

# 科技部補助專題研究計畫報告

## 威脅或賦能：科技發展對勞工認知的影響 - 36國比較研究

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本研究具有政策應用參考價值：否 是，建議提供機關勞動部, 科技部, 經濟部

(勾選「是」者，請列舉建議可提供施政參考之業務主管機關)

本研究具影響公共利益之重大發現：否 是

中華民國 110 年 02 月 01 日

中文摘要：人工智慧時代的科技發展對勞動市場有深遠的影響。本研究旨在從工作者認知角度探究科技是替代勞動力造成工作不保的威脅，還是使員工能夠承擔更重要工作任務使工作更豐富的賦能者。此外，根據社會資本和人力資本理論，本研究將測試工作者的社會資本（通過自評與管理者和同事的關係衡量）和人力資本（通過自評使用過去的技能 and 經驗程度及是否受訓練衡量），是否能調節科技進步對工作者認知後果的關係。本研究使用現有調查數據檔案收集的數據並以國家為單位分析所有變數。各國科技進步程度以世界經濟論壇的網絡準備度指數（Networked Readiness Index）為測量依據，而其他變數的數據則由國際社會調查計劃ISSP 2015-工作相關IV資料庫收集。樣本數為37個國家。分層迴歸測試假設的結果發現科技進步對勞工來說既非威脅也對工作豐富化沒有影響。甚而，科技進步與勞工對於工作不保的感受有負向的關係，亦即科技越進步的國家，人民感受工作不保的程度越低。社會資本則強化了這個負向的關係，亦即在社會資本愈強的國家，科技越進步，人民感受工作不保的程度會更低。其他調節變數的假設則沒有獲得驗證。社會資本和人力資本對工作豐富化沒有調節效果，卻有非常顯著的直接效果。

中文關鍵詞：科技進步、工作不保、工作豐富化、社會資本、人力資本

英文摘要：Technology development in the artificial intelligence era has a profound impact on the labor market. This study seeks to resolve the issue of whether technology serves as a threat to replace the human labor, or as an enabler to allow the workforce do more meaningful jobs. Also, based on social capital and human capital theories, this study tests whether the workforce's social capital, as measured by self-reported relationship with managers and coworkers, and human capital, as measured by self-reported use of past skills and experience and continued training, serve as moderators on the relationship between technology advancement and its consequences. The sample contains 37 countries. All variables are analyzed at the country level using data collected from existing survey data archive. The technology advancement data was collected by the World Economic Forum for its Networked Readiness Index (NRI), while data for the other variables were collected by the International Social Survey Programme, under the ISSP 2015 - Work Orientations IV. Hierarchical regression was used to test the hypothesized relationships, while controlling GDP and percent of knowledge workers in each country. Results show technology advancement neither as a threat nor as an enabler at the country level. Specifically, technology advancement is significant in decreasing the workforce's perception of job insecurity, and has no effect in enhancing the perception of job enrichment. Social capital shows a negative moderating effect on the already negative relationship between technology

advancement and perceived job insecurity. None other moderating effects were found. Furthermore, in regards to job enrichment perception, social capital and human capital seem to have a stronger effect than technology advancement.

英文關鍵詞： technology advancement, job insecurity, job enrichment, human capital, social capital

# **Threat or enabler: The effect of technology advancement on workforce perceptions**

## **Abstract**

Technology development in the artificial intelligence era has a profound impact on the labor market. This study seeks to resolve the issue of whether technology serves as a threat to replace the human labor, or as an enabler to allow the workforce do more meaningful jobs. Also, based on social capital and human capital theories, this study tests whether the workforce's social capital, as measured by self-reported relationship with managers and coworkers, and human capital, as measured by self-reported use of past skills and experience and continued training, serve as moderators on the relationship between technology advancement and its consequences. The sample contains 37 countries. All variables are analyzed at the country level using data collected from existing survey data archive. The technology advancement data was collected by the World Economic Forum for its Networked Readiness Index (NRI), while data for the other variables were collected by the International Social Survey Programme, under the ISSP 2015 – Work Orientations IV. Hierarchical regression was used to test the hypothesized relationships, while controlling GDP and percent of knowledge workers in each country. Results show technology advancement neither as a threat nor as an enabler at the country level. Specifically, technology advancement is significant in decreasing the workforce's perception of job insecurity, and has no effect in enhancing the perception of job enrichment. Social capital shows a negative moderating effect on the already negative relationship between technology advancement and perceived job insecurity. None other moderating effects were found. Furthermore, in regards to job enrichment perception, social capital and human capital seem to have a stronger effect than technology advancement.

