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A user-centred Enterprise Architecture for Digital Building Permit in Peru

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I first heard the term public sector innovation from my then-supervisor at the Pontifical Catholic University of Peru. At that time, I could have not anticipated the transformative journey that would follow.

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Thank you all. I hope the following pages inspire other researchers and policy designers to continue rethinking how we deliver public services. Today, more than ever, Peru needs courageous pioneers, those willing to step beyond comfort zone to create meaningful public value.

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Abbreviations

AEC:	Architecture, Engineering, and Construction
APIs:	Application Programming Interfaces
BIM:	Building Information Modeling
BPMN:	Business Process Model and Notation
DSR:	Design Science Research
EA:	Enterprise Architecture
FUT	Single Procedure Form
GIS:	Geographic Information System
ICT:	Information and Communication Technology
MVCS:	Ministry of Housing, Construction and Sanitation
RENIEC:	National Registry of Identification and Civil Status
RNE:	National Building Regulation
SGD:	Document Management System
SIMPLE:	Monitoring System of Issued Procedures and Permits
SUNARP:	National Superintendency of Public Registries
TUPA:	Single Text of Administrative Procedures
DGPRVU:	General Directorate of Housing and Urban Development Policies and Regulation

1 When regulation fails: informality and corruption in the construction sector

On February 21, Peru witnessed a tragedy as the ceiling of a bustling shopping mall's food court collapsed, injuring more than 80 people, including children, and causing the deaths of six (Zevallos Morón, 2025). This event underscored the critical importance of enforcing building regulations to ensure public safety. As Gelqui Gómez, inspector of the Peruvian Fireman Voluntary Company, emphasized: “regardless of the quality of building regulations, corruption leads to distortions in its enforcement” (in Zevallos Morón, 2025). Moreover, according to the 2019 National Household Survey, 64.1% of all surveyed homes nationwide did not have building permits (INEI, 2019). Consequently, it is common to identify ongoing or completed construction projects that lack proper construction permits, compromising the safety of residents, workers, and anyone in their vicinity. In this context, strengthening the transparency, efficiency, and legitimacy of the building permit process has become a pressing issue on the public policy agenda.

The issuing of a building permit is a critical administrative process that building owners must undergo to construct, modify, or maintain infrastructure in compliance with the authorities’ regulations (Aufa et al., 2022; Noardo, 2022; Ullah, Witt, & Lill, 2022). This process plays a vital role in ensuring sustainable and controlled urban development (Noardo et al., 2020) while facilitating the integration of new businesses into the economy. It is vital to increase local development, attract investors and promote workforce expansion, shaping the urban landscape while guaranteeing housing and environmental safety for the citizens (World Bank Group, 2020).

Despite its relevance in attracting and encouraging investment in the AEC industry (Architecture, Engineering, Construction), the issuing of building permits is often characterized as complex, error-prone, time-consuming, vulnerable to informal decisions, and non-transparent or arbitrary (Noardo et al, 2020; Shahi, McCabe & Shahi, 2019; Schenk, B., et al. 2024). The hindrances rely on the involvement of multiple stakeholders and the necessity to grasp the government processes’ organizational, legal framework, technological, and information nuances (Fauth & Seiß, 2023; Ataide, M., Braholli, O., & Siegele, D., 2023).

Questionable behaviours emerge in the issuing of a building permit due to its heterogeneous system, heavy workload, and informal and verbally incorporated control procedures (Lagunes, 2021). In Latin America, illegal and unethical practices in the AEC industry are a widespread problem that involves high-level authorities and street-level bureaucrats at all levels of government (Lagunes, 2021). To undermine this challenge, there is a tendency in the digital transformation of the public sector to encompass a digital and smooth exchange of information in the issuing of building permits. It is focused on promoting data-driven digital

processes and implementing technological functionalities in construction projects' planning, design, construction, and maintenance stages (Noardo, F. et al, 2022). The theory is that access to transparent and accurate building project data will enhance the project management process, permit the forecasting of the city development and facilitate the measurement of economic and environmental impact while reducing construction time (Baptista et al., 2024)

This topic is under-researched and under-theorized, besides the number of challenges encountered in the implementation of technology in building permit processes (Fauth & Seiß, 2023). Most of the research is focused on automatizing the building permit approval process by stages like turning rules into code for easier checking (Ataide, Braholli, & Siegele, 2023; Fauth & Seiß, 2023; Fauth & Soibelman, 2022; Siegele, 2023) and not on technology impact in all the subsystems of a building permit. Likewise, there is still a gap regarding the execution of pilot projects and the documentation of the validation stage (Fauth & Soibelman, 2022). Thus, the development of automated checks or software prototypes is not enough if there is no research on how to incorporate them in real-world cases, considering the existence of legal, organizational, and institutional layers intertwined in the issuance of a building permit (Ataide, Braholli, & Siegele, 2023). Specifically, according to the European Network for Digital Building Permit (2024), the research gap is on the technical aspects of building control, the permissions to occupy, and the challenges for digital transformation in the sector. Furthermore, the research regarding the introduction of technology in the issuance of building permits is highly focused on North America and Europe. This is confirmed by Noardo et al. (2022), who also review cases in Asia, the Middle East, and South Korea.

Given this research gap, the following proposal focuses on contributing to the design and validation of digital building permits in Latin America through a case study. The case study is in Peru, as this country has already enacted a path toward a transparent and efficient building permit process with the approval of Supreme Decree NO 146-2023-PCM. The latter was designed by applying a participatory process to determine the AS-IS process flow, resources, and public servants involved in the emission of these licenses. To unify and improve its efficiency, the standardization of 149 different administrative processes of building permits in 1800 Municipalities (PCM, 2023) was validated by Municipalities' representatives, professional unions, private actors, and experts from the Ministry of Housing, Construction, and Sanitation (MVCS).

Despite advancements in the legislative subsystem and the established deadline to implement this updated standardized process, professionals in the field continue to perceive a compliance gap between the current as-is process model used by the province and district Municipalities and the standardized process presented in Supreme Decree No. 146-2023-PCM. Specifically, the discrepancies are perceived in the time required to complete the building permit process, the associated costs, and the Municipality's units involved in evaluating the project's

feasibility. Moreover, according to the Peruvian authorities responsible for overseeing the implementation of this Decree, 763 bureaucratic barriers are still present throughout the lifecycle of this process, generating 50% of the bureaucratic barriers' cost on regional economies in Peru (Observatorio de Mercados INDECOPI 2024). This further reinforces the perception of a public problem in this regard.

Based on this situation, this thesis established as a research goal to design a user-centred enterprise architecture (EA) model, which addresses procedural and technological barriers encountered in the issuing of building permit processes at a local municipality in Peru. This EA will complement an ongoing initiative designed and implemented by the MVCS to monitor the administrative process of building permits. Specifically, the analysis conducted in this research permits the identification of barriers in the technological subsystem of the building permit such as the information asymmetry between municipal authorities and applicants regarding procedural requirements, the reliance on manual and paper-based procedures and the introduction of the Document Management System (SGD) as a parallel rather than a substitutive step. In terms of the procedural sub-system, it is identified that the field of AEC and the process of building permits in Peru faces the prevalence of informal practices and corruption among stakeholders, affecting the legitimacy of the process and reducing trust in the local governments. In response, three functionalities are presented to overcome this barrier, proposing a smart permit framework that can be implemented by other Municipalities to streamline and facilitate the permit request process.

To achieve this research goal, a design science research is conducted applied to a local government in Peru, the Surquillo Municipality, which was selected to design and validate the prototype in collaboration with the General Directorate of Housing and Urban Development Policies and Regulation of the MVCS. This research is expected to contribute a practical and validated solution to address procedural and technological barriers in the issuing of building permits.

At the outset, the research begins with a literature review to identify the core features and challenges of the building permit as a government transaction. This section also explores the role of ICT tools in addressing its limitations. The methodological approach is then introduced, justifying the selection of Peru as a case study by highlighting a gap in the literature concerning the impact of the technology subsystem on the organisational and procedural dimensions of the public service delivery. The fourth section presented an in-depth qualitative analysis based on the testimony of 11 interviewees, whose experiences inform a user-centred problem statement. This is framed using two complementary theoretical approaches: the systemic framework and the TOGAF ADM enterprise architecture methodology. In the fifth section, the designed artifact is detailed across its components: the preliminary phase, architecture vision, business architecture, information system architecture

and technology architecture. This is followed by a discussion of the validation results through the three iterative Design Science Research cycles, assessing how the proposed requirements meet the identified problems. Finally, the conclusion reflects on the research limitations and proposed a future research agenda to continue promoting a digital transformation in the public sector.

2 A systematic approach to study building permits

The AEC industry is well-known as the most delayed sector in terms of innovation (Ataide, Braholli, & Siegele, 2023) and its slow adoption of digital transformation initiatives (Battiski, K., 2022). Besides this reputation, an in-depth review of the literature regarding the issuance of building permits and the introduction of ICT tools enables the identification of different levels of e-permitting systems in municipal jurisdictions.

Considering these findings, this section presents a systematic approach to analysing the building permit system as a form of government transaction, providing a benchmarking overview of practices across Latin America. Furthermore, it outlines the key characteristics of the building permit process and explores how its workflow can be modelled using modelling languages such as BPMN. Then, following a systemic approach, the legislative, organizational, procedural, and technology subsystems of the building permit are described. Furthermore, the literature is categorized to identify common irregularities that could be encountered in these layers. The last part of this section reviews recommendations and hindrances expected in implementing digital building permits.

2.1 The building permits as government transactions

Government transactions are the point of contact between citizens and the access to their rights and the fulfilment of obligations. Some examples of these transactions are requesting a birth certificate, registering a property, or getting a building permit (Roseth et al. 2018). Furthermore, these transactions could be free of charge, while others require paying a fee, which is the case with building permits.

There are two variables used to differentiate government transactions, allowing for a deeper understanding of the challenges encountered in the context of building permits. First, by measuring the complexity of the administrative process, it is possible to differentiate between simple transactions, such as getting the requirements to move, transactions that require handing over physical documents, like the process to obtain an identity card, or complex services. The latter are characterized by the interaction of multiple departments and the constant interaction with the citizens, which is the case of a building permit (Schenk et al., 2024).

Secondly, according to the Inter-American Development Bank (2018), it is also possible to differentiate between four categories of government transactions: registration, certification, verification, obligations, services, and permits. The latter are particularly interesting as they imply the authorization to perform an activity in line with national and international regulations, which positions legal compliance at the centre of the discussion.

Regarding the features of government transactions, the Latinobarometro survey (La Corporación Latinobarómetro 2017)[1] presented a complete overview of government transactions in Latin America and the Caribbean. In this region, governments administered between 1000 to 5000 transactions per year, only at the national level. In the case of Peru, the number of transactions was 4535 transactions per year (IDB-GEALC Survey, 2017). However, besides its relevance and frequency, government transactions are well known due to their vulnerability to corruption and highly disproportionate effects on a poor population. Moreover, they mainly depend on in-person channels; paper-based processes; demand a lot of time on queues, waiting at the counter, filling forms or seeking for requirements and reading information; or take several interactions to be completed (Roseth et al. 2018).

Hence, it is not unexpected that phrases such as “You need another stamp” or “come back tomorrow” have been registered as all-too familiar for citizens (Roseth et al. 2018). Furthermore, authors argued, there are only three options when dealing with difficult transactions: suffer the process, pay a bribe, or give up, which is one of the main causes of informality in these countries (Roseth et al. 2018). Therefore, informality emerges to overcome transaction burdens-high transaction costs or bureaucratic barriers- imposed by public institutions, to achieve higher income (Ramos Navarro 2023; Cristia and Vlaicu 2022). Thus, the level of informality increases with a lack of law compliance, a long time invested in formality, and the complexity of the processes. Specifically, in Peru, the studied determinants of informality are the stifling regulatory regime, the weak capacity of the state in supervising and monitoring (Ramos, M., 2023).

