What Gets You Hired Now Will Not Get You Hired Then

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Since its inception, humanity has depended on the skills of individuals and groups. Over millennia, humanity and skills evolved, differentiating those who would prosper from those who did not. From gatherers to hunters, from agriculture to industry, and from IT to AI, the complexity and rate of change have increased exponentially, driven by language, curiosity, and communication. IT skills and a variety of IT professions have dominated the past 25 years.

At this juncture, advances in AI have altered the technology landscape, causing tectonic shifts in many professions. How will IT professions evolve, and how should IT professionals adapt? We contend that, first, required skill sets will rapidly change, increasing the importance of continuing education. Second, with the increased adoption of AI, the importance of data will also increase, demanding an ever-growing need for data science skills. Finally, many IT activities will be automated, requiring IT professionals to collaborate with AI assistants and take more strategic roles.

In 25 years, IT professionals, if they exist at all, will have completely different roles. Technological innovations are dramatically changing not only the way we work but the work itself. Will the IT professional be part of the 40% of roles eliminated due to automation, as predicted by Oxford University economists Dr. Carl Frey and Dr. Michael Osborne[1]?

Job destruction and, conversely, job creation are not new. Throughout history, roles and industries have been destroyed through technological innovations. Just 120 years ago, most people worked in agriculture (72.1% was the world average, with 77.9% in developing countries and 59.4% in developed countries[2]). By 2020, the world average decreased to 27% of the population[3] (and only about 3% of the U.S. workforce[4]). Further, the work of the remaining 27% differs from 120 years ago due to the tools used, knowledge required, and skills applied. While fewer than one in three people anchoring the food supply chain is no longer a concern due to the leveraging effects of automation, the shift to automation and industrialization has led to the loss of species and habitat, the rise of monocultures, reliance on artificial pesticides and fertilizers, and an increase of diet-related chronic illnesses.

We expect this trend to extend to the IT sector. Historically, technology has been used to replace routine, manual, repetitive work with automation and logic-based algorithms. Now, with even more sophisticated technology such as AI, machine learning (ML), high-performance computing, and smart sensors, this shift is no longer confined to routine manufacturing tasks. Technology innovation impacts more cognitive-intensive, adaptive, higher skilled workers, including IT professionals, software engineers, and data scientists.

Further, this transformation will not take a century but will likely happen in 25 (or fewer) years because of the accelerating pace of technological evolution. As happened with agriculture, technology will be both the enabler and villain of this transformation. The reasons for the transformation are also similar: the drive to

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increase efficiency to superhuman levels and the impossibility of managing the increased yield using old tools and old processes.

Let's look at the forces at play in the IT world.

HISTORICAL PERSPECTIVE

To think about the future of IT, take a step back and consider a bit of IT history. When looking at the major technology transitions over the last 30 years, two major shifts include the Internet revolution (1990–2010) and the mobile revolution (2005–2020), which have followed the traditional "S-curve" of adoption (Figure 1). The role of IT has faithfully followed these transitions over time.

With the advent of the Internet and the World Wide Web, the need for new skills emerged, such as Web infrastructure development; programming; and website conceptualization, development, and maintenance. Additionally, e-commerce and related new technologies (e.g., database systems, inventory management, shipping logistics, online payment processing, security management, etc.) generated new IT roles dealing with far more complex IT environments than traditional on-premise, mainframe-based computing.

This trend implied managing and understanding novel networking technologies (e.g., local area networks and wide area networks), which culminated in the cloud computing revolution toward the end of the 1990s. Cloud computing completely shifted the IT focus from managing an on-premise world to a hybrid environment, composed of a combination of virtualized IT infrastructure in the cloud and local resources, a mix of traditional independent software vendors software, infrastructure as a service environments, and a growing ecosystem of software-as-a-service choices (starting from productivity software, e-mail, and documents and then moving to full-fledged functions, like customer relationship management and human resources).

