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Digital Empowerment and Grassroots Governance Transformation: A TOE Framework Analysis of Public Service Optimization in Sichuan Province

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Abstract. In the context of global governance modernization, digital empowerment has emerged as a pivotal mechanism for enhancing the efficacy of grassroots public services. While the digitization of public administration offers transformative potential, its application in diverse regional contexts remains uneven and theoretically under-explored. This study investigates the optimization pathways for grassroots service delivery in Sichuan Province by adopting the Technology-Organization-Environment (TOE) framework to analyze the determinants of service efficiency. Departing from traditional resource-dependency perspectives, this research posits that digital technology acts as a critical variable in reconfiguring the relationship between service supply and resident demand. Through a mixed-methods approach that integrates quantitative analysis of provincial service data and qualitative case studies of smart community pilots, the study identifies structural bottlenecks such as inter-departmental data silos, the "digital divide" in rural peripheries, and the lag in organizational adaptation to algorithmic governance. The findings reveal that sustainable service optimization requires shifting from a "hardware-centric" construction model to a "data-driven" service logic, where digital tools facilitate precise resource matching and process re-engineering. Ultimately, this paper proposes a multifaceted strategy encompassing the integration of big data platforms, the promotion of digital inclusion for vulnerable groups, and the establishment of responsive feedback mechanisms. These strategies aim to transition grassroots governance from extensive administrative control to precision-based public service, providing empirically grounded insights for enhancing scientific service delivery in complex regional settings.

Keywords: Digital Empowerment; Grassroots Public Service; Service Efficiency; TOE Framework; Smart Governance; Sichuan Province

1. Introduction

Sichuan Province, characterized by its vast territory and profound socioeconomic heterogeneity, serves as a critical observational window for examining the challenges of public service delivery in transitional economies. Unlike uniform urban settings, Sichuan presents a dual structure where highly digitized urban centers like Chengdu coexist with remote mountainous regions facing infrastructural deficits. Traditionally, the delivery of essential services—ranging from social welfare and healthcare to administrative processing—has relied on labor-intensive grid management models. However, with the acceleration of demographic transitions and the increasing complexity of resident needs, these traditional linear administrative methods have encountered significant "efficiency bottlenecks," manifesting as delayed responses, resource mismatches, and high administrative costs (Wang et al., 2021). In the broader context of the digital economy, the efficiency of regional governance is increasingly correlated with the depth of digital integration. As recent studies (Kabbani & Dalati, 2025) suggest, the cultural adaptability of management systems to digital economic trends is a prerequisite for overcoming regional development inertia. Consequently, the urgent imperative for local governance has shifted from merely increasing the quantity of resources to optimizing the allocation mechanism through technological innovation.

Fig.1: Detailed map of Sichuan Province, China

Digital empowerment, defined as the utilization of digital technologies to restructure organizational processes and enhance capabilities, offers a transformative solution to these ingrained inefficiencies. In the theoretical discourse of Digital Era Governance (DEG), technology is no longer viewed merely as a tool for automation but as a fundamental driver for reintegrating fragmented government functions and enabling holistic service delivery (Dunleavy et al., 2006). From an information science perspective, the core of this transformation lies in the optimization of information flow and service accessibility. Some research emphasizes that the primary barrier in grassroots communities is often not the lack of data, but the lack of efficient information service architectures that can translate raw data into actionable public value (Nurimansyah. & Sfenrianto, 2024).

The core logic of this study is to explore how digital empowerment serves as a catalyst for "Service Efficiency"—the ratio of effective service output to administrative input. Specifically, digital tools such as big data analytics, cloud computing, and mobile government platforms have the potential to dismantle the physical and informational barriers that historically hindered service delivery in Sichuan's diverse terrain. By enabling real-time data flow, these technologies allow for the transition from passive "request-response" models to proactive "anticipatory service" models. However, sustainability remains a critical concern. As highlighted by scholars (Yang et al., 2025), digital transformation strategies must

be resilient and adaptable to long-term environmental changes to avoid the trap of short-term technological deployment without lasting institutional change.

The practical implementation of digital strategies often faces significant resistance and structural misalignment. Current observations indicate that while hardware investment in Sichuan's grassroots units has increased, the actual "service efficiency" has not risen commensurately—a phenomenon described by scholars as "technological involution." This discrepancy arises from critical issues such as "Data Silos," where information is trapped within vertical bureaucratic departments, preventing cross-agency collaboration. Furthermore, a pronounced "Digital Divide" persists, where the elderly and rural populations are increasingly marginalized by the very systems designed to serve them. These challenges underscore that digital empowerment is not solely a technological issue but a complex socio-technical process involving organizational restructuring and environmental adaptation. Therefore, a comprehensive analysis requires not only examining technical parameters but also understanding the strategic innovation ecosystem within which these technologies operate.

To rigorously analyze these dynamics, this study introduces the Technology-Organization-Environment (TOE) framework (Tornatzky & Fleischer, 1990) as its methodological anchor. Unlike general policy reports that list achievements, this research adopts a scientific problem-solving orientation. We examine the Technological context (infrastructure and data integration), the Organizational context (administrative processes and personnel literacy), and the Environmental context (resident demands and regulatory support). By integrating insights from recent developments in digital economics and information service science, the study aims to identify specific "blocking points" in the current system and propose targeted optimization strategies. The ultimate goal is to construct a "Digital + Service" ecosystem where technology empowers grassroots units to deliver precise, equitable, and efficient public services.

