# Digital public goods as avenue for digital platform design– Insights from India

By Julian Kurtz*, R. Srinivasan and Angela Roth

Digital public goods (DPGs) offer many opportunities for improving public life. They promote digital services for citizens, enable seamless data leveraging as digital platforms, and facilitate efficiency gains in the public sector. DPGs' impact is visible particularly in India. There, the implementation of the JAM-trinity meant and enabled financial inclusion for citizens, ensuring that every Indian has a bank account and is able to engage in economic activities and receive subsidies. Outside India, DPGs are largely unknown, and knowledge on platform design and implementation is still in its infancy. To gain insight into the design and implementation of digital platforms, a single case study of a DPG was performed. Using a sociotechnical systems perspective, twelve principles for public digital platform design were identified. This article discusses their relevance for platform providers, operators, and customers. The results show how academics and practitioners can learn from DPG implementations in India for platform value creation. Beyond the descriptive identification of design principles, the study contributes to the academic discourse on platform design and governance by contextualizing these principles within socio-technical dimensions and stakeholder roles. It extends existing literature by demonstrating how DPGs can inform scalable, inclusive, and adaptive platform architectures in the public sector.

## 1. Introduction

Digital platforms, which enable interaction between different user groups, are central to today's global economy and are said to offer great potential for economies and societies (Bonina et al., 2021). Digital platforms are protocol-based. Protocols are the technical standards and rules that underpin digital platforms, leading to interoperable, composable, unbundled data and information sharing (Carlson, 2017). Yet, "there is limited conceptual understanding and empirical knowledge about the challenges of scaling digital platforms in a global context"

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and the implications for their design as public goods (Nicholson et al., 2022, p. 2). Digital public goods (DPGs) entail the "institutionalised sharing of open source software, open data, open AI models, open standards and open content between governments and other actors" (Eaves et al., 2022, p. 9) "that adhere to privacy and other applicable laws and best practices, do no harm by design, and help attain the Sustainable Development Goals" (DPG Alliance, 2022, p.3). In India, DPGs are increasingly recognised as transforming value creation in the public sector. In particular, through the interaction of different user groups via digital platform technologies, DPGs offer a variety of opportunities for India because they enable inclusive, scalable, and interoperable digital infrastructure to gain access to advanced services and digital value creation (Gillwald & van der Spuy, 2019). DPGs are understood here as modular digital core architectures with protocol-based microservices that can be used to build different service offerings in the public sector and elsewhere (Sæbø et al., 2021). As such, DPGs can be seen as a specific form of digital platform – one that is open, modular, and designed for public value rather than private profit. This makes them a compelling subject for platform design research, particularly in contexts where scalability, interoperability, and inclusivity are critical.

To date, little attention has been paid to formalising learning for the replication of DPGs, especially in their implementation and application in India, where they are increasingly important (Gomez-Morantes et al., 2022). This reveals a clear research gap: while DPGs are deployed and impactful, the principles guiding their design and implementation remain underexplored. This lack of formalised learning is particularly problematic given the scale and societal impact of DPGs for example in India. There, the DPG trinity of "JanDhan-Aadhaar-Mobile" (JAM), comprising Aadhaar, financial inclusion, and mobile device adoption, has become a foundational infrastructure for digital governance. It is one example of DPG design. Aadhaar is the largest biometric database in the world and enables easy, but secure, identification of individuals (Rao & Nair, 2019). UPI is a single interface that enables easy financial transactions between individuals and institutions using a simple QR code (Shahid, 2022). With over 900 million unique mobile device users in India already in 2017 (Ghosh, 2017), this JAM-trinity enables every adult Indian citizen to have an interlinked bank account (UPI) linked to their identity (Aadhaar) and authenticated (through a mobile device). These figures illustrate not only the vast reach of DPGs but also the critical need to understand how they are designed, scaled, and governed. Without a clear understanding of the underlying design principles, replicating such success in other contexts remains challenging. This JAM-trinity contributes to the sustainable socioeconomic development of Indian society by integrating citizens into the financial system (Malladi et al., 2021). It makes government subsidies more accessible to those in need (V. K. Singh & Prasad, 2021). Although account usage was slow in starting, payment flows are steadily increasing, especially as government activities are transferred to the trinity (Dipa & Rohit, 2018). The provision of reliable digital infrastructure in remote areas is particularly helpful (Barik & Sharma, 2019). The introduction of the trinity of these DPGs alone means that by 2023, more than one billion Indians had a personal bank account and were able to participate in digital value creation (India Stack, 2023).

Nevertheless, the experience of building these digital platforms as DPGs is not well documented. As a result, they receive little recognition outside of India, even though they may be more effective than conventional platform approaches (Pereira et al., 2023; Riemensperger & Falk, 2020). These DPGs promote an alternative way of creating value in the digital sphere, as they follow new approaches to data sharing and ownership with protocol-based standards and scaling potential (Gomez-Morantes et al., 2022). More importantly, it is not only the architecture and technical structure of these platforms that are of interest but also the learning from their implementation as DPGs. This leads to the central challenge this study addresses: the lack of structured knowledge on how DPGs are designed from a sociotechnical perspective. Therefore, a formalisation of these platform design from a sociotechnical perspective is needed, which is why the following research question is stated:

***How are digital public goods designed for platform value creation in sociotechnical contexts?***

The aim of this study is to enrich knowledge of digital platform design by presenting design principles for platform design and implementation derived from a DPG implemented in India. The relevance of this work is primarily in shedding light on the implementation of DPGs in India. In India, specific core design tenets are followed to build and implement digital platforms in order to create added value. For its own digital platform design, other countries can learn from this implementation of DPGs to derive aspects that are not necessarily relevant only in the public sector.

This article introduces modular platform design, platform governance, and the sociotechnical perspective in section 2. Section 3 describes the case study research method. Section 4 presents the findings, which are discussed from the sociotechnical perspective in section 5. Section 6 outlines the implications for research and practice, while section 7 presents the conclusions and limitations of this work.

## 2. Theoretical background

Digital public goods (DPGs) have emerged as a specific type of digital platform architecture designed to deliver public value. DPGs are typically open-source, protocol-based systems that enable governments and other actors to build scalable, interoperable, and inclusive digital services. Their modular nature makes them particularly relevant for public sector innovation (especially digital platform value creation), where adaptability and reusability are essential.