The Internet also had a significant effect on the career evolution of IT professionals. In the mainframe era, IT information used to be in the hands of a few vertically integrated players who also controlled education and training. While originally conceived as a complement to the mainframe, the advent of the PC and its productivity software ecosystem brought a diverse set of professionals into IT, and the migration of PCs from office to home engendered the first generation of computing natives. Ethernet had been connecting the office and enterprise for two decades, but it was widespread Internet adoption that made IT information much more broadly available and online collaboration far easier, creating a new generation of self-taught, continuously learning, located-anywhere professionals.

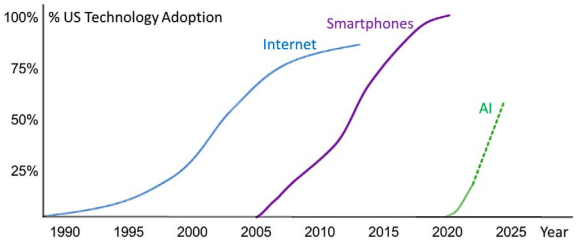

FIGURE 1. Technology adoption.[14]

The mobile revolution around 2010 was the second major cause of transformation for the IT profession. From a world of desktops, servers, and a fairly office-stationary workforce, the world shifted due to an explosion of devices and mobility options for workers. The ubiquitous adoption of smartphones and mobile apps created a set of new needs for different user interfaces and testing processes. The "BYOD" (bring-your-own-device) revolution came with an order-of-magnitude higher complexity and a new set of security concerns, resulting in creative ideas to address them. IT professionals found themselves having to maintain an acceptable level of security and protection of company resources to enable a flexible workforce, with diverse needs, using many different devices (from smartphones to tablets), and accessing information from unsecured locations (from homes to coffee shops).

Since its origins in the 1960s, AI has always been a potentially transformative technology. However, unfilled expectations leading to the "AI Winters" of the 1970s and 1980s likely caused many pundits to miss the invisible paradigm shift that was occurring. Hence, the generative AI disruptive revolution, which began at the end of 2022, with its broad and profound applicability to diverse areas of disciplines and user interfaces (textual, voice, image, video, math, writing, music, art, and many more) left everyone surprised. The use of large language models initially came with a significant cost of training that only few can afford both in terms of cost and availability of GPUs, but the community is starting to address this problem. It is the speed and time to adoption that improved compared to previous technology disruptions we discussed in this section. Many skills that we perceived only humans can have could potentially be replaced by AI.

NEED FOR IT PROFESSIONALS

Given the increasing complexity and increasing demand due to the near-universal integration of the Internet, mobile systems, and increasing sensor-based data and AI in our daily lives, does the world need more IT

professionals? Remember the wave of IT professionals in the 1990s driven by the dot-com boom? Individuals from other professions were retooling and retraining to become website developers because, in those days, everything had to be hand-coded in HTML. It was similar to the 1930s, when the world seemed to have an insatiable demand for switch operators due to the growth and proliferation of voice technology.

There was a boom period in the number of switchboard operators and IT professionals, respectively. Human skill and adaptability powered the initial wave of scaling the novel technology, but soon the limitations of even the most skilled individual operators and the total training capacity threatened to cap future growth. However, technology quickly adapted and advanced so that individuals could complete long-distance calls on their own, and websites are now almost self-generating through graphical tools. Those trained in narrowly specific skills in either case were not prepared for the next wave of technological change.

Over the last few years, the unmet demand for IT professionals has pushed the industry to create tools enabling self-service while maintaining compliance and security. Until recently, you had to learn a bit of HTML programming to create a website; now, you can use tools that allow its creation through an intuitive interface. If you can use a laptop or smartphone, you can create a website with the user experience and graphic design crafted by a new professional class of content creators.

Likewise, where in the past you had to hire an IT professional to create an e-commerce site, process data (data analytics) to create diagrams, or set up a database, you now have tools that are easy to use (through a graphical interface). By drawing what you want, the tools produce the required coding.

This evolution is not just enabling those with little to no experience in programming to create code; it also enables programmers to enhance their productivity by using automation in code generation. A whole new area, called low code/no code, is progressing rapidly, and, as the name suggests, it aims to enable the production of applications with no need to manually write the required software.

