Staffs' Digital Fluency in Urban Smart Community and Its Impact on Management: A Case Study of Chengdu's Micro-grid System

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Abstract. With the rapid development of information technology and smart cities, the exploration and practice of Chengdu's "Micro-grid System" governance model highlights the key role of digital transformation in enhancing the efficiency and quality of urban community management. This study examines the digital fluency of grid staff in Chengdu's Micro-grid System and its influence on their tech adoption and community engagement.Based on the Technology Acceptance Model (TAM), the study focuses on grid staff's perceived ease of use (PEOU), perceived usefulness (PU), and how these factors influence their digital fluency (DF)，Community Political Participation（SCAP）and intention to use (IU). Results indicate that grid staff's digital fluency is significantly influenced by their perceived ease of use and usefulness of technology. Digital fluency plays a mediating role between perceived ease of use, perceived usefulness, and intention to use, as well as between perceived ease of use, perceived usefulness, and participation in community politics. This research provides insights into digital management of smart urban communities, emphasizing the importance of enhancing grid staff's digital fluency to improve technology acceptance and community governance participation.

Keywords：Digital Fluency；Urban Smart Community；Chengdu's Micro-grid System；Technology Acceptance Model (TAM)；Community Management

1 Introduction

Grid management, as an integrated management model based on geographical areas, is diverse across countries and disciplines. In general, grid management focuses on managing the electrical grid. In China, grid management often refers to a new model of community management. Chengdu, a megacity with over 20 million people, has developed a unique "Micro-grid System" for grassroots governance based on smart urban community development. This governance model divides communities into micro-grids managed by micro-grid staff, achieving deeper community governance and refined grid management. With the rapid development and popularization of digital technology, digital means have provided new possibilities and platforms for grassroots community governance. Digital transformation has become an inevitable trend in social development, and "Digital Government 2.0" has brought new opportunities to the "Micro-grid System" governance model through digital empowerment.

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Digital fluency, the compatibility between a users' technology skills and required abilities, has emerged as a crucial metric for assessing individual and organizational performance[1]. The evolving digital environment poses new demands, making digital fluency a pivotal factor. The Micro-grid System governance model, while accumulating practical experiences, faces digital transformation challenges[2-4]. Examining the digital fluency of grid staff offers insights into the impact of digital transformation on grid management and strategies to enhance work quality.

This study examines the application of digital technology in Chengdu's Micro-grid System governance, emphasizing grid staff's digital fluency and its impact on their willingness of technology usage and community engagement. Based on literature review and the Technology Acceptance Model (TAM), this research constructs a theoretical framework for grid staff's digital fluency. Data was collected through literature research, surveys, field observations, and interviews on Micro-grid System governance. Analysis focused on digital fluency's application and impact on technology usage willingness. Conclusions and recommendations provide theoretical and practical support for the application of digital fluency in community governance and beyond.

2 Literature reviews

Grid management is defined based on the principles of computer grid management as the division of the management object into several grid units, coupled with the utilization of modern information technology and coordination mechanisms, to facilitate information exchange and resource sharing. Its goal is to integrate resources and enhance management efficiency. As society progresses and urbanization accelerates, more cities are adopting grid management in governance, evolving a research trajectory that spans from specific case studies to the formulation of theoretical frameworks[5]. Chengdu's "Micro-grid System" governance, with its detailed grid segmentation, has achieved extensive coverage and integration. The study of grid management encompasses themes such as grid technology, applications in public crisis management, and citizen participation. It also involves critical reflections on the concept of grid management itself, raising concerns over its potential for excessive emphasis[6-7].

Milakovich defined broad and narrow scopes of digital governance, and Dunleavy highlighted decision-making processes and the digitalization of electronic administration[8]. Early research advocated for digital governance as a paradigm of governance under the new technological revolution, poised to alter interactions among governments, citizens, and socio-economic governance entities[9]. With the onset of the digital era, digital governance research has broadened its scope. Studies by Li Tao and others have thoroughly delineated the concept, content, and scope of digital governance, aiming to optimize governance systems and capabilities by adhering to a "one core, multiple elements" model that encompasses economic, social, and technological dimensions[10].