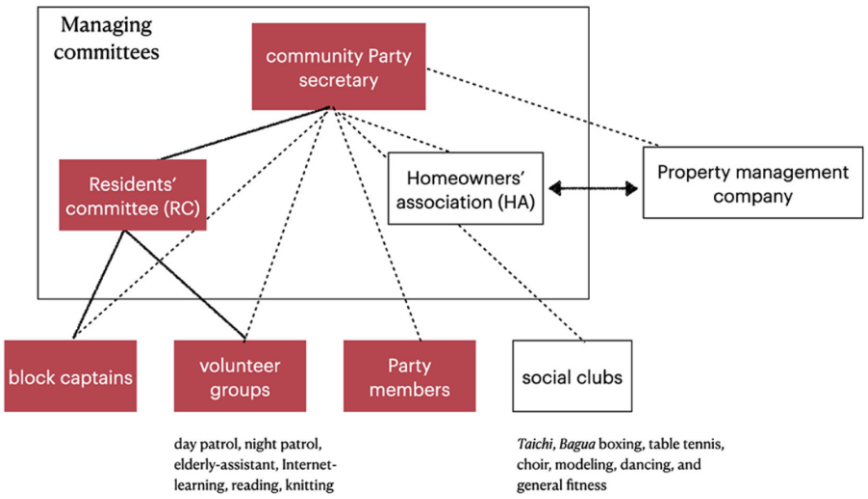


Fig.2: Conceptual framework illustrating multi-level interactions in China's community governance structure

2. Literature Review

2.1 Paradigm Shift: From Traditional Administration to Digital Era Governance

The evolution of grassroots governance in China represents a continuous transition from rigid administrative control to flexible, service-oriented delivery. Historically, the governance logic was dominated by a fragmented bureaucratic model, characterized by vertical segmentation where distinct government departments operated in isolation. While this structure ensured administrative uniformity, it created significant "information silos" and high transaction costs for residents seeking public services (Ma, 2023). With the advent of the information age, the theoretical focus has shifted towards Digital

Era Governance (DEG). According to Dunleavy et al. (2006), DEG emphasizes the reintegration of fragmented government functions through digital technologies. This shift represents a fundamental change in logic from "management" to "service," where the government's role evolves into that of a platform provider facilitating public value creation (He, 2023).

In the context of Sichuan Province, this paradigm shift is particularly critical. The complexity of the region's geography and the diversity of its population render traditional "labor-intensive" grid management models unsustainable. Consequently, recent academic discourse has pivoted towards "Digital Empowerment," which is defined as the process of leveraging digital tools not merely to automate existing tasks but to fundamentally re-engineer organizational processes and empower grassroots agents (Zheng et al., 2024). Current literature suggests that the integration of digital platforms (e.g., smart community apps, integrated government portals) serves as the primary mechanism for flattening organizational hierarchies, thereby enhancing the responsiveness and transparency of public service delivery in complex regional settings.

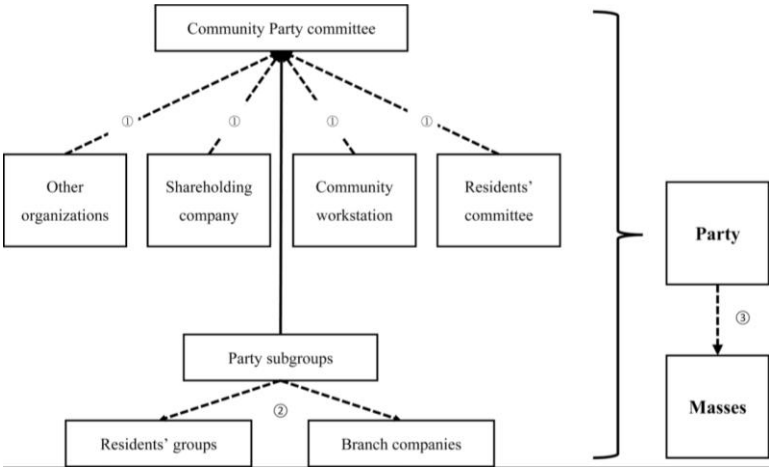


Fig.3: Structural diagram of grassroots Party organization integration in urban community governance

2.2 Digital Empowerment and Resource Allocation Efficiency

Resource allocation in grassroots governance has traditionally suffered from structural asymmetries and inefficiencies. Standard economic theories of public goods suggest that without accurate demand data, supply-side allocation inevitably leads to either surplus or scarcity. In the pre-digital era, the lack of real-time data forced local governments in Sichuan to rely on static census data, resulting in a mismatch between service supply (e.g., elderly care facilities, healthcare stations) and actual resident needs. The "Digital Divide"—manifesting as unequal access to ICT infrastructure between urban centers like Chengdu and remote rural areas—has further exacerbated these allocation inequalities (Zhang & Chen, 2023).

Digital empowerment addresses these inefficiencies by transforming the logic of resource allocation from "experience-based" to "data-driven." Through the lens of Information Processing Theory, digital platforms act as central nodes that reduce information asymmetry between the government and citizens. Scholars argue that "Smart Governance" enables the precise identification of service demands through big data analytics, allowing for the dynamic routing of resources to the most vulnerable areas. For instance, cloud-based health platforms can visualize regional disease patterns, enabling health commissions to allocate medical personnel proactively rather than reactively. However, existing studies also warn of the "technology enactment" gap, where the mere presence of digital hardware does not guarantee improved service performance if unaccompanied by corresponding changes in resource management protocols (Brixi et al., 2013).

2.3 Theoretical Framework: The TOE Approach to Service Optimization

To scientifically analyze the mechanisms of digital empowerment in grassroots services, this study adopts the Technology-Organization-Environment (TOE) framework (Tornatzky & Fleischer, 1990) as its theoretical anchor. Unlike general governance theories that treat technology as an exogenous variable, the TOE framework provides a comprehensive lens to examine the interaction between technological capabilities and institutional contexts (Xu, 2023).

First, the Technological Context refers to the "Hard Connectivity" of digital infrastructure. In this study, it encompasses the availability of 5G networks, the interoperability of cross-departmental data platforms, and the sophistication of algorithmic tools deployed in Sichuan's communities. The literature emphasizes that technological maturity is the prerequisite for service efficiency.

