproduction workers employed by this business
	T5E35N06	Specialized Equipment: Decreased number of nonproduction workers employed by this business
	T5E35N07	Specialized Equipment: Did not change number of nonproduction workers employed by this business
	T5E35N08	Specialized Equipment: Not applicable, did not employ nonproduction workers
	T5E35O09	Specialized Equipment: Increased number of supervisory workers employed by this business
	T5E35O10	Specialized Equipment: Decreased number of supervisory workers employed by this business
	T5E35O11	Specialized Equipment: Did not change number of supervisory workers employed by this business
	T5E35O12	Specialized Equipment: Not applicable, did not employ supervisory workers
	T5E35P13	Specialized Equipment: Increased number of nonsupervisory workers employed by this business
	T5E35P14	Specialized Equipment: Decreased number of nonsupervisory workers employed by this business
	T5E35P15	Specialized Equipment: Did not change number of nonsupervisory workers employed by this business
T5E35P16	Specialized Equipment: Not applicable, did not employ nonsupervisory workers	
T5E35P99	Specialized Equipment: Total Reporting	

“Indicate what effect [Artificial Intelligence, Cloud-based Computing Systems and Applications, Specialized Software, Robotics, Specialized Equipment] had on the following types of workers employed by this business during the three years 2016 to 2018.

The number of **production workers**

The number of **nonproduction workers**

The number of **supervisory workers**

The number of **nonsupervisory workers”**

DATA FIELD	Valid codes	Meaning of code
IMPACTWK_U	T1E06F01	Artificial Intelligence: Increased number of production workers employed by this business
	T1E06F02	Artificial Intelligence: Decreased number of production workers employed by this business
	T1E06F03	Artificial Intelligence: Did not change number of production workers employed by this business

DATA FIELD	Valid codes	Meaning of code
IMPACTWK_U (cont.)	T1E06F04	Artificial Intelligence: Not applicable, did not employ production workers
	T1E06G01	Artificial Intelligence: Increased number of nonproduction workers employed by this business
	T1E06G02	Artificial Intelligence: Decreased number of nonproduction workers employed by this business
	T1E06G03	Artificial Intelligence: Did not change number of nonproduction workers employed by this business
	T1E06G04	Artificial Intelligence: Not applicable, did not employ nonproduction workers
	T1E06H01	Artificial Intelligence: Increased number of supervisory workers employed by this business
	T1E06H02	Artificial Intelligence: Decreased number of supervisory workers employed by this business
	T1E06H03	Artificial Intelligence: Did not change number of supervisory workers employed by this business
	T1E06H04	Artificial Intelligence: Not applicable, did not employ supervisory workers
	T1E06I01	Artificial Intelligence: Increased number of nonsupervisory workers employed by this business
	T1E06I02	Artificial Intelligence: Decreased number of nonsupervisory workers employed by this business
	T1E06I03	Artificial Intelligence: Did not change number of nonsupervisory workers employed by this business
	T1E06I04	Artificial Intelligence: Not applicable, did not employ nonsupervisory workers
	T1E06I99	Artificial Intelligence: Total Reporting
	T2E09F01	Cloud-Based: Increased number of production workers employed by this business
	T2E09F02	Cloud-Based: Decreased number of production workers employed by this business
	T2E09F03	Cloud-Based: Did not change number of production workers employed by this business
	T2E09F04	Cloud-Based: Not applicable, did not employ production workers
	T2E09G01	Cloud-Based: Increased number of nonproduction workers employed by this business
	T2E09G02	Cloud-Based: Decreased number of nonproduction workers employed by this business
	T2E09G03	Cloud-Based: Did not change number of nonproduction workers employed by this business
	T2E09G04	Cloud-Based: Not applicable, did not employ nonproduction workers
	T2E09H01	Cloud-Based: Increased number of supervisory workers employed by this business
	T2E09H02	Cloud-Based: Decreased number of supervisory workers employed by this business
	T2E09H03	Cloud-Based: Did not change number of supervisory workers employed by this business
	T2E09H04	Cloud-Based: Not applicable, did not employ supervisory workers
	T2E09I01	Cloud-Based: Increased number of nonsupervisory workers employed by this business
	T2E09I02	Cloud-Based: Decreased number of nonsupervisory workers employed by this business
	T2E09I03	Cloud-Based: Did not change number of nonsupervisory workers employed by this business
	T2E09I04	Cloud-Based: Not applicable, did not employ nonsupervisory workers
	T2E09I99	Cloud-Based: Total Reporting
	T3E12F01	Specialized Software: Increased number of production workers employed by this business
	T3E12F02	Specialized Software: Decreased number of production workers employed by this business