In terms of citizens’ satisfaction with the government transactions, Datum reported that 88 percent of the survey’s participants were satisfied with the services (Datum International, 2019). In terms of the time invested, participants reported waiting at the Municipalities an average of one (01) hour, of which 55 minutes were spent waiting at the counter, while the attention took five (05) minutes (Datum International, 2019). Furthermore, once the citizens receive the public servant’s guidance, 18% of them will return to the Municipality or must refer the request to another entity, which could also take more time, depending on the entity (Datum International, 2019). Thus, in the cases of Ministries, Regional Governments, Programs, the waiting time could reach 30 to more days (Datum International, 2019).

2.2 A systemic approach to building permits

A building permit is a process that involves dialogue between the AEC industry and the public administration field (Fauth & Seiß, 2023). It includes a conjunction of procedures, data, information dynamics, and formal rules applied by public organizations to authorize the

1The 2017 survey included a questionnaire in the Institutions section to capture citizens' experiences with government transactions. More recent surveys conducted by this organization did not include the same questions, making 2017 the only year that provides a comprehensive description of these transactions.

execution and operation of a construction project. The main stakeholders involved in this system are the building permit authority, external experts, neighbours, boards and authorities, and its departments (Fauth et al., 2024). This list of stakeholders could vary depending on the building project and its circumstances; for instance, in some cases, the review stage is performed by a third party, and public authorities only receive the submissions (Fauth et al., 2024).

The building permit process is composed of three general stages: submission, review of the request, and grant of the building permit (Ullah, Witt, & Lill, 2022; Fauth et al., 2024). Other authors described these steps as pre-submission (permitting), permitting, and post-submission (permitting) (Eirinaki et al. 2018). The first stage is to define whether a building permit is needed or not, depending on the type of work that the property owner is requesting. Also, it is required to define the modality of permit, to fill out the application form and supporting documentation, to pay the fee, and to conduct any changes required by the authorities (Eirinaki et al. 2018). During the permitting or submission stage, the applicant sent the permit application, with the fee. Then, the permit is issued once the application is reviewed by diverse stakeholders from the Municipality and Professional College, depending on the building modality (Eirinaki et al. 2018). In a more detailed description, Ataide, Braholli, & Siegele (2023) added a pre-submission stage, submission of the application, formal review, content review, third-party participation, approval, issuance, and post-construction stage. Other authors also supported the division of the pre-check and issuance stage (Fauth & Soibelman, 2022).

Furthermore, a building permit could be analysed by reviewing the subsystems that are interconnected throughout its execution: the legislative, organizational, technological, and procedural ones (Fauth et al., 2024a). These subsystems aligned with the theoretical proposal of other authors who conducted comparative analysis in European countries, considering variances in the legal, cultural, technological, and institutional layers (Fauth et al., 2024b). Following this approach, the discussion regarding a successful digital transformation must include a description of the technology's impact on each of these layers. Also, by illustrating the interconnections related to the building permits, it is possible to determine the overall nature of its complexity instead of focusing on independent stages of the process; the latter enables problem-oriented analysis (Fauth et al., 2024b).

The first subsystem is the *legislative,* which is composed of the government level and the rules or regulations. According to the authors, the complexity of a building permit system varies according to the level at which the regulations are applied (local, regional, federal, or national) and the number of legal texts that are turned into machine-verified code (Fauth et al., 2024a). The latter is exemplified in Fauth and Soibelman's (2022) research regarding the building permit process in Germany and the USA, federal countries that encounter the

challenge of dealing with a high number of regulations at different levels. Plus, the rules could also include international or national standards applied to building permits, increasing their complexity.

The second subsystem is the *organizational,* composed of political, business management, and social aspects. The political aspects refer to the public organizations' structure, such as the number of staff in charge of the process and the assignment of roles into departments, which directly affect the business management aspects (Fauth et al., 2022). Thus, it is not the same to deal with two different departments for Planning and Building, each of them with a limited number of public servants, which reduces their capacity to deal with a high number of applications. For instance, in the case of the UK, the separate planning and technical reviews lead to segmented processes that depend on the effectiveness of communication channels to be conducted smoothly (Fauth et al., 2022). In this regard, the social aspect describes the relationship among the stakeholders, the employee's role in the system, their perception of the process, acceptance of digital tools, skills and knowledge, and working conditions.

The latter is related to the third subsystem, the *technological one.* It refers to the software, hardware tools, or manual and analog-systems that the organization has applied to perform the process. Moreover, data and information are another vital category in this subsystem as they determine which data requirements are needed for efficient communication between stakeholders.

The fourth subsystem is the *procedural one.* On one hand, it distinguishes procedures as those that could be cross-checked by an authority and, in that sense, are easier to digitize. On the contrary, the process is more detailed and regularly implies the application of complex regulations by authorities that could interpret it in different ways. For those reasons, a process would be required to be adapted before starting with the digitization process (Fauth et al., 2022). From an institutional point of view, the procedures could be guided by formal rules like those approved in regulations or laws, and unwritten, informal rules. These are socially accepted rules followed by group and individual behaviour. In this sense, the challenge in code checking is to deal with the rules' heterogeneity and identify them based on the local knowledge and individual experiences of the public servants that form part of the organizations (Brito, Costa, & Ferreira, 2022).

2.3 Irregularities in the issuance of building permits

The research on building permits is also focused on their vulnerability to variations, manipulation, and corruption (Gao, Zhong & Ding, 2024). Thus, in the case of Latin America, face-to-face transactions, the lack of standardized processes, and manual transactions have been demonstrated to increase the level of vulnerability to dishonest behaviour (Roseth, B., et al, 2018).

On one hand, it is possible to identify modifications or deviations of the building law, leading to the so-called non-by-right cases. In these cases, not all requirements are complied with by the applicants, which creates irregularities. According to Fauth and Soibelman (2022), this could occur because of not following the zoning or building code and does not imply illegal behaviour by itself. The non-by-right cases of Germany and the USA building permit processes had been modelled in previous research, identifying that it is more common to find incomplete applications in the pre-check stage (Fauth & Soibelman, 2022). In the case of Israel, the authors called this non-by-right case "inconsistencies or deviations" from the norm, caused by the complexity of the regulation and the subjectivity in which it is applied. According to the authors, this could be considered a cultural aspect of the building permit (Fauth, Bloch, & Soibelman, 2023). Interestingly, one identified trade-off of automation in building permits is flexibility versus timely processes. Thus, automation limits subjectivity, which could be required in the interpretation of legal concepts like "reasonable", "necessary", and "credible" (Gilman, 2020). In those cases, the role of human interpretation and judgment is difficult to replace by automating the rule compliance, especially if it is required to operationalize these concepts. Thus, in those cases where the public servant's discretion is required to determine service eligibility under "necessary" cases, it is vital to question the incapacity of machines capable of replicating this discretion (Dickinson, H., and Yates, S. 2023).

On the other hand, it is possible to identify questionable practices, both illegal and unethical, in the issuing of building permits (Wold, Lædre, & Lohne, 2019). They could be a result of bribery payments or political favouritism to expedite the approval of building permits (Lagunes, 2021). The latter has been researched in the case of local politicians in French cities exceeding 3500 inhabitants, finding that families of major supporters obtain 35% more building permits than the opponents' families (Lévêque, 2020). In Latin America, corruption in the AEC industry is a widespread problem that involves high-level authorities and street-level bureaucrats at all levels of government. Urban landscapes in most Latin American cities present a contrast between buildings that exceed legal height limits and those that comply with regulations. For example, Mexico City presents towers that rose 17 stories above the legal limit, each extra floor costing $150,000 more in bribe payments (Lagunes, 2016); in Lima, the capital of Peru, similar cases are investigated related to buildings exceeding the height determined in the metropolitan regulation.

These irregularities in the issuing of building permits have been defined as anomalies that contravene the regulations (Lagunes, 2021). An assessment of 50 building permit applications in the case of Mexico and Peru permits the identification of four types of irregularities through data, limits, design, and documentation. The data irregularities are mostly related to missing or erroneous data that uncover or misrepresent the real intentions of the builders. This is the most common irregularity, occurring in 40% of 50 applications (Lagunes, 2021).

Irregularities in terms of limits include violations of zoning, height, and constructed space. They are present in a total of 28%, followed by irregularities in the design blueprint. Also, there are irregularities in presenting documentation due to the lack of mandatory documents, and lastly, there could be parking irregularities that violate the parking requirements of local authorities (Lagunes, 2021).

These irregularities can be categorized using the taxonomy proposed by Fauth & Soibelman (2022), identifying that most of them occurred within the legislative layer of the building permit issuance process. Specifically, the category of rules and regulations is highly vulnerable to violations in the specifications of building limits, design of the 2D drawings, and the documentation that is required by the Administrative and Municipal law. Moreover, the origin of these violations could be traced to the organizational subsystem, as they are the result of informal arrangements between stakeholders involved in the process- the public servant and the applicants- to ensure special privileges- such as a speedier and more lenient process (Lagunes, 2021). In this sense, the literature focuses on barriers to guaranteeing law compliance, the presence of well-placed bribes, and political interests.

2.4 Information Technology: recommendations and limitations in implementing an e-permitting System

Information Technology is expected to perform as an organization supportive tool to achieve strategic goals in a more effective and efficient manner, by aligning the business and technology strategies (Saputra et al. 2022). Specifically, their integration into public administration organizations has been discussed in terms of its capacity to enhance accountability, efficiency, transparency and, ultimately, improving both, the back end, internal administrative process, and the front-end service (Ivanova et al., 2020; Rey-Moreno & Medina-Molina, 2016; González et al., 2024; De Lima-Omorog et al. 2018). Specifically, in the issuing of building permits, technology can affect the front-end service, reducing the information asymmetry in government-citizen interaction, where neither side has the information of the counterpart, by increasing the channels for observation and collection of data (Ivanova et al., 2020). This information asymmetry is deepened due to bureaucratic procedures or regulations that depend on technical knowledge and are inaccessible to the citizens. In that sense, the government becomes a monopolist in the field. Public servants are experts on the regulation and business process, in contrast to citizens who are not well-informed, reducing their capacity to be involved in the process (Ivanova et al., 2020; Schenk, Dolata, and Schwabe, 2024).

Specifically, Schenk, Dolata, and Schwabe (2024) collected the testimony of one public officer who pointed out: “I do not want to talk to citizens. I only want to talk to architects. They know their business and understand what to do” (pp. 954). To overcome this barrier,

Schenk et al (2024) proposed an omnichannel approach for service strategy to provide comprehensive personalized channels, interconnected with each other, where information is shared seamlessly. The omnichannel strategy has been analysed as a tool to deal with service provision hindrances by recognizing the interdependency of different channels, which could affect citizens' experience when accessing a public service. In this sense, replacing in-person contact with purely online services could have unexpected results. For instance, in the case of Spain, evidence pointed out that online channels do not replace the traditional interaction of in-person channels; on the contrary, they are perceived as a supplement, not an alternative (Rey-Moreno & Medina-Molina, 2016). In that sense, the existence of different channels that work separately can lead to inconsistencies in the process; for instance, getting diverse responses to the same inquiry.

In terms of the back-end service, there are different names to describe the introduction of Information, Communication, and Technology (ICT) to redesign the building permit process, some of them referring to e-permitting, electronic permitting, e-building, or digital building permits. They are characterized by the creation of a document management platform to connect the public sector with AEC professionals (Ataide Braholli & Siegele, 2023; World Bank & IFC, 2013). According to World Bank Group (2020), 170 out of 190 economies in the world have adopted online building regulations; 97 implemented e-formats to share documents, pre-approvals, and fees; and some others adopted electronic document management systems.