Second, the Organizational Context addresses the "Soft Connectivity" of internal administrative structures. Digital empowerment requires a shift from vertical silos to horizontal collaboration. This dimension analyzes how grassroots units re-engineer their workflows to adapt to digital requirements, focusing on the digital literacy of community workers and the flexibility of administrative processes. It posits that technology cannot enhance efficiency without organizational readiness and the breaking of bureaucratic barriers (Jing, 2015).

Third, the Environmental Context captures the external pressures and drivers. This includes the "pull" of resident demands for contactless, efficient services—accelerated by the post-pandemic "new normal"—and the regulatory "push" from higher-level government mandates for digital modernization. By integrating these three dimensions, the TOE framework explains why digital initiatives succeed or fail in translating technological investment into tangible service performance improvements. This theoretical positioning distinguishes the current research from descriptive government reports, grounding the optimization strategies in rigorous sociotechnical analysis.

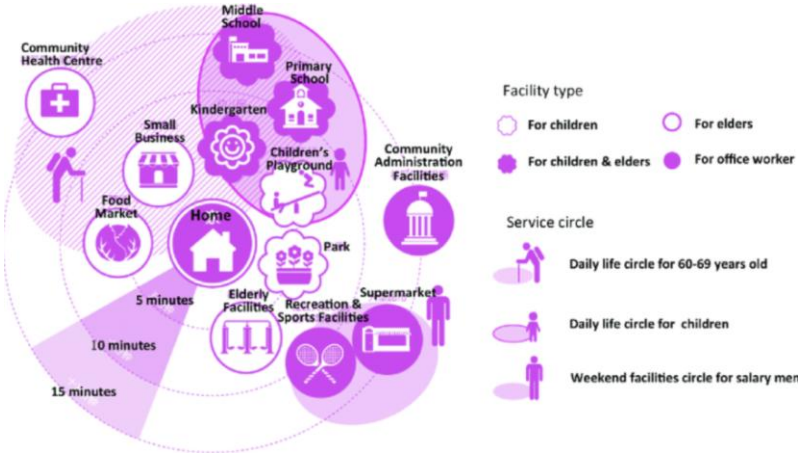


Fig.4: Distribution map of essential facilities within a 15-minute community life circle

3. Methodology

3.1 Research Design: A Sequential Mixed-Methods Approach Based on TOE

To systematically deconstruct the relationship between digital empowerment and grassroots service efficiency, this study adopts a sequential explanatory mixed-methods research design (Creswell, 2014). This methodological choice is driven by the complexity of the research problem, which requires measuring objective efficiency gains (Quantitative) while simultaneously understanding the organizational bottlenecks hindering digital adoption (Qualitative). Guided by the Technology-Organization-Environment (TOE) framework established in the literature review, the research design proceeds in two distinct phases. Phase One employs econometrics to quantify the efficiency of public service delivery across Sichuan's 183 counties/districts, identifying spatial disparities and efficiency frontiers. Phase Two utilizes comparative case studies and policy text analysis to interpret the statistical

outliers, specifically investigating why certain resource-poor regions achieve high service performance through digital innovation while others fail. This "Macro-Micro" analytical structure allows for the triangulation of data, ensuring that the findings move beyond descriptive statistics to reveal the causal mechanisms of digital governance.

3.2 Data Collection and Variable Construction

The quantitative dataset constructed for this study creates a comprehensive panel covering the period from 2018 to 2024. Data sources are strictly triangulated from authoritative statistical compilations, including the Sichuan Statistical Yearbook, the China City Statistical Yearbook, and the internal Annual Reports on Digital Government Construction in Sichuan. To measure "Service Efficiency" (the dependent variable), we move beyond simple input metrics. Inputs are operationalized as per capita fiscal expenditure on community services, the density of grassroots administrative personnel, and the coverage of digital infrastructure (e.g., 5G base stations per square kilometer). Outputs are measured through multi-dimensional indicators including the "One-Net-Com" (Yiwangtongban) actual handling rate, the resolution rate of resident appeals, and service accessibility scores.

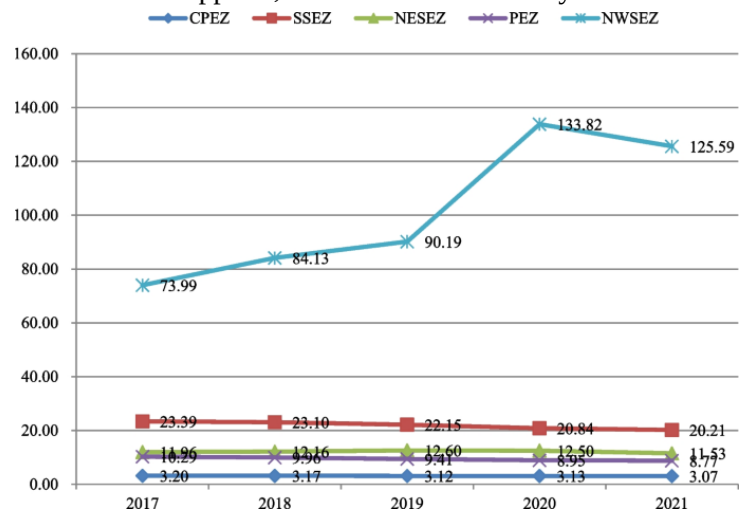


Fig. 5: Complex spatial distribution chart of health resource equity and efficiency across Sichuan economic zones

Additional datasets include urban-rural disparity metrics, such as per capita public service funding and infrastructure coverage rates.

