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Digital Divide among Marginalized Rural Communities in Developing Countries: Strategies and Practices to Reduce the 'Proxy Use of ICTs' for Rural E-governance

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Abstract:

Marginalized rural communities in developing countries experience a significant digital divide, preventing their 'direct interaction' with ICTs and depend on 'proxy use' via telecenters/kiosks to access rural e-governance services. We examine rural e-governance strategies and practices that might address the complexities of rural contexts in developing countries. Specifically, we study the factors that promote the "direct use of ICTs" among marginalized rural populations, aiming to reduce their future reliance on "proxy use". We employ a mixed-methods approach, combining in-depth interviews with the DEMATEL, a decision-making technique for identifying cause-and-effect chain components of complex systems. We utilize IS theories and literature to identify strategy and practice factors, and supplement these by conducting interviews with experts. These factors were analyzed using DEMATEL to develop an empirical framework depicting the causal linkages between them. Our findings reveal two novel strategies—software artifacts with easy setup and digital inclusion for insurance—and two novel practices: ICT artifact interface and awareness, which require a targeted approach for marginalized rural users to reduce their 'proxy-use'. This study makes a significant contribution to digital divide and rural e-governance research, offering valuable insights for stakeholders to support digital inclusion and promote the social upliftment of marginalized rural populations.

Keywords: Digital divide, ICT, Marginalized, Rural, E-governance, DEMATEL

[Department statements, if appropriate, will be added by the editors. Teaching cases and panel reports will have a statement, which is also added by the editors.]

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1 Introduction

ICTs such as smartphones, mobile apps, biometric authentication, digital payments, e-commerce, and sharing economy services can substantially improve the quality of life for rural inhabitants in the Global South (Corbett et al., 2023). ICTs serve as a crucial developmental tool to bridge the socioeconomic gap between “haves” and “have-nots” (Ncube et al., 2023). Also, ICTs can provide marginalized and underserved populations with access to education, public services, and financial services (Pradhan et al., 2021). The discussions on ICT4D have shifted away from the distinction between haves and have-nots and are now grounded in variations in usage patterns (Horn & Gifford, 2022). For digital technologies to exert influence in rural contexts, it is crucial to focus on the ‘direct use of ICTs’ among marginalized rural populations (Salemink et al., 2017), which might have considerable implications for the information systems development (Laato et al., 2024; O'Connor et al., 2024).

Despite the technological advancements, a substantial portion of the rural population may not directly embrace e-governance services (Sharma et al., 2021), mainly as a consequence of a lack of awareness, digital illiteracy, and limited resources, substantially widening the digital gap between the urban and rural populace (Hoque, 2020; Lokuge et al., 2025). Regardless of the rapid diffusion of ICTs in rural areas, challenges in rural e-governance are persistent because of the inadequate rural development exhibited by a lack of digital infrastructure, low-level education and skills, gender inequality, lower income levels, poor health services, and lack of social welfare (Venkatesh et al., 2014). In light of this, continued research into ICTs in rural regions is crucial (ITU, 2017). To our knowledge, no study has addressed marginalized rural users’ ‘direct use of ICTs’. In this research, we aim to fill this crucial gap in our understanding.

Due to low literacy levels in developing countries, particularly among marginalized rural citizens, the use of ICTs is often facilitated by someone with specific knowledge of ICTs, i.e., proxy ICT use (Venkatesh et al., 2020). Poorly literate citizens with minimal exposure to ICTs are particularly vulnerable to exclusion from digital advancements, thereby compounding their marginalization and exclusion (Salemink et al., 2017). Studies on ICT use in developing countries have revealed that women tend to utilize ICTs less frequently than men. Additionally, older individuals tend to resist changes and are likely to avoid using ICTs (Venkatesh et al., 2014). Generally, a significant portion of the population in developing countries faces limited access to or inadequate knowledge and proficiency in using ICTs, exacerbating the existing digital divide (ITU, 2011). In this regard, the common service centres (CSCs) in India are recognised as the most viable and efficient channels for driving the usage of ICTs among underserved populations (Dwivedi et al., 2016). Additionally, government and non-governmental organizations utilize CSCs to promote the use of ICTs among rural populations, aiming to alleviate poverty and address social inequalities (Pick et al., 2014).

Many IS studies have discussed and investigated the role of ICTs, digitalization, and e-governance targeted at rural areas (Ferrari et al., 2022; Sharma et al., 2021; Ye et al., 2021). These studies have examined the drivers, barriers, and impacts of ICT adoption, as well as the challenges of underutilization, information practices, and outcomes related to ICT access and use in rural areas (Das & Chatterjee, 2023; Hoque, 2020; Shou et al., 2024). Furthermore, in e-governance, strategic formulations involve setting goals and defining measures to achieve those goals (Wouters et al., 2023). Implementations of practices are required to close design-reality gaps and lead e-governance projects from failure to success (Laato et al., 2024; O'Connor et al., 2024). Therefore, understanding the strategies and practices needed to boost the direct use of ICTs among marginalized rural communities, such as those in developing countries, is crucial. It can provide the impetus to address these factors in e-governance systems, potentially bridging the digital divide faced by marginalized rural citizens.

Therefore, this paper aims to explore the strategy and practice factors for rural e-governance needed to ensure the ‘direct use of ICTs’ among the marginalized rural population and to analyze the mutual interlinkages between these factors to develop a better understanding.

For this research, India is a suitable setting due to the following reasons. First, India has the world's largest rural population, i.e., 909 million (World Bank, 2023). It has a total population of 1.43 billion people, of whom 65% live in rural areas (GOI, 2023). Second, to address and meet the demands of such a sizable cohort without any intermediary interference, India has established a high-quality digital public infrastructure (DPI). The International Monetary Fund also acknowledged India's stack (IMF, 2023), a collective name of DPIs, i.e., Aadhar (unique digital identity), unified payments interface or UPI (digital payments), Aadhar-enabled payment system (basic banking service for rural areas), and DigiLocker (document sharing and verification), to bolster its pursuit of sustainable development objectives. Innovation can be crucial in advancing

Sustainable Development Goals (SDGs). Innovative service delivery approaches are imperative to comprehensively serve the specific needs of marginalized communities. Finally, the total no. of active internet users in India is 622 million, of which 299 million belong to rural India, which is 31% of the total rural population, which is relatively low as compared to their urban counterparts, i.e., 67% (ICUBE, 2021), indicating a substantial digital divide that persists in India.

This research employs a mixed-methods approach, combining in-depth interviews with multi-criteria decision-making (MCDM) methods. In-depth interviews offer a flexible and nuanced approach to gathering data and gaining deep insights into the research study. Additionally, MCDM methods are well-suited for studying complex decision-making research problems that require input from domain experts and other relevant stakeholders.

This research makes several theoretical contributions to the IS and e-governance literature. First, it is likely the first attempt to study the strategies and practices needed for rural e-governance to ensure the direct use of ICTs among marginalized rural users, addressing the digital divide and SDGs. Second, it adds to the e-governance literature by addressing the second-order digital divide, i.e., the use of ICTs among marginalized rural users. Third, a comprehensive range of strategy and practice factors for rural e-governance was identified based on multiple theories, including usability theory, affordance theory, stakeholder theory, and the unified model of e-government adoption. Fourth, the mixed-method approach of this research is likely the first to combine the literature review and in-depth interview methods with a decision-making technique, DEMATEL. Fifth, it is likely the first attempt to examine the cause-and-effect relationships among the factors using a new threshold-based digraph analysis under DEMATEL, defined as "TH-DEMATEL". Sixth, this research presents significant new findings on rural e-governance, uncovering the cause-and-effect factors, their interlinkages, and their importance.

The remainder of the paper is structured as follows. Section 2 provides a brief literature review on digital divide, e-governance, and rural e-governance. Section 3 presents a theory-driven literature review to identify effective strategies and practices. Section 4 discusses methodology, which encompasses three aspects: the literature on methodology, qualitative method, and quantitative method. Section 5 illustrates the result and analysis. The discussion on findings from in-depth interviews and MCDM results is presented in Section 6. Section 7 provides theoretical and practical implications. Section 8 summarizes the study's conclusions. Finally, we report the limitations and propose future research directions in Section 9.

2 Literature Review

2.1 Digital Divide and ICT4D

The term "digital divide" refers to the inequality among individuals, households, businesses, and geographic regions at different socio-economic levels regarding access to and use of ICTs for various purposes (OECD, 2001). In ICT4D literature, the digital divide research stream primarily focuses on studying the disadvantaged populations (Venkatesh & Sykes, 2013; Oreglia & Srinivasan, 2016; Pick et al., 2014) and describes them as underprivileged, underserved, marginalized, disadvantaged, poor, or vulnerable groups (Addo & Senyo, 2021; Srivastava & Shainesh, 2015; Ye et al., 2021). The term "marginalized communities" is primarily used in this paper to refer to this segment of society.

Nuances of digital divide have been studied in numerous contexts, such as digital inequality (Hsieh et al., 2008; Van Deursen et al., 2017; Song et al., 2020), the success of digital divide initiatives (Venkatesh & Sykes, 2013), determinants of the digital divide (Song et al., 2020; Srivastava & Shainesh, 2015; Cruz-Jesus et al., 2017), dimensions of the digital divide (Okunola et al., 2017), the role of intermediaries in digital divide (Sein & Furuholt, 2012; Pick et al., 2014; Oreglia & Srinivasan, 2016).

Two types of digital divide have been emphasized (Cruz-Jesus et al., 2017): the global digital divide, which compares disparities between countries, and the domestic digital divide, which refers to inequalities within a single country. While gaps in ICT infrastructure significantly contribute to the global digital divide (Zhao et al., 2014), the disparity between urban and rural areas creates the domestic digital divide due to the significant costs associated with deploying and maintaining ICT infrastructure in rural regions. Further, in developing countries, digital divide-related disparities often arise due to differences in access to (first order), use of ICT (second order), and outcomes (third order) among regions, i.e., urban and rural areas or groups of people, i.e., urban and rural users (Song et al., 2020).

Next, we discuss digital divide-related disparities among 1) urban, 2) rural, 3) marginalized rural, and 4) marginalized urban communities, as depicted in Figure 1.

2.1.1 Urban vs. Rural Users

Digital divide issues between users from urban and rural areas have been examined by previous studies (Hoque & Sorwar, 2014; Venkatesh et al., 2014; Song et al., 2020). Research on the first-level digital divide reveals that Internet access is unevenly distributed among individuals, specifically between urban and rural users, based on demographic factors and geographical locations, such as urban or rural areas (Scheerder et al., 2017). Socio-demographic and socio-economic factors, such as age, education, and income, contribute to these disparities. Significant gaps in computer literacy, PC penetration, and teledensity highlight the divide between urban and rural areas (Sharma & Mishra, 2017). Additionally, this divide is evident in the number of mobile devices, internet service providers (ISPs), and individuals accessing the Internet (Dewan & Riggins, 2005; Song et al., 2020).

Since 2003, the scope of digital divide research has shifted from first-order digital divide based on ICT access to second-order digital divide based on ICT use (Song et al., 2020; Büchi et al., 2016; Van Deursen & Helsper, 2018). The significant drivers of the digital divide based on the use of ICTs are urban income, rural income, working-age population, and secondary education (Song et al., 2020). Subsequently, the digital divide expanded to encompass aspects such as the accessibility of relevant content, the quality of Internet connections, and users' digital knowledge and skills (e.g., Dewan and Riggins, 2005; Van Dijk & Hacker, 2003).

Demographic factors such as age and gender significantly impact the use of ICTs (Song et al., 2020; Cruz-Jesus et al., 2017). In developing countries, the use of ICT is more prevalent among younger citizens than among older adults, and men tend to use technology more frequently than women (Venkatesh et al., 2014; Cruz-Jesus et al., 2017). Furthermore, income and education have a substantial impact on the use of ICT in developing countries (Song et al., 2020; Srivastava & Teo, 2010), where individuals with higher incomes and education levels are more likely to utilize ICT. Therefore, a clear relationship exists between socioeconomic factors and the use of ICT.

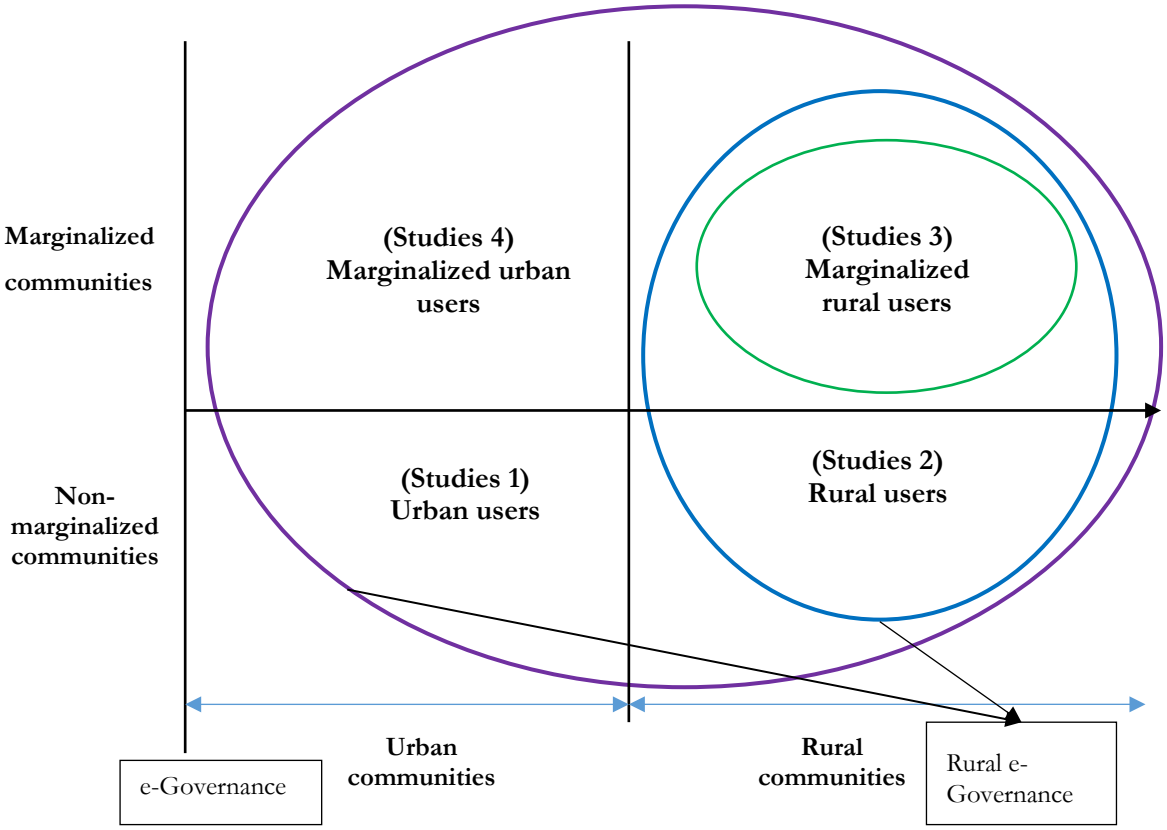
The true impact of digital connectivity requires an understanding of actual ICT usage (Salemink et al., 2017; Venkatesh et al., 2020). Merely providing access to technology alone does not suffice to address the cause; the meaningful use of ICTs is vital for harnessing its potential. Our research focuses on the direct use of ICTs among marginalized rural users (Studies 3, see Figure 1) in the context of e-governance in the Global South, particularly in India.

2.1.2 Urban vs. Marginalized Urban Users

Prior studies reveal considerable digital divide factors among urban users (Van Deursen et al., 2017). Non-marginalized urban users exhibit a greater tendency to embrace the use of ICTs, such as the internet, with higher confidence levels than marginalized urban users (Hsieh et al., 2008).

2.1.3 Rural vs. Marginalized Rural users

In developing countries, not all users in rural areas have equal access to ICTs. This divide is reflected in the considerable investments made by developing countries, such as China, India, Nigeria, and Brazil, to address ICT access in rural regions (Shou et al., 2024). In order to address the first-order digital divide of ICT access and the second-order digital divide of ICT use, government agencies and other stakeholders have created CSCs or kiosks, which have computing devices, internet facilities, and operating staff to facilitate access to e-governance services (Sharma et al., 2021; Dwivedi et al., 2016). Marginalized rural users mostly approach CSCs for e-governance services and information (Pick et al., 2014; Venkatesh & Sykes, 2013; Sharma & Mishra, 2017). CSCs provide single-point access for the delivery of e-governance services, narrowing the digital divide among marginalized communities (Oreglia & Srinivasan, 2016; Pick et al., 2014). In developing countries, where literacy rates are often lower in rural areas, direct use of ICTs is limited. Indirect or proxy use of marginalized rural users is most commonly facilitated by CSCs (Venkatesh et al., 2020). Therefore, merely providing access to ICTs does not seem to ensure the use of ICTs at desired levels among rural citizens due to structural barriers such as poor rural infrastructure, limited socio-economic activity, unemployment, and other challenges (Horn & Gifford, 2022).



Note: The four groups (**Studies 1, Studies 2, Studies 3, and Studies 4)** focus on digital divide issues of urban, rural, marginalized rural, and marginalized urban communities, respectively. A few representative articles from the digital divide literature are listed here:

Studies 1: Hsieh et al., 2008; Nishida et al., 2014; Pick et al., 2015; Song et al., 2020; Van Deursen et al., 2017; Van Deursen & Van Dijk, 2015; Pontones-Rosa et al., 2021

Studies 2: Song et al., 2020; Sein & Furuholt, 2012; Dwivedi et al., 2016; Nishida et al., 2014; Jha et al., 2016

Studies 3: Pick et al., 2014; Venkatesh et al., 2014; Venkatesh & Sykes, 2013; Sharma & Mishra, 2017; Dwivedi et al., 2016; Sharma et al., 2021; Oreglia & Srinivasan, 2016; Shou et al., 2024; Jha et al., 2016

Studies 4: Hsieh et al., 2008; Blumenstock, 2012; Van Deursen & Van Dijk, 2015; Pontones-Rosa et al., 2021

Figure 1: Categorization of urban and rural communities using ICTs

Rapid digitization may create new challenges for rural citizens who have limited digital skills or lack access to devices or connectivity (Horn & Gifford, 2022). The perpetual reliance of marginalized rural users on intermediaries to access and use e-governance services might keep their engagement with ICTs at minimal and significantly constrained levels. In the era of AI and GenAI, this may worsen the isolation of marginalized rural users from the rapidly evolving digital ecosystem, reinforcing digital exclusion and underrepresentation in the digital age. In light of this, to ensure overall rural development and upliftment in alignment with the UN SDGs, it is crucial for marginalized rural users to directly engage with ICTs, thereby improving their meaningful use of ICTs.