DATA FIELD	Valid codes	Meaning of code
IMPACTWK_U (cont.)	T3E12F03	Specialized Software: Did not change number of production workers employed by this business
	T3E12F04	Specialized Software: Not applicable, did not employ production workers
	T3E12G01	Specialized Software: Increased number of nonproduction workers employed by this business
	T3E12G02	Specialized Software: Decreased number of nonproduction workers employed by this business
	T3E12G03	Specialized Software: Did not change number of nonproduction workers employed by this business
	T3E12G04	Specialized Software: Not applicable, did not employ nonproduction workers
	T3E12H01	Specialized Software: Increased number of supervisory workers employed by this business
	T3E12H02	Specialized Software: Decreased number of supervisory workers employed by this business
	T3E12H03	Specialized Software: Did not change number of supervisory workers employed by this business
	T3E12H04	Specialized Software: Not applicable, did not employ supervisory workers
	T3E12I01	Specialized Software: Increased number of nonsupervisory workers employed by this business
	T3E12I02	Specialized Software: Decreased number of nonsupervisory workers employed by this business
	T3E12I03	Specialized Software: Did not change number of nonsupervisory workers employed by this business
	T3E12I04	Specialized Software: Not applicable, did not employ nonsupervisory workers
	T3E12I99	Specialized Software: Total Reporting
	T4E15F01	Robotics: Increased number of production workers employed by this business
	T4E15F02	Robotics: Decreased number of production workers employed by this business
	T4E15F03	Robotics: Did not change number of production workers employed by this business
	T4E15F04	Robotics: Not applicable, did not employ production workers
	T4E15G01	Robotics: Increased number of nonproduction workers employed by this business
	T4E15G02	Robotics: Decreased number of nonproduction workers employed by this business
	T4E15G03	Robotics: Did not change number of nonproduction workers employed by this business
	T4E15G04	Robotics: Not applicable, did not employ nonproduction workers
	T4E15H01	Robotics: Increased number of supervisory workers employed by this business
	T4E15H02	Robotics: Decreased number of supervisory workers employed by this business
	T4E15H03	Robotics: Did not change number of supervisory workers employed by this business
	T4E15H04	Robotics: Not applicable, did not employ supervisory workers
	T4E15I01	Robotics: Increased number of nonsupervisory workers employed by this business
	T4E15I02	Robotics: Decreased number of nonsupervisory workers employed by this business
	T4E15I03	Robotics: Did not change number of nonsupervisory workers employed by this business
	T4E15I04	Robotics: Not applicable, did not employ nonsupervisory workers
	T4E15I99	Robotics: Total Reporting
	T5E18F01	Specialized Equipment: Increased number of production workers employed by this business
	T5E18F02	Specialized Equipment: Decreased number of production workers employed by this business

DATA FIELD	Valid codes	Meaning of code
IMPACTWK_U (cont.)	T5E18F03	Specialized Equipment: Did not change number of production workers employed by this business
	T5E18F04	Specialized Equipment: Not applicable, did not employ production workers
	T5E18G01	Specialized Equipment: Increased number of nonproduction workers employed by this business
	T5E18G02	Specialized Equipment: Decreased number of nonproduction workers employed by this business
	T5E18G03	Specialized Equipment: Did not change number of nonproduction workers employed by this business
	T5E18G04	Specialized Equipment: Not applicable, did not employ nonproduction workers
	T5E18H01	Specialized Equipment: Increased number of supervisory workers employed by this business
	T5E18H02	Specialized Equipment: Decreased number of supervisory workers employed by this business
	T5E18H03	Specialized Equipment: Did not change number of supervisory workers employed by this business
	T5E18H04	Specialized Equipment: Not applicable, did not employ supervisory workers
	T5E18I01	Specialized Equipment: Increased number of nonsupervisory workers employed by this business
	T5E18I02	Specialized Equipment: Decreased number of nonsupervisory workers employed by this business
	T5E18I03	Specialized Equipment: Did not change number of nonsupervisory workers employed by this business
	T5E18I04	Specialized Equipment: Not applicable, did not employ nonsupervisory workers
	T5E18I99	Specialized Equipment: Total Reporting

“During the three years 2016 to 2018, why did this business produce [Artificial Intelligence, Cloud-based Computing Systems and Applications, Specialized Software, Robotics, Specialized Equipment], or produce goods or services that included [Artificial Intelligence, Cloud-based Computing Systems and Applications, Specialized Software, Robotics, Specialized Equipment]? **Select all that apply.**”