Digital fluency refers to an individual's ability to create and express through digital technology. Research has concentrated on aspects like information retrieval, quality assessment, and the capability to learn new technologies, including critical thinking and specific knowledge application. Influencing factors span demographics, organizational, psychological, and social

impacts. Predominantly focused on social media use, this paper aims to investigate the application of new technologies by grassroots community workers amidst the digital government transformation, enhancing the conceptual and framework understanding of digital fluency.

3 Research model and assumptions

This study uses the Technology Acceptance Model (TAM) to examine how perceived ease of use, usefulness, and intention to use affect new technology adoption. With IT advancement, TAM is applied in new areas, notably in public sector digital transformation, showing digital fluency's key role, especially under the "Micro-grid System" governance, significantly impacting community staff and resident engagement, highlighting TAM's value in enhancing public sector tech adoption. In conclusion, we have designed a research model, as shown in Figure 1.

Perceived ease of use (PEOU) and usefulness (PU) significantly influence tech acceptance and use. Digital fluency (DF), indicating confidence and capability in digital environments, improves with higher PEOU and PU, as they reduce psychological barriers to new tech, enhancing digital skills and confidence. Thus, we hypothesize:

H1b: PU positively impacts DF. H1a: PEOU positively impacts DF.

Intention to Use (IU) reflects the willingness to adopt specific technologies, influenced by DF, PEOU, and PU, enhancing tech acceptance and use. Stronger willingness arises when tech is perceived to improve work or life, leading to hypotheses:

H2a: DF mediates between PEOU and IU. H2b: DF mediates between PU and IU.

Community Political Participation (SCAP) involves activities like voting or engaging in public discussions. Individuals with higher DF are likelier to engage politically, effectively using digital tools for political information and expression. Perceived ease and usefulness of digital tools increase political participation likelihood, leading to hypotheses:

H3a: DF mediates between PEOU and SCAP. H3b: DF mediates between PU and SCAP.

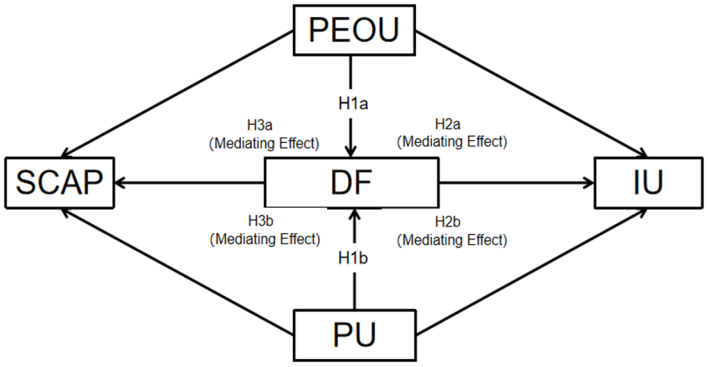

Fig.1. Research Model

4 Empirical analysis

Table 1 Sample Statistics Description

Topic	Option	Frequency	%
Gender	Male	99	46.5
	Female	114	53.5
Age	20—30	21	9.9
	31—40	62	29.1
	41—50	54	25.4
	51—60	62	29.1
	Above 60	14	6.6
Education	Elementary School	82	38.5
	Middle School	53	24.9
	High School	77	36.2
	College	1	0.4
Income	Under 4000	182	85.4
	4001—6000	24	11.3
	6001—8000	3	1.4
	8001—10000	2	0.9
	Above 10000	2	0.9

This study used a questionnaire in Chengdu with stratified sampling. Cronbach's Alpha, consistently over 0.90, confirmed its reliability. Of 232 micro-grid staff sampled, 213 questionnaires were valid. The data of table 1 showed a majority of female, middle-aged, lower-educated, low-income respondents, with varied but mostly unemployed occupations.

