SERVERLESS COMPUTING AND ITS INFLUENCE ON LABOR DYNAMICS WITHIN THE TECHNOLOGY INDUSTRY

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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 and Background

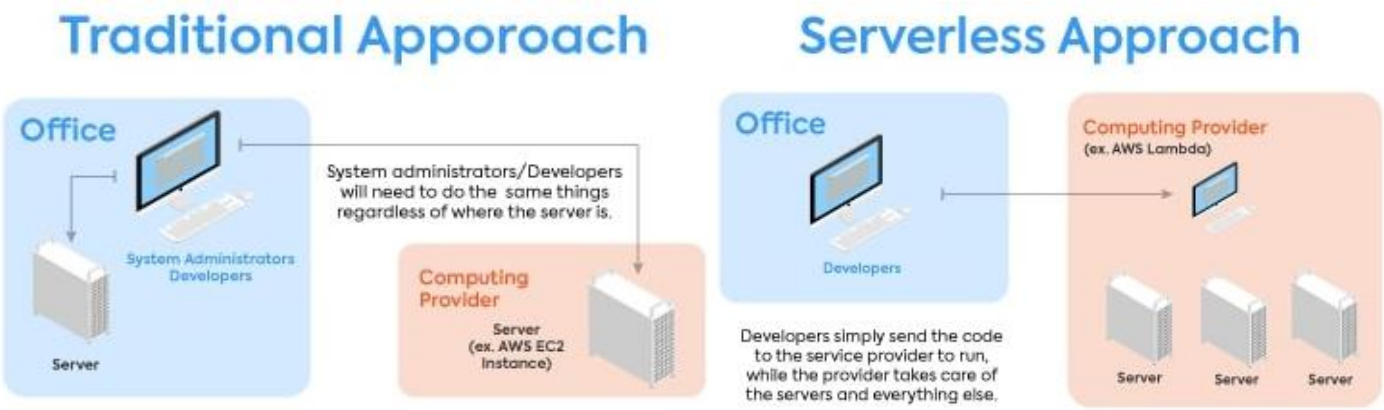
In 2008, Google released the Google App Engine, which enabled developers to create software and launch it on Google's cloud without having to worry about how the server was supplied or whether the operating system needed patches (Retter, 2021). This event marked the birth of serverless computing, with competitors including Microsoft and Amazon soon following suit with their equivalent services, such as Azure Functions and Lambda, respectively. Since then, the adoption of serverless architecture has skyrocketed in consumers ranging from startups to multinational corporations, with the serverless architecture market size exceeding $9 billion USD in 2022 (Global Market Insights Inc., 2022). Some of the many real-world use cases of this technology include Netflix's scalable on-demand media delivery, Major League Baseball's Advanced Media and real-time data updates, and even Coca-Cola's smart vending machines (Rumble Fish Software Development, 2023). However, as more businesses explore serverless computing's potential to streamline operations and drive innovation, questions arise about its impact on employment, industry competition, and even global security.

Serverless computing falls under the realm of cloud computing, which is a computing paradigm allowing for simple on-demand access to computing resources such as cloud-based applications, storage, services, and machines through the Internet (Bigelow, 2022). This allows businesses and users to save on capital, labor, and expertise that would otherwise be needed for buying and maintaining these computing resources themselves. Similarly, serverless computing enables companies to deploy applications and services without the need to provision or manage servers, eliminating the complexities of traditional server management. In addition, customers typically only pay for the resources they consume with no mandatory long-term commitment,

making serverless architecture scalable, efficient, and cost-effective. The figure below better illustrates the differences between a serverless and traditional approach to server management.

Figure 1

Illustration of Different Approaches to Server Management



Note. A common misconception with serverless computing is that there are no servers; in reality, the responsibility of managing servers is handled by a cloud provider instead. From *4 Benefits of Choosing Serverless Computing Early*, by L. Comeau, 2023. (https://www.goodfirms.co/blog/benefits-serverless-computing).