The framework to classify the different kinds of building permits has been studied in academia and the industry, mainly with a fragmented approach due to the number of sub-issues related to the digitalization of building permits (Noardo et al., 2022; Narayanswamy, Liu & Al-Hussein, 2019). With that in mind, this research adopts the classification proposed by Hjelseth (2016) and complements it with the analysis of Shahi et al. (2019) and Noardo et al. (2022), who updated the framework with the integration of GIS in the Automated Building Permits. Thus, the authors assess the technology maturity and level of automation to describe four levels of building permits. The Level 0 or traditional paper-based permit is characterized by the lack of automation. In these cases, the management of information depends on submitting multiple paper copies of drawings and specifications to the relevant departments in the local municipalities. This manner of managing the information led to difficulties in guaranteeing collaboration among responsible agencies and assuring efficiency and transparency (Shahi et al., 2019).

On the contrary, level 1 of the e-permitting system integrated basic capabilities such as the digital submission of 2D drawings, which levels up information management. Level 2 or Automated model-based e-permitting adds the creation of digital models and representations and levels of process automation throughout the e-permitting workflow (Shahi et al., 2019).

Furthermore, a level 3 e-permitting goes beyond the purpose of digitizing the workflow of an administrative process, envisioning an integrated city planning tool that can manage smart city data, city-level planning reviews, and integrated logistics planning (Shahi et al., 2019). These levels could also be used to analyse an incremental evolution of the building permit procedure, considering the process of going from a paper-based procedure to the introduction of an online platform that manages the submission of applications and 2D drawings (Ullah, Witt & Lill, 2022). Then, the path to boost efficiency requires the introduction of technological tools such as BIM or GIS at Level 4 e-permitting. The case of the Tallinn City Government (TCG) adoption of a BIM-based building permit is an example of this incremental digitalization path (Ullah, Witt & Lill, 2022). More cases of sophisticated digital building permits are present in Singapore, Hong Kong, and Finland (Doing Business, 2020).

To accomplish this level of automation and technology adoption, it is required to consider structural changes in the subsystems of the building permit (Noardo et al. 2020). The automated model of building permits integrates the use of automated code compliance checking through a code-checking system. It mainly consists of checking the code against the International Building Codes (IBC). The first step in this regard is to standardize the permitting process and guarantee effective management and sharing of data (Brito et al., 2022). This includes a review of the processes, policies, and workflows of all Departments involved in issuing a building permit to guarantee compliance (Brito et al. 2022). Once it is achieved, the regulation is translated to code using two methods: artificial intelligence (AI) and markup language (Shahi et al., 2019). AI permits text analysis and the generation of logic rules by applying content analysis and automatic classification of the content of text mining algorithms (Shahi et al., 2019; Brito et al., 2022). On the other hand, the second method relies on a hard copy of the rules that could be presented in PDF or HTML to translate them to code (Shahi et al., 2019).

In terms of the technological tools required to digitize the building permit process, the literature highlights the Building Information Modelling (BIM) software. It enables the introduction of digital building models in the life cycle of the built process, from the design to the operation stage (Ataide et al., 2023). Its interaction with the building permit systems has been investigated in cases such as Korea (Fauth & Soibelman, 2022), Switzerland (Vincendon, 2021), Vienna (OPSI, 2024), and Estonia (Klooster, Van Deth, Van Berlo & Meijer, 2019). Due to the open BIM version, it is possible to exchange data among software products of different applicants, including small- and medium-sized enterprises (SMEs), and public servants among diverse public organizations. In this sense, BIM fulfils one fundamental principle required to accomplish digital transformation in the public sector: interoperability (Ataide et al., 2023; Fauth et al., 2024). The latter is the capacity to share data and functions across systems, and it is paramount to accomplish the transformation of the process across the stakeholders involved in issuing a building permit. Moreover, this

technology guarantees a straightforward collaboration and mutual understanding among the stakeholders involved in the AEC field (Fauth et al., 2024). To accomplish this principle, it is required to unify the data type used across all the stakeholders, which is mostly troublesome due to the difficulty in aligning legal frameworks (Ataide et al., 2023). Its use depends on the industry's readiness to implement BIM tools, the availability of information (3D representations of the buildings), the cost and schedules of the projects, material properties, and the relationship among the elements of the project (Shahi et al., 2019). Specifically, to guarantee interoperable solutions, the BIM community applies two building SMART International open BIM standards: the Industry Foundation Classes (IFC) and the BIM Collaboration Format (BCF).

Furthermore, cases such as BRISE-Vienna pointed out the capacity of integrating BIM with artificial intelligence and augmented reality to implement a partially automated verification of regulation (OPSI, 2024). It not only reduced the process time by 50%, but also allows citizens to visualize the construction projects before beginning construction, while streamlining the workflow for public servants in charge of reviewing regulation compliance by encoding rules (OPSI, 2024)

The Geographic Information System (GIS) is an equally popular tool as it integrates geographic data into an analytical model to inform about the entire city and landscape's characteristics. GIS manages digital geospatial data using geometry, topology, and attribute data (Noardo et al., 2022). Its capacity to capture the surroundings of a building project complements the information provided by BIM to check how a planned building would look within existing buildings in the area. Thus, by updating 3D city models, a more accurate checking process could be encompassed, considering the building conforms to regulations before the building permit is approved (Ataide et al., 2023). The use of GIS is aligned with intelligent building systems and smart cities initiatives. Both spatial information systems are integrated with GeoBIM in cases such as Dubai (Ali Ismail & Hamoud, 2021).

Noteworthy, the technology subsystem could be composed of digital features integrated into a one-stop platform. On one hand, the creation of web platforms is vital to conduct monitoring and construction of quality reports with real-time data, which could be represented using dashboards (Bös & Patzlaff, 2016). Moreover, functionalities to include in the platform are the online payment, communication, notification, and submission features; auto-code check, auto-generated checklist, and remote monitoring (World Bank Malaysia Hub, 2020). These tools have been studied due to their capability to decrease time spent on issuing building permits, from an average of 168 to 114 days in 32% of the cases (World Bank Malaysia Hub, 2020).

The online payment functionality is well-known due to its impact on increasing transparency and accountability while reducing the risk of theft and corruption (World Bank Malaysia Hub,

2020). Thus, by automating decision-making, reducing or eliminating interactions between citizens and public servants, it is possible to design public services less prone to corruption (Cristia and Vlaicu 2022).

Furthermore, the introduction of e-formats to submit data by the cloud has proved to reduce the time spent on processing information (World Bank Malaysia Hub, 2020; Shahi et al., 2019). For instance, Kuwait launched an e-submission platform in 2019, which facilitates instant communication through public agencies such as Municipalities, the Public Authority of Industry, the Fire Services Directorate, and private actors. It reduces the time of issuing a building permit from 25 days to 7 days (World Bank Malaysia Hub, 2020). Likewise, another practice is the introduction of technology to guarantee quality control in the construction industry. That is the case in the United Arab Emirates, where the building inspection is conducted by using cameras and drones, reducing the need for inside inspections (World Bank Malaysia Hub, 2020). Other functionalities to be considered are the digital signature and data security solutions, considering that customers' data, construction plans, and personal information of investors are going to be exchanged through this channel.

In terms of the barriers encountered in implementing these ICT tools, the existence of centralized entities to issue and oversee the permitting process is paramount to ensure a successful implementation of the e-permitting systems. Thus, Shahi et al. (2019), by diving deeper into Singapore's case, recognized that a total adoption of BIM e-submissions requires hand-in-hand management of the process conducted by a centralized agency. This management aspect is also highlighted in the case of Italy, which is characterized by its fragmented public administration ecosystem composed of 5500 small Municipalities, each with less than 5000 citizens and different regulations and codes regarding the AEC industry (Fronk, 2021). Moreover, other barriers to consider are the cultural resistance to change, administrative costs, and data-sharing concerns related to the implementation of BIM and the transition process from analog to digital issuing of building permits (Fronk, 2021). To overcome these cumbersome barriers, the role of the government is vital in designing and reinforcing policies and regulations to promote technology adoption in the field (World Bank Group 2020). This is possible through the implementation of national strategies that accelerate its adoption across all government agencies.

Subsystem	Category	Irregularities or bureaucratic barrier	Good practices
Legislative	Rules and regulations	Violations of regulations regarding zoning, height, and constructed space (Wold, J. et al., 2019; Gao, 2024). Heterogeneous rules and regulations across the territory (Deloitte, 2018; Lagunes, P., 2021)	Standardisation (Brito, et al. 2022) Rule interpretation and digitalisation of building regulations (Noardo et al. 2020, Chakaroun and Srinivasan, 2020)
Organisational	Business Management aspect	Complex organisational structure of Units (Shahi, K., et al., 2019)	Centralised model of governance (Shahi, K., et al., 2019)
	Political and social aspect	Local interest of entrepreneurs and politicians (Lagunes, P, 2021).	Rule checking systems (Zhang and El-Gohary; Park and Lee; Brito D. et al. 2021; Brito D. et al. 2022), Blockchain technology (Celik, I. Petri, Y. Rezgui, 2023) Tools: Solibri Model Checker (SMC), Open BIM guidelines.
Procedural	Process,	Heterogeneous and informal processing system (Deloitte, 2018; Fauth, J et al., 2024).	
Technology	Data and information:	Missing or erroneous data regarding the building projects (Lagunes, P., 2021).	Promote interoperability to share data and functions across systems (Ataide, M & Braholli, O; Siegele, D., 2023) Tools: OpenBIM version

Table 1 Subsystems of the building permit process

3 Methodology

This chapter presents the research design, data collection methods, and data analysis strategies employed to design and validate the proposed Enterprise Architecture model. Given the research's focus on creating an innovative and user-centred solution to complex government transaction, the study adopts a Design Science Research (DSR) paradigm through a case study. The selected approach assures an information systems approach for the development of the artifact through iterative design, demonstration and evaluation of the proposal.

The selection of a Design Science Research (DSR) paradigm responds to the nature of the research goal: *design a user-centred enterprise architecture model which addresses procedural and technological barriers encountered in the issuing of building permit processes at a local municipality in Peru*. It proposes the creation of a prototype, in the form of a model, method, construction, or installation, that enhance the issuing of building permits (Vom Brocke, Hevner & Maedche, 2020). The DSR has been previously applied to create innovative artifacts to face real-world problems by proposing a blueprint of activities to answer a research question (Bhattacharjee, 2012; Vom Brocke et al., 2020; Henriques & O'Neill, 2023).

In this case, the nature of the research is fundamentally a problem-solving approach informed by Information Systems tools and the experiences and expertise of final users. This means that the prototype is based on existing solutions or processes. In terms of its contribution, following Gregor and Hevner (2013), the research project contributes to the design theory by dialoguing with the literature regarding the role of technology in fostering efficiency in the issuance of building permits and determining its main challenges to be implemented in a real-world case study. Moreover, this thesis contributes to generating design knowledge (DK) about how Information Systems (IS) could help to achieve desired government goals by designing database systems or modelling new business processes (Vom Brocke et al., 2020).

The DSR conducted in this thesis is composed of six steps: problem identification and motivation, defining the objective of the solution, design and development, demonstration, evaluation, and communication (Vom Brocke et al., 2020). Each of these stages, according to Sonnenberg & Nom Brocke (2012), must go through a feedback loop to determine if the problem identification meets requirements such as novelty and feasibility. Other requirements to consider are a simple, clear, and consistent prototype; the solution instantiation should be easy to use, true to real-world cases, and robust; and the evaluation should be effective, efficient, and externally consistent (Sonnenberg & Vom Brocke, 2012).

