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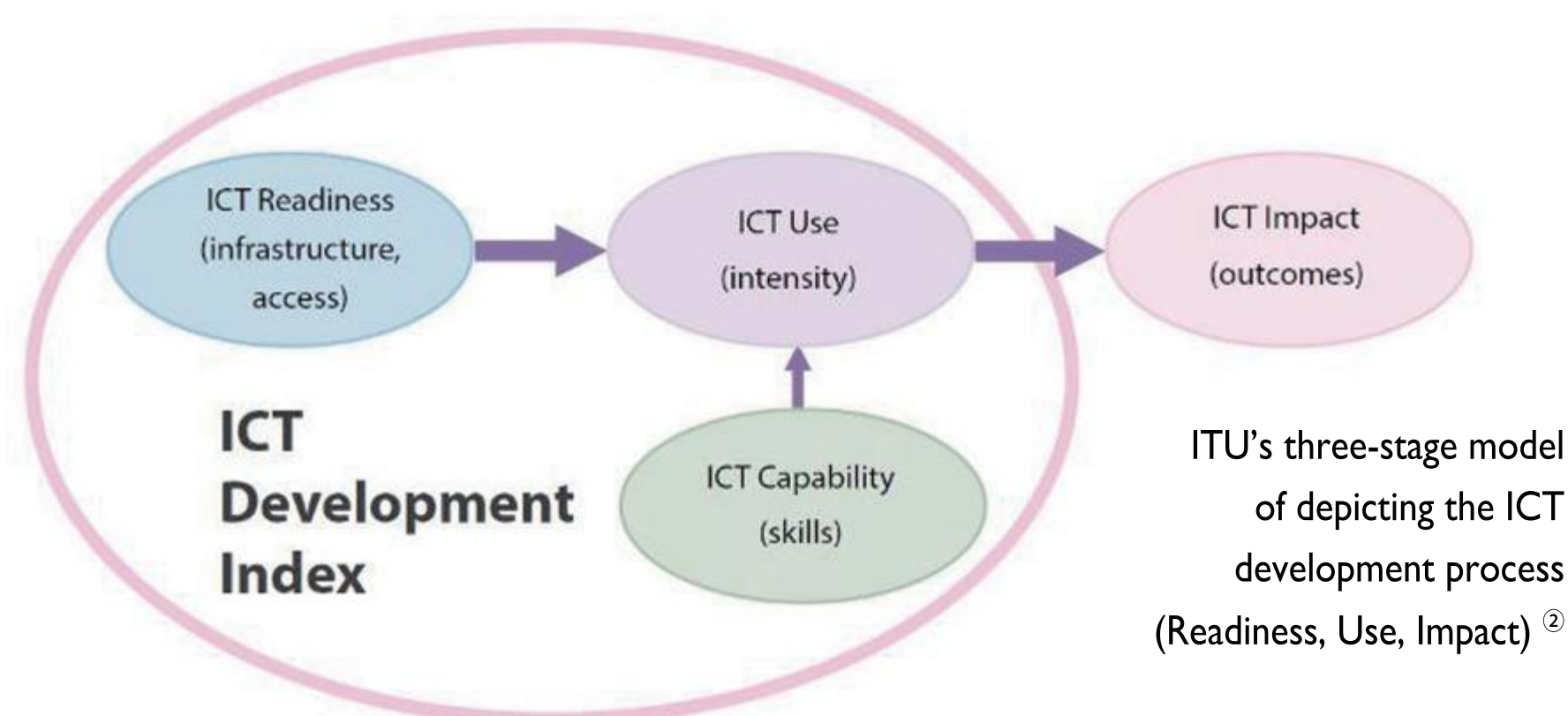
Smart city = ICT development ?
A Hierarchical Study of Policy Practice

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Smart Cities (SCs) are envisioned as catalysts to optimize urban life through the strategic integration of Information and Communication Technologies (ICT)[1]. However, the development of ICT has evolved beyond the technology itself, becoming a multi-stage, multi-level complex concept. This complexity necessitates comprehensive evaluation, exemplified by the three-stage model representing the ICT development process, established by the International Telecommunication Union (ITU)[2].