In this study, the KMO measure was impressively high at 0.946, and the Bartlett's test of sphericity results indicated a very strong validity of the variables analyzed.Analyzed using SPSS 18.0, Table 3 shows all variables have high alpha coefficients, all exceeding or meeting 0.9, indicating very high reliability for all five variables.Research data revealed that participants had a positive attitude towards technology, with all variable averages exceeding 4. The average DF was 4.10, indicating participants' confidence in their digital skills. The IU average was 4.12, showing a strong tendency to use technology. Averages for PU and PEOU were 4.11 and 4.12 respectively, suggesting participants generally found technology beneficial for work and life, and easy to use. The SCAP average was slightly lower at 4.01, still reflecting a positive engagement attitude. Variance analysis revealed consistent views among participants on digital fluency (variance 0.78), with the greatest divergence in views on intention to use (variance 1.02).

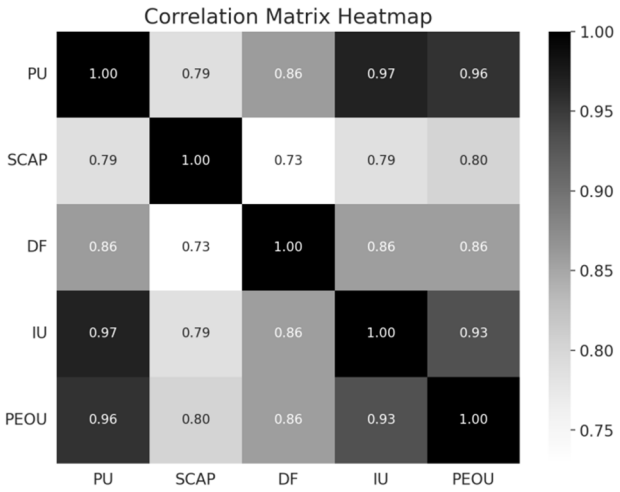

Fig. 2 Correlation Matrix Heatmap

Correlation analysis of figure 2 showed strong positive correlations between all variables, particularly between perceived usefulness and intention to use (0.97), indicating that seeing technology as useful enhances the willingness to use it. High correlations between perceived usefulness and perceived ease of use (0.96), and between IU and PEOU (0.93), highlighted the impact of usefulness and ease of use on technology acceptance. Digital fluency was significantly positively correlated with all variables (0.73 to 0.86), especially with intention to use and perceived ease of use, suggesting that users proficient in technology are more likely to embrace new technology.

Table 2 Regression Analysis of PU, PEOU and PU

Model	Unstandardized Coefficient		Standardized Coefficient	t	Significance
	B	Error	Beta		
(Constant)	3.276				
PU	.4173	.104	.411	4.511	.000
PEOU	.03801	.108	.411	3.506	.000
F			321.2		
p			0.000		
Adjusted R^2			0.751		

Dependent variable：digital fluency

See table 2, on the regression coefficients, at the 0.001 level, both PU and PEOU had a significant positive impact on digital fluency, thereby validating hypotheses H1a and H1b.

Table 3 Mediation Effect Analysis

Path	β	SE	95% CI
PEOU→DF→IU	0.9896**	0.026	[0.938, 1.042]
PU→DF→IU	0.9018**	0.034	[0.836, 0.968]
PEOU→DF→SCAP	0.6535**	0.077	[0.501, 0.806]
PU→DF→SCAP	0.7384**	0.0397	[0.6601, 0.8167]

