Impact of New Technology Use on Workforce: Exploratory Analysis

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Abstract

As new technologies continue to evolve and take center stage in organizations, workers will experience disruption and change. They might wonder what the future holds for them. This study presents an exploratory analysis on the impact of new technologies such as artificial intelligence, cloud-based computing, and robotics on the US workforce. Findings reveal that a majority of US companies which deploy these technologies do not report a decrease in the number of workers employed. In fact, more workers are employed after the technologies are utilized. Additionally, most companies report an increase in the skill level of their workforce. Practical and academic implications are also discussed.

Keywords: Artificial intelligence, cloud-based, robotics, technology, workforce

1. INTRODUCTION

New technologies such as artificial intelligence (AI), cloud-based computing, and robotics, are evolving at a rapid pace both in capabilities and widespread utilization. This trend is predicted to continue. According to McKinsey 2021 Global Survey, 57 % of organizations have adapted AI, compared to 45 % of organizations just a year prior (McKinsey, 2021). The top business functions that most frequently utilize AI include service-based operations, AI based product enhancements, and contact center automation (McKinsey, 2021). McKinsey's survey also reveals that organizations utilizing AI are able to reduce cost in service operations, manufacturing, human resources, and other functions.

As organizations realize returns on their AI investment, they will continue to invest and expand its deployment. This newest digital evolution will affect everyone involved including the workforce. As stated by Atanasoff & Venable (2017, p.333-334), "the global workforce can expect that the technological disruptions to industry and business structure will continue with new technologies on the horizon (e.g., artificial intelligence, robotics, 3-D printing)." Furthermore, Stone et al. (2016) posit that these disruptions will affect the way workers are either augmented or replaced by this latest technology. But how exactly will these disruptions affect the workforce? And what should we expect in the years to come? More specifically, what does this mean for the US workforce? To provide insight to these questions, this study explores the impact of new technologies such as AI, cloud-based, and robotics technology on employment trends within US based firms. The next section discusses key findings from the literature on technology and its impact on workforce.

2. LITERATURE REVIEW

There are mixed perspectives in the literature regarding the effects of technology on the workforce. The first one focuses on individual outcomes and the adverse effects of technology on employees ranging from technostress to job elimination or loss. Technostress refers to the "inability to cope with the new computer technologies in a healthy way" (Brod, 1984, p. 16). Furthermore, Tarafdar et al., (2011) suggest that technostress is caused by five conditions:

techno-overload (being pressured to work more and/or faster), techno-invasion (feeling of always being online and easily reachable), techno-complexity (needing to devote extra time to learn and understand the new technology), techno-insecurity (fear of losing a job to better skilled workers), and techno-uncertainty (lack of opportunity to build experience due to quickly changing technologies).

Techno-insecurity especially has significant implications for the workforce. Zhou, et al. (2020) predicted that 278 million jobs will be replaced by AI by 2049 in China. Additionally, this topic of human labor being replaced by machines has been discussed in literature for a few decades now. Rifkin (1996) postulated that although critical to the capitalist economy, new technology often eliminates jobs leading to "near-workerless world". However, economists argued that productivity gained from new technology leads to higher national income, ultimately generating new jobs and opportunities for workers. Subsequently Pew Research Center (2016) reported that employment has been steadily increasing over the last three decades. Jobs with higher social and analytical skills have been increasing much faster than jobs with physical or manual skills.

Other scholars also acknowledge that as the digital transformation continues, organizations need to play a critical role in mediating the stress and implementing various interventions. Atanasoff & Venable (2017, p. 332) stated "…The problem can be reframed as an opportunity for self-evaluation, including what knowledge, skills, and abilities the client wants to develop for future work. It is an opportunity to reevaluate general career direction." Such approach is intended to help employees cope and even prepare them for new opportunities by assisting with new career development and upskilling opportunities. Bughin et al. (2018) predict that the need for technological, social, and emotional skills will increase despite the decrease in need for manual and physical skills. These changes will require workers everywhere to strengthen their existing skill sets or acquire new ones.

