JeDEM Issue 17 (1): 33-64, 2025
ISSN 2075-9517
http://www.jedem.org
Date of submission: 04.03.2024
Date of acceptance: 24.10.2024
Article DOI: 10.29379/jedem.v17i1.906

From policy to practice in digital governance: A three-level analysis of citizen-centric applications

Anand R Navaratna

ORCID ID: 0009-0009-7199-259X
School of Management and Entrepreneurship, Indian Institute of Technology, Jodhpur, India
navaratna.1@iitj.ac.in

Deepak Saxena

ORCID ID: 0000-0002-9331-3799
School of Management and Entrepreneurship, Indian Institute of Technology, Jodhpur, India
saxenad@iitj.ac.in

Abstract: Amidst the growing importance of digital governance, the need to formulate a governance framework and integrate policy and regulation mechanisms is also increasing. There is also a need to assess the digital governance paradigm in terms of how citizens are responding to it. In doing so, we have carried out a three-level analysis: app developers' claims, app users' opinions, and finally, the gap between these levels - is compared by using ten citizen-centric applications from ten different countries hosted on Google Play Store. These applications are assessed based on their self-declaration on Google Play Store on 15 preset parameters, second by sentiment analysis of reviews through VADER and RoBERTa models and finally, a ten-parameter analysis. The paper comprehensively reviews the governance aspect of citizen-centric applications and highlights key elements of digital governance.

Keywords: Digital governance, Digital policy, Government application, Sentiment analysis, Practice

1. Introduction

Digital Transformation is no longer a prerogative of the private sector. At the national level, many countries are engaged in policy formulation and developing various applications to enable citizen-centric governance (Eom et al., 2018; Saxena et al., 2022). e-Governance has grown in popularity, with webpages becoming the new face of government (Thomas, 2023). At the same time, there is a need to undertake the study of e-governance acceptance by citizens both at the national and international levels (Evans and Yen, 2006). Saxena (2006) suggests that excellence in e-Governance

can be obtained through "e-Governance engineering". Off late, 'Digital Citizen Engagement'(DCE) initiatives are studied in detail (Pade-Khene et al., 2017). A case study pertaining to DCE concerning India (Malhotra et al., 2019) and South Africa (Osah & Pade-Khene, 2020) have been conducted. As part of these initiatives, MyGovernment (MyGov) applications are rolled out by various countries. Many case studies are either based around MyGov or taking it as a use case, especially of MyGov.in (India). Scholars (Mishra, 2019; Lamba et al., 2016) suggest that MyGov can be used to gauge citizen pulse. Misra et al. (2018) present a case of Digital Transformation using MyGov through a participatory and community engagement model.

However, with the increased adoption of these eGovernance applications, there is a need to examine the coherence between what these application developers claim and what its users or citizens say about it. This remains a less researched area in this domain. The main objective is to study governance aspects surrounding citizen-centric applications. Mobile applications have been chosen as opposed to e-government portals and websites as these are the new media through which citizens avail public services (Eibl et al., 2022). In this paper, we will carry out a three-level, algorithm-based, qualitative and quantitative analysis of ten applications of different governments across the globe based on data extracted from the Google Play Store. The remainder of the paper is as follows. In section 2 a detailed literature review is carried out, followed by setting out research methodology and objective in section 3. Section 4 is a compilation of results, while section 5 undertakes a detailed discussion of the results in view of extant literature. Section 6 offers the conclusion and limitations of this paper.

2. Literature review

Providing usable digital services to citizens has always been a challenge to governments across the globe. This process has evolved gradually in incremental steps, even before the use of technology to do so. The 'New Public Management (NPM)' concentrated on bringing practical and implementable insights from the private to public sectors (Dunleavy and Hood, 1994; Hood and Dixon, 1995). This process helped in tackling aspects like improvement in public spending (Mandl et al., 2008) using technical (Weerakkody et al., 2011) or managerial (Hood and Dixon, 1995) means. This development of the late 1980s-1990s was followed by the evolution of technology in the form of e-governance, primarily envisaged as an interface between government and citizens. It also involves using technology for data processing so that government services are available to citizens at the click of a mouse (Janowski, 2015). This step was expected to bring citizens and governments closer towards providing digital services with high satisfaction levels. However, there are mixed results for e-governance initiatives. Beyond a ceremonial role, some scholars have reported the failure of e-governance, with studies centring around a few countries like India (De' & Ratan, 2009) and Taiwan (Lin et al., 2015).

To understand the less-than-expected role played by e-governance initiatives, researchers have tried to understand the cause and effect of government outreach applications vis-a-vis citizens' acceptances of the same. One of the fundamental aspects that emerged from this is the perception of citizens versus the perception of government agencies. Dudley et al. (2015) argue that customer experience remains cumbersome, as agencies tend to follow the process, which they feel best suits

them. According to Curtis (2019), the digital transformation approach has provided less regard to citizens for whom the process is designed as they have provided thrust mostly on technology. Further, several authors (Castelnovo & Sorrentino, 2017; Carvalho & Brito, 2012) suggest that this haphazard transformation and failure to provide adequate services has frustrated citizens. Hence, scholars (Curtis, 2019; Mergel et al., 2018) emphasise shifting the focus from pure bureaucratic and organisational-centric processes to devising more citizen-centric ones. For instance, Saxena et al. (2022) emphasise reducing the number of touchpoints by simplifying the consumer journey on the platform, thereby increasing citizen satisfaction. Furr and Shipilov (2019) state that digital transformation needs to go beyond technology. Some authors (Osborne et al., 2021; Lember et al., 2019) have listed co-creation, co-production and co-management as factors that need to be embedded in the digital transformation for citizen-centric applications. Beyond the design aspects, Lamberti (2013) suggests that the success of citizen-centric applications relies on the ability to establish a dialogue with customers to develop customer intimacy. This signifies a collaborative approach (Martin and Webb, 2009) where citizen experiences are taken as valuable feedback to improve service delivery. Based on these insights, digital governance has moved from simply preparing websites to adaptive and hybrid governance mechanisms (Leiser & Murray, 2016; Tan & Taeihagh, 2021) based on mobile applications and AI-based adaptations. Towards a citizen-centric governance of public services, mobile applications and chatbots play a key role (Saxena et al., 2022).

However, the use of ICT for governance poses a two-pronged challenge. First, they have to be user-friendly and easy to operate (Casiano Flores et al., 2022; Saxena et al., 2022). Secondly, it has to gain the public's trust (Choi et al., 2016). In this regard, it is often suggested to make citizens a partner in developing the applications (Osborne et al., 2021; Lember et al., 2019). However, a substantial gap exists in works surrounding how citizens' opinions can be dovetailed into citizen-centric applications. Further, substantial work does not seem to exist surrounding ways technology or algorithms can be used to develop a customer-centric feedback system. This type of study is the need of the hour in view of the development of AI as a capable dimension. AI can be involved not only to better citizen experience but also to ensure citizen sentiments are adequately accommodated in the development cycle. This paper is a step in that direction.

One of the prominent means that evolved as an effective mechanism to access technological outreach is by way of reviewing user feedback. These feedbacks are more relevant in applications designed for use by the public for the larger good and governance (Alexopoulos, 2014). With the emergence of Natural Language Processing, sentiment analysis is being proposed to assess various initiatives and applications (Pi, 2021; Saxena, 2021). In general, sentiment analysis techniques can be classified into three categories: rule-based-lexicon analysis, supervised machine learning-based and unsupervised deep learning-based. VADER (Valence et al.) is one of the most popularly used techniques, which is lexicon-based (Hutto and Gilbert, 2014). VADER is best suited for short sentences and abbreviations. The added advantage is that VADER takes less time to process. This technique may be used for sentiment analysis of citizen responses (Cruz and Balahadia, 2021). However, this method becomes less reliable when grading larger, more organised sentences. Another popular technique to conduct sentiment analysis is Bidirectional Encoder Representations from Transformers (BERT) (Devlin et al., 2018). Being a recent model, BERT is often used in the sentiment analysis associated with Covid pandemic (Singh et al., 2021). For conducting sentiment analysis in this paper,

we have used an advanced Robustly Optimized BERT-Pretraining Approach (RoBERTa). Compared to BERT, RoBERTa uses about 10x more pre-trained uncompressed data. In our paper, we have used a simple VADER-based sentiment analysis combined with a complex and comparatively more accurate RoBERTa algorithm.

Our paper's dataset extraction source is from the Google Play Store (GPS). Google Play Store has emerged as a competitive market for app developers in both smartphone and mobile segments. As of October 2023, Play Store hosts about 2.5 million applications (Statista, 2019). GPS allows users to contribute towards review through two mechanisms: star rating and user reviews. The star rating is done on a scale of 1-5, with one being the lowest and five being the highest. The developers are also compensated based on the star rating (Linares-Vásquez et al., 2013). The star-based review has both advantages and disadvantages. While higher-rated apps have more users, low-rated apps may not find many takers. At times, users may also be confused about the rating scale, resulting in inconsistency between the rating and user feedback. Review with negative feelings may attract a high star rating, while positive feelings may attract fewer ratings (Noei & Lyons, 2019). To overcome this, the users can also provide a plain text, unstructured user review. According to Noei (2018), from the reviews, we can extract (i) expectations of users, (ii) user concerns, (iii) feature requests, (iv) bug reports, and (v) guidelines for better release planning.

While there are numerous studies of sentiment analytics on apps from the private sector (e.g. Tsao et al., 2019; Lawani et al., 2019), there is a relative lack of studies on how citizen opinions can inform the development cycle of public applications. In the medical health and application domain, Parker et al. (2019) undertook a study to analyse the gap between policy to practice in the privacy of user data on applications hosted on Google Play Store. Similarly, Grundy et al (2019), undertook a technical analysis of traffic, network and content analysis of medical applications hosted in Google Play Store and others. These papers only undertake a policy and regulation analysis surrounding privacy concerns, whereas larger digital governance aspects are missed. However, there seems to be a gap in the literature in terms of a qualitative and quantitative assessment of declaration versus practice in the governance domain. To address this gap, we comprehensively review the declaration vis-à-vis citizen feedback. Towards this end, we have undertaken a comparison of 10 citizen-centric applications from various countries. The next section outlines the research methodology adopted in this study. The review of citizen-centric applications of various countries on compliance, sentiment and theoretical analysis criteria is unique.

