Challenges Common Service Centers (CSCs) Face in Delivering e-Government Services in Rural India

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Abstract

Many developing countries across the world are allocating a significant share of their budgets for e-government initiatives. Common service centers (CSCs) are e-government initiatives that aim to increase access to public services and promote easy and direct interaction with the government. These e-government initiatives are largely underutilised, especially in rural areas in developing countries. This study attempts to identify the key challenges facing CSCs and determine their hierarchical relationships in the context of rural India. A set of 15 challenges was identified through a rigorous literature review and by surveying experts and CSC owners. Data were collected on the identified challenges and were analysed using interpretive structural modeling (ISM)-MICMAC-fuzzy MICMAC analysis. Subsequently, we developed a hierarchical model of challenges. The findings revealed that "longer travel time and transaction cost", "low digital literacy", and "low awareness" of e-government services are among the key challenges CSCs face in rural India. This study suggests several recommendations to all the stakeholders involved in the management of CSCs to improve the delivery of e-government services in rural India.

Keywords: Citizen access outlets, Common service centers (CSCs), e-government, Interpretive structural modeling (ISM), fuzzy MICMAC, Rural India.

1. Introduction

Advances in information and communication technologies (ICTs) over the last two decades have resulted in the more transparent working of public sector organisations and more effective service delivery (Dwivedi, Weerakkody, & Janssen, 2012; Sharma & Mishra, 2017). These technologies have enabled government services to go online, making them more accessible to citizens, leading to a phenomenon now popularly known as e-government (Rana, Dwivedi, & Williams 2013; Venkatesh, Thong, Chan, & Hu 2016; Dwivedi, Rana, Janssen, Lal, Williams, & Clement 2017).

E-government is defined as "the use of the Internet by government agencies to provide informational and transactional services to citizens" (West, 2004). E-government has helped reduce the gap between the government and citizens across developed and developing countries by making public services accessible via mobile phones, desktop computers, laptops, and other devices common in daily life (Shareef, Archer, Kumar & Kumar, 2010; Carter, Weerakkody, Phillips, & Dwivedi, 2016; Evans & Yen 2006; Kumar, Sachan, & Mukharjee, 2017). E-government initiatives such as online income tax filing, goods and services tax filing, and passport application filing have not only ensured greater transparency but have also reduced the time and cost associated with public service delivery and have helped integrate the working of multiple departments.

Despite recent bounds in technological innovation, several challenges persist. One such challenge in developing countries is the non-availability of internet-enabled computers on a one-to-one basis or even on a one-to-many basis in several parts of the country. In a UN e-government survey, in 2016, it was reported that 82% of the population in developed countries has internet access whereas this figure drops to 35% in the case of developing countries (United Nations, 2016). For example, as reported in the Census of India (2011), about 833 million (68.84%) live in rural and 377 million (31.16%). The NSO (2020) reported that 23% of urban population in India has access to computers, whereas in case of rural it drops to 4%. It is evident that the digital divide between the urban and rural populations is significant and this gap is increasing (Chandwani & Dwivedi, 2015). In such a scenario, e-government services may not be an effective solution for ensuring improved, transparent, and user-friendly public services.

To achieve their Sustainable Development Goals, developing countries such as India, Malaysia, Pakistan, Bangladesh, Saudi Arabia, UAE, and the nations of the African continent

have deployed an alternative solution: common service centers (CSCs). These centers have been established in rural India such that one CSC with internet connectivity can serve two or three villages. Instead of providing individual villagers direct access to e-government portals/websites (which would require several internet-enabled computers), CSCs serve as platforms to complete transactions required for e-service delivery, bringing public service delivery to citizens' doorsteps using ICT tools. To improve public service coverage in rural areas, the Government of India (GoI) set up 250,000 CSCs (Dwivedi et al., 2016a), employing more than a million people to deliver digital services to rural residents (Mandavia, 2019). In addition, GoI is developing digital infrastructure in villages to empower CSCs and subsequently minimise the digital divide. CSCs in India deliver various services to citizens residing in the rural hinterland, such as the following:

- **Telemedicine**: With the help of medical experts, the GoI has made telemedicine services available at almost no fee. As per the official Twitter handle of the GoI (@_DigitalIndia), in April 2020, during the COVID-19 national lockdown, more than 30,000 rural citizens across the country availed of teleconsultations using CSCs (Kumar, 2020).
- **Passport services**: CSCs enable citizens to fill online passport application forms and pay the required registration fee.[1]
- **Aadhar updating services**: In a recent development, the GoI permitted 20,000 CSCs to start an "Aadhar updation facility" where citizens can update their Aadhar (resident) cards with new information (Ojha, 2020).

Despite, or perhaps because of, their rapid proliferation, CSCs across India are facing numerous challenges. Researchers have also highlighted numerous concerns related to public service delivery at CSCs in India (Dwivedi et al. 2016a; Sharma & Mishra, 2017). These concerns may also influence the effectiveness of CSCs in rural India. These challenges may be organisational, technological, or societal, and may hinder the working of CSCs. Understanding the key challenges facing CSCs and their inter-relationships can help decision-makers develop strategies to improve their effectiveness. To the best of the authors' knowledge, there is no study available in the literature that has examined the challenges facing CSCs in rural settings, and subsequently, the interrelationships among these challenges. In this study, we propose the following two research questions:

[1] https://portal2.passportindia.gov.in/AppOnlineProject/pdf/PSP_Live_through_Common_Services_Centres.pdf

1. What are the key challenges encountered by CSCs in effectively delivering electronic public services to citizens in rural India?
2. What are the contextual and hierarchical relationships between challenges, and how can decision-makers develop effective strategies based on these relationships to improve public service delivery in rural India?

Methodologically, we employed interpretive structural modelling (ISM), MICMAC (Matrice d'Impacts Croises-Multiplication Appliqúe an Classment (cross-impact matrix multiplication applied to classification), and fizzy MICMAC to determine the interrelationships between the challenges CSCs face in rural India. The findings of this research will contribute new theoretical ideas to the domain of strategic planning for infrastructure and applications, which is a component of IS management processes research (Baskerville and Myers, 2002). In addition, identifying challenges and developing a hierarchical framework of challenges would help decision-makers develop and implement effective strategies for delivering integrated e-services to citizens at CSCs. In sum, this research supports IS researchers' broad consensus that research should respond to two goals: contribute to the body of knowledge and help practitioners address industry intricacies (Sein, Henfridsson, Purao, Rossi, & Lindgren 2011).

The remainder of the research paper is organised as follows. An overview of CSCs and a literature review of key challenges are presented in Section 2. Section 3 discusses the research methodology adopted to achieve the objectives of the paper. Section 4 covers the details of the data analysis, the ISM model, and other important findings. The discussion on the ISM results and MICMAC analysis are presented in Section 5. The next section covers theoretical and practical implications. We have summarised the limitations of the study and future work in Section 7 and present our concluding remarks in Section 8.

2. Literature review

This section presents an overview of e-government and CSCs in Indian context and reviews the literature pertaining to the key challenges CSCs face in electronic public service delivery.

2.1 Review of e-government

E-government has become a mechanism worldwide to make citizens' lives better, and government processes flexible and transparent. Advancements in information and communication technology such as better internet connectivity and easier access to desktops and

mobile devices have changed how governments work and have led citizens to expect more accessible and transparent public services. Luna□Reyes, Gil□Garcia, & Romero (2012) classified e-government practices into four categories: e□services (providing public services), e□management (improving managerial effectiveness), e□democracy (promoting democratic values and mechanisms), and e□policy (developing public policies). This study focuses on e-services, i.e., delivering public services using electronic media. Before delving deep into e-services, it is essential to understand the meaning of e-government. Silcock (2001) defined e-government as "the use of technology to enhance the access to and delivery of government services to benefit citizens, business partners and employees" and Evans & Yen (2006) defined e-government as "the communication between the government and its citizens via computers and web-enabled presence". Several previous studies have focused on the adoption of e-government services from citizen's point of view and have provided recommendations to improve the adoption rate (Venkatesh et al., 2003; Shareef et al., 2011; Sharma et al. 2013; Rana & Dwivedi, 2015; Rana et al., 2015; Sharma 2015; Carter et al. 2016; Dwivedi et al., 2017; Zuiderwijk, Janssen, & Dwivedi, 2015). E-Government adoption is the most researched domain in e-government research. The majority of the adoption studies published on e-government services across the globe are based on theoretical models of technology adoption like the technology acceptance model (Davis, 1989), UTAUT (Venkatesh et al. 2003), and IS success model (DeLone & McLean, 2003). The models mentioned above have been reviewed and extended by several researchers worldwide to address a large number of context-specific issues (Bhattacharya, Gulla & Gupta 2012; Sharma & Mishra, 2017; El-Haddadeh, Weerakkody, Osmani, Thakker & Kapoor 2019). Several studies in the literature have discussed the factors that influence the acceptance of e-government services in developed and developing countries. The key objectives of e-government projects are to reduce the cost of service delivery; minimise the effort required to deliver services; improve the ease of workflow processes, and increase transparency. Governments in developing countries adopt two approaches to provide public services: government web portals and common service centers (CSCs) where citizens visit to avail of e-services. The concept of CSCs is prevalent in many developing countries like India, Sri Lanka, Pakistan, Malaysia, Saudi Arabia, UAE, etc. Researchers (Sein 2011; Sein & Furuholt 2012; Meng, Samah & Omar 2013; Weerakkody, El-Haddadeh, Al-Sobhi, Shareef, & Dwivedi