### 2.1. Modular platform design

Platforms are specific business models bringing together multiple sets of users (Abdelkafi et al., 2019). They consist of subsystems and interfaces that form a common structure enabling innovation in the form of efficiently derived services and their implementation (Dai, 2023). Thereby, platforms and their ecosystems are able to scale innovation and economic activity to help solve societal problems, such as environmental challenges in sea (Costabile et al., 2022) or agricultural (N. Singh & Dey, 2023). The potential benefits of platforms, such as savings on fixed costs, efficiencies in services development, and the advantages of modular design, are well known (Gawer & Cusumano, 2014). For example, public institutions can offer a variety of public services through a platform. Digital technologies such as the internet make platforms accessible from anywhere (Inoue et al., 2023) and for anyone (Tiwana, 2013). The more innovative digital platforms are in providing public services, such as registering a new place of residence, registering an electricity or water connection, or filing a tax return, the more attractive it will be for citizens to use these services (Gawer & Cusumano, 2014). They can save time by eliminating the need to visit government offices, facilitate service through repeatable processes, and increase the transparency and traceability of processing statuses. For the public sector, it enables service quality assurance, quality assurance in processing procedures, and simplified documentation.

However, a platform in the public sector needs to be modular in order to deliver its various services (Beverungen et al., 2022). Modular design was first used in the context of new service development and incremental innovation based on reusable components or technologies (Gawer & Cusumano, 2014). Services can contain recurring functionalities, such as the identification of a citizen, the transmission of personal data, or the execution of financial transactions. The difficulty is to develop a modular set of technical conventions that engineers and managers in different institutions can use to coordinate their activities more effectively in order to ensure that the changing interactions between subsystems are permanent (Hofman et al., 2016). This includes the decision to close or open different modules of a digital platform for reuse or use by third parties. However, there is a lack of research on how to manage the openness of digital platforms (Duparc et al., 2022). One potential challenge in implementing digital modular platforms lies in their integration with open-source components, as they rely on predefined interfaces dictating module interactions, thus any deviation from this standardised design could lead to non-interoperability and potentially foster the creation of noncompliant modules, ultimately fragmenting the platform (Yoo, 2016). Apart from this challenge, three **design rules** for digital platforms are frequently presented to enable a modular design (Ortiz-Bejar & Ortiz-Bejar, 2021; Spagnoletti et al., 2015; Srinivasan, 2021) (see Figure 1).

According to the **first design rule**, platforms have a core layer that offers customers a product or a service they are willing to pay for (Olleros, 2008) (e.g. digital registries for citizen verification). According to the **second design rule**, platforms have a configuration layer that offers different platform design options to specific customer segments (Hein et al., 2020) (e.g. offering identity services for citizen verification). According to the **third design rule**, platforms have a customisation layer that offers specific services for individual customers (Broekhuizen et al., 2021; Tiwana, 2013) (e.g. dashboard visualisations). Customisation comprises the activities and outcomes of customising a supplier's value creation processes to meet customer requirements (Kleinaltenkamp et al., 2017).

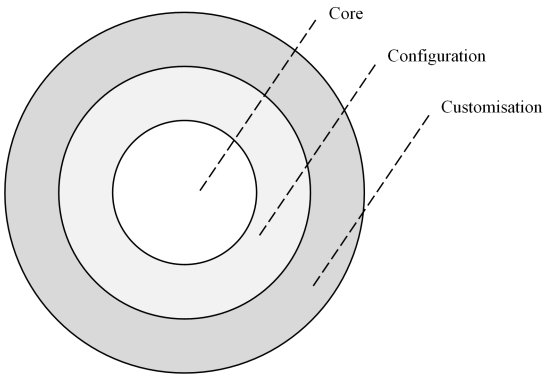


*Figure 1: Platform design according to Srinivasan (2021)*

Opening up digital platforms allows different user roles to engage in reciprocal transactions, increasing participation and network effects (Broekhuizen et al., 2021). Herewith, user roles, such as those of the provider side or customer side, can be either open or closed (Eisenmann et al., 2009). Consequently, a fully closed digital platform differs from an open one by discriminatory restrictions on participation in the different roles.

### 2.2. Governance

Tiwana et al. (2010) define platform governance as "who makes what decisions about a platform" (p.5). Opening

or closing modules of digital platforms is closely related to platform governance (Chen et al., 2022). Tiwana et al. (2010) define platform governance as "who makes what decisions about a platform" (p.5). Governance refers to an orchestrator, the lead organisation that organises a platform and provides key resources through which rules and practices can be enforced as policies (Costabile et al., 2022). Governance refers to an orchestrator, the lead organisation that organises a platform and provides key resources through which rules and practices can be enforced as policies (Costabile et al., 2022). The degree of openness of a digital platform must be governed by these rules and practices (Eisenmann et al., 2009). The more openly a digital platform is governed, the more value is created for the platform and its users through network effects, leading to a cumulative advantage (Gawer & Cusumano, 2014) and contextual value through data sharing (Kurtz et al., 2023). However, the more open a digital platform is, the more difficult the governance mechanisms and the greater the loss of knowledge and the coordination costs (Alam et al., 2022). The more open a digital platform is, the more important it is for all parties involved to have mutual trust in the confidentiality of the data shared (Broekhuizen et al., 2021). If data is being shared among multiple sponsors and providers with unrestricted participation, the platform can be defined as an interoperable one (Broekhuizen et al., 2021). On the other hand, selective access platforms are open but proprietary with a single sponsor and provider (Karhu et al., 2018). Further, closed digital platforms enable efficiencies in service development by reusing common parts and modules and adapting to different customer requirements, business needs, and technological developments while maintaining economies of scale and scope in processes (Gawer & Cusumano, 2014; Hein et al., 2020). Closed proprietary platforms with a single sponsor and provider can be denominated integrated platforms and core platforms are those being closed but shared (see Figure 2). Tiwana et al. (2010) and Srinivasan (2021) add that proprietary and shared digital platform approaches are also at odds. Proprietary digital platforms are incompatible with competing digital platforms, resulting in high switching costs for users and a fear of user lock-out (Cennamo, 2021). Shared digital platforms exist when there is compatibility with competing platforms, which may lead to lower switching and multihoming costs for users, and users' digital platform loyalty may be based on factors other than their investment costs (Basaure et al., 2020) (Figure 2).

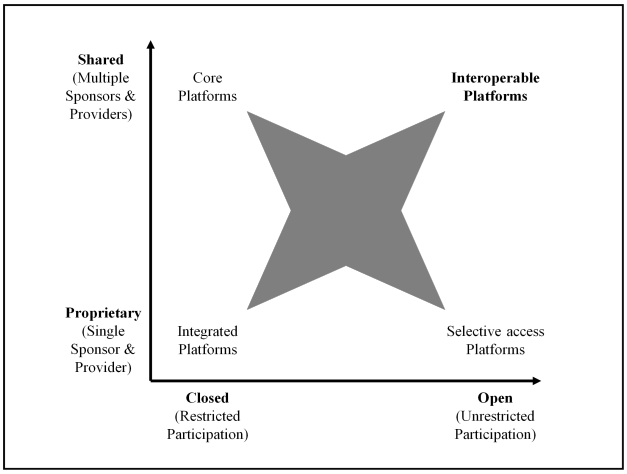


*Figure 2: Platform landscape partially adapted from Srinivasan (2021)*

DPGs, as a distinct type of digital platforms, adhere to an open and shared architecture that results in their interoperability (Nicholson et al., 2022). Their importance in the public sector lies in their ability to enhance service delivery, promote transparency, and ensure broader access to digital public services. As DPGs effect on the public sector and therefore on public governance, their interoperability can prevent abuse and corruption while upholding the rule of law, which can promote the democratic development of public governance (Crăciun et al., 2023). The democratic development of public governance can lead to greater transparency and "effective citizen control over data" (Lember et al., 2019, p. 12). DPGs can also assist in addressing public governance challenges such as poor access to healthcare, the reduction, recovery, and recycling of waste, and the rise of cybersecurity threats (Ritala, 2023). Nevertheless, in the context of the public governance and innovation dynamics of DPGs, they relate not only to the technological aspects of establishing interoperable digital platforms but also to the social impacts that need to be taken into account in the implementation and operation of DPGs (Hofman et al., 2016).