2.2 Digital Divide in Rural E-Governance

Much of the past research has implicitly focused on urban users when discussing the use of ICTs in e-governance initiatives, giving limited attention to the unique needs and opportunities of rural regions (Shou et al., 2024). Studies on the digital divide within the context of e-governance are scarce, especially in the case of rural e-governance (Okunola et al., 2017). The rural e-governance literature has primarily focused on "promoting CSCs" in developing countries (Sharma & Mishra, 2017; Sharma et al., 2021). For example, challenges confronted by CSCs in delivering e-governance services in rural regions have been studied (Sharma et al., 2021). Similarly, the risks faced by the government and citizens when using e-governance services through CSCs have been studied (Patnaik & Dixit, 2023). The role of intermediaries in influencing the adoption of CSCs to deliver e-governance services, particularly in rural areas, was investigated by Sharma and Mishra (2017). The factors influencing the adoption and use of CSCs in rural India were studied by Pick et al. (2014). However, CSCs in rural India facilitate 'proxy use of ICTs' for marginalized rural users due to their lack of or limited ability to 'direct use' of ICTs.

For clarity, we define the conceptual distinction between 'direct use of ICTs' and 'proxy use of ICTs'. The 'proxy use of ICTs' refers to the indirect use of ICTs by marginalized rural users, often through intermediaries, which frequently compensates for the barriers to their ICT use or access but can limit autonomy and the depth of engagement (Venkatesh et al., 2020). These intermediaries can be telecentre operators, family members, or community members. In contrast, the 'direct use of ICTs' refers to instances where marginalized rural users independently interact with ICT artefacts. This distinction is important because proxy use sustains asymmetrical dependencies, limits user agency, and raises concerns of misrepresentation, exclusion, and reduced trust in digital systems. In this research, we aim to study factors that can help reduce 'proxy use of ICTs' and enhance 'direct use of ICTs' by marginalized rural users for e-governance services. These factors entail addressing both the first-order digital divide (access) and the second-order digital divide (ICT use) faced by marginalized rural users.

Prior researchers have extensively studied digital inequalities concerning the first-order digital divide (ICT access) and the second-order divide (ICT use) (Van Dijk & Hacker, 2003; Dewan & Riggings, 2005; Scheerder et al., 2017; Cruz-Jesus et al., 2017; Song et al., 2020; Madon & Masiero, 2025). In addition, earlier scholars have highlighted the 'proxy use' of ICTs, where intermediaries act on behalf of rural users (Pick et al., 2014; Oreglia & Srinivasan, 2016; Venkatesh et al., 2020). In contrast, direct use of ICTs by marginalized rural users, where individuals themselves interact with ICT artefacts for e-governance services, remains underexplored. Earlier literature has not systematically theorized or investigated the direct use of ICTs as distinct from their proxy use. Previous studies primarily emphasise how CSCs facilitate e-governance services and information delivery in rural areas (Gollakota et al., 2012; Oreglia & Srinivasan, 2016). However, extant research has primarily overlooked addressing the direct use of ICTs among marginalized rural users for e-governance initiatives. To the best of our understanding, the existing literature lacks research on the strategies and practices needed to ensure the direct use of ICTs among marginalized rural communities. Therefore, to address this oversight, our study aims to understand the strategy and practices for the direct use of ICTs for rural e-governance. Furthermore, this study seeks to advance our understanding of the enablers of ICT4D in the context of developing countries, particularly India, with a targeted focus on marginalized rural communities.

3 Theory-driven Literature Review to Identify Factors

This research draws from multiple theories from the IS and HCI domains in the context of rural e-governance. In particular, the following four theories are employed to build a theoretical support for the strategies and practices needed to ensure the direct use of ICTs among marginalized rural users: 1) affordance theory (AT), 2) stakeholder theory (ST), 3) unified model of e-government adoption (UMEGA), and 4) usability theory (UT).

It is crucial not to rely on a single theory, framework, or model to avoid inadequacy in comprehensively addressing the research question. Given the multifaceted complexities of marginalized rural settings, employing multiple theories may help obtain broader perspectives necessary for effective rural e-governance. By integrating these four theoretical models, this study offers a multidimensional perspective that encompasses IT use experiences of marginalized rural citizens, their socio-economic considerations, and the responsibilities of key stakeholders towards them.

Each theory addresses distinct yet interrelated factors contributing to the direct use of ICTs among marginalized rural communities. AT helps consider the affordances available to rural citizens, given their socio-economic background (Glover, 2022), while ST highlights the role of stakeholders in rural e-governance activities, showing how accountability, transparency, reliability, and collaboration among government, NGOs, and private actors shape users' trust and confidence (Rowley, 2011). UMEGA, an extended model of TAM in the e-government context, provides theoretical support to understand factors related to technology acceptance, data security, and privacy in the e-government context (Dwivedi et al., 2017). Finally, UT has been used to analyze the interactions of marginalized rural users with digital platform interfaces. Combining these theoretical models offers a holistic approach to identifying critical factors responsible for the direct use of ICTs among marginalized rural communities.

3.1 Usability Theory (UT)

A substantial body of HCI and IS research has explored the usability of websites and mobile applications. Usability is a familiar and precisely defined concept that emphasizes the clarity of interaction between the user and the computer through an interface (Huang & Benyoucef, 2014). Navigation is considered a critical construct between the user and IT artefact, as it enhances interaction with the digital platform (Lee & Kazor, 2012). Therefore, the navigation design of IT artefacts should enable users to find what they need intuitively and efficiently (Venkatesh et al., 2014). Learnability is another key consideration, referring to the smoothness of the learning curve for users to understand IT artefacts and qualitatively improve their use of them (Lee & Kozar, 2012; Hoehle & Venkatesh, 2015). The HCI aspect of control refers to the degree to which users feel they can directly modify and shape their interaction with IT artifacts to achieve their goals effectively, for example, allowing users to quickly alter actions by clicking redo or undo buttons. Given marginalized rural users' constrained proficiency and familiarity with digital technologies, the importance of these practices will likely be higher for them.

IS concepts of ease of use and efficiency of IT artefacts can be important considerations, especially for rural settings. Ease of use addresses the cognitive load associated with IT artefact usage and consistently emerges as a pivotal factor influencing intentions to use technology (Venkatesh & Agarwal, 2006). Simple and intuitive designs of IT artifacts can create the necessary ease of use, leading to a substantial improvement in the usage of IT artifacts. In addition, focusing on efficiency can enable users to quickly and effortlessly achieve their goals using digital technology (Hoehle & Venkatesh, 2015).

3.2 Affordance theory (AT)

ICT infrastructure stimulates rural development by promoting economic opportunities, improving access to critical services, and bridging the digital divide. It empowers rural communities, fosters social inclusion, and paves the way for a more equitable and sustainable future (Glyptis et al., 2020; Heeks, 2010; Ochara & Mawela, 2015). To uplift their underserved population into the digital world, many governments in the global south launch initiatives for marginalized communities. One such strategy is to provide affordable computing devices to marginalized rural communities. For example, India's CSCs serve as shared facilities equipped with affordable computing devices and play a crucial role in delivering e-governance services to grassroots communities in their localities (Pick et al., 2014; Dwivedi et al., 2016).

Without a good-enough connection to modern telecommunication services, marginalized rural citizens might be unable to participate in digital transformation (Strover, 2001). Such a network must be affordable, particularly for economically disadvantaged communities (Sharma et al., 2021; Ncube et al., 2023). Therefore, a recommended strategy is to ensure an affordable network for marginalized rural communities.

Another critical consideration for rural communities is the availability of affordable internet data. Marginalized rural communities in developing countries cannot afford high data costs, exacerbating the digital divide (World Bank, n.d.; Ochara & Mawela, 2015). If internet data costs remain prohibitively high, rural citizens may find it financially challenging to access e-governance services (Martínez-Domínguez & Mora-Rivera, 2020). Therefore, the suggested strategy is to ensure that internet data rates are affordable for marginalized rural users.

ICT-enabled innovations to execute social welfare schemes targeted at marginalised communities can potentially boost their direct use of ICTs. India has set up a world-class DPI to facilitate digital access to various public and private services, thereby promoting digital, paperless, cashless, and privacy-centric transactions, which underpin its efforts toward SDGs (IMF, 2023). ICT-enabled innovations for digital financial inclusion also encompass the availability of affordable, equitable, safe, and accessible financial solutions and services from mainstream financial institutions (Schuetz & Venkatesh, 2020; Dhavamani et

al., 2024). Given the scarcity of physical bank branches, enhancing digital financial inclusion in rural areas is crucial for reducing transaction costs, promoting economic opportunities, and ensuring equitable access to government benefits and assistance (Niu et al., 2022). Thus, a recommended strategy is to facilitate digital financial inclusion among marginalized rural communities.

Another significant consideration is digital inclusion for beneficiaries. Developing countries spend vast amounts of money annually on poverty-alleviation initiatives, yet frequently encounter challenges and are often plagued by massive corruption (Muralidharan et al., 2016). In this regard, digital inclusion for beneficiaries plays a substantial role within underserved populations. It ensures delivery to the intended beneficiaries, reduces leakages, provides timely disbursement, and empowers beneficiaries, contributing to poverty reduction and inclusive development, thereby promoting digital financial inclusion. In developing countries, governments utilize digital technologies to either transfer funds directly to beneficiaries' bank accounts, thereby avoiding the need for middleman intervention, or provide in-kind support to vulnerable segments of society (IMF, 2023). Thus, an advisable strategy involves facilitating digital inclusion for beneficiaries among underserved populations, which may potentially increase their direct use of ICTs. Here, affordance theory helps us delineate the implications of technology within the context of its use, rather than emphasizing its intrinsic features (Addo & Senyo, 2021).

3.3 Stakeholder theory (ST)

E-governance initiatives operate within a complex network of stakeholders, including intermediaries, citizens, private players, government agencies, and others, all of whom are subject to their roles and interests, with enhanced accountability (Rowley, 2011). Accountability for e-governance is especially crucial in rural areas, which often bear the brunt of inaction. Ensuring that concerned stakeholders are held accountable improves monitoring, promotes integrity and ethical behaviour, and reduces the likelihood of corruption, bias, and unfair treatment while delivering e-governance services. Therefore, a recommended strategy is to provide accountable e-services for the direct use of ICTs.

Another consideration is transparency in e-governance initiatives. Transparency entails the clear visibility of processes, enabling citizens to access information and observe government operations and performance (Park & Gil-Garcia, 2022; Khan et al., 2021). In addition, transparency is widely deemed a fundamental requirement for good governance and a vital mechanism for maintaining a balance of power between the government and its citizens (Matheus et al., 2021). Therefore, a recommended strategy is to deliver transparent e-governance services, which will also benefit marginalized rural communities and enhance their direct use of ICTs.

Developing countries often face constraints in terms of funding, infrastructure, and human expertise (Asongu & Le Roux, 2017). Hence, many governments adopt a collaborative approach to their e-governance initiatives through public-private partnerships (PPPs) to leverage the capabilities of various stakeholders, thereby accelerating e-governance service delivery and ensuring financial sustainability for these initiatives (Wouters et al., 2023). It is essential for sharing resources, developing holistic solutions, engaging communities, and promoting innovation. Therefore, an advisable strategy is to collaborate with various stakeholders for the long-term sustainability of e-governance projects.

Another substantial aspect of e-governance initiatives is reliability. Reliable e-governance services ensure that citizens can consistently rely on digital platforms, allowing transactions to be promptly executed without errors and thereby reducing delays and frustrations (Li & Shang, 2020). It is especially crucial for rural users, as they might be unable to repeat the transactions due to financial or other constraints. Reliable e-governance services can help foster digital inclusion, narrow the digital divide, and build trust among marginalized citizens towards e-governance services, especially in rural areas. Therefore, the suggested practice is to provide reliable services for boosting the direct use of ICTs within marginalized rural communities.

3.4 Unified model of e-government adoption (UMEGA)

UMEGA provides a suitable theoretical foundation for understanding security and privacy, particularly in the context of e-government (Dwivedi et al., 2017). Security focuses on safeguarding citizens' data from unauthorized access or breaches, while privacy pertains to controlling and protecting citizens' data from being disclosed or misused. The privacy and security of personal information and financial transactions are two significant risk factors in the era of big data, which may adversely impact the use of e-governance services (Bindu et al., 2019). Hence, to foster the direct use of ICTs within marginalized rural communities, a recommended practice is to implement stringent measures that ensure the security and privacy of citizens'

data, especially considering the limited exposure of marginalized rural users to these technologies. This practice is crucial, as cyber-attacks and theft stories have rendered them extremely cautious in the digital world.

Based on these theories, the factors are systematically captured and summarized in Table 1. Furthermore, for analysis, the identified factors have been classified into either strategy or practice categories. The strategy or practice categorization is based on whether factors are goal-oriented or design-oriented.

Table 1. Theory-driven factors

Theory*	Factors	Description	Reference	Strategy/ Practice
UT	ICT artefact ease of use	It is the degree to which a marginalized rural user finds an e-governance service easy to use and develops an intent to use it.	Venkatesh & Agarwal, 2006; Hoehle & Vekatesh, 2015; Hoehle et al., 2016; Pee et al., 2018;	Practice
UT	Efficiency of ICT artefacts	It is the degree to which the e-governance service optimises the task completion time and effort for marginalized rural users.	Adapted from Li and Zhu, 2019; Hoehle & Vekatesh, 2015; Hoehle et al., 2016; Venkatesh & Agarwal, 2006;	Practice
UT	Control of ICT artefacts	It is the degree to which a marginalized rural user perceives control when receiving service through the e-governance app or website.	Adapted from Li and Zhu, 2019; Hoehle et al., 2016.	Practice
UT	Learnability of ICT artefact	It is the degree to which a marginalized rural user can quickly learn to use an e-governance service.	Lee & Kozar, 2012; Li and Zhu, 2019; Hoehle & Vekatesh, 2015; Hoehle et al., 2016;	Practice
UT	ICT artefact Navigability	It is the degree to which a marginalized rural user can easily navigate and find the necessary information.	Lee & Kozar, 2012; Verkijika & Wet, 2018; Pee et al., 2018; Hoehle & Vekatesh, 2015; Hoehle et al., 2016	Practice
AT	Affordable Computing devices	It is the degree to which marginalized rural users can access e-governance services on a computing device that is affordable to them.	Adapted from Dwivedi et al., 2016; Sharma et al., 2021; Sarangi & Pradhan, 2020	Strategy
AT	Affordable Network Quality	It is the degree to which marginalized rural users can smoothly utilize e-governance services using an affordable network.	Dwivedi et al., 2016; Oshara & Mawela, 2015; Martínez-Domínguez & Mora-Rivera, 2020	Strategy
AT	Affordable Internet Data	It is the degree to which marginalized rural users can access e-governance services using internet data that is affordable to them.	Adapted from Strover, 2001; Oshara & Mawela, 2015; Martínez-Domínguez & Mora-Rivera, 2020.	Strategy
ST	Accountability for e-governance	It is the degree to which the government responds to the queries of marginalized rural users	Malodia et al., 2021; Saldanha et al., 2022; Park & Gil-Garcia, 2022;	Strategy

		and is responsible for all e-service activities directed towards rural users.	Matheus et al., 2021; Rowley, 2011	
ST	Transparency in e-governance	It is the degree to which the government provides e-governance services openly and transparently for marginalized rural communities.	Malodia et al., 2021; Saldanha et al., 2022; Park & Gil-Garcia, 2022; Matheus et al., 2021; Rowley, 2011 ; Khan et al., 2021	Strategy
ST	Reliability of e-governance	It is the degree to which the government provides reliable and authentic e-governance services to marginalized rural communities.	Malodia et al., 2021; Li & Shang, 2020; Sá et al., 2016; Rowley, 2011	Practice
ST	Collaboration for e-governance	It is the degree to which the government collaborates with other stakeholders to deliver effective e-governance services.	Samsor 2021; Wouters et al., 2023; Rowley, 2011	Strategy
UMEGA	Data Security	It is the degree to which the government adopts security mechanisms to prevent unauthorized modification and access to the data of marginalized rural users.	Dwivedi et al., 2017; Sharma et al., 2021; Sá et al., 2016	Practice
UMEGA	Data Privacy	It is the degree to which the government adopts security mechanisms to prevent the unauthorized disclosure of data from marginalized rural users.	Dwivedi et al., 2017; Sharma et al., 2021; Sá et al., 2016	Practice
AT	Digital Financial Inclusion	It is the degree to which the government introduces suitable online payment mechanisms to ensure the financial inclusion of marginalized rural users.	Pradhan et al., 2021; Niu et al., 2022; Hussain et al., 2023	Strategy
AT	Digital Inclusion for Beneficiaries (Cash or in-kind support)	It is the degree to which the government introduces suitable online mechanisms for direct benefit transfer to bank accounts, ensuring the digital inclusion of marginalized rural users.	Mukhopadhyay et al., 2019; Markose et al., 2022; Varshney et al., 2021; Kishore & Birthal, 2023	Strategy

Note: *- Legend: AT: Affordance theory; ST: Stakeholder theory; UT: Usability theory; UMEGA: Unified model of e-government adoption

4 Methodology

This study employs a mixed-methods approach, combining the in-depth interview method with the decision-making technique DEMATEL, to uncover and examine strategies and practices for rural e-governance that ensure and promote the direct use of ICTs among marginalized rural users. Mixed-methods research can offer rich insights, as combining inferences from qualitative and quantitative methods enables the counterbalancing of the inherent limitations of individual research methods (Venkatesh et al., 2013; Ye et al., 2021). Further, various methodologies and designs can be employed to triangulate the investigation of the same phenomenon (Ye et al., 2021).

