



New Technology Boosts Texas Firms' Output, Alters Worker Mix

By Emily Kerr, Pia Orrenius and Christopher Slijk

ABSTRACT: A Federal Reserve Bank of Dallas survey of manufacturing and services firms in Texas found that as companies adopt new technologies, the number of workers is little changed though the employees' skill levels shift. While some manufacturers see tighter margins as a result of technology and globalization, service sector firms may realize increased pricing power.

Technological change is the economy's greatest opportunity and its greatest challenge. It affects almost every aspect of economic activity, impacting outcomes for firms and workers. Technological change is also what economists believe drives productivity growth and, thus, higher standards of living.

Nevertheless, such evolution doesn't come easy. During the Industrial Revolution, Luddites famously opposed the introduction of new machines they felt threatened their jobs. When it comes to labor, technology can be a complement, as well as a substitute. Robots and other automated factory tools substitute for labor on the assembly line. However, these technologies complement workers who build, program and repair this type of equipment.

Technological change can also reach beyond the walls of the firm and transform how companies interact with workers and customers. Resulting efficiency gains can lower prices of goods and services to the point that higher demand increases industry employment. Ride-sharing platforms such as Uber and Lyft have significantly lowered the cost of travel, increasing ridership and, hence, vehicle-for-hire employment.

The pace of technological change and adoption varies over time. Research suggests the aging of the labor force is leading to an acceleration in automation technology investment and implementation as a substitute for the slower growth of the prime-aged workforce.¹

To gain insight into the role of technology in business operations in Texas, the Federal Reserve Bank of Dallas queried more than 300 firms in the manufacturing and service sectors in June. Specifically, companies were asked about the technologies they plan

to adopt or have already implemented, why they undertook technological change and the impact they expect on firm employment and pricing power.²

Emerging Technologies

The Dallas Fed technology survey looked at the emerging technologies in Texas businesses—the ones only narrowly in use now but on the brink of wider adoption. When asked which technologies firms plan to adopt within the next three years, artificial intelligence was most often cited, followed by 3-D scanning, biometric authentication, blockchain and 3-D printing (*Table 1*).

Further analysis shows that significantly more manufacturers than services firms are planning technology adoption in the near future (*Chart 1*). More than one-fifth of manufacturers plan to adopt 3-D scanning, a technology that captures a physical object's exact shape and specifications into a digital 3-D representation.

3-D scanning has tremendous utility in the manufacturing sector for reverse engineering, product development and quality control. Nearly one-fifth of manufacturing firms plan to adopt 3-D printing, a complementary technology for prototyping and design iterations, with additional uses for customization and low-volume production.

A similar 20 percent of firms plan to incorporate robotics into manufacturing processes in the near future, adding to the 20 percent that have already implemented it.

Among service sector firms, artificial intelligence tops the list of emerging technologies, with several companies mentioning the use of machine-learning platforms for analytics and decision insights. Biometric authentication—a technology that can transform access

**TABLE
1**

Top 10 Emerging Technologies Among Texas Firms

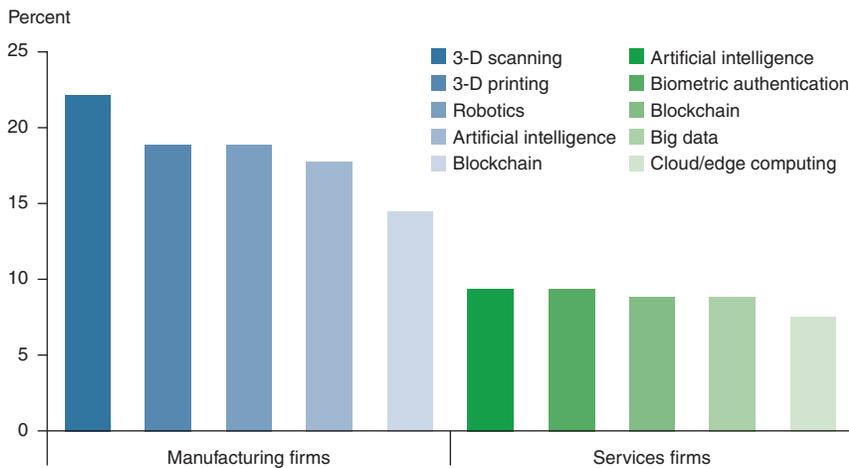
	Plan to adopt (%)	In process of adopting (%)	Already adopted (%)
Artificial intelligence (voice recognition, decision trees, autonomous vehicles, etc.)	12	8	5
3-D scanning	11	1	5
Biometric authentication	11	2	8
Blockchain	11	2	1
3-D printing	10	2	7
Big data	10	9	11
Robotics	8	4	10
Cloud computing/edge computing	8	11	42
Virtual reality/augmented reality	6	4	5
Digital currencies (cryptocurrency, bitcoin, etc.)	6	0	2