2013) have proposed various definitions of CSCs. We propose a comprehensive definition of CSCs in the Indian context:

Common service centers (CSC) are traditional office spaces in rural and remote India where computers and services are inaccessible, with the objective of delivering integrated, government e-services to the population under the supervision of trained data entry operators catering to a sizable population for carrying out necessary transactions efficiently.

Researchers (Dwivedi et al., 2012; 2016a; 2016b; Ramli, 2017; Bindu, Sankar & Kumar, 2019; Choi & Chandler, 2020) argue that e-government (Web portal and CSCs mode) improves the quality of public services and also help governments improve their credibility among citizens by decreasing corruption and increasing transparency. To achieve these objectives, governments worldwide are investing heavily in e-government projects but facing multiple challenges. (Ojha & Pandey, 2017). It is important to note that e-government challenges are common in developing countries and developed countries. Chen et al. (2006) studied e-government implementation challenges in both developing and developed countries. They compared developing and developed countries concerning "history and culture", "technical staff", "infrastructure", "citizens", and "government officers". Further, researchers (Dada 2006; Dwivedi et al. 2012; Meng et al. 2013; Chandwani & Dwivedi 2015; Dwivedi et al. 2016a; Ramli 2017; Glyptis, Christofi, Vrontis, Del Giudice, Dimitriou, & Michael 2020) also argue that e-government services face multiple challenges in developing countries. These challenges are related to technology, security and privacy, leadership skills, financing, political, social, legal, and workforce aspects. Most of these challenges are common in both channels (web portals and CSCs) of e-government service delivery. The challenges faced by e-government services leave dissatisfied citizens, and hence governments face criticism from them. Therefore, understanding challenges faced by CSCs are of great importance to decision makers in governments that will help them in developing effective strategies to deliver smooth and transparent services to citizens residing in rural India.

2.2 Common service centres (CSCs) in Indian context

The Information Technology Department under the GoI has been implementing technological innovations in rural areas to minimise the digital divide between rural and urban populations. The integration of information technology in governance has helped the Indian government develop innovative ways (for example, CSCs) of delivering public services to

citizens and businesses, focusing on the rural sector (Dwivedi et al. 2016a) Over the past one and half decades, the government has rolled out many initiatives to support India's digital infrastructure and to promote e-government; these include framing policies and guidelines for social media, security, and citizen engagement, and standards related to information security, metadata, enterprise architecture, and interoperability, among others. The GoI set up CSCs under the National e-Governance Plan (NeGP) in 2006 to deliver government services to citizens electronically. Private and public agencies operate CSCs in 6,00,000 villages across India and deliver healthcare, education, banking, agriculture, insurance, and utility payment services to citizens. In addition, the Ministry of External Affairs in 2014 partnered with CSCs in rural areas to launch pre-passport services such as filling the online application, paying the fee online, and fixing the appointment to visit the Passport Office (Srivastava 2015). As per the statistics available, around 2,19,000 passport applications were submitted using CSCs across India in 2016–17.[2] Some of the services provided by CSCs in 2019 included filling in the Symbiosis University application form, filing an online application for a TVS loan, and agriculture services such as soil testing. CSCs, in partnership with HDFC Bank, are helping small traders and village-level entrepreneurs (VLEs) by providing "Small Business MoneyBack Credit Cards" to make banking services more accessible (Ray 2019). VLEs, with a network of 2,70,000 operators, are perhaps the most significant stakeholders of the CSCs scheme. CSCs also plan to establish 6,000 academies at the block level and provide courses from Symbiosis University, National Institute of Open Schooling (NIOS), National Institute of Electronics & Information Technology (NIELIT), Indira Gandhi National Open University (IGNOU), and Pradhan Mantri Gramin Digital Saksharta Abhiyan (Prime Minister Village Digital Literacy Campaign) (PTI 2019). Also, e-health can help reach residents living in remote areas. Telemedicine is one of the most significant e-healthcare initiatives in recent times that is being delivered through CSCs to residents living in rural areas. These are some of the innovative and prominent initiatives associated with e-government that can reach people living in rural areas and transform their lives (Kumar 2017).

2.3 Key challenges faced by CSCs in rural India

Governments in developing countries are employing CSCs to deliver e-services mainly in underdeveloped areas. Researchers (Meng et al. 2013; Chandwani & Dwivedi 2015 Dwivedi et

[2] http://cschelp.in/Passport.php

al. 2016a; Ramli 2017; Glyptis et al. 2020) also argue that e-government (web portal and CSCs) face multiple challenges in developing countries. These challenges vary from web portal mode of e-services delivery to CSC mode of e-service delivery. In this study, we are attempting to identify challenges CSCs face in rural India. Understanding of these challenges is essential for policy makers to develop an effective strategy to deliver electronic public service delivery to citizens in an effective and transparent manner. To identify critical challenges facing CSCs, we conducted a keyword search in two prominent databases namely Scopus and Google Scholar. The combinations of prominent keywords used while searching databases were "key challenges + common service centers + developing countries"; "challenges + CSCs + e-government"; "barriers + CSCs+ India"; and "drivers + common service centers + e-services". Our search resulted in 1682 research articles, book chapters, reports. We filtered results using three main criteria namely deduplication, title, and abstract based shortlisting. The filtering process reduced the list of final articles to 41. We finalised a list of 15 key challenges (see Table 1) using literature review of 46 articles. In addition, five experts from academia and government settings were invited to provide feedback on the 15 identified challenges. These experts agreed with the identified set of challenges faced by CSCs in rural settings.

Table 1
Key challenges being faced by CSCs

Challenge	Description	Sources
Lack of digital literacy in rural India	Lack of digital literacy hinders rural residents in using e-government services	Ciborra, & Navarra 2005; Chen et al. 2006; Almarabeh & AbuAli 2010; Malik, Dhillon & Verma 2014; Srivastava 2015; Dwivedi, et al 2016a; Kumar 2017
Lack of interoperability	The lack of integration and interoperability of the various e-government services available to rural users can reduce the pace at which they are adopted	Ndou 2004; Almarabeh & AbuAli 2010; Malik et al. 2014; Bindu et al. 2019
Lack of training for CSC operators	Lack of training for CSC operators impede them from effectively delivering e-government services in rural areas	Signore, Chesi & Pallotti 2005; Almarabeh & AbuAli 2010; Meng et al. 2013
Problem of dormancy	Non-use of e-services by citizens could reduce the net benefits of CSCs	Almarabeh & AbuAli 2010
Technological and networking challenges	Lack of good quality desktop computers, printers, internet connectivity, and other required equipment at CSCs may discourage residents from using e-government services	Jaeger & Thompson 2003; Chen et al. 2006; Rana et al. 2013; Meng et al. 2013; Malik et al. 2014; Srivastava 2015; Dash & Pani 2016; Dwivedi et al. 2016a; Ojha & Pandey 2017; Ramli 2017; Kumar 2017; Glyptis et al. 2020