Another perspective looks primarily through the economic and organizational lens. It presents technology as an opportunity to increase efficiency, value, and evolutionary benefits. Davenport et al. (2020) discuss how AI will transform marketing strategies, human behaviors and create new business models. Additional benefits of technology discussed in the literature relate directly to workers themselves in cases where technology enhances their own work and allows them to produce more superior output (Colbert et al., 2016; Lauande Rodrigues & De Minicis, 2021). This allows employees to switch focus from trivial to more impactful and complex tasks. As a result, increasing their own self efficacy, sense of accomplishment, and job satisfaction. Historically, technology created changes in employment but at the same time it has also created new jobs especially in countries that have higher levels of innovation and economic growth such as the US (Manyika et al., 2017).

The aim of this study is to conduct an exploratory analysis and to investigate the impact of firms' technology use on its workforce.

3. METHOD

This study used the US Census Annual Business Survey (ABS) data collected in 2019 (United States Census Bureau, 2019). This survey captured data regarding the extent to which US firms used emerging technologies and their impact on workforce during 2016-2018 time period. The exact name of the data set used was titled "AB1800TCB03A Annual Business Survey: Impact of Technology Use on the Workforce of Employer Firms by 2-digit NAICS for the United States and States: 2018" and contained information about firms with paid employees and receipts of $1,000 or more grouped by industry using a 2-digit NAICS (North American Industry Classification System) code. The data set also included aggregate data for all sectors. Since Census suppresses certain data to maintain confidentiality, only the aggregate level data was used to perform the analyses.

Measures

The ABS survey captured information about the following five technology groups:

- Artificial Intelligence
- Cloud-based
- Robotics
- Specialized Software
- Specialized Equipment

For each technology group the participants were asked to rate the extent to which they used each technology (in the 2016-2018 timeframe). Those companies which selected low, moderate, or high usage of these technologies were directed to answer subsequent questions about employment impact.

The response choices for employment impact

were presented for each technology group. Participants were asked to identify the effects of adopting or using each specific technology (between 2016-2018) on workforce based on the following ten answer choices:

Number of Workers:

- Increased
- Decreased
- Did not change

Skill Level of Workers:

- Increased overall
- Decreased overall
- Did not change overall

Science, Technology, Engineering, and Mathematical (STEM) skills of workers:

- Increased overall
- Decreased overall
- Did not change overall
- Not applicable, did not employ workers with STEM skills

Hence if an organization utilized more than one technology, they were directed to answer the corresponding employment impact questions for each technology group they reported.

Table 1 below lists the total number of employer firms included in the survey per each technology group.

Technology Group	Total Number of Employer Firms
Artificial Intelligence	141,731
Cloud-Based	1,550,716
Robotics	88,657
Specialized Software	1,821,368
Specialized Equipment	855,657

Table 1: Total Number of Firms Included in the Survey Per Each Technology Group

4. FINDINGS

The data was analyzed using Tableau Desktop version 22.2.0 and Microsoft Excel 365 software. The results focus on AI, cloud–based, and robotics technology groups. However, graphs for the remaining two groups (specialized software and specialized equipment) are provided for reference in the Appendix. All graphs represent the percentages of firms based on the total number of employer firms included in the sample as reported in Table 1.

Table 2 contains percentages of employer firms broken down by the three foci technology groups and ten employment impact codes. In addition, Figures 1-3 present corresponding bar graphs for each technology group sorted by employment impact code in descending order.

	AI	Cloud-based	Robotics
Number of Workers			
Increased	15.0	12.5	10.0
Decreased	6.3	3.7	8.1
Did not change	78.8	83.8	81.9
Skill Level of Workers			
Increased	40.9	28.2	23.6
Decreased	1.8	0.8	2.3
Did not change	57.3	70.9	74.1
STEM Skills of Workers			
Increased	31.2	15.8	20.3
Decreased	1.1	0.5	1.6
Did not change	39.8	42.3	54.4
Not applicable	27.9	41.4	23.7

Table 2: Percentages of Firms by Technology and Employment Impact Code.