### 2.3. Sociotechnical systems

To manage the openness of digital platforms, both technical and nontechnical aspects are relevant, as the innovation dynamics of digital platforms affect social configurations and are social in nature (Hofman et al., 2016). Here, a sociotechnical systems perspective (STP) offers a fruitful approach to studying DPGs as interoperable digital platforms and shedding new light on innovation dynamics. The STP is particularly suitable for studying DPGs because it captures the interplay between technical architectures and the social contexts in which they operate. Given that DPGs are implemented as digital platforms in complex public sector settings, this lens enables a holistic understanding of how design decisions are shaped by both technological and societal factors. The different

STP dimensions helped to cluster the data to structure knowledge on how to design DPGs. This perspective has its roots in the British coal industry and focuses on the joint optimisation of social and technical subsystems (Bostrom & Heinen, 1977; Trist & Bamforth, 1951). Not only the technical architects of digital platform providers but also different customers, stakeholders, and partner groups interact on a digital platform (Rolland et al., 2018). The STP applied in the present study emphasises the interaction of different entities of resources in different social and technical units (Kopp et al., 2019). The context of a digital platform can be structured along the sociotechnical dimensions of people, goals, environment, technology, processes, infrastructure, and culture, all of which are interrelated (Davis et al., 2014; Hein et al., 2020; Nicholson et al., 2021; Reuver et al., 2018).

For digital platform research, an STP is especially fruitful, as (for example) the dimensions of infrastructure (e.g. server locations) and technology (e.g. semi-conductors) play core roles in building information and communication technology (Kim et al., 2015). Awareness of the dimensions of people, goals, processes, culture, and environment can ensure the best possible service quality for platform users (Janssen & Estevez, 2013). Moreover, the STP is playing an increasing role, especially in the socioeconomic sectors of developing countries, although research on digital platforms from this perspective tends to be both conceptual and scarce (Gomez-Morantes et al., 2022). Therefore, an STP helps in reflecting on the social and technical aspects of managing digital platforms and can inform new contributions (Kapoor et al., 2022), especially when studying cases from emerging countries. More importantly, digital platforms in the public sector can themselves be seen as sociotechnical systems aimed at improving governance (Janssen et al., 2009).

## 3. Methodology

To address the lack of knowledge about the formalisation of DPGs as an avenue for digital platform design, a comprehensive study of their architecture design, implementation, and adoption by multi-user sets is needed. Fürstenau et al. (2019) call for more case study research on platform design in government settings in different countries. According to Yin (2018, 5), "case study research allow you to focus in-depth on a 'case' and to retain a holistic and real-world perspective – such as in studying […] organisational and managerial processes". This is a promising method for formalising knowledge about the design and implementation of DPGs, as it makes it possible both to derive research findings from real-life conditions and to formulate direct recommendations for action. As DPGs are still unexplored and an unconventional phenomenon, a single case was studied to add to the knowledge base on DPGs and digital platform design. As shown in Figure 3, data collection in this case study included personal interviews with key informants, reviews of project documents and memoranda and of illustrative material (e.g. publications part of a company's history) and public documents, and field observations (Yin, 2018).

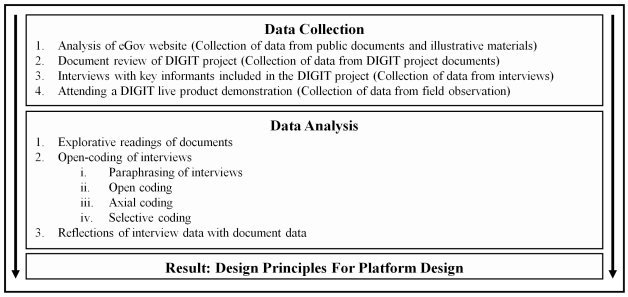


*Figure 3: Research design*

### 3.1. Single case description

To formalise as much of the experience of designing and implementing DPGs as possible, a mature single case was studied: the implementation of the DIGIT platform by the organisation eGov. A holistic case study design was applied following Yin (2018). eGov is a company founded in India in 2003 as a collective of technology, strategy, and policy experts to develop solutions to societal challenges (eGov Foundation, 2023d). The company designed the DIGIT platform (see Figure 4), an open-source service delivery and governance platform intended to enable good-quality citizen services where citizens, employees, vendors, administrators, and policymakers can collaborate and exchange information seamlessly (eGov Foundation, 2023a).

DIGIT was selected for the case study because it exemplifies key characteristics of a DPG: it is open-source, designed for reuse and adaptation across contexts, and aims to address systemic public service delivery challenges in low-resource settings. Its implementation across multiple Indian states and its adoption in other countries demonstrate its scalability and adaptability—core attributes of representative DPGs. Moreover, DIGIT's focus on inclusion, such as enabling access to services for individuals without formal identity or banking access, aligns with the broader goals of DPGs to promote equity and accessibility.

DIGIT promotes different learning potentials for the design of future digital platforms addressing service delivery challenges. For example, an enhanced understanding of financial inclusion in India could inform the development of effective transactional mechanisms on digital platforms in global or other contexts where joint financial spheres are not always prevalent. Furthermore, it is of great importance for digital platforms to

possess the ability to guarantee the security of the personal identities of their diverse user base. This is a crucial aspect that must be considered in a multitude of contexts. Consequently, even when the specific circumstances may vary, the formalised knowledge derived from the DIGIT case can assist in the development of digital platforms.