Delay in receiving e-certificates	Delays in receiving e-certificates (e.g., birth certificate, income certificate, land registration certificate, etc.) is an issue for e-government service delivery in rural India	Bhattacharya et al. 2012; Sharma & Mishra 2017; El-Haddadeh et al. 2019; Bindu et al. 2019
Lack of awareness	Limited knowledge of e-services and their advantages can reduce their usage in rural settings	Simon 2004; Shareef et al. 2010; Shareef et al. 2011; Dwivedi et al. 2012; Weerakkody et al. 2013; Sharma et al. 2013; Rana et al. 2015; Dash & Pani 2016; Srivastava 2015; Dwivedi et al 2016a; Sharma & Mishra 2017; Ramli 2017; Bindu et al. 2019
Privacy and security issues	Security breaches, lack of protection against fraud and cyber-attacks, and interception of confidential information (such as personal information) in e-government systems will reduce rural users' engagement with CSCs	Edmiston 2003; Signore et al. 2005; Bhattacharya et al. 2012; Mittal & Kaur 2013; Rana et al. 2015; Kumar et al. 2017; El-Haddadeh et al. 2019; Bindu et al. 2019
Lack of infrastructure	Lack of necessary infrastructure like electricity and basic amenities at CSCs may discourage residents from using e-government services in rural India	Jaeger & Thompson 2003; Ciborra, & Navarra 2005; Edmiston 2003; Ndou 2004; Chen et al. 2006; Malik et al. 2014; Srivastava 2015; Dash & Pani 2016; Dwivedi et al. 2016b; Kumar et al. 2017; Bindu et al. 2019; Glyptis et al. 2020
Language problem	The lack of availability of e-government services in the local language reduce their usage by users who can only read the local language and not English	Ndou 2004; Signore et al. 2005; Meijer 2015; Srivastava 2015;
Lack of community-centric services at CSCs	e-Government services are generally developed without taking inputs from rural users. As a result, it does not fulfill their expectations and is not actively used by them	Meng et al. 2013; Meijer 2015; Chandwani & Dwivedi 2015; Dwivedi, et al., 2016a
Lack of trust	Lack of trust can stop citizens from availing the benefits of e-government service delivery	Simon 2004; Al-Busaidy & Weerakkody 2009; Mittal & Kaur 2013; Weerakkody, et al. 2013; Sharma 2015; Meijer 2015; Venkatesh et al. 2016; Carter et al. 2016; Sharma & Mishra 2017; Janseen et al. 2018; Sharma et al. 2018; Santa, MacDonald, & Ferrer 2019; Rana et al. 2019
Resistance to change	Rural users' reluctance to change to the automated system can impact the initiative's capacity to deliver e-government services in rural India	Rana et al. 2013; Chandwani & Dwivedi 2015; Rana et al. 2015; Lallmahomed, Lallmahomed, & Lallmahomed 2017
Loner travel time and transaction costs	Longer travel time required and high travel transaction costs may discourage rural users from using e-government services	Liang & Huang 1998; Devraj, Fan & Kohli 2002
Lack of net benefits of CSCs	Problems related to the expected benefits in the long term from CSCs in rural India	Proposed by authors

in rural India		

3. **Research methods**

A combined interpretive structural modeling (ISM), MICMAC, and fuzzy MICMAC research methodologies were adopted to achieve the proposed objectives of the study (Janssen, Luthra, Mangla, Rana, & Dwivedi 2019; Rana, Luthra, & Rao 2019). ISM is a systematic and interactive research method for understanding the interrelationships among a set of factors, identified based on feedback received from domain experts and other key stakeholders (Warfield, 1974). Researchers (Janssen, Rana, Slade, & Dwivedi 2018; Hughes, Rana, & Dwivedi 2020) have used ISM to explore the interrelationships among key decision variables in various contexts.

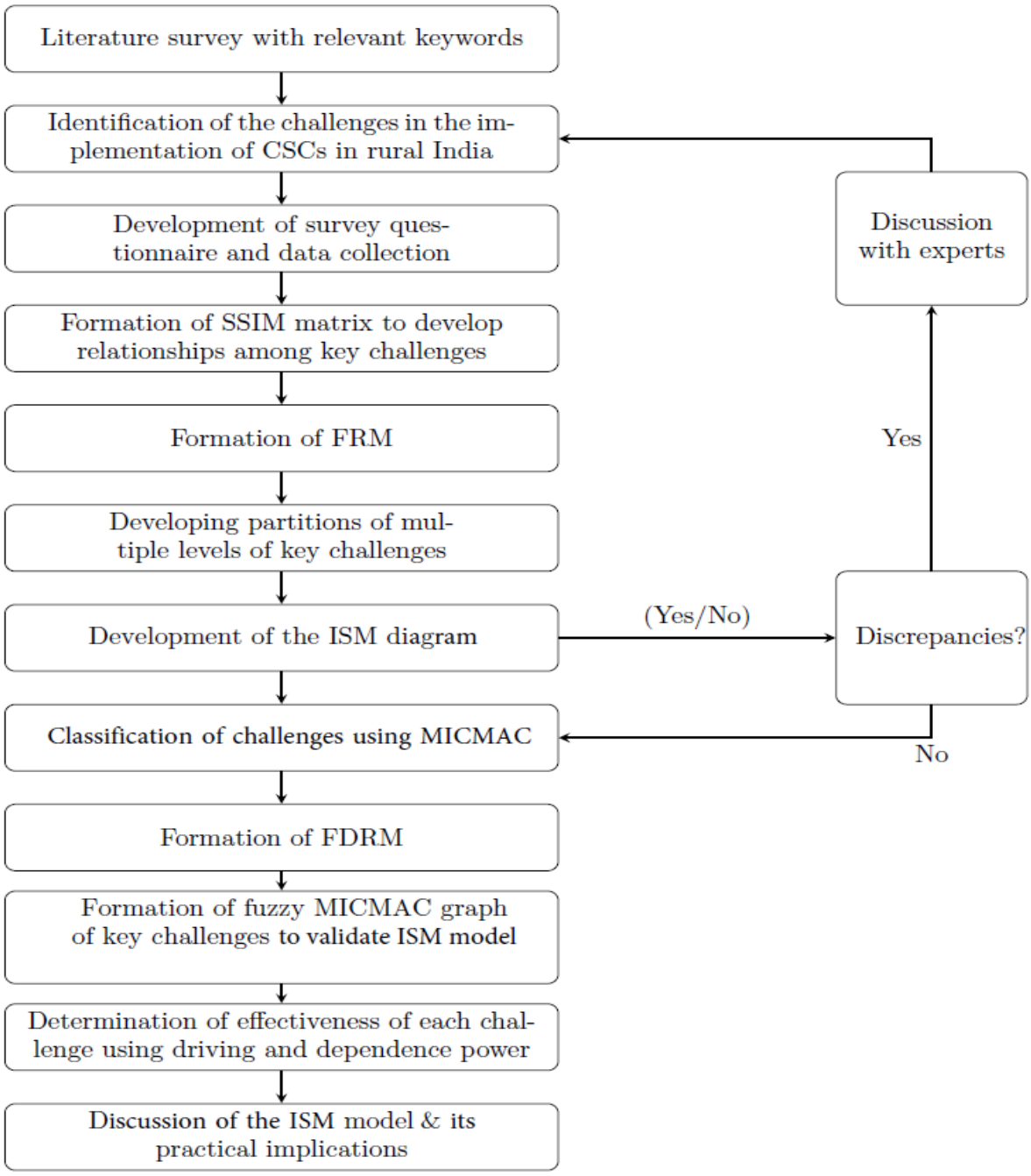

Fig. 1. ISM-fuzzy MICMAC flowchart (Adapted from Sharma et al. 2018)

The integration of ISM with the fuzzy MICMAC method is considered to improve robustness as it provides a holistic and comprehensive understanding of the problem under consideration. In the extant literature, this combination is considered better than other multi-criteria decision-making methods such as the analytic network process (ANP) and analytical hierarchy process (AHP) (Rana et al., 2019). The integrated ISM and fuzzy MICMAC method

helps in exploring interrelationships and dependencies among decision variables to uncover hidden patterns. In this study, we have adopted the ISM, MICMAC, and fuzzy MICMAC method (see Figure 1) with the help of the following steps as recommended in the literature (Al-Muftah, Weerakkody, Rana, Sivarajah, & Irani 2018; Rana et al. 2019).