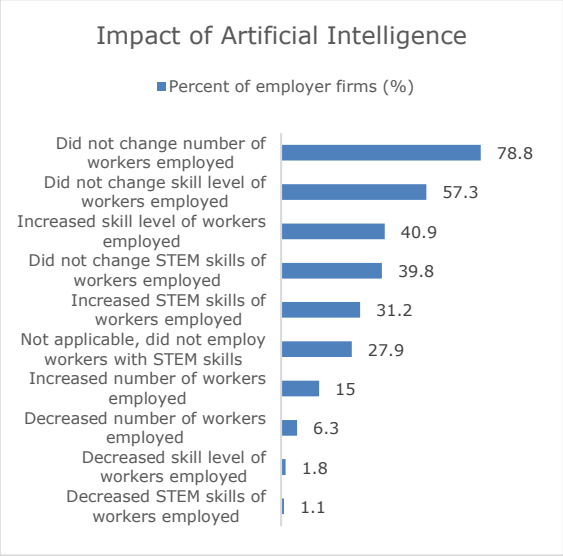

Figure 1: Impact of Artificial Intelligence Technology on Firms' Workers

The first graph in Figure 1 represents the impact of AI on individual employment impact codes. The data shows that implementation of artificial intelligence did not change the number of workers employed in almost 79 % of the firms utilizing AI. In fact, the number of workers increased in 15 % of those organizations. In addition, the skill level of workers increased in 41 % of firms, with STEM skills being higher in 28 % of the organizations. Approximately 6 % of the firms incurred a

decrease in the number of workers and 2% reported decrease in the skill level of their workers.

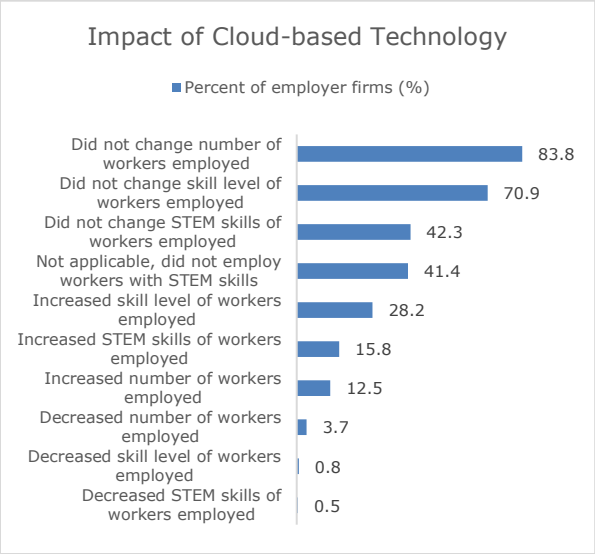

Figure 2: Impact of Cloud-based Technology on Firms' Workers

Similarly, the cloud-based technology presented in Figure 2, did not change the number of workers employed in 84% of the firms. It actually increased the workforce in 13% of the firms. Although the increase in skill level was not as high as in case of AI, it still generated an increase in skill level of workers in 28 % of the firms. About 4 % of firms reduced the size of their workforce as a result of the cloud-based technology and only less than 1 % reported a decrease in workers' skill levels.

A comparable trend was observed in robotics where 82 % of organizations reported no change to the number of workers employed as presented in Figure 3. Additionally, 24% of firms which utilized robotics, reported increase in the skill level of their employees, and 10% of firms reported increase in the number of workers employed. About 8% of firms reported a decrease in the number of employees. Compared to AI (at 6%) and cloud-based technologies (at 4%), robotics presented the largest decrease in workers employed and the smallest percent in the increase of the workers employed.

