Digital transformation of public services toward Government 4.0

Transformação digital de serviços públicos em direção ao Governo 4.0

Carlos Williamy Lourenço Andrade https://orcid.org/0009-0007-7475-762X
Mestre em Informática Aplicada. Universidade Federal Rural de Pernambuco (UFRPE) - Brasil. carloswilliamylourenco@gmail.com

Katyeudo Karlos de Sousa Oliveira https://orcid.org/0000-0002-4414-1599
Mestre em Informática Aplicada. Universidade Federal Rural de Pernambuco (UFRPE) - Brasil. karlos_oliveira@usp.br

Ricardo André Cavalcante de Souza https://orcid.org/0000-0002-2639-3143
Doutor em Ciência da Computação. Universidade Federal de Pernambuco (UFPE) – Brasil. ricardo.souza@ufpe.br

ABSTRACT

This paper presents enablers for the digital transformation of public services, used to support an agile method called Pro-Digital.Gov, designed to help public organizations [re]build digital services in alignment with the Government 4.0 model. The methodology involved a systematic mapping of academic and gray literature to identify the enablers, followed by a case study applying the proposed method, with a qualitative evaluation of the results. The key distinction of this work lies in its integrated approach to the technological, human (both soft and hard skills), and organizational dimensions for digital transformation of citizen-centered public services. Pro-Digital.Gov was applied in the development of a web application to support the vaccination program of a Brazilian city, receiving positive feedback from project stakeholders regarding the method's utility, agility, and efficiency, as well as its ability to encourage citizen participation and engagement in the development of the digital service. The results obtained from applying and evaluating the proposed method indicate that it can be replicated in other contexts and organizations as a viable, efficient, and practical means of guiding the development of digital public services in line with the Government 4.0 paradigm.

Keywords: Digital Transformation. Government 4.0. Public Service. Enablers.

RESUMO

Este trabalho apresenta habilitadores para transformação digital de serviços públicos, usados para subsidiar um método ágil denominado Pro-Digital.Gov para apoiar organizações públicas na [re]construção de serviços digitais em conformidade com o modelo de Governo 4.0. A metodologia consistiu em um mapeamento sistemático da literatura acadêmica e cinza para identificação dos

habilitadores e um estudo de caso da aplicação do método proposto, com avaliação qualitativa dos resultados. O diferencial do trabalho está em abordar de maneira integrada as dimensões tecnológicas, humanas (soft e hard skills) e organizacionais para a transformação digital de serviços públicos centrados nos cidadãos. O Pro-Digital.Gov foi aplicado no desenvolvimento de um aplicativo web para dar suporte ao programa de vacinação de um município brasileiro, com avaliação positiva dos envolvidos no projeto quanto à utilidade, agilidade e eficiência do método, bem como ao estímulo à participação e engajamento dos cidadãos no desenvolvimento do serviço digital. Os resultados obtidos a partir da aplicação e avaliação do método proposto indicam que ele pode ser replicado em outros contextos e organizações como um caminho viável, eficiente e prático para direcionar o desenvolvimento de serviços públicos digitais em conformidade com paradigma de Governo 4.0.
Palavras-chave: Transformação Digital. Governo 4.0. Serviço Público. Habilitadores.

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1 INTRODUCTION

According to Daub et al. (2020), the digital transformation of public services enables governments to become more efficient and resilient while meeting public expectations for a positive user experience. Although the task is complex, a tested and proven formula can accelerate progress, even with limited resources. D'Emidio et al. (2019) note that satisfaction with public services significantly boosts confidence in government. Citizens who are satisfied with a public service are nine times more likely to trust the government than those who are not.

According to OECD (2017b), the shift from the e-government paradigm to digital government has facilitated a move from reactive to proactive service delivery mechanisms, where digital technologies are central to the modernization and innovation strategies of governments. This transformation enables the creation and delivery of public value through the engagement of a broad ecosystem of stakeholders, leading to improved responses to user demands. To achieve this, governments must map, understand, and integrate the needs and desires of citizens into the design and delivery of public service strategies. The focus should move from citizen-centered to citizen-driven approaches, aiming to better align public service delivery processes with citizen expectations.

The widespread use of the internet for communication through websites and social media has empowered citizens and increased their demand for more efficient, digitally-based public services. The economy and agility provided by digital solutions motivate the planning and execution of digital government strategies (WEF, 2017a). An effective digital government strategy requires the engagement and active participation of citizens, from the formulation of public policies to the timely provision of information to enhance public service effectiveness (OECD, 2019d). Digital technologies, coupled with citizen participation, are crucial for the digital transformation of public services (Sagarik et al., 2018).

The concept of Government 4.0 has evolved from the use of digital transformation to shape public policies and deliver citizen-driven public services (Von Lucke, 2016; Sagarik et al., 2018). Distinguished from the traditional electronic government, Government 4.0 aims to provide public value through services powered by digital technologies, characterized by the digital redesign of business processes and active citizen involvement (OECD, 2014; WEF, 2018). Baxendale (2019) emphasizes that digital transformation transcends mere technology usage and should not be viewed as a temporary project. Instead, it represents a continuous mode of working, thinking, and acting, with the goal of leveraging digital technologies to enhance user experiences.

