The Evolution of a Technical Skill: A Study of AI-Skill Demand

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In an era marked by fast IT advancements, the work landscape is profoundly transformed due to complex sociotechnical factors connected to digital technologies. This age of unparalleled innovation challenges traditional job roles and necessitates a fundamental shift in our approach to skills and learning. The very nature of work itself is in flux, increasingly meshed with the relentless advance of technology and organizational innovation, highlighting the importance of comprehending the demand trends of future skills. According to the latest Future of Jobs report (Leopold et al., 2023), employers surveyed across multiple economies estimate that 44% of workers’ skills will be disrupted in the next five years. The interplay between work and technology underscores the significance of understanding the evolving skills landscape to achieve unprecedented levels of productivity and innovation. This work-in-progress discusses the importance of analyzing the evolution of emerging digital skills, focusing on the case of Artificial Intelligence (AI) skills from job advertisement data to uncover how employers understand and interpret this technological change in the interplay with the changes in the nature of work itself.

AI has become increasingly ubiquitous over the last decade, with deep learning, neural networks, and other AI technologies being widely deployed. AI “comprises a wide-ranging set of technologies that allow individuals and organizations to integrate and analyze data and use that insight to improve or automate decision-making” (Mikalef et al., 2022, p. 1). As a result, demand for AI skills grew dramatically in 2010–2022 across industries and occupations, making it a critical technology for organizations, as documented by recent peer-review articles and industry (Acemoglu et al., 2022; Alekseeva et al., 2020; Maslej et al., 2023). Moreover, its expansion to multiple industries is analogous to other General Purpose Technologies (GPTs) that hold the potential for large-scale economic impact in the following years (Goldfarb et al., 2023). While seen and expected impacts are varied, so are the instantiations in which AI-technologies and scientific applications are developed, including computer vision, natural language processing, search and optimization, planning and decision, and more (Perrault et al., 2020).

As AI becomes increasingly important in the context of work and skills, scholars continue to explore its evolution and adoption across organizations of this evolving technological frontier with emerging computing capabilities that are continually changing (Berente et al., 2021). Scholars face the challenge of understanding both AI’s dynamic impacts while also observing continuous new developments and understandings of the IT artifact itself. Consequently, researchers are still uncovering the processes that guide its evolutionary patterns and diffusion across organizations, highlighting the importance of which features or dimensions of the technology are highlighted while moving across
industries and firms (Ansari et al., 2010). To fill this gap in knowledge, this article builds on previous research on technology evolution and advancements in semantic change to examine how companies portray AI in job advertisements, ultimately seeking to answer the question of how AI emerges and expands within the workforce. By analyzing changes in the demand and content of skills tied to AI in job descriptions over the years, the project aims to provide new light into mechanisms that guide companies’ understanding of technology in the context of work.

While multiple perspectives have been developed to identify and explain technological change patterns (Grodal et al., 2023), it is impossible to fully understand the evolution of technology without taking into consideration how actors understand and interpret technology (Bijker & Law, 1994; Kaplan & Tripsas, 2008). Consequently, the cognitivist perspective sets interpretations at the center of the stage, arguing that the actual value and potential of technology are open to interpretation and not dictated by the inherent features of the technology alone. This interpretative flexibility shapes the evolution of technology as the cognitive predispositions of different actors spur different interpretations of each technological variation and thus construct different possibilities of action.

Grodal et al (2023), argue that, similarly to other perspectives, researchers of technology evolution have recognized the importance of three theoretical mechanisms: variation, selection, and retention. In the context of the cognitive perspective, variation as the introduction of technological alternatives depends highly on how actors recombine cognitive concepts, such as categories. In terms of selection, selection is the mechanism through which a subset of technological variations gains the favor of their environment, influenced by a fit between producers' framings of the technology and users' cognitive understandings. Finally, retention is the consistent recreation and reselection of a technological variation over time because actors become inert and cognitively locked into a specific understanding. Also, expressed in the form of a "taken-for-granted" understanding, technology is stabilized.

These cognitive processes are inherently related to the categorization processes in which "actors jointly construct an understanding of the appropriateness and worth of some practice" (Strang and Meyer 1993, p. 489). Consequently, following work by organizational theorists has begun to explore the role of categories in technology evolution and industry dynamics (Grodal & Kahl, 2017); we focus on the role of skill categories expressed in job descriptions as a signal of worth and appropriateness of AI technologies.

