Creative Work, Technology and Occupational Innovation

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This paper explores the relationship between creative work, technology, and occupational innovation. The relationships between creative and non-creative tasks within occupations, the prototypicality of creative tasks to their respective occupations, and the proximity of creative tasks to technology are analyzed Using data from the O*NET database. A total of 1385 creative tasks across 430 occupations were analyzed. The study reveals that similarities between creative and non-creative tasks, and between creative tasks and technology are positively related to occupational innovation levels. The results underscore the importance of job design, wherein the structuring of creative tasks and the integration of technology reflect the collective decisions of experts and worker groups. As technology continues to advance, its symbiotic relationship with creative tasks within occupations can further drive innovation and shape the future of work.

CCS CONCEPTS • Information Systems • Social and professional topics • Human-centered computing

Additional Keywords and Phrases: Creativity, Innovation, Task, Technology, Occupation, Future of Work

1 INTRODUCTION

Economic growth is ascribed to changes in rates of demographic growth and innovation [5]. Innovation is a collective phenomenon, the result of many building on the ideas of others [6]. The theory of human capital puts emphasis on skills and their development [2]. Current views of artificial intelligence contrast its potential to substitute for human labor with its potential to augment human capital, particularly in occupations related to knowledge production, because new forms of AI are generative [4]. With such a backdrop, and with the uncertainty surrounding the degree to which AI will disrupt the economy, questions around innovation and one of its major precursors, creativity, are important to reconsider, because a better understanding of how creativity is related to the emergence of innovation will be a step toward understanding what the impacts of AI may be on work and workers.

Creativity in the workplace—the generation of novel and useful ideas, applications, and solutions—is commonly recognized as a key driving force of innovation, which is commonly thought of as an organizational construct [1]. Creativity plays an essential role in innovation by providing new technologies, reimagining business models, inventing needed drugs, and crafting transformative works of art. Creativity leads to new ideas, and innovation processes turn the ideas into products and services.

Creativity is not limited to a selected few occupations. It spans diverse occupational domains including science, education, and healthcare. This pervasive force is often manifested through occupational tasks that require creative thinking and involves designing, creating, and developing new products, systems, or ideas.

While it is clear that creativity drives innovation, there are relatively few studies focusing on understanding the linkage between workplace creativity and occupational innovation in relation to tasks. This paper aims to explore this relationship. More specifically, it seeks to understand the creative tasks within an occupation, as well as their relationships to the non-creative tasks, the technology used by and the identity of the occupation. Using these relationships as indicators of how the creative tasks are organized in relation to the rest of the work ecosystem, we analyze their associations to the level of innovation of an occupation.

2 DATA AND METHODOLOGY

We analyze several datasets released by the Department of Labor in the form of the O*NET database, as these data reflect practice in the US economy. The datasets are collected through surveying job incumbents and experts using standardized

questionnaires. The key datasets for this study include Task Statements, Task to Detailed Work Activities, Technology Skills, Occupation Data, and Work Styles.

The Task to Detailed Work Activities dataset maps each task into one or more detailed work activities. These detailed work activities can be categorized to general work activities, which are similar actions that are performed in many different occupations. One of the general work activities is Thinking Creatively, which is defined as: "Developing, designing, or creating new applications, ideas, relationships, systems, or products, including artistic contributions." There are 1385 tasks across 430 occupations that fall into this category. In this study, we call them creative tasks.

The Technology Skills dataset provides information about software technology used by each occupation. These skills are classified into 17 software classes under the United Nations Standard Products and Services Code (UNSPSC). UNSPSC provides a definition for each technology class. The Occupation Data dataset provides descriptions of each occupation. We use the Innovation rating from the Work Styles dataset in O*NET as the dependent variable to measure occupational innovation.

We then measure three key similarities between the creative tasks to other elements of the occupation they belong to (Figure 1). These similarities are measured by semantic similarity using text embeddings. We first identify creative tasks and combine them into a paragraph. We then combine the rest of the tasks within the occupation into a paragraph. We also combine the definition of all technology classes used by the occupation. Last, we identify the description of the occupation. We embed this textual information with pre-trained models from the Universal Sentence Encoder [3], which return vectors that represent meaning. Then we calculate the cosine similarity between the embeddings of creative tasks and the embeddings of other elements, deriving the following measures.