In the post-pandemic scenario of COVID-19, which accelerated the digital transformation of various economic sectors and government functions, adopting agile and lean approaches is essential. These approaches should be creativity-driven and centered on citizen needs to effectively guide the digital transformation of public services (Gabryelczyk, 2020). The rapid digital acceleration prompted by COVID-19 offers an opportunity to observe how governments and organizations acted and reacted quickly, providing vital lessons for the future digital transformation of public services (Agostino et al., 2020).

In this context, it is necessary to explore innovative approaches to advance the digital transformation of public services in light of the

challenges posed by Government 4.0. Accordingly, the research question guiding this study is: *"How can public services be (re)built through digital transformation enablers toward Government 4.0?"* The overall objective of this paper is to present the specification, implementation, application, and evaluation of a method called Pro-Digital.Gov. Specifically, the study aims to evaluate the implementation of the Pro-Digital method in a digital public service designed to support immunization programs in the city of Iguatu, in the state of Ceará, located in Brazil's Northeastern region. The proposed method is intended to guide the digital transformation of public services through technological, human, innovation-driven, and organizational enablers, in alignment with the Government 4.0 strategy.

2 BACKGROUND

According to Schwab (2016), the Fourth Industrial Revolution (4IR) is characterized by the exponential advancement of innovations resulting from the convergence of technologies such as artificial intelligence, robotics, Internet of Things (IoT), nanotechnology, and biotechnology, among others. 4IR is compelling companies to reevaluate their business practices, governments to innovate in public policies and public services delivery, and individuals to rethink how to develop careers, cultivate skills, and nurture relationships, while concerns about privacy, consumption patterns, and time devoted to work and leisure emerge.

Citizen engagement in the formulation of public policies and so in the design and delivery of public services represents the biggest challenge for governments due to the redistribution and decentralization of power made possible by the combination of technologies that characterize 4IR (Schwab, 2016). Known also as Industry 4.0, 4IR requires governments to adapt their methods of delivering public services to meet citizens' personal and contextual needs (Malhotra et al., 2020). The advancement of 4IR has driven the development of digital public services led by citizens, leading to a new paradigm of government known as Government 4.0.

Government 4.0 results from digital transformation of public services to optimize work processes and systems to gain operational efficiencies and boost productivity (Marcellis-Warin et al., 2022). Government 4.0 is based on the agile management paradigm and requires digital skills from all main stakeholders, including civil servants and citizens (Stern et al., 2018; Marcellis-Warin et al., 2022; Von Lucke, 2016; Sagarik et al., 2018). According to the Observatory of Public Service Innovation (OPSI, 2022), among the principles for digital transformation for the public services are Data-driven or data-informed decision-making – building consensus based on evidence; Openness – enabling transparency and access to information; Design-driven – following a cycle of discovery, prototyping, and delivery; Iterative – incorporating more agile working methods and rapid feedback cycles; and User-focused – starting with user needs and testing early and often.

A specific challenge in the digital transformation of public services is the recruitment of new types of talent and the integration of digital tools, methods, and culture into both strategic plans and daily operations (OPSI, 2022). Digital transformation is complex across all sectors, including education, health, and business, because it entails more than just adopting new digital technologies. It also requires cultural and behavioral changes among stakeholders (Oliveira & Souza, 2022). This task becomes even more

difficult in the public sector, considering the need for standardized and regulated processes' digital transformation.

Digital transformation occurs through the integration of technological, organizational, and human enablers (OECD, 2019c). From a systematic mapping of both academic and gray literature, a set of enablers for digital transformation of public services was identified. For this work, enablers support, guide, and drive the public services digital transformation toward Government 4.0.

The enablers for the digital transformation of public services are categorized into five categories. The technological enablers include elements such as hardware, software, data, and communication infrastructure. The organizational enablers encompass principles and good practices of public administration. The innovation approaches as enablers include human-centered and creativity-based methods that can be used to redesign public services. The soft skills as enablers cover the mindsets and social, cognitive, and emotional skills that stakeholders need to effectively (re)design a public service. The hard skills as enablers focus on the technical skills and practical knowledge required for the development of public services. The combination and association of enablers from different categories can enhance the effectiveness of digital transformation in public services.

The Technological Enablers are:

- **Big Data:** The analysis of large volumes of digital data facilitates data-driven innovation, enhancing productivity and convenience (OECD, 2015). In the public sector, big data technology can be utilized to improve overall welfare services, such as identifying individuals in social vulnerability (Ubaldi et al., 2019).
- **Blockchain:** This technology involves new occurrences and transactions being automatically recorded in "blocks" that are chronologically linked to each other through advanced cryptography, forming a digital ledger (OECD, 2019c). These chains of information blocks are significant for various functions within public administration to ensure the integrity of public services, such as electronic voting, public competitions, and the security of citizen documents (Ubaldi et al., 2019).
- **Cloud Computing:** This technology enhances the accessibility, availability, volume, diversity, and omnipresence of computing resources, facilitating the use of other digital technologies such as artificial intelligence and big data, and supporting more comprehensive digital transformation efforts (OECD, 2015). Additionally, cloud computing enables collaborative and distributed work environments (OECD, 2019c).
- **Artificial Intelligence:** This technology can enhance citizen interactions with the public sector by personalizing services, reducing waiting times, and providing 24/7 support through the use of robots (bots). It also increases the accuracy and assertiveness of responses, offering a more pleasant and appropriate experience for citizens (Ubaldi et al., 2019).
- **Internet of Things (IoT):** This represents a new kind of ecosystem characterized predominantly by networks of connected devices. In the public sector, IoT applications include lighting systems and other mechanisms within smart cities, smart homes, public security, and the management of transportation and logistics (Lal Das et al., 2017).