Consequently, **how does the construction of SCs influence progression across the various stages of ICT development?** By studying Chinese practice, our findings will illuminate the direct contributions of SC policies to ICT development's transformative journey, providing clarity on how SCs can effectively foster technological advancement and urban innovation.
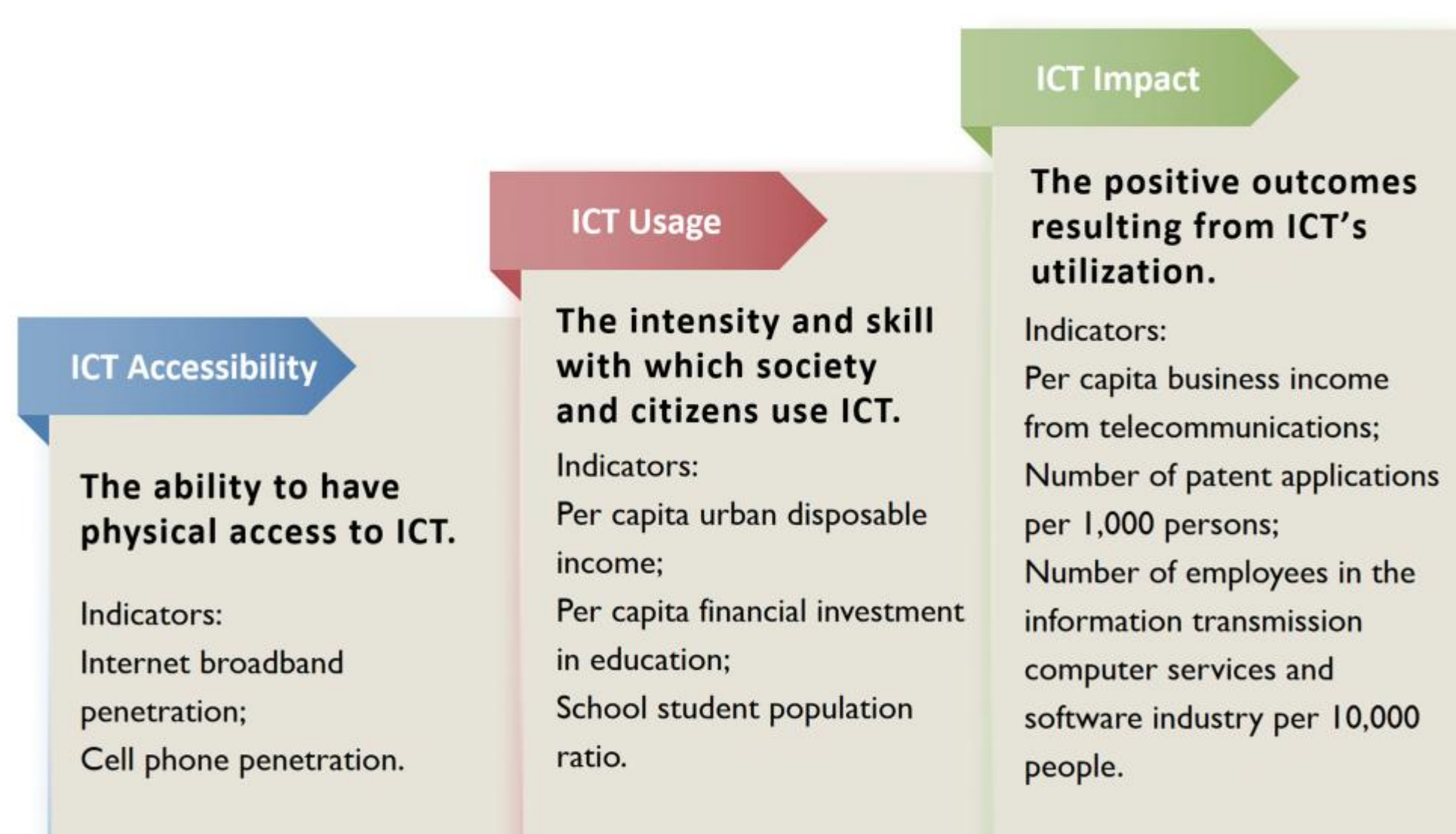