These advantages have led to the widespread adoption of serverless computing within the technology industry, which has redefined job roles and skill demands for IT professionals. Businesses can now relinquish traditional server management responsibilities to third-party cloud providers, leading to significant shifts in the technology job market. In addition, this also leads to certain industry skills becoming more and less marketable, such as familiarity with using cloud platforms and experience managing on-premises servers, respectively. Because of this, IT professionals are also compelled to adapt by acquiring relevant skills to keep up with the shifting job market or transitioning to alternative roles.

My literature review provides background on serverless computing resources, specifically from AWS, and how they have impacted the cloud services market along with desired information technology knowledge and skills. In addition, my literature review also discusses the various interactions between Amazon's upper management, IT professionals, and consumers to better understand current economic and labor dynamics. To provide the necessary background information to understand the reasons behind the analysis being conducted, I gathered information on historical trends within the IT job market prior to and after the introduction of various cloud services. Additionally, I also identified which sectors of the IT job market have been impacted the most by the introduction of AWS's serverless solutions and what the consequences were. In my analysis, I found that the demand for certain skills in the IT job market has greatly changed since 2001, with many organizations transitioning to cloud hosting solutions.

Methods

For my literature review, I consulted primary and secondary sources about the evolution of IT job demands and the impact of cloud hosting solutions, particularly serverless computing. Primary sources included past research such as the *Ofcom Cloud Services Market Study* and comprehensive overviews provided by AWS on serverless computing. I supplemented these with research papers addressing the changing nature of IT job requirements and profiles. Additionally, I delved into secondary articles exploring the historical context and transformative effects of cloud computing. This helped to reveal how the landscape of IT jobs has shifted both before and after the advent of cloud computing tools.

While most of these sources don’t specifically focus on serverless computing, one exception includes the *Serverless Architecture Market Size*, which offered valuable insights into the growth drivers, challenges, and market share of different serverless services based on historical data and forecasts. This source highlights the impact of serverless architecture within the IT industry.

To better understand Amazon's hiring practices and service offerings, I analyzed a variety of sources including hiring principles, recruitment pages, and the AWS website. Although these sources were not solely focused on serverless computing, they offered valuable insights into Amazon's hiring culture and talent acquisition strategies, establishing a benchmark for industry standards.

In addition to traditional research methods, I employed Actor-Network Theory (ANT) analysis to visualize the intricate interactions among various stakeholders involved in serverless computing. This theoretical framework allowed me to examine the roles played by both human and non-human entities, such as IT professionals, Amazon's upper management, and consumers, in shaping the dynamics of serverless architecture.

To better understand this framework, I conducted background research drawing from authoritative definitions by scholars such as Crawford and Edler-Vass. Crawford's definition emphasizes the influence of actors, whether human or non-human, within larger techno-social systems (Crawford, 2020), while Edler-Vass describes the concept of actor-networks as dynamic assemblages of physical and social factors (Edler-Vass, 2015). For instance, an iPhone 15 can be seen as an actor-network, representing an assemblage of physical factors like technological innovations along with social factors like consumer demand and brand popularity.

For my topic, my actor-network is the assemblage of interconnected human and non-human entities that shape and influence the dynamics surrounding serverless computing. This framework is a good fit for several reasons. First, an actor-network equally weighs human entities like IT professionals with non-human entities such as AWS serverless technologies and the Internet, which best represents larger techno-social systems such as the serverless architecture market. Second, actor-networks are not often set in stone, which goes well with the fact that various actors within my actor-network such as serverless computing technologies innovate and change over time. Third, actors can each have their own network in ANT, which allows me to apply the same framework when analyzing individual entities such as AWS. Lastly, my research also explores the social and economic impact of serverless computing on IT professionals, which aligns with ANT's emphasis on how actors influence each other.

Literature Review

Ofcom Cloud Services Market Study

Cloud computing has quickly become essential for delivering digital services, transforming industries like telecommunications and broadcasting. Cloud infrastructure services, which Ofcom's study is focused on, are built on physical servers and virtual machines hosted in data centers around the world (Ofcom, 2023). This consists of products called infrastructure as a service (IaaS) which includes storage, computing, and networking, as well as platform as a service (PaaS), which includes the software tools needed to build and run applications (Ofcom, 2023).

In the UK, AWS and Microsoft dominate the cloud infrastructure market, collectively holding a market share of 70% to 80% in 2022, with Google trailing behind at 5% to 10% (Ofcom, 2023). These market leaders, known as hyperscalers, offer a wide array of services to customers across various industries.