NOTES: Shown are the top 10 responses to the question, "Which of the following technologies has your firm already adopted? Is your firm in the process of adopting? Does your firm plan to adopt within the next three years?" Data were collected June 12–20, 2018, and 314 Texas business executives responded.

SOURCE: Dallas Fed Texas Business Outlook Surveys.

**CHART
1**

Manufacturing Leads Services Firms in Technology Adoption



NOTES: Shown are the top five responses by firm type to the question, "Which of the following technologies does your firm plan to adopt within the next three years?" Data were collected June 12–20, 2018, and 224 Texas service sector executives and 90 Texas manufacturing executives responded.

SOURCE: Dallas Fed Texas Business Outlook Surveys.

management for physical and digital resources—is planned for adoption at roughly 10 percent of firms. This is followed closely by blockchain, the decentralized digital ledger technology underpinning cryptocurrencies such as bitcoin, and big data.

In taking stock of the technologies that Texas firms have already adopted, the top responses are not surprising:

communication platforms such as email and Skype, social media, high-speed internet, intranet networks and mobile apps. Roughly half or more of firms use these.

Why Firms Adopt New Technology

Adopting new technology is often expensive and disruptive. Firms may require financing, or they may draw on

savings. Installation of new equipment may disrupt operations and likely requires retraining workers and spelling out new processes. There is always the risk that the new equipment will not work as intended. Given the high cost and uncertainty, the survey asked firms why they change.

Raising productivity was the No. 1 response, cited as a main reason for technology adoption by two-thirds of firms (Table 2). Productivity means doing more with less—producing more output with the same or less input. Services firms secondarily mentioned remaining competitive and/or fending off new market entrants as an impetus, while manufacturing firms disproportionately mentioned lowering costs. More than half of all respondents cited increasing output.

Employment Effects

The Dallas Fed survey next asked how adoption of new technology will affect firm employment over the next five years. Interestingly, technology is not expected to replace workers on net. Only 14 percent of firms said technology adoption will decrease their need for workers, and a similar share said it will actually increase their need for workers (Chart 2).

Half of firms expect no impact on employment, and about a quarter of firms said the adoption of technology will change the *type* of workers needed but not the number.

On the manufacturing side, Texas business executives note that production is increasingly automated and technology-dependent, shifting some labor demand from blue-collar workers to programmers, engineers, and robotics and/or computer design specialists.³

In the service sector, executives noted a shift to workers who are more technologically adept—conversant in analytics, artificial intelligence platforms and computer programming—and able to handle more sophisticated demands.

Overall Jobs Outlook

Notably, technological adoption has not appreciably changed the overall employment outlook. The majority of

Texas firms surveyed—65 percent—plan to add jobs over the next five years. An additional 26 percent said they would keep employment about the same, and only 9 percent of firms indicated they would decrease employment over the period.

Texas manufacturers are particularly bullish, with 78 percent expecting higher headcounts five years out. Optimism among manufacturers is likely helped by robust conditions in the state’s energy industry, bolstered by sustained, relatively high oil prices over the past year or so.

Employment projections vary slightly between large versus small firms. Interestingly, nearly 20 percent of large firms surveyed—ones with at least 500 employees—expect to pare headcounts over the next five years compared with just 7 percent of smaller firms (*Chart 3*). Even still, nearly three-quarters of large firms plan to increase employment.

