DIGITAL TRANSFORMATION AND EMPLOYMENT PATTERNS AMONG MANUFACTURING AND SERVICE ENTERPRISES IN CHINA: A MODEL ANALYSIS
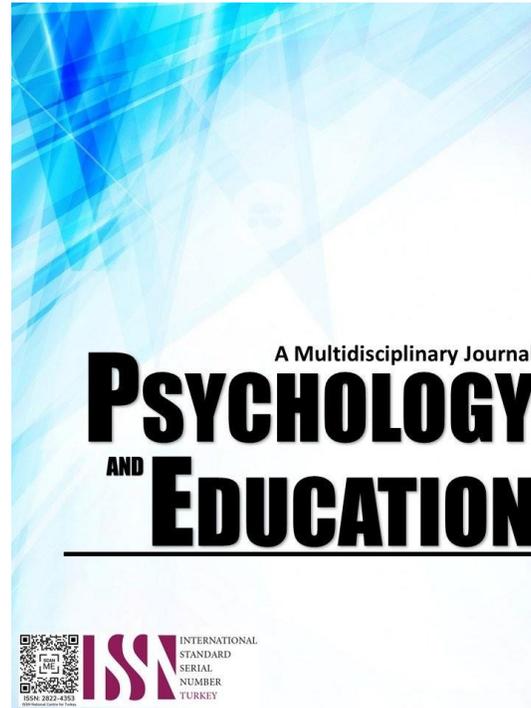
Digital Transformation and Employment Patterns among Manufacturing and Service Enterprises in China: A Model Analysis

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Abstract

This study examines the relationship between digital transformation and employment patterns among 364 manufacturing and service enterprises in Guangdong Province, China. Using correlation and regression analyses, the research reveals that digital transformation significantly affects employment opportunities and structure in manufacturing firms, particularly in the areas of marketing and sales and partner relationships. However, its influence on service enterprises is confined to employment structure, with minimal impact on turnover rates in both sectors. Notably, digital transformation in partner relationships emerged as the strongest predictor of an upskilled workforce in both enterprise types. These findings highlight the nuanced labor market implications of digitalization and suggest that sector-specific strategies and government support are vital to maximizing the benefits of digital transformation while mitigating employment risks.

Keywords: *digital transformation, employment patterns, manufacturing, service enterprises, China, model analysis*

Introduction

The rapid advancement of digital technologies has profoundly reshaped economic systems worldwide, prompting a reconfiguration of industrial structures and employment dynamics. In China, the digital economy accounted for 38.6% of the national GDP in 2020, highlighting its pivotal role in economic development (China Academy of Information and Communications Technology, 2021).

Digital transformation, defined as integrating digital technologies into all areas of enterprise operation, has become a strategic imperative for enhancing efficiency, reducing costs, and sustaining competitiveness across industries (Ren & Liu, 2021). However, its implications for employment remain a subject of growing academic and policy concern.

While digital transformation is often lauded for enabling new business models and productivity gains, there is mounting evidence of its disruptive effects on labor markets. In particular, the diffusion of automation, artificial intelligence, and cloud-based systems can displace workers by automating routine tasks, thereby altering employment opportunities and workforce structure (Acemoglu & Restrepo, 2020).

In contrast, other studies emphasize the potential of digital technologies to stimulate job creation through the emergence of new roles and sectors, especially those requiring high-level digital skills (Zhang & Dong, 2019; Fleisher et al., 2023). The theoretical foundation for this dichotomy lies in skill-biased and routine task-biased technological change, which suggest that digitalization increases demand for high-skilled labor while diminishing opportunities for routine or low-skilled workers (Angelini et al., 2020; Sharfiei, 2024).

China's manufacturing and service sectors have undergone accelerated digitalization, particularly in economically dynamic regions such as Guangdong Province. However, despite substantial investments in digital infrastructure and enterprise modernization, the empirical evidence on how digital transformation affects employment patterns across sectors remains inconclusive. Some studies suggest that automation makes manufacturing more prone to labor substitution, whereas the service sector may benefit more from digital augmentation and market expansion (Huang et al., 2023; Meng, 2021). Additionally, inconsistencies exist regarding the effect of digital transformation on workforce turnover, with some findings attributing low sensitivity of turnover rates to technological changes (Mahlasela & Chinyamurindi, 2020).

Given these uncertainties, a nuanced understanding of how digital transformation influences employment opportunities, turnover rates, and employment structure across industrial contexts is critically needed. Previous research has often addressed these issues in isolation or within limited sectoral scopes. This study aims to address these gaps by employing a model-based analysis to compare the effects of digital transformation on employment patterns in manufacturing and service enterprises in Guangdong Province, China.