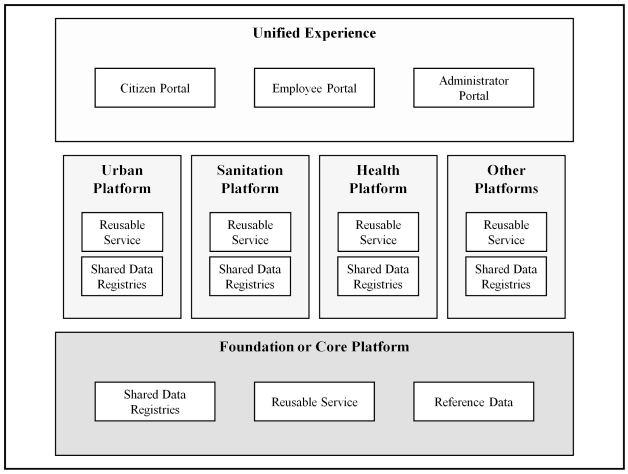


*Figure 4: DIGIT architecture according to eGov*

The platform consists of reusable building blocks, shared data registries, open application programming interfaces (APIs), and specifications that can be composed into microservices that can be further recombined to deliver unified data and experiences (eGov Foundation, 2023c). This ensures a three-layer thinking for building DPGs at eGov. The company relies on eight core design tenets to build the DIGIT platform (see Figure 5). Furthermore, the three-layer thinking can be observed in other reference architectures as they pertain to data spaces (Kari et al., 2023).

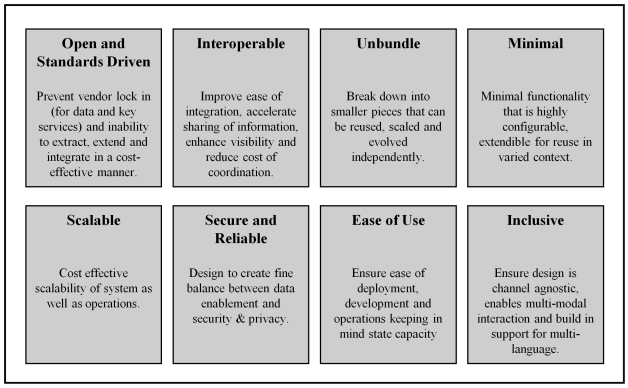


*Figure 5: Core design tenets for platform design according to eGov*

The first core design tenet is *open and standards-driven* to avoid vendor lock-in and the inability to extract, extend, and integrate in a cost-effective manner. The second is *interoperable* to improve ease of integration, accelerate information sharing, improve visibility, and reduce coordination costs. The third is *unbundling*, to break the platform infrastructure down into smaller pieces that can be reused, scaled, and developed independently. The fourth is *minimal* functionality that is highly configurable, is extensible for reuse in different contexts, and reduces costs. The fifth is *scalability*, for cost-effective scalability of both systems and operations. The sixth is *secure and reliable* design to create a fine balance between data enablement and security & privacy. The seventh is *ease of use* to ensure ease of deployment, development, and operation, taking into account government capabilities. The last is *inclusive* to ensure that the design is channel agnostic, enables multimodal interaction, and builds in support for multi-language etc. (EGov Foundation, 2023b)

eGov follows these core design tenets in all its activities. They design platforms in the public context in India but also in other environments outside India. Therefore, eGov applies the tenets extensively in platform design, which provided an opportunity to study them in depth, detail and advance them, and to consider formalising them as design principles for DPGs. This required extensive data collection to reflect eGov's activities guided by the core design tenets, providing an opportunity to formalise practical knowledge for platform design.

### 3.2. Data collection

Data was collected from multiple sources to ensure "triangulation, the use and combination of different methods to study the same phenomenon [including] interviews, […] content analysis of documents, and archival research" (Voss et al., 2002, p. 12). The first step was to collect data by analysing the content of the eGov website (Nathan & Yeow, 2011), where eGov provides an extensive collection of freely available knowledge, in particular about the architecture of the DIGIT platform, in order for others to understand the design and purpose of the platform. In the second step, documents that documented the building and implementation of the platform in the northern state of Punjab were reviewed (Roussy & Rodrigue, 2018). Besides public documents, non-public documents about this implementation were provided by eGov to the research team. In Punjab, the DIGIT platform has enabled citizens to access services through web portals, mobile applications, and citizen service centres, and it helps municipalities collect fees such as property taxes, water and sewerage charges, trade licences, and other revenues. This exploratory reading supported the preparation of the semi structured interviews with the various expert stakeholders of eGov. The interviews included the following thematic areas: 1) The design and implementation processes of DIGIT, 2) Challenges and enablers in scaling and adapting DIGIT, 3) Governance structures and stakeholder roles, 4) Technical and organizational design principles, and 5) Contextual factors influencing DIGIT adoption and use. In the third step, interviews were conducted in person and audio-record with various key stakeholders in eGov with experience in implement-

ing the platform in Punjab and in other contexts, including abroad (Yin, 2018). Seven eGov employees were interviewed to gain a deeper understanding of the design, implementation, and scalability of DIGIT. In this way, it was possible to ensure that many different experiences in various levels of the organisation in the technical set-up of the platform and its social roll-out were taken into account (see Table 1). The final step was to review archived documents, project reports, and other internal eGov documents (Yin, 2018).

*Table 1: Overview of interviews*

| # | Name | Role | Duration |
|---|---|---|---|
| 1 | Interviewee A | Chief Executive Officer | 28 minutes |
| 2 | Interviewee B | Chief Product Officer | 22 minutes |
| 3 | Interviewee C | Director – Policy | 48 minutes |
| 4 | Interviewee D | Head of Policy & Advocacy | 28 minutes |
| 5 | Interviewee E | Product Manager | 54 minutes |
| 6 | Interviewee F | Senior Technical Architect | 52 minutes |
| 7 | Interviewee G | VP – GTM & Advisory | 48 minutes |

This data collection helped in analysing, detailing, and advancing the core design tenets based on different sources. In particular, the interviews provided the basis for formalising sound design principles for DPGs based on the tenets. In addition, the extensive data collection allowed for the identification of design principles that are not based in the core design tenets guiding eGov.

### 3.3. Data analysis

An exploratory reading of the eGov website and documents was first carried out. This was done in order to understand eGov's mission and why they designed DIGIT. In addition, the available internal documents helped in understanding the architecture of the DIGIT platform and its purpose, thus enabling reflection on the design goals for the DPGs and the design of the digital platform (Yin, 2018). The audio recordings were transcribed using f4x software. This resulted in 45,408 words of transcript. The transcripts were then coded in MAXQDA to investigate the design principles for DPGs. This was an open coding procedure according to Gioia et al. (2013). Therefore, in a first coding step, the transcript data was open coded after paraphrasing in order to structure the data. In a second step, the transcript data was coded using an axial approach to classify the material into different themes. In a third step, the transcript data was coded in a selective approach to link the transcript data to the dimensions of the STP. The final step of the data analysis involved a reflection on the interview data with the archived documents, project reports, and other internal documents of eGov to identify the development of design principles for DPGs (Yin, 2018).

For example, the quote "*We are unbundled. What this means is basically when you take a big domain, we break it down into small building block pieces which are configurable, and then these can all be assembled to put together an application. So, you know, and these independent pieces can be scaled and evolved independently also, which makes it more cost effective, especially in a microservices architecture.*" in Interview F was paraphrased and classified to "act according to three-layer thinking to preserve modularity". This resulted in the design principle 12 of unbundling.