3. Research methodology

3.1. Research Objective

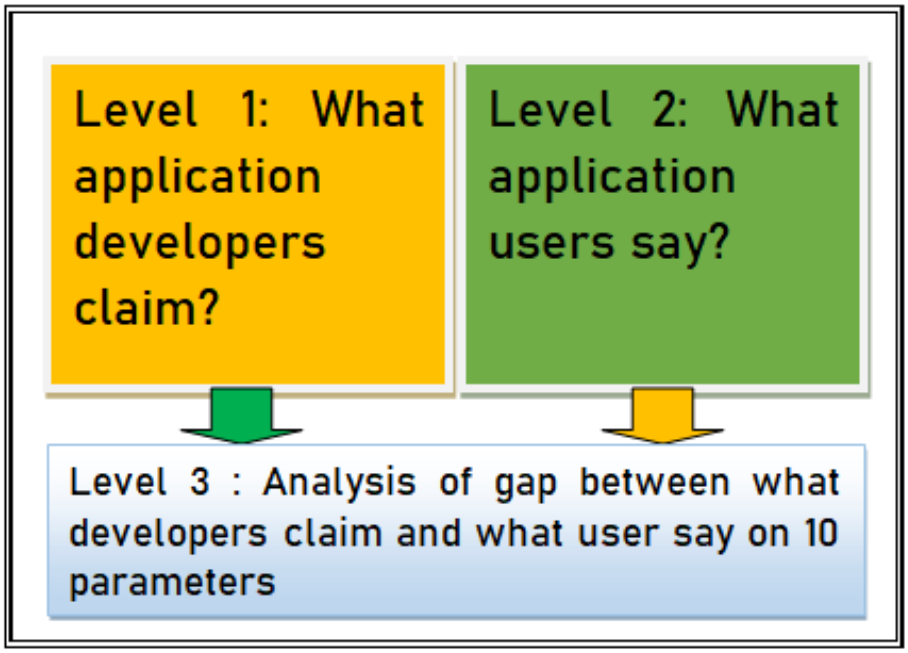
We conducted the research at three levels, as outlined in Figure 1. Level 1 and Level 2 are independent. The results obtained through these two levels are compared in Level 3. Through this study, we intend to achieve the following objectives:

1) By analysing self-declarations by the app developers, determine what parameters are declared by applications for awareness of general citizens. Each application is assessed on 15 preset compliance self-declaration parameters.

2) Through sentiment analysis, determine the feelings expressed by users towards the application. Using this we try to access the sentiments expressed by citizens or users of these applications towards their digital onboarding experiences.

3) Determine the outcomes and gap between the stated declaration and the people review. Towards this end, we use ten preset parameters for assessments, namely eGovernment to Digital Government, Digital Government to Digital Governance, Digital Ecosystem, Digital Governance and Ease of Use, Understanding of Self-declaration, Government as regulator and a developer, Focus on service quality, Star rating v/s reviews, Prominent Sentiment Keywords and Algorithmic Analysis.

Figure 1: Research Questions



We wish to clarify here that this paper does not focus on evaluating the actual use of the governance apps. The paper focuses on evaluating citizen feedback captured in the form of reviews on the app hosting platform.

3.2. Methodology

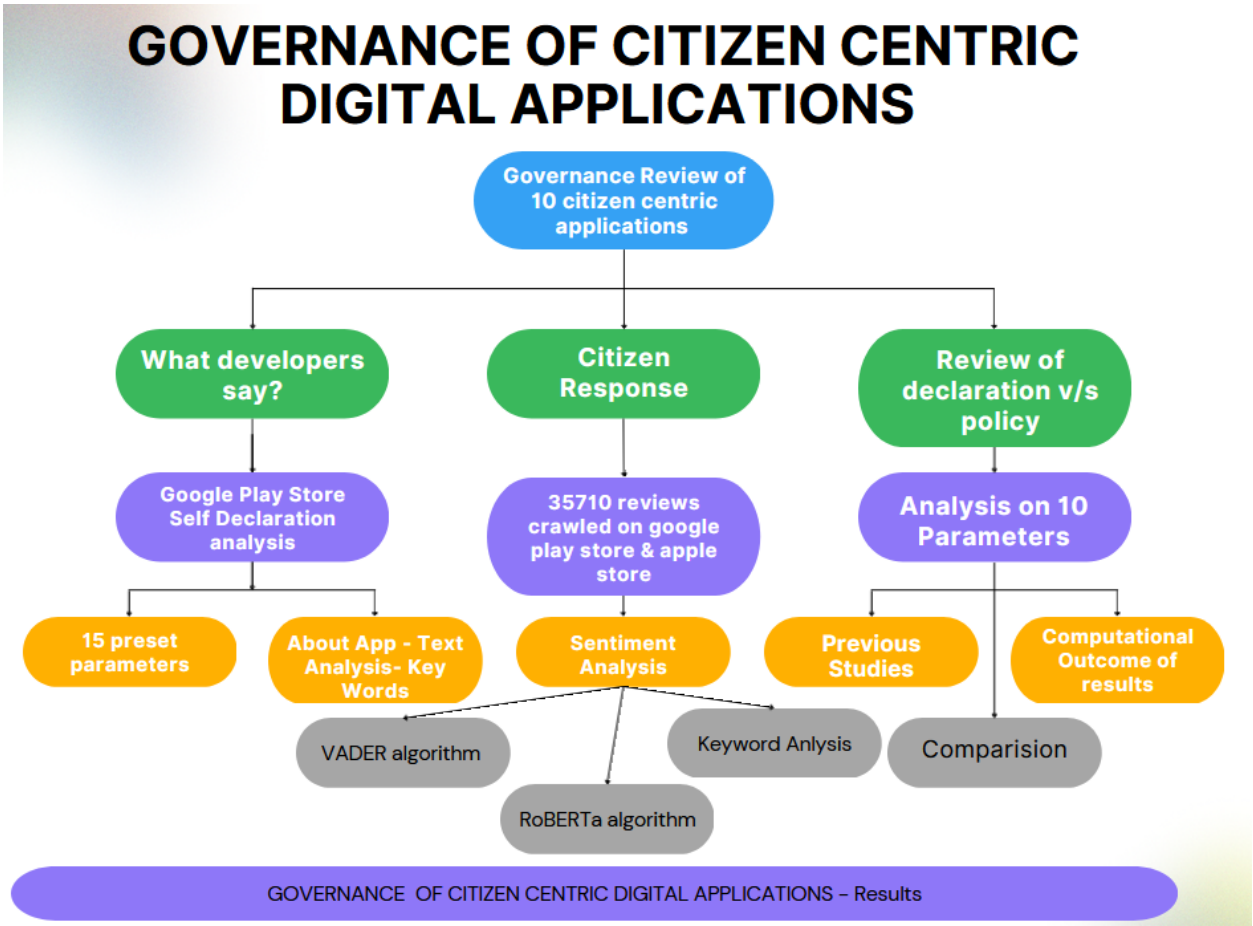
We undertook a detailed tabulation of results under different segments to answer our first research question, what application developers claim. The self-declaration by the developer may be positive or negative. Here, if the declaration on each parameter is available, it is declared true or assessed on that parameter. For example, one application developer has declared, “Data is collected by application”, and another developer has declared “, Data is not collected by application” In both

cases, on the parameter of 'data collection', both applications score. However, if one application, for example, has not declared at all if location information is collected, then on the parameter of 'location', it does not score. The intention is to objectively see if the developer has self-declared or not.

To answer the second research question of what users say about the application?, we have carried out sentiment analysis, and the results are tabulated in Table 7 as keywords. We have focused on category-based results rather than individual applications to keep the analysis as per applications. We have followed two algorithms and the results obtained thereof are also compared individually.

Finally, towards comparing policy (declaration on the app) to practice, we have tabulated word cloud-generated keywords extracted from developer claims and sentiments (most negative and most positive). This is followed by a detailed discussion before concluding the paper. We have taken a conscious call to keep the paper and assessment criteria objective. Hence, we have not assessed individual application-based assessments in most cases. If the developer has designed the application, self-declared it (positive or negative declaration) and users are using it, then that serves the purpose of self-declaration.

Figure 2: Research Methodology and Metadata



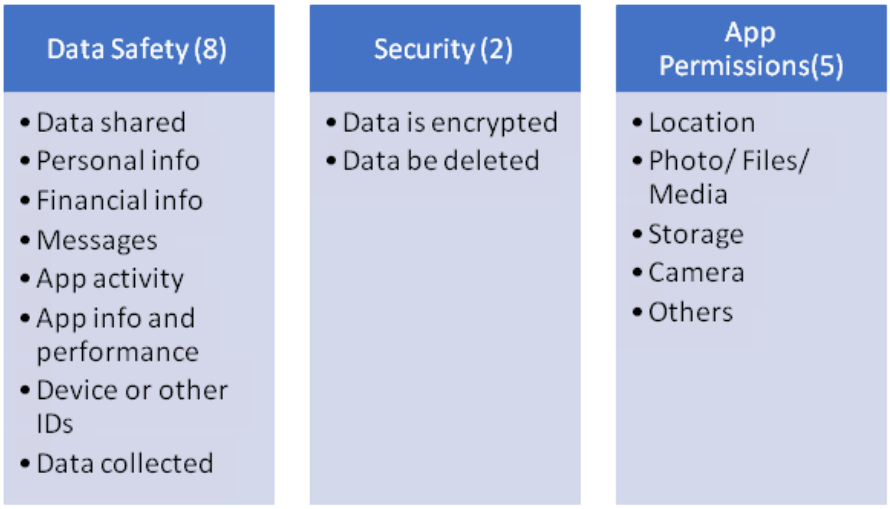
The methodology followed is represented in Figure 2. As part of level 1, Ten governmental applications, mostly of MyGov string, were searched in the Google Play Store and shortlisted. If there are applications developed by other countries that do not match the string of MyGov but have substantial downloads and reviews, then those were considered, too. These applications were then scrapped for self-declaration on the present parameters of the Google Play Store. A text analysis based on Voyant (V02.6.10), an online web-based reading and text analysis environment for self-declaration on the application, was listed to understand the keywords on the' about application'. At level 2, among the shortlisted applications, user reviews were scrapped using the Python code pipeline. Reviews from Google Play Store and Apple Store are included for review. These reviews, including their star rating, were subjected to two algorithmic sentiment analyses - VADER and RoBERTa. The output of these two levels was then qualitatively analysed. Based upon the analysis, detailed discussions and conclusions are arrived at.