- Step 1: We finalised the set of challenges influencing the usage of CSCs in rural India. The challenges were identified with the help of a systematic literature review, opinion of experts and CSC owners.
- Step 2: Data collection related to the interrelationships among the finalised set of challenges facing CSCs.
- Step 3: Development of the structural self-interaction matrix (SSIM) with the help of pairwise comparison of the finalised challenges based on the inputs of experts.
- Step 4: Development of the initial reachability matrix (IRM) from the SSIM discussed in the aforementioned step. In this step, we confirmed the transitive relationships (if any) among all the challenges to develop the final reachability matrix (FRM).
- Step 5: In this step, we computed the driving and dependence power of each challenge by adding the one's row and column wise in the FRM.
- Step 6: Development of the reachability set, antecedent set, and intersection set from the aforementioned sets. The reachability set is the set of challenges it influences. The antecedent set is the set of the challenge itself and other challenges influence by it. We further developed partition levels by checking if the same challenges were in the reachability set and intersection set.
- Step 7: Development of a digraph of challenges based on the partition levels obtained in Step 6.
- Step 8: Development of a four-quadrant graph (MICMAC analysis) of all challenges using the driving and dependence power of each challenge faced by CSCs in rural India.
- Step 9: Validation of the ISM model using fuzzy MICMAC analysis.
- Step 10: Discussion and practical implications of the finally developed ISM model.

4. Data analysis

We collected data related to key challenges CSCs face in rural India using the adapted questionnaire from the extant literature (Sharma et al. 2018; Rana et al. 2019; Al-Muftah et al.

2018; Hughes et al. 2020). There were three sections in the survey questionnaire—the demographic details of the respondents, the ranking of the key challenges, and data related to the pairwise comparison of the key challenges being faced by CSCs in rural India. We adopted the convenient sampling approach to collect data. Data were collected from 21 participants (academics and industry experts) who attended a workshop on e-government challenges in a premier business school in August 2019 in Tamil Nadu, India.

Table 2
Respondents' profiles

Demographic	Group	Frequency	Percentage
Gender	Male	17	59
	Female	12	41
Geographic location	International	5	17
	National	24	83
Highest qualification	Doctorate	15	52
	Post-graduate	11	38
	Graduate	3	10
Work experience	Less than 5 years	4	14
	Between 5 and 15 years	22	76
	More than 15 years	3	10
Sector classification	Public sector	16	55
	Private sector	11	38
	Self-employed	2	7
CSCs experience	Less than 1 year	5	17
	Between 1 to 3 years	13	45
	More than 3 years	11	38

In addition, data were also collected from eight owners of CSCs in September 2019, who are private players and have partnered with the government to facilitate e-services by employing data entry operators who serve as intermediaries between citizens and the government portal. The respondents' profiles are presented in Table 2. Data were gathered from respondents with a

diverse gender background (59% male and 41% female) and academic profile (doctorate: 52%, post-graduate: 38%, and graduate: 10%). Most of the respondents worked in the public sector and had more than five years of work experience. Five professors from international universities participated in the data collection process, whereas the remaining 24 were Indian nationals. In addition, the respondents were familiar with the working of CSCs and some of them had first-hand experience of availing services from CSCs.

In the next section of the ISM questionnaire, participants were asked to rank the finalised 14 challenges on a scale of 1–5 (1-not significant, 2-somewhat significant, 3-significant, 4-very significant, and 5-extremely significant). The summary of the average score of each challenge is presented in Table I (Appendix). Based on the average ranking of the challenges by respondents (Table I Appendix), lack of digital literacy among citizens was found to be the most critical challenge in the proliferation of CSCs in rural settings followed by lack of awareness about e-government services, technological and networking challenges, reluctance to change to computerized services, delay in receiving e-certificates, lack of infrastructure, and lack of trust in electronic services. The average score of all the identified challenges was greater than 3.0 on a scale of 5.0, indicating that all the challenges are critical in explaining why CSCs have failed to deliver net benefits in rural India. Given the importance of all the challenges, we decided to include them in the analysis. ISM is an appropriate method to understand the aggregate opinion of experts on the interrelationships among the key challenges faced by CSCs in rural India. In the following sub-sections, the data analysis steps undertaken in this study using the ISM methodology are summarised.

4.1 *Development of structural self-interaction matrix (SSIM)*

We developed the SSIM with the help of a pairwise comparison of all the finalised challenges by experts and CSC owner's inputs. Data were gathered from 29 respondents using the ISM questionnaire. In the next stage, we compiled all the responses received from respondents based on the majority of the responses with respect to each cell and consequently, the final SSIM was developed (Table 3). Four symbols, namely V, A, X, and O, were used, where V indicates that challenge i influences challenge j, A indicates that challenge j influences challenge i, X indicates that challenge i and challenge j influence each other, and finally O indicates that challenge i and challenge j are unrelated.

Table 3
Relationship matrix for challenges faced by CSCs in rural India

C(i, j)	15	14	13	12	11	10	9	8	7	6	5	4	3	2
1. Lack of digital literacy in rural India	X	V	V	V	V	V	V	V	V	V	V	V	V	V
2. Lack of interoperability	V	A	V	V	V	V	X	V	A	V	X	X	V	
3. Lack of training for CSC operators	V	A	A	A	A	X	A	A	A	X	A	A		
4. Problem of dormancy	V	A	V	V	V	V	X	V	A	V	X			
5. Technological and networking challenges	V	A	V	V	V	V	X	V	A	V				
6. Delay in receiving e-certificates	V	A	A	A	A	X	A	A	A					
7. Lack of awareness	V	X	V	V	V	V	V	V						
8. Privacy and security issues	V	A	X	X	X	V	A							
9. Lack of infrastructure	V	V	V	V	V	V								
10. Language problem	V	A	A	A	A									
11. Lack of community-centric services at CSCs	V	A	X	X										
12. Lack of trust	V	A	X											
13. Resistance to change	V	A												
14. Longer travel time and transaction costs	V													
15. Lack of net benefits of CSCs in rural India														

4.2 *Development of the initial reachability matrix (IRM) and final reachability matrix (FRM)*

In the next step in the ISM methodology, the SSIM is transformed into the IRM by assigning binary numbers (0 and 1) to V, A, X, and O as per the rules discussed in the extant literature (Mangla, Luthra, Rich, Kumar, Rana, & Dwivedi 2018; Sharma, Mangla, Luthra, & Al-Salti. 2018; Rana et al., 2019). In SSIM, we assign "1" for the (i, j) cell and "0" for the (j, i) cell for V; "0" for the (i, j) cell and "1" for the (j, i) cell for A; "1" for both the (i, j) cell and (j, i) cell for X; finally, "0" for both the (i, j) cell and (j, i) cell for O to obtain the IRM. Furthermore, we checked the transitive relation of all possible combinations of challenges. For example, challenge C1 is related to challenge C4, and challenge C4 is related to challenge C8, then challenge C1 must be related to challenge C8. After satisfying the transitivity rule in IRM, a FRM was developed. There was no case of contradiction of transitivity among challenges in the FRM. See Table II (Appendix) for the IRM and FRM.

4.3 *Developing hierarchical levels for ISM model*

In the final step of the ISM methodology, we categorised the challenges into different hierarchical levels. We developed a reachability set and antecedent set for each challenge with the help of FRM (Warfield, 1974). Also, we computed the intersection set for the aforementioned sets. If the challenges in the reachability set and intersection set are the same, we assign the challenge(s) to the highest level of the hierarchical model and drop challenge(s) from further analysis. This procedure is repeated until all the sets are exhausted. The complete set of iterative processes to obtain the level for each challenge is provided in Table III (Appendix). The summary of the levels assigned to each challenge is given in Table 4.

Table 4
Levels of key challenges CSCs face in rural India

S.N.	Challenge for eGov Service Delivery in Rural India	Level
C1	Lack of digital literacy in rural India	I
C7	Lack of awareness	II
C14	Longer travel time and transaction cost	
C4	Problem of dormancy	III
C9	Lack of infrastructure	
C2	Lack of interoperability	
C5	Technological and networking challenges	
C8	Privacy and security issues	IV
C12	Lack of trust	
C13	Resistance to change	
C11	Lack of community-centric services at CSCs	
C6	Delay in receiving e-certificates	V
C3	Lack of training for CSC operators	
C10	Language problem	
C15	Lack of net benefits of CSCs in rural India	VI

4.4 *ISM model*

The final set of levels assigned to each challenge (see Table 6) was obtained with the help of the iterative procedure available in Appendix I using the FRM (see Table 5). Next, we developed an ISM (Figure 2) for a deeper understanding of the interrelationships among challenges faced by CSCs in rural India.