This comprehensive data analysis made it possible to detail, advance, and formalise the core design tenets of eGov for platform design for the public sector in the form of design principles. The interviews allowed a reflective consideration from both technological and social perspectives.

## 4. Results

According to the research approach, an overview of the DIGIT architecture design was first obtained by studying the website. In addition, interviewees provided archival documents such as internal project documents and archival records on the DIGIT case. Interviewee A stated that they "*have a very diverse organisation where everyone approaches knowledge from a different point of view [...] and that it is very interesting to get someone to tell the [eGov] story [...] to look at our questions [...] and to look more at this specific case*" (Interviewee A). To address these points, this study explores design principles (assigned to sociotechnical dimensions) in order to formalise learnings from the implementation of the digital DIGIT platform of eGov as a DPG. These design principles are represented in the first column of Figure 6; they reflect the eight promoted core design tenets of eGov, which where detailed and advanced, and four other design principles identified in the study. In total, 237 codes from the interview dataset led to these twelve design principles. These were aggregated into the seven dimensions of STP according to Davis et al. (2014) in the second column, which represent DPGs as an avenue for digital platform design and implementation.

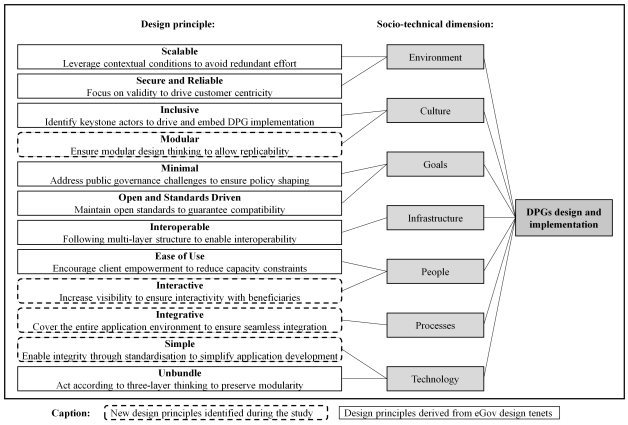


*Figure 6: Twelve design principles for DPG design and implementation*

### 4.1. Environment

In the STP dimension "environment", two design principles emerge.

**DP1:**

In order to leverage contextual conditions to avoid redundant effort, **DPGs need to be scalable.**

This refers to the adaptation of DPGs in a context of unchanging governance when implementing or scaling DPGs in other environments with disparate governance contexts. Interviewee C stated that in "*some areas you will find digital literacy, awareness of importance of process and the adherence to process and system and maturity is a lot higher. Some places a little more feudal*". This environment needs to be taken into account when designing DPGs so that they can be scaled as digital platforms. In order to avoid redundant efforts when implementing DIGIT in other contexts, e.g. when implementing it in the state of Punjab, eGov "*made changes to the platform to enable [scalability]*" (Interviewee A) and to be able to "*look at the systemic challenges*" (Interviewee F). In particular, they focused on looking at the ecosystem capacity of the environment. This was to "*try to understand the impact of [DIGIT] at a systemic level*" (Interviewee F). In order to avoid redundant efforts and to increase the level of scalability, it is necessary to find information technology (IT) providers that bring specific skills (Interviewee F) and to find partners in the local environment that will help in entering it (Interviewee A).

**DP2:**

In order to focus on validity to drive customer-centricity, **DPGs need to be secure and reliable.**

This refers to increasing visibility when implementing or scaling up DPGs in new environments with disparate governance contexts. Interviewee F argues that they "*want the community to be involved in a public way so that everyone else is inspired by it*". This leads to people using DIGIT and building on it, which means that eGov sometimes does not know who else is building on DIGIT because "*they've learned from others who are building on DIGIT, by accident*" (Interviewee F). Here, it is very important to respond to market demand. Interviewee G said that "*we now have a demand from the ecosystem that many people are saying 'come on' and 'we want to build it on DIGIT'. So we are providing a platform. We're not coming in and saying 'we can run your programme'*". In some environments, DIGIT can be re-engineered or directly automated, but in others it is absorbed, tying up a lot of eGov capacity. This underlines the need to build DIGIT as a secure and reliable platform, as eGov itself does not have the capacity to respond to all market demands (Interviewee A). This allows third parties to build on DIGIT to meet market demands.

### 4.2. Culture

In the STP dimension "culture", two design principles emerge.

**DP3:**

In order to identify key actors to drive and embed DPG implementation, **DPGs need to be inclusive.**

This refers to the focus on and need for inclusive activities when implementing or scaling up a DPG. eGov says its focus is on inclusion. They should convince people who have the capabilities, but they should also be able to convince people who do not have similar capabilities (Interviewee A; Interviewee D). They "*look at it to try and get a sense of what the personas are, what they are like*" (Interviewee B). It is therefore important to understand the behaviour of the implementation domain. Interviewee C stated that in Punjab, for example, they worked with a key actor who was "*also a bit of an entrepreneur*" to help eGov speed up the implementation of DIGIT. However, different work mentalities must always be taken into account. For example, it was explained that it is culturally ingrained to be a good performer when there is no bad news. However, this does not help when it comes to identifying failures in the implementation of DIGIT in order to improve it, or when it comes to negotiating service level agreements because the actual performance of the platform is not sufficiently visible.

**DP4:**

In order to ensure modular design thinking to allow replicability, **DPGs need to be modular.**

This refers to establishing replicable design thinking when implementing or scaling up a DPG. It must be ensured "*that everything you build there is designed in such a way that the data you collect once doesn't have to be collected again, and that there is interoperability between the design of your product itself*" (Interviewee G). Built modules should

be reused, as should modules that have already been experienced, even if they are slightly different (Interviewee G). This helps in diversifying one's own background with people from multiple backgrounds all following a modular design thinking culture (Interviewee A). This leads to the ability to evangelise domain knowledge, as "*having all these years of experience and being able to move from one sector to another, you have the ability to write the rules*" (Interviewee A). Rules are expressed in policies, which have to be written in order to transform governance and replicate the approach. The problem is that so far, "*the policies and the [statutes] become not robust enough*" (Interviewee G). Therefore, there is a need "*for some policy reforms and some policy standardisation to happen*" (Interviewee C).

### 4.3. Goals

In the STP dimension "goals", two design principles emerge.

**DP5:**

In order to address public governance challenges to ensure policy shaping, **DPGs need to be minimal.**

This refers to addressing public governance challenges to ensure policy shaping when implementing or scaling up DPG. Interviewee F stated that "*you are in the business of changing people's lives. And I think that's one of the core things that we all believe in here. So we are focused on improving or enhancing the quality of life for citizens by creating an open public digital infrastructure*". With their DIGIT platform, they want to improve state capacity (Interviewee D) where "*the implementation will be on infrastructure provisioning, seamless service delivery, efficient operations and increase revenues*" (Interviewee G). Thus, eGov is seeking seamless solutions for urban and non-urban areas by following an approach of simplification and ease (Interviewee A). To this end, they are currently cataloguing all the products and services they offer in order to provide minimal solutions to various problems. This is necessary to run a sustainable operating model for solutions to public governance challenges (Interviewee A). A learning here was that "*going back to the policy is very important. That one of the biggest learnings is [that] policy is the biggest skill*" (Interviewee A).