- **5G Networks:** This technology distinguishes itself from previous generations (3G and 4G) by offering higher speeds, greater data transfer capacity, and support for numerous applications through the virtualization of the network's physical layers. For public administration and citizens, the benefits include enhancements in traffic and transportation policies through the use of autonomous vehicles, as well as improvements in employment, income, and infrastructure (OECD, 2019c).
- **Social Networks:** Insights derived from users' activities on social networks can enhance both emergency and routine public service quality and communication. The use of social networks can lead to more transparent decision-making and inclusive processes, as well as the development of more responsive and efficient services (Mickoleit, 2014).
- **Software Applications (App):** This technology involves digital information encoded through a programming language for various applications in public services. An exemplary case is the MOPA software app in Mozambique, which is a successful citizen participation project aimed at enhancing waste management. MOPA includes a voice interface in local dialects, making it accessible to populations with varying levels of education. Additionally, it allows users to add comments, images, and other information to aid in the swift intervention of public agents (OECD, 2018b).

The Organizational enablers are:

- **Government 4.0 Strategic Plan:** This plan involves developing and implementing a digital transformation strategy for public services that adopts open and inclusive processes, and promotes accessibility, transparency, and accountability. It recognizes the varying contexts and expectations of citizens and addresses the specific needs of those unable to access or use digital technologies. This approach helps prevent new forms of digital exclusion, ensuring that all citizens can benefit from the opportunities presented by digital transformation (OECD, 2014, 2019b, 2019d; NESTA, 2019a; WEF, 2017a, 2019).
- **Digital Technology Procurement Standards:** These standards guide the acquisition and/or contracting of digital technologies, taking into account the required digital skills and job profiles. The standards for acquisition and/or contracting should be regularly updated to remain compatible with the ongoing modernization, development, and implementation of digital technologies. This ensures that procurement processes stay aligned with the latest advancements and needs in the field (OECD, 2014, 2017e, 2019b, 2020; NESTA, 2019a; WEF, 2017a, 2017b, 2019).
- **Public Employee Development:** This initiative involves continuously training and empowering public employees to deliver citizen-focused services, with an emphasis on strategy and skills tailored to current demands. This enabler is essential for equipping public employees with the digital competencies required to develop and manage public services effectively. It also promotes a culture within the public sector that is conducive to digital innovation, ensuring that employees are prepared and motivated to embrace new technologies and methods (NESTA, 2019a; OECD, 2017d, 2019b; WEF, 2017a, 2019).

- **Communication through Digital Channels:** This approach leverages digital technologies to enhance communication within public administration, aiming to eliminate or mitigate spatial and temporal constraints. It increases the ability to share experiences, knowledge, and best practices across different government levels (municipal, state, and federal). Utilizing digital channels not only facilitates the dissemination of and access to public services for citizens but also acts as a tool for increasing efficiency by simplifying and automating internal processes (OECD, 2014; NESTA, 2019a; Ubaldi et al., 2019; WEF, 2017a, 2019).
- **Citizen-Centered Digital Services:** This approach prioritizes the needs and expectations of people in the design, provision, execution, and analysis of public policies and services. To effectively implement this, governments can actively involve citizens in decision-making processes as well as in the collection and analysis of data. This involvement helps validate the performance of public policies and services, ensuring they meet the actual needs of the community (OECD, 2014, 2019b; WEF, 2017b).
- **Open Data:** This approach involves making digital data freely accessible, ensuring it adheres to the necessary technical and legal attributes for unrestricted use, reuse, and redistribution by anyone, anytime, and anywhere. This openness is intended to foster transparency and enable innovation across different sectors and layers of governance (OECD, 2014, 2019b, 2019d; NESTA, 2019a; WEF, 2017b).
- **Continuous Feedback:** This approach entails the ongoing evaluation of practices and the provision of feedback to stakeholders, including public employees and citizens. By adjusting evaluations and guidelines based on this feedback, it promotes a culture of continuous improvement and responsiveness within public services (OECD, 2014, 2017d, 2019b, 2019d; NESTA, 2019a; WEF, 2017b).
- **Active Transparency:** This strategy focuses on enhancing transparency through mechanisms that facilitate and promote the access, use, and reuse of a growing body of evidence, statistics, and data related to transactions, processes, and outcomes. The goal is to improve openness and accessibility, thereby encouraging citizen participation in policy-making, value creation, and service delivery (OECD, 2014, 2019b, 2020; NESTA, 2019a; WEF, 2017a).
- **Agility:** This refers to the capability to develop public policies, products, and services through an iterative, incremental, and experimental approach. Emphasizing flexibility and adaptability, this method allows for rapid adjustments based on feedback and changing needs (OECD, 2017a, 2017d, 2018a, 2019a; NESTA, 2019b).