Competition among cloud providers primarily revolves around attracting new customers with incentives like product innovation, discounts, and a variety of software services. However, certain market features hinder customers from switching providers or adopting a multi-cloud strategy. Egress fees, or charges for data transfer out of a cloud, act as a deterrent to switching and increase the cost of migration (Ofcom, 2023). Additionally, technical barriers pose challenges in adapting data and applications to new cloud services (Ofcom, 2023). Lastly, committed spend discounts, while cost-efficient, encourage customers to remain with a single provider for most of their cloud requirements (Ofcom, 2023).

These features discourage customers from adopting a multi-cloud strategy, imposing significant barriers on those seeking to switch providers. Consequently, customers are locked into their current provider, granting market leaders greater power. Practices like these drive-up product prices and restrict access to innovative offerings (Ofcom, 2023). As such, understanding these dynamics is crucial for analyzing the impact of serverless computing on innovation and growth within the cloud computing market. However, it's also essential to explore how these market dynamics have shaped the demand for IT knowledge and skills.

The Demand for IT Knowledge and Skills

In addition, many of the current market dynamics are caused by major economic events that play a large role in impacting marketable IT skills and knowledge. One of these was the

global economic downturn in 2001, which resulted in a significant decrease of 528,496 information technology jobs, from 10.4 million to 9.9 million (Galup et al., 2004). Despite this decline, there was a simultaneous increase in the usage of the World Wide Web from 66.9% in 2000 to 71.1% in 2003 (Galup et al., 2004). Consequently, organizations were compelled to carefully assess the required skills for job roles amidst this changing landscape, emphasizing job advertising and applicant screening (Galup et al., 2004). This economic downturn profoundly influenced the demand for specific knowledge and skills in the IT job market.

During this period, the availability of skilled IT professionals underwent shifts, influenced by factors such as the transition from host-based to network computing skills and prevailing economic conditions (Galup et al., 2004). A comprehensive skill set for IT professionals encompassed technical specialties, technology management, business functional, and interpersonal and management skills (Galup et al., 2004). Analysis of job advertisements between July 2001 and November 2002 revealed minimal differences in job classification counts, with high demand observed for roles like Business Analysts/Modelers, Application Programmers/Analysts, Software Engineers, Managers, and Systems Administrators (Galup et al., 2004). Notably, popular hardware skills included TCP/IP, WAN, Routers, Firewalls, while sought-after software skills comprised SQL, Unix, C++, Oracle, and Java (Galup et al., 2004). It's important to note that these findings predate the advent of cloud computing, explaining the absence of demand for cloud-related skills during this period. Despite these insights into evolving skill requirements, understanding the direct impact of cloud adoption on IT job roles and employment trends is crucial for understanding the evolution of the cloud services market.

Impact of Cloud Hosting Solutions on IT Jobs

As shown earlier, most IT job roles in the early 2000's emphasize managing or working indirectly with on-premises equipment, which incurs additional expenses for companies. Because of this, the introduction of cloud computing spurred rapid adoption among organizations seeking to reduce IT costs and enhance efficiency, leading to substantial growth in the global public services market from $182 billion in 2018 to over $300 billion in 2021 (George et al., 2023). This growth is fueled by factors like increased flexibility, scalability, and the ability to leverage advanced technologies such as artificial intelligence and blockchain without significant infrastructure investment (George et al., 2023). Major tech vendors like Amazon, Microsoft, and Google offer state-of-the-art solutions, further driving adoption among businesses of all sizes.

This surge in cloud adoption has reshaped the IT job landscape, with traditional roles declining as organizations migrate their infrastructure and software to the cloud (George et al., 2023). Research suggests that by 2025, approximately 80% of companies may shutter their traditional data centers, impacting roles focused on maintaining on-premises hardware and software (George et al., 2023). Positions in server, storage, and network administration are also experiencing reduced demand as resources transition to the cloud, affecting data center operations and IT support roles (George et al., 2023).