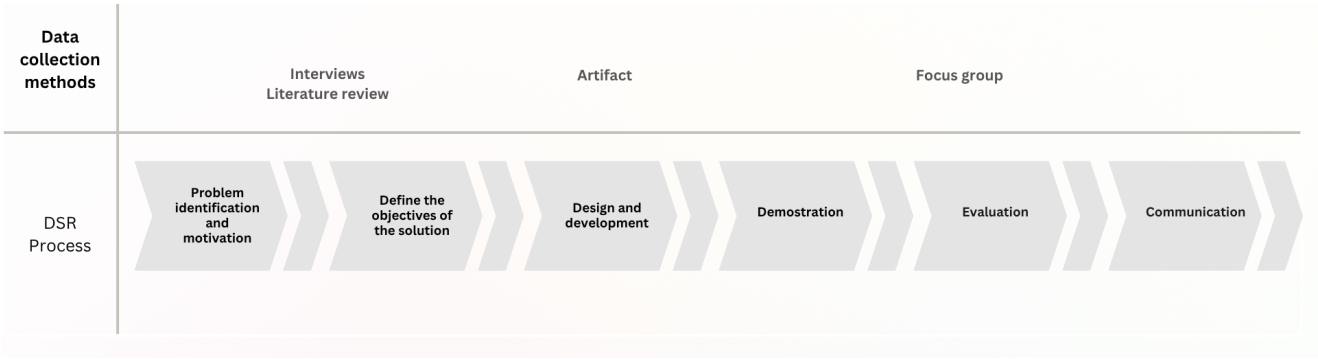
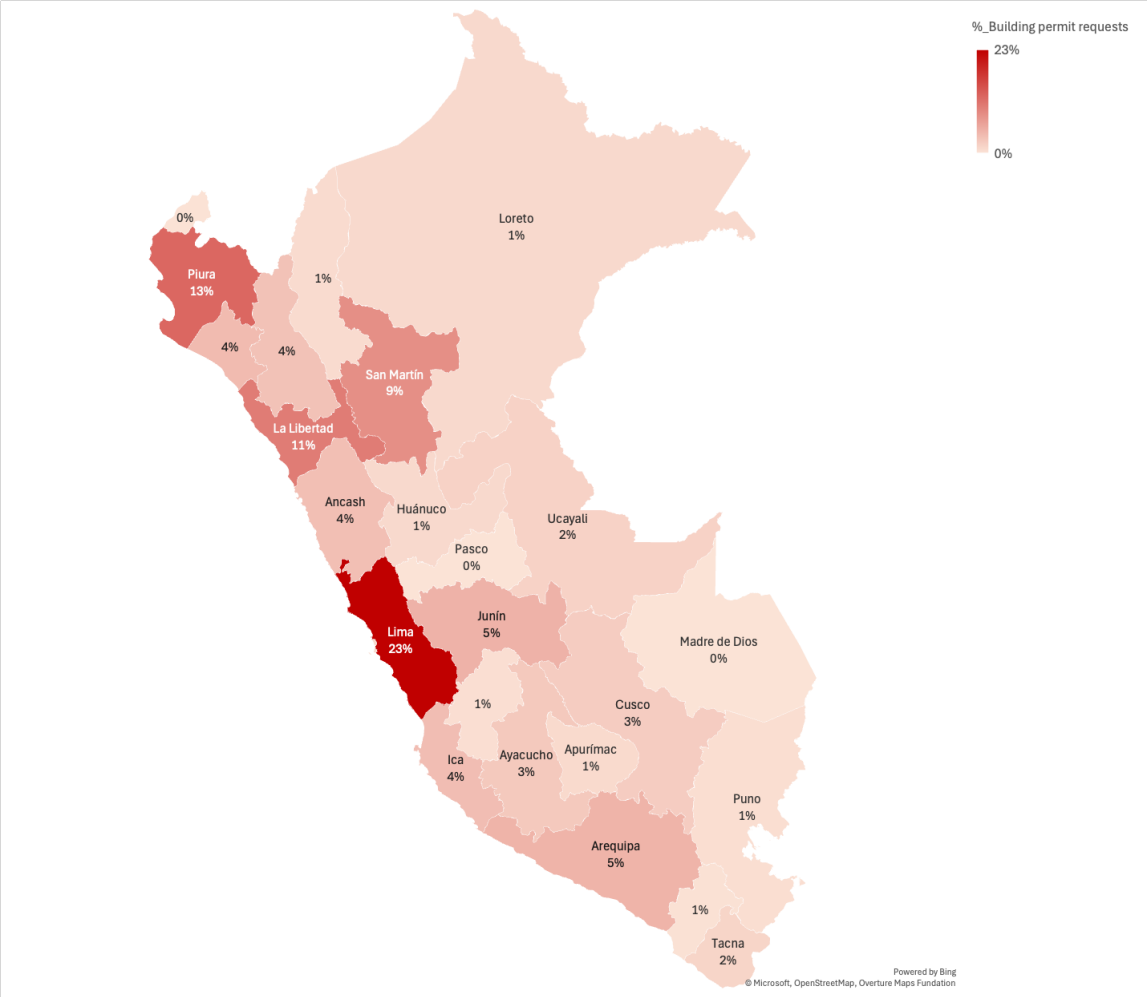


Figure 1 DSR methodology process and data collection methods

The first stage of the DSR process involves identifying a relevant problem and articulating the motivation behind addressing it, thereby establishing the significance of designing a solution for the selected government transaction. In that sense, the fieldwork must substantiate the existence of a research-worthy problem that is not well analysed, creating a gap in the knowledge that could be filled by the research results (Mandviwalla et al., 2024). The selected problem must be present in a problem statement that demonstrates that it is significant, researchable, and relevant. This is required as "not all problems are research-worthy, and not all research-worthy problems are appropriate to apply a design research method" (Mandviwalla et al., 2024, p.169).

For the analysis of the public problem, it was vital to select a case to study. Peru was identified as a representative case study of a favourable environment for the implementation of a digital tool in the AEC field. Indeed, an analysis of the citizens' preferences pointed out Peru as a country with *high acceptance of digital tools among citizens*. According to the Latinobarometro survey of 2023, more than 50% of all survey participants strongly agree or agree with using online tools as payment tools. In terms of the building permit process, Lima City outperforms the Latin America and the Caribbean average in variables such as the number of procedures, time (days), cost (% of warehouse value), and the building quality control index[2] (The World Bank, 2020). For instance, Lima's process requires 44.2 fewer days and costs 1.9% less than the warehouse value, while achieving a margin of four (04) points above the regional average of quality control results (The World Bank, 2020). Furthermore, according to the National Registry of Municipalities (RENAMU), Lima is the region that received more requests for building permits in 2024, equivalent to 23% (8,364) of all the requests registered in that period (See Figure 2).

[2] This index assesses the quality of regulations, the strength of the control and safety mechanisms, liability and insurance regimes, and professional certificates required to access a building permit approval (The World Bank Group, 2020)



Source: INEI, 2024

Figure 2 Percentage of building permit requests per region in 2024

Secondly, Lima is recognized as the best department to start a business in Peru, mainly due to the quality of information management in administrative procedures. Key processes include the issuance of building permits, property registration, and business openings (The World Bank, 2020). Given these factors, Lima fulfils institutional, organizational, and economic criteria of quality, providing the foundation required to design an EA model to digitise the building permit process.

Once the city was selected, a collaboration proposal was extended to the General Directorate of Housing and Urban Development Policy and Regulation of the Ministry of Housing, one of the stakeholders involved in the design of the Supreme Decree No. 146-2023-PCM. The result of this discussion was to determine that the sector required a digital tool that enhanced their ability to promote the standardization of the building permit process. Furthermore, considering the plethora of differences among local governments in Lima, it was concluded that the most effective approach to developing an accurate tool was by selecting a single local

municipality where the prototype could be designed, prototyped, and validated. This setting would allow for the unravelling of interlocking challenges and the identification of context-specific needs. In this sense, the main features of the selected local government were (1) the political willingness to participate in the research project, (2) to have access to a pre-existing Digital Document Management System, and (3) to receive more than 20 building permit requests per month.

With this selection in mind, the problem identification and motivation stage were focused on the applicant experience and the public administration's perspective of Surquillo municipality stakeholders, which were modelled in an as-is business process to deeply understand its particularities and bottlenecks. The fieldwork started in November 2024 until May 2025, by conducting 11 semi-structured interviews to collect the experience of citizens and architects dealing with the process of requesting a building permit. Moreover, a direct observation was conducted as a data collection technique to "look over the shoulder" and determine the main dynamics among stakeholders involved in the issuing of building permits (Recker, 2021). It also allows a thorough description of the municipality's infrastructure, which is vital considering that the process is currently conducted only in person.

Role	Interviewee code
Applicant (AP): Architects or engineers with over two (02) years requesting building permits	AP_01
	AP_02
	AP_03
	AP_04
	AP_05
Public Servant (PS): Officials who process, review, or approve building permits	PS_01
	PS_03
Deputy Manager	PS_02
Technical Supervisor of the Commission for the Elimination of Bureaucratic Barriers	TS_01
	TS_02
Professional College representative	PC_01

Table 2 List of interviewees

In terms of data analysis, the interviewees' testimonies were coded to inform an as-is process model. Coding is a data analysis technique that allows the reduction of qualitative data to meaningful information aligned with conceptual categories that are relevant for the research

goal (Recker, 2021). In this case, the tags or labels applied are used to differentiate among stakeholders, business rules, and the layers of the building permit: legislative, organisational, procedural, and technology. Once all interviews were analysed, the data informed a Business Process Model and Notation (BPMN) of the as-is process.

The Business Process Model and Notation (BPMN) modelling language was selected for modelling the process due to its widespread use in both academia and organizations (Cruz et al., 2012; Fauth & Soibelman, 2022). The BPMN provides an overview of the process flow conducted by stakeholders involved in the process, including the business rules presented in each step of the process. Moreover, the messages exchanged among the stakeholders- the property owner, the building developer, and the public organisations in charge of granting the building permits- are visualized.

Once the information was collected and analysed, the second stage of the DRS process is the identification of the objectives to design the solution. Specifically, three main bottlenecks were highlighted from the as-is process model. Hence, each of the identified problems informed the objectives of the research and guided the ideal-to-be model.

The third stage of the DSR process, design and development of the artefact, started in May 2025 with one interview with a Specialist of the General Directorate of Housing and Urban Development Police and Regulation of the Ministry of Housing, who was questioned around the proposed requirements introduced in the to-be-model to determine their viability. After collecting the feedback, the artifact was designed. It is an enterprise architecture model of a digital building permit- Level 1 in digital building permits composed by three requirements. It aims to deliver the service of building projects' submission management by effectively introducing ICT tools and fostering a process of digital transformation in the Surquillo municipality. The framework selected for this stage is the TOGAF ADM, which fosters a complete assessment throughout the components of the enterprise, focusing on the alignment of the architecture vision, the business architecture, information systems architecture and technology architecture.

The three proposed requirements are tested to assess the impact of ICT tools in the Architecture, Engineering, and Construction (AEC) field. This corresponds to the fourth stage of the DSR process: the demonstration phase. Since the introduction of ICT in the building permit process is a contemporary phenomenon, the applied theoretical framework required an exploration of the interconnections among all subsystems within a real-world context. Unlike experimental or historical research, the case study approach acknowledges the vital role of context shaping the research outcomes (Yin, R.K. 2018). For the validation, a prototype of the three requirement was developed to determine the effectiveness, efficacy, feasibility and completeness of the proposal. With that aim in mind, a no-code and interactive prototype was created using FIGMA to support the front-end experience of public servants, architects and

engineers interacting with the platform (See Appendix 1). To assess the end-users' experience, three DSR cycles were conducted organized in four focus groups- one (1) virtual and three (3) in person- as a data collection technique. In total 17 participants (See Appendix 8) shared their experiences in these focus groups discussing about pertinence of the proposal and potential impact on digitizing the building permit process. The participants were classified in five (05) stakeholders groups: public servants from the Surquillo Municipality (3), public servants from other municipalities (4), experts from the Ministry of Housing (2), applicants (7) and one (01) representative from the Arquitects' College.