Innovation approaches as enablers for the digital transformation of public services:

- **Co-creation:** This approach utilizes digital technologies and data to facilitate collaboration with and among society, leveraging the perspectives, knowledge, and creativity of people to address challenges throughout the public service development process (Puttick et al., 2014; NESTA, 2017; WEF, 2017b; OECD, 2018a).
- **Design Thinking:** This approach aims to immerse stakeholders in the problem to deeply understand the needs of the people involved, identify insights, and then explore alternative solutions. Utilizing Design

Thinking allows for a balance between the government's desired changes and the citizens' wishes, fostering solutions that are both innovative and aligned with public needs (Puttick et al., 2014; NESTA, 2017; OECD, 2017e).

- **Human-Centered Design (HCD):** This approach aligns government decision-making with the end user's perspective. HCD facilitates the development of more humanized public services by shifting focus from an administrative bias centered on internal procedures and bureaucracy to the citizen's perspective. By involving citizens in the co-creation process, HCD helps produce outcomes that are more attuned to social demands (Puttick et al., 2014; NESTA, 2017).
- **Collective Intelligence:** This concept emerges when individuals collaborate, often aided by digital technologies, to share information, insights, ideas, and solutions to address various challenges. Governments are increasingly adopting this approach to better understand citizens' problems and social issues. It involves generating dynamic data about these problems and sourcing ideas and solutions from a wider array of inputs, including open innovation and crowdsourcing. This approach also aims to enhance decision-making by using online platforms that enable citizens to propose ideas, offer feedback, and even participate in decision-making processes, such as voting on the allocation of public funds (OECD, 2018a, 2019b; NESTA, 2019a, 2019c).
- **Prototyping:** This method is employed when there's a hypothesis about a potential solution but uncertainties remain regarding its design, functionality, and user acceptance. Interaction with the prototype provides valuable feedback, which is used to refine and improve the solution concept. Through iterative development and enhancement of the prototype, deeper insights are gained, allowing the transition from a basic version with limited functionalities to a more detailed and valuable version for users. This process ensures that the final product is more closely aligned with the needs and expectations of citizens (NESTA, 2017, 2019a, 2019b, 2019c; Puttick et al., 2014).

Soft Skills as enablers for the digital transformation of public services:

- **Agile mindset:** This refers to the ability to adapt, learn, act, and react to changes and manifestation of risks within a project (OECD, 2017a, 2017d, 2018a, 2019a; NESTA, 2019b).
- **Data-driven Mindset:** This ability emphasizes the importance of basing decision-making on data that reflects the needs and expectations of citizens. It involves the capability to analyze and correlate existing data sets, which can uncover new insights, guide the collection of additional data, and translate these insights into potential innovations. This mindset is essential for creating informed, effective, and innovative solutions in public service (OECD, 2017a, 2017d, 2018a, 2019a; NESTA, 2019b).
- **User Focus:** This skill involves the ability of public sector employees to closely engage with the citizens they serve, ensuring that services are tailored to meet user needs effectively. This approach is closely associated with conducting ethnographic analysis to understand user behaviors and preferences, and networking with stakeholders to gather diverse insights (OECD, 2017a, 2017d, 2018a, 2019a; NESTA, 2019b).

- **Curiosity:** This skill involves actively seeking and exploring new ideas and methods. It includes questioning, investigating, and experimenting with concepts beyond daily tasks. Fostering curiosity helps individuals and organizations discover opportunities and insights that improve their work and results (OECD, 2017a, 2017d, 2018a, 2019a; NESTA, 2019b).
- **Narrative Communication:** This skill involves using storytelling to effectively present and clarify problems, insights, and solutions, fostering an emotional and empathetic connection with the audience. It's crucial for compellingly conveying ideas to potential funders, decision-makers, partners, and the public (OECD, 2017a, 2017d, 2018a, 2019a; NESTA, 2019b).
- **Insurgence:** This skill involves challenging the status quo and collaborating with individuals from diverse professional backgrounds to drive change. It requires building partnerships both within and outside of government, along with a deep understanding of decision-making processes and how to influence them for improved outcomes (OECD, 2017a, 2017d, 2018a, 2019a).
- **Empathy:** This skill involves the ability to listen and put oneself in the place of public service users and other stakeholders to understand their pains, challenges, and difficulties when accessing and using a public service (OECD, 2017a, 2017d, 2019a, 2019b; NESTA, 2019b).
- **Engagement with Stakeholders:** This skill involves the ability to assess in advance how stakeholders are impacted by a public service, enabling the design of more effective and personalized solutions (OECD, 2014, 2019a, 2019b; NESTA, 2019b; WEF, 2017a, 2018, 2019).
- **Creativity:** This skill involves the ability to embrace different perspectives, uncover insights, and propose multiple solution alternatives for public interest problems. It requires openness to divergent ideas and feedback, as well as a deep understanding of the problem before suggesting solutions (NESTA, 2017, 2019b).