DATA FIELD	Valid codes	Meaning of code
MOTPRODTECH	T1E21K01	Artificial Intelligence: Upgrade goods or services
	T1E21K02	Artificial Intelligence: Expand the range of goods or services
	T1E21K03	Artificial Intelligence: Enter new markets/adapting existing products to new markets
	T1E21K04	Artificial Intelligence: Increase or maintain market share
	T1E21K05	Artificial Intelligence: Adopt standards and accreditation
	T1E21K06	Artificial Intelligence: Some other reason
	T1E21K99	Artificial Intelligence: Total Reporting
	T2E24K01	Cloud-Based: Upgrade goods or services
	T2E24K02	Cloud-Based: Expand the range of goods or services
	T2E24K03	Cloud-Based: Enter new markets/adapting existing products to new markets
	T2E24K04	Cloud-Based: Increase or maintain market share
	T2E24K05	Cloud-Based: Adopt standards and accreditation
	T2E24K06	Cloud-Based: Some other reason
	T2E24K99	Cloud-Based: Total Reporting
	T3E27K01	Specialized Software: Upgrade goods or services
	T3E27K02	Specialized Software: Expand the range of goods or services
	T3E27K03	Specialized Software: Enter new markets/adapting existing products to new markets
	T3E27K04	Specialized Software: Increase or maintain market share
	T3E27K05	Specialized Software: Adopt standards and accreditation

DATA FIELD	Valid codes	Meaning of code
MOTPRODTECH (cont.)	T3E27K06	Specialized Software: Some other reason
	T3E27K99	Specialized Software: Total Reporting
	T4E30K01	Robotics: Upgrade goods or services
	T4E30K02	Robotics: Expand the range of goods or services
	T4E30K03	Robotics: Enter new markets/adapting existing products to new markets
	T4E30K04	Robotics: Increase or maintain market share
	T4E30K05	Robotics: Adopt standards and accreditation
	T4E30K06	Robotics: Some other reason
	T4E30K99	Robotics: Total Reporting
	T5E33K01	Specialized Equipment: Upgrade goods or services
	T5E33K02	Specialized Equipment: Expand the range of goods or services
	T5E33K03	Specialized Equipment: Enter new markets/adapting existing products to new markets
	T5E33K04	Specialized Equipment: Increase or maintain market share
	T5E33K05	Specialized Equipment: Adopt standards and accreditation
	T5E33K06	Specialized Equipment: Some other reason
	T5E33K99	Specialized Equipment: Total Reporting

During the three years 2016 to 2018, why did this business adopt or use [Artificial Intelligence, Cloud-based Computing Systems and Applications, Specialized Software, Robotics, Specialized Equipment]? **Select all that apply.**

DATA FIELD	Valid codes	Meaning of code
MOTUSETECH	T1E04C01	Artificial Intelligence: To automate tasks performed by labor
	T1E04C02	Artificial Intelligence: To upgrade outdated processes or methods
	T1E04C03	Artificial Intelligence: To improve quality or reliability of processes or methods
	T1E04C04	Artificial Intelligence: To expand the range of goods or services
	T1E04C05	Artificial Intelligence: To adopt standards and accreditation
	T1E04C06	Artificial Intelligence: Some other reason
	T1E04C99	Artificial Intelligence: Total Reporting
	T2E07C01	Cloud-Based: To automate tasks performed by labor
	T2E07C02	Cloud-Based: To upgrade outdated processes or methods
	T2E07C03	Cloud-Based: To improve quality or reliability of processes or methods
	T2E07C04	Cloud-Based: To expand the range of goods or services
	T2E07C05	Cloud-Based: To adopt standards and accreditation
	T2E07C06	Cloud-Based: Some other reason
	T2E07C99	Cloud-Based: Total Reporting
	T3E10C01	Specialized Software: To automate tasks performed by labor
	T3E10C02	Specialized Software: To upgrade outdated processes or methods
	T3E10C03	Specialized Software: To improve quality or reliability of processes or methods
	T3E10C04	Specialized Software: To expand the range of goods or services
	T3E10C05	Specialized Software: To adopt standards and accreditation
	T3E10C06	Specialized Software: Some other reason
	T3E10C99	Specialized Software: Total Reporting
	T4E13C01	Robotics: To automate tasks performed by labor
	T4E13C02	Robotics: To upgrade outdated processes or methods
	T4E13C03	Robotics: To improve quality or reliability of processes or methods
	T4E13C04	Robotics: To expand the range of goods or services
	T4E13C05	Robotics: To adopt standards and accreditation
	T4E13C06	Robotics: Some other reason
	T4E13C99	Robotics: Total Reporting
	T5E16C01	Specialized Equipment: To automate tasks performed by labor
	T5E16C02	Specialized Equipment: To upgrade outdated processes or methods