However, cloud computing presents new opportunities for IT professionals, with high-demand roles like cloud architects, engineers, and security specialists emerging (George et al., 2023). These roles often offer higher salaries compared to non-cloud positions and provide avenues for career growth around major public clouds like AWS, Azure, and Google Cloud (George et al., 2023). Professionals with experience in traditional IT roles can transition to

cloud-based careers, leveraging transferrable skills to succeed in cloud architecture, engineering, and application development (George et al., 2023).

In summary, cloud adoption presents both challenges and opportunities for IT jobs, with organizations having to help IT workers develop the latest cloud skills through training and certification. IT professionals also need to proactively enhance their cloud knowledge to transition from legacy to cloud-based roles. However, companies that do invest in skilling up their IT personnel will gain a competitive advantage in the cloud era. As such, with the right strategies, the cloud revolution can positively transform IT careers.

Analysis

Acknowledging Scope of Studies

Something important to acknowledge is that all these studies don't entirely focus on serverless computing, but rather on cloud computing, which is a much broader field. However, since serverless computing is a specific type of cloud computing, much of the information and takeaways from these studies also apply to serverless computing. For instance, the introduction of serverless computing is a major contributor to the impact on IT professionals and organizations that cloud computing has left. As such, throughout this analysis, sources that discuss cloud computing can be assumed to have takeaways applicable to serverless computing as well.

Another important acknowledgement to make is the fact that the scope of the Ofcom Study done on the Cloud Market is limited to the UK, rather than the US. However, cloud service providers like AWS have a global outreach, and offer many of the same services in regions including North America, South America, Europe, and more. As such, using this study

still provides an accurate representation of cloud computing, while also providing an alternative perspective on the interactions occurring within it.

Serverless Architecture vs. PaaS

With these concerns addressed, clarifying the difference between serverless computing and platform as a service (PaaS) will also be important for distinguishing its impact on the market from that of similar technologies. As previously discussed, serverless applications enable developers to focus on only writing application code without having to worry about server management. However, unlike PaaS, serverless applications are capable of scaling instantly, automatically, and on demand without any extra configuration from the developer or vendor. Although the user has less control over the deployment environment, having the ability for an application to precisely scale up and down in response to an event within seconds or even milliseconds is a clear advantage serverless architecture has over PaaS. Because of this, serverless billing is also extremely precise, with users only having to pay for the exact amount of resources used. As an analogy, consider a tap in a modern home, where water represents computing power. Consumers who use water from the tap pay for exactly as much water as they use, and the tap can be switched on and off at any time to produce as much water as needed. Meanwhile, PaaS is more comparable to a water bottle delivery service – although a user can still obtain as much water as needed, they must ask the vendor to deliver more or less depending on their demand. This best summarizes the benefits of serverless architecture over PaaS; it provides an easier, more precise, and flexible means of scaling up and down.

Serverless architecture fills a new niche in the market and has certain advantages compared to PaaS that make it useful for specific applications. Because of this, many companies have opted to adopt various tools used for developing serverless applications, such as AWS

Lambda. However, in doing so, companies must spend time and resources to train current employees while also updating job requirements or adding in new positions. In addition, technical barriers such as these mean that companies need to put additional effort into reconfiguring old data and applications to be based on serverless architecture. Outside of this, easing this transition to serverless architecture also requires the government to implement forward-looking policies to support the process of retraining IT workers impacted by cloud usage.

The Evolution of the IT Industry

Serverless architecture has also led to in-demand IT knowledge and skills greatly changing since 2001, with new technologies revolutionizing the landscape. Traditional roles that once dominated the industry, such as systems administration and network engineering, have evolved to meet the demands of cloud-based environments. The shift towards cloud computing has necessitated a reevaluation of skill sets, with a growing emphasis on expertise in cloud architecture, deployment, and management. In-demand skills now include proficiency in cloud platforms like AWS, Azure, and Google Cloud, as well as knowledge of serverless computing frameworks such as AWS Lambda. These changes reflect a broader trend towards the adoption of cloud-native technologies, where organizations seek professionals who can leverage the benefits of cloud computing to drive innovation and efficiency.