Additionally, generative AI and its conversational interfaces, like ChatGPT, are also supporting the creation of software with limited to no IT knowledge. At the same time, we are seeing that software is becoming pervasive in most science, technology, engineering, and mathematics (and even standard) curricula so that most people in primary school can generate basic software applications.

Autogeneration works fine today at creating a stand-alone application. It does not work as well to extend an existing application because extension requires knowledge of what exists and what it takes to extend it. The more complex the system you need to change, the more knowledge is required. In other words, coding activity is rapidly shifting from programmers to tools, but the system activity is still in the hands of IT professionals.

In the coming years, we can expect novel software architectures to support easier plug-ins of new applications and to handle the systems' activity, which means that the need for IT system professionals will decrease.

EMERGING TECHNOLOGIES

In addition to autocode generation and other automated tools, the following are some of the trends in information technology affecting the role and skills required of the IT professional[5,6,7]:

- AI.
- The Internet of Things.
- Machine learning.
- Edge computing.
- Blockchain.
- Homomorphic encryption.

What is of particular note with these trends is that they defy the conventional boundaries of the IT profession: they are enabled by the curation of massive data rather than proprietary code bases; they operate largely outside of the data center; and, in fact, beyond just being physically distributed, they are inherently distributed in design, governance, and operations. Together, they point away from individual workloads to be crafted and maintained over a lifecycle and toward edge-to-cloud to core dynamic workflows that are continuously orchestrated and operated at superhuman levels of efficiency.

If we look at the new "AI revolution" commencing in the last couple of years, a few differences emerge from the previous tectonic shifts. First, adoption is much faster and with far more reach than previous transitions. If we look at the time to reach 50% of U.S. users, it took PCs 20 years, the Internet 12 years, and smartphones 6 years—but just 3 years for generative AI. This means that the time for IT professionals to catch up with the new trends is much shorter and might require a training ecosystem different from traditional educational institutions (e.g., universities), which tend to be slow to adapt to new trends.

Second, the AI revolution is fueled by data, which is creating a blur between the IT and the data scientist professions. Data analysis tools and data-driven insights are becoming fundamental across a wide variety of areas, such as health care, marketing, science, and

TABLE 1. Evolution trends of some of the key IT profession skills.

Skills	Evolution trend
AI programmers	↑
Data scientists	↗
Solution architects	→
Support	↘
System administrators	↓

finance. This new data economy is mandating new IT skills for understanding the role of data in ML, reasoning around responsible and trustworthy AI, understanding the technology landscape to position the correct guardrail without inhibiting innovation, and so on.

Third, AI is going to automate several IT tasks, ranging from simple IT support questions and answers to complex coding copilots or even automated IT control and optimization with minimal human-in-the-loop intervention. This will cause a generational shift in the sense that IT professionals who know how to use the new AI tools and technology will likely replace those who do not know, and this may happen very fast, given the speed at which the field is evolving.

GLOBAL TRENDS

In addition to the rapidly changing technology landscape, cultural changes are impacting the IT professional. Recently, some of us wrote a comprehensive report on the global future of the workforce, especially in the context of the COVID pandemic and the technological shifts described.[8,9] The push toward automation is strong not only in the IT sector but in almost every work sector, from physical labor to creative- and knowledge-based industries.

One trend that garnered significant attention during the pandemic was that of remote and hybrid work, fueled by IT, with remote work tools and technologies for coordination, security, and communications. Although this trend increased the need for IT infrastructure and shaped some of the latest developments in IT, it did not dramatically increase the demand for IT professionals.

In a related trend, we are witnessing an increasing globalization of the workforce, with a larger pool of talent available to companies even far away from their physical locations. This globalization trend, largely enabled by IT, is also affecting the IT sector in particular since, almost by definition, IT professionals are native users of the IT technologies that enable this decentralized work model. Concomitantly, it enables the decentralization of the IT infrastructure as well, which is no longer always tied to the physical location of its owners.