DATA FIELD	Valid codes	Meaning of code
MOTUSETECH (cont.)	T5E16C03	Specialized Equipment: To improve quality or reliability of processes or methods
	T5E16C04	Specialized Equipment: To expand the range of goods or services
	T5E16C05	Specialized Equipment: To adopt standards and accreditation
	T5E16C06	Specialized Equipment: Some other reason
	T5E16C99	Specialized Equipment: Total Reporting

During the three years 2016 to 2018, did this business sell the following technologies or goods or services that included the following technologies?

DATA FIELD	Valid codes	Meaning of code
TECHSELL	T1E20J01	Artificial Intelligence: Yes
	T1E20J02	Artificial Intelligence: No
	T1E20J03	Artificial Intelligence: Don't know
	T1E20J99	Artificial Intelligence: Total Reporting
	T2E20J01	Cloud-Based: Yes
	T2E20J02	Cloud-Based: No
	T2E20J03	Cloud-Based: Don't know
	T2E20J99	Cloud-Based: Total Reporting
	T3E20J01	Specialized Software: Yes
	T3E20J02	Specialized Software: No
	T3E20J03	Specialized Software: Don't know
	T3E20J99	Specialized Software: Total Reporting
	T4E20J01	Robotics: Yes
	T4E20J02	Robotics: No
	T4E20J03	Robotics: Don't know
	T4E20J99	Robotics: Total Reporting
	T5E20J01	Specialized Equipment: Yes
	T5E20J02	Specialized Equipment: No
	T5E20J03	Specialized Equipment: Don't know
T5E20J99	Specialized Equipment: Total Reporting	

“During the three years 2016 to 2018, to what extent did this business use the following technologies in production processes for goods or services?”

DATA FIELD	Valid codes	Meaning of code
TECHUSE	T1E03B01	Artificial Intelligence: Did not use
	T1E03B02	Artificial Intelligence: Tested, but did not use in production or service
	T1E03B03	Artificial Intelligence: Low use
	T1E03B04	Artificial Intelligence: Moderate use
	T1E03B05	Artificial Intelligence: High use
	T1E03B06	Artificial Intelligence: Don't know
	T1E03B99	Artificial Intelligence: Total use
	T1E03BA9	Artificial Intelligence: Total Reporting
	T2E03B01	Cloud-Based: Did not use
	T2E03B02	Cloud-Based: Tested, but did not use in production or service
	T2E03B03	Cloud-Based: Low use
	T2E03B04	Cloud-Based: Moderate use
	T2E03B05	Cloud-Based: High use
	T2E03B06	Cloud-Based: Don't know
	T2E03B99	Cloud-Based: Total use
	T2E03BA9	Cloud-Based: Total Reporting
	T3E03B01	Specialized Software: Did not use

<b>DATA FIELD</b>	<b>Valid codes</b>	<b>Meaning of code</b>
TECHUSE (cont.)	T3E03B02	Specialized Software: Tested, but did not use in production or service
	T3E03B03	Specialized Software: Low use
	T3E03B04	Specialized Software: Moderate use
	T3E03B05	Specialized Software: High use
	T3E03B06	Specialized Software: Don't know
	T3E03B99	Specialized Software: Total use
	T3E03BA9	Specialized Software: Total Reporting
	T4E03B01	Robotics: Did not use
	T4E03B02	Robotics: Tested, but did not use in production or service
	T4E03B03	Robotics: Low use
	T4E03B04	Robotics: Moderate use
	T4E03B05	Robotics: High use
	T4E03B06	Robotics: Don't know
	T4E03B99	Robotics: Total use
	T4E03BA9	Robotics: Total Reporting
	T5E03B01	Specialized Equipment: Did not use
	T5E03B02	Specialized Equipment: Tested, but did not use in production or service
	T5E03B03	Specialized Equipment: Low use
	T5E03B04	Specialized Equipment: Moderate use
	T5E03B05	Specialized Equipment: High use
	T5E03B06	Specialized Equipment: Don't know
	T5E03B99	Specialized Equipment: Total use
	T5E03BA9	Specialized Equipment: Total Reporting