3.2.1. Data Collection

Coding of GPS self-declaration: Google Play Store follows elaborate due diligence before hosting an application in its Play Store. The prerequisites required for knowledge of both developer and user can be accessed from "Understand App Privacy & Security Practices with Google Play's Data Safety Section - Computer - Google Play Help". Studies have carried out data and privacy assessments using Google Play Store data (Guamán et al., 2023; Sun et al., 2023). Some works have carried out vulnerability assessments like third-party tracking using Google Play Store applications (Binns et al., 2018). A detailed study to understand the privacy-related attribute was also undertaken based on Google Play Store application data (Caputo et al., 2023; Singh et al., 2023). However, a study into aspects of digital governance applications using Google Play Store is conspicuous by its absence. We have coded assessment parameters based on Google's user policy for apps and digital content. These parameters are coded against each application. Three prominent heads and 15 parameters, as listed in Table 1, are used to access the self-declaration criteria of these ten applications. As a second assessment tool, to study what the application is intended to do is extracted from 'About App' information provided by the developer, based upon which each user downloads the application

Based upon the assessment metrics, the self-declaration assessment of the developer is studied.

Table 1: Self Declaration parameters



Collection of Reviews: The collection of data began with the shortlisting of applications on GPS. A search string of 'government application' was used for governmental applications. Based on the output, ten applications were shortlisted. The availability of reviews and sufficient diversification in the country was ensured to avoid skewed outcomes. The list of applications considered for review is listed in Table 2.

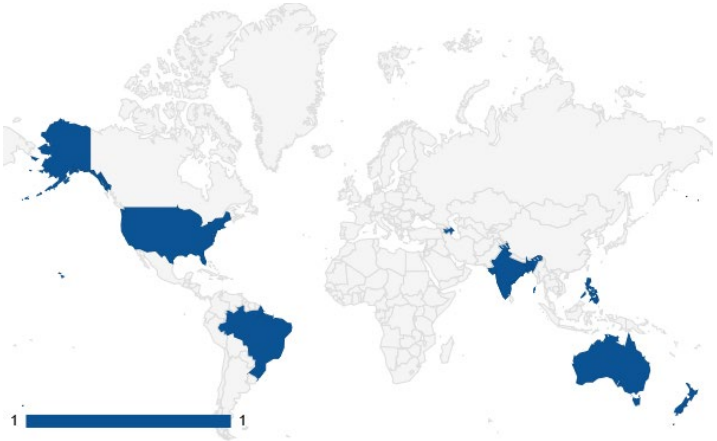
Table 2: List of applications considered

Sl. No.	Application Name	Developer	GPS Application ID	Downloads	Reviews Considered
1	maltapps	Government of Malta	mt.gov.maltapps	10K+	96
2	eGovPH	DICT eGovernment, Government of Philippines	egov.app	500K+	2510
3	My Gov	Aspire to Innovate, Government of Bangladesh	com.orangebd.amarshorkar	100K+	727
4	IRS2Go	IRS, USA	gov.irs	10M+	11246

5	myGov	Services Australia	au.gov.mygov.mygovapp	10L+	717
6	myGov	eGov Development Center, Azerbaijan	az.gov.my	5L+	93
7	gov.br	Serviços e Informações do Brasil	br.gov.meugovbr	50M+	1737
8	NZeTA	MBIE, New Zealand	nz.govt.mbie.eta	1L+	858
9	SGWorkPass	Ministry of Manpower, Singapore	sg.gov.mom.sgwork-pass&hl	10L+	2045
10	MyGov	MyGov India	in.mygov.mobile	5M+	14607

As shown in Figure 3, the above selection of government apps is evenly distributed globally. Sufficient distribution between global north and south, developing-developed countries and all ethnicities following vivid digital strategy and governance policy are represented. This can be seen on the heat map in Figure 3. The total number of reviews considered for analysis is 35710. Based upon the popularity of the applications, reviews and star ratings vary from application to application.

Figure 3: Heat Map of government applications reviewed in this study



3.2.2. Data Processing Tools

For self-declaration, the About section of each application is extracted and subjected to text analysis. The keywords obtained are listed against each application. The libraries related to sentiment analysis using VADER and RoBERTa are utilised through coding on the Jupyter environment. The libraries used in these are listed in Table 3.

Table 3: Libraries/ tools used for data processing

Tool/ Process	Library	Output Parameters	Justifications
Voyant	web-based text reading, analysis environment	Raw frequency, Z score and TF-IDF	The tool is used to extract world clouds and keywords from corpus data. Keywords help in knowing the focus areas within the text (Wang et al., 2024)
Review Extraction	google_play_scraper App_store_scraper Pandas Numpy	Reviews from Google and Apple store	The library is used to obtain the latest and live reviews available in respective stores. The store identifier of each application is used to call respective reviews. A total of 35710 reviews are mined (Wang et al., 2024)
VADER	Nltk Tqdm sia	Polarity score - Positive, Negative, Neutral and Compound.	Based upon the polarity score the sentiment is classified as Positive, Negative and Neutral. The compound is a consolidation of all scores varying from -1 to +1. -1 is the most negative, while +1 is the most positive (Hutto and Gilbert, 2014; Cruz and Balahadia, 2021).
RoBERTa	Transformers AutoTokenizer	Polarity score - Positive, Negative, and Neutral	Based upon the polarity score the sentiment is classified

	Model: cardiff-nlp/Twitter-roberta-base-sentiment		as Positive, Negative and Neutral. This algorithm is more advanced and accurate. However, this is computationally heavy (Devlin et al., 2018; Singh et al., 2021)
WordCloud	wordcloud	keywords	Based on the star rating, keyword mapping is undertaken on sentiments obtained for each application. To save on the length of the paper, keywords are represented in text format for ready reference (Wang et al., 2024)

4. Results

This section deals with aspects of interpreting sentiments obtained from VADER and RoBERTa. A few examples are given in Table 4 based on the results obtained in our experimentation.

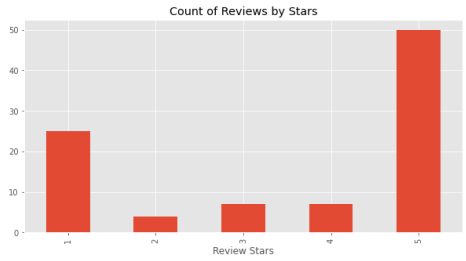
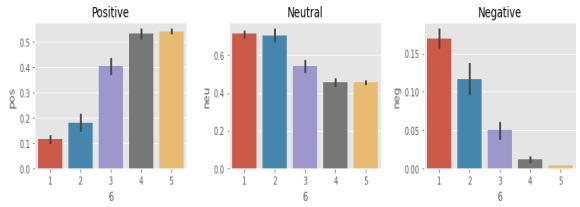
Table 4: Interpretation of sentiments with an example from MyGov India application

Application	**User Review**	**VADER**	**RoBERTa**	**Remarks**
MyGov India	"Pathetic and ridiculous."	Negative	Negative	Both have classified review as negative
	"The application was good, but there are no scheme's benefits for impoverished people in this application."	Neutral	Negative	With longer reviews, VADER tried to be safe by classifying it as neutral. However, RoBERTa has it as negative. Words like destabilised and not functionality better would be the main reason.
	"No daily updates"	Negative	Neutral	Here, both are classified as opposite. On close observation,

				the review is small and positive. Due to the lexical aspect, the VADER score indicates negative. Thus, the efficiency of RoBERTa is higher.

The second important aspect we came across in our study is the ambiguity between star rating (1 to 5. With 5 being best and 1 being worst) and unstructured text review. In the case of RoBERTa, the polarity score is classified into three classes: Positive, Negative and Neutral only, while VADER, apart from these, provides a single sentiment representation value of the compound. This value varies between -1 to +1. The more the value is towards +1, it is positive, and -1 is the most negative. We have used this metric to plot matrices between star rating and sentiment analysis. A few examples of the same are listed in Table 5. The metrics of government applications are listed in Table 6.

Table 5: Plot of various metrics

Metric	**Output**	**Remarks**
Star Rating Count		This bar graph indicates a simple count of reviews as per star rating.
Star Rating V/S Sentiments		The x-axis indicates star rating, and Y indicates polarity score. This graph shows lower star ratings have negative polarity while higher stars have positive polarity. In the case of neutral polarity, stars exist almost evenly.

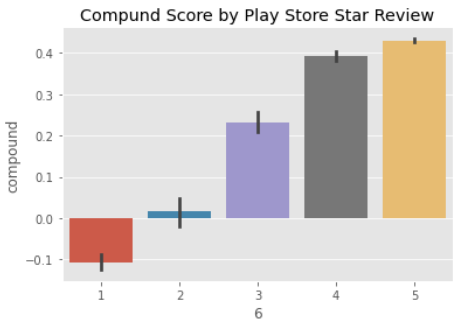
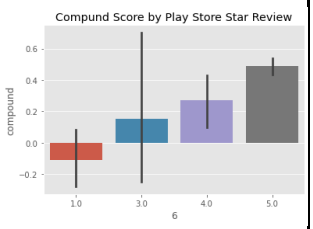
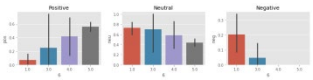
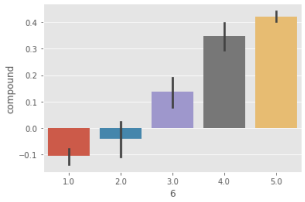
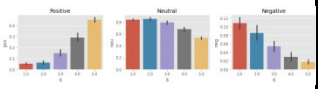
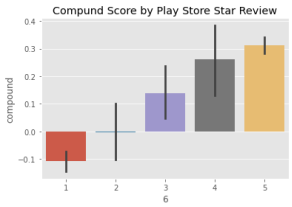
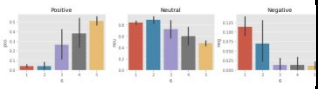
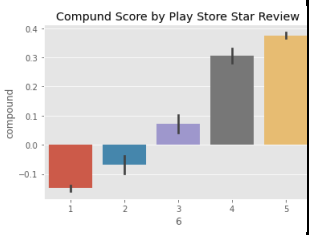
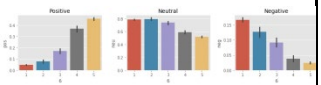
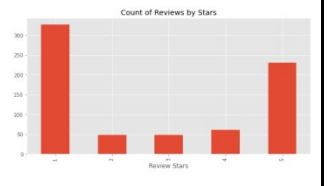
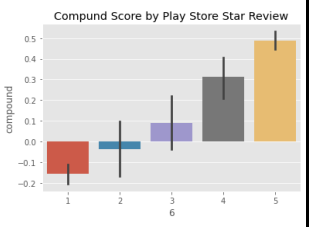
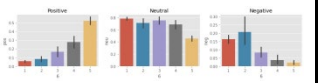
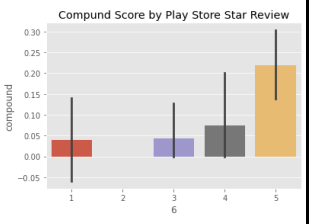
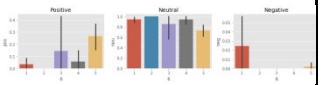
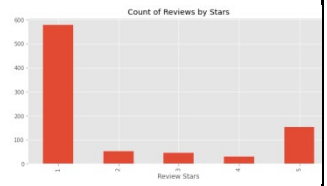
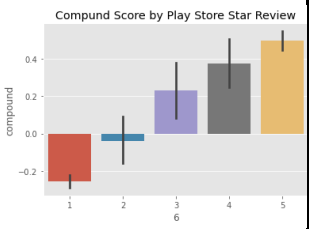
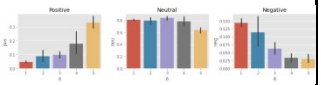
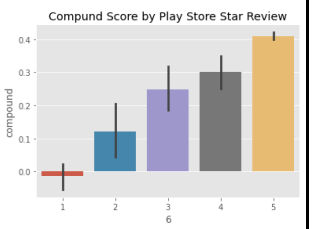
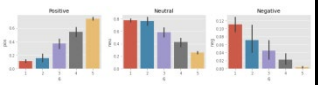
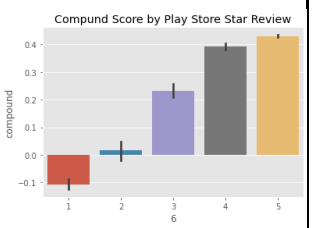
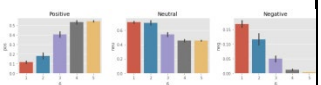
Star v/s Compound polarity score		The x-axis indicates a star rating, and Y indicates a compound score. The bar graphs indicate the average range of compound scores with respect to star rating. The black line indicates the height to the lowest value of the compound score under each star category. It is interesting to note that reviews with two stars have a slightly +ve value on the compound score but way less than +1 to be ranked as positive.