**DP6:**

In order to maintain open standards to guarantee compatibility, **DPGs need to be open and standards-driven.**

This refers to maintain open standards to guarantee compatibility when implementing or scaling up a DPG. As DIGIT is "*an open-source DPG that provides reusable building blocks to build, deliver and govern citizen services,*" it helps "*all the actors in the ecosystem*" (Interviewee F). They ensure openness by trying to go live as a platform very quickly, that everyone has a portal as a digital front end for everything they do, and that every application is rolled out through the portal so that everyone can access it (Interviewee G). Particularly in the early stages, when DIGIT was being introduced in different ways in different environments, the need for standardisation and a unified platform approach grew (Interviewee G). As a result, the basic approach of eGov for DIGIT is one of the principles they work by and try to follow in their design. "*We are open and standards-driven. This prevents us from being locked into one supplier of key data and services and helps us to extract, extend and integrate digital data in a cost-effective way*" (Interviewee F). Compatibility is therefore encouraged through openness and standards.

### 4.4. Infrastructure

In the STP dimension "infrastructure", one design principle emerges.

**DP7:**

In order to have a multilayer structure enabling interoperability, **DPGs need to be interoperable.**

This refers to following a multilayer structure when implementing or scaling up a DPG. Following a multilayer structure implies constantly reflecting on the platform core. "*Basically, the platform approach allows for shared data and reusable building blocks. What we were just talking about. So we have what we call a foundational core platform, these are core services and core registries that can be used across any domain*" (Interviewee F). Besides the core of the platform, customisation is always needed. Customisation, such as the client's organisational mechanism, usually remains in the customisation modules until eGov says: "*It's best if [eGov] tells [the customer] exactly what colour your screen should be. What language? How many steps do you need?*" (Interviewee A). eGov tends to look at configuration as repetitive music and turn configuration into what they call accelerators, because if somebody does something 25 times, or 25 different people do it, that means that a specific configuration has to become a core function. The multilayer structure allows such transitions from configurations to the core, enabled by the modular platform architecture. "*Once a module is built, everybody can use it*" (Interviewee F). The difficulty is that when partners build on DIGIT's foundational architecture, eGov needs to track these activities to ensure that these third-party customisations can also become part of DIGIT's core to "*have a report map for the core platform*" (Interviewee A).

### 4.5. People

In the STP dimension "people", again two design principles emerge.

**DP8:**

In order to encourage client empowerment to reduce capacity constraints, **DPGs need to be easy to use.**

This refers to encouraging clients in self-tooling when implementing or scaling up a DPG. Closed platforms can be more elegant and beautiful, but they often lack support for customers who want to develop their own applications. In contrast, open platforms like Android provide users with tools, resources, and the ability to develop their own applications (Interviewee A). Empowering clients to operate and develop on the platform themselves frees up limited eGov resources. DIGIT is "*easy to use, or we strive to be easy to use. I think we are still a work in progress, but we are getting there. We've got a lot of tutorials, we've got a lot of videos, guides that tell people how to work with us, how to integrate, how to design and build on top of it*" (Interviewee F). However, it is also important to consider the customer's capacity and ability to design the platform independently. Therefore, eGov monitors "*the adoption by [clients'] employees as a first level of saying that as a part of the implementation, if the employees don't use it, then it's not implemented at all*" (Interviewee G). Over time, clients will mature as they gain the functional capabilities and maturity to operate and design the platform themselves. The easier the platform is to use, the faster customers will mature (Interviewee C). Nevertheless, with its limited resources including customers' ability to pay, eGov has been careful to implement DIGIT first in "*high-capacity states*" (Interviewee C).

**DP9:**

In order to increase visibility to ensure interactivity with beneficiaries, **DPGs need to be interactive.**

This refers to interacting with different people with different backgrounds when implementing or scaling up a DPG. "*It requires the application of human intellect to think about law, policy, implementation, social structures, looking at social, behavioural, communication change, and at the same time thinking about how all of this is reinforced and how it can be cognitive in decades*" (Interviewee C). This requires taking into account the catchment areas of different people. "*We have lots of documentation and tutorials. We have a community for support. There are discussion forums where we try to get the conversation going*" (Interviewee F). These catchment areas need to be targeted with different advertising channels. For example, Interviewee G explained that "*at some point you will use the school children in years eight and nine to actually popularise the platform and its application, to train them on it. And they went and taught their parents and the neighbourhood and all that sort of thing. So things like that were done to make sure that the communication [increased] on the ground"*. These channels also need the support of partners such as NGOs or local organisations. eGov, for example, has been working with various local NGOs in different African countries to gain access to citizens and understand the local situation so that DIGIT can be used to best effect.

### 4.6. Process

In the STP dimension "process", one design principle emerges.

**DP10:**

In order to cover the entire application environment to ensure seamless integration, **DPGs need to be integrative.**

This refers to the focus on covering the entire application domain to ensure seamless integration when implementing or scaling up a DPG. The ease of use for the customer needs to be ensured; as eGov argue, they "*want to keep it as light as possible*" (Interviewee A). DIGIT's implementation processes are designed so that one can "*simply write through the configuration, rather than having to build it from scratch. It helps staff and suppliers by making their lives easier. They only have to log into one portal*" (Interviewee F). In addition, they focus on integrating all framework conditions. This means that they spend a lot of time "*understanding the process from the ground and not just from what we are told on […], but to see the entire value chain*" (Interviewee E) leading to "*process maturity*" (Interviewee C). In this vein, it was important to reduce vendor dependency. Reduced vendor dependency provides benefits, as "*you can write SQL queries and tell it how to do this mapping, which means you can swap your database underneath. Tomorrow you want to use my SQL instead of Postgres. You don't have to change your application. You just have to change some configuration and swap the database. So and it also helps us in terms of performance and scaling because the database is isolated from the load that's coming in, the queue takes care of it and we just read at a rate that's comfortable for us"* (Subhashini Srinivasan).

### 4.7. Technology

In the STP dimension "technology", two design principles emerge.

**DP11:**

In order to enable integrity through standardisation to simplify application development, **DPGs need to be simple.**

This refers to enabling integrity through standardisation to simplify application development when implementing or scaling up a DPG. One key aspect is to "*follow API-first design, which is again a fundamental microservices principle*" (Interviewee F). The creation of registries and the definition of services with clear APIs will be made available to anyone who needs to build solutions on DIGIT, with

a focus on clarifying the concept of registries in their context. Users can choose the modules they need and build their solutions on DIGIT. This emphasises a simple approach aiming to keep each service simple with a maximum of three or four APIs to ensure ease of understanding, maintenance, and adaptability to different applications (Interviewee F). An authenticated and integrated front-end application was therefore created, one which is simple for clients to use, as opposed to doing different things individually in the back-end technology and then distributing them to different customers (Interviewee G).