The mixed-method approach is deemed suitable in the context of this study for the following reasons. Use of ICTs among marginalized rural communities is a multifaceted and complex phenomenon influenced by

various factors such as the digital divide, socio-economic conditions, and diverse characteristics of rural users, including literacy level, gender, education, income, and other relevant factors (Lythreatis et al., 2022; Salemink et al., 2017; Oreglia & Srinivasan, 2016). In contrast to employing these methods, integrating them can enrich the research on ICT use in marginalized rural communities. It can provide a more thorough understanding and representation of the strategies and practices for rural e-governance to ensure and lift the direct use of ICTs among marginalized rural users. Figure 2 illustrates the research framework followed in this study.

4.1 Interviews

The mixed-method approach in this research has the in-depth interview method as its primary component. An in-depth interview is a qualitative research method characterized by conducting detailed individual interviews with select participants to delve into their viewpoints regarding a specific concept, program, or circumstances (Boyce & Neale, 2006). In-depth interviews can offer valuable insights into the complexities surrounding rural e-governance that quantitative methods may not fully address, as they capture diverse perspectives, uncover a rich understanding, and provide profound knowledge (Boyce & Neale, 2006). We then conducted a thematic analysis of the transcribed interview data to gain deeper insights into strategies and practices for rural e-governance, aiming to ensure and increase the direct use of ICTs among marginalized rural users.

4.1.1 Data collection settings

The data for this study were collected from the state of Chhattisgarh for the following compelling reasons. Approximately 76% of Chhattisgarh's population resides in rural areas and villages, i.e., around 19.6 million people (Census of India, 2011). Additionally, the state is well-regarded for its extensive forest cover, with around 44% of its geographical area under forest cover (PIB, 2022a). The diverse rural terrain of Chhattisgarh, which includes tribal populations residing in forest areas and farming villages, presents a compelling context for investigating the direct use of ICTs among marginalized communities, making it a suitable choice for our research study.

4.1.2 Sample size

Interviews were conducted with executives directly involved in various e-governance activities in rural areas. The participants were selected to represent diverse experiences in rural e-governance. A total of 12 e-governance executives from eight distinct districts of Chhattisgarh, India — Balod, Bemetara, Balodabazar-Bhatapara, Dhamtari, Durg, Kurud, Mahasamund, and Raipur —participated in the study. These participants hold positions like e-district managers, CSC managers, the chief executive officer (CEO) of Janpad Panchayat, and village-level entrepreneurs (VLEs). The selection of experts ensures a strategic blend of expertise in e-governance in rural settings, as reflected in the demographic profiles of experts in Table A.1 (see Appendix A).

Earlier scholars exemplified that in thematic analysis, data saturation is often reached within the first 6 to 12 interviews, especially in homogeneous participant groups (Guest et al., 2006; Braun & Clarke, 2021). Data saturation occurs when additional interviews fail to generate new themes, insights, or patterns, signifying that sufficient information has been gathered to comprehensively address the research objectives (Braun & Clarke, 2021). Experts, such as e-district managers, are state government-appointed officials responsible for overseeing the day-to-day implementation of e-governance initiatives at the district level. CSC managers are appointed by the state governments' designated agency under the CSC scheme. CSC managers oversee the operations of kiosks or CSCs that facilitate various schemes of the state and central governments. In addition, the CEO (Janpad Panchayat) is responsible for managing a wide range of rural development projects within the villages under its jurisdiction, including overseeing e-governance initiatives. In Appendix A and elsewhere in this paper, terms E1 to E12 denote the experts (respondents) with whom in-depth interviews were conducted.

This study employed a purposive sampling approach, targeting specifically government employees responsible for overseeing rural e-governance services. This sample aligns with the study's objectives, research question, and available resources for participant selection. Further, a chain referral approach was employed to enhance the number of participants in the in-depth interviews. To achieve this, previously interviewed respondents were asked to suggest individuals within their network who could provide insights into e-governance services in rural areas (Iong & Phillips, 2023).

Individual meetings were scheduled with each expert to conduct the interview at their workplaces. Prior appointments were made via telephonic conversations to secure in-person meetings with the experts, ensuring their availability and direct participation during the interview process. Primary data was collected during field visits from November 2022 to February 2023. Each interview session lasted approximately 60 to 120 minutes and was recorded through voice recordings and detailed notes taken using pen and paper. The interviews were conducted bilingually in English and Hindi, encompassing an affable approach to data collection. Preliminary tests were conducted with two participants as part of a pilot study to ascertain the comprehensibility and pertinence of the questions. Data were obtained from a heterogeneous sample regarding gender composition (male: 58%, female: 42%) and educational qualifications (postgraduate: 66%, graduate: 34%). All participants were assured of the confidentiality and anonymity of individuals and organizations involved in the study.

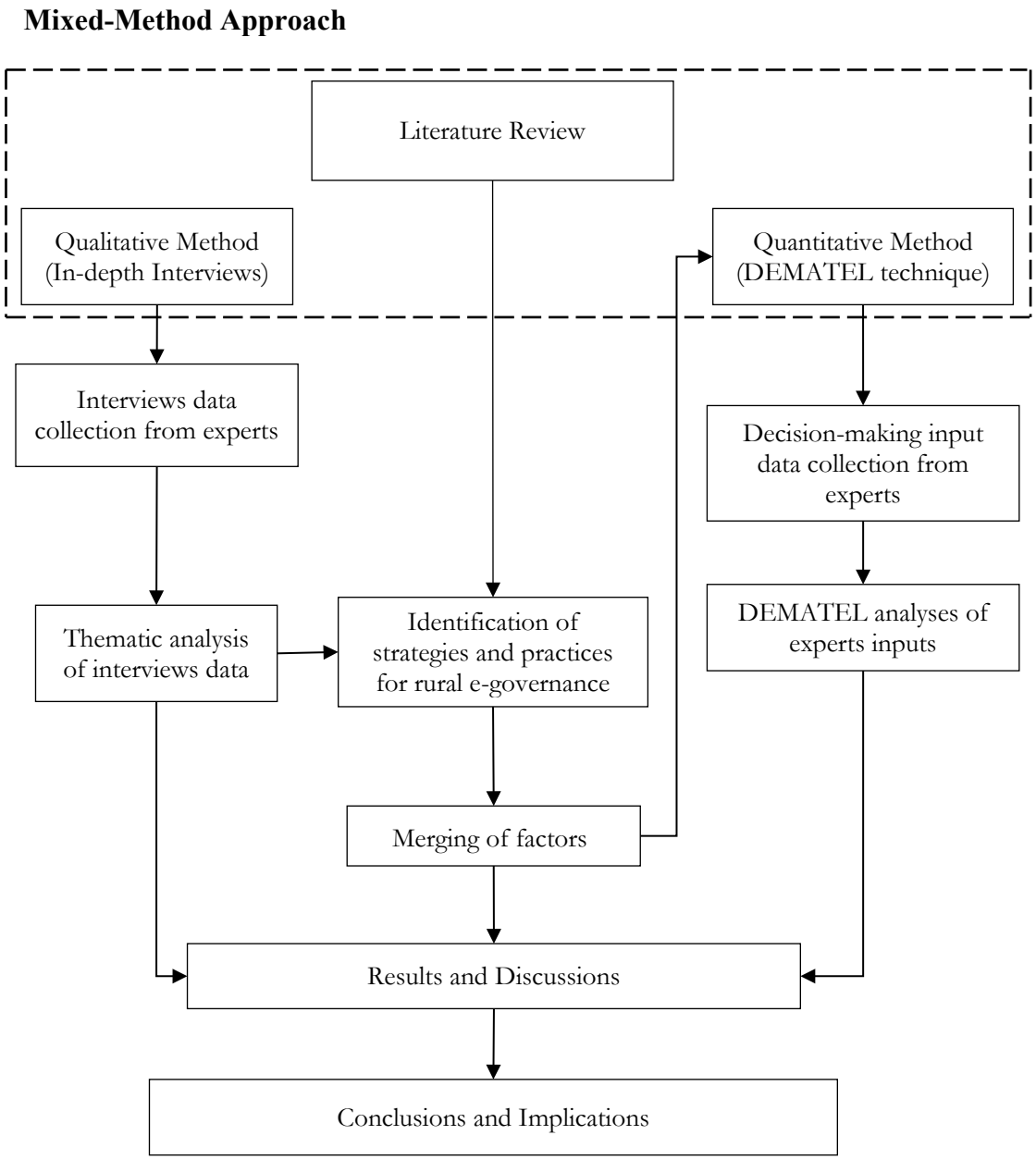


Figure 2: Research framework

The process involved semi-structured interviews, which were open-ended, exploratory, and intermittently guided by questions (see Appendix B). The semi-structured interviews facilitate a comprehensive investigation into the factors influencing strategies and practices in utilizing ICTs, providing greater insight.

Before the interview began, participants' desire to exclude audio or video recording was duly respected. It aligns with ethical principles governing informed consent and regard for participant autonomy. Written protocol was utilized in the interviewing process (Homburg et al., 2014).

4.1.3 Thematic Analysis

Thematic analysis was employed to identify the strategies and practices for rural e-governance that could facilitate the direct use of ICTs among marginalized rural users. Thematic analysis is a qualitative research method that involves reading through a data set (such as transcripts from in-depth interviews or focus groups) and identifying patterns across the data to derive themes. It emphasizes the identification, analysis, and interpretation of qualitative data patterns (Braun & Clarke, 2006). By iteratively examining and comparing data, distinct themes and overarching dimensions can be discerned, leading to an empirically grounded model (Sjodin et al., 2021). To ensure coding reliability, a panel of three members (two professors and one research scholar) performed thematic analysis, extracting, refining, resolving discrepancies, and categorizing themes based on the interview responses. In addition, theme validation was achieved through several strategies: (1) cross-checking themes against the raw data to ensure internal consistency and distinctiveness, (2) debriefing sessions within the panel to refine interpretations, and (3) triangulation with the DEMATEL technique to strengthen the robustness of the study. These steps enhance the credibility and trustworthiness of the findings while ensuring that the themes accurately represent the direct use of ICTs among marginalized rural communities. Subsequently, as illustrated by Sjodin et al. (2021), second-order (aggregate dimensions) were established by classifying the factors through zero-order and first-order codes in Table B.1 (see Appendix B). Finally, we triangulated our data using different methodological techniques (Ye et al., 2021).

4.2 MCDM in ICT, e-governance, and rural development domains

Past research on decision-making issues related to ICT, e-governance, and rural development has employed MCDM methods, such as AHP, LBWA, MARCOS, Delphi-AHP, and ISM MICMAC due to the multifaceted and complex nature of these decision-making situations (Gupta et al., 2017; Torkayesh & Torkayesh, 2021; Hassan & Lee, 2019). For example, Gupta et al. (2017) applied the AHP method to identify the most critical factors and sub-factors influencing the adoption of e-government from the perspective of senior government officers. Hassan and Lee (2019) investigated the relative importance of essential e-government success factors from policymakers' perspectives using AHP. Torkayesh and Torkayesh (2021) evaluated the ICT development of major developed countries using an integrated MCDM approach based on LBWA, evaluating alternatives and ranking according to MARCOS methods. Choi et al. (2016) assessed the implementation of e-government in developing countries to identify design-reality gaps using the Delphi-AHP method. Bigdeli et al. (2013) applied the AHP method to examine the relative importance of factors influencing electronic information sharing among local governments. Kahraman et al. (2007) used the AHP method to prioritize strategies for e-government applications. Sharma et al. (2021) investigated the challenges of CSCs in delivering e-governance services in rural India by conducting the ISM-MICMAC analysis on the factors.

There is a lack of established guidelines for determining the suitability of different MCDM methods for different decision scenarios. Although numerous MCDM methods exist, none can be deemed universally "best" or most suitable for all situations (Tavana et al., 2013). In this study, the DEMATEL technique was employed as a quantitative method to evaluate the factors that can contribute to the direct use of ICTs in marginalized rural areas. DEMATEL is a suitable choice for our study for the following reasons. First, it is more appropriate for real-world applications compared to other traditional methods that assume criteria to be independent of each other (Lu et al., 2013). Second, it provides rankings among the factors, i.e., factors are listed in order of their importance within the system. Finally, this technique establishes causal relationships among multiple factors by classifying them into cause-and-effect groups (Kumar & Dixit, 2018). In doing so, the causal relationships between critical factors can be used to identify important factors from each group. Therefore, DEMATEL analyses can be used to assess the factors influencing the direct use of ICTs among marginalized rural communities, thereby contributing to the advancement of rural e-governance.

4.2.1 DEMATEL

The subjective impressions and insights of domain experts, which have matured over the years, were quantified in the DEMATEL analyses. This study utilized data from 12 experts to conduct a DEMATEL

analysis. Previous research has established that a sample of between 5 and 10 experts is sufficient for conducting a DEMATEL analysis, as this range allows for the collection of diverse expert opinions while ensuring methodological rigor and analytical validity (Koley et al., 2025; Kumar & Dixit, 2018). The DEMATEL method examines the interactions among criteria by classifying them into cause-and-effect groups. A causal diagram can be created to depict the inter-relationships among the factors involved in decision-making scenarios (Kumar & Dixit, 2018). Further, digraph maps can be created to provide deeper insights into how factors involved in decision-making scenarios influence each other and the strengths of these influences (Wu, 2008).

4.2.2 Extending DEMATEL: TH-DEMATEL

This study makes a novel methodological contribution by extending the DEMATEL method. In the proposed TH-DEMATEL, precise and elaborate steps were developed to determine a suitable threshold value, thereby segregating the obvious and non-obvious influences within the system. Then, a digraph was drawn to visually represent the linkages among factors. Conventional DEMATEL requires researchers to set a threshold value either by taking the average value or any value based on the expert's advice to filter out less effective interrelationships. However, this choice is often arbitrary and associates certain risks, i.e., either omitting meaningful but subtle links or including spurious ones. To address this limitation, we extend DEMATEL into a threshold-based digraph analysis (TH-DEMATEL), which introduces a systematic procedure for determining threshold values. This refinement reduces subjectivity, enhances reproducibility, and allows for the distinction between "obvious" and "non-obvious" influences within the system. By visualizing both strong and subtle interdependencies, TH-DEMATEL provides richer theoretical insights into factor interrelationships.

The steps for the DEMATEL and TH-DEMATEL methods are mentioned in Appendix C.

5 Result and Analysis

5.1 Interviews

Due to low levels of education and limited or no digital experience, rural users in developing countries face significantly higher learning complexities when engaging with digital devices. Therefore, rural users might highly value the ease of use of ICT software and hardware artefacts. Additionally, senior citizens and women in rural areas may face even greater difficulties handling digital devices. Therefore, prioritizing ease of use in ICT artifacts may facilitate better digital participation and inclusion, overcoming rural citizens' limited backgrounds and low skill levels, and narrowing the digital divide. An e-district manager during the interview described:

> *"Actually, they (rural citizens) don't like complex things to use; they wish things could be done easily without much effort. Due to low digital literacy and limited access to digital technologies, they generally resist using anything digital; even if they have to use it, they wish for simple steps to engage with digital platforms. In my view, the design of digital platforms should prefer simplicity, ensuring an intuitive and straightforward user experience among marginalized communities." (E5, echoed by 3,8,10)*

During the interaction with IT artefacts, rural users' ability to effectively manage and interact with IT artefacts remains one of the primary concerns. Rural users feel a sense of control when they can use mobile apps independently without any difficulties. A female e-district manager during the interview shared her views:

> *"Well, rural citizens have unique needs and challenges while operating mobile apps for e-governance services and information. They (rural citizens) will become regular users if they can manage mobile applications effortlessly, enabling them to get services and information independently. It will, in turn, lead to increased participation in e-governance initiatives. However, control over IT artefacts is subjective and can differ among individuals depending on their interests, unique backgrounds, and socio-economic circumstances." (E4, echoed by 2,5,1,11)*

The government's primary objective for providing e-governance services is to reduce the time and effort needed to reach and serve most citizens. Therefore, it is crucial to make IT artefacts responsive to the disadvantaged settings of rural communities. By optimizing the performance and functionality of IT artefacts

for rural settings, the government can enhance the overall efficiency of digital solutions without unwanted delays or complications. One of the participants illustrated the following:

> *"They (rural citizens) have limited exposure to these digital things; they wish that with minimal steps, they could complete the process and benefit from the services without any delays. By leveraging efficient IT artefacts to access various government documents or e-governance initiatives, they could save time and resources. Especially given that rural citizens need to devote most of their time to farming activities or daily wage work." (E8, echoed by 6,7,9,11, 12)*

One significant hindrance in the direct use of ICTs among marginalized communities is the interface and presentation. The interface and presentation of IT artifacts are crucial, as they provide users with the primary levers for interacting with digital devices. During the interview, one of the participants stated:

> *"They (Rural users) prefer digital interface design to be in their local language. However, most of the apps are in English, and often, the dialogue boxes in the apps are in English only, creating a major language barrier. In addition, they desire simple, familiar fonts and colours in e-governance apps. Visual aids such as icons, images, and infographics can enhance comprehension and simplify complex notions. The interface should not carry too much information." (E2, echoed by 1,4,5,8,10)*

Another difficulty for rural users interacting with IT artefacts is the lack of smooth traversing through mobile or web apps to find the desired information or services without getting lost or confused. IT artefacts should have interface and navigation menu designs that are intuitive for rural users. Simple, navigable IT artifacts reduce cognitive load among rural citizens, regardless of age, gender, or digital literacy level. Moving across different tabs, dialogue boxes, and screens should be seamless for rural users. During the field visit, the e-district manager shared his views:

> *"The navigability aspect of IT artefacts for rural users should follow a clear and easy path without complexities. Due to various e-governance initiatives, most of the services have shifted from traditional offline services to online services, triggering a need for smartphone access or visiting CSCs among rural communities. Compared to their urban counterparts, rural citizens, due to less or no digital literacy, are hesitant to use mobile apps due to the navigability complexities associated with IT artefacts." (E10, echoed by 2,6,9,12)*

Another expert explained the aspects of navigability among rural communities:

> *"They (rural users) often find it difficult to determine the correct actions, such as whether to swipe right or left or which buttons must be tapped on the screen while using mobile and web apps. As a result, they find difficulties and often spend considerable time navigating through mobile and web apps. To overcome this barrier, the government frequently introduces digital literacy camps and training programs in rural areas. This enables them to augment their understanding of digital technologies and navigate through the apps proficiently." (E7)*

To overcome the multidimensional issues prevalent in developing countries, governments have introduced multiple channels, including CSCs, mobile apps, and web applications, to deliver e-governance services. Many villagers live tiring and repetitious lives. Their exhaustion from farming and daily wage labour leaves them with scarce resources, time, and energy to engage with the digital world. In this regard, CSCs are more prevalent among marginalized communities, helping people access e-governance services without hassle. One of the interviewees explained the availability of computing devices in rural areas:

> *"Most rural populations utilize e-services through CSCs only as rural users have limited experience with the digital world, prompting them to choose CSCs over other means. Rural citizens are heavily reliant on CSCs for e-governance services and information. Therefore, there is a need to provide low-cost computing devices among rural citizens so that they can use ICT directly without being reliant on anyone." (E11, echoed by 4,7,9,12)*

Another participant commented,

> *"In rural areas, people usually do not have personal computers at home due to affordability issues, so they use CSCs as their primary gateway to the digital world. The affordability of computing devices such as computers or mobiles and others needs to be prioritized to enhance the direct use of ICTs within rural communities." (E1)*

Due to the poor socio-economic conditions in rural communities, access to an affordable quality network is a significant concern in these areas. During the field visits, one respondent commented:

> *"Affordable network quality refers to reliable, high-speed internet connectivity at a cost affordable among marginalized communities. If the network quality is not affordable, then the direct use of ICT among marginalized rural users will be hindered. It helps close the gap between urban and rural populations regarding availing feature-rich e-governance services." (E3, echoed by 2,5,8,10,11)*

For e-governance initiatives, various software artifacts (mobile and web applications) facilitate services via digital platforms. Continuous monitoring, evaluation, and feedback mechanisms should be in place to identify and address software-related issues in e-governance. One of the respondents engaged in rural e-governance initiatives commented:

> *"To address the limitations of rural infrastructure, customizing the software artefacts for easy setup is vital. The software should be readily downloadable and function on the computing devices present in rural users' handsets with minimal effort or complications. However, many apps exhibit poor functionalities or contain bugs, discouraging rural users." (E9, echoed by 1,3,6)*

Another major impediment to accessing e-governance services is the high cost of internet data, which marginalized communities cannot afford. Due to their poor socio-economic circumstances, rural citizens often face financial constraints that make it challenging to afford an internet subscription. During an interview, the e-district manager explained,

> *"Actually, ensuring the affordability of internet data among rural citizens is crucial in the use of ICTs. A few years ago, internet data costs were prohibitively high, and it was not affordable for rural citizens. However, with significant technological advancements and a competitive telecom sector market, internet data prices have reduced. To provide high-speed internet data to rural communities, the government of India has launched the Bharatnet project, a rural broadband project to connect all gram panchayats across the country. In the same way, the government can further consider providing low-cost internet data plans to marginalized rural users." (E12, echoed by 1,4,7,10)*

Accountability is a crucial aspect of the success of e-governance services, which entails holding government officials and agencies responsible for the delivery of e-governance services. In rural e-governance, this responsibility extends to ensuring that e-governance services are accessible to marginalized communities and utilized by them efficiently and effectively.

During the field visit, one chief development officer stated the following:

> *"When e-governance initiatives were introduced among rural communities, a remarkable and comprehensive change was witnessed. To have proper accountability in the systems, many state governments have enacted laws to ensure timely and efficient public service delivery to its citizens. It establishes clear time frames for service delivery and makes government officials and agencies accountable for delays or inability to deliver the services within the specified time. If the services aren't provided within the time frame, the respective agencies or departments must justify the delays that happened." (E7 echoed by 3,5,8,12)*

Another difficulty in rural areas is the lack of reliable e-governance services. An unreliable e-governance system with frequent downtime issues can quickly erode trust and discourage citizens from using it. On the other hand, a reliable system guarantees the seamless completion of tasks or transactions, thereby forestalling unwarranted citizen frustration. During our interview, the Chief Executive Officer of the block expressed his views:

> *"e-services need to be available among marginalized rural citizens consistently and effectively, without frequent disconnections. For successful e-governance initiatives, trust needs to be built among the citizens; only then will they use it. In our district, we look after consistent internet connectivity, smooth operations of CSCs and proper functioning of mobile apps to access essential services in rural areas. A reliable e-governance system instils confidence among rural citizens, enabling them to use digital platforms to access government services and information." (E2 echoed by 1,4,6,9)*

In rural areas, where resources and expertise are limited, collaboration among various stakeholders becomes even more crucial for effectively implementing e-governance solutions and addressing the unique

needs of rural populations. Cooperation and coordination at the local level are necessary to effectively accomplish e-governance objectives for long-term sustainability. It encourages partnerships between public and private entities through the Public-Private Partnership (PPP) model. One of the respondents during field interviews shared the following:

> *"To bring numerous benefits to rural communities, the government collaborates with various stakeholders to provide better service delivery, promoting inclusivity, and providing IT training with the help of various NGOs and private agencies. It involves sharing resources, expertise, and responsibilities to achieve common goals, i.e., enhancing service delivery and fostering citizen engagement. Collaboration plays a substantial role throughout the stages of e-governance initiatives, i.e., from designing IT-driven solutions to delivering e-services for marginalized communities." (E5 echoed by 1,3,8,10,12)*

Another difficulty faced by rural communities is a lack of information about the prevalent e-governance services. It necessitates raising awareness among rural communities about the availability of e-governance mobile and web applications, as well as other technological support. One of the participants stated:

> *"Often, due to a lack of awareness, rural citizens are clueless about the e-governance services available to them. Unlike their urban counterparts, rural citizens have less exposure due to their involvement in regular fieldwork or as daily wage earners and are often unaware of the existing e-governance initiatives, which results in low usage of ICTs among rural communities." (E6 echoed by 2,5,7,11)*

Another interviewee stated,

> *"Certainly, the government is constantly raising awareness about e-governance services with the help of multiple stakeholders through numerous modes, i.e., community meetings, public announcements, text messages on mobile, arranging camps, wall painting, radio, televisions, and distribution of informative material." (E9)*

E-governance systems often collect, store, and integrate data from multiple sources and systems to provide comprehensive services. This integration may involve connecting different levels of government, such as central and state governments, government agencies, departments, and databases, to enable seamless data sharing and exchange. Effective data management includes data quality management, data lifecycle management, and compliance monitoring. A CSC manager from a district has commented on data management:

> *"Effective data management enables decision-makers with precise, reliable, and timely information. Moreover, it prevents data duplication and mitigates the perils associated with siloed data management approaches lacking standardized protocols. The government collaborates with various government agencies, technology vendors, citizens, NGOs and other stakeholders to ensure the effective use of data to benefit underserved populations."*
>
> *"Apart from this, I would like to add another point on data security and privacy. Rural citizens are oblivious to data security and data privacy; they exhibit the lowest level of apprehension regarding these issues. Compared to urban people, rural citizens have limited technological exposure; they are unaware of the latest cybersecurity threats or understand the complications of data breaches." (E1 echoed by 3,4,6,8,11)*

In recent years, the government has actively concerted efforts to implement ICT-based innovations for new e-governance services, especially beneficial to marginalized rural communities. It is an attempt to purposefully apply emerging technologies to ensure the equitable inclusion of underserved populations. In this regard, the Indian government has successfully established a world-class DPI that aligns with the Sustainable Development Goals. India Stack is the collective name for a set of widely used digital platforms in India, comprising three distinct layers: unique identity, complementary payment systems, and data exchange. In this context, digital financial inclusion is a significant step towards inclusive growth, ensuring the overall economic development of marginalized communities (PIB, 2022b). One of the participants has illustrated the prominence of digital financial inclusion:

> *"To ensure access to formal banking services to marginalized sections, with the support of DPI, the government has introduced the Bank Mitra and Aadhar Enabled Payment Service (AEPS) initiatives through CSCs. Bank Mitra is a worthy initiative that provides all banking-related facilities at the doorstep. AEPS eliminates the need for a physical bank to deposit, withdraw, or transfer*

> *money through any of the nearest CSCs. In addition, nowadays, rural citizens have slowly embraced the usage of the Unified Payments Interface (UPI) through mobile phones to simplify various financial transactions, i.e., fund transfers, utility bill payments, and business transactions." (E8 echoed by 1,5,6,9)*

Another issue faced by rural communities is the lack of health and agricultural insurance services. Rural citizens confronted significant hardships in accessing healthcare services and recovering from agricultural losses. The Indian government has introduced a robust digital mechanism for health and agricultural insurance, which assists marginalized rural communities in extreme circumstances.

One of the interviewees, i.e., the chief executive officer, stated that:

> *"Earlier, in the event of a sudden health crisis and agricultural losses, they (rural citizens) often had to bear the burden of huge expenses or losses, which consumed a substantial portion of their hard-earned income. In this regard, the government of India has introduced health and agriculture insurance schemes, which ensure that marginalized communities have better access to healthcare services in government and privately listed hospitals (Ayushman Bharat smart digitalized card). For agriculture losses, the government of India has launched crop insurance schemes such as Pradhan Mantri Fasal Bima Yojna, an integrated IT solution enabling information access to multiple stakeholders." (E10 echoed by 2,4,7,10,12)*

5.1.1 Results of Interview Data Analysis

Analysis of interview data reveals the following new strategies and practices needed for rural e-governance to ensure the direct use of ICTs among marginalized rural users: 1) the ICT artefact interface: underscoring the imperative of tailoring language and layout to the specific requirements of marginalized rural citizens to enhance comprehension and usability. 2) Software artefacts with easy setup: enable e-governance services to function even with low internet bandwidth and are designed to work on a broader range of devices, including old computers or low-end smartphones, which might be more prevalent in marginalized rural communities, to overcome internet speed and data constraints and device compatibility issues. 3) Data management: In general, it serves as a facilitator for seamless information exchange among various administrative units by circumventing the tendency towards departmental silos. It may help identify and correct errors, duplications, and other issues in citizens' data, thereby making e-governance more effective. The benefits may be more pronounced for rural citizens due to higher historical discrepancies in rural data and may indirectly boost the direct use of ICTs among marginalized rural users. 4) Awareness: enhances the level of cognizance of the usage of ICTs among underserved populations, which, as a result, serves as informed participation, fostering inclusivity and empowering communities. 5) Digital inclusion for insurance: represents a considerable socio-technological advancement by eliminating intermediaries from the distribution channel. It fosters transparency and reduces the risk of mismanagement or resource diversion, ensuring that support reaches its intended recipients more effectively, particularly during challenging periods. This study contributes to ICT4D literature by identifying two novel strategies and practices that shape the direct use of ICTs among marginalized rural citizens. At the strategic level, software artefacts with easy setup exemplify that barriers to ICT use arise not only from infrastructure limitations but also from complex installation and onboarding processes, thereby extending usability theory to encompass the initial stages of ICT artefacts use. Furthermore, digital inclusion for insurance expands the scope of digital inclusion initiatives beyond the dominant focus on mobile money and transfers (Wamba-Taguimdje & Kala Kamdjoug, 2025; Abubakre & Mkansi, 2022), highlighting the transformative potential of crop and health insurance in strengthening rural communities. At the practice level, the ICT artefact interface contributes to the literature by underscoring the need for intuitive layouts and linguistic tailoring for users with low digital literacy. Similarly, awareness among the marginalized rural users demonstrates that continuous outreach is required for long-term, sustainable direct use of ICTs. Together, these findings refine ICT4D scholarship by highlighting the factors that determine whether rural users engage with ICTs directly or through proxy use.

These factors revealed through interviews are summarized in Table 2.

Table 2: Interview-driven data analysis factors.

Factors	Strategy/ Practice	Description	Reference

ICT artefact Interface	Practice	It is the degree to which an e-governance service presents the necessary information in a language and layout that marginalized rural users understand.	Through Interview
Software artefacts with easy setup	Strategy	It is the degree to which marginalized rural users can easily download and install the needed ICT artefacts.	Through Interview
Data Management	Strategy	It is the degree to which the government can manage and archive the data as needed for marginalized rural users.	Through Interview
Awareness	Practice	It is the degree to which the government spreads awareness about e-governance services to marginalized rural users.	Through Interview
Digital Inclusion for Insurance	Strategy	It is the degree to which the government introduces suitable online mechanisms for insurance, such as health and crop insurance, to ensure the digital inclusion of marginalized rural users.	Through Interview

5.2 Integration of Interview and Theory-driven Results

As outlined earlier, data from both methods (interviews and theory-driven) were analysed independently using an inductive coding approach (Braun & Clarke, 2006). Various codes emerged during the merging of data under each method. Then, we utilized a deductive approach to cluster the codes into themes or factors under each method (Tagare et al., 2023). Then, we analysed the composite list from both methods and performed the merging of factors, thereby producing a final list of twenty-one factors.

The final factors were then grouped based on their similarities. Table 3 summarizes the groups, factors, and corresponding methods. For example, ICT artefact ease of use, efficiency of ICT artefact, control of ICT artefact, learnability of ICT artefact, and ICT artefact navigability are grouped due to their similarities as attributes of ICT artefacts. Likewise, affordable computing devices, affordable network quality, and affordable Internet data depict similarities in terms of the affordability of IT artefacts. Hence, these factors are grouped under ICT infrastructure features. Factors such as accountability for e-governance, transparency in e-governance, reliability of e-governance, and collaboration for e-governance capture the similarities in terms of functional aspects of the e-governance system and thus have been grouped under e-governance features. Likewise, data security and privacy factors share similarities in safeguarding citizens' data. Hence, these factors have been grouped under information data management. Eventually, factors such as digital financial inclusion and digital inclusion for beneficiaries depict similarities in digital platform innovations and thus have been grouped under ICT-enabled innovations.

Table 3: List of factors clustered in groups identified through theory-driven or interviews

Groups	Factors	Method
ICT artefact features	ICT artefact ease of use, Control of ICT artefact, Efficiency of ICT artefact, Learnability of ICT artefact, ICT artefact Navigability	Theory driven
	ICT artefact Interface	Interview
ICT infrastructure features	Affordable computing devices, Affordable network quality, Affordable Internet data	Theory driven
	Software artefacts with easy setup	Interview
e-Governance features	Accountability for e-governance, Transparency in e-governance, Reliability of e-governance, Collaboration for e-governance	Theory driven

	Awareness	Interview
Information technology management	Data security, Data privacy	Theory driven
	Data management	Interview
ICT-enabled innovations	Digital financial inclusion, Digital inclusion for beneficiaries	Theory driven
	Digital Inclusion for Insurance	Interview

5.3 Results of the MCDM method

5.3.1 Factors importance and cause-effect analysis using DEMATEL

In DEMATEL, the prominence value (P + Q) represents the overall influence a factor exerts on other factors, either dispatching influence on other factors or receiving influence from other factors in the system. Similarly, the relation value (P - Q) represents the net influence, whether it is dispatch or receive. Therefore, the relation value will place a factor in the cause group if it has a net effect as dispatch influence and a factor in the effect group if it has a net effect as receive influence. Table 4 illustrates the factor influences, where prominence values (i.e., overall influence in the system) are used to determine the importance rankings among the factors, while relation values (i.e., net influence in the system) are used to classify the factors into either cause or effect groups.

Table 4: Degree of influence

Factors Code	Factors	Prominence (P + Q)	Rank	Relation (P - Q)
F1	ICT artefact ease of use	1.5733	5	-0.0599
F2	Control of ICT artefacts	1.2117	8	-0.0931
F3	Efficiency of ICT artefacts	1.7646	1	-1.4088
F4	ICT artefact Interface	1.0714	13	0.682
F5	Learnability of ICT artefact	1.3064	7	0.1769
F6	ICT artefact Navigability	1.0672	14	-0.1316
F7	Affordable Computing devices	0.9416	15	0.68
F8	Affordable Network Quality	0.8729	18	0.7345
F9	Software artefacts with easy setup	1.0824	11	0.8358
F10	Affordable Internet Data	0.9062	16	0.823
F11	Accountability for e-governance	1.1563	9	-0.4003
F12	Transparency in e-governance	0.8425	20	0.1146
F13	Reliability of e-governance	1.4863	6	-1.0609
F14	Collaboration for e-governance	1.0798	12	0.2902
F15	Awareness	1.1131	10	0.6071

F16	Data Management	0.3533	21	-0.1412
F17	Data Security	0.8643	19	0.2791
F18	Data Privacy	0.8889	17	0.2703
F19	Digital financial inclusion	1.7544	2	-0.665
F20	Digital Inclusion for Insurance	1.7311	4	-0.7674
F21	Digital Inclusion for Beneficiaries	1.7316	3	-0.7652
Average Prominence Value		1.18		

Based on the higher prominence (P + Q) values, the importance ranking of the factors is as follows (see Table 4). In the causal diagram in Figure C.1 (see Appendix C), the placement of factors along the x-axis shows their importance, while the placement of factors above or below the x-axis shows that they are in cause or effect groups, respectively.