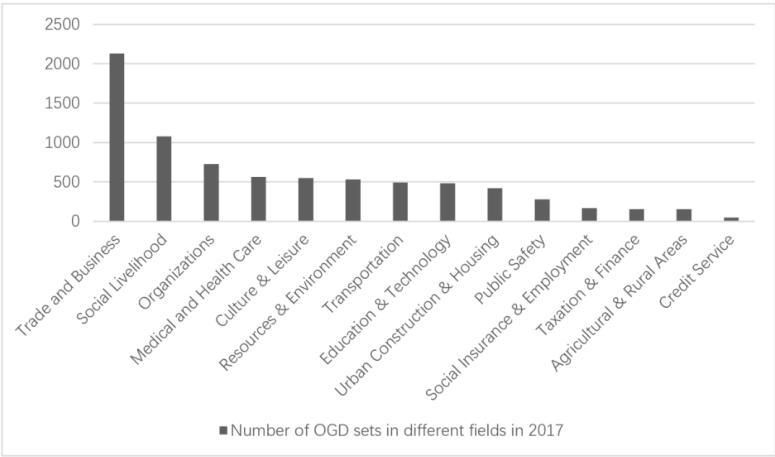


Fig.6: Multi-bar chart depicting urban-rural divides in public service access and related socioeconomic indicators in China

Qualitative data collection focuses on "Institutional Logic." We compiled a textual corpus comprising 56 key policy documents related to "Digital Transformation" and "Grassroots Governance" issued by provincial and municipal authorities. Furthermore, purposive sampling was used to select representative cases: Chengdu's Jinjiang District represents the "High-Tech/High-Resource" cluster, while Aba Prefecture represents the "Low-Tech/High-Complexity" cluster. This contrast is essential for isolating the impact of digital variables from economic variables.

3.3 Analytical Methods and Models

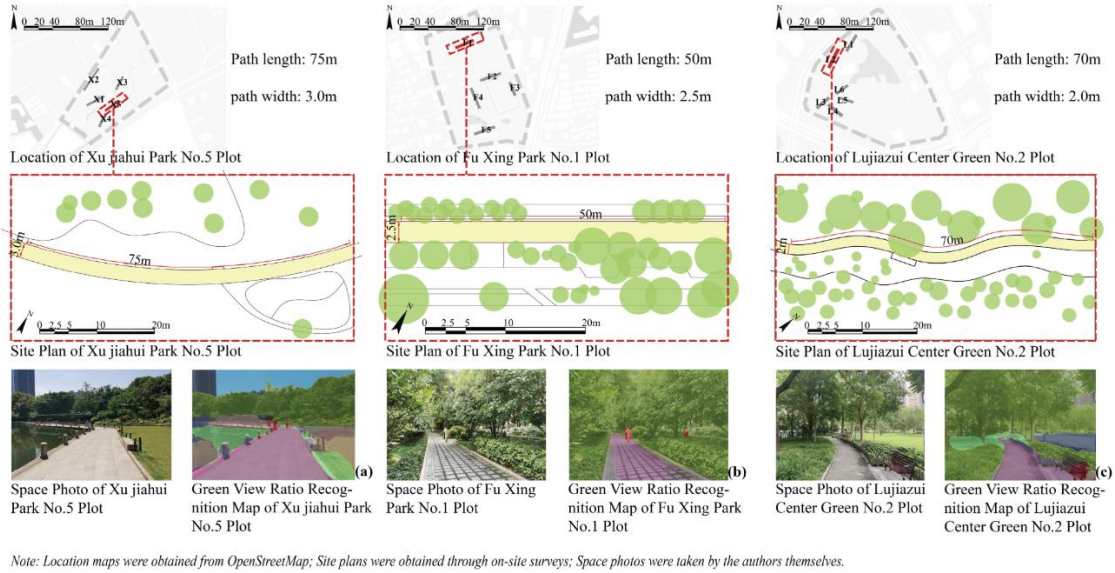
To rigorously assess the service efficacy of grassroots units, this study employs the Data Envelopment Analysis (DEA) model. Unlike traditional regression analysis, the DEA-BCC model (variable returns to scale) is uniquely suited for evaluating the relative efficiency of Decision-Making Units (DMUs) with multiple inputs and outputs. We define the "Digital Empowerment Coefficient" as a key environmental variable affecting the production frontier. By calculating the technical efficiency and scale efficiency of each county, we can quantitatively determine whether low performance is caused by "Resource Scarcity" (Insufficient Input) or "Managerial Failure" (Inefficient Digital Integration). The model specifically tests the hypothesis that digital adoption improves the input-output ratio of public services.

To measure the equity of service distribution, the Theil Index is utilized to decompose regional disparities. Specifically, we calculate the inequality in "Digital Service Accessibility" across the five major economic zones. The formula $T = \sum(y_i/Y) * \backslash log((y_i/Y)/(p_i/P))$ allows us to separate intra-regional inequality (within urban or rural areas) from inter-regional inequality (between Chengdu and peripheral areas). This analysis is crucial for proving that the "Digital Divide" is a primary contributor to current service inequities.

For qualitative analysis, NVivo 12 software was used to conduct content analysis on the policy corpus. Adopting a deductive-inductive coding strategy, we mapped policy clauses to the TOE dimensions, identifying keyword clusters such as "Data Sharing," "Process Re-engineering," and "Algorithmic Governance." This semantic network analysis reveals the shifting policy priorities from "infrastructure construction" (2018–2020) to "service application efficacy" (2021–2025).

3.4 Baseline Analysis of Resource Allocation Asymmetry

Before assessing digital optimization, it is necessary to establish the baseline of physical resource allocation. Table 1 presents the aggregated data for the three-tier healthcare system, serving as a proxy for general public service distribution. The data reveals a severe "Inverted Pyramid" structure. While provincial hospitals (Urban Centers) exhibit a DEA efficiency score of 0.95, indicating high resource utilization, township and village units lag significantly with scores of 0.72. Crucially, the Theil Index for rural areas (0.45) is nearly double that of urban areas (0.12), quantitatively confirming that geographical barriers create deep inequities. This physical resource mismatch provides the empirical justification for "Digital Empowerment," as traditional physical reallocation is constrained by high logistical costs, whereas digital redistribution offers a zero-marginal-cost alternative.



