TECHNOLOGY MODULE FOR 2018 ABS

(To be sent to all businesses and industries)

We provide both a short definition and detailed definition for each technology -- Short definition: Definition that appears near the question, and Detail definition: Definition that appears in pop-up or in detailed instructions.

Artificial Intelligence:

Short definition: 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.

Detail definition: 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. Systems with artificial intelligence perform functions including, but not limited to, speech recognition, machine vision, or machine learning:

- Speech recognition transforms human speech into a format useful for computer applications (for example, a digital assistant)

- Machine vision uses sensors and software that allow images to be used as an input for computer applications (for example, systems that sort or inspect objects or support navigation in mobile equipment)

- Machine learning uses statistical software and data to "learn" and make better predictions without reprogramming (for example, recommender systems for websites, or sales and demand forecasting)

Artificial Intelligence technologies also include virtual agents, deep learning platforms, decision management systems, biometrics, text analytics, and natural language generation and processing.

Cloud-based Computing Systems and Applications

Short definition: Cloud systems and applications are computing resources available on-demand via the internet.

Detail definition: Cloud systems and applications are computing resources available on-demand via the internet. Cloud computing enables ubiquitous, convenient, on-demand internet access to a shared pool of configurable computing resources (e.g., networks,

servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

Specialized Software (excluding Artificial Intelligence):

Short definition: Specialized software is software dedicated to performing a particular business function.

Detail definition: Specialized software is custom or packaged software dedicated to performing a particular business function. Specialized software includes, but is not limited to, software applications for accounting, sales, marketing, customer service and billing, logistics, health care delivery, telemedicine, computer-aided design (CAD), computer-aided engineering (CAE), or inventory management. Specialized software excludes general purpose software such as word processing or spreadsheets. Exclude Artificial Intelligence software reported above.

Robotics:

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

Detail definition: Robotic equipment (or robots) are automatically controlled, reprogrammable, and multipurpose machines used in automated operations in industrial and service environments. Robots may be mobile, incorporated into stand-alone stations, or integrated into a production line. A robot may be part of a manufacturing cell or incorporated into another piece of equipment.

Industrial robots may perform operations such as: palletizing, pick and place, machine tending, material handling, dispensing, welding, packing/repacking, and cleanroom.

Service robots are commonly used in businesses for such operations as cleaning, delivery, construction, inspection, and medical services such as dispensing or surgery.

Specialized Equipment (excluding Robotics):

Short definition: Specialized equipment is equipment capable of automatically carrying out pre-specified task(s).

Detail definition: Specialized equipment refers to equipment capable of automatically carrying out pre-specified task(s). Specialized equipment includes, but is not limited to, computer numerically controlled (CNC) machinery, computer-aided manufacturing (CAM) systems, manufacturing cells, materials working lasers, automated guided vehicles systems, automated storage and retrieval systems, and automated materials handling systems. Exclude robotics equipment reported above.

Q1. Production Technology for Goods and Services

During the three years 2016 to 2018, to what extent did this business use the following technologies in producing goods or providing services?

Mark one for each row.

	Did not use	Testing, but not using in production or service	Low Use	Moderate Use	High Use	Don't know
Artificial Intelligence						
Cloud-based Computing Systems and Applications						
Specialized Software						
Robotics						
Specialized Equipment						

<u>SKIP PATTERN</u>

If all answers to Q1 are "Did not use", "Testing", or "Don't know" then proceed to Q5.

As before, if a respondent answers that a technology was used (low, moderate, or high), Q2-Q4 follow for each technology used.

Q2: Motivation for Technology Adoption and Utilization (Processes and Methods)

For each of the technology categories, please indicate whether any of the following was a reason for technology adoption and utilization during the three years 2016 to 2018.

Check all that apply for each row.