Hard Skills as enablers for the digital transformation of public services:

- **Technological Resource Management:** This skill involves the ability to identify and use technology tools appropriately based on specific needs, enabling the automation of interactions with society and the streamlining of internal government processes (WEF, 2016; OECD, 2017c).
- **Time Management:** This skill involves managing one's own work pace and helping manage the team's time to promote self-management, boost productivity, enhance efficiency, and facilitate agility in decision-making (WEF, 2016; OECD, 2017c).
- **Financial Resource Management:** This skill involves effectively managing project budgets to establish clear goals and objectives, ensuring the optimal use of public resources (WEF, 2016; OECD, 2017c).
- **People Management:** This skill involves the ability to motivate and guide individuals throughout a project's development, managing change through effective communication and maintaining ethical standards (WEF, 2016; OECD, 2017c).
- **Quality Management:** This skill involves the ability to conduct testing and reviews of projects, services, or processes, assessing the quality or performance at various stages or of the project as a whole. This process ensures higher quality in the provision of public services (WEF, 2016; OECD, 2017c).

- **Risk Management:** This skill involves analyzing uncertainties and anticipating mitigation and control actions during the development and execution of public services. It includes developing strategies to control costs, deadlines, quality, and scope restrictions for projects (WEF, 2018; OECD, 2019c).

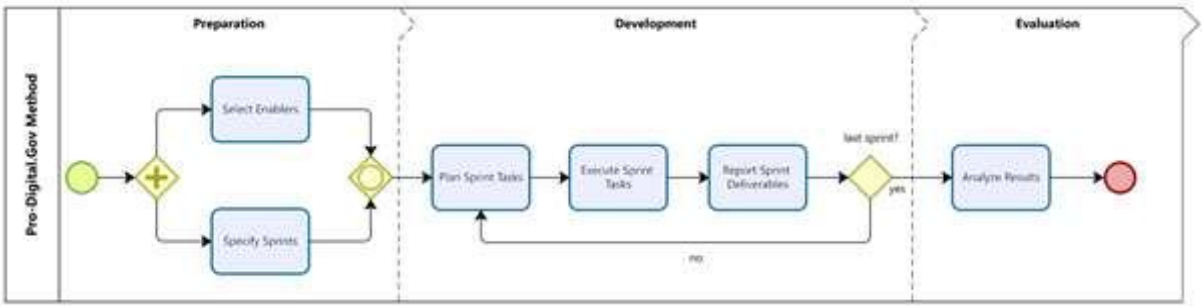
Given that the digital transformation of public services requires the application of a combination of technological, organizational, and human drivers to [re]build public services, a method is needed to guide initiatives with this goal. The following section introduces Pro-Digital.Gov, a method designed to guide the digital transformation of public services.

3 THE PRO-DIGITAL.GOV METHOD

Figure 1 presents the workflow of the Pro-Digital.Gov method in BPMN, organized into three stages. The first stage, Preparation, involves selecting the combination of enablers to be used in the project and specifying the iterations (sprints) that will guide the agile execution of the project. The second stage, Development, focuses on [re]building the public service based on the selected enablers and executing the sprints. The final stage, Evaluation, is dedicated to analyzing the results achieved from stakeholder's feedback.

The evaluation of the Pro-Digital.Gov method implementation was qualitative in nature and was conducted through an online questionnaire administered to 61 public servants who took part in developing the digital health service—enabled by a web app—to support immunization programs in the city of Iguatu, located in the state of Ceará, in Brazil's Northeastern region.

Figure 1
Workflow of the Pro-Digital.Gov Method



Source: authors' own elaboration

The Preparation stage includes two key activities: Select Enablers and Specify Sprints. The Select Enablers activity involves analyzing the project's context and objectives for the digital transformation of the public service. Based on this analysis, the most suitable combination of technological, organizational, and innovative approaches, along with the necessary soft and hard skills, is chosen for use during the Development stage. The Specify Sprints activity defines the iterations that will be carried out during the Development stage.

The Development stage encompasses the activities of Plan Sprint Tasks, Execute Sprint Tasks, and Report Sprint Deliverables for each sprint defined during the Preparation stage. In the Plan Sprint Tasks activity, the project

team defines the tasks necessary to achieve the sprint goal, determines the sequence of these tasks, and assigns responsibilities to specific team members. The Execute Sprint Tasks activity involves the project team carrying out the planned tasks using the tools, practices, techniques, and enablers selected during the Preparation stage. These sprints should be executed within a fixed time interval, usually two to four weeks, as prescribed by the agile management paradigm. In the Report Sprint Deliverables activity, the work products and results achieved during the sprint are presented and delivered to the stakeholders. Delivering value quickly to users is a key practice of agility. At the end of the last planned sprint, the initial version of the digital public service will be ready to be made available to the target audience.

The Evaluation stage involves the activity Analyze Results, which consists of gathering feedback from key stakeholders about the digital transformation of the public service using the Pro-Digital.Gov method. The results are then analyzed to identify opportunities for improvement.

4 APPLICATION OF THE PRO-DIGITAL.GOV METHOD

The Pro-Digital.Gov method was applied through an action research within the context of the Immunization Project, aimed at digitally transforming the health digital service supporting immunization programs in the Brazilian city of Iguatu. The city and the health service were selected because one of the authors involved in the action research is a public servant working at the municipality's health department.