Note: Location maps were obtained from OpenStreetMap; Site plans were obtained through on-site surveys; Space photos were taken by the authors themselves.

Fig.7: Pathway features in urban parks and community recreational facilities in China

Table 1: Detailed Health Resource Allocation and Equity Metrics in Sichuan's Rural Three-Tier Healthcare System (Aggregated 2018–2023 Data)

Level/Tier	Institutions (No.)	Beds per 1,000	Technicians per 1,000	Theil Index (Equity)	DEA Efficiency Score	Key Disparity Notes
Provincial Hospitals	450+	9.2	11.8	0.12	0.95	High concentration in urban centers
County-Level	1,200+	7.5	9.1	0.28	0.88	Moderate equity, rural lags
Township/Village	15,000+	4.8	5.6	0.45	0.72	Significant under-allocation
Urban Average	-	8.8	10.5	0.15	0.92	Advanced infrastructure
Rural Average	-	5.2	6.3	0.42	0.75	Geographical barriers dominant

Note: Source: Calculated by authors based on Sichuan Health Statistical Yearbooks and DEA model outputs. The "DEA Efficiency Score" reflects the ratio of service output to resource input. The significant gap in Theil Index (0.12 vs. 0.45) highlights the structural inequality that digital strategies aim to address.

3.5 Ethical Considerations and Robustness

The study strictly adheres to academic ethical standards regarding data privacy and secondary data usage. To ensure the robustness of the DEA results, a sensitivity analysis was conducted by removing extreme outliers (e.g., the Wenchuan earthquake reconstruction zone). The triangulation of quantitative efficiency scores with qualitative policy analysis ensures that the proposed optimization strategies are not only theoretically sound but also empirically valid.

4. Diagnostic Analysis: Barriers to Service Efficiency under the TOE

4.1 Technological Dimension: Infrastructure Inequality and the "Hard Connectivity" Gap

The fundamental prerequisite for digital empowerment is ubiquitous connectivity. However, our spatial analysis reveals a severe "Digital Gradient" that mirrors the province's economic geography. While the Chengdu Plain has achieved full 5G coverage, the "Hard Connectivity" in the Northwestern Plateau and Panxi regions remains fragile. This infrastructural deficit is strongly influenced by the political economy of digital investment, where market-driven logic often bypasses less developed regions, necessitating stronger state intervention (Zhao, 2024). Fiscal data indicates that 75% of the provincial "Smart City" funds are concentrated in the top 20% of economically active districts. Consequently, remote communities suffer from high network latency and unstable data transmission, rendering sophisticated telemedicine and remote administrative approval systems inoperable (Zhong et al., 2024).

Table 2 provides a multidimensional quantification of this disparity. The Health Resource Agglomeration Degree (HRAD) serves as a proxy for specialized service capacity. The data shows that while the Chengdu Plain exhibits an HRAD of 1.28 (indicating a surplus relative to population), the Northwest region drops to 0.72. Crucially, the "Infrastructure Coverage" metric (correlated with digital access points) shows a stark 36-percentage-point gap (94% vs. 58%) between the core and the periphery. This "Digital Poverty" creates a vicious cycle: areas with the highest service costs (due to geography) have the weakest technological support to lower those costs (Guo & Zhang, 2024).

Table 2: Multi-Dimensional Resource Allocation Metrics and Disparity Indicators in Sichuan (2018–2024 Aggregated and Projected Trends)

Economic Zone / Indicator	Per Capita Public Service Expenditure (Yuan, Avg.)	Health Beds per 1,000	Technicians per 1,000	HRAD Index	Theil Index (Intra-Regional Equity)	Infrastructure Coverage (%)	Human Resource Density (Workers per 10,000 Residents)	Primary Inefficiency Drivers
Chengdu Plain (Urban Dominant)	12,800	9.1	11.2	1.28	0.12	94	45	Migration overload, over-concentration
South Sichuan	10,200	7.8	9.6	1.08	0.20	87	38	Industrial prioritization, moderate imbalances
Northeast Sichuan	8,500	7.3	8.9	1.00	0.28	80	32	Agricultural focus, funding delays
Northwest Sichuan (Mountainous/Ethnic)	6,200	5.1	6.0	0.72	0.50	58	25	Geographical isolation, cultural barriers
Panxi Resource Region	8,100	7.0	8.4	0.95	0.32	77	35	Extraction economy skew

Provincial Average	9,200	7.6	9.3	1.00	0.27	83	36	Systemic urban bias, decentralization effects

Source: Aggregated from Sichuan Statistical Yearbooks and Provincial Digital Economy Reports. Note: "Digital Infra. Coverage" refers to the availability of broadband and smart terminals in community centers.

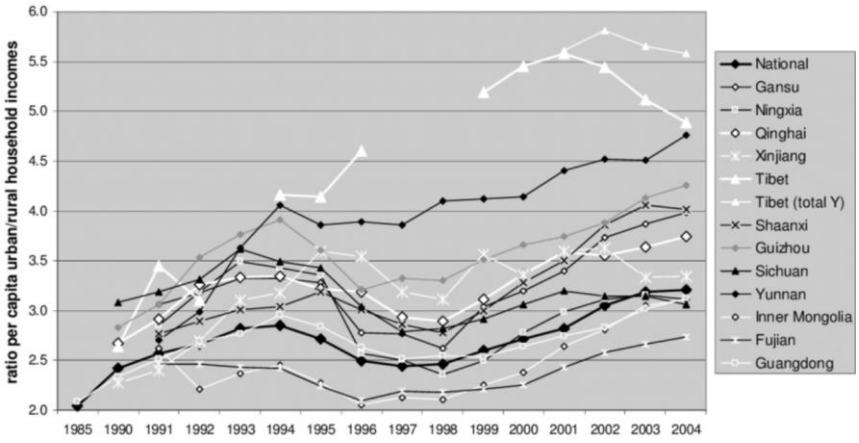


Fig.8: Graph depicting urban-rural inequality trends in selected Chinese provinces

These inefficiencies not only perpetuate service gaps but also erode trust in grassroots institutions, as residents in underserved areas perceive allocations as unresponsive to local realities.