Research Objectives

Specifically, this paper seeks to determine:

1. The relationship between the extent of digital transformation in five business areas, relationships with partners, product and service improvement, production operations, marketing and sales, and customer relationships and employment outcomes.
2. The predictive influence of digital transformation on employment opportunities, turnover rates, and employment structure.

Methodology

Research Design

This study employed a quantitative, descriptive-predictive research design to examine the impact of digital transformation on employment patterns among manufacturing and service enterprises in Guangdong Province, China. The analytical framework was guided by the theories of Skill-Biased Technological Change (SBTC), Routine Task-Biased Technological Change (RBTC), and Schumpeterian growth, which posit that technological advancement influences labor demand based on skill level and task routine intensity. Correlation and multiple regression analyses were used to identify associations and predictive relationships between digital transformation and three employment variables: employment opportunities, turnover rate, and employment structure.

Respondents

The target population consisted of manufacturing and service enterprises that were formally registered and continuously operating in Guangdong Province from 2021 to 2023. A simple random sampling technique was applied to ensure representativeness and minimize selection bias. The final sample included 364 enterprises, comprising 179 manufacturing and 185 service firms. Eligibility criteria required that firms be established in 2021 or earlier and exhibit continuous operation throughout the study period.

Instrument

An adapted questionnaire, based on the instrument developed by Ren and Liu (2021), was utilized to collect primary data. The survey comprised three sections:

1. Enterprise profile (industry type, size, year established, etc.);
2. Extent of digital transformation, operationalized across five ICT-reliant domains: relationships with partners, product and service improvement, production operations, marketing and sales, and customer relationships. Each domain was assessed using a 5-point Likert scale (1 = Not Implemented, 5 = Fully Implemented);
3. Employment patterns, comprising three dependent variables:
   - Employment opportunities, measured by the logarithmic change in full-time employees from 2021 to 2023;
   - Turnover rate, defined as the ratio of employee departures to total employees during the same period;
   - Employment structure, measured by the proportion of employees with a college degree or higher.

The questionnaire underwent expert validation and pilot testing to ensure construct validity and internal consistency. Cronbach's alpha values for the digital transformation domains exceeded 0.80, indicating high reliability.

Data Analysis

Descriptive statistics were computed to summarize demographic and firm-level characteristics. Pearson's correlation coefficients were used to explore the bivariate relationships between digital transformation and employment indicators. Subsequently, stepwise multiple regression analysis was conducted to identify significant predictors of employment opportunities and employment structure, while controlling for multicollinearity using Variance Inflation Factor (VIF) diagnostics. The regression models were estimated separately for manufacturing and service enterprises to detect sector-specific effects.

Ethical Considerations

Data were collected from senior managers or enterprise owners through structured online and in-person surveys. Ethical approval was secured from the Central Philippine University Research Ethics Review Board, and informed consent was obtained from all participants. Participation was voluntary, and all responses were anonymized to ensure confidentiality and compliance with ethical research standards.

Results

Table 1. *Relationships between Extent of Digital Transformation and Employment Patterns in terms of Employment Opportunities in Manufacturing Enterprises and Service enterprises*

	Manufacturing Enterprises(n=179)		Service Enterprises(n=185)	
	Pearson's r	*Sig.*	*Pearson's r*	*Sig*
Overall Extent of Digital Transformation	-0.142	0.057	0.049	0.505
Relationships with partners	-0.036	0.635	0.053	0.470
Product and service improvement	-0.045	0.546	0.077	0.300
Production operations	-0.051	0.494	0.062	0.405
Marketing and sales	-0.219**	0.003	0.021	0.772
Customer relationships	-0.185*	0.013	-0.013	0.864

* p<0.05 ** p<0.01
Note. Correlation strength interpretation guidelines: very strong ($0.8 \leq r < 1.0$), strong ($0.6 \leq r < 0.79$), moderate ($0.4 \leq r < 0.59$), weak ($0.2 \leq r < 0.39$), and very weak ($0 \leq r < 0.19$).