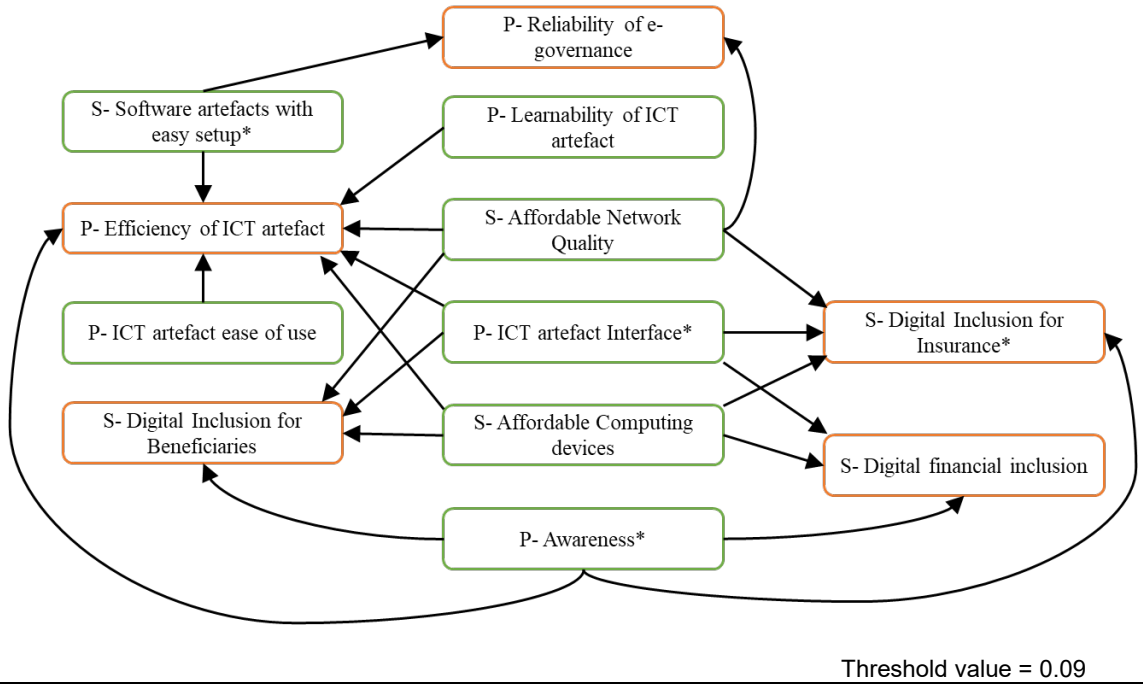
An analysis of inter-relationships among factors that exert a significantly higher net influence could be fruitful for a deeper understanding. These factors can be identified based on spotting a significant natural gap in (P-Q) values, sorted in descending order. For example, from F15 to F17, the drop in relation values is much higher, from 0.6071 to 0.2791 (see Table 4). Based on this relation (P-Q) values approach, we can identify the major cause factors (e.g., with relation values greater than F17) that substantially influence other factors: 1) software artefacts with easy setup, 2) affordable internet data, 3) affordable network quality, 4) ICT artefact interface, 5) affordable computing devices, and 6) awareness. These cause group factors represent foundational requirements for facilitating the direct use of ICTs among marginalized rural users. These cause group factors necessitate immediate attention and should be prioritized over others for better rural e-governance services. Without these, rural users remain dependent on intermediaries, or "proxy use," which undermines the direct use of ICTs. These factors must be prioritized before expecting citizens to value factors like efficiency, reliability, or digital inclusion in financial and welfare services. This sequencing effect underscores that digital inclusion cannot be achieved solely through advanced service features; rather, it depends on lowering access barriers and simplifying user engagement.

Likewise, based on the negative relation (P-Q) values, major effect factors that are substantially influenced by other factors are 1) efficiency of ICT artefact, 2) reliability of e-governance, 3) digital inclusion for insurance, 4) digital inclusion for beneficiaries, 5) digital financial inclusion, and 6) accountability for e-governance. These major effect group factors represent desirable features for better rural e-governance services. The factor efficiency of the ICT artefact ranks highest in prominence value, indicating its importance among all effect factors. Other major effect factors are digital financial inclusion, digital inclusion for beneficiaries, digital inclusion for insurance, reliability of e-governance, and accountability for e-governance in that order of importance. Also, major effect factors are more important than major cause factors. This finding shows that in marginalized contexts, effect factors become salient only after basic affordability and accessibility constraints are addressed. In other words, usability and governance features matter most when structural barriers to the use of ICTs have been minimized; sequencing effects are not fully captured in prior ICT4D studies. This sequencing effect underscores that digital inclusion cannot be achieved solely through advanced service features; rather, it depends first on lowering usage barriers and simplifying user engagement. The findings illustrate that before expecting marginalized rural users to adopt digital services, governments need to prioritize affordability, awareness, and software artefacts with easy setup. Without these factors, investments in sophisticated features like reliability or efficiency will not translate into meaningful usage of ICTs.

However, one problem with the relation (P-Q) values-based cause-effect analysis is that we cannot ignore obvious influences from the systems, thereby failing to focus on the non-obvious influences for effective decision-making. Therefore, we develop our empirical framework, which consists of interrelationships between the factors, using the DEMATEL digraph map (see Figure 3).

5.3.2 An empirical framework based on the DEMATEL digraph map

As discussed in steps 8-10 (See Appendix C), based on expert inputs, a threshold value was determined to obtain a suitable digraph map that captures non-obvious influences useful for decision-making. This process helped us finalize the digraph shown in Figure 3, corresponding to a threshold value of 0.09. In addition, if we continue to increase the threshold, the following digraph map corresponding to the threshold value of 0.1 would be left with very few (six) factors and (five) linkages, making it unamenable to meaningful analysis. Therefore, finalising the digraph map corresponding to the threshold value 0.09, yielding twelve factors and twenty linkages, seems justified.



Note: a) Green indicates cause factors, and orange indicates effect factors.
b) * highlights the novel factors.
c) S and P represent the strategies and practices, respectively.

Figure 3: Empirical Framework consisting of interrelationships between the factors

Based on digraph map analysis, the most crucial effect factor is the efficiency of ICT artefacts since it receives links from seven cause factors. Also, it is the top-ranked factor based on prominence values. Further, the following two effect factors are digital inclusion for beneficiaries and digital inclusion for insurance, each with four links. Likewise, the most crucial cause factor is awareness. It is one of four cause factors with links to four effect factors.

6 Discussion

This study examined the strategies and practices needed for rural e-governance to ensure the 'direct use' of ICTs among marginalized rural communities. Multiple theories, including usability theory, stakeholder theory, affordance theory, and the unified model of electronic government adoption, were employed to identify a comprehensive range of factors that can serve as strategies or practices for rural e-governance (see Figure 4). The theory-driven literature review yielded sixteen factors, comprising eight strategies and eight practices, as shown in Table 1. Next, in-depth interviews yielded five novel factors: (1) digital inclusion for insurance, (2) software artefacts with easy setup, (3) data management, (4) ICT artefact interface, and (5) awareness. The first three are strategies, and the last two are practices, as shown in Table 2. These factors were further analysed and merged to produce a final list of twenty-one factors. Then, the factors were bucketed into five overarching groups based on their shared characteristics (see Table 3). The final list of strategic and practice factors, along with their descriptions and groupings, is outlined in Table D.1

(see Appendix D). Finally, experts' data were collected to apply the DEMATEL technique and study the causal relationships among the factors, as shown in Figure C.1 (see Appendix C).

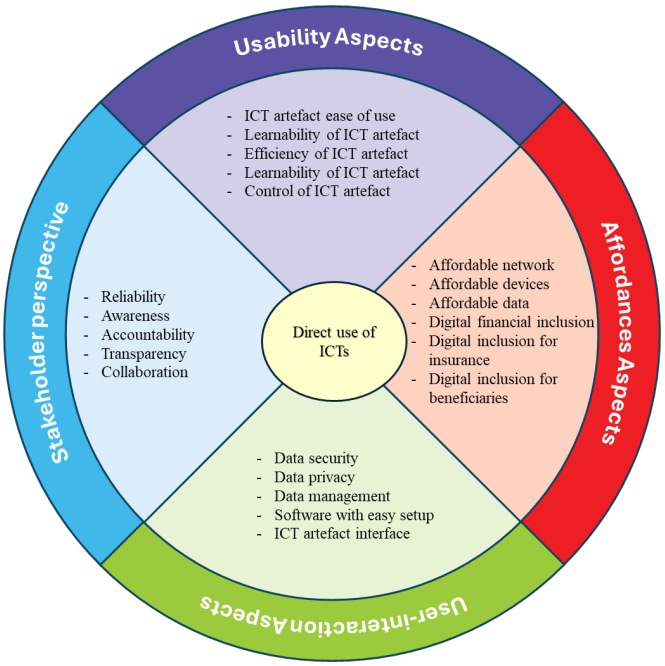


Figure 4: Factors categorized based on multiple theories for 'direct use of ICTs'

DEMATEL analysis helped select the eight top-most factors based on their prominence values being higher than the average, as shown in Table 4. The remaining thirteen factors exhibit below-average importance value. The topmost factors include the practices, "ICT artefact ease of use" (Pee et al., 2018), "efficiency of ICT artefact" (Li & Zhu, 2019), "control of ICT artefact" (Hoehle et al., 2016), and "learnability of ICT artefact" (Hoehle & Venkatesh, 2015). These practices can enhance the direct use of ICTs in rural communities by collectively influencing the design of ICT artifacts, embracing simple and intuitive design, given the distinct requirements and limitations of marginalized rural users. We suggest that "ICT artefact ease of use" is critical in pushing the direct use of ICT artefacts among marginalized rural populations. This practice can enable marginalized rural users to initiate the process using their own computing devices. In contrast, complex or difficult-to-use IT artefacts can intimidate users with low technological proficiency or literacy. The study highlights that the "efficiency of ICT artefact" is crucial for optimizing marginalized rural users' task completion time and effort. This practice might lead to faster and more responsive service delivery in rural e-governance initiatives, consequently fostering trust among marginalized rural users. The findings recommend that "control of ICT artefact" is a significant factor, which signifies whether marginalized rural users can handle the functions and features of ICT artefacts without any hassle or assistance. Implementing this as a practice can empower marginalized rural users. Independent user control over ICT artefacts may lead to increased frequency of usage, fostering direct use of ICTs within marginalized rural communities. In addition, the learnability of ICT artefacts is crucial for marginalized rural users to quickly learn the functionalities of mobile apps and websites without difficulties and complexities. Implementing this as a practice can reduce the cognitive load among marginalized rural users.

Likewise, the topmost factors include crucial strategies, "digital financial inclusion" (Pradhan et al., 2021), "digital inclusion for beneficiaries" (Kishore & Birthal, 2023), and a novel strategy, "digital inclusion for insurance,". These strategies can elevate the direct use of ICTs in marginalized rural communities due to their inherent socio-economic incentives. Formal banking services in many rural areas are often scant or non-existent, leaving citizens without access to essential financial services such as savings bank accounts, loans, insurance, and other services. This study highlights that marginalized rural citizens can access formal banking services through mobile banking, thus facilitating inclusive financial services to rural communities. The digital financial inclusion strategy can bridge the digital divide by ensuring that marginalized rural citizens have equitable access to financial services, stimulating their participation in e-governance services, and, in turn, enhancing the direct use of ICTs by marginalized rural users. Similarly, our study highlights that digital inclusion for beneficiaries can facilitate the verification and authentication of beneficiaries' information through digital means, ensuring that benefits (i.e., government welfare schemes) reach the intended

recipients. It can, in turn, improve marginalized rural users' direct use of ICTs. Furthermore, this strategy can expedite government assistance through digital means, eliminating intermediary interventions, improving socio-economic conditions, and alleviating poverty among marginalized rural communities.

The digital inclusion strategy for insurance can facilitate access to insurance services (including health and crop insurance) for marginalized rural communities through digital means. We suggest that digital inclusion for insurance can leverage technologies to deliver insurance-related services, ensuring much-needed risk coverage and support to marginalized rural communities. It can, in turn, improve marginalized rural users' direct use of ICTs. For instance, integrating the Ayushman card with Aadhaar (digital unique identity) facilitates the health insurance process, and linking land records and individual bank accounts streamlines the crop insurance process, reducing errors and ensuring prompt settlements for vulnerable sections of society, such as marginalized rural farmers.

Another topmost practice is ensuring the "reliability of e-governance" (Malodia et al., 2021). This factor can be crucial for delivering authentic and reliable e-governance services. Our findings suggest that this factor ensures that rural users can access e-governance services as needed, without interruption. This practice can foster trust among marginalized rural communities by enhancing the effectiveness of e-governance services and, in turn, increasing the direct use of ICTs among these users.

The DEMATEL digraph map helped us analyze causal linkages among these factors. Most importantly, our findings indicate that the identified factors are not independent but are closely interrelated. Thus, an empirical framework, i.e., through a digraph, has been constructed (considering a threshold value of 0.09) to highlight the interrelationship between the explored factors, as illustrated in Figure 3. This framework highlights the interrelated nature of the factors responsible for the 'direct use of ICTs' among marginalized rural users in the context of rural e-governance. Further, it is evident from the framework that factors within the same group and across different groups can exert influence on each other. For example, digital financial inclusion is an effect factor influenced by three cause factors: ICT artefact interface, affordable computing devices, and awareness.

The most crucial effect factor, the efficiency of ICT artefacts (see Figure 3), receives influences from the following seven cause factors: software artefacts with easy setup, ICT artefact ease of use, learnability of ICT artefact, affordable network quality, ICT artefact interface, affordable computing devices, and awareness. It suggests that the task completion time and effort for marginalized rural users while interacting with e-governance services is interdependent on other factors, such as the ease of download and installation of software by marginalized rural users and CSCs, marginalized rural users finding it easy to use e-governance services and willing to use it, quicker learning curve, affordability of network with acceptable quality, display language and layout as per marginalized rural users' comfort, affordability of computing devices, and knowledge about e-governance services offered for their benefit.

Likewise, the most crucial cause factor is awareness, which dispatches influences to the following four effect factors: efficiency of ICT artefact, digital inclusion for insurance, digital financial inclusion, and digital inclusion for beneficiaries. This factor suggests that knowledge about e-governance services offered to benefit marginalized rural communities is crucial for achieving desirable outcomes in digital inclusion schemes, including insurance, finance, and subsidies, as well as optimizing e-governance services for rural users.

These and other novel insights into the strategy and practice factors for rural e-governance can enhance the direct use of ICTs among marginalized rural users, leading to more inclusive and efficient rural e-governance services.

6.1 Theoretical Contributions

The current study makes several theoretical contributions to a scarcely researched topic. The main theoretical contributions are as follows. First, our research is likely the first attempt that focuses on reducing the 'proxy use of ICTs' among marginalized rural users for rural e-governance and examines the needed strategies and practices to ensure the 'direct use of ICTs' among marginalized rural users, addressing the digital divide and United Nations SDGs, specifically SDG 9C (W.E.F., 2023). We extend digital divide research in the second order (ICT use) to highlight practice-level conditions that shape citizens' agencies in e-governance participation. Second, our study makes a valuable contribution to the ICT4D literature by integrating multiple theories, including the UT, AT, ST, and UMEGA. This approach transcends the limitations of relying on a single theory, offering a comprehensive understanding of how usability, affordability, and governance dynamics intersect and influence the direct use of ICTs among marginalized

rural users. Third, our mixed-method approach is likely the first to combine the in-depth interview method with a decision-making technique, namely DEMATEL. Fourth, our study contributes two novel strategies, including software artefacts with easy setup and digital inclusion for insurance, as well as two novel practices, such as ICT artefact interface and awareness, based on in-depth interviews. These additions refine existing conceptualizations of usability and affordances by situating them in resource-constrained rural contexts. Fifth, our study also makes a novel methodological contribution by extending the DEMATEL method to develop a new threshold-based digraph map analysis called TH-DEMATEL. We developed steps to identify the threshold value that reveals both obvious and non-obvious influences in the system and draw a digraph to visually represent the linkages. Sixth, our research proposed an empirical framework that highlights the interlinked relationships among strategy and practice factors for rural e-governance, uncovering the cause-and-effect factors, their interlinkages, and their importance. Seventh, our study contributes by identifying digital inclusion strategies for insurance, subsidies, and finance as desirable effect factors, and affordance strategies for quality network and computing devices as desirable cause factors, based on TH-DEMATEL analysis. Finally, our findings contribute to theorizing in ICT4D literature by showing how digital inclusion strategies (insurance, subsidies, finance) emerge as desirable effect factors, while affordance strategies (network quality, affordable devices) emerge as desirable cause factors. This theorization clarifies which factors matter and how they interact causally, advancing the understanding of digital inclusion as a system of interconnected affordances rather than as isolated factors.

6.2 Practical implications

The findings of this study have substantial practical implications for government agencies, decision-makers, NGOs, developers, and other stakeholders involved in rural e-governance services. First, our research helps relevant stakeholders narrow the second-order digital divide (i.e., inequalities in ICT use) confronted by marginalized rural communities in developing countries by improving their understanding of desired rural e-governance strategies and practices. They can employ the proposed empirical framework to ensure the direct use of ICTs among marginalized rural communities and reduce the ‘proxy use of ICTs’. Second, our research informs government agencies that strategizing for relevant affordances can help promote the digital inclusion of marginalized rural communities and thereby narrow the digital divide. Third, our empirical framework suggests that decision-makers should prioritize ICT infrastructure-related strategies to provide targeted subsidies for affordable network quality, affordable Internet data plans, and affordable computing devices, which directly address affordability barriers and foster the inclusive diffusion of ICT artifacts among users with low digital literacy. Decision-makers need to develop regulatory frameworks that direct government portals and mobile applications to adhere to usability and accessibility standards, which ensure digital inclusion among marginalized rural users. Fourth, our empirical framework provides practices that developers should consider in the design and development of the ICT artefact features, keeping in mind the marginalized rural communities, explicitly focusing on the ICT artefact's ease of use, ICT artefact interface, and learnability of ICT artefacts to ensure usability and learnability for continued engagement with e-governance services. Fifth, our study informs NGOs and practitioners that increasing awareness about e-governance services among marginalized rural communities is a crucial practice for elevating the direct use of ICTs. This awareness can be achieved by organizing digital literacy workshops, deploying mobile kiosks, conducting local dialect campaigns, and collaborating with community leaders to enhance outreach. In addition, they build trust where skepticism and low cognizance about the direct use of ICTs remain a significant barrier. Sixth, for e-governance practitioners and developers, our study recommends prioritizing user-centric design aspects specifically targeting marginalized rural users. These include implementing software artefacts with easy setup that function on low-end smartphones, designing interfaces in local languages with simple layouts, and ensuring learnability through step-by-step prompts or guided tutorials. Practitioners should also focus on data management systems that eliminate duplication, correct discrepancies, and provide transparent and easy mechanisms for rural users to track their records, thereby building trust in e-government services. Finally, collaboration between government, NGOs, private agencies, and technology providers is essential to reduce the proxy use of ICTs. By co-developing solutions such as insurance enrollment digital platforms or mobile subsidy disbursement channels, stakeholders can align technological innovations with the lived realities of marginalized rural citizens. In doing so, this will not only promote digital inclusion but also contribute to the broader goals of equitable ICT and align with SDG 9C. Together, these strategies and practices can strengthen digital inclusion and enhance the direct use of ICTs among marginalized rural communities.