Table 6: Tabulation of various processing results of Government applications

Government Application	**Star Rating Count**	**Star v/s Compound polarity score**	**Star Rating V/S Sentiments**
maltaapp a -Malta			
eGovPH-Philippines			
My Gov - Bangladesh			

IRS2GO-USA			
MyGov - Australia			
MyGov-Azerbaijan			
NZeTA - New Zealand			
SGWork-Pass - Singapore			
MyGov - India			

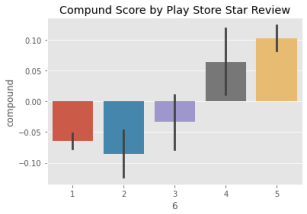
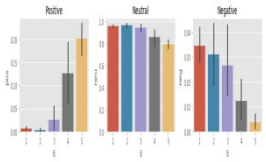
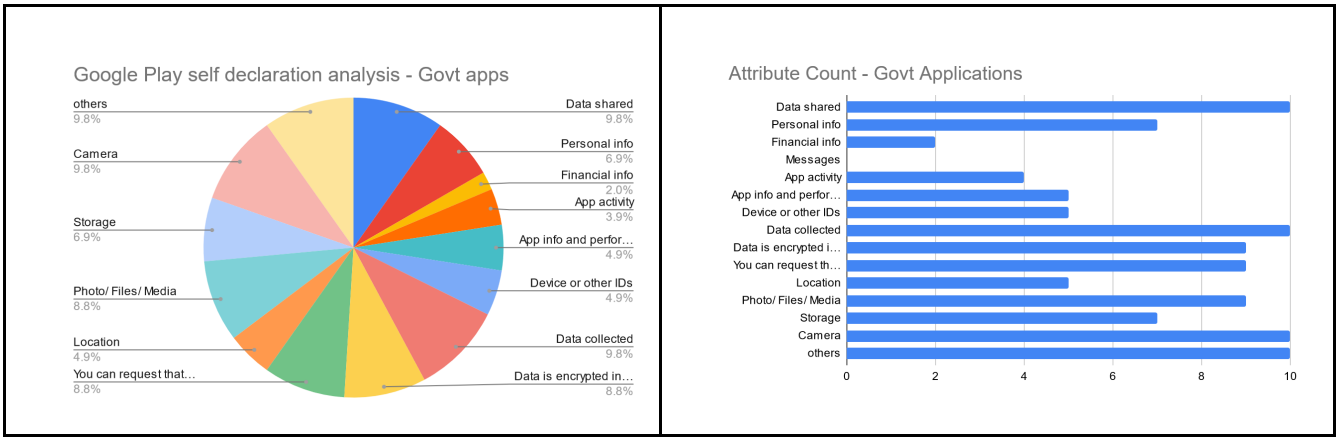
Gov.br - Brazil			

Table 7: Tabulation of top 20 keywords in three basket

Self Declaration - What applications claim?	Most Positive Sentiment	Most Negative Sentiment
Safety	Love	Reinstalling
Data	Amazing	Horrendous
Services	Talk	Problem
Users	Great	Page
Government	Good	Stopped
Practices	Excellent	OTP issue
eGovernment	Secure	Verity
Files	Easy	Time
Location	Quick	Refund
IDs	Friendly	HMI
Devices	Digital	Code
Performance	myGov	Security
Personal	Service	Deny
Support	Accurate	Data
Details	Transparency	Error
Collect	Transaction	Update
Delete	Satisfaction	Delete
Citizens	Informative	Slow
Transparency	Convenient	Validating
Store	Transaction	Reconnecting

Many interesting patterns emerge after dealing with developers' questions about Google Play declaration. Consider the pie chart in Figure 4(a-b), with a graded 10% for each attribute. Firstly, all ten applications have declared that they either ask for user data or do not and whether data is shared with other parties. Thus, the global importance and policy awareness of data usage and its declaration is reflected on the ground. Added attributes under security, like data encryption and encryption of data during transmission are also declared by developers. The provision to enable the facility to delete the data on request by users varies from 7-9. This means there are few applications that have not declared this attribute.

Figure 4: (a) GPS self-declaration analysis - Government apps (4b) Attribute count Government apps



Only 5% of applications in the government segment have been declared on location aspects. In general, about five attributes are assessed below 5%; this makes about ⅓ attributes under each category undeclared by developers.

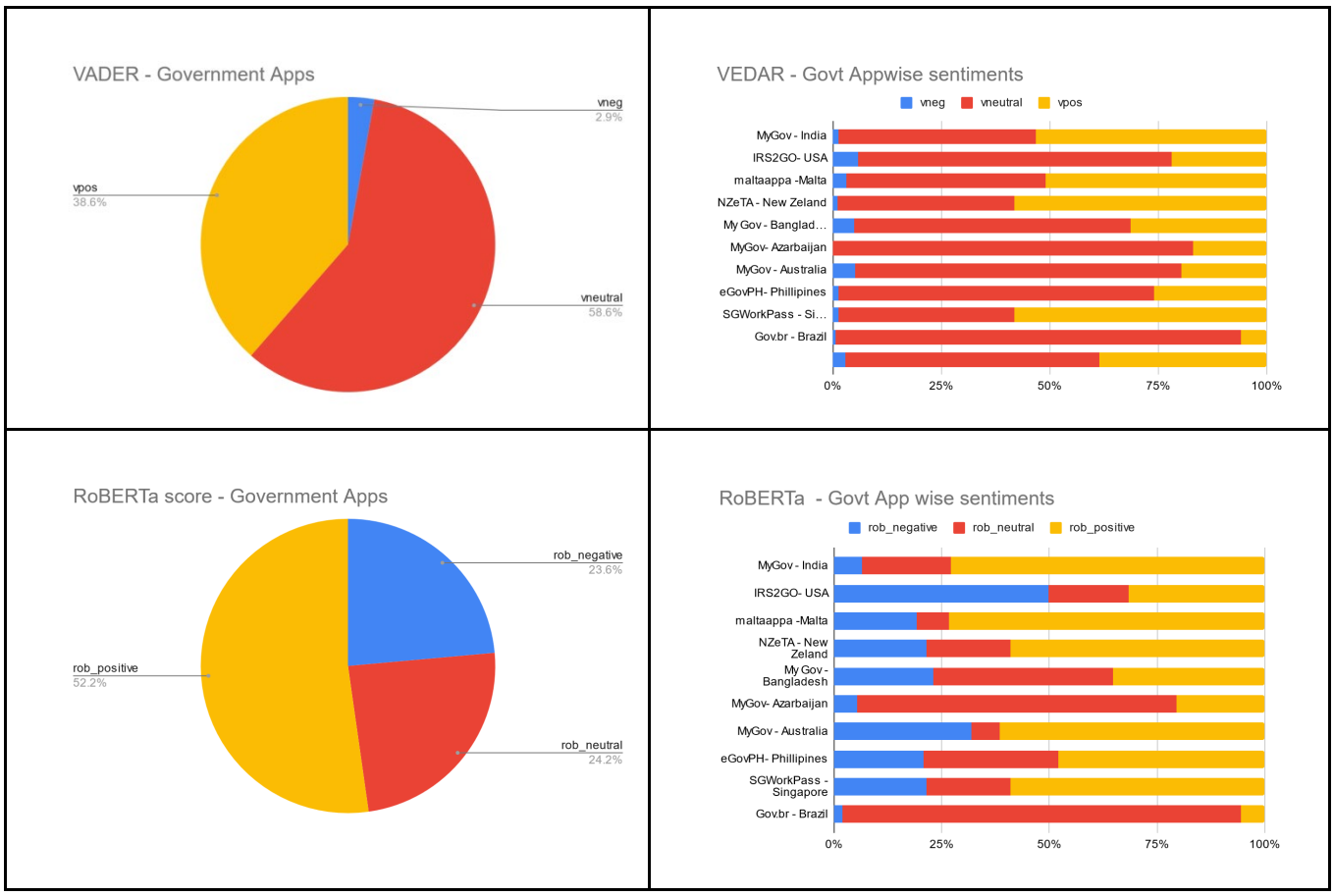
Now comes the question of declaration versus the usage by citizens. It can be seen that even after the non-availability of the declaration on the above-listed attributes, these applications continue to remain most popular in individual segments. The total number of downloads and user reviews indicates that these applications have embarrassed citizens. However, it may also be argued that governments enjoy monopolies in certain areas (such as issuing certificates for land records), and the citizens do not have any other option. The next segment will give us an insight as to what is the citizen response towards these applications.

In terms of keyword analysis, the crux areas appear to be very different, as indicated in Table 7. Under government applications, aspects like data, information, security, practices, government, and developers appear prominently.

Once the application is downloaded by the user and reviewed, we will have to see their approach towards these applications. The following consolidated results bring out a few interesting facts. Figure 5(a-d) presents the analysis of Government applications meant for citizen-government governance. In the diagrams, blue represents a negative score, red represents a neutral score, and yellow represents a positive score.