Taking this trend further, an increasing reliance on cloud-based service providers for IT infrastructure eliminates even the ever-shrinking group of onsite IT operators who were needed to maintain these sites. A final factor is the rise of open source as the dominant development model in both cloud and AI/ML segments, which has permitted this new global workforce to both directly contribute to software packages consumed globally and to localize leading software packages to language and usage, further enabling diverse participation.

FUTURE PERSPECTIVE

As we know, advancing technology and changing behaviors will affect the IT professional. The question is how much and how fast. So what can one do?

To remain competitive, IT professionals will need to increasingly focus on delivering solutions rather than horizontal technologies, be multiskilled in bringing together cross-disciplinary ideas/concepts; continuously

TABLE 2. Evolution of IT profession technologies: From the past 25 years toward the next 25 years.

Technologies	Examples of IT profession technologies evolution	
	Past 25 years	Next 25 years
Devices and user interfaces	Monitor, keyboard, and mouse	Immersive, gesture, and intent
Computer	Mainframe, mini, micro, laptop, and phone	Post-Moore, heterogeneous, and quantum
Connectivity	Modem, wireless, and broadband	Satellite and global
Tools	Office and search based	Personal assistants
Information source	Libraries and the World Wide Web	Real time
Development	Source Code Control System, Revision Control System, and Git	Composability

TABLE 3. Evolution of IT profession skills: From the past 25 years toward the next 25 years.

Skills	Examples of IT profession skills evolution	
	Past 25 years	**Next 25 years**
Editing	Text, HTML, audio, and image	All modalities
Designing	Chips, hardware, software, and apps	Customized solutions
Databases	DB2 and Oracle	Immersed knowledge bases
DevOps	Compilers, linkers, loaders, GitHub, Jenkins, Puppet, Ansible, Chef, etc.	Critical thinking/intuition/ability to recognize deep fakes

learn about emerging technologies; and enhance nontechnical skills to work with diverse teams, to work virtually and across cultures, and to have the intuition to challenge the tools and experts intelligently.

For example, consider that "AI won't replace you, but a person using AI will." Generative AI can help in three ways: reducing cognitive load by automating structured tasks; increasing cognitive capacity for unstructured tasks; and improving the learning process.[10] Quite a bit was written about the influence of COVID on the future of work, and it can be found in many references.[11,12,13]

To remain competitive, IT professionals should look at the evolution trend of core skills, the focus areas for future technology impact, and needed skills as highlighted in the Tables 1–3.

CONCLUSION

The IT professional has been the critical scaling factor that has enabled the pervasive adoption of information technology across the globe and the range of human pursuits. However, even with the expansion of the professional base to a global and distributed workforce, the advent of generative AI/ML and edge-to-cloud to core workflows is demanding more than the traditional training capacity and industry response can provide. The operational roles are outstripping the capabilities of even the most skilled individual practitioners.

The solution lies in the IT professional aggressively adopting these same technologies so that, now, expansive and distributed infrastructure can be operated dynamically with superhuman levels of efficiency. The limits of individual productivity can be eclipsed by enabling end user self-sufficiency through workflow orchestration. Like the technology adoption cycles of the past, this will necessitate a transformation of the skills and tools utilized by the profession with the shift from low-level implementation and operational knowledge to systems architecture, distributed orchestration, and user experience design.

This is a repetition of the previous cycle of technology adoption: human adaptability and skills start as the enablers of new technology adoption but, eventually, become the bottleneck to continued growth, which then necessitates automation to increase equitable availability and lower cost to further expand adoption.

Those who remain in the profession, whether it is agriculture, manufacturing, or IT, evolve their skills toward systems architecture and design, and those who move on are free to employ the benefits of the technology adoption while they begin the search for what will come next. As the IT profession embraces these novel technologies to continue to scale IT adoption, we should also remember the hard-learned lessons of prior industries: automation and industrialization yield efficiencies but at the cost of increased risks from monoculture and loss of diversity and robustness in the supply chain.

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