Transformative Impact on IT Employment

In addition, the transformative effect of cloud and serverless computing on IT employment cannot be overstated. Traditional roles focused on maintaining on-premises hardware and software are seeing a decline in demand as organizations migrate their

infrastructure to the cloud. This shift is driven by the scalability, flexibility, and cost-effectiveness offered by cloud-based solutions. As a result, roles such as data center operations and IT support are evolving or diminishing, while new roles centered on cloud architecture, engineering, and security are emerging. Cloud architects, cloud system engineers, and cloud security specialists are among the most sought-after positions, commanding higher salaries and offering opportunities for career growth. The demand for these roles underscores the importance of adapting legacy skill sets to the evolving demands of the cloud era.

One of the key challenges facing IT professionals is the need to adapt legacy skill sets to cloud environments. As organizations transition to cloud-based infrastructure, professionals with experience in systems administration and network engineering must acquire new competencies in cloud architecture and management. This shift reflects a broader change in market demand, where proficiency in cloud technologies is increasingly valued over traditional IT skills. However, the transition is not without its challenges, as professionals may encounter technical barriers and require additional training to navigate cloud platforms effectively. Nonetheless, the ability to adapt legacy skill sets to cloud environments presents opportunities for career advancement and professional development in the rapidly evolving technology industry.

Social Groups in Primary Sources

The primary sources discussed in the paper shed light on various social groups involved in the adoption of cloud and serverless computing technologies. These groups include Amazon's consumers, IT specialists, hiring teams at tech companies, and upper management within cloud service providers like Amazon Web Services (AWS) and Microsoft. Amazon's consumers represent a diverse range of individuals and organizations leveraging cloud services for various purposes, from startups to multinational corporations. IT specialists encompass professionals

with expertise in cloud architecture, deployment, and management, whose skills are in high demand as organizations transition to cloud-based infrastructure. Hiring teams at tech companies play a crucial role in identifying and acquiring talent with the requisite skills to navigate the complexities of cloud computing. Finally, upper management within cloud service providers like AWS and Microsoft drive strategic decisions that shape the direction of the industry, including product innovation, market competition, and workforce development.

Application of ANT to Labor Dynamics

Actor-Network Theory (ANT) provides a framework for understanding the complex interactions between companies, employers, employees, consumers, and new technologies in shaping labor dynamics within the technology industry. When using ANT to analyze this situation in the context of cloud and serverless computing, we can see that the main actors include social groups such as Amazon's consumers, IT specialists, hiring teams, and upper management, along with technological components like cloud platforms and serverless frameworks.

ANT helps elucidate how interactions between these actors contribute to an overall shift in labor dynamics within the technology industry. For instance, companies seeking to leverage serverless computing technologies become nodes within the actor-network, influencing the demand for specific skills and job roles. Employers, represented by hiring teams and upper management, must adapt their hiring practices and workforce strategies to align with the requirements of the cloud era.

Simultaneously, employees, particularly IT specialists, navigate these changes by acquiring new competencies in cloud architecture, deployment, and management. ANT helps us

understand the agency of individual actors within the network as they respond to shifts in market demand and technological innovation. Additionally, consumers play a crucial role in shaping labor dynamics by driving the adoption of cloud services and influencing the development of new technologies through their usage patterns and feedback.

Moreover, ANT highlights the role of non-human actors, such as cloud platforms and serverless frameworks, in mediating interactions between companies, employers, employees, and consumers. These technological components act as intermediaries within the actor-network, shaping the flow of information, resources, and opportunities in the labor market.

Gathering and Maintaining Allies in ANT

The actors involved in the adoption of cloud and serverless computing technologies gather and maintain their allies through the process of translation, where a central network worth building and defending is created (Sidorova et al., 2000). The first of these is problematization, where the relevant actors and problems are identified. For instance, companies may problematize the inefficiencies of traditional on-premises infrastructure, leading them to seek solutions offered by cloud and serverless computing technologies. Similarly, IT specialists may problematize the limitations of their current skill sets due to technological advancements, prompting them to pursue training and certification in cloud architecture and management.

Once a problem has been identified, actors engage in interessement, or the process of enlisting other actors to support their cause (Sidorova et al., 2000). This may involve framing the problem in a way that resonates with the interests and motivations of potential allies. For instance, employers may interesse IT specialists by highlighting the career opportunities and salary benefits associated with cloud-related roles. Likewise, cloud service providers may

interesse companies by emphasizing the cost savings and scalability offered by their platforms. Through interessement, actors seek to align the interests of diverse stakeholders towards a common goal, such as the adoption of cloud and serverless computing technologies.