**p<0.01，*p<0.05

In Table 3, mediation analysis reveals DF mediates between PEOU and IU. Initial regression shows significant PEOU impact on DF (coef. = 0.7958, $p < 0.05$) and IU (coef. = 0.9896, $p < 0.05$). Including both PEOU and DF, their impacts on IU remain significant (coef. = 0.7895 and 0.2514, respectively, $p < 0.05$), validating DF's mediating role (H2a confirmed). Regression confirms DF's mediation between PU and IU. PU significantly affects DF (coef. = 0.7659, $p < 0.05$) and IU (coef. = 0.9018, $p < 0.05$). Even with both PU and DF, their impacts on IU are significant (coef. = 0.9018 and 0.1100, respectively, $p < 0.05$), confirming DF's mediation between PU and IU (H2b confirmed). Analysis explores PEOU's mediation through DF on SCAP. PEOU significantly impacts DF (coef. = 0.7958, $p < 0.05$) and SCAP directly (coef. = 0.7837, $p < 0.05$). Controlling for PEOU, DF impacts SCAP significantly, indicating DF's mediation (H3a confirmed). For H3b, DF mediates between PU and SCAP. PU affects DF significantly (coef. = 0.7659, $p < 0.05$). Controlling for PU, DF significantly impacts SCAP (coef. = 0.2084, $p = 0.0166$), partially mediating PU's impact (H3b confirmed).

5 Conclusions

This research, based on the Technology Acceptance Model, provides insights into digital engagement in Chengdu's "Micro-grid System" context. Key findings highlight the mediating role of digital fluency between perceived ease of use, perceived usefulness, intention to use, and community political participation. PEOU and PU significantly influence IU and DF, which in turn positively affects technology adoption and community politics participation. High alpha coefficients and robust regression models, validated by significant F and p-values, stress the importance of enhancing digital fluency for broader technology adoption and community involvement. Low remuneration within the "Micro-grid System" project is identified as a major barrier to its dissemination.The study's primary focus on Chengdu may limit the generalizability of findings to areas with different socio-economic backgrounds. The cross-sectional design limits inferring causality between variables.Low remuneration in the "Micro-grid System" project could be a significant factor limiting technology adoption and community involvement.

To enhance digital fluency and its impact on technology acceptance and use, targeted educational and training programs should be developed, emphasizing technology's ease of use and utility. User-friendly technological solutions can reduce complexity and enhance usefulness, promoting wider adoption. Integrating useful and easy-to-use digital tools could increase community engagement, especially in political participation. More intuitive digital platforms are needed to facilitate civic involvement and access to political information. Future research should explore the impact of low remuneration in the "Micro-grid System" project on technology adoption and community participation further.

References

[1] Wang, Q., Myers, M. D., & Sundaram, D.: Digital natives and digital immigrants towards a model of digital fluency. Business & Information Systems Engineering, pp. 409-419 (2013).
[2] Liu, L., & Su, Y.: Digital Transformation and Strategic Analysis of Human Resource Value. Advances in Management and Applied Economics (2022).
[3] Curzi, Y., Fabbri, T., Scapolan, A., & Boscolo, S.: Performance Appraisal and Innovative Behavior in the Digital Era. Frontiers in Psychology, 10, pp. 1-11 (2019).
[4] Turulja, L., & Bajgoric, N.: Information technology, knowledge management and human resource management. Vine, 48, pp. 255-276 (2018).
[5] Zeng, W.: On the development path of grid management theory. Legal System and Society, pp. 94-98 (2020).
[6] Dunleavy, P.: New Public Management Is Dead? Long Live Digital-Era Governance. Journal of Public Administration Research & Theory, Vol.16, No 3 (2005).
[7] Xu, X., & Zhou, L.: Digital Governance System Construction in Urban Government's Good Governance. Management World, pp. 140-141 (2004).
[8] Wei, L., Gu, C., Ni, G., et al.: Digital Governance: A New Challenge Facing Human Society. Social Policy Research, No.02, pp. 3-12 (2021).
[9] Zhang, P.: Theoretical Evolution and Research Development of Technology Acceptance Model. Information Science, Vol.35, No.09, pp. 165-171 (2017).
[10] Williams, D. L., Crittenden, V. L., Keo, T., & McCarty, P.: The use of social media: An exploratory study of usage among digital natives. Journal of Public Affairs, Vol.12, pp. 127–136 (2012).