Figure 5: (a) VADER sentiment analysis - Government apps (5b) VADER app-wise sentiment (5c) RoBERTa sentiment analysis - Government apps (5d) RoBERTa app-wise sentiment

Figure 5: (a) VADER sentiment analysis - Government apps (5b) VADER app-wise sentiment (5c) RoBERTa sentiment analysis - Government apps (5d) RoBERTa app-wise sentiment



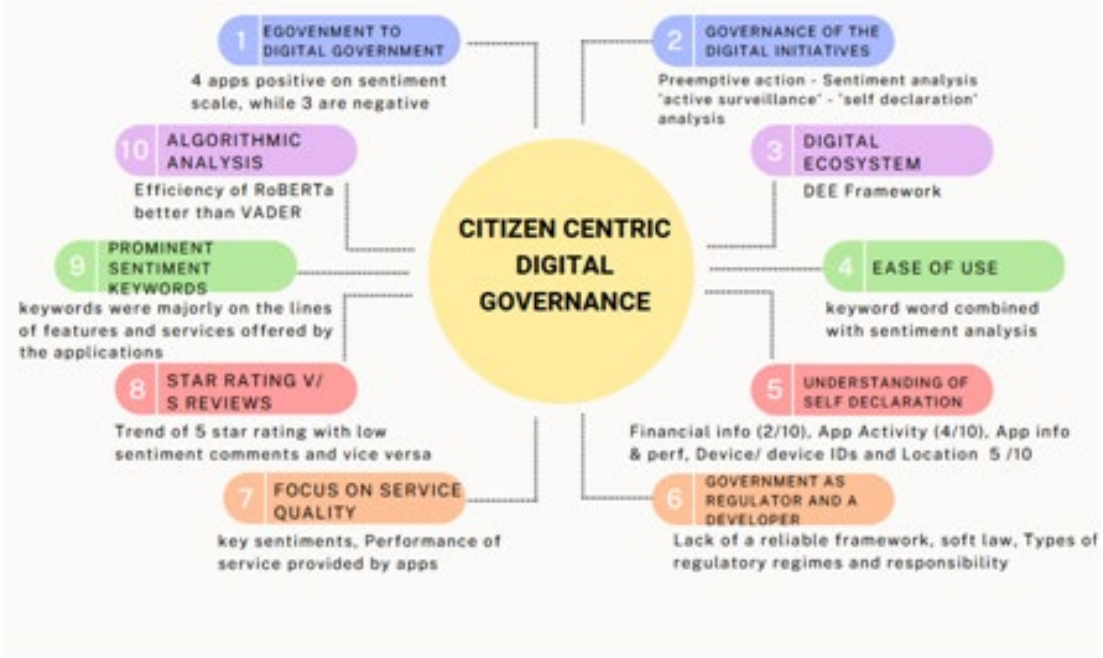
At the outset, through both algorithms used in the analysis, it is evident that the satisfaction level among citizens is 50% only if we consider neutral+negative together. Thus, from the intended intention of citizen enabling, the general public feels there is much more to be done for improvement or is neutral on the polarity score. On an individual application basis, Gov. br of Brazil, MyGov of Bangladesh, eGovPH of Philippines and MyGov of Azerbaijan have a high negative sentiment listed on the reviews. Interestingly, IRS2GO of the USA, a tax filing and management system, has 50% negative reviews in the more robust RoBERTa model. New Zealand, India and Singapore have good positive ratings on both models, which amplifies its success story. Interestingly, Australia was negative in VADER but showed substantial improvement in RoBERTa

5. Discussion

This brings us to the larger question of digital governance mechanisms instituted versus its intended result. The results indicate that irrespective of the country's nature, ethnicity and financial status, the citizens have come out in the open to use the citizen-centric applications and have re-viewed them accordingly. On a theoretical grounding, the results of the experimentation through above stated two levels bring about a larger discussion on many aspects. In the following paragraphs, we

have sequenced the arguments from the larger fundamental to the user level. We have coded these arguments under ten broad heads, as shown in Figure 6.

Figure 6: Concept map of discussion on review of citizen-centric applications



1) e-Government to Digital Government: According to the OECD (2014), "e-Government" refers to the "use by the governments of information and communication technologies (ICTs), and particularly the Internet, as a tool to achieve better government" while "digital government" is defined as the "use of digital technologies, as an integrated part of governments' modernisation strategies, to create public value." Though OECD adopted this definition in 2014, the concept of digital government has long been discussed and debated. Silcock (2001), while discussing the larger context of "what is e-Government", stated that using technology to enhance the access to and delivery of government services to benefit citizens, business partners, and employees becomes e-Governance. Chung and Kim (2019) have studied policy by comparing digital government policies focusing on eGovernment Acts in the US v/s Korea. Thus, the country-specific acts and peculiarities must be accommodated in the journey towards the digital government. The listed ten applications in the study clearly indicate this migration from using ICT to aid the government to be an integral part of the government to govern through value creation to the public. The applications built by different countries and for different purposes are now integral parts of respective governments to facilitate their citizens. As per the analysis, the acceptance of these applications in India, Singapore, Australia and New Zealand are successful, while initiatives in Bangladesh, Azerbaijan and the Philippines are not at par with the expectations of their citizens, while the USA has applications which are just on the fence. The country's ethnicity, financial status and global status seem immaterial, as our study has shown that countries from vivid backgrounds have taken the initiative to digitally onboard their citizens.

2) Governance of the Digital Initiatives: With the evolution of technology, computational power and the ability of governments to adopt digital government initiatives, the risk associated with its governance and sustainability have also to be deliberated. Data privacy, data theft, cyber-security and social discrepancy remain the main challenges (Linkov et al., 2018). At the same time, the government is also responsible for onboarding all its citizens on these applications, which are extensions of the government itself. Failing to do so will bring in the phenomenon of "digital divide". This will create a tangible social gap between haves and have-nots of digital means. Erkut Burak (2020) carries out an analysis of the knowledge problem of economics in light of digitisation. Doing so, he asks, migrating from digital government to governance as to whether we are there yet. On the same lines, Sharma et al. (2020) present areas related to governance framework and the challenges related to digital governance. While many countries with time have evolved their strategies, in June 2017 OECD Ministerial Meeting in Paris highlighted the following three options: (1) a laissez-faire, industry-driven approach; (2) a precautionary and preemptive strategy on the part of government and (3) a stewardship and "active surveillance" approach by government agencies to reduce risks derived from digitalisation while promoting private sector innovation. While option 1 emphasises minimum governance or interference by the government, option two calls for drawing plans not just as a precautionary step but also as a preemptive mechanism. These include aspects like safety and protection from data privacy, data theft, cybersecurity and social discrepancy. Option 3 requires governments to wear two hats: private sector innovation encourager and its doorkeeper as well. In our paper, the aspect of areas where precaution or preemptive action is to be taken is determined by means of sentiment analysis. At the same time, the means of 'active surveillance' is enabled by 'self-declaration' analysis. Hence, our study and scope make the digital governance strategy analysis more comprehensive.

3) Digital Ecosystem: Li et al. (2012) defined a digital ecosystem as "…a self-organising, scalable and sustainable system composed of heterogeneous digital entities and their interrelations focusing on interactions among entities to increase system utility, gain benefits, and promote information sharing, inner and inter cooperation and system innovation. Further, Dini et al. (2011) argue that digital ecosystems are bottom-up, user-driven and open source-oriented. In our study, these ten applications are floated as part of government initiatives for citizens at large. These applications are free and available for download. Further, the quantum of downloads and reviews that were crawled (Table 2) shows a large acceptance of these applications by the ecosystem. Sussan and Acs (2017) introduce a Digital entrepreneurial ecosystem (DEE) framework. This framework includes (i) digital infrastructure governance, (ii) digital user citizenship, (iii) digital entrepreneurship, and (iv) digital marketplace. Through this study, we have undertaken a detailed study of ten applications in the domain of self-declaration and governance; through sentiment analysis have built on to the user citizen emotions and through qualitative analysis, bringing out aspects relevant to digital entrepreneurship. Incorporating these suggestions allows new and updated applications to be released to the marketplace or environment.

4) Ease of Use: Apart from effectiveness, convenience and efficiency, the popularity of digital governance is attributable to its ability of ease of use. One of the effective models popularly used for assessing new technology was developed by Davis (1989), called the Technology Acceptance Model (TAM). It was developed on the causal relationship between the Theory of Reasoned Action (TRA)

in explaining technology acceptance behaviour (Venkatesh & Davis, 2000; Warsono et al.,2023). The Technology Acceptance Model (TAM) is a concept that explains that the main determinants that affect technology acceptance are perceived ease of use and perceived usefulness of new technology (Chatzoglou et al., 2015). Further, more recently SARAL (Smartphone Applications embracing Low-literate users) framework is proposed by Srivastava et al (2021). This framework emphasises the ease of handling an application UI/ UX for a low-literate user. They list five themes coded over 13 attributes towards this. In the context of citizen-centric applications, the ease of use is the main takeaway for effective, convenient and efficient use of these applications. As indicated in Table 2, the quantum of downloads and reviews registered clearly indicates successful adaptation. Also, certain keywords listed in Table 7 indicate the ease of use. Citizen onboarding happens mostly even without citizen participation in the application development process (Lember et al., 2019). Even without this, our study notes downloads varying up to 10M+ on the Google Play Store. Thus, application review and rating are the major deciding factors in the traction of usage of applications (Caputo et al., 2023). Having said that, it is also evident from the word analysis of both positive and negative sentiments, that citizens have expressed aspects like features, services and efficiency of the delivery from the applications as one of the major factors attributing to the use of applications. Understanding the needs of the citizens and making their journey painless remains a big challenge. Some literature suggests using design features to improve this sentiment (King and Cotterill, 2007; Lent and Arend, 2004), while some have even listed specific touchdown points to ensure a smooth application experience (Saxena et al., 2022). Involvement of citizens directly or understanding their needs and overcoming the bureaucratic procedure for citizen purposes plays a crucial role in the success of the citizen-centric application. From a fundamental analysis standpoint, the keyword word combined with sentiments analytical-ly enumerates the same in our study.