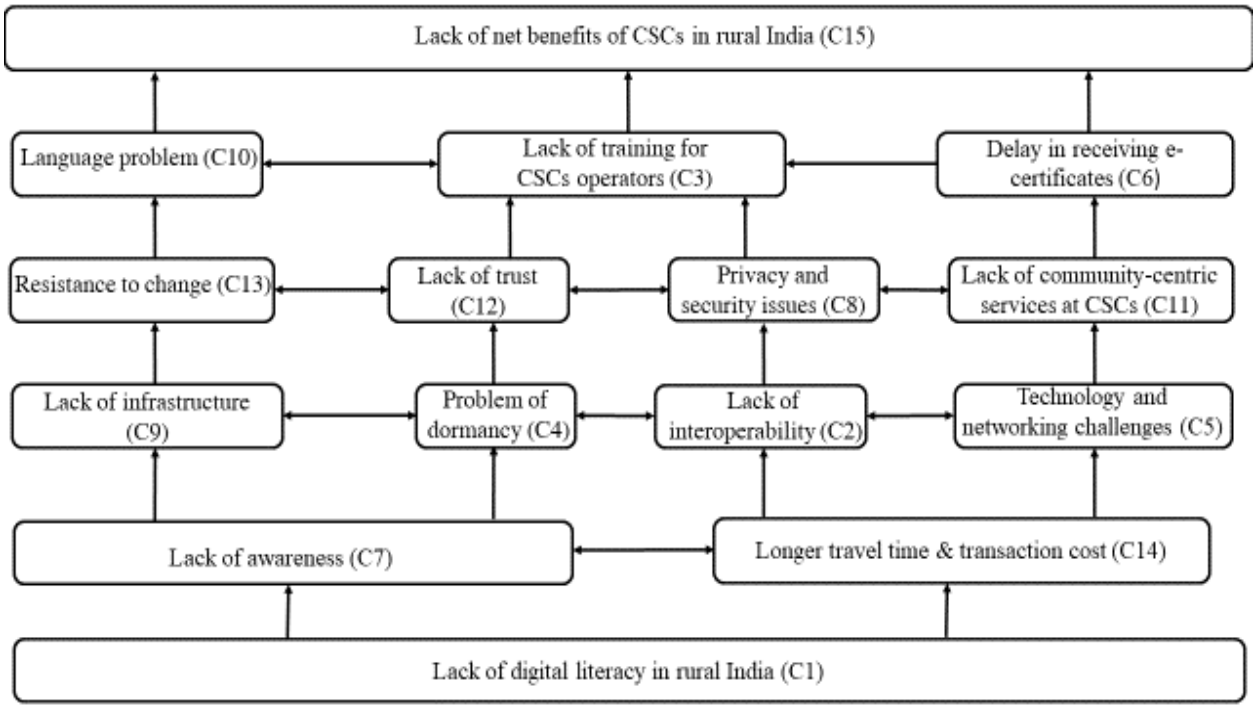

Fig. 2. ISM Model for key challenges of CSCs

4.5 *MICMAC analysis for classification of challenges faced by CSCs*

Duperrin and Godet (1973) introduced the basic notion of MICMAC. MICMAC analysis helps in developing a graph that classifies the identified factors based on their driving and dependence power (Saxena & Vrat 1990). Furthermore, researchers (Al-Muftah et al. 2018; Rana et al. 2019; Hughes et al. 2020) argue that this method helps in the validation of the hierarchical model developed using ISM. In this study, the MICMAC analysis was performed to classify challenges faced by CSCs in rural India (see Figure 3) into four regions-the autonomous region, dependent region, linkage region, and independent region based on the dependence and driving power of each challenge. The description of each region is given below.

4.5.1 Autonomous region

Challenges with low dependence and low driving power fall in this region. It has been observed that no challenge falls in this category. This finding implies that all of the selected challenges influence the successful realisation of the net benefits of CSCs in rural India.

4.5.2 Dependent region

The challenges with high dependence and low driving power fall in this category. The challenges C3, C6, C10, and C15 fall under the dependent region. These challenges are positioned at a

higher level in the structural model. These challenges are considered as desired outcomes. These challenges are influenced by other challenges and hence decision-makers should prioritise these challenges.

4.5.3 Linkage region

Challenges with higher dependence and high driving power fall under this region. The challenges C8, C11, C12, and C13 fall under the linkage region. These challenges are positioned in the middle of the structural model and hence these challenges are considered unstable challenges. Therefore, decision-makers need to pay special attention to handling these challenges.

4.5.4 Independent region

Challenges with low dependence and high driving power fall under this region. The challenges C1, C2, C4, C5, C7, C9, and C14 fall under the independent region. The challenges falling in this region are positioned at the lowest level of the structural model. These challenges are considered key challenges in the structural model and hence decision-makers need to give them the highest priority.

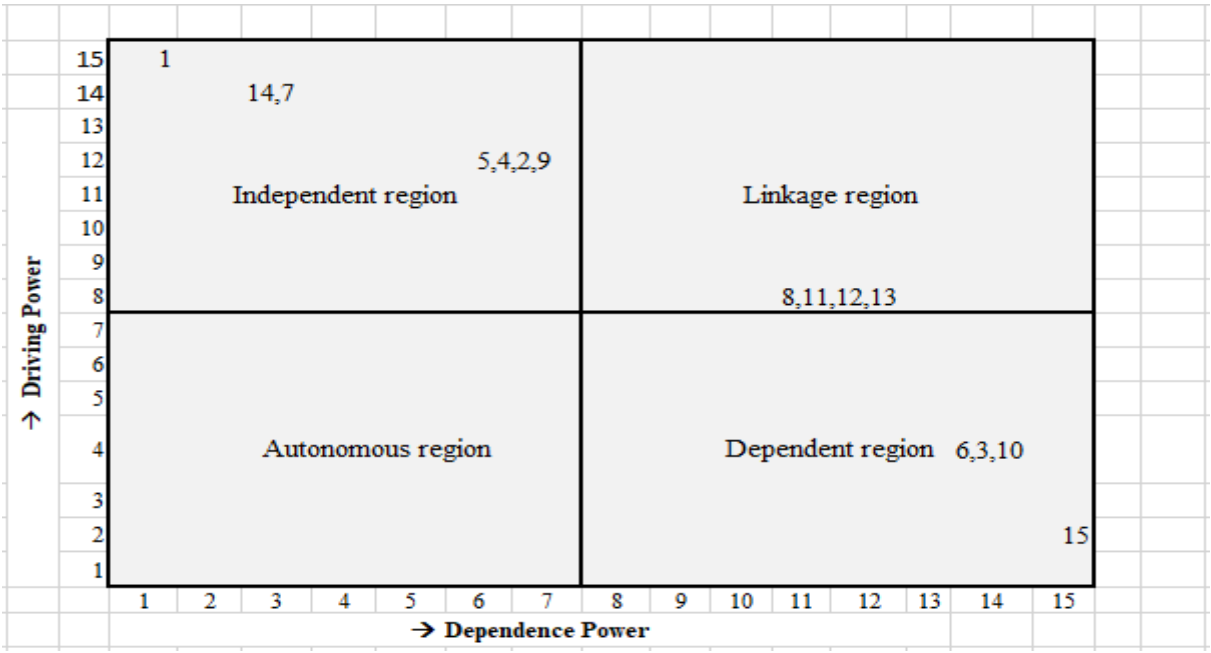

Fig. 3. Classification of challenges faced by CSCs using MICMAC analysis

4.6 *Fuzzy MICMAC and fuzzy direct relationship matrix*

The fuzzy direct relationship matrix (FDRM) was developed by inputting a diagonal series of zero values in the correlation matrix and ignoring the basic law of transitivity for the IRM. The conventional MICMAC analysis assumes values like "0" and "1", which do not

capture responses at the highest level of accuracy. We have used the notion of fuzzy set theory to improve the sensitivity of the MICMAC analysis. Fuzzy MICMAC analysis allows us to conduct a deeper investigation of the relationships among challenges as it assumes the "possibility of reachability" in comparison to the simple notion of reachability considered so far in the case of conventional MICMAC analysis. Fuzzy set theory helps in capturing the possibilities of interactions among challenges on the scale of 0-1 (see Mangla et al. 2018; Sharma et al. 2018 for further details) as provided in Table 5.

Table 5
Possibilities of reachability

Possibilities of reachability	No	Negligible	Low	Medium	High	Very High	Full
Values	0.0	0.1	0.3	0.5	0.7	0.9	1.0

In the second wave of data collection, we revised the survey questionnaire by adding Table 5 so that respondents can fill the same with ease. We had collected the contact details of all the respondents who had participated in the first wave of data collection. In the second wave of data collection, we sent emails with a personal message to all the respondents in October 2019.