This validation tool was selected due to its capacity to gather users' contributions about the functionality and usability of the artifact; while it is cost-effective, flexible, and the most effective tool to interact directly with the end-users (Henriques and O'Neill, 2023; Stewart and Shamdasani, 2015). It is composed of a process to collect the in-depth feedback of end-users, fostering the discussion that reveals perceptions, preferences, and concerns regarding the functionalities of the prototype. To guarantee neutrality throughout the process, it is paramount to avoid pressuring participants to reach consensus, nor to confirm the accomplishment of the research objectives. For that purpose, a questionnaire was developed, including open-ended questions to allow participation without boundaries or guided responses (Henriques and O'Neill, 2023).

The analysis of the information collected during the focus groups is based on a multimodal approach. First, a review of the audio recordings is conducted to capture comments, explanations, and attitudes of the participants while interacting with the artifact. In addition, a non-verbal analysis is included from an ethnographic perspective, which includes the observation of non-verbal behaviours such as gestures or facial expressions that could embody the implicit attitudes and engagement level with the proposed prototype.

Regarding the limitations of the methodological approach, even though the theoretical framework captures the complexity of the building permit systems- by considering its technological, legislative, procedural and organizational layers- the use of a single case study may lead to an oversimplified representation of the problem. This limitation, often referred to in the literature as an oversimplification of the administrative process which can obstacle the nuanced interdependencies inherent in such systems (Mandviwalla et al., 2024). Moreover, even if the complexity is accurately framed, one weakness of the methodology is that it requires time and effort to be potentially implemented in other cases, which could discourage its adoption (Mandviwalla et al., 2024). Other concerns about the case study research are related to its rigor, as evidence shows some sloppy research, lacking systematic procedures, affecting the quality of findings and conclusions of single case studies (Yin, R.K. 2018).

Lastly, the use of AI-tools, particularly Open AI's ChatGPT and Grammarly, support the writing refinement and translation of the forms and regulations from Spanish to English. In

this way, it assisted polishing the academic writing, and ensuring clarity in the technical and complex translation of construction sector vocabulary.

4 The case study: the as-is Peruvian building permit process

In this section, the analysis is focused on exploring the key features of the Peruvian building permit process by proposing a research alignment of the systemic framework previously described in the literature review with the layers and phases of the Open Group Architecture Framework (TOGAF), specifically its Architecture Development Method (ADM).

TOGAF, as an Enterprise Architecture framework, has been previously applied to design and implement information technology in public organizations, demonstrating notable improvements in efficiency and effectiveness (Saputra et al. 2022; Omari et al. 2024). Simultaneously, the systemic framework used to analyse building permits—comprising legislative, organizational, procedural, and technological subsystems—enables the alignment of this research with comparative studies conducted in other regions. This increases the external validity of the findings and facilitates future cross-national analyses considering legal, cultural, technological, and institutional variations (Fauth et al., 2024b).

The integration of both frameworks provided a structural foundation for assessing the as-is model of the Building Permit Process and informed the subsequent design of the to-be model. It enables a comprehensive diagnosis of subsystem-specific challenges and supports the identification of targeted ICT-based functionalities to increase efficiency, traceability, and transparency of the process.

Subsystem (Theoretical Framework)	TOGAF ADM Correspondence	Peruvian case study
Legislation: legal norms, decentralization, national vs. local regulation and inconsistencies	Preliminary Phase and Architecture Vision	Law No 29090: Law for the Regulation of Urban Land Subdivision and Building Construction Law No 27972: Organic Law of Municipalities determines that the issuing of building permits falls under the jurisdiction of the district and province municipalities Supreme Decree No 146-2023-PCM: Approves standardized administrative procedures and an exclusive service for urban land subdivision licenses and building permits, whose processing falls under the jurisdiction of municipal governments Law for the Modernization of Public Management (No. 27658): National Policy for the Modernization of Public Management
Organisation: structure, roles, coordination across units and governance bodies	Business Architecture	Decentralized and multi-level governance structure
Procedure: formal and informal workflows, discretion and documentation issues	Business Architecture and Application Architecture	Informal practices and arrangements between stakeholders
Technology: tools used, data entry and flow, document handling, IT readiness	Information Systems Architecture and Technology Architecture	Manuel and paper-based building permit process

Table 3 Alignment of building permit subsystems with TOGAF architecture layers

4.1 Legislative subsystem

According to the literature, to determine the complexity of the building permit system in Peru it is necessary to review the level on which the regulations are applied (local, regional, federal, or national), and the number of legal texts that are turned into machine-verified code (Fauth et al., 2024). This includes not only national regulations, as there could be international standards that affect the building permit system in the case study.

The issuing of building permits in Peru is regulated under Law N 29090, which describes the administrative process workflow required to acquire an urban and building license. According to this regulation, a building is a construction that fosters people in activity, including fixed and complementary facilities attached to it. Specifically, those building projects that require a license to be executed are the construction of a new building, expansion, renovation or remodelling, refurbishment, historical preservation, fencing system, or the demolition of a building (Congreso de la República, 2019). Notably, the regulation to grant building permits describes four (04) modalities of the process, which vary according to the dimensions, use, and the activities conducted in the property.

Modality A, or automatic license with professionals' sign, is applied for the construction of a single-family, dwelling of up to 120 square meters; expansion or renovation of a single-family dwelling; construction of fences exceeding 20 meters length; demolition of buildings of up to three (3) floors' height; minor activities or expansion and renovation. Moreover, Modality A building permit is required for the development of public investment projects, public-private partnerships, or private concessions; military-related works undertaken by the Armed Forces; and buildings associated with programs promoted by the Housing Sector (Congreso de la República, 2019).

Modality B building permit is granted after the review of the Municipality or the prior evaluation of the urban reviewers, and it is applied in cases of building project modification or projects with an expired approval period; and single-family or multi-family housing, or residential condominiums, with a height of no more than five (5) floors and a total roofed area that not exceeds 3,000 square meters. Additionally, there are included the expansion or renovation, fences, demolition of buildings up to five (05) floors, and those cases of buildings that fit under the Modality A description and decided to add the construction of semi-basements and basements. Moreover, buildings that are considered National Cultural Heritage must be granted with a modality B of building permit to perform any modifications.

In the case of the modalities C and D, the level of complexity increased as they required the review of two (02) representatives of the Architects' Professional School, and three (03) from other Professional Schools. On one side, Modality C regulates the construction of multifamily housing, townhouses, or condominiums that include multifamily dwellings exceeding five (05) floors or total roofed areas of more than 3,000 square meters. Furthermore, it includes those cases of commercial, cultural, entertainment, and performance venues' buildings that do not exceed the maximum roofed area of 30,000 square meters. On the other side, the modality D focuses on industrial buildings that exceed thirty thousand (30,000) square meters of roofed area, either individually or collectively. It also includes marketplaces outstripping 15,000 square meters of roofed area; and buildings for educational, transportation, healthcare, and hospitality purposes; and fuel sales establishments.

This regulation also determines the number of stakeholders involved directly in the issuing of building permits. This includes the property owners; the urban enabler, who oversees executing the work, and the professionals responsible for the project-architects, civil engineer, sanitary engineer, electrical or electromechanical engineer. Other actors include the urban developer, the construction's responsible party, and the technical commission that, in its function of expert body, issues binding opinions to grant or deny the building permit.

In terms of the government's level at which the regulations are applied, according to Law N 27972, the Organic Law of Municipalities, this administrative process is led by district and provincial Municipalities. Article 92, regarding the issuing of building permits, pointed out that all construction, rebuilding, conservation, refurbishment, or modification of a property requires a building permit that must be granted by the province or the district municipality, depending on the property's location. Furthermore, the building projects must be aligned with each of the urban development plans of the district or provincial municipalities, depending on the case. This regulation determines that the building permit processes and their cost vary according to the service provided by the Municipality, which levels up the complexity of the process, considering that Peru has 196 provincial municipalities and 1676 district municipalities.

At the national level, the Ministry of Housing, Construction, and Sanity (MVCS) is the governing body of the AEC sector, in charge of designing, regulating, and implementing national policy on housing, promoting construction, and urban development. Considering its functions, the MVCS led the design and approval of the Supreme Decree No. 146-2023-PCM in 2023, which standardized 149 administrative processes and services of building permits. Thus, after a co-creation process with Province and District Municipalities, the MVCS presented a version of the optimal workflow (TO-BE model) to review and grant building permits. This regulatory instrument is aligned with the Peruvian framework for promoting modernization, which is composed of the **N**ational Policy for the Modernization of Public Management and the Law for the Modernization of Public Management (No. 27658). As the Technical Secretary of the Commission for the Elimination of Bureaucratic Barriers pointed out, the goal of this instrument is to standardize the process for all municipalities, as currently there is no consistency or predictability around the building permits' requirements over the thousands of Peruvian municipalities (TS_01, 2025; TS_02, 2025). Thus, considering that each municipality has diverse logistical capacities and the cost of the administrative process, at least the government must ensure that the requirements are the same (2025).

In this way, the legislative layer of the building permit system in Peru is described as highly complex due to the involvement of different entities, at local and national level, which regulates the process according to project's size and use, classifying building permits into four modalities (A to D). It also determines the participation of multiple stakeholders aligned

under the local urban development plans and municipality's jurisdiction. Given the existence of 196 provincial and 1,676 district municipalities across the country, this leads to high variability in cost, structures, procedural steps, and service capacity, thereby increasing systemic complexity. Despite several attempts to standardize the process, inefficiencies remain deeply entrenched.

Furthermore, despite its technical sophistication, none have been translated into machine-verifiable code. As of 2025, Peru has begun developing a Digital Legislative Repository, systematizing regulations since 1904[3]. Nonetheless, this represents only a preliminary step; significant challenges remain in digitizing the legislative framework and enabling automated regulatory enforcement in permit issuance.

4.2 Organizational subsystem and governance structure

The second subsystem is composed of political, business management, and social aspects. In this regard, this section describes the main features of the Surquillo Municipality to determine how its political, public management, and social characteristics affect the issuing of building permits.

The Surquillo Municipality is in the central and southwestern area of Lima, which is mainly known due to its commerce and services' diversity, such as property and rental ones. Furthermore, the district has an unplanned urban growth due to other districts' development. Consequently, its territory occupation is characterized by a diverse and unplanned growing process, leading to the creation of a semi-industrial and commercial district, where most of its population came from other cities of Peru. According to the last National Census (2017), the estimated population of Surquillo for 2025 is 91,023 inhabitants, which means 221 inhabitants per hectare.