ITU's three-stage model of depicting the ICT development process (Readiness, Use, Impact) [2]

Method

Hierarchical Model: We selected a set of representative indicators to construct a three-stage hierarchical model for a city's ICT development index. The accompanying figure illustrates the composition of indicators at each level within the model.

Causal Inference: We employed a multi-period Difference-in-Differences (DID) model to compare the changes in ICT indicators over time between the experimental (SC) group and the control group.

Data: We collected prefecture-level cities' data from 2007 to 2019. After standardizing these data, we calculated the ICT develop Index for the whole and each stage using PCA and arithmetic averaging.

Sample: We excluded cities with too many missing values. Final data contains 209 cities, including 99 in experimental group and 110 in control group.

ICT Accessibility
The ability to have physical access to ICT.
Indicators:
Internet broadband penetration;
Cell phone penetration.

ICT Usage
The intensity and skill with which society and citizens use ICT.
Indicators:
Per capita urban disposable income;
Per capita financial investment in education;
School student population ratio.

ICT Impact
The positive outcomes resulting from ICT's utilization.
Indicators:
Per capita business income from telecommunications;
Number of patent applications per 1,000 persons;
Number of employees in the information transmission computer services and software industry per 10,000 people.

Outcome

Do you think which stage of ICT development has been most significantly affected by Smart City policy?

ICT Accessibility? China's SC policies focus on strengthening the information infrastructure, as well as initiating smart application services [3].

ICT Impact? SCs in China have shown notable progress in governance and infrastructure, while their performance in economic and environmental aspects is less pronounced [4].

or ICT Usage? Among the smart city domains, pilot projects related to smart government have been the most common but those on smart living and smart people have not received as much attention [5].

Surprisingly, the impact is ranked as:

Usage > Impact > Accessibility.

VARIABLES	Overall	Accessibility	Usage	Impact
Enhancement effect of SC	0.161**	0.005	0.015***	0.009**
	(2.30)	(0.78)	(2.87)	(2.01)
Control Variables	Controlled	Controlled	Controlled	Controlled
Observations	2,239	2,385	2,449	2,436
R-squared	0.925	0.929	0.884	0.772