Broader Trends, Pricing Power

Globalization and technological change are two pervasive forces that define our economic times. Since the fall of the Berlin Wall in 1989 and the end of the Cold War, international trade and exchange have surged. The expansion of global economic activity in developing countries has led to falling poverty and other improvements for some of the world’s poorest populations. But there have also been costs. Manufacturers in advanced economies, including the U.S., have sustained steep declines in employment.⁴ Thanks to technological improvement, however, manufacturing output has continued to grow.

Against the backdrop of these broader trends in the 21st century, the Dallas Fed survey asked how these long-term industry trends—technological change and globalization—have affected firms’ ability to pass on cost increases to customers over the past five years. About half of firms noted there was no net effect on pricing power.

Among the remainder, the breakdown of positive and negative impacts varied between the service sector and manufacturing firms (*Chart 4*). Service

TABLE 2 Firms Adopt Technology Mainly to Raise Productivity

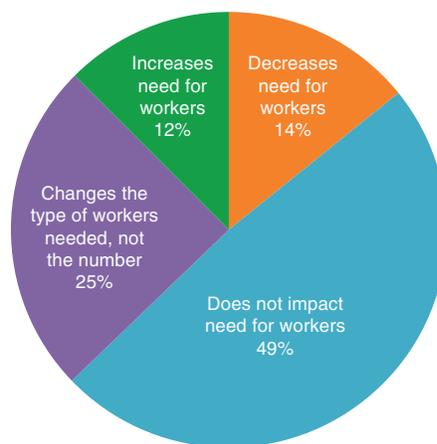
	All Firms (%) (295)	Services firms (%) (209)	Mfg. firms (%) (86)
Raise productivity	66	64	71
Remain competitive/fend off new competitors	53	56	45
Increase output (revenue/sales/production)	53	52	53
Lower costs	40	33	56
Expand into new business lines/markets	19	18	20
Strengthen security and/or protect information	18	19	16
Meet industry standards/government regulations	10	11	7

NOTES: Shown are responses to the question, “What are the main reasons why your firm is adopting these technologies? You may select up to three.” Data were collected June 12–20, 2018. Figures in parentheses represent the number of Texas business executives responding.

SOURCE: Dallas Fed Texas Business Outlook Surveys.

CHART 2 Technology Affects Type, Not Number of Workers Needed

On net, how will the adoption of these technologies affect employment at your firm over the next five years?



NOTE: Data were collected June 12–20, 2018, and 296 Texas business executives responded.

SOURCE: Dallas Fed Texas Business Outlook Surveys.

sector companies were more likely to report increased pricing power (24 percent) than decreased (19 percent). Respondents pointed to technology as key to their ability to raise prices.

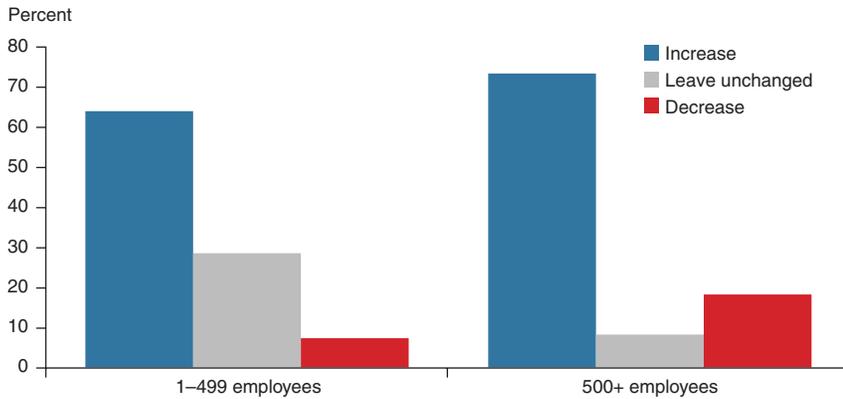
A commercial heating, ventilation and air conditioning company noted: “We have bought some industry-specific customized tools that allow us to complete repairs on equipment much faster than our competitors; we charge for this since there is a benefit of decreased downtime to our customer.”