	Automate tasks performed by labor	Upgrade outdated processes or methods	Improve quality or reliability of processes or methods	Expand the range of goods or services	Adopt standards and accreditation	Other	Did not use
Artificial Intelligence							
Cloud-based Computing Systems and Applications							
Specialized Software							
Robotics							
Specialized Equipment							

Q3: Impact of Technology on Workforce (Processes and Methods)

For **{each of the above technology categories checked}**, please indicate whether this technology helped reorganize your workforce during the three years 2016 to 2018.

A. Did the technology allow your business to change its **number of workers**?
Mark one.
● Yes, we <u>increased</u> the number of workers
● Yes, we <u>decreased</u> the number of workers
● No, we <u>did not change</u> the number of workers

B. Did the technology impact the **skill level of workers**?
Mark one.
● Yes, worker skills <u>increased</u> overall
● Yes, worker skills <u>decreased</u> overall
● No, worker skills <u>did not change</u> overall

Q4: Impact of Technology on Worker Types (Processes and Methods)

For **{each of the above technology categories checked}**, please indicate whether this technology had an impact on the types of workers during the three years 2016 to 2018.

A. Did the technology impact the **number of production workers** employed by your business?
Mark one.
- ● We <u>increased</u> the number of production workers
- ● We <u>decreased</u> the number of production workers
- ● We <u>did not change</u> the number of production workers
- ● Not applicable, <u>we did not employ</u> production workers

B. Did the technology impact the **number of non-production workers** employed by your business?
Mark one.
- ● We <u>increased</u> the number of non-production workers
- ● We <u>decreased</u> the number of non-production workers
- ● We <u>did not change</u> the number of non-production workers
- ● Not applicable, we <u>did not employ</u> non-production workers

C. Did the technology impact the **number of supervisory workers** employed by your business?
Mark one.
- ● We <u>increased</u> the number of supervisory workers
- ● We <u>decreased</u> the number of supervisory workers
- ● We <u>did not change</u> the number of supervisory workers
- ● Not applicable, <u>we did not employ</u> supervisory workers

D. Did the technology impact the **number of non-supervisory workers** employed by your business?
Mark one.
- ● We <u>increased</u> the number of non-supervisory workers
- ● We <u>decreased</u> the number of non-supervisory workers
- ● We <u>did not change</u> the number of non-supervisory workers
- ● Not applicable, we <u>did not employ</u> non-supervisory workers

E. Did the technology impact the **types of skilled workers** employed by your business?

Mark one.

- ● Yes, worker scientific, technological, engineering and mathematical skills <u>increased</u> overall
- ● Yes, worker scientific, technological, engineering and mathematical skills <u>decreased</u> overall
- ● No, worker scientific, technological, engineering and mathematical skills <u>did not change</u> overall
- ● Not applicable, we <u>did not employ</u> workers with scientific, technological, engineering and mathematical skills

Q5. Technology-Based Goods and Services

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

Mark one for each row.

	Yes	No	Don't know
Artificial Intelligence			
Cloud-based Computing Systems and Applications			
Specialized Software			
Robotics			
Specialized Equipment			

SKIP PATTERN

If all answers to Q5 are "No" or "Don't know" then proceed to Q9.

If a respondent answers that a good or service was produced that included/embedded the technology, Q6 – Q8 follow for each embedded technology.

Q6: Motivation for Technology Adoption and Utilization (Goods and Services)

For each of the technology categories, please indicate whether any of the following was a reason for your business to produce the technology, or produce goods or services that included or embedded the technology, during the three years 2016 to 2018.

	Upgrade goods or services	Expand the range of goods or services	Enter new markets or adapt existing products to new markets	Increase or maintain market share	Adopt standards and accreditation	Other	Did not produce
Artificial Intelligence							
Cloud-based Computing Systems and Applications							
Specialized Software							
Robotics							
Specialized Equipment							

Check all that apply for each row.

Q7: Impact of Technology on Workforce (Goods and Services)

For **{each of the above technology categories checked}**, please indicate whether producing this technology, or goods or services that included or embedded this technology, led you to reorganize your workforce during the three years 2016 to 2018.