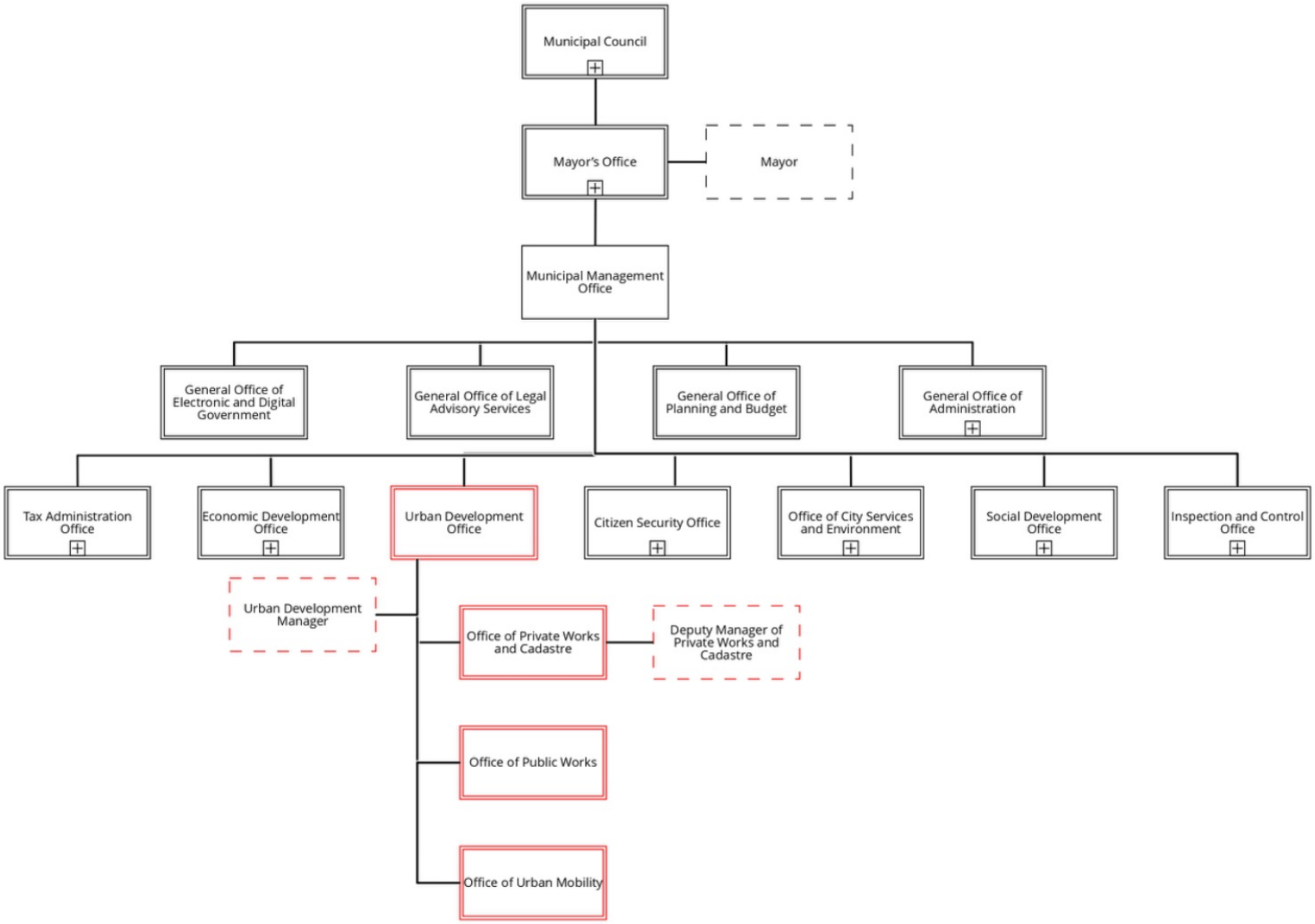
In terms of its public organizations' structure, the Municipality of Surquillo is composed of six (06) Units, one of them in charge of Urban Development (See Figure 3). The Unit of Urban Development is the line body that oversees the correct use of land, according to social, economic, cultural, and environmental development strategies. It is composed of three Subunits: private work, private work and cadastre, and civil defence. The Sub-Unit of Private Work and Cadastre is the office responsible for guaranteeing the correct use of the land by granting building permits, authorisation and certificates to construct in the district, following the National Building Regulations.

The Deputy Manager of the Sub-Unit of Private Work and Cadastre is an architect with over 17 years of experience leading the building permit process in local governments (PS_02, 2025). Thus, she has worked in eight (08) different municipalities in Lima, and this is the

[3] Access the Digital Legislative Repository at: https://www.leyes.congreso.gob.pe/

fourth time she is leading a Unit in the urban development field (PS_02, 2025). This experience complements her profile as she has in-depth knowledge regarding how the issuing of building permits works in practice and which common barriers need to be overcome. Furthermore, during the design of the prototype, she has participated actively, creating and validating the prototype, allowing in-person visits to the Sub-Unit Office and the observation of the regular daily activities of the public servants who work in her team. This proves the political willingness to introduce ICT tools in the selected case study.

Another factor to consider in the description of the organisation is that there is only one in-person information channel at the Municipality, managed by a staff member with no background in architecture or engineering. As described by an interviewee who is currently working at the Sub-unit, the public servant assigned to this role cannot be dismissed due to the conditions of their employment contract; as a result, he/she was designated to the front-facing role of assisting applicants, despite lacking technical expertise (PS_02, 2025). A key consequence of this decision is that, in those cases in which the applicant requests specialized or technical guidance, one of the two public servants responsible for reviewing building files must interrupt their tasks to provide support (PS_02, 2025). This compromised the core responsibilities of the technical public servants and generated more delays in the overall permit review process.



Source: Municipalidad de Surquillo 2023

Figure 3 Organigram of the Surquillo Municipality

Furthermore, after applying participant observation (PO) as a data collection method, it was possible to have a deeper understanding of the resources and infrastructure of the Municipality, which could affect the applicant's experience throughout the process of getting the building permit. The first factor that catches the attention is that the Sub-unit of Private Work and Cadastre has only one public servant in charge of answering the applicants' questions. Furthermore, as is presented in Appendix 2 the information exchange is not fluent as there is a wall of glass that separates the public servant from the applicant, and there are a significant number of papers stuck to the glass. The latter limits eye contact among actors while trying to provide all the required information in a disorganized and overwhelming manner. From a user-centred perspective, this setup creates an impersonal and confusing experience, especially for first-time applicants, who are not familiar with the technical vocabulary used by public servants. In other words, the applicant faces physical and communication challenges when looking for information at the Surquillo Municipality.

4.3 Procedural subsystem and informality in process execution

In this section, it is described the as-is application of the previously described regulations, Urban Land Subdivision and Building Construction Law, and the Supreme Decree No 146-2023-PCM. Specifically, to describe the process in detail, the testimony of 11 architects with over two (02) years of experience dealing with the process of issuing permits in Lima was analysed.

The process for issuing a building permit begins with the property owner, who decides to initiate a construction on her property. According to Law No. 29090, any project involving a new building, expansion, renovation or remodelling, refurbishment, historical preservation, fencing system, or demolition requires a license before execution. For the first five project types, given their legal implications and the technical complexity of the requirements, the property owner must seek professional guidance at an early stage. This is essential to identify the type of building project permitted on the property, the next administrative steps, and the documentation required by the Municipality.

In this first step, as presented in the BPMN model (Figure 4), the property owner must decide which kind of building project is looking for. However, the concepts described in the regulation (Law No. 29090) are too technical and complex to decide in a seamless manner which one to request. For that reason, applicants required to conduct a in-depth research of the information in online and in-person channels.

Regarding the online channels, even though the Peruvian government has offered access to a Unique Digital Platform (Gop.pe) to consolidate municipal information in a single platform, the information provided regarding building permits is outdated. Thus, the last update was

recorded in July 2021 when the Supreme Decree No. 146-2023-PCM was approved in 2023. Moreover, information is incomplete as it only describes the Modality A requirements, not giving access to the other three modalities of building permits. Furthermore, not all local governments have fully integrated their services' information into the platform, which is the case with the Surquillo Municipality. In other words, if the building developer searched in Gop. pe, they would not find the complete information.

The second channel to review the information online is by logging in to the Municipality Digital Platform, which offers the option to manage a procedure only by creating an account and submitting a request. Thus, there is no option to review the requirements online; instead, the available online functionalities are limited to paying taxes, starting a process by filling out a form, or tracking previous requests online.

As one of the interviewees mentioned:

> *"Even though the municipality uploaded information in their website, it is common that it is outdated or complex enough that, when you try to submit your project file in-person, it is not fulfilling all the requirements because you do not understand it... Not only that, but it also happens that the public servants are misinformed about the latest updates on the regulation, leading to delays in the submission stage" (AP_02, 2025).*

A third option mentioned by interviewees is to review the Single Text of Administrative Procedures (TUPA), a municipal regulation that includes all the approved administrative processes, detailing requirements and processing fees under the jurisdiction of Surquillo Municipality (SP_02, 2025; PS_03, 2025; PS_01, 2025). It is a PDF document of 144 pages in length that, with a formal and technical language, which describes over 50 different administrative processes, including the building permit one.

The last option, which is the only reliable source of information, is the in-person channel. Thus, considering the different modes of building permits, the applicants prefer to go in person to the Municipality, not only to review the requirements, but to confirm with the public servants which workflow to follow during the submission stage. Nevertheless, the in-person channel also presents barriers and bottlenecks that set back the building permit process and affect the building developer experience due to the deficient infrastructure and the lack of professionals providing information to applicants.

Here, the Sub-Unit of Private Work and Cadastre is staffed by a single public servant responsible for attending to applicants' inquiries, resulting in long queues during peak hours. As shown in Appendix 3, the Municipality waiting area is not adequate considering this work dynamic as it lacks air conditioning and relies on a single fan to mitigate the high temperatures. Additionally, while waiting, building developers have access to a whiteboard displaying information related to the building permit process. However, the information is

presented in a disorganized and cluttered manner, making it difficult for applicants to locate the specific details they require.

Once it is the building developers' turn, they encounter a barrier in the process: the public servant attending in the Office of Citizen Services and Document Management (MAC) often lacks specialized knowledge in architecture or construction. According to the interviews, due to the limited institutional resources, it is common for Municipalities to assign staff with general experience in documentation handling to solve applicants' inquiries. Meanwhile, specialists are working in the background, focused on reviewing the project files rather than engaging directly with the applicants (PS_02, 2025). For that reason, in this pre submission stage, the property owner deals with a first barrier due to the lack of accessible information.

In case the property owner has the information to overcome this first barrier, then he/she must determine if the type of construction requires a building permit and which specific modality (A, B, C and D). Depending on the type of construction, only in the case of new building, expansion, renovation or remodelling and refurbishment; the complexity increases, and he/she must contact a building developer, a certified architect or civil engineer. They oversee the project design and gather technical documentation required by the Subunit of Private Work and Cadastre to fulfil with zoning regulations, land-use compatibility assessments, and application requirements before submission.

For that purpose, the main information the applicant requires, before starting designing, is the *Urban Planning Parameters.* It outlines the technical and regulatory specifications for building construction aligned with the National Building Regulations and rules of each municipality (GOP.PE, 2024). Specifically, it specifies the type of building that can be constructed in the property, its permitted uses, maximum height (number of floors), the minimum percentage of open space, and the number of parking spaces allowed (GOP.PE, 2024). According to the interviewees, most of property owners, are not aware of this certificate, which is worrisome given that it determines which type of building they are allowed to construct on their property. Some owners approach building developers with proposals that do not comply with national and regional regulation. Therefore, as pointed out by the interviewees, some owners choose to build without a license and even resort to paying bribes to obtain a future Construction Compliance Certificate that retroactively certifies the compliance with the national regulation. This certificate is a prerequisite for obtaining a Factory Declaration, which certifies the legal existence of the building and enables the legal independence of the property. In other words, without a building license, property owners became part of a cycle of informality, which not only hinders their ability to register the property but also prevents them from selling in the future.

With the information of the *Urban Planning Parameter*, the building developer begins designing the preliminary project to be presented to the property owner for their approval.

Once it is approved, the building developers must contact other specialists to complete the design of the building project, considering the sanitary, electrical, and/or structural features of the project, in case it is required.

Then, the building developers must review all the specialists' documentation to guarantee compatibility throughout all specialties' drawings. Furthermore, the building developer must ensure that the project file has all the requirements of the Municipality. In this stage of the process, the building developer faces the second barrier of the process as they required to submit all this information in person and in paper, investing more time and costs to guarantee fulfilling with all the requests of the Municipality.