Table 2. *Relationships between Extent of Digital Transformation and Employment Pattern in terms of Turnover Rate in Manufacturing Enterprises and Service Enterprises*

	Manufacturing Enterprises (n=179)		Service Enterprises (n=185)	
	Pearson's r	Sig.	Pearson's r	Sig
Overall Extent of Digital Transformation	-0.030	0.689	0.025	0.734
Relationships with partners	-0.094	0.210	-0.041	0.577
Product and service improvement	0.009	0.901	-0.015	0.842
Production operations	-0.006	0.933	0.003	0.972
Marketing and sales	-0.044	0.562	0.067	0.364
Customer relationships	0.019	0.805	0.086	0.242

* $p<0.05$ ** $p<0.01$
Note. Correlation strength interpretation guidelines: very strong ($0.8 \leq r < 1.0$), strong ($0.6 \leq r < 0.79$), moderate ($0.4 \leq r < 0.59$), weak ($0.2 \leq r < 0.39$), and very weak ($0 \leq r < 0.19$).

Table 3. *Relationships between Extent of Digital Transformation and Employment Pattern in terms of Employment Structure in Manufacturing Enterprises and Service Enterprises*

	Manufacturing Enterprises (n=179)		Service Enterprises (n=185)	
	Pearson's r	Sig.	Pearson's r	Sig
Overall Extent of Digital Transformation	0.305**	0.000	0.273**	0.000
Relationships with partners	0.357**	0.000	0.273**	0.000
Product and service improvement	0.284**	0.000	0.244**	0.001
Production operations	0.203**	0.006	0.178*	0.015
Marketing and sales	0.186*	0.013	0.228**	0.002
Customer relationships	0.144	0.055	0.175*	0.017

* $p<0.05$ ** $p<0.01$
Note. Correlation strength interpretation guidelines: very strong ($0.8 \leq r < 1.0$), strong ($0.6 \leq r < 0.79$), moderate ($0.4 \leq r < 0.59$), weak ($0.2 \leq r < 0.39$), and very weak ($0 \leq r < 0.19$).

Table 4. *Stepwise Regression Results for Employment Opportunities among Manufacturing Enterprises*

Predictor	B (SE)	Beta	t	Sig.	95.0% Confidence Interval for B	
					lower bound	upper bound
Constant	0.006		0.929	0.354		
Marketing and Sales	-0.005	-0.219	-2.992	0.003	-0.009	-0.002

Note:
$R^2 =0.048$, adjusted $R^2=0.043$, $F(1, 177) =8.955$, $p=0.003<0.001$. B=unstandardized coefficient.
Excluded Variables: Customer Relationships (p=0.184).

Table 5. *Stepwise Regression Results for Employment Structure among Manufacturing Enterprises (N=179)*

Predictor	B (SE)	Beta	t	Sig.	95.0% Confidence Interval for B	
					lower bound	upper bound
Constant	0.161		34.893	0.000		
relationships with partners	0.007	0.357	5.089	0.000	0.004	0.009

Note:
$R^2 =0.048$, adjusted $R^2=0.043$, $F(1, 177) =8.955$, $p=0.003<0.001$. B=unstandardized coefficient.
Excluded Variables: Customer Relationships (p=0.184).

Table 6. *Stepwise Regression Results for Employment Structure among Service Enterprises (N=185)*

Predictor	B (SE)	Beta	t	Sig.	95.0% Confidence Interval for B	
					lower bound	upper bound
Constant	0.149		41.277	0.000		
relationships with partners	0.004	0.273	3.840	0.000	0.002	0.006

Note:
$R^2 =0.048$, adjusted $R^2=0.043$, $F(1, 177) =8.955$, $p=0.003<0.001$. B=unstandardized coefficient.
Excluded Variables: Customer Relationships (p=0.184).

Discussion

This study aimed to assess how digital transformation influences employment opportunities, turnover rates, and employment structure across manufacturing and service enterprises in Guangdong Province. The results provide empirical evidence that supports a differentiated understanding of digital transformation's labor market effects highlighting sector-specific dynamics and extending theoretical frameworks such as skill-biased technological change (SBTC), routine-task biased change (RBTC), and creative destruction

In terms of employment opportunities, a significant negative correlation was observed between the extent of digital transformation in the domain of marketing and sales and employment levels in manufacturing enterprises ($r = -0.219$, $p = 0.003$), as shown in Table 1. Regression analysis further confirmed that marketing and sales transformation was the only significant predictor, with a unit increase

in digital transformation corresponding to a 0.005-point decline in employment (β = -0.219, p = 0.003; see Table 4). These findings resonate with the results of Chen et al. (2023), who reported a 7.80% decline in manufacturing employment in China due to automation in sales and front-facing roles. This reflects the substitution effect where AI and digital tools displace routine customer engagement tasks a phenomenon well-documented in the literature on labor automation (Acemoglu & Restrepo, 2020).