Table 6
Stabilised matrix of important challenges faced by CSCs

Challenges (i)/(j)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	0.9	0.9	0.7	0.7	0.9	0.9	0.9	0.9	0.7	0.7	0.7	0.9	0.9	0.7	0.9
2	0	0.9	0.7	0.7	0.7	0.7	0	0.9	0.9	0.7	0.9	0.7	0.9	0	0.9
3	0	0	0.7	0	0	0.7	0	0	0	0.9	0	0	0	0	0.9
4	0	0.9	0.7	0.9	0.9	0.7	0	0.9	0.7	0.7	0.7	0.9	0.7	0	0.7
5	0	0.9	0.9	0.9	0.7	0.9	0	0.7	0.7	0.7	0.7	0.7	0.9	0	0.9
6	0	0	0.9	0	0	0.7	0	0	0	0.7	0	0	0	0	0.9
7	0	0.9	0.7	0.9	0.9	0.9	0.7	0.7	0.9	0.7	0.9	0.7	0.9	0.9	0.5
8	0	0	0.7	0	0	0.9	0	0.9	0	0.7	0.7	0.7	0.7	0	0.9
9	0	0.7	0.7	0.7	0.9	0.7	0	0.7	0.9	0.7	0.7	0.9	0.7	0	0.9
10	0	0	0.7	0	0	0.7	0	0	0	0.7	0	0	0	0	0.9
11	0	0	0.9	0	0	0.7	0	0.7	0	0.7	0.7	0.7	0.9	0	0.7
12	0	0	0.9	0	0	0.7	0	0.9	0	0.7	0.7	0.9	0.7	0	0.7
13	0	0	0.7	0	0	0.7	0	0.7	0	0.9	0.9	0.9	0.7	0	0.9
14	0	0.7	0.7	0.9	0.9	0.7	0.9	0.7	0.7	0.9	0.9	0.7	0.9	0.9	0.7
15	0.9	0	0	0	0	0	0	0	0	0	0	0	0	0	0.9

These respondents were requested to rate the interaction between each combination of two possible challenges, with the help of the scales presented in Table 5. We received 18 responses and sent a reminder after one week with a personal message and received all 29 responses. Data were collected in the linguistic form and translated into numbers (see Table 6). Table 6 represents the stabilised matrix of the key challenges faced by CSCs in rural settings. This matrix helps to stabilise the dependence and driving powers of the key challenges with the help of the fuzzy multiplication concept (Sharma et al. 2018; Rana et al. 2019).

4.7 ISM model validation

In this sub-section, we attempt to validate the ISM model with the help of the fuzzy MICMAC analysis presented in the aforementioned subsection. We have computed the driving power by adding rows and dependence power by adding columns to the stabilised matrix presented in Table 8. In the next step, we computed effectiveness by subtracting the dependence power from the driving power and assigned levels based on the scores (see Table 7).

Table 7
Effectiveness and ranking of important challenges faced by CSCs

Key Challenges	Driving Power (A)	Dependendence Power (B)	Effectiveness (A-B)	Model Validation levels
1	12.3	1.8	10.5	I
2	9.6	5.9	3.7	III
3	3.2	10.6	-7.4	V
4	9.4	5.7	3.7	III
5	9.6	5.9	3.7	III
6	3.2	10.6	-7.4	V
7	11.2	2.5	8.7	II
8	6.2	8.7	-2.5	IV
9	9.2	5.5	3.7	III
10	3	10.4	-7.4	V
11	6	8.5	-2.5	IV
12	6.2	8.7	-2.5	IV
13	6.4	8.9	-2.5	IV
14	11.2	2.5	8.7	II
15	1.8	12.3	-10.5	VI

Challenges with low values of effectiveness are placed at a higher level in the ISM model and vice-versa (Mangla et al. 2018: Sharma et al., 2018; Rana et al. 2019). The positioning of the identified challenges in Table 9 validates the model presented in Figure 2.

5. Discussion on ISM and MICMAC analysis

The objective of this study was to develop a hierarchical model and categorise the key challenges faced by CSCs in rural India so that an effective strategy can be developed to minimise the gap between the government and citizens. A systematic literature review was carried out, data were collected from experts and CSC owners, and subsequently, ISM was employed to develop a hierarchical model of the challenges to understand their interrelationships.

The hierarchical model places challenges at different levels so that decision-makers may prioritise which challenges to address first. The developed hierarchical model is presented in Figure 2. "Lack of digital literacy in rural India" appears at the bottom level in the hierarchical model (see Figure 2), which shows that digital literacy is the foundation for realising the long-term benefits of CSCs in rural India. Therefore, this research study establishes the fact that "lack of digital literacy in rural India" is one of the key challenges that is inhibiting the realisation of the net benefits of CSCs in rural settings. This finding is consistent with the results reported by other studies (Jaeger & Thompson, 2003; Dwivedi et al., 2016a; Dash & Pani, 2016; Bindu et al. 2019). "Longer travel time and transaction cost" and "lack of awareness" appear at the next level of the ISM model, which implies that a lack of awareness about the net benefits of CSC and a general perception of the time and cost required to travel to CSCs among citizens residing in rural areas are also important challenges in realising the net benefits of CSCs in rural India.

The concept of "longer travel time and transaction cost" has been drawn from transaction cost theory (TCT), primarily developed by Williamson (1975), aimed at understanding the organisation and governance structures of its economic activities (Devraj et al, 2002). Citizens who visit CSCs to complete online transactions to avail e-services in rural areas spend significant time and money on travel and some daily wage workers lose even their earnings of the day. "Lack of awareness" and "longer travel time and transaction costs" are interrelated as greater awareness may minimise the overall transaction cost. This finding is consistent with the findings reported by Devraj et al. (2002), who state that transaction costs play a significant role in user satisfaction.

In the next level of the ISM model, "lack of infrastructure", "problem of dormancy", "lack of interoperability", and "technology and networking challenges" are the challenges inhibiting the realisation of the impact of CSCs in rural India. These four challenges are also interdependent, and understanding the nature of these challenges and their interrelationships will assist decision-makers in mitigating their effects and ensuring the long-term net benefits of CSCs in rural India. These challenges are primarily infrastructure-related. Many a time, lack of proper infrastructure leads citizens to avoid CSCs even for availing of important e-government services and encourages them to explore alternative solutions.

The next level of the ISM model includes "resistance to change", "lack of trust", "privacy and security issues", and "lack of community-centric services at CSCs". Researchers (e.g. Al-Busaidy & Weerakkody 2009; Mittal & Kaur, 2013; Meijer, 2015; Bindu et al. 2019) have established the importance of the aforementioned challenges in the extant literature. The role of intermediaries at CSCs is to enhance the trust of citizens in CSCs. The increased trust will help in managing other challenges like "resistance to change" and privacy and security issues. These challenges appear at the middle level of the ISM model and hence are considered as unstable challenges that require special care. Finally, the next layer of challenges- "language problem", "lack of training for CSC operators", and "delay in receiving e-certificates" influence the net benefits realised from CSCs in rural India. In many cases, citizens need certificates in their local languages and, therefore, there is a need for greater expertise among CSC operators to tackle such challenges. Sometimes, challenges related to language result in delays in delivering e-certificates to citizens. Therefore, these interlinked challenges should be addressed simultaneously to ensure the net benefits of CSCs in rural settings.

We undertook a MICMAC analysis to categorise the key challenges into four regions as elaborated in Section 4.5. The findings reveal that none of the challenges fall in the autonomous region, which implies that all the challenges selected for this study were appropriate and all the challenges have a direct or indirect impact on the net benefits of CSCs in rural India. This finding justifies the selection of challenges CSCs face in this study. The challenges "lack of digital literacy in rural India", "lack of interoperability", "problem of dormancy", "technology and networking challenges", "lack of awareness", "lack of infrastructure" and "longer travel time and transaction cost" fall in the independent region. The challenges falling in the independent region have the power to influence challenges falling in the linkage and dependent regions

(Mangla et al. 2018; Rana et al. 2019). These challenges are placed in the lower level of the ISM model and are considered as foundational challenges that need special attention. Decision makers need to address these challenges first to mitigate the impact of challenges in the other quadrants. Next, the linkage region includes "resistance to change", "privacy and security issues", "lack of trust", and "lack of community-centric services at CSCs". These challenges are normally considered as unstable challenges and placed in the middle of the ISM model. Decision-makers need to take special care while mitigating the impact of these challenges. Finally, "lack of net benefits of CSCs in rural India", "lack of training to CSC operators", "language problems", "delay in receiving e-certificates" fall in the dependent region. These challenges are placed in the highest level of the ISM model (Mangla et al. 2018; Rana et al. 2019). Government agencies and other stakeholders in decision-making bodies need to prioritise these challenges to mitigate their impact on the overall effectiveness of CSCs and hence ensure that better e-services are delivered at CSCs in rural settings.