(a) ICT develop index   (b) ICT accessibility   (c) ICT usage   (d) ICT impact
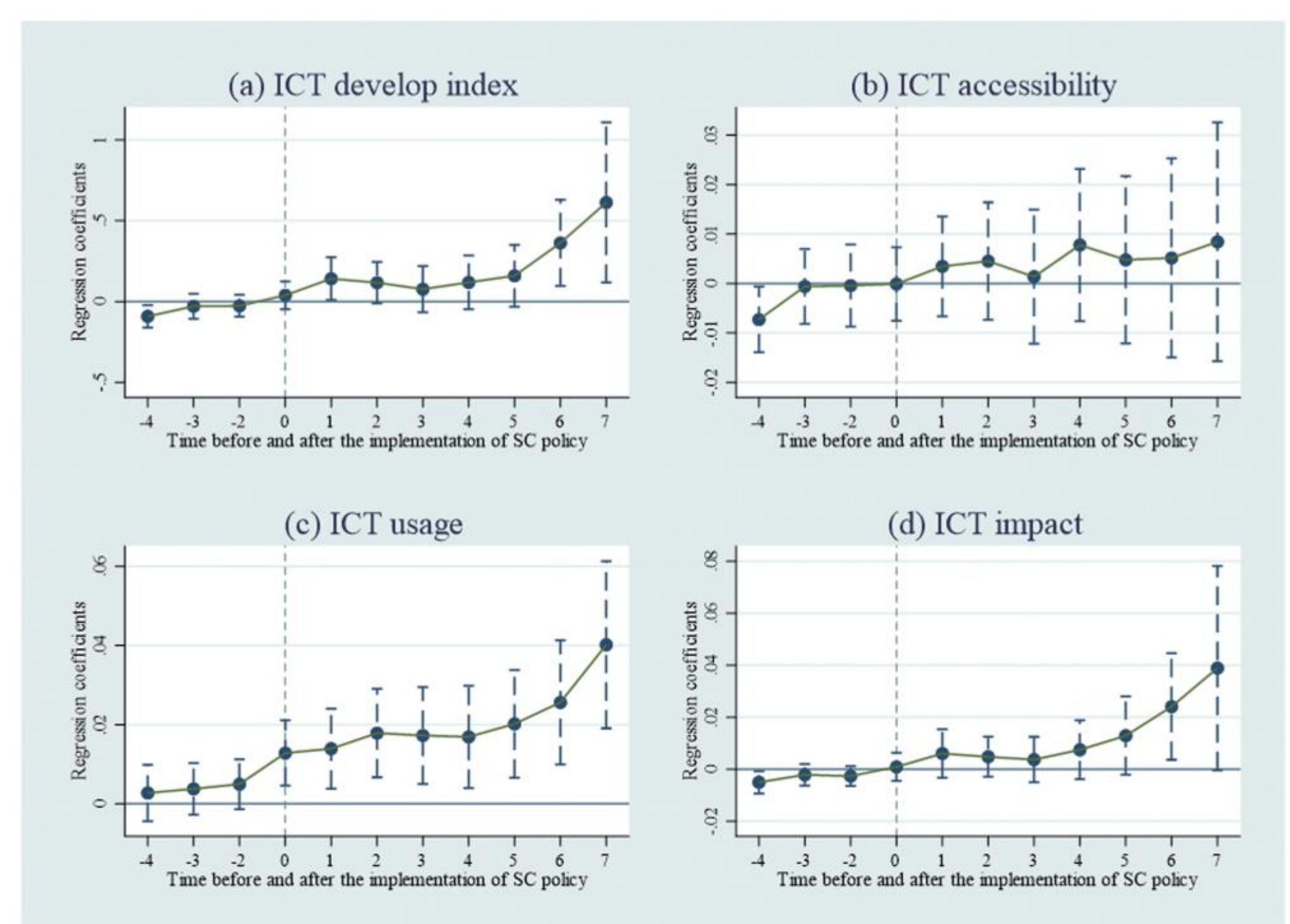
Conclusion

In smart city policy, there is a priority placed on strengthening ICT infrastructure and smart application services, while 'smart living' and 'smart people' are less emphasized. However, our study underscores the substantial influence these policies have on shaping individual ICT usage and proficiency. We attribute this influence to the talent effect spurred by ICT industry clustering and have conducted further research to elucidate this phenomenon.

Reference
[1] Ahad, M.A. et al. (2020) 'Enabling technologies and sustainable smart cities', Sustainable Cities And Society, 61, pp. 102301.
[2] ITU (2017) 'The ICT development index (IDI): conceptual framework and methodology' https://www.itu.int/en/ITU-D/Statistics/Pages/publications/mis2017/methodology.aspx.
[3] Pei, L., Zhou, Z.T. and Sun, J.J. (2016) 'What Programs will Smart City Do in China? A Qualitative Analysis Based on Policy', Library & Information, (6), pp. 41–46.
[4] Shen L. et al. (2018), 'A holistic evaluation of smart city performance in the context of China', J Clean Prod, 200, pp. 667-679.
[5] Wang, B., Loo, B.P.Y. and Huang, G. (2022) 'Becoming Smarter through Smart City Pilot Projects: Experiences and Lessons from China since 2013', Journal Of Urban Technology, 29(4), pp. 3–24.

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Availability
The formal results of this study are under review by *Digital Transformation and Society*.