5) Understanding of Self-declaration: Google Play Store has set a few preset aspects which developers use to declare relevant information to users. With emerging awareness of data protection rights (Yang et al., 2019; Wang et al., 2019), developers are indeed reporting the intention and necessity to use, share or store user data. However, certain technical intricacies like data encryption, transportation, camera, location, microphone access, photo and media usage re-choir larger public awareness. It was surprising to note that few applications, even government-owned, have stated that they collect data from users but have stated they do not provide any option to delete such data even if the user desires. These finer aspects need larger public awareness and require citizens across the globe to be technically aware. This appears to be a work in progress which requires larger public participation (Saxena et al., 2023). Some researchers have argued that the need for dynamic or automated GDPR is the solution (Guamán et al., 2023). Against the backdrop of the European Union GDPR laws of 2010, the role of not just application developers but also application distributors like Google Play Store has also come under close scrutiny. Not just personal data collection but its storage and further distribution have drawn researchers for study. Guamán (2023), for example, indicates that about 48% of applications considered in the study are not compliant with EU rules concerning GDPR. Furthermore, 33% do not declare if data is collected at all, and about 15% partially or do not disclose the purpose of data usage. Hacker et al. (2023) also note these issues in the larger context of regulating the Large Generative AI-Language Model (LGAIM). This is also consistent with our study

of these ten applications. These are indicated in Figure 4 and discussion thereof. Thus, self-declarations by application developers and distributors alike have more active roles to play to ensure transparency.

6) Government as regulator and a developer: In this case, the government plays the dual role of application developer (directly or on its behalf) and policy issuer. Thus, aspects of self-declaration, its parameters and contents are expected to be immaculate as a matter of ethics. This aspect poses a potential gap. The papers arguing and suggesting mechanisms to regulate or gov-ern AI models or applications do exist (Saxena et al., 2023). The fundamental need for citizen-centric applications or their underlying technology is well documented and brought out in the literature. However, the uniqueness in the domain of citizen-centric applications is that the government is both the service provider and also the regulator. While swinging between these roles, our study has brought out a mismatch in the level of compliance through declaration and sentiments expressed by the citizens. The role of the government as a regulator is well-researched. The potential area for further study is the dual role of governments in the context of citizen-centric applications. On the other hand, as these applications are developed or promoted by the government, citizens feel that these applications are already in compliance with safety standards. This faith in government initiative prevails. The choice between control of digital governance by government-instituted regulation or self-regulation by stakeholders is never-ending (Katzenbach and Ulbricht, 2019; Yeung and Bygrave, 2021). Due to the lack of a reliable framework for compliance law, governments are forced to issue soft law with diverse arguments for centralisation or decentralisation of AI regulation between public, private and other institutes (Gutierrez and Marchant, 2021). The interrelation between types of regulatory regimes and responsibility (May 2007; Djeffala et al., 2022) is also crucial in determining a suitable regime for a technology. In our paper, we have reviewed Google's self-declaration parameters. The need of the hour is a fundamental study to standardise the self-regulation framework through digital governance policy.

7) Focus on service quality: Our results do not indicate any specific compartmentalisation in terms of ethnicity or geographical location. These applications were rolled out for download and utilisation, which people have done. Some applications may need changes in features or services, which may attract more positive reviews. In government applications, if apps of Bangladesh, Azerbaijan and Brazil attracted negative sentiments, India attracted high positivity. At the same time, the app's performance in the USA was evenly distributed. Thus, irrespective of the state of the nation, it is the service that the app has provided that is acting as a deciding factor of sentiments. One of the application parts of our analysis was the Singapore government’s work permit application. Along similar lines, Saxena et al. (2022) have provided a decision tree-based approach for a citizen to find a job in the country using a citizen-centric application. The paper interestingly lists five touchdown points to the government for the smooth rollout of services for its citizens. Our study has also highlighted through sentiment analysis that irrespective of the country's economic stature or geographic location, the quality of service will draw positivity towards the success of these applications. The key sentiments listed in Table 7 indicate that the focus of the citizen is primarily on the quality of service and features of the applications. Citizens have also expressed negative sentiments when its quality of service takes a hit.

8) Star rating v/s reviews: As many studies previously have brought out the aspect of ambiguity between star rating and reviews posted by users, we have not concentrated predominantly on star ratings (Noei & Lyons, 2019; Noei, 2018). However, in our study, evidence exists that high star-rated reviews had low polarity values and vice versa. These are clearly plotted in Table 6. Here a very interesting aspect to observe is that applications of New Zealand, Brazil and Australia on star rating terms have more single-star ratings than five stars, while on the sentiment scale, New Zealand and Australia have positive sentiment. Similarly, IRS2GO of the USA and Bangladesh have a neck-to-neck tally between 1-to-5-star ratings but differ in the sentiment expressed. Our study has, in detail tabulated the star rating and sentiment analysis ambiguity for all these ten applications. It is indeed possible that a user their star rating has rated the application high, but in text review, the sentiment expressed can be of lower value or vice versa. Table 6 is an analytical outcome online of empirical results listed by Noei & Lyons (2019) and Noei (2018).

9) Prominent Sentiment Keywords: As we have used ten applications for review, tabulation of most positive and negative keywords indicated user emotions centred around features and application performance alone. Aspects like security and data collection did not prominently feature in keyword analysis. However, the keywords were majorly on the lines of features and services offered by the applications. These are listed in detail in Table 7 above. A close look at the nature of keywords shows that people have let their emotions and feedback out on the application's efficacy more than on technicality compliance or regulation. The citizens are observed to give feedback to application developers. It will be interesting to see how often these sentiments are incorporated into the application. The 'Citizen in the middle' or 'citizen involved' development approach discussed in our literature review will be a reality. The relevance and importance of keywords are now a well-established concept. The context of bibliometric analysis (Ellegaard and Wallin, 2015) or the context of Data Envelopment Analysis (Emrouznejad & Yang, 2018) have established the same. On applying the fundamental concept of keywords, the study on the cancer support groups (Seale et al., 2006) is significant. The closest that can be associated with our paper is public perception in the context of COVID-19 by Boon-Itt (2020), which undertook both sentiment analysis and keyword analysis. However, in the context of digital transformation and analysis of citizen-centric applications, we can be the first of few in that direction.

10) Algorithmic Analysis: We have extensively used two algorithms to assess users' sentiments. The study has brought out clearly the nature, differences and samples of both VADER and RoBERTa. VADER continues to be a fence sitter and neutral-prone algorithm. It is also interesting to note that the text converter was effective in converting and analysing Brazilian re-views, but Wordcloud was not effective in mapping the most positive and negative reviews of Bangladesh. This throws up another aspect of sentiment analysis and citizen-centric applications. Using vernacular languages in reviews is also an interesting feature worth studying. The efficiency of language translation libraries and subsequent sentiment analysis is another domain for study. On the lines of the pre-existing study of VADER and RoBERTa, our study by use of a large data set model and extensive experimentation has established the efficiency of RoBERTa to be higher in the context of longer text inline with results of Devlin et al. (2018) and Singh et al. (2021). However, it is pertinent to note that the code execution time taken for RoB-ERTa is five to six times more in terms of time. Thus inclusion of VADER and RoBERTa in the same paper for the same data set with the use case being a citizen-

centric application review is unique and exhaustive. Experimentation on using hybrid sentiment analysis models will be interesting for further study.

This paper's key findings and assessments are summed up in Table 8.

Table 8: Summary of the paper and its findings

Level	Analysis Parameter	Result	Takeaway
What Application Developers Claim?	About application in Google Play Store	About six applications laid out in detail the objectives and expectations that citizens could have from application	The About section must be comprehensive and must lay out what to expect towards services it can provide
	15 Preset parameters (8 were on safety, 2 on security and 5 on app permissions)	The result is tabulated in Fig 5. Financial info (2/10), App Activity (4/10), App info performance, Device/ device IDs and Location are declared by only five apps on 10 declared.	The applications must do more on safety/ security/ permissions/ data protection aspects. Similar finding with different approaches is also indicated by Guamán et al., 2023, and Saxena et al., 2023
		Aspects like location, personal, financial, data and messages remain grey areas	Many applications have declared that they do not give users the facility to delete their data once registered.
	Keyword Analysis	The claims of the government/ developers are listed in Table 7	Developers' claims for safety, security, transparency, e-Government and support are a few notable keywords
			On the flip side, the keywords did not figure out aspects like ease of use, HMI or application features.
			The study of keywords, as indicated by Seale et al.(2006) and Boon-Itt (2020), indicates how these can forge an underlying core focus area.
What do users say?	Sentiment Analysis	Used two independent sentiment	RoBERTa provided better results compared

		analysis algorithms to overcome bias	to VADER. This is a fundamental validation of algorithms.
			RoBERTa is computationally heavy, yet it was successfully tested on this large dataset.
	Dataset	A large dataset of 35710 reviews was crawled and tested	It was a novel approach, though it was time-consuming.
	Sentiments	The detailed outcome is tabulated in Fig 6 and the associated paragraph. Four of ten applications have satisfaction less than or equal to 50 %, taking negative and neutral sentiments together.	Gov.br of Brazil, MyGov of Bangladesh, eGovPH of Philippines and MyGov of Azerbaijan have a high negative sentiment. New Zealand, India and Singapore have good positive ratings on both models.
	Star rating v/s reviews	Thirty-five thousand seven hundred ten reviews and their star rating were reviewed. Refer Table 6	Evidence exists that high star-rated reviews have complimented low polarity values and vice versa. Applications of New Zealand, Brazil and Australia on star rating terms have more single-star ratings than five stars, while on the sentiment scale, New Zealand and Australia have a positive sentiment.
	Keyword Analysis	The sentiments of citizens are listed in Table 7	The ease of doing aspects like – easy, quick, friendly, accurate and convenient were positive, while negative keywords were on HMI and a host of technical issues like error, code, slow, OTP etc. It has compliance keywords like security, data, etc.
Review	Application, data and Algorithm	Ten applications globally and 35710 reviews were reviewed	Well-distributed and large dataset. The results are tabulated in

		on two independent algorithms.	detail and are free of author bias.
	Compliance through self-declaration	The result is tabulated in Fig 5	As the data indicates, there exists a gap in self-declaration. This is in line with previous studies by Guamán et al., 2023, Yang et al., 2019; Wang et al., 2019. This is also alarming in the context of the rate at which AI and digital governance are moving.
	Relevance of Citizen Inclusion	Incorporation of citizens in the development and review of application performance	There was no available data point to study citizen involvement in application development. Sentiment analysis, discerning sentiment-star rating paradox and use of robust algorithms in line with Alexopoulos 2014, Hutto and Gilbert 2014, Linares-Vásquez et al., 2013 and Noei & Lyons, 2019
	Citizen Onboarding to user cycle	Evidence-based approach	Most citizens downloaded the application due to the purpose it served (service offered by the government). They stayed on the app due to its preserved ease of use. Its usefulness is provided through their review, both good and bad. Venkatesh & Davis, 2000 fundamentally indicate this, Chatzoglou et al., 2015. However, user compliance checks before onboarding do not seem to be a major issue for end users as aspects related to it are not echoed either in sentiment

			analysis or keyword analysis.
	e-Government to Digital Government Digital Government to Digital Governance Digital Ecosystem Digital Governance and Ease of Use Understanding of Self-declaration The government, as regulator and a developer Focus on service quality Star rating v/s reviews Prominent Sentiment Keywords Algorithmic Analysis	Deliberated in detail in Section 5	Against the backdrop of results obtained in the first two levels, analysis has been carried out on these ten parameters with previously established studies. Many aspects have been comprehensively established in the discussion. The governance aspect in citizen-centric applications is a new and emerging field with many research interests.