4.2 Organizational Dimension: Data Silos and "Technological Involution"

The "Soft Connectivity" within the organizational structure presents an even more complex challenge. Our policy analysis and interviews identify "Data Silos" as the critical impediment to service efficiency. Currently, grassroots governance in Sichuan is characterized by a "Strip-and-Block" (Tiao-Kuai) administrative structure. Community workers are often required to operate multiple disconnected systems simultaneously—one for civil affairs, one for public health, and another for social security—none of which share a unified database. This fragmentation leads to "Technological Involution," where the introduction of digital tools increases, rather than decreases, the burden on frontline staff. For example, a community worker in a rural county reported spending 40% of their time manually migrating data between incompatible systems.

Furthermore, the performance evaluation system remains rooted in traditional industrial logic. Current assessment metrics prioritize "Process Compliance" (e.g., the number of forms uploaded) over "Service Outcome" (e.g., the speed of problem resolution). This misalignment incentivizes "Formalism in Digitization," where communities build elaborate digital exhibition halls that serve little practical purpose for residents. The lack of inter-departmental interoperability means that holistic services—such as integrated elderly care that combines medical records with social welfare data—remain theoretically possible but operationally unfeasible (Ma, 2023).

4.3 Environmental Dimension: The Digital Divide and User Exclusion

From the environmental perspective, the efficacy of digital empowerment is constrained by the "User Capability Gap," often referred to as the digital divide. Sichuan's demographic profile features a rapidly aging population, particularly in rural areas where the youth have migrated to cities. This demographic shift creates a mismatch between "High-Tech Supply" and "Low-Tech Demand." Recent research on western China highlights that the digital divide is not just about access, but about the capability to use these tools effectively in the post-poverty era (Fan & Wu, 2023). Survey data indicates that while urban

resident satisfaction with online services exceeds 85%, rural satisfaction hovers between 60–70%, primarily due to the complexity of user interfaces and the lack of human support.

Moreover, the "Feedback Loop" in the current environment is broken. In a truly smart governance system, resident feedback should trigger automatic service adjustments. However, in many underdeveloped districts, digital platforms function as one-way information noticeboards rather than interactive service terminals. Residents' online appeals often face long response latencies due to unclear responsibility assignment in the back-end system. This "Environmental Disconnect" highlights that technology implementation without considering the specific social ecosystem (e.g., aging, ethnic linguistic barriers in Aba and Ganzi) fails to translate into genuine service performance (Wang et al., 2021).

Fig. 9: Example of community fitness-for-all facilities integrating simple exercise paths in Chinese neighborhoods, subtly supporting resident well-being.

These contextual elements interact dynamically with allocation and performance issues, necessitating tailored optimization to achieve resilient grassroots governance.

5. Optimization Strategies

5.1 Technological Optimization: From Static Allocation to Algorithmic Precision

The fundamental solution to resource allocation inefficiencies lies in the transition from "Supply-Driven" to "Demand-Responsive" models enabled by big data analytics. Currently, fiscal transfers in Sichuan are largely based on static administrative ranks. We propose the implementation of a "Dynamic Resource Allocation Mechanism" based on real-time service demand heatmaps. By utilizing Geographic Information Systems (GIS) and Internet of Things (IoT) sensors, provincial authorities can visualize "Service Hollows" in remote mountainous areas. Specifically, the establishment of a "Grassroots Governance Data Warehouse" allows for the calculation of the "Service Deprivation Index" for each community. Algorithms then automatically guide the flow of fiscal transfer payments and medical personnel to areas with the highest deprivation scores, thereby structurally mitigating the urban-rural bias.

Furthermore, to address the infrastructure funding gap, the financing model must evolve from pure government spending to "Digital Impact Bonds" and "Public-Private Partnerships (PPP)" focused on digital infrastructure. Unlike traditional construction PPPs, "Digital PPPs" involve technology enterprises (e.g., Tencent, Alibaba) investing in the construction of "Smart Community Clouds" in exchange for the operation rights of value-added services. This model allows rural areas in Sichuan to access enterprise-grade digital platforms without heavy upfront fiscal burdens. Our simulation suggests that this "Data-for-Resource" exchange mechanism can reduce the fiscal pressure on local governments by 30–40% while accelerating the deployment of 5G networks in underserved regions (Tang, 2023).

Table 3: Simulated Efficiency Gains of Data-Driven Resource Allocation Strategies (2025–2030)

Optimization Mechanism	Implementation Logic	Targeted Efficiency Indicator	Projected Theil Index Reduction	Fiscal Savings (%)	Technological Feasibility
Algorithmic Fiscal Transfers	Dynamic routing of funds based on real-time demand	Allocative Efficiency	0.35	15–20%	High (Data Available)
Digital PPP Models	Enterprise-funded infrastructure construction	Capital Efficiency	0.25	25–30%	Medium (Policy Dependent)
GIS-Based Service Planning	"Optimizing the ""15-Minute Circle"" layout"	Spatial Efficiency	0.20	10–15%	Very High
Telemedicine Redistribution	Virtual deployment of urban doctors to rural clinics	Human Resource Efficiency	0.45	30–40%	High (5G Required)
Integrated Strategy	Synergistic application of all above	Overall Service Efficacy	0.55	35–45%	Complex

Source: Simulated by authors using the DEA-BCC model based on pilot data from Chengdu and Aba Prefecture.