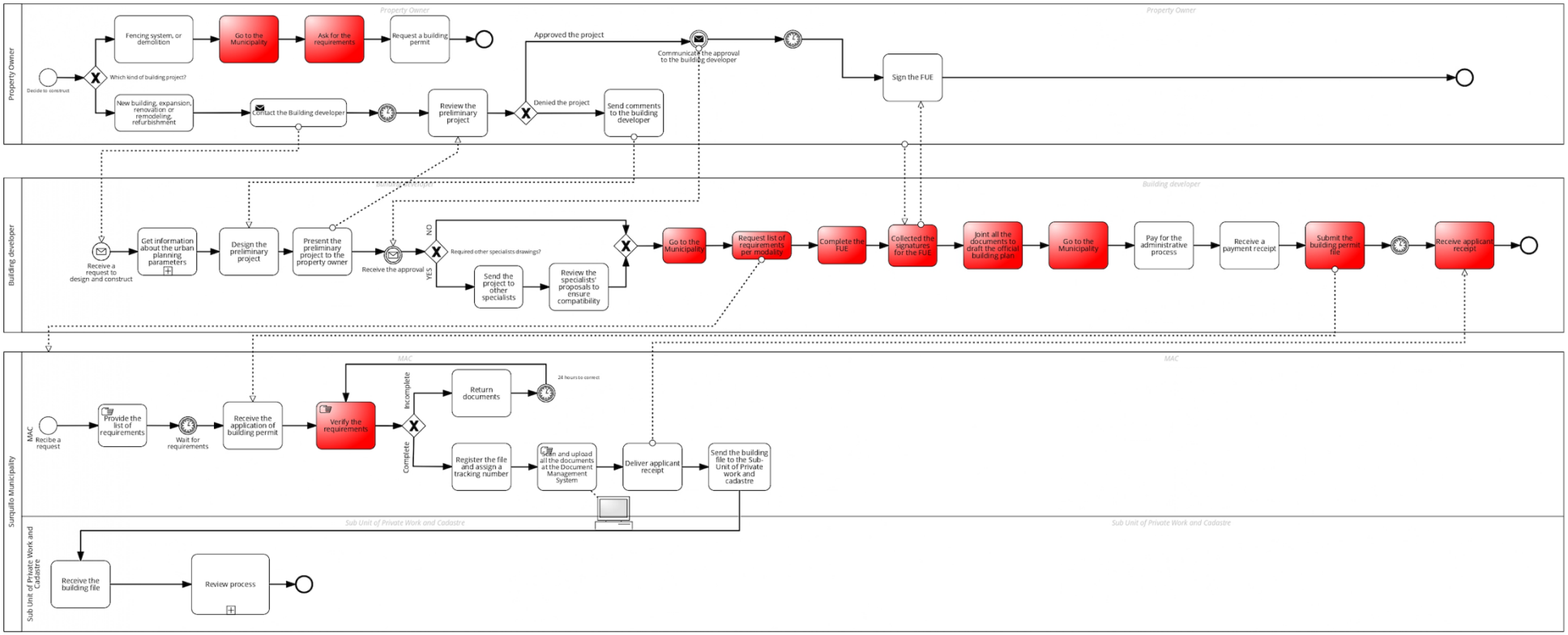


Figure 4 AS-IS Building permit process model

Note: *The BPMN diagram highlights the repetitive tasks and bottlenecks of the as-is process in red.*

When the building developer is sure of fulfilling all the requirements, they submit the building project at the Municipality, including three (03) copies of all the documentation printed and signed by all the professionals involved in the project and the property owner. Plus, they must include one (01) digital version of the file, which is collected by a CD or a USB. As soon as the building developers submit their building project, a third entity is included in the process: the Surquillo Municipality.

In the Office of Citizen Services and Document Management (MAC), the public servants receive the project files, check requirements, and register the application; they cannot solve specialists' inquiries. For that purpose, in the case of a building permit C or D, the applicant must request an appointment with the review commission, which could take between one (1) to two (02) weeks more (AP_02, 2025). Other interviewees mentioned that Municipalities hired professionals with no experience in the field, some of whom have not even graduated (AP_01, 2025). Therefore, building projects are continuously bounced back repeatedly even though applicants addressed the observations (AP_03, 2025).

Considering their experience, the interviewees mentioned that Municipalities required a differentiated role assignment that increased their capacity to appropriately solve users' inquiries and solve the information gap that is presented in this stage of the building permit process. The AP_02 interviewee mentioned, as a good practice, the creation of a platform that gathers all information and processes regarding new construction projects, and a functionality to filter among types of constructions like remodelling (2025).

In this way, throughout the first and second stages of the building permit, the problem is framed in terms of an information asymmetry between the Municipality and the applicants. This problem has been identified previously in the analysis of building permit processes in German municipalities (Schenk et al., 2024). According to the authors, the public discourse around the process highlights the lack of transparency, the arbitrary decisions, and the time-consuming steps to be granted a building permit (Schenk et al., 2024). Thus, only 4% of municipalities presented information in a citizen-friendly manner, including explanations about the specific terms (Schenk et al., 2024). The negative effect of this information asymmetry is that it positions the building owners in a legally vulnerable situation, as they must trust the building developer's capacity to follow the regulations to avoid any kind of violation or fines.

Once the building project has been submitted to the Municipality, the post-submission stage starts. According to the regulation, applicants may receive up to eight (08) rounds of observations on their projects. If the limit is exceeded, the applicant must resubmit the entire project file. In this sense, interviewees described a process of reviewing and

resolving observations that potentially takes between one to two years (AP_01, 2025). The reason for these delays could be attributed to various factors, as one of the interviewees mentioned: “There are many observations, and they tend to be repetitive; they’re not addressed collectively. Last year, they said the problem was that the panel of specialists wasn’t meeting, which delayed the process. But shouldn’t this take less time?” (AP_02, 2025). In this sense, it is not only a problem of managing effectively the number of observations, but the lack of professionals and specialists to approve the building projects that set up the process. These delays could last between one to two years, as one of the interviewees stated: “The project was presented in the middle of 2023, they approved it this year (2025). The longer time waiting was during the review of the observations” (AP_03, 2025).

These delays may also stem from construction projects failing to comply with existing regulations (TS_01, 2025; TS_02, 2025). Such non-compliance is often a consequence of information asymmetries, which undermine the quality of building projects and hinder their alignment with the regulatory frameworks.

The other identified limitation in the issuing of building permits is that this process is highly reliant on manual and paper-based procedures like hand-filled forms and handwritten signatures on physical documents. Therefore, some interviewees reported feeling frustrated when filling in all the information by hand, especially given the volume of required data and percentages of the Unique Urban Planning Form (FUE). For instance, applicants must look up the regulation to determine what counts as a covered area or free space. According to the manual, everything with a roof must be measured. However, when applicants indicated the respective number, the Municipality raised an observation: “You indicated the covered area is 20.5, but it’s 2.75.” Public servants did not explain how they calculated the number, although it was clear that they had access to more detailed information.

This lack of clarity forced applicants to reconsider and review the regulations, adding further delays and confusion to the process. The complaints are also related to the manner information is collected, as only the original printed version is accepted. Some of the interviewees mentioned that they fill out the FUE online, but they must print and sign it by hand, as Municipalities did not allow the use of digital signatures. The latter creates extra costs and time invested in coordinating all stakeholders involved in the building project, including all professionals and the property owner(s).

A third limitation in the process is the presence of informal practices or arrangements between stakeholders. The experience of the interviewees clearly described some of these practices, such as constructing buildings that exceed the permitted number of

floors established by regulation. To avoid any sanction, these informal constructions are later formalized by paying bribes to public servants and authorities (AP_02, 2025; AP_03, 2025). As interviewees detailed:

> *"We are currently building with a permit for seven (07) floors. But when I asked why someone else was allowed to build ten, they told me it's because they paid. We followed the rules, and then another person added (03) three or (04) four more floors. That's why we've also asked to extend our project by (01) one more floor. They won't give us the final approval for the completed work, but at least that extra floor will be there for us. At some point, when they start granting more floors officially, we'll just regularize it. People end up in this situation because they see that others are allowed to do it" (AP_03, 2025).*

Similarly, one of the interviewees reported being asked to pay a bribe to avoid on-site inspection visits (2025). This practice is so extended in the sector that interview 3 pointed out that 100% of professionals have had to pay a bribe once if they want to continue working in the sector (AP_03, 2025). Beyond bribery, other interviewees detailed the existence of informal networks within the Municipalities: "clients often say they know someone in the municipality and just ask me to draw the plan, that it will be approved" (AP_03, 2025). One major consequence of these informal practices is that applicants who refuse to engage in them often experience longer waiting times for their building permit, also known as a common bureaucratic barrier in the literature (AP_03, 2025). Even more concerning, professionals who follow formal procedure are known as slow or inefficient, in contrast to those who conform to the status quo and appear more capable due to navigating the process through informal rules.

However, contrary to the common assumption that delays in the issuing of building permits are primary due to corruption, testimonies of public officials, such as the Technical Secretary of the Commission for the Elimination of Bureaucratic Barriers or the Deputy Manager of the Subunit of Private Work and Cadastre at Surquillo Municipality, suggest otherwise. Thus, the root cause often lies in the limited understanding of regulatory frameworks (2025). From the applicants' perspective, the regulatory documentation (TUPA) demands a high degree of commitment and willingness to interpret it. Yet not all applicants have the background knowledge to comprehend its content (PS_03).

For this reason, the interviewees mentioned the existence of a supplementary and informal service provided by third actors, external to the Municipality, also known as process facilitators or "*promotors*". They offer the service of supporting applicants with all activities that require interaction with the Municipality. In the pre-submission stage, they oversee corroborating the requirements identified by reviewing the TUPA by

requesting the information from the Municipality. Plus, during the submission and post-submission stage, they are responsible for submitting the building projects, even signing documentation, and then following up on the status of the request. The latter implies constant in-person visits to the Municipality to talk with the professionals in charge of the project, reviewing the pending requirements, or pushing for the license approval. As pointed out by interviewees, it is common that Engineering and Construction firms hired them as permanent workers, an average of (03) three process facilitators per firm (PS_03, 2025).

4.4 Technological subsystem and data management limitations

An essential aspect in the analysis of digital building permits in Peru is the current analog information management system used by the Municipality of Surquillo. As previously described, the issuing of building permits requires applicants to provide a physical building file composed of three (03) printed copies and one (01) digital version, either on CD or USB drive. Once the file is received and verified to meet all formal requirements, one public servant is responsible for scanning each document and uploading the information into the Document Management System (SGD). This platform is an interoperable document management application designed to share, in a secure manner, documentation throughout different public institutions. In Peru, both the Municipality of Surquillo and the Ministry of Housing, Construction, and Sanitation (MVCS) currently operate on this platform.

After digitising the building file, it is forwarded to the Sub-Unit of Private Work and Cadastre, where one administrative assistant ensures that all documents have been properly uploaded and stored. This information is shared with the Sub Manager, who classifies the requests considering the modality of the building permits (A, B, C, and D) and assigns each case to a responsible professional for technical review.

At the Surquillo Municipality, two (02) public servants are assigned to manage the post-submission stage of the process. One is responsible for reviewing the project files, identifying observations, generating reports, and then managing the signing of documentation of A and B building permit modalities. The second is tasked to also deal with coordinating with external stakeholders such as the professional associations, specifically the College of Architects and the College of Engineers, as part of the technical validation process of Modality C and D.

It is also relevant to mention that during the pandemic, and due to the limitations for in-person activities, Municipalities had to adapt their process layer by integrating technological tools to continue collecting building permit requests and granting projects.

For that reason, interviewees mentioned the creation of an online document submission systems. One example to mention is the Ventanilla Municipality, which digitalizes the Single Procedure Form (FUT), to facilitate the submission of requests, requirements, and access to diverse services. During 2020, digitalisation allowed request submission by attaching all the requirements through the digital platform of the Customer Service Desk (PS_03,2025). This office was responsible for assigning a professional to review and answer each of the requests. In parallel, the applicant could send the paper documentation by a courier service for further review (PS_03,2025). This adapted process allows a seamless transition to the use of Single Procedure Form to accelerate the administrative process while waiting for the requested in-paper documentation (PS_03,2025).

Yet, this step towards adopting ICT tools in public administration came to a standstill due to the lack of a longstanding vision of its adoption (PS_03, 2025). Indeed, ICT tools were implemented as a short-term solution to overcome the pandemic barriers and, once in-person activities were allowed, Peruvian Municipalities returned to the traditional in-paper and in-person manner. As one of the interviewees pointed out: "Currently, the secretary of the Sub-Unit of Private Work and Cadastre oversees scanning the building projects once they are assigned to the Sub-Unit. Even so, she only does it when she is free from other responsibilities, as it is not a priority" (PS_03, 2025).