4.1 The Preparation Stage

The Preparation stage begins with the Select Enablers activity, which aims to define the most suitable combination of enablers for the digital transformation of public services, considering the specificities and constraints of the Immunization Project. By category, the enablers selected for the Immunization Project were: Technological - cloud computing, social networks, and software app; Organizational - Government 4.0 strategic plan, continuous feedback, citizen-centered digital services, public employee development, and agility; Innovation Approaches - co-creation, Human-Centered Design (HCD), collective intelligence, and prototyping; Soft skills - curiosity, empathy, narrative communication, agile mindset; and Hard skills - people management, technology resource management, and time management. The next section presents how each selected enabler was applied in the Immunization Project.

The Preparation stage concludes with the Specify Sprints activity. A sprint refers to an iteration in agile management (Schwaber, 2004). In the Immunization Project, the sprints were specified based on the stages of the HCD: Discovery, which focused on understanding the problem and defining a challenge to guide the digital transformation of the public service; Ideation stage, to identify insights related to the challenge and generating and refining ideas to address them; and Implementation, dedicated to materializing the ideas and delivering the solution to users. Each stage of the HCD was executed iteratively and incrementally through sprints, each with specific goals, as presented in Table 1.

Table 1
Sprints by HCD stage

HCD Stage	Sprint	Purpose of the sprint
Discovery	#1 Understanding the challenge	Gather information about the context of the problem to fully understand the challenges faced by the Immunization Project.
	#2 Immersing in the context	Immerse yourself in the context to identify the needs and expectations of stakeholders, including public officials and citizens, in relation to the specific public health service.
Ideation	#3 Identifying insights	Organize the key findings from the Inspiration stage and identify the insights related to the challenge.
	#4 Generating and refining ideas	Generate and refine ideas to address the insights.
	#5 Prototyping ideas	Turn the ideas into tangible prototypes.
Implementation	#6 Testing the solution	Gather user feedback on the prototype to refine and enhance the Pilot version of the digital public service.
	#7 Launching the solution	Launch the Minimum Viable Product (MVP) of the digital public service, making it accessible for public use.
	#8 Presenting the solution	Present the digital public service designed to support immunization to the project sponsor and other stakeholders.

Source: authors' own elaboration

4.2 The Development Stage

The Development stage involved executing tasks with the support of various practices, techniques, and tools, resulting in work products (artifacts) that contributed to achieving the goals of the eight sprints specified in the Preparation stage.

Sprint #1 "Understanding the challenge" began with creating a Problem Map (NESTA, 2019c), which visually captured the various problems associated with promoting vaccination. Following this, an Empathy Map (IDEO, 2015) was developed to group the pains, needs, and feelings of citizens regarding public health, particularly vaccination. Based on the findings from these tasks, a Design Challenge was formulated to guide the project development: "How might we encourage population vaccination in an agile and practical way?".

Sprint #2 "Immersing in the context" began with Immersion (IDEO, 2015), which involved visiting a community to observe how people live, work, and interact. The team visited a health center and spoke with citizens about the health services provided by the municipality. During these conversations, the main pain points identified in Sprint #1 were confirmed, with the primary concern being the vaccination process. Common questions included: "When will it be my turn?"; "How will I know it's my turn?"; "Where will I get my vaccine?"; and "How will I know when I need to retake it?" Based on these findings, the team created Personas (IDEO, 2015), fictional characters

representing the behaviors and concerns observed among the people involved in the vaccination process.

Sprint #3 "Identifying insights" began with identifying insights related to the design challenge. Civil servants and citizens involved in the Immunization Project collaborated, using the results of previous sprints to summarize key opportunities on Insights Cards (IDEO, 2015). Based on these insights, the team formulated questions starting with "How might we …?" (IDEO, 2015), encouraging creative exploration of potential solutions. The questions created included: "How might we improve public services to strengthen citizens' trust in public administration?"; "How might we improve education and raise awareness about vaccination among young people?"; and "How might we enhance mobility to ensure citizens have better access to essential health screenings?".

Sprint #4 "Generating and refining ideas" kicked off with a Co-Creation Session (IDEO, 2015) aimed at actively involving stakeholders in the collaborative generation and evaluation of ideas. Participants included nurses, administrative staff, health agents, nursing technicians, and citizens. The session resulted in a variety of ideas for improving public services related to immunization programs within health interventions. Following this, Storytelling (IDEO, 2015) was used to craft a narrative that conveyed the evolution of one of the ideas. The final product was an animation depicting a scenario where digital technologies are leveraged to encourage vaccination.

Sprint #5 "Prototyping ideas" started with creating the User Journey (IDEO, 2015) to map the user experience central moments before, during, and after interacting with the solution. Then, a Prototype (IDEO, 2015) of the solution was produced, from which users can provide more constructive feedback when they see and interact with the materialized idea instead of just hearing some explanations about it. The tool https://marvelapp.com was used to build the prototype. Finally, the Get Feedback was carried out to obtain people's feedback on the conceived idea, finding out what people's real needs are and what can be improved.

Sprint #6 "Testing the solution" began with the evolution of the Prototype into a Pilot version (IDEO, 2015) of the solution accommodating previous feedback. The Pilot represents a functional version that is tested in controlled environments. It has been developed as a web application, with some services already partially available for evaluation by real users. Following this, the Get Feedback was conducted again to gather additional user insights. Finally, the DSI Strategy Canvas tool (Ribeiro et al., 2021) was created to outline a digital social innovation strategy. In the context of the Immunization Project, the strategy is guided by key social values such as inclusion, accessibility, collaborative management, civic engagement, and decision-making support.