**Keywords:** technology advancement, job insecurity, job enrichment, human capital, social capital

# **Introduction**

## **Background**

The fast development of technology and its extensive coverage of almost every aspect of human activity has made it an integral part of the world, producing a profound impact on human beings in modern society. The labor market is also sensitive to the changes in technology. Ever since the first industrial revolution, machine has been taking over jobs that used to be occupied by humans, forcing humans to continuously upgrade their skills to make a living. However, up to the last decade, the discussion about skill upgrade and labor replacement has always been about the low-skilled workers, whose jobs are disappearing due to automation. The time is different because of Artificial Intelligence (AI). The rapid development and realization of AI technology is now threatening the entire labor market.

With this incoming threat from ever advancing technology, how has the general workforce's perception about work changed? Two general reactions can be found in the existing literature: perceived job insecurity and perceived job enrichment. Perceived job insecurity refers to employees' feeling of a possibility of job loss. Perceived job enrichment is the employees' feeling of how interesting and meaningful their job has become. Different societies are at different stages of economic development and therefore technology adoption level may vary country by country, which provide a superb testing ground of the workforce reactions toward technology advancement.

This study seeks to investigate the possibility of two general workforce perceptions following technology advancement, perceived job insecurity and perceived job enrichment. Also, to test the social capital theory and human capital theory, this study proposes to examine as moderators to the above relationship, the overall workplace relationship quality and the human capital enhancement level of the workforce. This study seeks to use publicly available data archive to produce country-level data for the research variables and test the proposed relationships among study variables at country-level.

## **Objectives of the Study**

This study is designed to answer the following research questions: 1) What is the effect of technology advancement on the perception of job insecurity by the general workforce? 2) What is the effect of technology advancement on the perception of job enrichment by the general workforce? 3) Will the general workforce's social capital and human capital moderate the relationship between technology advancement and perception of job insecurity? 4) Will the general workforce's social capital and human capital moderate the relationship between technology advancement and perception of job enrichment?

By adopting a macro-level quantitative method using country as the unit of analysis, this study will compare and correlate the research variables collected from 36 countries who participated the ISSP 2015 Work Orientation Module survey. This research seeks to add value at the macro level to the understanding of how technology development affect the collective perception of the labor force in a country, as well as how social capital and human capital can enhance or alleviate the effect of technology on the perceptions of work.