Finally, we used fuzzy MICMAC analysis to validate the ISM model (see Figure 2) of the key challenges faced in CSCs in rural India. The results reveal that the levels assigned to the effectiveness score are the same as those obtained in the various stages of interpretive structural modeling, which helps validate the ISM model.

6. Theoretical contributions and practical implications

6.1 Theoretical contributions

This study has a number of theoretical contributions to the ongoing research endeavour to explore the critical challenges faced by CSCs in delivering digital services. First, this is the first research, which undertakes systematic literature review to identify a set of challenges, which were further finalised in consultation with experts from academia and industry along with CSC owners. Second, the identified challenges were examined using ISM to develop a hierarchical model of these challenges, which were further validated using fuzzy MICMAC analysis. Therefore, the theoretical contribution of this research is the development of a hierarchical model of the challenges being faced by CSCs. The next contribution of this research is rather contextual where no such framework was developed based on the well-established methodologies including ISM, MICMAC and fuzzy MICMAC. The inclusion of fuzzy MICMAC technique on the ISM and MICMAC based analysis allows the researchers to analyse and understand the framework at more granular level with the highest level of accuracy. Finally, this research also allows the

researchers to understand the effective and ranking of relevant challenges faces by CSCs. The analysis of bring such relevant challenges could help researchers to consider a handful of such challenges for developing a parsimonious model of challenges for CSCs in the developing country context in general and India in particular.

6.2 Practical implications

The findings presented in this research study have significant and important practical implications for decision makers in governments and other stakeholders involved in the management of CSCs in rural India. This research study attempts to develop a base to understand the key challenges and their interrelationships in the context of CSCs in rural India. An understanding of the key challenges CSCs face is critical for decision-makers in government and private agencies involved in the management of CSCs in rural India, where the majority of the Indian population lives. The identified challenges may serve as a checklist that covers comprehensively all possible challenges associated with CSCs in rural India. The findings may help decision-makers understand each challenge and its impact as well as develop short-term or long-term strategic plans to mitigate them to minimise the gap between governments and citizens by ensuring better e-services delivery at CSCs. Overall, a better understanding of each challenge and its impact on the net benefits of CSCs will help in running them more effectively and efficiently. Furthermore, this research study offers multiple practical implications for decision-makers to improve the working of CSCs in rural settings in developing countries in general and India in particular.

6.2.1. Government regulations and policies

The government plays a critical role in setting up regulations and policies for the sustainable operation of CSCs in rural settings. These regulations help in identifying possible locations for new CSCs by maintaining an appropriate distance between CSCs so that citizens' longer travel time and transaction costs can be minimised. Further, public and private partnerships help support governments in setting up new CSCs by financing infrastructure and managing other resources-including human resources-by following well-established regulations and policies designed and enforced by government agencies. Government agencies also support all stakeholders involved in the management of CSCs by providing necessary guidelines to mitigate potential challenges.

6.2.2. Allocation of funds and necessary resources

Basic infrastructure is key to the success of CSCs in rural settings (Almarabeh & AbuAli, 2010; Dwivedi et al, 2016a; Srivastava, 2015; Dash & Pani, 2016; Bindu et al., 2019). Governments in developing countries spend significant resources on developing basic and necessary infrastructure across the country. In India, the government has set up nodal agencies in all states to manage and control the functioning of CSCs in rural settings. These agencies provide necessary guidelines to CSCs in their respective states. These state agencies also come up with innovative ways to increase the usage of CSCs in rural India. In addition, the government spends a substantial amount on research and development activities related to CSCs. The research activities include impact evaluation studies as well as research on the challenges faced by CSCs in rural India and recommendations to surmount them.

6.2.3. Necessary training programs for all stakeholders

Studies (Ndou, 2004; Almarabeh & AbuAli, 2010; Malik et al. 2014; Bindu et al., 2019) have shown that operators' training is critical for the success of the CSCs in rural settings. Government and other agencies involved in the management of the CSCs in rural India need to arrange training programs for operators and managers on the latest technological updates, new services in CSCs, interoperability issues, and language-related problems, among other issues. Governments may arrange these training programs in collaboration with premier academic institutions in each state. These training programs will help operators and other stakeholders serve citizens in a more informed way. In addition, the training programs should not only be arranged for operators and managers working at CSCs, but also for the owners of CSCs in rural settings. Governments and other agencies need to arrange such training programs for operators and managers at regular intervals, whereas training programs for CSC owners may be arranged once a year.

6.2.4 Awareness programs for citizens

Many researchers (Dwivedi et al. 2016a; Dash & Pani 2016; Malik, Dhillon & Verma 2014; Bindu et al. 2019; Sharma & Mishra 2017) have established the fact that there is low awareness of e-government services in rural settings in developing countries. The government and other private agencies need to arrange awareness programs for citizens on the newly added services and their benefits. In the case of India, as social media including Facebook, WhatsApp, and YouTube are quite popular, awareness programs can be launched on these platforms. In

addition, details of e-public services along with their benefits can be written on a big noticeboard in local languages in ration shops, which most rural residents visit to receive subsidised food items.

6.2.5 Minimising longer travel time and transaction cost for citizens

CSCs are an important digital initiative for many governments in developing countries. In rural settings, the time and travel costs borne by citizens in visiting CSCs are critical. CSCs are expected to reduce the time spent by the users while availing of services. In rural settings, this is unlikely, as whenever a rural user travels to the neighboring CSC to avail e-services, they end up spending the entire day at the center to complete the application process. This leads to a further increase in additional costs like food, water, etc. In some cases, the users are daily wage workers, and when they spend an entire day at the center, they have to forego their entire day's wage. Travel costs, or the costs incurred in reaching the CSC, are yet another driving factor in determining the transaction cost and is closely linked with and influences the time cost. Governments in partnership with private entities may establish more CSCs, preferably one in each village, so that the time and travel cost can be minimised.

In the aforementioned five subsections, we have provided suggestions to mitigate the impact of the challenges faced by CSCs in rural India. Despite the multiple challenges facing CSCs, governments worldwide are moving forward with these initiatives due to their potential benefits. Governments can deliver public services at the citizen's door and citizens feel empowered as they can get their required government services at the nearby CSCs. In the pre-CSCs era, citizens used to visit government offices multiple times to get government certificates (income certificates, bill payments, etc.). Overall, CSCs are providing value to citizens and the government. It is important to note that India used CSCs to provide teleconsultation to more than 30,000 citizens across India during the CORONA-19 pandemic lockdown. This is one of the several examples where CSCs are contributing in the sustainable development of the country.

7. Limitations and future work

This research study has several limitations and hence provides several opportunities for researchers to take this work to the next level. Firstly, the hierarchical model developed in this study is based on the opinions of experts (academic and industry) and CSC owners selected using the convenient sample method, which may lead to some bias in the developed model. This bias in the data restricts possible generalisation of the findings. Future research may validate the

proposed research model with a different set of experts and CSC owners, possibly from other parts of India or other developing countries. Secondly, we have identified a set of 15 challenges in this study; however, future researchers may drop some of the challenges and explore some contextual challenges related to government regulations, local capabilities, and the identification of right locations. In future research, we suggest conducting a focus group discussion to identify an optimum number of challenges and develop a new model using the same or modified methodology. Thirdly, the proposed model has not been tested empirically in this study, so there is another opportunity for researchers to collect data and test the proposed research model using the structural equation modeling (SEM) approach. Finally, we have used averages to rank the identified challenges, which may not be a comprehensive measure and hence provides an opportunity for future researchers to rank the identified challenges with the help of popular multi-criteria decision-making (MCDM) techniques such as ANP, AHP and TOPSIS.

