Enhancing Software Efficiency and Exploring the Employment Implications

The Impact of Immigration Policies and Automation on the U.S. Technology Workforce

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By

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

In the late 1900s, technology was evolving with the development of satellites, internet and computers. America was on the forefront of cutting-edge technology with innovative scientists and engineers working toward a brighter future. However, a simple mundane problem shook the world.

The Y2K bug, a computer flaw rooted in the two-digit year code programming practices, emerged as a challenge in technology, society, and policy. As the year 2000 approached, there was a widespread fear that computers would misinterpret the year "00" as 1900 instead of 2000, potentially leading to disruptions across various sectors including banking, power plants, airlines, and more (National Geographic, 2020). This analysis aims to unravel the complexity of the technical, societal, and policy-oriented challenges and responses associated with the Y2K problem, drawing from literature and case studies.

The technical aspect of the Y2K problem is associated with programming practices and the use of two-digit year codes to save on costly data storage. This seemingly simple practice laid the groundwork for a potential crisis, as systems relying on date calculations were at risk of malfunctioning or providing incorrect outputs. The response to this technical challenge was monumental, involving extensive efforts from software and hardware companies, as well as governments in the US and UK (Bennet, 1999). Despite these efforts and stress, the actual transition into the new millennium was notably uneventful because of minimal disruptions reported (Manion and Evan, 2000).

In terms of socially, the Y2K bug served as a catalyst for significant changes in the composition and dynamics of the information technology workforce in the United States. The H-1B visa is a non-immigrant visa in the United States under the Immigration and Nationality Act.

It allows U.S. employers to temporarily employ foreign workers in specialty occupations. The H-1B visa program played a pivotal role, facilitating the influx of skilled IT professionals from India to assist in manual date corrections and other remediation efforts (Khanna and Morales, 2017). This movement not only addressed the immediate technical challenges but also had lasting impacts on the demographic composition and diversity of the IT workforce in the United States. The policy dimension of the Y2K problem was characterized by a delicate balancing act between preparing for an uncertain future and managing the risks and costs associated with extensive remediation efforts. The H-1B visa legislation, for instance, was instrumental in addressing the short-term demands of the IT workforce but raised questions about its utility in addressing longer-term trends and the potential for creating dependencies on foreign labor.

While the Y2K bug serves as a notable example, its broader significance lies in how it underscored the importance of immigration policies in the U.S. technology sector. The H-1B visa program facilitated an influx of skilled IT professionals, impacting the sector's demographic and skill distribution. This moment in history exemplifies the critical role of policy decisions in shaping workforce dynamics within the technology industry. This highlights a vital field of inquiry, focusing on the nuanced impact of immigration policies, notably the H-1B visa program, on the U.S. technology industry with changes in demographic composition. This analysis offers insights into the intricate relationship between legislative measures, workforce immigration trends, and the evolution of technology sectors in the U.S for H-1 visas. This encourages a deeper understanding of how lives are transformed by technology and policy, enabling us to better anticipate for immigrants hoping for a future in U.S.

Technical Topic

The transformative impact of the Y2K bug on the IT industry was profound, underscored by a significant influx of highly skilled professionals under H-1B visas. These individuals played an instrumental role, meticulously updating systems to transition from a two-digit date format to a comprehensive four-digit format, effectively bridging the century from the 1900s to the 2000s. The resolution of this urgent issue opened doors for these professionals to further their careers in a nation rich with opportunities in the technology sector. This shift has left an indelible mark on American society, altering social dynamics, particularly within the tech industry. Nonetheless, it raises a crucial question about the future: As we gravitate towards more "in-house" technological solutions, could we potentially witness a decline in the influx of immigrant talent in the technology sector?

This past summer, I had the privilege of interning with HawkEye 360, a pioneering aerospace company that specializes in crafting satellites, developing embedded software, and devising algorithms for data analysis. My experience here was unparalleled, as it encompassed a unique blend of physics, mathematics, and computer science—a combination not typically found in academic courses.