## **Methodology**

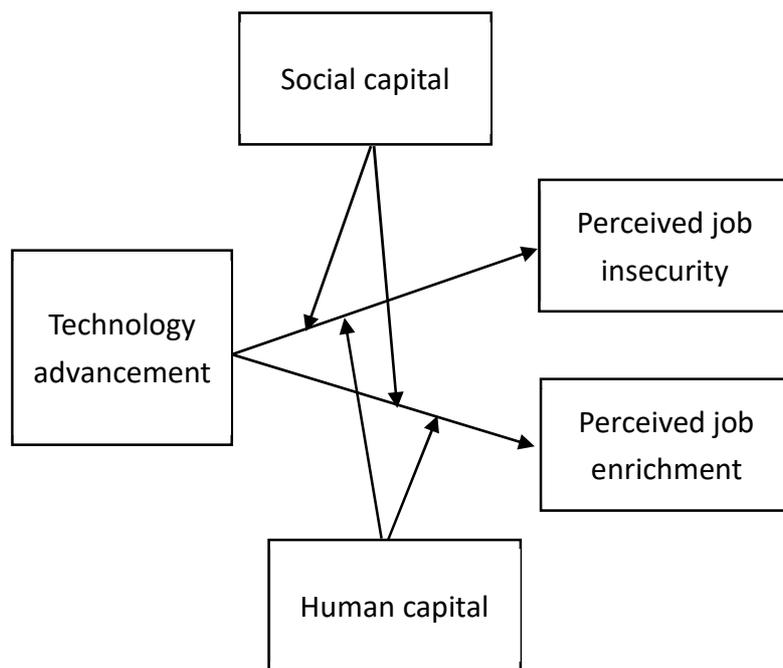
### **Research Design**

This study proposes to answer the research questions using a macro-level quantitative approach to test the study hypotheses. One of the unique contribution of this study is to resolve the issue of whether technology serves as a threat to replace the labor force or as an enabler taking over routine tasks so the workforce can pay attention to more meaningful aspects of a job. Also, based on social capital and human capital theories, this study will test whether the workforce's social capital, as measured by self-reported relationship with managers and coworkers, and human capital, as measured by self-reported use of past skills and experience as well as continued training, serve as moderators to the effect of technology advancement on its consequences. All variables will be analyzed at the country level using data collected from existing survey data archive. The data for technology advancement was collected by the World Economic

Forum for its Networked Readiness Index (NRI), while data for the other variables were collected by the International Social Survey Programme (ISSP), under the ISSP 2015 – Work Orientations IV.

This research employs ISSP data for two reasons. First, the participants in ISSP are randomly selected to represent a cross-section of each representative country, hence ISSP includes individuals from all kinds of industries and occupations; second, ISSP Work Orientations module is ideal for the study of workforce perceptions because it provides continuous data on workers’ perceptions of job security, job enrichment, workplace relationships, and human capital investment. Data on each variable were aggregated to the country level to represent the collective perception of the workforce in each economy.

The hypotheses proposed in this study are as follows, which are also illustrated in the research framework in Figure 1:



**Figure 1. Research framework**

H1: Technology advancement has a positive effect on perceived job insecurity.

H2: Technology advancement has a positive effect on perceived job enrichment.

H3: The workforce’s social capital has a moderating effect on the relationship between

technology advancement and perceived job insecurity.

H4: The workforce's social capital has a moderating effect on the relationship between technology advancement and perceived job enrichment.

H5: The workforce's human capital has a moderating effect on the relationship between technology advancement and perceived job insecurity.

H6: The workforce's human capital has a moderating effect on the relationship between technology advancement and perceived job enrichment.

## **Sampling and Data Collection**

The intended sample for this study was the 37 countries who participated in the data collection of the International Social Survey Programme, the ISSP 2015–Work Orientations IV. Total individual level data collected from the 37 participating countries is 51,668.

## **Data Analysis**

This research used primarily Pearson correlations and multiple regression for data analysis in SPSS version 23.0. Correlations was utilized to find initial and linear relationships between research constructs. Hierarchical regression was performed to test the research hypotheses.

### **Correlation Analysis**

The correlation analysis was conducted to understand the relationship between the key variables and the control variables. Table 1 presents the mean, standard deviation, and correlation amongst GDP, Percentage of Knowledge Workers, Technology Advancement, Perceived Job Insecurity, Perceived Job Enrichment, Human capital, and Social Capital. Technology advancement is found to have a strong negative correlation to Perceived Job Insecurity ( $r = -.61, p < .01$ ) and a strong positive correlation to Human Capital ( $r = .74, p < .01$ ), but shows no correlation to Perceived Job Enrichment ( $r = .18, n.s.$ ) and Social Capital ( $r = .05, n.s.$ ). In addition, Human Capital reveals strong negative correlation to Perceived Job Insecurity ( $r = -.45, p < .01$ ),

and strong positive correlation to Perceived Job Enrichment ( $r = .47, p < .01$ ). Also, Social Capital shows strong positive correlation to Perceived Job Enrichment ( $r = .62, p < .01$ ), but no correlation to Perceived Job Insecurity ( $r = -.22, n.s.$ ). For the correlation between control variables and dependent variables, neither GDP nor Percentage of Knowledge Workers has a significant correlation to any of the dependent variables.