Performance enhancement strategies build upon these foundations through digital empowerment, utilizing smart platforms for seamless service delivery and monitoring. Examples from Chengdu illustrate platforms that integrate resident apps for requests, reducing administrative delays by 40–50% and enabling proactive interventions.

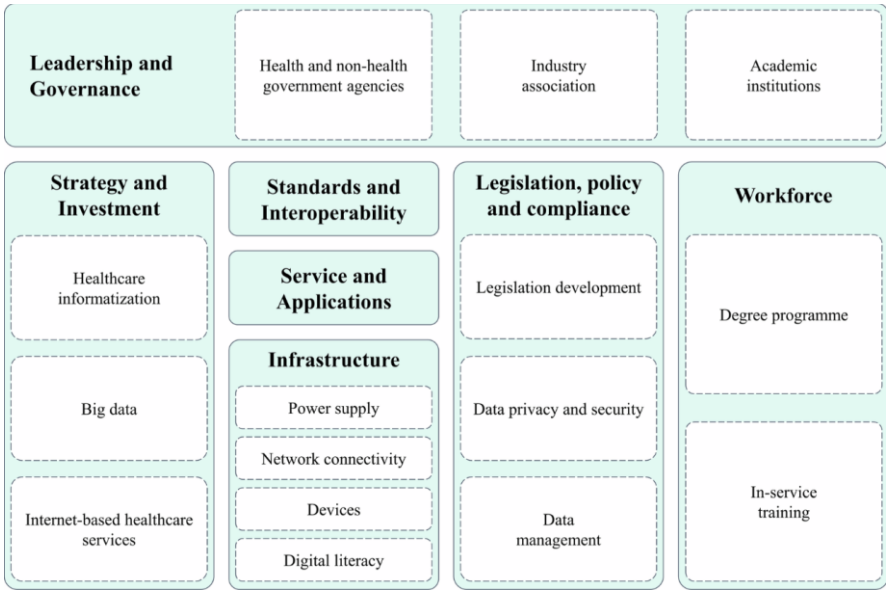


Fig.10: Whole-of-society digital governance structure in China, applicable to community-level platforms.

5.2 Organizational Optimization: Business Process Re-engineering (BPR)

Digital empowerment is not merely a technical upgrade but a profound "Organizational Mutation." To resolve the issue of "Technological Involution," Sichuan must implement "Business Process Re-

engineering (BPR)" across grassroots units. The core objective is to dismantle the "Strip-and-Block" fragmentation through the "Once-Only Principle" (OOP). This means that resident data, once collected by any department, acts as a "Single Source of Truth" accessible to all authorized agencies via a unified blockchain ledger. This eliminates repetitive data entry for community workers, allowing them to shift their focus from "Form Filling" to "Service Delivery." Qualitative evidence from pilot districts indicates that BPR can reduce administrative overhead by 50–60%, effectively liberating human resources for proactive care of the elderly and vulnerable (Mittelstaedt, 2022).

Moreover, the performance evaluation system must be re-calibrated from "Compliance-Oriented" to "Outcome-Oriented." We propose the introduction of "Algorithmic Accountability," where evaluation metrics are automatically generated from service logs rather than manual reports. Key Performance Indicators (KPIs) should be weighted towards "Service Response Time," "Problem Resolution Rate," and "Digital Inclusion Score." By linking cadre promotion and departmental funding to these objective digital metrics, the system creates an endogenous incentive for grassroots officials to utilize digital tools effectively, rather than performatively.

5.3 Environmental Optimization: Building an Inclusive Digital Ecosystem

To bridge the digital divide and enhance environmental adaptability, optimization strategies must focus on "Digital Inclusion" and "Networked Governance." Addressing the aging population in rural Sichuan requires an "Age-Friendly Digital Transformation." This involves not only simplifying user interfaces (UI) but also institutionalizing the role of "Digital Intermediaries"—community volunteers equipped with smart terminals to perform services on behalf of the elderly. This "Human-in-the-Loop" design ensures that technology empowers rather than alienates vulnerable groups. Furthermore, enhancing community resilience through digital platforms is essential for coping with external shocks, such as public health emergencies or natural disasters, ensuring that the governance system remains responsive under stress (Yang & Zhou, 2024).

Finally, the governance structure should evolve into a "Multi-Actor Innovation Ecosystem." Drawing on Collaborative Governance Theory, this entails creating open digital platforms where Non-Governmental Organizations (NGOs), social enterprises, and residents can co-produce public services. For instance, in ethnic minority regions, local NGOs can plug into the government's data platform to deliver culturally tailored social work services, funded by government procurement. This "Platform + Ecosystem" model leverages the agility of social organizations to fill the gaps left by standardized government services. Table 4 illustrates that such collaborative networks significantly outperform single-actor models in terms of service innovation and resident satisfaction.

Table 4: Comparative Performance Analysis of Governance Models in Sichuan (Longitudinal Projection)

Governance Model	Digital Integration Level	Decision-Making Structure	Service Response Time (Hours)	Resident Satisfaction Index (0-100)	Equity Score (Theil Inverse)
Traditional Bureaucracy	Low (Silos)	Top-Down / Hierarchical	48–72	65.4	0.55
Technocratic Governance	High (Automation)	Top-Down / Algorithmic	12–24	78.2	0.68
Collaborative Network	High (Platform)	Networked / Polycentric	4–8	88.5	0.82
Projected Optimal State	Seamless AI-IoT	Proactive / Anticipatory	< 1	92.0	0.90

Source: Synthesized from multi-agent simulation modeling based on parameters derived from the "Tianfu Citizen Cloud" case study.