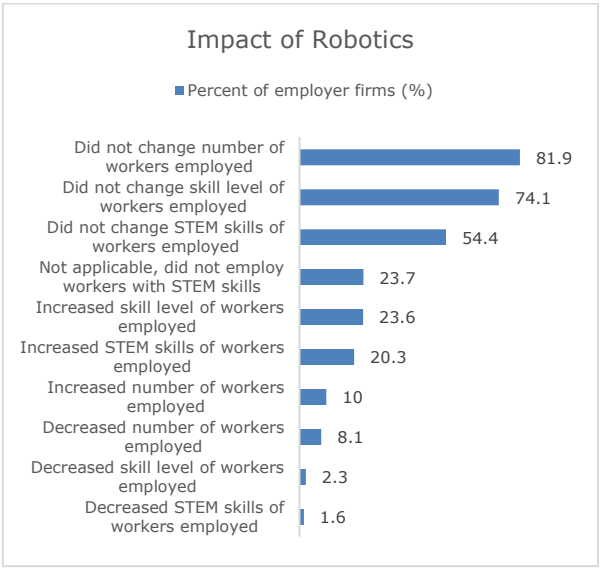

Figure 3: Impact of Robotics Technology on Firms' Workers

Figures for specialized software and specialized equipment technologies provided in the Appendix present similar findings. More specifically the number of workers did not change in majority (87%) of the firms utilizing these technologies.

The next graph in Figure 4, demonstrates a different view of the data where each employment impact code is broken down by the technology group. All technologies appear to demonstrate a similar pattern in terms of the impact on the workforce. One technology that

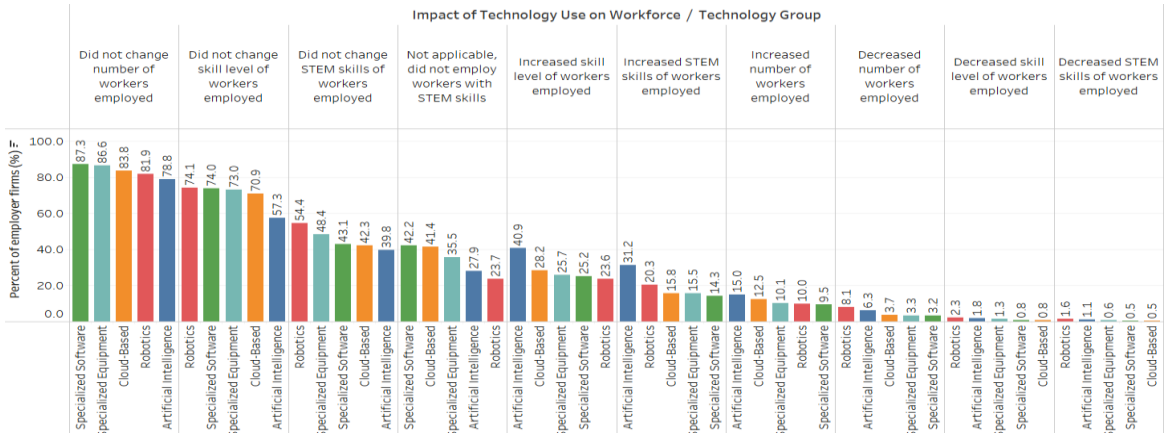

Figure 4: Employment Impact Code by Technology Group

stands out in terms of skill set is AI. Out of the five technologies, artificial intelligence shows the largest impact on workers new skill development (41%), including STEM skills (31%). AI also led in terms of the increase in the number of workers employed (15%).

5. DISCUSSION AND CONCLUSION

This study investigated the effects of emergent technology use on workforce. More specifically it used Census data to explore the impact of technology on workforce in terms of number of workers, skill level, and STEM skills of workers among US firms.

The results reveal that majority of firms which utilized newer technologies did not change the number of workers employed. In fact, the organizations that implemented these technologies showed an increase in the number of workers employed. This is most likely attributed to the complexities and challenges associated with implementing new technologies (Berente, 2021; Devonport et al., 2020; Stone et al., 2016). Additionally, workers whose tasks have been automated are often reassigned to new tasks within the organization (Manyika et al., 2017). However, organizations might also be replacing unskilled workers with more skilled workers instead of upskilling internally. Therefore, these numbers might represent a net effect of various employment changes within organizations. Findings in this study are similar to the survey results reported by Bughin et al. (2018) who indicated that approximately 77 % of organizations do not anticipate changes in the net size of their workforce in the US, and approximately 17 % of firms anticipate their workforce to grow. Nonetheless, causality cannot be established in this paper and findings should be interpreted with caution.