Sprint #7 "Launching the solution" began with the evolution of the Pilot into a Minimum Viable Product (MVP) (Ries, 2011), incorporating previous feedback to create a more streamlined and functional version of the solution. The MVP consisted of a web application designed to support the immunization service, allowing for better management of vaccine information and the identification of users outside the coverage areas of primary health units. The MVP was then launched for public use, accessible to citizens via https://vacina.iguatusaude.com/.

Sprint #8 "Presenting the Solution" began with the development of the Strategy Canvas (Cham & Mauborgne, 2005) to compare the MVP with similar

solutions implemented by other public health organizations in Brazil. Following this, a Pitch (IDEO, 2015) was crafted to showcase the developed solution, emphasizing the social value it delivers. Finally, the municipal health department held a meeting with managers from various departments, nurses, administrative technicians, health agents, and citizens to present the Pitch and discuss the solution.

Table 2 outlines the enablers for the digital transformation of public services used in the Immunization project.

Table 2

Description of the enablers used in the Immunization Project

Category	Enablers
Technological	**Cloud Computing:** Google Drive was utilized to store and share the work products from each sprint, while Google Forms was employed to collect information and feedback. **Software Apps:** Trello was used to track and monitor project tasks, Personaapp for designing personas, Canva for crafting storytelling visuals, and Marvelapp for building prototypes. **Social Networks:** WhatsApp facilitated real-time communication and information exchange between the team and stakeholders. Facebook and Instagram were employed to promote the project and engage with the broader community.
Organizational	**Government 4.0 Strategic Plan:** This plan involved the restructuring of the public organization's strategy to develop citizen-oriented digital public services. It was guided by enablers of digital transformation for public services, following agile management principles and the HCD approach. Continuous Feedback: Using Trello, the team tracked task progress (to do, doing, and done), allowing continuous feedback on challenges and best practices during task execution. Citizens also provided feedback on solution versions developed during the sprints. **Citizen-Centered Digital Services:** The discovery phase of the HCD provided a deep understanding of citizens' pain points and desires related to public health services. For instance, it was revealed that the lack of nearby health units significantly impacted immunization rates among residents. **Public Employee Development:** Throughout the project, public servants had the opportunity to develop both soft and hard skills critical for 21st-century work. **Agility:** The project was carried out iteratively and incrementally using timeboxed sprints, reducing risks and delivering value quickly through focused development cycles.
Innovation Approaches	**Co-Creation:** Citizens and civil servants were actively involved in executing the tasks outlined in each project sprint, fostering collaboration and shared ownership of outcomes. **Human-Centered Design (HCD):** The Immunization Project was guided by Discovery, Ideation, and Implementation stages to ensure solutions were tailored to user needs. **Collective Intelligence:** Through input from citizens, the team identified service bottlenecks, enabling more precise and effective public service delivery.

	Prototyping: The development of incremental versions of the software allowed users to provide feedback on the digital public service, leading to timely adjustments and improvements.
Soft Skill	**Curiosity:** This skill was essential for exploring and identifying a relevant challenge to guide the project's development. It also helped uncover insights that served as a foundation for generating solution ideas. **Empathy:** This skill was key in understanding the problem and designing the solution from the perspective of citizens, ensuring their needs shaped the final product. **Narrative Communication:** This skill was applied to convey and explain the solution through visual storytelling, creating a narrative that illustrated a usage scenario and highlighted the public value delivered by the developed solution. **Agile Mindset:** The team adopted an agile mindset to deliver value iteratively and incrementally, focusing on continuous improvement and responsiveness to user needs.
Hard Skill	**People Management:** This skill was demonstrated through effective self-management by the team, allowing them to handle individual and collective tasks throughout the project sprints. **Technology Resources Management:** The team utilized this skill to operate a range of technological tools, including task management platforms and prototyping tools. **Time Management:** This skill was applied to ensure tasks were completed on schedule, meeting the planned milestones in each sprint within strict, non-extendable deadlines.

Source: authors' own elaboration

4.2 The Analyze Results Stage

This stage involved evaluating the Pro-Digital.Gov method by the project team and other civil servants involved in the Immunization Project, followed by a qualitative analysis of the results. To achieve this, five closed-ended questions were presented, with responses based on a 5-point Likert scale ranging from "strongly disagree" to "strongly agree." Table 3 provides the closed questions (Q1 to Q5) organized by evaluation criteria.