**DP12:**

In order to act according to three-layer thinking to preserve modularity, **DPGs need to be unbundled.**

This refers to the use of a three-layer approach when implementing or scaling up a DPG. This is secured by unbundling. According to Interviewee F, "*unbundling basically means that if you take a large domain, we break it down into small building blocks that are configurable, and then those can all be put together to create an application. So, you know, and these independent pieces can also scale and evolve independently, which makes it more cost-effective, especially in a microservices architecture*". This also means that external feedback on the various layers and modules is incorporated into the company's own technology approach (Interviewee A). Among other things, this technology approach is to be mapped in an application catalogue, which in the long term could be integrated into a possible app store for all applications that can be used with DIGIT (Interviewee D). This unbundling of the platform, including the division of the platform into different building blocks, gives customers more flexibility and choice in selecting specific features or services that best meet their needs.

## 5. Discussion

Following the outlined design principles derived from the DIGIT case and aggregated to sociotechnical dimensions, the replication of DPGs is proposed as an avenue for digital platform design. The socio-technical dimensions provided the structuring of the case data to derive knowledge for DPG design. Academics and practitioners outside India can learn from the widespread design and use of digital platforms in the public sector in India for their own platform design. Our study of eGov's DIGIT platform in India sheds light on such platforms. On one hand, "literature on platformisation of the public sector is currently limited" (Senyo et al., 2021, p. 9) and on the other hand, the Indian economy is growing with a strong services and platform industry (Pradhan et al., 2021).

Focusing the investigation on DIGIT in India, its sociotechnical dimensions ensure not only the building of DPGs as digital platforms but also their user-centric implementation (Delgosha & Hajiheydari, 2020). The STP promotes consideration of the modular design of DPGs, which refers to a rather technical perspective. The implementation of DPGs for eGovernment services in specific environments refers rather to a social perspective. Therefore, the joint modular design of DPGs and their implementation in the public sector follows the STP discussed in this article. This dual perspective of technical modularity and social adaptability highlights a key insight. Public sector platforms must balance standardization with contextual responsiveness, a tension less pronounced in private sector platforms where market incentives often drive uniformity. Following the STP allows decisions to be made for an open platform design of DPGs based on a modular structure (Hofman et al., 2016).

The three-layer thinking for building DPGs through eGov's DIGIT structure is in line with the three design rules of digital platforms: Outlined in chapter 2.1, coring, configurating, and customising are three fundamental design rules for digital platform design (Srinivasan, 2021). While these rules are not exclusive to the public sector, their application in DIGIT reveals how public platforms must embed principles of equity, accessibility, and interoperability. These are are often secondary in private sector platforms focused on competitive advantage. Coring, the first design rule for digital platforms, relates to the technological core (Olleros, 2008). Similar to how eGov has structured its DIGIT platform, the modular architecture of DPGs is based on reusable building blocks, with shared data registries as the first layer. The second layer of DIGIT relates to APIs and the resulting microservices that can be combined to enable easy implementation (Wulf & Blohm, 2020). This is analogous to the second design rule of configuring platforms to offer flexibility to the customer (Hein et al., 2020), bridging the more technological core dimension and the social dimension of customisation. Customisation as the third design rule for platforms is reflected by the third layer of DIGIT, which ensures adaptation to the specific platform user environment in order to provide customers with a unified experience. This layered architecture not only supports technical scalability but also institutional adaptability. It is critical for public sector platforms that must serve diverse administrative contexts and citizen needs. This emphasises the social aspect of the design and implementation of DPGs in relation to platform design.

The design of the DIGIT platform by eGov follows the STP, is in line with the three fundamental platform design rules, and provides twelve design principles for digital platform design. These principles are anchored in the public sector. Following the design rules, the twelve

design principles are grounded in the eight design tenets of eGov by detailing them, advancing them and identifying design principles in the case study beyond the eGov design tenets. If DPGs such as the DIGIT platform follow the three fundamental platform design rules and the STP, their design can share similarities with digital platforms in other environments. It is therefore possible to consider the twelve design principles derived from the DIGIT case study beyond their current context of implementation in the public sector: they are relevant to platform design in private contexts and other environments. This paves the way for digital platform design with DPGs as a platform design avenue.

However, according to Schmid et al. (2020), the design and implementation of a digital platform depends on different incentives for users to participate on it. Therefore, different design principles become relevant for different platform users (Reibenspiess et al., 2022). Accordingly, design principles should be clustered according to the different user sides of a platform, which further promotes the formalisation of platform design knowledge through the design principles derived from the DIGIT platform (Figure 7). Assigning the design principles to the platform user side allows for more targeted design and implementation of the platform, especially if different user groups are to be addressed. This user-centric clustering is particularly salient in the public sector, where platforms must accommodate a broader spectrum of users. These users include citizens, bureaucrats, and third-party developers who each have distinct needs and constraints.

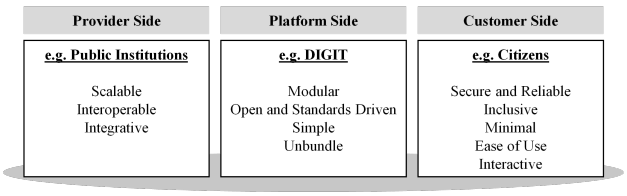


*Figure 7: Design principles according to different platform user sides*

First, if the focus is on the user group on the provider side, the DPG design principles of *scalable*, *interoperable*, and *integrative* should be considered more closely. According to Ritala (2023), platforms need to be scalable to incentivise multiple communities and groups, especially providers on platforms, to join them. This scalability is essential for enabling providers to extend their services across different contexts and user bases. Fürstenau et al. (2019) underscore scalability as the outcome of a process-driven orchestration of stakeholders that sustains network effects. Furthermore, scalability on the provider side requires interoperability, as additional providers are brought into the customizing layer. Following Eloranta et al. (2021) and Abraham et al. (2023), interoperability is critical for scaling the platform by increasing the number of users on the provider side to increase the potential for overall platform value creation. If interoperability is enabled by the infrastructure and scalability can therefore take place in different environments, integrative value creation processes are also required. However, Helfat and Raubitschek (2018) argue that these integrative processes are not an end in themselves and need to be constantly renewed. Nevertheless, if these three design principles of DPGs are taken into account in the design rules of platforms, the result is an extension of the services offered by the provider side. These three design principles *scalable*, *interoperable*, and *integrative* are therefore placed on the provider side in Figure 7, as they are foundational to enabling and expanding the service offerings and collaborative potential of providers.