6. Conclusion

Our study was carried out in three levels, involving ten applications with 15 self-declaration parameters and after analysis of review of about 35710 using two algorithms, we have established the expected trend vs reality of user response to applications under ten broad themes. We have seen in our level 1 that self-declaration on aspects of data is undertaken by developers by and large. However, more attention is required on aspects of data handling, sharing, and transmission. Aspects like location, photo, media and ability to delete user data by user are not found to be uniform across platforms. In level 2, we have seen a large set of sentiments mined by au-thors for analysis and subjected to two types of algorithms for analysis. In this section, it emerged that users are assessing the applications based on user experience and governance issues. Four applications out of 10 have less than 50% satisfaction on sentiment analysis. Further, in the review stage, the paper weighs on ten parameters on larger aspects of digital infrastructure, ecosystem and eGovernment to eGovernance aspects. The comparison between the declaration and user sentiment is a valuable one as it allows the readers to see what is being claimed and what the users feel in terms of a stated declaration by the developers.

However, some limitations of our study are to be noted. The first limitation of our study is the review of only ten applications and the use of only two algorithms. Further study can be carried out on the fundamentals of self-declaration of digital applications. It would be ideal to establish a proposed declaration guideline. Second, the use of other algorithms, transformers or hybrid models can also be explored for analysis. Assessment of individual applications against the backdrop of fundamental models like TAM or SARAL can be undertaken. Third, our study does not cover the actual usage of the apps. To address this limitation, future studies may collect field-based data to evaluate usability. Fourth, this study does not examine the contribution of individual apps toward the digitalisation of governance. Future studies may do well by incorporating these aspects by potentially

analysing usage data vis-à-vis non-digital channels. Fifth, this study did not seek to make comparisons across or rank the countries in terms of app usage. Future studies may perform such comparisons to identify leaders and laggards in this area. Finally, a better assessment of declaration versus implementation could be through technical analysis of each feature.

References

Alexopoulos, C., Loukis, E., & Charalabidis, Y. (2014). A platform for closing the open data feedback loop based on Web2. 0 functionality. JeDEM-eJournal of eDemocracy and Open Government, 6(1), 62-68.

Boon-Itt, S. (2020). A text-mining analysis of public perceptions and topic modelling during the COVID-19 pandemic using Twitter data (preprint). JMIR Public Health and Surveillance, 6(4). https://doi.org/10.2196/21978

Binns, R., Lyngs, U., Van Kleek, M., Zhao, J., Libert, T., et al. 2018. Third-Party Tracking in the Mobile Ecosystem. Proceedings of the 10th ACM Conference on Web Science - WebSci '18. https://doi.org/10.1145/3201064.3201089.

Caputo, D., Pagano, F., Bottino, G., Verderame, L., & Merlo, A. (2023). You Can't Always Get What You Want: Towards User-Controlled Privacy on Android. IEEE Transactions on Dependable and Secure Computing, 20(2): 975–987.

Carvalho, C., & Brito, C. (2012). Assessing Users' Perceptions on how to Improve Public Services Quality. Public Management Review, 14(4), 451–472. https://doi.org/10.1080/14719037.2011.649976

Casiano Flores, C, Rodriguez Müller, AP, Virkar, S, Temple, L, Steen, T & Crompvoets, J (2022). Towards a co-creation approach in the European Interoperability Framework, Transforming Government: People, Process and Policy, https://doi.org/10.1108/tg-03-2022-0033.

Castelnovo, W., & Sorrentino, M. (2017). The digital government imperative: a context-aware perspective. Public Management Review, 20(5), 709–725. https://doi.org/10.1080/14719037.2017.1305693

Chatzoglou, Prodromos, Dimitrios Chatzoudes, and Symeon Symeonidis. 2015. "Factors Affecting the Intention to Use e-Government Services." Pp. 1489–98 in.

Choi, H., Jae Park, M., Jeung Rho, J., & ZO, H. (2016). Rethinking the assessment of e-Government implementation in developing countries from the perspective of the design–reality gap: Applications in the Indonesian e-procurement system. Telecommunications Policy, 40(7): 644–660.

Chung and Kim. 2019. "A Comparative Study of Digital Government Policies, Focusing on e-Government Acts in Korea and the United States." Electronics 8(11):1362. doi: 10.3390/electronics8111362.

Cruz, C. A. A., & Balahadia, F. F. (2021). Analyzing Public Concern Responses for Formulating Ordinances and Laws using Sentiment Analysis through VADER Application. International Journal of Computing Sciences Research, 6, 842-856.

Curtis, S. (2019). Digital transformation—the silver bullet to public service improvement? Public Money & Management, 39(5), 322–324. https://doi.org/10.1080/09540962.2019.1611233

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and Acceptance of Information Sistem Technology. MIS Quarterly, 13(3), 319-339

De', R., & Ratan, A. L. (2009). Whose gain is it anyway? Structurational perspectives on deploying ICTs for development in India's microfinance sector. Information Technology for Development, 15(4), 259–282. https://doi.org/10.1002/itdj.20129.

Devlin, J., Chang, M. W., Lee, K., & Toutanova, K. (2018). Bert: Pre-training of deep bidirectional transformers for language understanding. arXiv preprint arXiv:1810.04805.

Dini, Paolo, Mehita Iqani, and Robin Mansell. 2011. "The (Im)Possibility of Interdisciplinarity: Lessons from Constructing a Theoretical Framework for Digital Ecosystems." Culture, Theory and Critique 52(1):3–27. doi: 10.1080/14735784.2011.621668.

Djeffal, C., Siewert, M. B., & Wurster, S. (2022). Role of the state and responsibility in governing artificial intelligence: a comparative analysis of AI strategies. Journal of European Public Policy, 1–23.

Dudley, E., Lin, D. Y., Mancini, M., & Ng, J. (2015). Implementing a citizen-centric approach to delivering government services. McKinsey & Company. https://www.mckinsey.com/industries/public-sector/our-insights/implementing-a-citizen-centric-approach-to-delivering-government-services

Dunleavy, P., & Hood, C. (1994). From old public administration to new public management. Public Money & Management, 14(3), 9–16. https://doi.org/10.1080/09540969409387823

Ellegaard, O., & Wallin, J. A. (2015). The bibliometric analysis of scholarly production: How great is the impact? Scientometrics, 105(3), 1809–1831. https://doi.org/10.1007/s11192-015-1645-z

Eibl, G., Lampoltshammer, T., & Temple, L. (2022). Towards identifying factors influencing mobile government adoption: An exploratory literature review. JeDEM-eJournal of eDemocracy and Open Government, 14(1), 1-18. https://doi.org/10.29379/jedem.v14i1.693

Emrouznejad, A., & Yang, G. (2018). A survey and analysis of the first 40 years of scholarly literature in DEA: 1978–2016. Socio-Economic Planning Sciences, 61, 4–8. https://doi.org/10.1016/j.seps.2017.01.008

Eom, S.-J., Hwang, H., & Kim, J. H. (2018). Can social media increase government responsiveness? A case study of Seoul, Korea. Government Information Quarterly, 35(1): 109–122.

Erkut, Burak. 2020. "From Digital Government to Digital Governance: Are We There Yet?" Sustainability 12(3):860. doi: 10.3390/su12030860.

Evans, D., & Yen, D. C. (2006). e-Government: Evolving relationship of citizens and government, domestic, and international development. Government Information Quarterly, 23(2): 207–235.

Furr, N., & Shipilov, A. (2019). Digital Doesn't Have to Be Disruptive. Harvard Business Review. https://hbr.org/2019/07/digital-doesnt-have-to-be-disruptive

Grundy, Quinn, Kellia Chiu, Fabian Held, Andrea Continella, Lisa Bero, and Ralph Holz. 2019. "Data Sharing Practices of Medicines Related Apps and the Mobile Ecosystem: Traffic, Content, and Network Analysis." BMJ l920. doi: 10.1136/bmj.l920.

Guamán, D. S., Rodriguez, D., del Alamo, J. M., & Such, J. (2023). Automated GDPR compliance assessment for cross-border personal data transfers in android applications. Computers & Security, 130: 103262.

Gutierrez, C. I., & Marchant, G. E. (2021). A Global Perspective of Soft Law Programs for the Governance of Artificial Intelligence. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.3855171

Hacker, P., Engel, A., & Mauer, M. (2023). Regulating ChatGPT and other Large Generative AI Models. Proceedings of the 2023 ACM Conference on Fairness, Accountability, and Transparency. https://doi.org/10.1145/3593013.3594067

Hood, C., & Dixon, R. (2015). What We Have to Show for 30 Years of New Public Management: Higher Costs, More Complaints. Governance, 28(3), 265–267. https://doi.org/10.1111/gove.12150

Hutto, C & Gilbert, E (2014). VADER: A Parsimonious Rule-Based Model for Sentiment Analysis of Social Media Text, Proceedings of the International AAAI Conference on Web and Social Media, vol. 8, no. 1, pp. 216–225.

Janowski, T. (2015). Digital government evolution: From transformation to contextualization. Government Information Quarterly, 32(3), 221–236. https://doi.org/10.1016/j.giq.2015.07.001

Katzenbach, C., & Ulbricht, L. (2019). Algorithmic governance. Internet Policy Review, 8(4), 1-18.

King, S., & Cotterill, S. (2007). Transformational government? The role of information technology in delivering citizen-centric local public services. Local Government Studies, 33(3), 333–354.

Lamba, A., Yadav, D., & Lele, A. (2016). Citizen Pulse. Proceedings of the 3rd ACM IKDD Conference on Data Sciences, CODS 2016. https://doi.org/10.1145/2888451.2888463.

Lamberti, L. (2013). Customer centricity: the construct and the operational antecedents. Journal of Strategic Marketing, 21(7), 588–612. https://doi.org/10.1080/0965254x.2013.817476

Lawani, A., Reed, M. R., Mark, T., & Zheng, Y. (2019). Reviews and price on online platforms: Evidence from sentiment analysis of Airbnb reviews in Boston. Regional Science and Urban Economics, 75, 22-34.

Leiser, M., & Murray, A. (2016). The role of non-state actors and institutions in the governance of new and emerging digital technologies. The Oxford Handbook of Law, Regulation and Technology, 670–704.