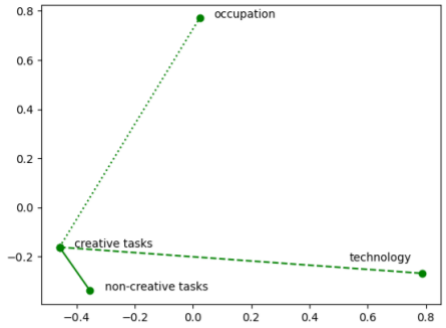

Figure 1: The occupation of Chief Sustainability Officers represented by textural embeddings). The three cosine distances between creative and non-creative tasks, between creative tasks and occupation description, and between creative tasks and technology are 0.43, 0.69 and 0.86 respectively. Distances in this case are 1 - cosine similarity.

Internal task synergy. We calculate the cosine similarity between the embeddings of creative tasks and the embeddings of the non-creative tasks. The higher the similarity is, the more synergy between the creative tasks and the non-creative tasks exists within an occupation.

Prototypicality. We compute the cosine similarity between the embeddings of the creative tasks and the embeddings of the occupation description. The more similar they are, the more prototypical the creative tasks are to the occupation.

Technology proximity. This is measured by the cosine similarity between the embeddings of creative tasks and the embeddings to the definition of the technology classes used by the occupation. Again, high similarity between the two entities indicates the creative tasks have closer proximity to technology, which may indicate more potential for augmentation or support from technology.

We hypothesize that occupations with creative tasks tend to be more innovative if they present higher internal task synergy; the creative tasks are more prototypical; and the creative tasks have higher technology proximity.

3 RESULTS AND FUTURE WORK

We test our hypothesis with ordinary least squares regression models. We use the Think Creatively level rating from the O*NET Work Activities as a control variable and the major occupation group (Management, Business and Financial Operations, Computer and Mathematical, etc.) as fixed effects. As the three similarity measures are correlated, we include them in three models separately. We report the results of the regression models in the table below.

Table 1: Regression Results

Predictors	Model 1: Controls and Fixed Effects	Model 2: Main Effects (Internal task synergy)	Model 3: Main Effects (Prototypicality)	Model 4: Main Effects (Technology proximity)
Constant	2.382(0.105) ***	2.247(0.109) ***	2.332(0.109) ***	2.340(0.105) ***
Internal task synergy	-	0.385(0.101) ***	-	-
Prototypicality	-	-	0.212(0.117)	-
Technology Proximity	-	-	-	0.477(0.167) **
R-squared	0.466	0.486	0.471	0.478

*p < 0.05; **p < 0.01; ***p < 0.001

As shown above, synergy between creative tasks and non-creative tasks, and having creative tasks supported by technology can increase worker's innovation level. This finding is particularly notable with respect to the relationship between creative task and technology. With recent advancements in generative AI, many are concerned about its effect on creative work. What we discover here indicates that creative work supported by technology is more likely to increase innovation capacity in workers. This suggests that when technology is doing creative work, and is changing how human work is being organized, there's potential for increased innovation capacity if we can harness this power provided by technology.

Job design is a process that concerns how activities are grouped into tasks and tasks into jobs, as well as one that maximizes the capability of workers in certain work environments. The structure of creative tasks and the usage of technology within an occupation reflect the collective decisions and experiences of the job experts and worker groups, which can have significant impact on workers' ability to innovate.

Descriptions of tasks and technologies adopted by an occupation adjust to each other: more technology is created around the important tasks, and tasks are designed with considerations of the technological tools available. In highly innovative occupations, we can expect more technology being designed to support workers to do creative work more productively, or to support the innovation process itself through brainstorming and ideation. As these technologies advance, we may also see the workers take advantage of the technology and do their creative work more efficiently. Similarly, non-creative tasks may change or emerge to increase creative synergy and boost occupational innovation. Understanding the dynamics between these entities can provide signals to guide the economy through design decisions for occupational tasks and technologies to optimize innovation capacity.

Future work can investigate specific creative tasks and non-creative task parings and technology's supportive role in transitioning creative work into innovation. In addition to using the occupation level innovation measure from O*NET, organizational and industrial phenomena linked to innovation, such as the introductions of new products and services, can be incorporated to further advance the understanding of the link between creative work and innovation.

Additionally, generative AI makes claims to creativity; future research might consider how creative tasks might lead to greater productivity if human workers are augmented, and how occupations might change if such tasks are fully automated.

In conclusion, this study serves as a foundation for future research to delve deeper into the dynamics between creative work, technology, and innovation, which could guide economic and organizational decisions.

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