Table 3
Questions for evaluating the Pro-Digital.Gov Method

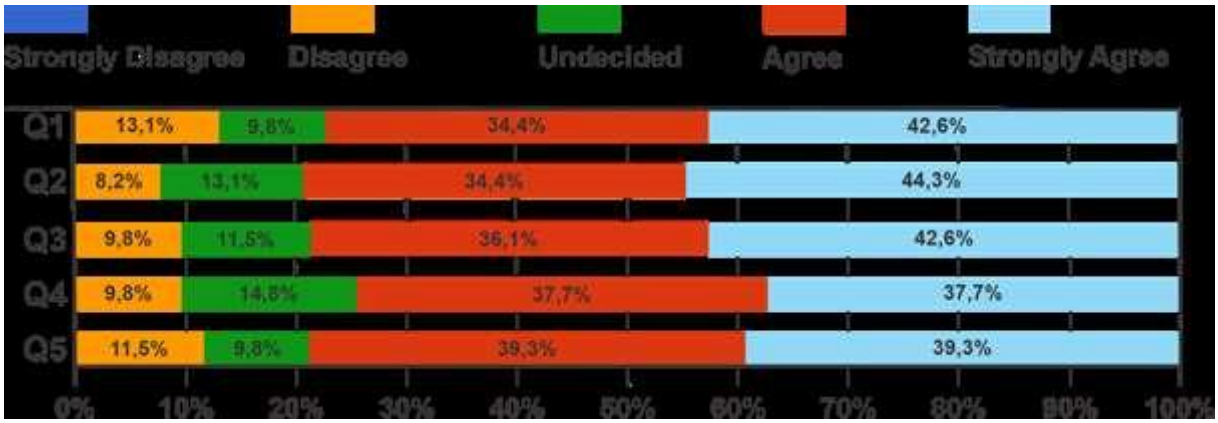
ID	Evaluation criteria	Question
Q1	Utility	Does the Pro-Digital.Gov method offer the necessary tools to understand the problem from the citizen's perspective, enabling the identification of insights and the development and evaluation of solution ideas based on stakeholder feedback, ultimately leading to the implementation of a valuable digital public service?
Q2	Agility	Does the Pro-Digital.Gov method facilitate agile management of the digital public service development project by ensuring continuous value delivery to stakeholders?
Q3	Citizen engagement and participation	Does the Pro-Digital.Gov method promote citizen mobilization, engagement, and active participation both during the project development and after the digital public service is deployed?

Q4	Service offer	Was the Pro-Digital.Gov method a key factor in delivering a higher quality and more efficient digital public service to citizens?
Q5	Intention of use and recommendation	Do you plan to use or recommend the Pro-Digital.Gov method for developing or modernizing other digital public services?

Source: authors' own elaboration

Figure 2 presents an infographic displaying the responses from 61 civil servants involved in the Immunization Project to questions Q1 through Q5, which were used to evaluate the Pro-Digital.Gov method.

Figure 2
Result of the evaluation of the Pro-Digital.Gov method



Source: authors' own elaboration

Regarding Usefulness (Q1), 77% of respondents agreed that the Pro-Digital.Gov method offers an efficient roadmap for creating valuable digital public services. As noted by Mergel et al. (2018), citizens now expect public services to be accessible, efficient, and flexible. To meet these expectations, governments around the world are adopting digital transformation as a strategic approach to boost service performance, enhance the citizen experience, optimize operations, and develop new service models.

In terms of Agility (Q2), 78.7% of respondents agreed that the Pro-Digital.Gov method consistently delivers value to stakeholders in a short timeframe. As noted by NESTA (2017), governments are increasingly adopting agile methods and tools to create digital public services.

Regarding Citizen Engagement and Participation (Q3), 78.7% of respondents agreed that the Pro-Digital.Gov method encourages active citizen involvement during the development of digital public services. According to Misra et al. (2018), governments are increasingly adopting participatory governance models in the formulation and implementation of public policies and services.

Regarding Service Offer (Q4), 75.4% of respondents agreed that the Pro-Digital.Gov method is essential for delivering more efficient digital public services aimed at addressing social needs. As Lee et al. (2018) suggest, governments must reevaluate management practices and enhance service delivery to ensure effective, high-quality outcomes that meet the changing needs of society.

Regarding Intention of Use and Recommendation (Q5), 78.6% of civil servant respondents agreed that the Pro-Digital.Gov method provided a

positive experience. As Ahn & Chen (2022) emphasize, civil servants play a pivotal role in adopting new technologies and processes within government. Their attitude and willingness to reuse and recommend such methods are essential for sustaining successful digital transformation efforts in public organizations.

3 CONCLUSION

In addition to technology, organizational changes are crucial for discovering new ways to create value for citizens. Digital transformation presents an opportunity to reimagine how public services are delivered. However, this shift also requires changes in behavior and the adoption of an agile mindset by both civil servants and citizens. The accelerated digital transformation across all sectors has pressured governments to make rapid, decisive actions and implement new digital public services.

Digital transformation in public services is a pathway to achieving Government 4.0, characterized by the integration of technologies in the development of digital solutions and strategies such as collective intelligence, co-creation with active user participation, and agility. To meet citizens' expectations and enhance government popularity, it is essential to foster the development of digital public services through an innovative, user-centered, and creativity-driven approach. In this context, the contributions of this work are particularly noteworthy.

The scientific contributions of this work are: a comprehensive survey of technological, human, innovation approaches, and organizational enablers for the digital transformation of public services, identified through a systematic review of academic and gray literature; and the development, application, and evaluation of the Pro-Digital.Gov method, which can be used by public organizations to drive the digital transformation of public services.

The technical contribution includes the application of the Pro-Digital.Gov method to develop a web application that supports public immunization services in municipal public health interventions, available at https://vacina.iguatusaude.com. The results outlined in this work lead to the conclusion that the Pro-Digital.Gov method is an effective approach for [re]building public services, advancing towards Government 4.0.

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