Interestingly, service enterprises showed no significant relationship between digital transformation and employment opportunities (all p > 0.30 in Table 1). This contrasts with findings from Meng (2021), who suggested that digital transformation in services often leads to job creation through platform-based innovation and market expansion. One explanation may be that service firms in Guangdong are in earlier stages of digital maturity, where automation improves efficiency without yet generating new employment roles.

Regarding turnover rates, no significant relationships were found across either sector or any digital transformation domain (see Table 2). This aligns with Mahlasela and Chinyamurindi (2020), who emphasized that technology alone is not a direct driver of employee attrition. Instead, factors such as organizational support, perceived fairness, and job redesign may act as mediators. Our null findings imply that digital adoption in its current form may neither destabilize nor improve retention unless complemented by workforce engagement initiatives.

In contrast, the impact of digital transformation on employment structure was consistently significant and positive across both sectors, especially in increasing the share of college-educated workers. Correlation analysis (see Table 3) revealed strong relationships between digital transformation and employment structure in both manufacturing (r = 0.305, p < 0.001) and service enterprises (r = 0.273, p < 0.001). This finding supports the SBTC theory, which asserts that technology enhances demand for high-skilled labor (Angelini et al., 2020; Fleisher et al., 2023).

Further, regression analysis identified the "relationships with partners" domain as the strongest predictor of employment structure in both sectors. In manufacturing, this variable explained 12.3% of the variance (β = 0.357, p < 0.001; Table 5), while in services, it accounted for 7.0% (β = 0.273, p < 0.001; Table 6). This finding reflects the increasing complexity of inter-firm digital collaboration, which requires personnel with advanced analytical and technical coordination skills echoing the observations of Ren and Liu (2021) and Sharfiei (2024). Notably, although other domains such as product improvement and operations showed significant bivariate correlations (see Table 3), they were excluded from final models due to multicollinearity.

These sector-specific outcomes contribute to refining the discourse on digital labor effects. Whereas automation in manufacturing directly displaces certain job categories, digital transformation in services appears more oriented toward augmenting human capital rather than eliminating it. Moreover, our findings suggest that workforce restructuring is occurring more rapidly in enterprise functions involving external partnerships and market integration domains where digital transformation is most visible and impactful.

Nevertheless, this study is not without limitations. The exclusive focus on firms operating from 2021 to 2023 may omit earlier adopters of digital transformation or those still in the nascent stages. Moreover, the cross-sectional nature of the data limits causal inference. Longitudinal studies could help capture lag effects or delayed employment impacts. Additionally, qualitative investigations could enrich the interpretation of how firms manage digital upskilling and redeployment strategies internally.

Our findings highlight that while digital transformation may reduce employment in specific manufacturing domains, it simultaneously contributes to a more educated workforce across both sectors. Policymakers and enterprise leaders should therefore align digital investment with targeted human capital development to ensure inclusive labor market transitions.

Conclusions

This study provides empirical and theoretical contributions to the ongoing discourse on the labor market implications of digital transformation in emerging economies, with specific focus on Guangdong Province, China. By examining both manufacturing and service enterprises, it presents a differentiated view of how digital transformation affects employment opportunities, turnover rates, and employment structure. The findings advance current understanding by showing that digital transformation does not uniformly reduce or increase employment across sectors; rather, its impact depends on the functional area and industry context.

Specifically, the study confirms that digital transformation in marketing and sales negatively influences employment opportunities in manufacturing firms, reinforcing concerns around task automation and labor substitution. In contrast, no such effect was observed in the service sector, suggesting that service enterprises may be undergoing a more adaptive or incremental digital shift. Across both sectors, the most consistent and positive influence of digital transformation was seen in the upgrading of employment structures particularly in increasing the proportion of college-educated employees underscoring the skill-biased nature of technological change.

These findings offer a scientific basis for recommending targeted workforce development policies. Enterprises should integrate digital upskilling strategies aligned with transformation in high-impact domains such as customer relations and inter-firm collaboration. Governments, in turn, should craft sector-specific support programs, including financial incentives and training subsidies, to help mitigate displacement risks while fostering high-quality employment growth.

Future research should adopt longitudinal and mixed-method approaches to explore how digital maturity evolves over time and affects

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employment dynamics. Investigating mediating variables such as firm innovation capacity, leadership orientation, and employee adaptability will deepen the understanding of digital transformation's complex relationship with labor outcomes. In doing so, scholars and practitioners alike can better shape inclusive and resilient digital economies.

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