In this research, we propose a novel approach to capture the evolutionary patterns of variation, selection, and retention of AI categories in labor market data and theorize around these patterns as AI skills spread through occupational and industry sector categories in the market. To capture the categorization processes as scale, we draw on computational linguistics to capture semantic change -or shifts in the meaning and uses of words over time- using word embeddings.
This research argues that by looking into the categorization processes behind an emerging digital skill, like AI, we can learn about the coevolution of technology and work jointly. While job demand for popular IT skills is high, evidence shows that organizations need to adapt to changing environments by recombining and adjusting their digital technologies, including AI. This adaptation process necessitates the development of new skills to innovate, learn, and respond to emerging threats and opportunities in the realm of evolving digital technologies (Berente et al., 2021; Ciarli et al., 2021). Simultaneously, the advancement of digital technologies alters how knowledge is encoded for productive and innovative activities (Ciarli et al., 2021). Observing broad and specific categories of AI tools and knowledge in the market provides a microscope to the interplay between technology and the organizational demand for work. Job advertisement data allows for gathering granular information on skill terms close to how companies use them.

While dominant research in the study of skills and technology focuses on skill-biased technological change (Autor et al., 1998) and its subsequent refinement of routine-biased technological change (Goos et al., 2014) which explain historical patterns in the labor market in response to technological advancements, including digital technologies like AI. These studies tend to view digital technologies as external to the innovation processes within firms, overlooking the internal innovation and reconfiguration processes of firms. To gain a deeper understanding of the intricate interplay between digital technologies, innovation, and skills, it is crucial to enhance our comprehension of the categorization processes that jointly shape digital technologies, firm innovation routines, and skills formation (Ciarli et al., 2021). This article aims to identify patterns in AI skill categorization that can inform technology evolution theories.

We examine the demand for AI skills by using an expansive data set on job advertisements and skill requirements over 14 years in the USA. We create a granular dictionary of unique terms associated with AI to explore their variation over the years and co-occurrences with other skill categories (cognitive, social, etc.). Later, we design a strategy to capture semantic change -or shifts in the meaning and uses of words over time- through word embeddings, deriving patterns of emergence and expansion of AI categories.

Word embeddings are a type of natural language processing technique used to represent words or phrases in a vector space, where each dimension represents a different feature or characteristic of the word or phrase. Technically, they are vector representations of words in an \((n < N)\)-dimensional space, where \(N\) is the total number of words in a corpus and vectors are dense (i.e., no zero) and usually consist of real numbers (Stoltz & Taylor, 2021). These vectors are generated by machine learning algorithms that analyze large amounts of text data to learn the context and relationships between words. By using word embeddings, words with similar meanings or usage patterns will be closer to each other in the vector space, allowing for more accurate analysis and processing of natural language data. Word embedding has the advantage of capturing contextual patterns of usage across words and documents (Kozlowski et al., 2019). Paraphrasing DiMaggio et al. (2013), as meanings
emerge out of word relationships rather than residing within words per se, these tools have the potential to recognize and uncover the relationality of meaning by treating terms as varying in meaning across different contexts. By implementing word embeddings over time to the job postings and through iterative pattern identification and theorization (Berente et al., 2019; Lindberg, 2020), the project aims to identify the main trend in the evolution of the AI skill category and its change mechanisms. This research uses the process-nature (Langley, 1999) of job advertisement data to unpack evolutionary patterns and mechanisms of discourse and uses the computer method to surface procedural patterns over time and across documents (Pentland et al., 2021).

Consequently, this research-in-progress aims to contribute to the management literature on technology evolution and the changing nature of work by studying the categorization processes of AI skills while spreading in the market across occupations and industry sectors. The strategy proposes leveraging labor data and word embedding methodologies to theorize changes in the discourse around AI over time. Moreover, it aims to contribute to the growing literature on the Demand for AI skills and other emerging technologies impacting the workforce by highlighting mechanisms that drive evolutionary trajectories. These findings could contribute to the practical understanding of the relationship between the changing skill profiles of workers and emerging technologies by providing a richer context of when and where AI skills and demands exist and how workers might respond to them. Overall, it helps to understand the changing nature of work by illustrating the trajectories of the demand for future skills.

References