Second, if the focus is on the user group on the customer side, the DPG design principles of *secure and reliable*, *inclusive*, *minimal*, *ease of use*, and *interactive* should be considered more closely. Users are motivated to use platform services, especially in the public sector, when they are secure and reliable e.g. concerning leveraging data privacy (Lember et al., 2019). This principle is placed on the customer side in Figure 7 because it reflects the fundamental need for trust and dependability from the user's perspective, particularly in environments where the platform provider may not be directly involved. A minimal design of services addressing multiple problems can motivate users to use them (Candi, 2007). Moreover, Costabile et al. (2022) argues that ease of use promotes user adoption. In addition, especially when designing platforms for different environments, Mukti et al. (2022) argue that interactivity with different users should be ensured in order to meet their needs. In this context, attention should also be paid to inclusivity. This ensures that the platform is used by those who are able to use it and that those who do not yet have the necessary capabilities to use it are supported. These five design principles are therefore placed on the customer side in Figure 7, as they directly influence user engagement, accessibility, and satisfaction. If these five design principles of DPGs are taken into account in the design rules of platforms, the result is transparency and responsiveness on the user side.

Third, if the focus is on the platform side as an intermediary itself, the DPG design principles of *modular*, *open and standards-driven*, *simple*, and *unbundled* should be considered more closely. Following Frattini et al. (2014), in particular, the DPG design principle of modularity should be followed for leveraging data on platforms. From a technological point of view, the simplicity of e.g. protocols helps to ensure data leveraging and thus the modularity and composability of the platform technology. The goal here is to follow the openness and standards of these protocols to ensure multiple technology or infrastructure partnerships. This is also made possible by unbundling,

which ensures the modularity of the technology (Grover, 2022). If these four design principles of DPGs are taken into account in the design rules of platforms, the result is that multiple partners can be involved in the provision and operation of the platform. The design principles clustered in Figure 7 summarise the discussion of the different incentives and the relevance of design principles for users on different platform sides. The clustering emerged from considering the design principles with the existing literature.

## 6. Implications

The design principles presented for DPGs and their relationship to platform design rules have implications for theory and practice. After learning from the design and implementation of the DIGIT platform in India, this study provides support for replicating this design in other environments. The empirical insights advance knowledge about digital platform design.

This study has theoretical implications in enriching the understanding of digital platform design. It addresses existing research gaps in platform research, as "generally valid design principles and criteria are scarce" (Abdelkafi et al., 2019, p. 3). By elaborating the design principles of DPGs in platform design in addition to the general design rules for platforms, the study provides knowledge on modular platform design. This addresses the call of Mertens et al. (2023) for increasing knowledge around platform design. Furthermore, the results concern platform design but also its implementation in different social environments. Originating in the public sector, the design principles are also applicable in other environments. Therefore, the principles are generic and relate to platform implementation in different contexts. While they can be relied upon as presented in this study, researchers can innovate around them and adapt them to other contexts. Subsequently, this study supports Ritala (2023) in addressing grand challenges in the public sector with platform value creation enriching knowledge on platform implementation independent of platform environments. In addition, the sociotechnical approach identified in the results enriches more technologically oriented platform design and implementation research (Duparc et al., 2022).

This study has managerial implications in enriching understanding of designing and implementing DPGs and platforms by presenting explicit design principles clustered in terms of the different user sides of platforms. Besides the three design rules of platforms, the twelve design principles presented with DPG design can guide practitioners designing and implementing platforms. The STP can help them address specific dimensions. Especially in the public sector, where digital platform design is also in its infancy, "platform[s] become a venue where citizens and public sector organisations can interact and exchange services and information" (Vestues et al., 2021, p. 3). They therefore enhance good governance by increasing the democratic capacity of institutions and the potential for efficiency in government services (Crăciun et al., 2023). Outlining the design principles and their clustering to the user sides of platforms, this study fosters the building of platforms according to multiple user needs. The design principles can guide platform design and implementation in multiple governed environments. This responds to the call of Nicholson et al. (2020, 1) who argue that "there is limited understanding and empirical knowledge of the challenges of scaling of digital platform". By following the twelve design principles and three design rules for platform design and implementation, practitioners will be able to promote digital platform design in the public sector. Furthermore, by linking the analysed DIGIT platform with three environment-independent platform design rules, the principles presented in this paper are not only relevant for the public sector.

## 7. Conclusion, limitations and future research

This study contributes to the digital platform literature by relating design principles for DPGs to the design and implementation of digital platforms. Research on platforms often focuses on platform design from a more technological perspective (Dai, 2023; Kapoor et al., 2022), missing general platform design principles (Abdelkafi et al., 2019). The main objective was to enrich knowledge on platform design and implementation by studying an empirical case of DPG implementation. DPGs are modular digital platforms implemented in a public context; they have been less studied and documented from an academic perspective. Platform literature can learn from the implementation of DPGs, especially when applying an STP, as this perspective allows one to investigate social and technological dimensions of platform design and implementation. This perspective is rarely found in the platform literature but fosters "design choices [having] implications for platform capabilities, enterprise learning, and strategic adaption" (Babüroğlu & Selsky, 2021, p. 20).

A single case study with eGov and their implementation of the DIGIT platform as a DPG was conducted to formalise the learning from this case by twelve design principles for platform design and implementation. Eight design tenets were identified by eGov in the design and implementation of the DIGIT platform. Through this in-depth case study, the eight design tenets have been detailed, advanced and formalised into eight sufficient design principles for digital platform design. These eight

design principles, derived from the design tenets, should be validated in future research to enhance their robustness. In addition, four other design principles were identified during data collection and analysis. The twelve resulting design principles were assigned to sociotechnical dimensions and clustered according to the provider, customer, and platform user sides in discussion with existing literature, thus explicitly showing their relevance for different platform user sides. Knowledge of the design principles helps academics to consider DPGs as an avenue for digital platform design, to learn from DPGs to enrich current platform knowledge, and to promote formalisation of the rarely studied DPG research area. In addition, as the case studied is in India, this study bridges digital platform design knowledge from India with other countries to promote multiple perspectives on platform value creation. Nevertheless, the findings of single case studies are not necessarily generalisable. Consequently, further elaboration of these design principles is required in other cases.

This empirical study is based on the DIGIT case of eGov in the public sector. However, as DIGIT is an implementation in different states in India and other countries, it is a mature case with many lessons to be learnt. Nevertheless, the states in India, as well as India as a whole and the other countries are unique environments. To address this, the research team itself consisted of researchers from India and other countries, ensuring multiple reflections in the discussion and thus securing generalisability. Although the heterogeneous nature of the research team should serve to minimise the contextual dependency of the single case study, reflections on the implementation of other DPGs and the design of digital platforms remain limited.

Future research should validate the design principles presented and investigate their impact in different environments. It may be worth investigating the principles in, for example, public sector of environments other than India to promote good governance. Furthermore, the findings might help in building digital platforms in a business-to-business (B2B) setting, which would extend their validity. They could help shape the design and implementation of B2B platforms, particularly in the manufacturing context, as platform design in industrial settings is still in its infancy (Matzner et al., 2021).

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