Several services firms also touched upon the significant value in data analytics—an office moving company reported that “technology now allows us to have immediately available metrics to price to a standard and price to demand. ... When costs go up, we can model what cost sharing we can push through to our customers.” A law firm mentioned that because of cost modeling, it shifted from a billable-hours pricing model to a value-added model, allowing the firm to capitalize on the

**CHART
3**

Employment Expectations More Polarized Among Large Firms

Overall, do you expect your firm to increase employment, leave employment unchanged, or decrease employment over the next five years?



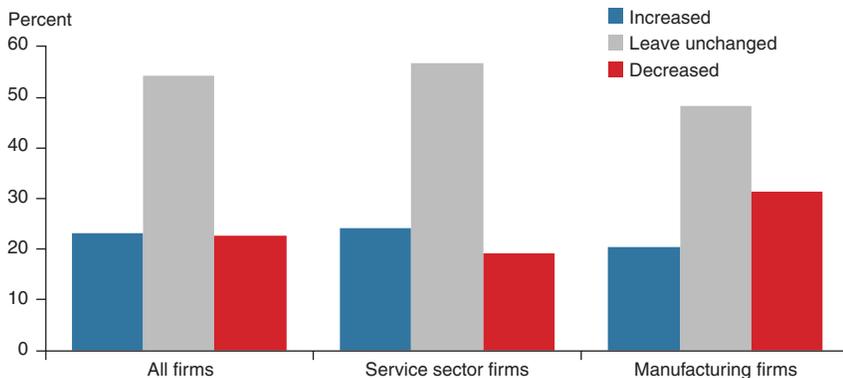
NOTE: Data were collected June 12–20, 2018, and Texas business executives from 248 small firms and 49 large firms responded.

SOURCE: Dallas Fed Texas Business Outlook Surveys.

**CHART
4**

Technology, Globalization Lift Pricing Power for Services, Not Manufacturing

On net, how have long-term trends in your industry, such as technological change and globalization, affected your firm's ability to pass on cost increases to customers over the past five years?



NOTE: Data were collected June 12–20, 2018, and 203 Texas service sector executives and 83 Texas manufacturing executives responded.

SOURCE: Dallas Fed Texas Business Outlook Surveys.

time savings of automating repetitive-type work and other business efficiencies technology has prompted.

Conversely, among manufacturers, an outsized share experienced a declining ability to raise prices, a response consistent with greater exposure to international competition and surging imports from China. A textile manufacturer commented, “Our clients

are getting very aggressive in sourcing from all corners of the globe.” A fabricated metals producer mentioned that “Our domestic customers have many more options to find lower-priced products in the international marketplace than ever before and, with the internet, can find those options easily.”

A high-tech producer said, “My customers are being approached by

foreign companies to provide products similar to ours. They use that information as leverage to keep my prices low.”

Increased Firm Productivity

The June 2018 Dallas Fed technology survey yielded unique insights into what technology Texas firms are adopting and why, as well as how they view their long-term prospects. Firms adopt new technology to increase productivity and, as a result, their long-term employment prospects remain bullish.

Texas firms are not adopting technology to shed workers, although one-quarter of respondents said adopting new technology changes the types of workers needed.

Policymakers and education and workforce experts should take note: Employment will continue growing in Texas firms but the type of skills in demand is evolving. Just as firms must be agile and ready to adopt new technology, workers have to be flexible and attentive to changing job market needs.

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Notes

¹ “Demographics and Automation,” by Daron Acemoglu and Pascual Restrepo, National Bureau of Economic Research, Working Paper no. 24421, March 2018.

² For complete results, see www.dallasfed.org/research/surveys/tssos/2018/1806/specquest.aspx. The survey was a follow-up to the conference, “Technology-Enabled Disruption: Implications for Business, Labor Markets and Monetary Policy,” held in May at the Federal Reserve Bank of Dallas and cohosted by the Federal Reserve Bank of Atlanta. For conference program and agenda, see www.dallasfed.org/research/events/2018/18ted.

³ A follow-up anecdotal survey was conducted via email to gather further insights from firms on how technology affects the type of worker needed and how technological change and globalization impact pricing power. Twenty-two business executives submitted responses June 29–July 9, 2018. Comments from this survey are referred to here and as anecdotes in this article.

⁴ Since 1990, manufacturing employment in Texas has declined just 10 percent, compared with nearly 30 percent for the U.S. as a whole.