6.3 Limitations and Future Research Directions

The digital divide research in this study builds on the support of existing theories and insights from ICT4D and IS research. Therefore, some factors or factor categories in our research have been studied in the IS literature for different phenomena, such as adoption, challenges, and barriers for e-governance or ICTs in rural or other settings. In essence, earlier research in the IS field offers valuable perspectives that can be highly valuable to the 'direct vs proxy use of ICTs' phenomenon among marginalized rural users. Moreover, the actual phenomena of interest — i.e., the level of direct use of ICTs — differ substantially among different user categories: urban, rural, marginalized urban, and marginalized rural. For example, marginalized rural users may require higher ease of use of ICT artefacts than their urban counterparts. Therefore, even though a few of the final factors of our study's phenomenon (e.g., ICT artefact ease of use and efficiency of ICT artefact) are often highlighted in earlier literature on other phenomena, such as usability (Hoehle et al., 2016; Hoehle & Venkatesh, 2015; Venkatesh & Agarwal, 2006), these have been subtly explored in our research context to address the unique requirements of marginalized rural users.

This study has some limitations that may be worth addressing in future research. The expert panel size (n = 12) is consistent with prior MCDM and qualitative studies (Koley et al., 2025). However, some degree of subjective bias is inherent in expert-based evaluations, which limits generalizability. Further, this research study is limited to a particular state (Chhattisgarh) within one country, i.e., India. The findings could be validated through data from other states and countries. Further, cross-country comparisons might also help generalize the conclusions drawn in this study. In the future, researchers can explore and identify novel strategies and practices from new contexts, thereby broadening the applicability of current findings for decision-makers. Future researchers could further explore ICT-enabled innovations in rural e-governance services, thereby opening a new avenue for in-depth investigation. Moreover, studying the influence of these factors on the direct use of ICTs could shed light on the distinctive challenges encountered by marginalized rural communities residing in resource-constrained settings.

7 Conclusion

In this research, we employed a mixed-method approach combining in-depth interviews and the MCDM method to identify and analyze the interrelationships among strategic and practice factors for rural e-governance needed to boost the 'direct use of ICTs' among marginalized rural users. Governments and stakeholders across developing countries should implement these crucial strategies and practices to augment the direct use of ICTs among marginalized rural communities and reduce the 'proxy use of ICTs'. Through an integrated approach involving a theory-driven method and in-depth interviews with e-governance experts, this study identified twenty-one strategies and practices, which were then analyzed using the DEMATEL technique. In addition, all the factors were assigned, either strategies (based on long-term goals) or practices (that close the design-reality gap). Furthermore, the factors were categorized into five overarching groups depending on their similar characteristics. This study proposed and employed TH-DEMATEL to analyse the cause-and-effect relationships among the factors. We also established an empirical framework that highlights the interlinked relationships among the final twelve factors. Our study offers practical insights to decision-makers, policymakers, and stakeholders, providing a realistic representation of the direct use of ICTs among marginalized rural communities. Our research contributions are significant in rural e-governance settings of developing nations with analogous contexts.

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Acknowledgments

Declaration of AI

Appendix A: Title of the Appendix (If Applicable)

Appendix B

For our writing style guidelines, please see the provided PDF on https://aisel.aisnet.org/cais/format.html.

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Appendix A

Table A.1: Demographic profile of respondents driven factors (Working in various organisations: Central govt./State govt./Private Enterprise)

Expert	Age	Job designation	Work experience in years	Gender	Educational Qualification
E1	36	e-District Manager	8	Male	Graduate
E2	39	e-District Manager	11	Female	Graduate
E3	41	e-District Manager	9	Male	Postgraduate
E4	34	Janpad CEO	8	Male	Graduate
E5	40	e-District Manager	10	Female	Postgraduate
E6	38	e-District Manager	9	Male	Graduate
E7	32	e-District Manager	5	Male	Graduate
E8	39	CSC Manager	8	Male	Postgraduate
E9	35	e-District Manager	7	Female	Graduate
E10	29	e-District Manager	4	Male	Postgraduate
E11	40	Janpad CEO	9	Male	Graduate
E12	45	VLE (Village Level Enterpreneur)	10	Male	Graduate

Appendix B

Excerpts of Interview Topic Guides:

General questions for the government officials, namely e-District Managers/CEO Janpad/CSC Managers:

1. Please let us know about your current roles and responsibilities.
2. What are the difficulties you face in ensuring active usage of e-governance apps/websites by villagers?
3. What steps the government has taken to address those difficulties?
4. What strategies and best practices can work to ensure the active use of ICTs among rural communities?
5. What should be the order of prioritisation of these strategies and best practices?

General questions asked to the Gram Panchayat (village-level committee):

1. Please tell us which apps/websites you and other villagers use.
2. What are the difficulties villagers face in actively using e-governance apps and websites?
3. What steps the government needs to take to address those difficulties?
4. What strategies and best practices can work to ensure the active use of ICTs among you and other villagers?
5. What should be the order of prioritisation of these strategies and best practices?

Table B.1: Classification of zero-order, first-order, and second-order codes

Zero-order (Excerpts from in-depth interviews)	First-order	Second-order (Aggregate dimensions)
• They (rural users) expect simple steps to complete the e-service task	Simple to use	ICT artefact ease of use
• They should complete tasks on their own	Quick system response without lag or freezing	
• They want apps such that they can understand easily	Intuitive design that requires little or no efforts	
• They want minimal steps to complete the tasks	Icons and buttons to understand easily	
• Earlier they used to wait for hours; now it's being done instantly	Faster completion of transactions compared to traditional methods	Efficiency of ICT artefacts
• As soon as they perform task, they receive the service instantly	Lower incidence of repeated attempts or errors during use	
• The system should fill details automatically, so they don't have to type everything	Instant confirmation of successful transactions	
• They should manage the app on their own without asking someone for help	Ability to navigate and operate the service without external help	Control of ICT artefact
• They feel good when they finish the task without middlemen	Sense of autonomy in completing tasks independently	
• They can complete the task whenever they want	Control over timing and pace of service completion	
• If they do a mistake they can go back and correct it	Freedom to make corrections or changes	
• The app needs to be in local language, so that they can read and follow easily	Simple and familiar symbols/icons/fonts for easy recognition	ICT artefact Interface
• The screen should be less crowded so that they can see what to do next	Clear and uncluttered layout that avoids confusion	

• The icons should be simple so that they can understand quickly	Information presented in the local/regional language	
• The colours and big letters make it easy to notice the important parts	Use of visual cues (colour, size, highlights) to guide attention	
• They ask for steps that are easy to remember	Ability to understand functions after initial exposure	Learnability of ICT artefact
• After using two or three times they can do the task easily without confusion	Minimal practice needed for using proficiently	
• The app needs to show hints that guide them what next to press	Supportive cues (hints, prompts) that facilitate learning	
• Platform should be intuitive so that they should learn by themself	Clear and repeatable steps that are easy to remember	
• They can find the service on app easily without wasting time on searching	Clear menu structure that guides users logically	ICT artefact Navigability
• The menu needs to be simple so that they should know where to move next	Minimal steps needed to reach the desired function	
• They should not feel confused while moving from one feature to another	Visible and intuitive links, buttons, and back options	
• They want simple low-cost smartphones	Desire for low-cost smartphones	Affordable computing device
• They look for devices within their limited budgets.	Devices priced within rural household budgets	
• They cannot afford expensive devices	Durable devices to avoid frequent replacements	
• They want apps that install easily	Easy installation without intermediaries	Software artefacts with easy setup
• They prefer a setup with just a few simple steps	Desire for minimal steps in account creation and setup	
• They expect a quick start without long updates	Need for lightweight apps that work on basic devices	
• They expect apps that run on basic phones	Desire for quick start without lengthy updates or downloads	
• They look for network plans that are low-cost to keep active	Affordable access for basic network availability	Affordable network quality
• They want steady speed to load pages and complete tasks at low cost	Preference for consistent speed at low cost	
• They look for affordable options just to stay connected	Expectation of stable connectivity without interruptions within budget	
• They look for lower recharge packs which they can afford regularly	low-cost recharge packs for regular use	Affordable Internet Data
• They look for longer validity, so recharges last longer	Preference for longer validity data plans at affordable rates	
• They prefer the lowest data plan	low-cost internet plans suited to rural budgets	
• Officials need to resolve issues proactively	Expectation of timely responses to user queries and complaints	Accountability for e-governance
• Officials need to be responsible for all the e-services delivered	Assurance that issues raised will be resolved by officials	
• The government should be accountable for e-services delivered	clear responsibility when errors or failures occur	
• Government needs to convey details of request or services without hidden rules	Visibility of application or request status in real time	Transparency in e-governance services
• They should be aware of the status of their application	Openness in displaying timelines for approvals or completion	

• Government needs to show records and updates	Clear disclosure of service procedures and requirements	
• Services provided by government need to be dependable and not uncertain	Confidence that transactions/services will be completed successfully	Reliability of e-governance
• Government need to ensure that digital platforms shouldn't crash or hang	e-services work consistently without failures	
• Records to be safe and available when needed.	Stability of platforms without frequent technical issues	
• Conducting campaigns to share available e-services	Government campaigns to inform rural users about services	Awareness
• To organize awareness sessions in villages and panchayats	Community-level awareness drives (meetings, kiosks, panchayats)	
• To demonstrate rural users on how e-services work swiftly	Demonstrations and training sessions for rural users	
• Government to work with local bodies and private agencies to deliver services	Collaboration with NGOs and community-based organizations	Collaboration for e-governance
• NGOs are required to guide them in using e-services	Coordination with banks, private agencies providers for service delivery	
• Collaboration with telecom providers to improve access and affordable plans	Engagement with private telecom/ICT providers for better infrastructure	
• All stakeholders need to coordinate for providing better services	Collaboration with NGO, local officials, private agencies	
• All departments should be able to handle and retrieve all data as and when needed	Proper storage and archiving of user records for future access	Data Management
• All government departments to have a proper data management system	Assurance of secure handling of personal and service data	
• No loss or duplication of rural users' records	Integration of data across departments for seamless service	
• Rural users' personal data needs to be protected from outsiders	Protection of personal data from unauthorized access	Data security
• Safe handling of data and sensitive information	To safeguard data against any cyber security threat	
• The government need to safeguard data leaks or misuse	Safe handling of transactions and sensitive information	
• Government needs to handle personal information strictly confidential	Assurance that personal information is kept confidential	Data privacy
• Protection from outsiders seeing users' personal information.	Expectation that user data is not shared without consent	
• Government should ensure clear signs that their privacy is protected.	Protection from exposure of sensitive details to third parties	
• Government tries to remove middlemen in financial transactions	Removal of intermediaries in financial disbursements	Digital Financial Inclusion
• Government trying to include rural peoples to use digital channels for financial aspects	Access to secure digital payment options for rural users	
• Availability of multiple options (UPI, wallets, bank apps) for payments without charges	Assurance of low-cost or no-cost digital transactions	
• Benefits need to be disbursed on time without delays	Access to direct transfer of subsidies, pensions, and welfare benefits	Digital Inclusion for Beneficiaries
• Government to provide secure online systems for benefit transfers	Elimination of intermediaries in benefit disbursement	
• To remove middlemen in receiving beneficiaries from government	Inclusion of vulnerable and unbanked populations through digital accounts	
• They want simple options to enroll in health or crop insurance	Access to online enrollment for health and crop insurance schemes	Digital Inclusion for Insurance
• They expect affordable and subsidized digital insurance options	Easy status tracking of insurance policies and claims	
• They expect fast claim settlement without any intermediaries	Assurance of timely claim settlement via online mechanisms	

Appendix C

Next, we explain the steps of the TH-DEMATEL method, wherein steps 1-7 are the same as classic DEMATEL, while steps 8-10 introduce modifications.

Step 1: First, literature from the IS domain and experts' inputs were used to identify and finalize the criteria or factors (denoting strategies and practices) needed for rural e-governance to ensure the direct use of ICTs among rural users.

Step 2: A direct influence matrix was constructed, which captures the levels of influence among criteria.

In this step, experts are asked to indicate the direct influence exerted by a criterion on other criteria using a scale of 0 (no influence) to 4 (very high influence) with five levels, thereby obtaining pair-wise comparison matrices of each expert. The direct influence matrix is obtained by taking a mean of the corresponding matrix elements from the pair-wise comparison matrices as follows:

$$D = \frac{1}{K}\sum_{k=1}^{K} A_{n,n}^{k} \qquad (1)$$

Where A^k is a real-valued (n, n) pair-wise comparison matrix of the kth expert $k = 1,2, \dots, K$. K is the number of experts, and n is the number of criteria. For example, matrix D is shown in Table C.1 (see Appendix C), where $F1, F2, \dots, F21$ denote the factor codes.

Step 3: We normalize the direct influence matrix by scaling its elements as follows (e.g., Table C.2, Appendix C):

$$D_{norm} = s.D$$

$$s = \left(\frac{1}{\sum_{j=1}^{n}|D_{i,j}|}, \frac{1}{\sum_{i=1}^{n}|D_{i,j}|}\right) \qquad (2)$$

Step 4: The full direct-indirect influence matrix was computed by accounting for each criterion's infinite series of direct and indirect effects. The full direct-indirect influence matrix is calculated as follows (e.g., Table C.3, Appendix C):

$$F = D_{norm}(I - D_{norm})^{-1} \quad (3)$$

Where I is the identity matrix.

Step 5: The influence dispatched by a criterion to other criteria was calculated row-wise, and the influence received by a criterion from other criteria column-wise using Eqs. (4) and (5).

For ith row ($i = 1,2, \dots n$) $P_i = \sum_{j=1}^{n} F_{i,j}$ (4)

For jth column ($j = 1,2, \dots n$) $Q_j = \sum_{i=1}^{n} F_{i,j}$ (5)

Next, the prominence value was calculated, which measures the overall influence in the system contributed and experienced by a criterion, and the relation value, which measures the relative influence in the system contributed or experienced by a criterion.

For kth criterion ($k = 1,2, \dots n$)

$$Prominence\ value_k = P_k + Q_k$$

$$Relation\ value_k = P_k - Q_k$$

Next, the criteria were segregated into cause and effect groups using the relation values (Kumar & Dixit, 2018):

$$Relation\ value_k \geq 0 \rightarrow cause\ group$$

$$Relation\ value_k < 0 \rightarrow effect\ group$$

Step 6: A cause-effect diagram can be plotted using this information. It can be constructed by plotting the cause group's criteria first, then the effect group's criteria, and then the linkages (e.g., Fig. C.1, Appendix C).

Step 7: The relative importance of criteria was found using the prominence values (e.g., Table 4). A higher prominence value for a given criterion indicates its higher relative importance. It helps prioritise the top criteria/factors.

Step 8: To obtain the digraph map, the threshold value (α) must be finalized. It is typically done by averaging all the elements in matrix F, where n is the total number of criteria.

$$\alpha = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n}[F]_{ij}}{n^2} \quad (6)$$

Matrix, F (e.g., Table C.3, Appendix C) provides all the necessary information on how one factor influences the other, i.e., either dispatching or receiving. The threshold value needs to be determined to ignore obvious

influences from the system and to focus on the non-obvious influences for effective decision-making. Only those elements whose influence level in the matrix F is higher than the threshold value are selected for the digraph map (Tzeng & Huang, 2011).

Step 9: Alternatively, the threshold value can be decided by taking inputs from decision-makers or experts to remove the obvious influences from the system.

Step 10: This research proposes a novel alternative for the threshold value. A graphical analysis of drops in the number of linkages has been provided as the threshold value is progressively increased by 0.01 (e.g., Fig. C.2, Appendix C). In addition, details of additional linkages have been shown that drop from the system when the threshold is increased (e.g., Table C.4, Appendix C). This process helps decision-makers identify a suitable threshold value to keep only the non-obvious influences.

Table C.1. Direct influence matrix (D).