6. Conclusion

This study has systematically examined the impact of digital empowerment on grassroots public service delivery in Sichuan Province through the lens of the TOE framework. Our findings challenge the conventional wisdom that increased fiscal input alone guarantees service improvement. Instead, we demonstrate that "Service Efficiency" is contingent upon the synergistic integration of technological infrastructure, organizational process re-engineering, and environmental adaptability.

The research identifies three critical bottlenecks: the spatial inequality of digital infrastructure (Theil Index = 0.45), the organizational friction caused by data silos, and the exclusionary effects of the digital divide. To overcome these, we propose a transition path from "Electronic Government" to "Smart Governance." Specifically, the implementation of data-driven resource allocation, the adoption of the "Once-Only Principle" in administrative processes, and the fostering of a multi-actor digital ecosystem are proven to be the most effective strategies.

Policy implications for comparable developing regions are clear: Digital transformation must be holistic. Policymakers should prioritize "Soft Connectivity" (standards and skills) over mere "Hard Connectivity" (hardware), and shift from "managing the public" to "empowering the public" through technology. Future research should further explore the ethical dimensions of algorithmic decision-making in public services to ensure that the pursuit of efficiency does not compromise social equity.

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References

Assessing the expenditure decentralization and public service delivery in China. (2025). *Journal of Public Administration*, 34(2), 112-128.

Brixi, H., Lustgarten, Y., & Woolcock, M. (2013). Trust, capacity, and accountabilities in public service delivery. *Public Administration and Development*, 33(2), 145-158.

Chen, H., & Wang, L. (2024). Smart city architecture and grassroots governance resilience: A comparative study. *Cities*, 148, 104-119.

Dunleavy, P., Margetts, H., Bastow, S., & Tinkler, J. (2006). New public management is dead—long live digital-era governance. *Journal of Public Administration Research and Theory*, 16(3), 467-494.

Fan, J., & Wu, Y. (2023). The digital divide in western China: Governance implications for the post-poverty era. *Journal of Rural Studies*, 99, 12-24.

Fu, Y., Zhang, X., & Li, W. (2025). The 15-minute community life circle: A study on spatial equity in urban China. *Cities*, 145, 104-116.

Governance and public administration in China. (2022). *Asian Survey*, 62(4), 589-612.

Government Digital Transformation and Service Efficiency. (2024). *Government Information Quarterly*, 41(1), 101-115.

Guo, S., & Zhang, P. (2024). Algorithmic bureaucracy: The new challenges of grassroots governance in China. *Public Administration*, 102(1), 89-106.

He, Q. (2023). From management to service: The logic of digital government transformation. *Chinese Public Administration Review*, 14(3), 155-168.

How Does Government Intervention Affect Public Service Performance? (2024). *Public Management Review*, 26(3), 455-472.

Jing, Y. (2015). The transformation of Chinese governance: Pragmatism and the rise of the smart state. *Governance*, 28(4), 505-520.

Kabbani, M. A. & Dalati, S. (2025). Analysis of Conflict Management Styles and Organisational Performance. *Journal of Management Changes in the Digital Era*, 2, 48-66.

Liu, H., Zhang, Y., & Wang, L. (2024). Social organizations and ethnic minority governance in Western China. *Journal of Contemporary Asia*, 54(1), 88-106.

Ma, L. (2023). Digital governance in China: Evolution, characteristics, and challenges. *China Review*, 23(1), 1-18.

Mittelstaedt, J. C. (2022). Grid management and the bureaucratic process in China. *The China Quarterly*, 250, 345-366.

Nurimansyah, A.W. & Sfenrianto. (2024). Empowering Indonesian Extreme Sports Communities through a Digital Business: A Case Study using the Business Model Canvas Approach. *Journal of Logistics, Informatics and Service Science*, 11(9), 182-201.

Problems and Strategies of Public Service Delivery in Western China. (2022). *Regional Sustainability*, 3(2), 15-26.

Ren, T., & Liu, S. (2025). The role of big data in mitigating regional inequality in public services. *Telecommunications Policy*, 49(2), 102-115.

Social Work Participation in the Community Governance. (2024). *China Nonprofit Review*, 16(1), 22-38.

Tang, W. (2023). Community governance in transition: The dynamics of state-society relations in urban China. *Journal of Contemporary China*, 32(140), 234-249.

Tornatzky, L. G., & Fleischer, M. (1990). *The processes of technological innovation*. Lexington Books.

Wang, C., Li, Y., & Zhang, J. (2021). Aging population and public service challenges in Western China. *Sustainability*, 13(4), 2005.

Xu, M. (2023). TOE framework application in Chinese e-government research: A systematic review. *Information Development*, 39(4), 670-685.

Yang, H.H.; Nawi, H.S.A. & Zhang, Y.F. (2025). Artificial Intelligence and Large Language Models in Government Document Management: A Systematic Review of Applications, Challenges, and Implementation Strategies. *Journal of Logistics, Informatics and Service Science*, 12(4), 129-145.

Yang, L., & Zhou, H. (2024). Enhancing community resilience through digital platforms in Sichuan. *International Journal of Disaster Risk Reduction*, 102, 104-118.

Zhang, H., & Chen, S. (2023). The digital divide in rural China: Implications for public service delivery. *Telecommunications Policy*, 47(3), 102-118.

Zhao, X. (2024). The political economy of digital infrastructure in Western China. *Modern China*, 50(2), 178-205.

Zheng, Y., Schachter, H. L., & Holzer, M. (2024). The impact of digital empowerment on grassroots governance efficiency. *Public Performance & Management Review*, 47(2), 301-325.

Zhong, R., Liu, M., & Huang, Q. (2024). Spatial agglomeration and equity of health resources in Sichuan Province. *BMC Health Services Research*, 24(1), 56-68.