### **Hierarchical Regression**

This study conducted hierarchical regression analysis in SPSS version 23.0 to test all six hypotheses. When testing the moderation effect of social capital and human capital, the researcher first centered the independent variable technology advancement and the moderator variables social capital and human capital. The centered technology advancement was then multiplied with the centered moderator variables to create the interaction terms TAXSC and TAXHC representing the moderating effect of social capital and human capital respectively.

#### **H1: Technology advancement has a positive effect on job insecurity**

A significant negative correlation can be found between technology advancement and perceived job insecurity ( $r = -.61, p < .01$ ). The regression analysis further confirmed this negative relationship between the two variables. Technology advancement does show a strongly significant and negative influence on perceived job insecurity ( $\beta = -.57, p < .01$ ). That is, when technology advancement level is higher, it actually lowered the perception of job insecurity, instead of heightening it. Therefore, hypothesis 1 was not supported.

#### **H2: Technology advancement has a positive effect on job enrichment.**

The correlation analysis does not show a significant correlation between technology advancement and job enrichment ( $r = .18, n.s.$ ). The regression analysis in also shows a similar result. Technology advancement has a minimal and insignificant influence on perceived job enrichment ( $\beta = .16, n.s.$ ). That is, there is no evidence supporting the effect of technology advancement on job enrichment. Therefore, hypothesis 2 is not supported.

#### **H3: The workforce's social capital has a moderating effect on the relationship between technology advancement and perceived job insecurity.**

Social capital does not have a significant main effect to perceived job insecurity ( $\beta = -.22, n.s.$ ). However, TAxSC is significant ( $\beta = -.32, p < .05$ ), which means social capital does have a moderating effect on the relationship between technology advancement and perceived job insecurity. Hypothesis 3 is supported.

**H4: The workforce's social capital has a moderating effect on the relationship between technology advancement and perceived job enrichment.**

Social capital has a strongly significant and positive main effect on job enrichment ( $\beta = .60, p < .001$ ). However, TAxSC is not significant ( $\beta = -.23, p > .05$ ), which is an indication that social capital has no moderating effect. Therefore, hypothesis 4 is not supported.

**H5: The workforce's human capital has a moderating effect on the relationship between technology advancement and perceived job insecurity.**

Human capital does not show a significant main effect on perceived job insecurity ( $\beta = -.17, n.s.$ ). Similarly, TAxHC is not significant ( $\beta = -.23, n.s.$ ). There is no proof that human capital moderates the relationship between technology advancement and perceived job insecurity. Therefore, hypothesis 5 is not supported.

**H6: The workforce's human capital has a moderating effect on the relationship between technology advancement and perceived job enrichment.**

Human capital was found to have a strongly significant and positive main effect ( $\beta = .75, p < .01$ ) on job enrichment. However, TAxHC has only a negligible effect ( $\beta = .05, n.s.$ ) on job enrichment, indicating that human capital does not moderate the relationship between technology advancement and perceived job enrichment. Therefore, hypothesis 6 is not supported.

## **Conclusions**

Technology development is assumed to have a profound impact on the labor market. This study was designed to investigate the two general reactions to technology advancement that can be found in the existing literature: perceived job insecurity and perceived job enrichment. It seeks to resolve the issue of whether technology serves as a threat to replace the human labor, or as an enabler to allow the workforce do more meaningful jobs. The sample contains 37 countries. All variables were analyzed at the

country level using data collected from existing survey data archive. Controlling GDP and percent of knowledge workers in each country, this study found technology advancement neither as a threat nor as an enabler at the country level. Specifically, contrary to the hypotheses, hierarchical regression analysis showed a significant effect of technology advancement in decreasing the workforce's perception of job insecurity, while no effect of technology advancement in enhancing the perception of job enrichment was found.