Code	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21
F1	0.0000	3.5000	3.8333	0.0000	3.0000	3.0833	0.0000	0.0000	2.4167	0.0000	0.0000	0.0000	1.5833	0.0000	0.7500	1.3333	0.0000	0.0000	3.5833	3.5833	3.5833
F2	1.8333	0.0000	3.0833	0.0833	1.4167	3.4167	0.0000	0.0000	1.0833	0.0000	0.0000	0.0000	1.5000	0.0833	0.0000	1.4167	0.0000	0.0000	3.0833	3.0000	2.8333
F3	1.7500	0.0000	0.0000	0.0000	0.7500	0.9167	0.4167	0.0000	0.0000	0.0000	0.0000	0.0000	2.3333	0.0000	0.0000	0.0833	0.0000	0.0833	0.2500	0.2500	0.2500
F4	3.9167	3.0833	4.0000	0.0000	3.5833	3.9167	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.6667	0.0000	1.5833	1.0833	0.0000	1.0000	3.9167	3.9167	3.9167
F5	3.0000	3.0833	3.9167	1.0833	0.0000	3.0833	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.5833	0.0000	1.4167	0.9167	0.0000	0.0000	3.9167	3.9167	3.9167
F6	2.0833	3.0000	3.6667	0.0000	1.4167	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.5000	0.0000	1.2500	1.1667	0.0000	0.0000	1.6667	1.6667	1.6667
F7	3.1667	1.5000	3.1667	2.0833	2.5833	3.2500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.1667	0.0000	1.2500	0.7500	0.0000	0.0000	4.0000	4.0000	4.0000
F8	2.9167	1.2500	3.7500	1.3333	1.5833	1.3333	1.0000	0.0000	0.0000	2.3333	0.0000	0.0000	3.6667	0.0000	0.0000	1.2500	0.0000	0.0000	3.6667	4.0000	4.0000

F9	3.0833	2.8333	2.8333	2.5000	1.2500	2.8333	2.9167	0.0000	0.0000	0.0000	1.5833	0.0000	3.2500	0.0000	0.0000	1.5833	2.5000	1.2500	3.1667	3.1667	3.1667
F10	1.3333	1.1667	2.8333	1.1667	1.0833	1.6667	2.3333	1.0833	1.1667	0.0000	1.4167	0.0000	2.5000	0.0000	1.9167	1.2500	1.5000	1.0833	3.4167	3.4167	3.4167
F11	1.5000	0.0000	3.3333	0.0000	0.0833	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.1667	3.1667	1.5833	0.0000	0.0000	0.0000	0.0000	1.3333	1.4167	1.4167
F12	0.0000	0.0000	1.6667	0.0000	0.0833	0.0000	0.0000	0.0000	0.0000	0.0000	3.1667	0.0000	3.1667	2.9167	3.0000	0.0000	0.0000	0.0000	1.7500	1.7500	1.7500
F13	0.1667	0.0000	3.0833	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	1.8333	0.0000	1.9167	0.0000	0.0000	0.0000	0.0000	0.3333	0.3333	0.3333
F14	1.5833	1.0833	2.7500	1.3333	0.0000	0.0000	0.0000	2.1667	0.0000	0.0000	2.4167	1.0833	1.1667	0.0000	0.0000	0.0000	1.7500	2.7500	3.0833	2.9167	3.0000
F15	2.8333	3.5000	3.6667	0.0000	3.2500	2.2500	0.0000	0.0000	0.0000	0.0000	0.0000	1.3333	0.0000	0.0000	0.0000	0.0000	2.2500	2.7500	4.0000	4.0000	4.0000
F16	0.0000	0.0000	0.6667	0.0000	0.3333	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.5833	1.5833	0.0000	0.0000	0.0000
F17	0.0000	0.0000	1.2500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	3.1667	0.0000	3.0000	0.0000	0.1667	0.0000	0.2500	4.0000	4.0000	3.9167	3.9167
F18	0.0000	0.0000	1.5000	0.0000	0.0833	0.0000	0.0000	0.0000	0.0000	0.0000	3.0833	0.0000	3.6667	0.5000	0.0000	0.0000	4.0000	0.0000	3.7500	3.7500	3.8333
F19	1.3333	0.9167	3.6667	0.0833	0.8333	0.0000	0.0000	0.0000	0.0000	0.0000	3.8333	1.5833	4.0000	1.7500	0.0000	0.0000	0.0000	0.0833	0.0000	2.5000	2.5000
F20	1.2500	0.9167	3.6667	0.0000	0.8333	0.0000	0.0000	0.0000	0.0000	0.0000	3.6667	1.5833	3.9167	1.7500	0.0000	0.0000	0.0833	0.0000	1.4167	0.0000	1.4167

F21	1.1667	0.917	3.6667	0.0000	0.8333	0.0000	0.0000	0.0000	0.0000	0.0000	3.8333	1.5833	3.917	1.7500	0.0000	0.0000	0.0833	0.0000	1.4167	1.4167	0.0000

Table C.2. Normalised direct influence matrix (D_{norm}).

Code	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21
F1	0.0000	0.0583	0.0639	0.0000	0.0500	0.0514	0.0000	0.0000	0.0403	0.0000	0.0000	0.0000	0.0264	0.0000	0.0125	0.0222	0.0000	0.0000	0.0597	0.0597	0.0597
F2	0.0306	0.0000	0.0514	0.0014	0.0236	0.0569	0.0000	0.0000	0.0181	0.0000	0.0000	0.0000	0.0250	0.0014	0.0000	0.0236	0.0000	0.0000	0.0514	0.0500	0.0472
F3	0.0292	0.0000	0.0000	0.0000	0.0125	0.0153	0.0069	0.0000	0.0000	0.0000	0.0000	0.0000	0.0389	0.0000	0.0000	0.0014	0.0000	0.0014	0.0042	0.0042	0.0042
F4	0.0653	0.0514	0.0667	0.0000	0.0597	0.0653	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0111	0.0000	0.0264	0.0181	0.0000	0.0167	0.0653	0.0653	0.0653
F5	0.0500	0.0514	0.0653	0.0181	0.0000	0.0514	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0264	0.0000	0.0236	0.0153	0.0000	0.0000	0.0653	0.0653	0.0653
F6	0.0347	0.0500	0.0611	0.0000	0.0236	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0250	0.0000	0.0208	0.0194	0.0000	0.0000	0.0278	0.0278	0.0278
F7	0.0528	0.0250	0.0528	0.0347	0.0431	0.0542	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0361	0.0000	0.0208	0.0125	0.0000	0.0000	0.0667	0.0667	0.0667
F8	0.0486	0.0208	0.0625	0.0222	0.0264	0.0222	0.0167	0.0000	0.0000	0.0389	0.0000	0.0000	0.0611	0.0000	0.0000	0.0208	0.0000	0.0000	0.0611	0.0667	0.0667
F9	0.0514	0.0472	0.0472	0.0417	0.0208	0.0472	0.0486	0.0000	0.0000	0.0000	0.0264	0.0000	0.0542	0.0000	0.0000	0.0264	0.0417	0.0208	0.0528	0.0528	0.0528
F10	0.0222	0.0194	0.0472	0.0194	0.0181	0.0278	0.0389	0.0181	0.0194	0.0000	0.0236	0.0000	0.0417	0.0000	0.0319	0.0208	0.0250	0.0181	0.0569	0.0569	0.0569

F11	0.0250	0.0000	0.0556	0.0000	0.0014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0361	0.0528	0.0264	0.0000	0.0000	0.0000	0.0000	0.0222	0.0236	0.0236
F12	0.0000	0.0000	0.0278	0.0000	0.0014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0528	0.0000	0.0528	0.0486	0.0500	0.0000	0.0000	0.0000	0.0292	0.0292	0.0292
F13	0.0028	0.0000	0.0514	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0167	0.0306	0.0000	0.0319	0.0000	0.0000	0.0000	0.0000	0.0056	0.0056	0.0056
F14	0.0264	0.0181	0.0458	0.0222	0.0000	0.0000	0.0000	0.0361	0.0000	0.0000	0.0403	0.0181	0.0194	0.0000	0.0000	0.0000	0.0292	0.0458	0.0514	0.0486	0.0500
F15	0.0472	0.0583	0.0611	0.0000	0.0542	0.0375	0.0000	0.0000	0.0000	0.0000	0.0000	0.0222	0.0000	0.0000	0.0000	0.0000	0.0375	0.0458	0.0667	0.0667	0.0667
F16	0.0000	0.0000	0.0111	0.0000	0.0056	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0264	0.0264	0.0000	0.0000	0.0000
F17	0.0000	0.0000	0.0208	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0528	0.0000	0.0500	0.0000	0.0028	0.0000	0.0042	0.0667	0.0667	0.0653	0.0653
F18	0.0000	0.0000	0.0250	0.0000	0.0014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0514	0.0000	0.0611	0.0083	0.0000	0.0000	0.0667	0.0000	0.0625	0.0625	0.0639
F19	0.0222	0.0153	0.0611	0.0014	0.0139	0.0000	0.0000	0.0000	0.0000	0.0000	0.0639	0.0264	0.0667	0.0292	0.0000	0.0000	0.0000	0.0014	0.0000	0.0417	0.0417
F20	0.0208	0.0153	0.0611	0.0000	0.0139	0.0000	0.0000	0.0000	0.0000	0.0000	0.0611	0.0264	0.0653	0.0292	0.0000	0.0000	0.0014	0.0000	0.0236	0.0000	0.0236
F21	0.0194	0.0153	0.0611	0.0000	0.0139	0.0000	0.0000	0.0000	0.0000	0.0000	0.0639	0.0264	0.0653	0.0292	0.0000	0.0000	0.0014	0.0000	0.0236	0.0236	0.0000

Table C.3. Full direct-indirect influence matrix (*F*)

Code	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21

F1	0.0197	0.0729	0.1002	0.0034	0.0612	0.0642	0.0028	0.0004	0.0424	0.0000	0.0187	0.0094	0.0564	0.0100	0.0162	0.0279	0.0039	0.0034	0.0804	0.0817	0.0815
F2	0.0433	0.0118	0.0782	0.0032	0.0322	0.0640	0.0015	0.0003	0.0201	0.0000	0.0144	0.0073	0.0473	0.0093	0.0031	0.0273	0.0023	0.0021	0.0649	0.0647	0.0620
F3	0.0325	0.0045	0.0095	0.0007	0.0157	0.0187	0.0070	0.0001	0.0014	0.0000	0.0030	0.0023	0.0439	0.0025	0.0014	0.0030	0.0004	0.0018	0.0098	0.0099	0.0099
F4	0.0859	0.0710	0.1102	0.0021	0.0750	0.0809	0.0010	0.0004	0.0047	0.0000	0.0206	0.0104	0.0453	0.0109	0.0315	0.0247	0.0040	0.0200	0.0918	0.0933	0.0931
F5	0.0669	0.0661	0.1017	0.0190	0.0142	0.0634	0.0009	0.0004	0.0039	0.0000	0.0185	0.0100	0.0552	0.0104	0.0271	0.0204	0.0025	0.0031	0.0851	0.0865	0.0864
F6	0.0452	0.0583	0.0823	0.0010	0.0318	0.0096	0.0007	0.0002	0.0029	0.0000	0.0093	0.0055	0.0414	0.0056	0.0226	0.0227	0.0020	0.0023	0.0411	0.0417	0.0416
F7	0.0727	0.0436	0.0943	0.0364	0.0582	0.0684	0.0008	0.0004	0.0037	0.0000	0.0198	0.0108	0.0668	0.0113	0.0260	0.0183	0.0024	0.0033	0.0902	0.0917	0.0916
F8	0.0665	0.0358	0.1017	0.0250	0.0400	0.0354	0.0191	0.0011	0.0041	0.0389	0.0205	0.0108	0.0921	0.0118	0.0054	0.0262	0.0029	0.0031	0.0832	0.0901	0.0900
F9	0.0733	0.0648	0.0934	0.0448	0.0377	0.0641	0.0495	0.0004	0.0041	0.0000	0.0488	0.0116	0.0905	0.0124	0.0061	0.0331	0.0045	0.0266	0.0833	0.0846	0.0845
F10	0.0434	0.0356	0.0891	0.0232	0.0331	0.0417	0.0409	0.0185	0.0218	0.0007	0.0454	0.0117	0.0762	0.0119	0.0362	0.0259	0.0303	0.0241	0.0839	0.0855	0.0854
F11	0.0314	0.0047	0.0716	0.0010	0.0058	0.0036	0.0006	0.0012	0.0013	0.0000	0.0110	0.0418	0.0669	0.0337	0.0027	0.0012	0.0014	0.0020	0.0309	0.0327	0.0327
F12	0.0109	0.0074	0.0513	0.0016	0.0077	0.0043	0.0004	0.0021	0.0006	0.0001	0.0654	0.0101	0.0699	0.0569	0.0510	0.0008	0.0041	0.0054	0.0425	0.0432	0.0432

F13	0.0072	0.020	0.0588	0.0009	0.0019	0.0017	0.0004	0.0013	0.0003	0.000	0.0223	0.0332	0.0087	0.0354	0.0019	0.0004	0.0013	0.0019	0.0109	0.0111	0.0111
F14	0.0404	0.0272	0.0777	0.0237	0.0097	0.0080	0.0013	0.0365	0.0021	0.0014	0.0611	0.0278	0.0512	0.0114	0.0031	0.0032	0.0335	0.0495	0.0724	0.0711	0.0725
F15	0.0651	0.0732	0.1016	0.0019	0.0663	0.0505	0.0009	0.0004	0.0040	0.000	0.0257	0.0322	0.0380	0.0123	0.0052	0.0055	0.0421	0.0499	0.0941	0.0956	0.0955
F16	0.0012	0.0007	0.0144	0.0001	0.0062	0.0007	0.0001	0.0000	0.0001	0.0000	0.0040	0.0007	0.0052	0.0010	0.0003	0.0002	0.0285	0.0284	0.0047	0.0048	0.0048
F17	0.0096	0.0051	0.0482	0.0005	0.0051	0.0020	0.0004	0.0005	0.0005	0.0000	0.0744	0.0117	0.0778	0.0126	0.0037	0.0006	0.0096	0.0683	0.0803	0.0804	0.0805
F18	0.0097	0.0051	0.0523	0.0007	0.0062	0.0021	0.0004	0.0007	0.0005	0.0000	0.0729	0.0119	0.0878	0.0205	0.0011	0.0006	0.0683	0.0058	0.0764	0.0777	0.0791
F19	0.0328	0.0215	0.0857	0.0028	0.0196	0.0057	0.0007	0.0014	0.0017	0.0001	0.0769	0.0359	0.0874	0.0394	0.0029	0.0019	0.0018	0.0037	0.0137	0.0546	0.0546
F20	0.0301	0.0206	0.0822	0.0014	0.0187	0.0053	0.0007	0.0014	0.0016	0.0001	0.0715	0.0345	0.0828	0.0379	0.0027	0.0018	0.0030	0.0023	0.0351	0.0127	0.0357
F21	0.0288	0.0205	0.0823	0.0014	0.0186	0.0052	0.0007	0.0014	0.0015	0.0001	0.0742	0.0346	0.0829	0.0380	0.0027	0.0017	0.0030	0.0023	0.0351	0.0357	0.0127

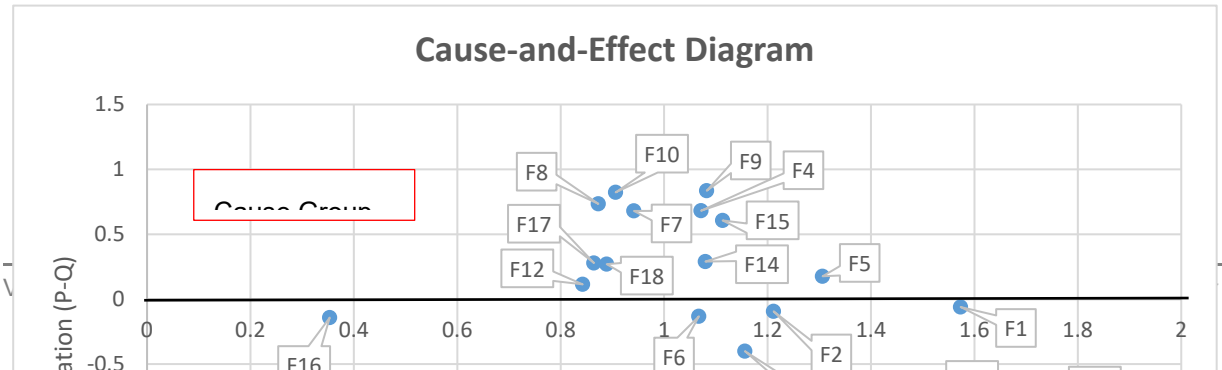
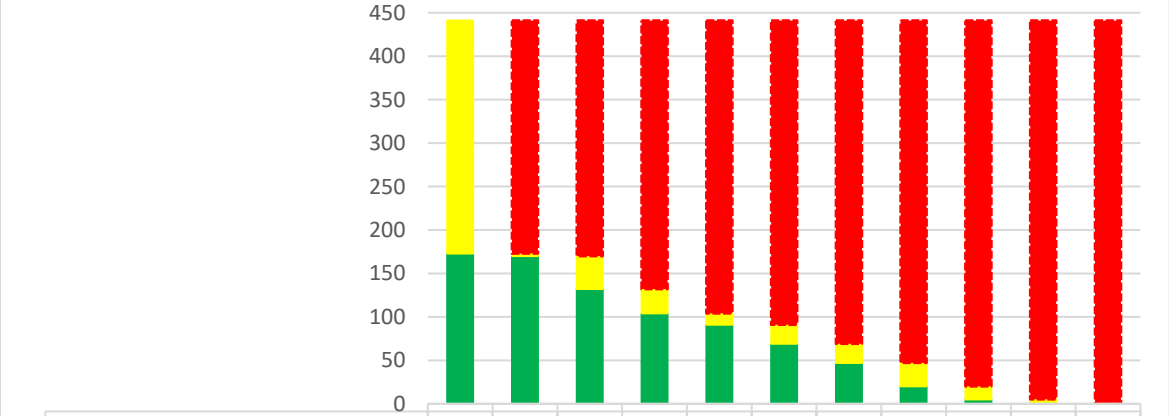


Figure C.1. Cause-effect groups and factor influences



No. of linkages dropped in previous cycle	0	268	271	309	337	350	372	394	421	436	440
No. of linkages drop with respect to the threshold value	268	3	38	28	13	22	22	27	15	4	1
No. of linkages remained	173	170	132	104	91	69	47	20	5	1	0
Threshold value	0.028	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.1	0.11	0.12

Figure C.2. Graphical illustration of drop in the number of linkages with increasing threshold values within the system