As a member of the Space Engineering Team, I collaborated closely with four software engineers, two fellow interns, and a systems engineer. My mentor, a seasoned software engineer, held the responsibility of manually updating the satellite software whenever a new version was developed. This intricate process involved managing three distinct software components—prehook, capture, and downlink—for a fleet of 27 satellites. Recognizing the monotonous and time-intensive nature of this task, she delegated it to me, allowing me to immerse myself in the intricacies of the process.

This experience, while initially educational, quickly revealed itself to be tedious. I swiftly mastered BitBake, a Python build tool, and familiarized myself with the company's repository structures. Yet, the repetitiveness of the task soon became apparent. This realization catalyzed my proposition for an innovative, automated solution: a streamlined, agile approach utilizing a custom shell and Python script to autonomously identify and deploy the latest software versions to the appropriate satellites.

My proposal received an enthusiastic endorsement from my team, acknowledging the substantial time and resource savings it promised. After extensive research and development, I successfully integrated the necessary technologies and Python packages to actualize my vision. I crafted a shell script to query Nexus, our database, extracting the latest software version and channeling this information into a Python script. This script facilitated the secure transfer of software packages to virtual machines assigned to each satellite, concurrently establishing soft links for the three software components through SSH protocols. I also created many barricades to ensure no packet loss during the downloading to transferring process. I performed vigorous testing by running my script on individual ground satellites and ensuring the correct compatible version was deployed.

The culmination of my project was presented to the team during a stand-up meeting, where it was met with unanimous approval and recognition for its potential to revolutionize our software deployment process. My innovation not only represented a significant leap in efficiency but also prompted contemplation on the potential ramifications of automation. As the number of satellites were increasing exponentially, the team was previously discussing hiring a software engineer to manage the deployment of software. However, my script was able to eliminate that

position. While I learned valuable skills and created a more efficient solution, I wondered if my involvement had a broader negative impact.

In summation, while my internship at HawkEye 360 endowed me with invaluable skills and the satisfaction of enhancing operational efficiency, it also instilled a sense of responsibility to consider the broader implications of technological advancements, ensuring that progress does not marginalize the human element that remains integral to the industry.

STS Topic

The crucial role of immigrants in the U.S. technology industry is highlighted through a myriad of statistical evidence, showing the profound impact they have on innovation, technological advancement and economic dynamism. The National Bureau of Economic Research reports that while immigrants constitute 16 percent of all U.S. inventors, they are responsible for a staggering 23 percent of total innovation output in regards to patents (Bernstein et al., 2022).. The social fabric of the U.S. technology sector is woven with immigrant employees and leadership. A remarkable 55 percent of startups in this tech hub, each valued above $1 billion, have been founded or managed by immigrants (Anderson, 2018). The National Bureau of Economic Research, in a 2014 working paper, attributes between 30 to 50 percent of the aggregate growth in U.S. output from 1990 to 2010 to the influx of scientists, technology professionals, engineers, and mathematicians, driven by H-1B visa policies (Peri, Shih and Sparber, 2014). This highlights the intricate relationship between immigration policies and technological advancement. Through this mass amount of statistical evidence, it is evident that immigrants have a profound impact on society and are a vital factor in America’s technological global standing.

While these immigrants have advanced into high roles, many of them were brought to the US for manual technological jobs, similar to the Y2K problem. In a paper by Gaetano Basso, Giovanni Peri, Ahmed S. Rahman, correlations between computer-driven productivity growth and immigration were drawn, specifically from 1980s to 2010. They concluded that immigration increased in areas with computer-intensive growth, particularly affecting low-skilled immigration. Computerization resulted in more manual and service jobs for immigrants; native-born workers did not experience this growth and instead saw declines in routine jobs and increases in cognitive jobs (Basso, Peri, Rahman, 2020). While manual jobs were computerized, they were not automated and were by hand processes which were tedious and time consuming. This is why they were allocated as immigrant jobs. This clearly shows how immigrants were brought in for low-skilled jobs, but through the previous statistics, it's evident that these immigrants have a long lasting impact on our current technology.