Lember, V., Brandsen, T., & Tõnurist, P. (2019). The potential impacts of digital technologies on co-production and co-creation. Public Management Review, 21(11), 1–22. https://doi.org/10.1080/14719037.2019.1619807

Lent, A., & Arend, N. (2004). Making choices: How can choice improve local public services. New Local Government Network

Li, Wenbin, Youakim Badr, and Frédérique Biennier. 2012. "Digital Ecosystems: Challenges and Prospects." Pp. 117–22 in Proceedings of the International Conference on Management of Emergent Digital EcoSystems. Addis Ababa Ethiopia: ACM.

Lin, C. I. C., Kuo, F.-Y., & Myers, M. D. (2015). Extending ICT4D Studies: The Value of Critical Research. MIS Quarterly, 39(3), 697–712. https://doi.org/10.25300/misq/2015/39.3.09

Linares-Vásquez, M., Bavota, G., Bernal-Cárdenas, C., Di Penta, M., Oliveto, R., et al. (2013). API change and fault proneness: a threat to the success of Android apps. Proceedings of the 2013 9th Joint Meeting on Foundations of Software Engineering - ESEC/FSE 2013, 477–487.

Linkov, Igor, Benjamin Trump, Kelsey Poinsatte-Jones, and Marie-Valentine Florin. 2018. "Governance Strategies for a Sustainable Digital World." Sustainability 10(2):440. doi: 10.3390/su10020440.

Malhotra, C., Sharma, A., Agarwal, N., & Malhotra, I. (2019). Review of Digital Citizen Engagement (DCE) Platform. Proceedings of the 12th International Conference on Theory and Practice of Electronic Governance, 148–155.

Mandl, U., Dierx, A., & Ilzkovitz, F. (2008). The effectiveness and efficiency of public spending (No. 301). Https://Ec.europa.eu/Economy_finance/Publications/Pages/Publication11902_en.pdf; European Commission, Directorate-General for Economic and Financial Affairs.

Martin, S., & Webb, A. (2009). "Citizen-centred" public services: contestability without consumer-driven competition?. Public Money & Management, 29(2), 123–130. https://doi.org/10.1080/09540960902768038

May, P. J. (2007). Regulatory regimes and accountability. Regulation & Governance, 1(1): 8-26.

Mergel, I., Kattel, R., Lember, V., & McBride, K. (2018). Citizen-oriented digital transformation in the public sector. Proceedings of the 19th Annual International Conference on Digital Government Research: Governance in the Data Age. https://doi.org/10.1145/3209281.3209294

Mishra, S. S. (2019). Testing the antecedents to e-Democracy towards citizens' happiness: a structural equation modelling approach to "MyGov" initiative, India. International Journal of Public Administration, 43(15): 1–11.

Misra, A., Misra, D. P., Mahapatra, S. S., & Biswas, S. (2018). Digital transformation model. Proceedings of the 19th Annual International Conference on Digital Government Research Governance in the Data Age - Dgo '18. https://doi.org/10.1145/3209281.3209359.

Ehsan Noei, E. 2018. Succeeding in Mobile Application Markets (From Development Point of View). Ph.D. Dissertation

Noei, E., & Lyons, K. (2019). A Survey of Utilizing User-Reviews Posted on Google Play Store. Proceedings of the 29th Annual International Conference on Computer Science and Software Engineering, 54–63.

OECD. 2014. "Ministerial Council Meeting 2014, OECD, Paris.", https://www.oecd.org/mcm/ministerial-council-meeting-2014.htm

OECD. 2017. "Ministerial Council Meeting 2017, OECD, Paris.", https://www.oecd.org/mcm/ministerial-council-meeting-2017.htm

Osah, J., & Pade-Khene, C. (2020). e-Government strategy formulation in resource-constrained local government in South Africa. Journal of Information Technology & Politics, 17(4): 1–26.

Osborne, S. P., Nasi, G., & Powell, M. (2021). Beyond co-production: value creation and public services. Public Administration, 99(4). https://doi.org/10.1111/padm.12718

Pade-Khene, C., Machiri, M., & Thinyane, H. (2017). Building foundations before technology: An operation model for digital citizen engagement in resource constrained contexts. Proceedings of the European Conference on e-Government, ECEG, 118–126.

Parker, Lisa, Vanessa Halter, Tanya Karliychuk, and Quinn Grundy. 2019. "How Private Is Your Mental Health App Data? An Empirical Study of Mental Health App Privacy Policies and Practices." International Journal of Law and Psychiatry 64:198–204. doi: 10.1016/j.ijlp.2019.04.002.

Pi, Y. (2021). Machine learning in governments: Benefits, challenges and future directions. JeDEM-eJournal of eDemocracy and Open Government, 13(1), 203-219.

Saxena, D. (2021). Big data for digital transformation of public services. In Disruptive technology and digital transformation for business and government (pp. 250-266). IGI global.

Saxena, D., Muzellec, L., & McDonagh, J. (2022). From Bureaucracy to Citizen-Centricity. International Journal of Electronic Government Research, 18(1): 1–17.

Saxena, D., Wall, P. J., & Lewis, D. (2023). Artificial Intelligence (AI) Ethics: A Critical Realist Emancipatory Approach. In 2023 IEEE International Symposium on Technology and Society (ISTAS) (pp. 1-5). IEEE.

Saxena, K. B. C. (2006). Towards excellence in e-governance. International Journal of Public Sector Management, 18(6): 498–513.

Seale, C., Ziebland, S., & Charteris-Black, J. (2006). Gender, cancer experience and internet use: A comparative keyword analysis of interviews and online cancer support groups. Social Science & Medicine, 62(10), 2577–2590. https://doi.org/10.1016/j.socscimed.2005.11.016

Sharma, Gagan Deep, Anshita Yadav, and Ritika Chopra. 2020. "Artificial Intelligence and Effective Governance: A Review, Critique and Research Agenda." Sustainable Futures 2:100004. doi: 10.1016/j.sftr.2019.100004.

Silcock, R. 2001. "What Is e-Government." Parliamentary Affairs 54(1):88–101. doi: 10.1093/pa/54.1.88.

Singh, M., Jakhar, A. K., & Pandey, S. (2021). Sentiment analysis on the impact of coronavirus in social life using the BERT model. Social Network Analysis and Mining, 11(1), 33.

Singh, S., Sharma, P., Ghimire, P., Shrestha, R., & Gnanavel, S. (2023). Assessment of App Store Description and Privacy Policy to Explore Ethical and Safety Concerns Associated with the Use of Mental Health Apps for Depression. Indian Journal of Psychological Medicine, 45(2): 173–178.

Srivastava, Ayushi, Shivani Kapania, Anupriya Tuli, and Pushpendra Singh. 2021. "Actionable UI Design Guidelines for Smartphone Applications Inclusive of Low-Literate Users." Proceedings of the ACM on Human-Computer Interaction 5(CSCW1):1–30. doi: 10.1145/3449210.

Statista (2019) . Google Play Store: number of apps 2019 | Statista. Statista. Statista. https://www.statista.com/statistics/266210/number-of-available-applications-in-the-google-play-store/.

Sun, R., Xue, M., Tyson, G., Wang, S., Camtepe, S., et al. (2023). Not Seen, Not Heard in the Digital World! Measuring Privacy Practices in Children's Apps. Proceedings of the ACM Web Conference 2023, 2166–2177.

Sussan, Fiona, and Zoltan J. Acs. 2017. "The Digital Entrepreneurial Ecosystem." Small Business Economics 49(1):55–73. doi: 10.1007/s11187-017-9867-5.

Tan, S. Y., & Taeihagh, A. (2021). Adaptive Governance of Autonomous Vehicles: Accelerating the Adoption of Disruptive Technologies in Singapore. Government Information Quarterly, 38(2): 101546.

Thomas, J. C. (2003). The New Face of Government: Citizen-Initiated Contacts in the Era of e-Government. Journal of Public Administration Research and Theory, 13(1): 83–102.

Tsao, H. Y., Chen, M. Y., Lin, H. C. K., & Ma, Y. C. (2019). The asymmetric effect of review valence on numerical rating: A viewpoint from a sentiment analysis of users of TripAdvisor. Online Information Review, 43(2), 283-300.

Venkatesh, Viswanath, and Fred D. Davis. 2000. "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies." Management Science 46(2):186–204. doi: 10.1287/mnsc.46.2.186.11926.

Wang, Xiaohui, Tao Zhang, Youshuai Tan, Weiyi Shang, and Yao Li. 2024. "How to Effectively Mine App Reviews Concerning Software Ecosystem? A Survey of Review Characteristics." Journal of Systems and Software 213:112040. doi: 10.1016/j.jss.2024.112040.

Wang, Y., Chen, Q., Hong, T., & Kang, C. (2019). Review of Smart Meter Data Analytics: Applications, Methodologies, and Challenges. IEEE Transactions on Smart Grid, 10(3): 3125–3148.

Warsono, Hardi, Teguh Yuwono, and Ika Riswanti Putranti. 2023. "Analyzing Technology Acceptance Model for Collaborative Governance in Public Administration: Empirical Evidence of Digital Governance and Perceived Ease of Use." International Journal of Data and Network Science 7(1):41–48. doi: 10.5267/j.ijdns.2022.12.008.

Weerakkody, V., Janssen, M., & Dwivedi, Y. K. (2011). Transformational change and business process reengineering (BPR): Lessons from the British and Dutch public sector. Government Information Quarterly, 28(3), 320–328. https://doi.org/10.1016/j.giq.2010.07.010

Yang, Q., Liu, Y., Chen, T., & Tong, Y. (2019). Federated Machine Learning. ACM Transactions on Intelligent Systems and Technology, 10(2): 1–19.

Yeung, K., & Bygrave, L. A. (2021). Demystifying the modernized European data protection regime: Cross-disciplinary insights from legal and regulatory governance scholarship. Regulation & Governance. https://doi.org/10.1111/rego.12401.

About the Authors

Anand R Navaratna

Anand R Navaratna is a Research Scholar at the School of Management and Entrepreneurship, Indian Institute of Technology, Jodhpur in the domain of Digital Transformation. He has a rich industry experience of over 15 years in the field of Technology Management and Policy design.

Deepak Saxena

Deepak Saxena is a member of the faculty in the School of Management and Entrepreneurship, IIT Jodhpur. He holds a PhD in Management Information Systems from Trinity College Dublin (Ireland). After obtaining his PhD, he worked with Trinity College Dublin (Postdoctoral Research Fellow), Dublin Institute of Technology (Lecturer), and Birla Institute of Technology & Science Pilani (Assistant Professor). His area of interest includes digital transformation and responsible AI.