8. Conclusion

Information and communication technologies are providing new opportunities for governments to deliver public services at citizens' doorsteps. Governments across developing countries like India, Pakistan, Bangladesh, Sri Lanka, Saudi Arabia, and the UAE are setting up CSCs with the intention of leveraging ICT to improve the welfare of citizens. This research study is aimed to identify key challenges faced by CSCs in developing countries, particularly in rural India. We identified 15 key challenges with the help of an extensive literature review and by surveying experts and owners of CSCs. This research study employed an ISM-MICMAC–fuzzy MICMAC analysis to develop a hierarchical structural model of the identified challenges. The findings show that challenges such as "lack of digital literacy in rural India", "lack of training for CSC operators", "problem of dormancy", "language problem", "lack of awareness", "lack of infrastructure", and "longer travel time and transaction cost" were found to be more critical and were positioned in the lower level of the structural model. The positioning of these challenges in the structural model shows that decision-makers need to prioritise these challenges in their strategies to improve the delivery of e-government services in rural settings. The findings of this study would be useful for decision-makers in government settings, telecommunication companies, public/private internet service providers, and other agencies involved in the operation of CSCs in rural India.

Appendix

Table I
Average ranking of key challenges of CSCs

S.N.	Challenges for e-government Service Delivery in Rural India	Score (5)
C1	Lack of digital literacy in rural India	4.6
C2	Lack of interoperability	3.2
C3	Lack of training to CSC operators	3.7
C4	Problem of dormancy	3.2
C5	Technological and networking challenges	3.05
C6	Longer duration in receiving e-certificates	4.0
C7	Lack of awareness	4.3
C8	Privacy and security issues	3.1
C9	Lack of infrastructure	3.8
C10	Language problem	3.8
C11	Lack of community centric services at CSCs	3.2
C12	Lack of trust	3.6
C13	Resistance to change	4.1
C14	Longer travel time & transaction cost	3.2
C15	Lack of net benefits of CSCs in rural India	4.5

Table II
Initial reachability matrix (IRM)/Final reachability matrix (FRM)

Element (i)/(j)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	0	1	1	1	1	1	0	1	1	1	1	1	1	0	1
3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1
4	0	1	1	1	1	1	0	1	1	1	1	1	1	0	1
5	0	1	1	1	1	1	0	1	1	1	1	1	1	0	1
6	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1
7	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8	0	0	1	0	0	1	0	1	0	1	1	1	1	0	1
9	0	1	1	1	1	1	0	1	1	1	1	1	1	0	1
10	0	0	1	0	0	1	0	0	0	1	0	0	0	0	1
11	0	0	1	0	0	1	0	1	0	1	1	1	1	0	1
12	0	0	1	0	0	1	0	1	0	1	1	1	1	0	1
13	0	0	1	0	0	1	0	1	0	1	1	1	1	0	1
14	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
15	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Table III(a)
Level Partition – Iteration 1

Challenge	Reachability Set (RS)	Antecedent Set (AS)	RS ∩ AS	Level
1	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,15	1,15	
2	2,3,4,5,6,8,9,10,11,12,13,15	1,2,4,5,9,14	2,4,5,9	
3	3,6,10,15	1,2,3,4,5,6,7,8,9,10,11,12,13,14	3,6,10	
4	2,3,4,5,6,8,9,10,11,12,13,15	1,2,4,5,7,9,14	2,4,5,9	
5	2,3,4,5,6,8,9,10,11,12,13,15	1,2,4,5,7,9,14	2,4,5,9	
6	3,6,10,15	1,2,3,4,5,6,7,8,9,10,11,12,13,14	3,6,10	
7	2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,7,14	2,4,5,7,9,14	
8	3,6,8,10,11,12,13,15	1,2,4,5,7,8,9,11,12,13,14	8,11,12,13	
9	2,3,4,5,6,8,9,10,11,12,13,15	1,2,4,5,7,9,14	2,4,5,9	
10	3,6,10,15	1,2,3,4,5,6,7,8,9,10,11,12,13,14	3,6,10	
11	3,6,8,10,11,12,13,15	1,2,4,5,7,8,9,11,12,13,14	8,11,12,13	
12	3,6,8,10,11,12,13,15	1,2,4,5,7,8,9,11,12,13,14	8,11,12,13	
13	3,6,8,10,11,12,13,15	1,2,4,5,7,8,9,11,12,13,14	8,11,12,13	
14	2,3,4,5,6,7,8,9,10,11,12,13,14,15	1,7,14	2,4,5,7,9,14	
15	15	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15	15	I

Table III(b)
Level Partition – Iteration 2

Challenge	Reachability Set (RS)	Antecedent Set (AS)	RS ∩ AS	Level
1	1,2,3,4,5,6,7,8,9,10,11,12,13,14	1	1	
2	2,3,4,5,6,8,9,10,11,12,13	1,2,4,5,9,14	2,4,5,9	
3	3,6,10	1,2,3,4,5,6,7,8,9,10,11,12,13,14	3,6,10	II
4	2,3,4,5,6,8,9,10,11,12,13	1,2,4,5,7,9,14	2,4,5,9	
5	2,3,4,5,6,8,9,10,11,12,13	1,2,4,5,7,9,14	2,4,5,9	
6	3,6,10	1,2,3,4,5,6,7,8,9,10,11,12,13,14	3,6,10	II
7	2,3,4,5,6,7,8,9,10,11,12,13,14	1,7,14	2,4,5,7,9,14	
8	3,6,8,10,11,12,13	1,2,4,5,7,8,9,11,12,13,14	8,11,12,13	
9	2,3,4,5,6,8,9,10,11,12,13	1,2,4,5,7,9,14	2,4,5,9	
10	3,6,10	1,2,3,4,5,6,7,8,9,10,11,12,13,14	3,6,10	II
11	3,6,8,10,11,12,13	1,2,4,5,7,8,9,11,12,13,14	8,11,12,13	
12	3,6,8,10,11,12,13	1,2,4,5,7,8,9,11,12,13,14	8,11,12,13	
13	3,6,8,10,11,12,13	1,2,4,5,7,8,9,11,12,13,14	8,11,12,13	
14	2,3,4,5,6,7,8,9,10,11,12,13,14	1,7,14	2,4,5,7,9,14	

Table III(c)
Level Partition – Iteration 3

Challenges	Reachability Set (RS)	Antecedent Set (AS)	RS ∩ AS	Level
1	1,2,4,5,7,8,9,11,12,13,14	1	1	
2	2,4,5,8,9,11,12,13	1,2,4,5,7,9,14	2,4,5,9	

4	2,4,5,8,9,11,12,13	1,2,4,5,7,9,14	2,4,5,9	
5	2,4,5,8,9,11,12,13	1,2,4,5,7,9,14	2,4,5,9	
7	2,4,5,7,8,9,11,12,13,14	1,7,14	2,4,5,7,9,14	
8	8,11,12,13	1,2,4,5,7,8,9,11,12,13,14	8,11,12,13	III
9	2,4,5,8,9,11,12,13	1,2,4,5,7,9,14	2,4,5,9	
11	8,11,12,13	1,2,4,5,7,8,9,11,12,13,14	8,11,12,13	III
12	8,11,12,13	1,2,4,5,7,8,9,11,12,13,14	8,11,12,13	III
13	8,11,12,13	1,2,4,5,7,8,9,11,12,13,14	8,11,12,13	III
14	2,4,5,7,8,9,11,12,13,14	1,7,14	2,4,5,7,9,14	

Table III(d)
Level Partition – Iteration 4

Challenges	Reachability Set (RS)	Antecedent Set (AS)	RS ∩ AS	Level
1	1,2,4,5,7,9,14	1	1	
2	2,4,5,9	1,2,4,5,7,9,14	2,4,5,9	IV
4	2,4,5,9	1,2,4,5,7,9,14	2,4,5,9	IV
5	2,4,5,9	1,2,4,5,7,9,14	2,4,5,9	IV
7	2,4,5,7,9,14	1,7,14	7,14	
9	2,4,5,9	1,2,4,5,7,9,14	2,4,5,9	IV
14	2,4,5,7,9,14	1,7,14	7,14	

Table III(e)
Level Partition – Iteration 5

Challenges	Reachability Set (RS)	Antecedent Set (AS)	RS ∩ AS	Level
1	1,7,14	1	1	
7	7,14	1,7,14	7,14	V
14	7,14	1,7,14	7,14	V

Table III(f)
Level Partition – Iteration 6

Challenges	Reachability Set (RS)	Antecedent Set (AS)	RS ∩ AS	Level
1	1	1	1	VI

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