In addition to the main effect of technology advancement, this study also attempted to find boundary conditions of the main effect on workforce perceptions. Based on social capital and human capital theories, this study tested whether the workforce's social capital as measured by self-reported relationship with managers and coworkers, and human capital as measured by self-reported use of past skills and experience and continued training, serve as moderators on the relationship between technology advancement and its consequences. Social capital shows a negative moderating effect on the already negative relationship between technology advancement and perceived job insecurity. None other moderating effects were found. Furthermore, in regards to job enrichment perception, the two proposed moderators, social capital and human capital, appear to have a stronger direct effect than technology advancement.

108年度專題研究計畫成果彙整表

計畫主持人：葉俶禎		計畫編號：108-2410-H-003-040-		
計畫名稱：威脅或賦能：科技發展對勞工認知的影響 - 36國比較研究				
成果項目		量化	單位	質化 (說明：各成果項目請附佐證資料或細項說明，如期刊名稱、年份、卷期、起訖頁數、證號...等)
國內	學術性論文	期刊論文	1	1. Yeh, C. R., Wong, C. C. J., Chang, W-W., & Lai, C. C. (2020). Labor displacement in artificial intelligence era: A systematic literature review. Taiwan Journal of East Asian Studies, 17(2), 25-75. (THCI)
		研討會論文	3	1. 葉俶禎、張煒雯、黃子君、賴志樑 (2020). 從實務觀點檢視人工智慧工作取代理論. 2020台灣資訊社會研究學會年會暨論文研討會, 2020年11月7日, 台灣師範大學。 2. Yeh, C.R., Wong, C.C.J., & Chang, W.W. (2019). 「人vs機器」還是「人x機器」：人工智慧科技發展對勞動市場的影響。The 2nd International Conference of CISS on Artificial Intelligence for Social Sciences, Oct 18-19, 2019. Taipei, Taiwan, ROC. 3. Yeh, C.R., & Wong, C.C.J. (2019). Research in Labor Displacement in AI Era: A Literature Review. The 2nd International Conference of CISS on Artificial Intelligence for Social Sciences, Oct 18-19, 2019. Taipei, Taiwan, ROC.
	專書	0	本	
	專書論文	0	章	
	技術報告	0	篇	
	其他	0	篇	
	國外	學術性論文	期刊論文	0
研討會論文			2	1. Ho, C.-R., & Yeh, C.R. (2019). An Investigation into e-HR Practices at a Multinational Corporation in Taiwan. The 18th International Research Conference in Asia of the Academy of Human Resource Development (AHRD) - Innovation and Evolution in the

					Digital Era, November 5-8, 2019, Hanoi, Vietnam. 2. Yeh, C.R. (2019). Workplace Technology Overload on Employees' Work-life Balance and Psychological Well-being: the Moderating Effect of Human Resource Policies. The 18th International Research Conference in Asia of the Academy of Human Resource Development (AHRD) - Innovation and Evolution in the Digital Era, November 5-8, 2019, Hanoi, Vietnam. (Best Paper Award)
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		技術報告	0	篇	
		其他	0	篇	
參與計畫人力	本國籍	大專生	0	人次	
		碩士生	3		聘三位碩士班研究生兼任研究助理，增進研究能力
		博士生	0		
		博士級研究人員	0		
		專任人員	0		
	非本國籍	大專生	0		
		碩士生	0		
		博士生	0		
		博士級研究人員	0		
		專任人員	0		
其他成果 (無法以量化表達之成果如辦理學術活動、獲得獎項、重要國際合作、研究成果國際影響力及其他協助產業技術發展之具體效益事項等，請以文字敘述填列。)				論文獲2019年國際學會Academy of Human Resource Development 亞洲年會最佳研討會論文獎：Yeh, C.R. (2019). Workplace Technology Overload on Employees' Work-life Balance and Psychological Well-being: the Moderating Effect of Human Resource Policies. The 18th International Research Conference in Asia of the Academy of Human Resource Development (AHRD) - Innovation and Evolution in the Digital Era, November 5-8, 2019, Hanoi, Vietnam. (Best Paper Award)	