A. Did producing the technology or goods or services that included or embedded this technology lead your business to change its **number of workers**?
Mark one.
- ● Yes, we <u>increased</u> the number of workers
- ● Yes, we <u>decreased</u> the number of workers
- ● No, we <u>did not change</u> the number of workers

B. Did producing the technology or goods or services that included or embedded this technology impact the **skill level of workers**?
Mark one.
- ● Yes, worker skills <u>increased</u> overall
- ● Yes, worker skills <u>decreased</u> overall
- ● No, worker skills <u>did not change</u> overall

Q8: Impact of Technology on Worker Types (Goods and Services)

For **{each of the above technology categories checked}**, please indicate whether producing this technology, or goods or services that included or embedded this technology, had an impact on the types of workers during the three years 2016 to 2018.

A. Did the technology impact the **number of production workers** employed by your business?
Mark one.
● We <u>increased</u> the number of production workers
● We <u>decreased</u> the number of production workers
● We <u>did not change</u> the number of production workers
● Not applicable, <u>we did not employ</u> production workers

B. Did the technology impact the **number of non-production workers** employed by your business?
Mark one.
● We <u>increased</u> the number of non-production workers
● We <u>decreased</u> the number of non-production workers
● We <u>did not change</u> the number of non-production workers
● Not applicable, we <u>did not employ</u> non-production workers

C. Did the technology impact the **number of supervisory workers** employed by your business?
Mark one.
● We <u>increased</u> the number of supervisory workers
● We <u>decreased</u> the number of supervisory workers
● We <u>did not change</u> the number of supervisory workers
● Not applicable, <u>we did not employ</u> supervisory workers

D. Did the technology impact the **number of non-supervisory workers** employed by your business?
Mark one.
● We <u>increased</u> the number of non-supervisory workers
● We <u>decreased</u> the number of non-supervisory workers
● We <u>did not change</u> the number of non-supervisory workers
● Not applicable, we <u>did not employ</u> non-supervisory workers

E. Did the technology impact the **types of skilled workers** employed by your business?

Mark one.

● Yes, worker scientific, technological, engineering and mathematical skills <u>increased</u> overall
● Yes, worker scientific, technological, engineering and mathematical skills <u>decreased</u> overall
● No, worker scientific, technological, engineering and mathematical skills <u>did not change</u> overall

● Not applicable, we <u>did not employ</u> workers with scientific, technological, engineering and mathematical skills

Q9: Factors Adversely Affecting Technology Adoption and Utilization

For each technology, please indicate whether any of the following factors adversely affected the adoption or utilization of the technology during the three years 2016 to 2018.

Check all that apply for each row.

	Cost of technology	Maturity of technology	Access and reliability of required data	Access to required human capital and talent	Laws and regulations	Concerns regarding safety and security (physical and IP)	Other	None
Artificial Intelligence								
Cloud-based Computing Systems and Applications								
Specialized Software								
Robotics								
Specialized Equipment								

Appendix (Additional Definitions):

Production worker: A worker (up through the line-supervisor level) engaged in fabricating, processing, assembling, inspecting, receiving, storing, handling, packing, warehousing, shipping (but not delivering), maintenance, repair, janitorial and guard services, product development, auxiliary production for the own use of business (e.g. a power plant), recordkeeping, and other services closely associated with these production operations in the business covered by the report. Employees above the working-supervisor level are excluded.

Non-production worker: A worker engaged in the following activities: factory supervision above the working foreman level, sales (including driver-salesman), sales delivery (highway truck drivers and their helpers), advertising, credit collection, installation and servicing of own products, clerical and routine office functions, executive, purchasing, financing, legal, professional, and technical. Also included are employees on the payroll of the business engaged in the construction of major additions or alterations to the plant who are utilized as a separate work force.

Supervisory worker: A worker whose major responsibility is to supervise, plan, or direct the work of others, such as top executive and managerial positions, officers of corporations, department heads, and superintendents.

Non-supervisory worker: A worker who does not supervise, plan, or direct the work of others.