This paper has important implications for employees, employers, and educators. As organizations continue to utilize emergent technologies, employees should stay abreast of these trends and create development plans to help them maintain or develop new skills for roles that are being created to support such technologies. Those roles are hard to automate and consist of non-routine tasks which require creativity and strong problem solving skills (Bughin et al., 2018; Lauande Rodrigues & De Minicis, 2021). Information Systems (IS) professionals especially should continue to stay current in their field and seek opportunities to gain exposure in new technologies. Findings in this paper revealed that considerable number of firms which utilize AI, cloud-based, and robotics technologies reported an increase in the skill level of their employees. This suggests that employees might have access to in house opportunities for exposure or development of new skills. IS professionals in particular might not only be comfortable but also excited about such opportunities. Prior literature shows that IS professionals demonstrate certain common occupational propensities that include high preference for intrinsic rewards at work such as an interesting job, opportunities to learn new skills, skills that do not go out of style, as well as creative and impactful work (Toskin & McCarthy, 2021).

Employers also have an important part in this digital transformation. As suggested by other scholars (Atanasoff & Venable, 2017), they should play an active role in mitigating employee stress due to new technology adaptation, as well as provide training and growth opportunities to upskill and reskill their workforce.

Last but not least educators, especially those in the IS discipline, should feel empowered to revise curriculum that will prepare students for successful careers in AI, cloud-based, and robotics technologies. Findings in this study also emphasize the importance of STEM skills. Manyika et al., (2017) predict that the employment for IS professionals such as computer engineers and computer specialists is expected to grow by 34 % by 2030. More specifically, employers will be looking for advanced IS and programming skills, high cognitive skills, social and emotional skills as well as creativity (Bughin et al., 2018; Lauande Rodrigues & De Minicis, 2021).

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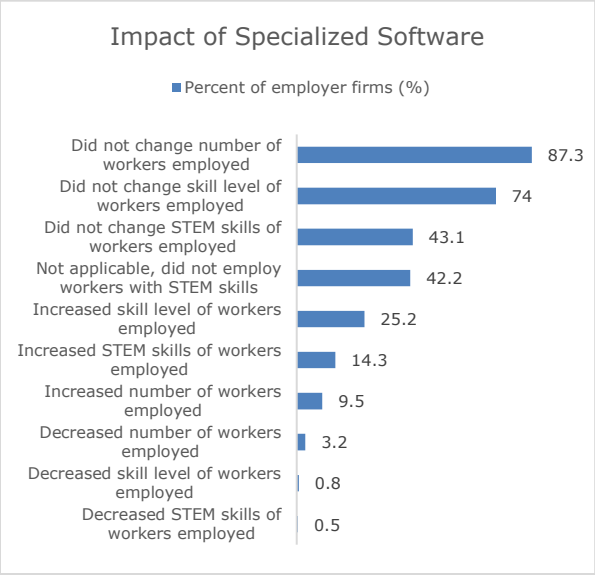
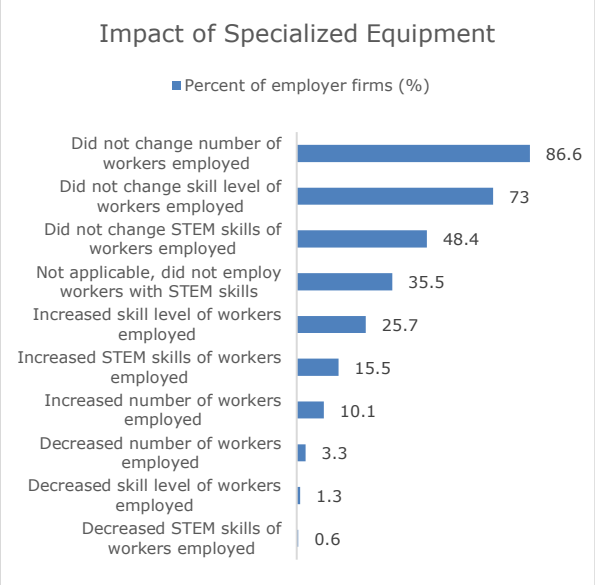
Appendix A.
Additional Figures



Impact of Specialized Software Technology on Firms' Workers



Impact of Specialized Equipment Technology on Firms' Workers