As the connection between immigrant's importance and origin of immigrants is established, the future of American technology is evolving away from manual tendencies. In a paper by Benedict Dellot and Fabian Wallace Stephens, they discuss the rapid advancements in artificial intelligence (AI) and robotics. They underscore the substantial contributions these technologies have made in diverse sectors including healthcare, finance, journalism, and logistics (Dellot and Stephens, 2017). A study conducted by the University of Oxford predicts that up to 35% of jobs in the UK are at risk of automation, sparking concerns about the potential ramifications for employment, particularly for low-skilled workers (Frey and Osborne, 2013).

These trends raise important questions about future implications, especially regarding the availability and nature of manual technological jobs for the immigrant population especially with the increase of automation. According to a Harvard Review survey, an overwhelming 90% of

workers perceive an increase in their productivity due to automation, and 85% acknowledge that it has improved collaboration (Srivastava and Govindarajan, 2020). Automation provides significant time savings, with over 60% of occupations experiencing a 30% reduction in time spent on tasks (Brynjolfsson and Mitchell, 2017). These findings highlight the substantial benefits of automation in enhancing productivity and efficiency in the workplace. Therefore, despite the potential impact on job markets, the continuous advancement and implementation of automation technologies seem evident to economists. These conclusions by economists will influence the plans of policy makers in the realm of immigration regulation.

This analysis emphasizes the likelihood that the relentless progression of automation in the technology sector will constrict job opportunities for immigrants. A reduction in immigration into technology also will reduce the global standing of America, due to the crucial roles immigrants play in advancements.

Research Question and Methods

"In what ways have immigration policies, particularly the H-1B visa program, shaped the demographic composition and skill distribution in the U.S. technology sector?"

This question underpins the research's importance as detailed in the STS section. Grasping the interplay between immigration rates in the U.S. and shifts in the technological employment landscape is crucial for forecasting technological progression trends. These conclusions are crucial to policy makers, which in turn impact immigrants on H1-B visas. My initial approach involves analyzing H1-B visa allocation trends within the United States, with a focus on specific employment sectors. Concurrently, I will examine technological sector trends

that are phasing out or diminishing low-skilled labor roles. This aims to explain the evolving nature of personnel recruitment as technology advances.

From a legal perspective, I will delve into various legislations that determine H1-B visa quotas for each country, alongside the rationale behind these allocations. This will include an examination of the influence exerted by different governing political parties and their impact on these numbers. Additionally, another point of focus will be the role of major tech corporations in shaping these decisions. Based on this analysis, I will put forward my recommendations for regulatory adjustments and strategies for companies in terms of immigrant hiring practices.

Conclusion

The research conducted through both the technical and STS projects offers valuable deliverables, contributing to a comprehensive understanding of the interplay between immigration policies, technological advancements, and the workforce in the U.S. technology sector. The technical project successfully identifies and implements an innovative automation solution for software deployment, resulting in a more efficient and streamlined process at HawkEye 360. This project serves as a microcosm of the broader trend towards automation and AI in the technology sector. It highlights the potential for enhanced operational efficiency, yet also underscores the implications on employment opportunities, specifically for positions held by immigrant labor.

The STS project delves into the critical role of immigrant labor in the U.S. technology sector, emphasizing their significant contributions to innovation and economic growth. It further explores the potential challenges and shifts in employment opportunities for immigrants as automation and AI continue to advance.

By examining both the technical and societal dimensions of this issue, this research highlights the need for thoughtful consideration and planning to balance the pursuit of technological innovation with the preservation of employment opportunities in a dynamic workforce. It emphasizes the importance of a holistic approach that considers both the technical efficiencies gained through automation and the societal implications on the workforce particularly immigrant labor in manual and technical roles. Overall, the combination of the technical and STS projects serves as a powerful tool for understanding and addressing the challenges and opportunities at the intersection of technology, society, and policy.

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