Table C.4: Drop of linkages in the system w.r.t increases in threshold values

Threshold values <	No. of linkages remained	Dropped linkage codes	Dropped Linkages with factor names	Influence Types Based on Experts Inputs
0.028 (Average)	441-268 = 173	268	Any factors scoring lower than the average value were removed in the initial phase due to weak influence	Weak
0.03	173-3=170	16-17	Data Management – Data security	Obvious
		16-18	Data Management – Data Privacy	Obvious
		21-1	Digital Inclusion for Beneficiaries- ICT artefact ease of use	Obvious
0.04	170-38=132	2-5	Control of ICT artefact - Learnability of ICT artefact	Obvious
		3-1	Efficiency of ICT artefact - ICT artefact ease of use	Obvious
		4-15	ICT artefact Interface - Awareness	Obvious
		6-5	ICT artefact Navigability - Learnability of ICT artefact	Obvious
		7-4	Affordable Computing devices- ICT artefact Interface	Obvious
		8-2	Affordable Network Quality- Control of ICT artefact	Obvious
		8-5	Affordable Network Quality- Learnability of ICT artefact	Obvious
		8-6	Affordable Network Quality- ICT artefact Navigability	Obvious
		8-10	Affordable Network Quality- Affordable Internet Data	Obvious
		9-5	Software artefacts with easy setup- Learnability of ICT artefact	Obvious
		9-16	Software artefacts with easy setup- Data Management	Obvious
		10-2	Affordable Internet Data-Control of ICT artefact	Obvious
		10-5	Affordable Internet Data-Learnability of ICT artefact	Obvious
		10-15	Affordable Internet Data-Awareness	Obvious
		10-17	Affordable Internet Data-Data security	Obvious
		11-1	Accountability for e-governance-ICT artefact ease of use	Obvious
		11-14	Accountability for e-governance-Collaboration for e-governance	Obvious
		11-19	Accountability for e-governance- Digital financial inclusion	Obvious
		11-20	Accountability for e-governance- Digital Inclusion for Insurance	Obvious

		11-21	Accountability for e-governance- Digital Inclusion for Beneficiaries	Obvious
		13-12	Reliability of e-governance- Transparency in e-governance	Obvious
		13-14	Reliability of e-governance- Collaboration for e-governance	Obvious
		14-8	Collaboration for e-governance- Affordable Network Quality	Obvious
		14-17	Collaboration for e-governance- Data Security	Obvious
		15-12	Awareness- Transparency in e-governance	Obvious
		15-13	Awareness- Reliability of e-governance	Obvious
		19-1	Digital financial inclusion- ICT artefact ease of use	Obvious
		19-12	Digital financial inclusion- Transparency in e-governance	Obvious
		19-14	Digital financial inclusion- Collaboration for e-governance	Obvious
		20-1	Digital Inclusion for Insurance- ICT artefact ease of use	Obvious
		20-12	Digital Inclusion for Insurance- Transparency in e-governance	Obvious
		20-14	Digital Inclusion for Insurance- Collaboration for e-governance	Obvious
		20-19	Digital Inclusion for Insurance- Digital financial inclusion	Obvious
		20-21	Digital Inclusion for Insurance- Digital Inclusion for Beneficiaries	Obvious
		21-12	Digital Inclusion for Beneficiaries- Transparency in e-governance	Obvious
		21-14	Digital Inclusion for Beneficiaries- Collaboration for e-governance	Obvious
		21-19	Digital Inclusion for Beneficiaries- Digital financial inclusion	Obvious
		21-20	Digital Inclusion for Beneficiaries- Digital Inclusion for Insurance	Obvious
0.05	132-28=104	1-9	ICT artefact ease of use- Software artefacts with easy setup	Obvious
		2-1	Control of ICT artefact- ICT artefact ease of use	Obvious
		2-13	Control of ICT artefact- Reliability of e-governance	Obvious
		3-13	Efficiency of ICT artefact- Reliability of e-governance	Obvious
		4-13	ICT artefact Interface- Reliability of e-governance	Obvious
		6-1	ICT artefact Navigability- ICT artefact ease of use	Obvious
		6-13	ICT artefact Navigability- Reliability of e-governance	Obvious
		6-19	ICT artefact Navigability- Digital financial inclusion	Obvious

		6-20	ICT artefact Navigability- Digital Inclusion for Insurance	Obvious
		6-21	ICT artefact Navigability- Digital Inclusion for Beneficiaries	Obvious
		7-2	Affordable Computing devices- Control of ICT artefact	Obvious
		9-4	Software artefacts with easy setup- ICT artefact Interface	Obvious
		9-7	Software artefacts with easy setup- Affordable Computing devices	Obvious
		9-11	Software artefacts with easy setup- Accountability for e-governance	Obvious
		9-17	Software artefacts with easy setup- Data Security	Obvious
		10-1	Affordable Internet Data- ICT artefact ease of use	Obvious
		10-6	Affordable Internet Data- ICT artefact Navigability	Obvious
		10-7	Affordable Internet Data- Affordable Computing devices	Obvious
		10-11	Affordable Internet Data- Accountability for e-governance	Obvious
		11-12	Accountability for e-governance- Transparency in e-governance	Obvious
		12-19	Transparency in e-governance- Digital financial inclusion	Obvious
		12-20	Transparency in e-governance- Digital Inclusion for Insurance	Obvious
		12-21	Transparency in e-governance- Digital Inclusion for Beneficiaries	Obvious
		14-1	Collaboration for e-governance- ICT artefact ease of use	Obvious
		14-18	Collaboration for e-governance- Data Privacy	Obvious
		15-17	Awareness - Data Security	Obvious
		15-18	Awareness - Data Privacy	Obvious
		17-3	Data Security- Efficiency of ICT artefact	Obvious
0.06	104-13=91	1-13	ICT artefact ease of use- Reliability of e-governance	Obvious
		5-13	Learnability of ICT artefact- Reliability of e-governance	Obvious
		6-2	ICT artefact Navigability- Control of ICT artefact	Obvious
		7-5	Affordable Computing devices- Learnability of ICT artefact	Obvious
		12-3	Transparency in e-governance- Efficiency of ICT artefact	Obvious
		12-14	Transparency in e-governance- Collaboration for e-governance	Obvious
		12-15	Transparency in e-governance- Awareness	Obvious

		13-3	Reliability of e-governance- Efficiency of ICT artefact	Obvious
		14-13	Collaboration for e-governance -Reliability of e-governance	Obvious
		15-6	Awareness- ICT artefact Navigability	Obvious
		18-3	Data Privacy- Efficiency of ICT artefact	Obvious
		19-20	Digital financial inclusion- Digital Inclusion for Insurance	Obvious
		19-21	Digital financial inclusion- Digital Inclusion for Beneficiaries	Obvious
0.07	91-22=69	1-5	ICT artefact ease of use- Learnability of ICT artefact	Obvious
		1-6	ICT artefact ease of use- ICT artefact Navigability	Obvious
		2-6	Control of ICT artefact- ICT artefact Navigability	Obvious
		2-19	Control of ICT artefact- Digital financial inclusion	Obvious
		2-20	Control of ICT artefact- Digital Inclusion for Insurance	Obvious
		2-21	Control of ICT artefact- Digital Inclusion for Beneficiaries	Obvious
		5-1	Learnability of ICT artefact- ICT artefact ease of use	Obvious
		5-2	Learnability of ICT artefact- Control of ICT artefact	Obvious
		5-6	Learnability of ICT artefact- ICT artefact Navigability	Obvious
		7-6	Affordable Computing devices -ICT artefact Navigability	Obvious
		7-13	Affordable Computing devices- Reliability of e-governance	Obvious
		8-1	Affordable Network Quality- ICT artefact ease of use	Obvious
		9-2	Software artefacts with easy setup- Control of ICT artefact	Obvious
		9-6	Software artefacts with easy setup- ICT artefact Navigability	Obvious
		11-13	Accountability for e-governance- Reliability of e-governance	Obvious
		12-11	Transparency in e-governance -Accountability for e-governance	Obvious
		12-13	Transparency in e-governance- Reliability of e-governance	Obvious
		14-11	Collaboration for e-governance- ICT artefact ease of use	Obvious
		15-1	Awareness- ICT artefact ease of use	Obvious
		15-5	Awareness- Learnability of ICT artefact	Obvious
		17-18	Data Security- Data Privacy	Obvious
		18-17	Data Privacy- Data Security	Obvious

0.08	69-22=47	1-2	ICT artefact ease of use- Control of ICT artefact	Obvious
		2-3	Control of ICT artefact- Efficiency of ICT artefact	Obvious
		4-2	ICT artefact Interface- Control of ICT artefact	Obvious
		4-5	ICT artefact Interface- Learnability of ICT artefact	Obvious
		7-1	Affordable Computing devices- ICT artefact ease of use	Obvious
		9-1	Software artefacts with easy setup- ICT artefact ease of use	Obvious
		10-13	Affordable Internet Data- Reliability of e-governance	Obvious
		11-3	Accountability for e-governance- Efficiency of ICT artefact	Obvious
		14-3	Collaboration for e-governance- Efficiency of ICT artefact	Obvious
		14-19	Collaboration for e-governance- Digital financial inclusion	Obvious
		14-20	Collaboration for e-governance- Digital Inclusion for Insurance	Obvious
		14-21	Collaboration for e-governance- Digital Inclusion for Beneficiaries	Obvious
		15-2	Awareness- Control of ICT artefact	Obvious
		17-11	Data Security- Accountability for e-governance	Obvious
		17-13	Data Security- Reliability of e-governance	Obvious
		18-11	Data Privacy- Accountability for e-governance	Obvious
		18-19	Data Privacy- Digital financial inclusion	Obvious
		18-20	Data Privacy- Digital Inclusion for Insurance	Obvious
		18-21	Data Privacy- Digital Inclusion for Beneficiaries	Obvious
		19-11	Digital financial inclusion- Accountability for e-governance	Obvious
		20-11	Digital Inclusion for Insurance- Accountability for e-governance	Obvious
		21-11	Digital Inclusion for Beneficiaries- Accountability for e-governance	Obvious
0.09	47-27=20	1-19	ICT artefact ease of use- Digital financial inclusion	Obvious
		1-20	ICT artefact ease of use- Digital Inclusion for Insurance	Obvious
		1-21	ICT artefact ease of use- Digital Inclusion for Beneficiaries	Obvious
		4-1	ICT artefact Interface- ICT artefact ease of use	Obvious

		4-6	ICT artefact Interface- ICT artefact Navigability	Obvious
		5-19	Learnability of ICT artefact- Digital financial inclusion	Obvious
		5-20	Learnability of ICT artefact- Digital Inclusion for Insurance	Obvious
		5-21	Learnability of ICT artefact- Digital Inclusion for Beneficiaries	Obvious
		6-3	ICT artefact Navigability- Efficiency of ICT artefact	Obvious
		8-19	Affordable Network Quality- Digital financial inclusion	Obvious
		9-19	Software artefacts with easy setup- Digital financial inclusion	Obvious
		9-20	Software artefacts with easy setup- Digital Inclusion for Insurance	Obvious
		9-21	Software artefacts with easy setup- Digital Inclusion for Beneficiaries	Obvious
		10-3	Affordable Internet Data- Efficiency of ICT artefact	Obvious
		10-19	Affordable Internet Data- Digital financial inclusion	Obvious
		10-20	Affordable Internet Data- Digital Inclusion for Insurance	Obvious
		10-21	Affordable Internet Data- Digital Inclusion for Beneficiaries	Obvious
		17-19	Data Security- Digital financial inclusion	Obvious
		17-20	Data Security- Digital Inclusion for Insurance	Obvious
		17-21	Data Security- Digital Inclusion for Beneficiaries	Obvious
		18-13	Data Privacy- Reliability of e-governance	Obvious
		19-3	Digital financial inclusion- Efficiency of ICT artefact	Obvious
		19-13	Digital financial inclusion- Reliability of e-governance	Obvious
		20-3	Digital Inclusion for Insurance- Efficiency of ICT artefact	Obvious
		20-13	Digital Inclusion for Insurance- Reliability of e-governance	Obvious
		21-3	Digital Inclusion for Beneficiaries- Efficiency of ICT artefact	Obvious
		21-13	Digital Inclusion for Beneficiaries- Reliability of e-governance	Obvious
0.1	20-15=5	7-3	Affordable Computing devices- Efficiency of ICT artefact	Non-obvious
		7-19	Affordable Computing devices- Digital financial inclusion	Non-obvious
		7-20	Affordable Computing devices- Digital Inclusion for Insurance	Non-obvious
		7-21	Affordable Computing devices- Digital Inclusion for Beneficiaries	Non-obvious
		4-19	ICT artefact Interface- Digital financial inclusion	Non-obvious

		4-20	ICT artefact Interface- Digital Inclusion for Insurance	Non-obvious
		4-21	ICT artefact Interface- Digital Inclusion for Beneficiaries	Non-obvious
		8-13	Affordable Network Quality- Reliability of e-governance	Non-obvious
		8-20	Affordable Network Quality- Digital Inclusion for Insurance	Non-obvious
		8-21	Affordable Network Quality- Digital Inclusion for Beneficiaries	Non-obvious
		9-3	Software artefacts with easy setup- Efficiency of ICT artefact	Non-obvious
		9-13	Software artefacts with easy setup- Reliability of e-governance	Non-obvious
		15-19	Awareness- Digital financial inclusion	Non-obvious
		15-20	Awareness- Digital Inclusion for Insurance	Non-obvious
		15-21	Awareness- Digital Inclusion for Beneficiaries	Non-obvious
0.11	5-4=1	1-3	ICT artefact ease of use - Efficiency of ICT artefact	Non-obvious
		5-3	Learnability of ICT artefact - Efficiency of ICT artefact	Non-obvious
		8-3	Affordable Network Quality - Efficiency of ICT artefact	Non-obvious
		15-3	Awareness - Efficiency of ICT artefact	Non-obvious
0.12	1	4-3	ICT artefact Interface- Efficiency of ICT artefact	Non-obvious
Note: Non-obvious influences listed in the last column are corresponding to the threshold value of 0.09				

Appendix D

Table D.1: Combined Factors (Strategies and practices) from Interviews and Theory driven

Groups	Factors	Strategy/ Practice	Description	Reference
ICT artefact features	ICT artefact ease of use	Practice	It is the degree to which a rural user finds an e-governance service easy to use and develops an intent to use it.	Venkatesh & Agarwal, 2006; Hoehle & Venkatesh, 2015; Hoehle et al., 2016; Pee et al., 2018;
	Efficiency of ICT artefact	Practice	It is the degree to which the e-governance service optimises the task completion time and effort for rural users.	Adapted from Li and Zhu, 2019; Hoehle & Venkatesh, 2015; Hoehle et al., 2016; Venkatesh & Agarwal, 2006;
	Control of ICT artefact	Practice	It is the degree to which a rural user perceives control when receiving service through the e-governance app or website.	Adapted from Li and Zhu, 2019; Hoehle et al., 2016.
	ICT artefact Interface	Practice	It is the degree to which an e-governance service presents the necessary information in the language and layout understood by the rural users.	Through Interview
	Learnability of ICT artefact	Practice	It is the degree to which a rural user can quickly learn to use an e-governance service.	Lee & Kozar, 2012; Li and Zhu, 2019; Hoehle & Venkatesh, 2015; Hoehle et al., 2016;
	ICT artefact Navigability	Practice	It is the degree to which a rural user can easily navigate and find the necessary information.	Lee & Kozar, 2012; Verkijika & Wet, 2018; Pee et al., 2018; Hoehle & Venkatesh, 2015; Hoehle et al., 2016
ICT infrastructure features	Affordable computing devices	Strategy	It is the degree to which rural users can access e-governance services in a computing device that is affordable to them.	Dwivedi et al., 2016; Sharma et al., 2021; Sarangi & Pradhan, 2020
	Software artefacts with easy setup	Strategy	It is the degree to which the rural user can easily download and install the needed ICT artefacts.	Through Interview
	Affordable Network Quality	Strategy	It is the degree to which rural users can smoothly use the e-governance service using an affordable network.	Dwivedi et al., 2016; Oshara & Mawela, 2015; Martínez-Domínguez & Mora-Rivera, 2020
	Affordable Internet Data	practice	It is the degree to which rural users can access the e-governance service by using internet data that is affordable to them.	Adapted from Strover, 2001; Oshara & Mawela, 2015; Martínez-Domínguez & Mora-Rivera, 2020.
e-Governance features	Accountability for e-governance	Strategy	It is the degree to which the government responds to rural users' queries and is responsible for all e-	Malodia et al., 2021; Saldanha et al., 2022; Park & Gil-Garcia,

			service activities towards rural users.	2022; Matheus et al., 2021
	Transparency in e-governance	Strategy	It is the degree to which the government provides e-governance service openly and transparently for rural users.	Malodia et al., 2021; Saldanha et al., 2022; Park & Gil-Garcia, 2022; Matheus et al., 2021
	Reliability of e-governance	Practice	It is the degree to which the government provides reliable and authentic e-governance services for rural users.	Malodia et al., 2021; Li & Shang, 2020; Sá et al., 2016
	Awareness	Practice	It is the degree to which the government spreads awareness about e-governance services to rural users.	Through Interview
	Collaboration for e-governance	Strategy	It is the degree to which the government collaborates with other stakeholders to deliver effective e-governance services.	Samsor 2021; Wouters et al., 2023
Information Technology Management	Data Management	Strategy	It is the degree to which the government could manage and archive the data as needed for rural users.	Through Interview
	Data Security	Practice	It is the degree to which the government adopts security mechanisms to prevent unauthorised modification and access to rural users' data.	Dwivedi et al., 2017; Sharma et al., 2021; Sá et al., 2016
	Data Privacy	Practice	It is the degree to which the government adopts security mechanisms to prevent unauthorised disclosure of rural users' data.	Dwivedi et al., 2017; Sharma et al., 2021; Sá et al., 2016
ICT-enabled Innovations	Digital Financial Inclusion	Strategy	It is the degree to which the government introduces suitable online payment mechanisms to ensure the financial inclusion of rural users.	Pradhan et al., 2021; Niu et al., 2022; Hussain et al., 2023
	Digital Inclusion for Beneficiaries (Cash or in-kind support)	Strategy	It is the degree to which the government introduces suitable online mechanisms for direct benefits transfer to the bank account to ensure the digital inclusion of rural users.	Markose et al., 2022; Varshney et al., 2021; Kishore & Birthal, 2023
	Digital Inclusion for Insurance	Strategy	It is the degree to which the government introduces suitable online mechanisms for health and crop insurance to ensure the digital inclusion of rural users.	Through Interview