Following interessement is enrollment, which refers to the act of recruiting or mobilizing actors into a network (Sidorova et al., 2000). Companies, represented by cloud service providers like AWS and Microsoft, cultivate alliances with, or enroll, consumers by offering innovative services, reliable infrastructure, and responsive support. These companies leverage marketing strategies, pricing models, and customer feedback mechanisms to maintain consumer loyalty and expand their user base. Additionally, employers forge alliances with employees and prospective hires by providing training programs, career development opportunities, and competitive compensation packages. By investing in their workforce, employers cultivate a loyal and skilled labor pool capable of driving innovation and maintaining competitive advantage in the market.

Actors within the technology industry form alliances through negotiations, aligning interests, and establishing mutual dependencies. Companies collaborate with software vendors and employers partner with educational institutions, forging connections based on shared goals and complementary capabilities. These alliances strengthen actor-networks against competing factions, consolidating resources and defending against market challenges. As networks undergo tests of strength, actors deploy strategies like innovation and strategic partnerships to resist encroachments and assert dominance. The outcomes of these tests determine the balance of power within the industry, shaping labor dynamics and technological evolution.

Throughout this process, actors identify and leverage obligatory passage points, or key junctures where decisions are made and power is exercised within the network (Sidorova et al., 2000). These passage points serve as gateways or chokepoints that influence the flow of

resources, information, and opportunities, shaping the trajectory of the network. For example, the decision to adopt cloud and serverless computing technologies represents an obligatory passage point for companies seeking to modernize their IT infrastructure and gain a competitive edge in the market.

Discussion

Serverless computing has significantly transformed the technology industry, revolutionizing how companies implement their business solutions. This paradigm shift has led to a decline in traditional IT jobs associated with on-premises hardware and infrastructure management, while simultaneously fueling growth for IT professionals with proficiency in cloud-related skills. As organizations increasingly adopt serverless architectures, the demand for individuals capable of navigating cloud platforms and developing serverless applications continues to rise.

Takeaways for Companies and IT Professionals

In the rapidly evolving landscape of technology, advancements are constantly being made both within and outside the cloud market. Understanding how individuals can adapt to these changes, regardless of their industry, is crucial for ensuring job security and marketability. Professionals must be proactive in acquiring the necessary skills to remain relevant in a rapidly changing job market. For companies, comprehending the shift in labor dynamics is essential for effective talent acquisition strategies. Understanding which job positions will be more relevant in the near future allows organizations to optimize the benefits gained from hiring individuals with

specific skill sets. By aligning hiring practices with emerging technology trends, companies can ensure they have the talent necessary to drive innovation and remain competitive.

Talent acquisition teams within companies should adjust their approach to filling job positions based on evolving technology trends and marketable skills. By identifying emerging skill requirements and adapting job descriptions accordingly, organizations can attract candidates with the expertise needed to thrive in a serverless computing environment. Companies should also prioritize investing in the professional development of their current employees. Encouraging staff to gain experience working with new and promising technologies, particularly those relevant to their field, can better prepare them for future technological shifts. Offering training programs and opportunities for skill enhancement can empower employees to adapt to changing job requirements and contribute to the organization's success.

Future Research

While serverless computing represents a significant aspect of cloud computing, there are numerous alternative cloud computing models and emerging technology trends that warrant further investigation. Future research should explore the impact of these alternative models on labor dynamics within the technology industry. Additionally, examining newer technology trends outside of cloud computing, such as generative AI, presents opportunities for in-depth analysis and exploration of their implications on the workforce and job market.

In conclusion, understanding and adapting to the shifting labor dynamics brought about by serverless computing is imperative for both individuals and organizations in the technology industry. By recognizing the importance of acquiring relevant skills, aligning talent acquisition strategies with emerging technology trends, and investing in employee development, companies

can position themselves for success in an increasingly serverless computing-centric environment. Similarly, continued research into the broader implications of serverless computing and emerging technology trends is essential for staying on top of industry developments while driving future innovation.

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