In terms of data and information management, one of the most essential tools is the FUE, the unique form for construction permit applications in Peru (FUE[4]). It was designed to collect pivotal information regarding the building projects, property owners, and the professionals responsible for the project. Specifically, it gathers information regarding the property owners, building project, and the responsible professional, such as identification and the characteristics of the property and building project. It is used as a reference form modelling language applied in all Peruvian municipalities, assuring standardization in the data exchange among citizens and government. The Table 4 presents the form's structure with the three entities represented in the BPMN: the property owner, building project and building developer.

[4] FUE due to its capitals in spanish: *Formulario único de edificación*

Entity	Category	Variable	Source
Property Owner	Identification	Full Name/ Denomination, DNI/CE/RUC	Section 2.1; 2.2
	Contact Information	Address, Phone, Email	Section 2.1; 2.2
	Legal Condition	Ownership Status, Marital Status	Section 2; 2.1
	Delegate actions	Legal Representative Type Full Name/ Denomination, DNI/CE/RUC Address Registration Source (Mandate, Mercantile, Office)	Section 2.3
Building Project	Location & Lot Details	Department, District, Lot, Sub-lot	Section 3
	Property details	Area, Perimeter Property regime, number of property code	Section 3.2 Section 4
	Project Details	Area	Section 6
	Type of Construction	New Build, Remodelling, Demolition	Section 1.2
	Estimated Value	Unit value per area, estimated value per area	Section 7.1
	Type of process	Preliminary design under review, building permit, regularization of the building permit	Section 1.1
	Approval modality	A, B, C, D; Annexes A, B, C, D	Section 1.3; 1.4
Building Developer	Identity	Name, DNI/CE, Registration (CAP/CIP), Address	Section 6.2; 7.2
	Role	Architect, Engineer, Other	Section 6.2
	Project Details	Plan Type, Number of Plans Submitted	Section 6.2

Source: Presidencia del Consejo de Ministros (PCM) 2023

Table 4 Collected variables from the FUE per entity

According to the interviewees, there are some limitations around the way information is gathered through this instrument. First, in terms of the budget specifications described in the FUE section 7 (See Table 4), it is required to determine the estimated unitary value of the area, which, according to AP_02, does not allow for diving deeper into the specifications and features of, for instance, a remodelling project (2025). Thus, it is not the same to detail the estimated value of building a new block as remodelling it. Furthermore, other interviewees mentioned the difficulty of conducting the calculation by hand, when it was also required to align the unit value with the Official Tables of Unit Construction Values (AP_05, 2025). The latter specify the reference costs per square meter based on construction type, the quality of the materials

and the region (Metropolitan Lima, the Constitutional Province of Callao, the coast, the highlands, and the jungle), which are modify once per year (Ministry of Housing 2024) Other consequences of an analog information management system are the lack of data integrity, nor availability of data retrieval when it is required (PS_03, 2025). Noteworthy, according to the National Policy of Housing and Urbanism, for 2030, Peru will implement a Monitoring System for Procedures and Issued Licenses (SIMPLE) system, as part of services required to expand the existing alternatives for accessing adequate housing, prioritizing populations in poverty or social vulnerability (Ministry of Housing 2021) It, as is mentioned in the Policy, must be an automated service which ensures traceability of municipal licenses and authorizations.

As presented in this section, the technology layer is characterized by the lack of ICT tools implemented in the issuing of building permits, specifically in the pre-submission and submission stage. Thus, the current process is a Level 0 or traditional paper-based system which lacks any automated task. On one hand, the management of information depends on paper copies submitted through an in-person channel at the Municipality. The latter, according to the literature, led to difficulties in collaborative tasks among stakeholders, while reducing efficiency and transparency in the process (Shahi et al., 2019).

For this reason, the Municipality has been working on scanning and uploading the project files into the SGD, an interoperable system that is used by both the Surquillo Municipality and the Ministry of Housing, among other stakeholders. However, this tool is increasing the number of steps in the submission stage, without any improvement in terms of costs, neither invested time, Furthermore, it was registered that the adoption of technology is not groundbreaking in the Municipality, which introduced a digital version of the Single Procedure Form (FUT*)* for online submissions during the COVID-19 pandemic. However, digital adaptations were temporary, and municipalities reverted to analog methods post-pandemic due to the lack of a long-term vision, which must be considered when aligning the research goals with the local government vision.

5 Problem statement and the research objectives

The building permit process in Surquillo Municipality faces three interrelated challenges that undermine its regulatory compliance, efficiency, and transparency. First, there is a persistent information asymmetry between municipal public officials and applicants, which leads to misunderstandings regarding building requirements, procedural delays, and non-compliance with technical norms.

Second, the continued reliance on manual, paper-based workflows, requiring hand-filled forms and handwritten signatures, results in frequent errors such as illegible entries, missing information, and a lack of standardized data formats. Although the Municipality has adopted the Document Management System (SGD), this digital tool has not simplified the process. Rather than replacing or streamlining the existing process, it has introduced an additional step: scanning and uploading documentation. The result is that public servants perform these activities in parallel with the traditional paper-based process, increasing the time and resources needed to manage it.

The third problem is related to the implementation of the law and regulation, as informal practices among stakeholders, building developers, and public servants, were normalized throughout the issuing of building permits. This informal practice consists of bribes' payments to avoid compliance with regulations, creating a dual-track system: one governed by the formal procedure and another by informal norms. The latter increases the perception of inefficiency around those professionals who follow the formal track for longer periods, compared to those who follow unofficial channels to overcome the mandatory steps. This undermines the legitimacy of the building permit process, the building developers, the municipality, and reflects a breakdown of the regulatory framework.

These three problems reflect deeper structural inefficiencies in the existing process and hinder the adoption of a user-friendly and transparent building permit process, even after the approval of regulatory instruments to pursue a modern process. According to the literature, these problems are aligned with the data and information category of the building permit's technological subsystem and the procedural one. As presented in Table 5, the analysis of the as-is process, interconnecting the legislative, organisational, procedural, and technology layers, allows a holistic understanding of the bottlenecks presented in the process and its main consequences in terms of costs, time invested, and institutional legitimacy.

Sub-system	Problem statement	Consequences	Artifact requirements
Technological: data and information	Information asymmetry between municipal authorities and applicants regarding regulatory requirements, procedural steps, and technical standards	Project delays, non-compliance with regulations, and decreased overall quality of construction	Interactive digital guide that dynamically presents regulatory requirements based on the users' needs
	Reliance on manual, paper-based procedures—such as hand-filled forms and handwritten signatures—combines with the integration of the Document Management System (SGD) as a parallel rather than substitutive activity	Extra costs and time invested on mobility and coordination Missing files and information	Electronic form submission with automatic field validation and integrated with the municipal Document Management System (SGD)
Procedural	Prevalence of informal practices among stakeholders in the field	Undermined the legitimacy of the process Reduce trust in the municipality	Status tracking functionality and SMS or email notifications

Table 5 Identified problems in the issuing of building permit per sub-system

Considering the identified problem statement and the requirements for the artifact, the research goal of the thesis is to *design a user-centred enterprise architecture model that addresses these procedural and technological barriers in the building permit process of a local municipality in Peru.* The proposed solution includes the development of an interactive digital guide that enables applicants, both citizens and building developers, to seamlessly review the requirements to obtain a building license. Moreover, to integrate a digital tool within this complex and segmented process, the proposed solution is framed as a complementary alternative to the existing in-person service channel.

By adopting an omnichannel approach, the model integrates online and traditional channels, ensuring a seamless and personalized experience across all touchpoints. In this way, the applicant has the option to use the electronic form to submit automatically a request for a building permit, including all the documentation required, or go in-person to the Municipality to present the request. Third, it is also considered the design of a notification and tracking system that allows applicants monitoring the process, integrating SMS and email notifications to assure a seamless exchange of information.

6 The artifact

The technology adoption by any organisation requires the design of a roadmap that guides its disruptive effect while aligning the technology use to the organization's vision, mission and goals. This roadmap or enterprise architecture (EA) supports the integration of a technology ecosystem into the organisation and the creation of new projects, systems, or even processes.

TOGAF framework provides the ADM method to determine how to build, manage and implement information systems (Saputra et al. 2022). The latter is a widely used framework that supports the organisation in the design of an EA by defining eight (08) sequential stages. This section focuses on the first five sections: its preliminary stage, architecture vision, business architecture, information system, and the technology architecture phase; as it is adapted to the research goal, which focuses on the design of three functionalities. In this sense, this holistic approach for ICT introduction into local public management looks to guarantee a long-standing adoption of the proposed functionalities and respond to the social or political context.

6.1 Preliminary phase

The preliminary phase allows the identification of where, what, why, who, and how the transformation of the organisation is going to be achieved (Desfray & Raymond, 2014). For that purpose, it is required to consider non-architectural inputs, such as the business objectives and business drivers, and the pre-existing governance and legal framework. Furthermore, there are architectural inputs, which are presented as the baseline of the preliminary phase. This section presented four (04) main steps: the organisational context, the Enterprise Architecture's (EA) key business drivers and its objectives aligned to the problem statement presented above, identify the organisational model for EA (scope, roles and responsibilities of the team and the governance strategy), and define the EA principles.

In terms of the organisational context, there are two units to consider within the Surquillo Municipality. First, the Sub-Unit of Private Work and Cadastre, as the sponsor of the project, is responsible of reviewing activities related to the granting of authorizations, rights, licences, buildings, work conformity, declarations of existing structures, subdivisions and certification to determine the value of introducing ICT tools and to ensure all stakeholders' participation. Furthermore, the Office of Citizen Services and Records Management, as the Organic Unit responsible for managing the administrative processes and the document repository, will transform its manner of

processing the reception, registration, classification, distribution, and control of documentation within the Municipality.

The soft unit of the enterprise- which will experience changes, without direct effects- is the General Office of Electronic and Digital Government, the technical support body of the Municipality. It oversees aligning the prototype with the ICT tools currently implemented in the Municipality, such as the Document Management System (SGD), which allows the interoperable exchange of electronic documentation.

In addition to the Surquillo Municipality, other public sector institutions are also affected by the changes introduced. The Ministry of Housing, Construction, and Sanitation, specifically the General Directorate of Housing and Urban Development Policies and Regulation (DGPRVU), plays a pivotal role in enabling these transformations. As the entity responsible for regulating and managing procedures for the planning and improvement of the urban population centres, it must guarantee the design of a regulatory framework that ensures a seamless and longstanding adoption. Noteworthy, it is required to approve regulations that establish as mandatory the use of these tools at local governments and provide Municipalities with a period to adapt their structure, roles and responsibilities to the implementation of ICT tools. This approach is essential to ensure a sustainable and uninterrupted adoption, avoiding setbacks like those experienced after the COVID-19 pandemic.

The external actors or units involved in this project are the architects and engineers applying for building permits in the Surquillo Municipality, also known as the applicants or the end-users. Furthermore, citizens with no background in the AEC field could also apply for a building permit, being part of the service users. In terms of groups or communities of professionals, the Professional College of Architects and the Professional College of Engineers must be considered as they are the owners of one of the databases required to guarantee the automated verification of professional credentials.

Equally relevant is to describe the required changes in the Architecture Governance to guarantee the institutional alignment, stakeholders' coordination, and the consistency in the development of Enterprise Architecture. Thus, to conduct this research, the governance structure is anchored in the Surquillo Municipality, through its Sub-Unit of Private Work and Cadastre that provides the support, legitimacy, and access to key public servants to dive deeper into the process dynamic.

One advisory commit is organized composed by experts who oversee the strategic design and direction of the project, while ensuring compliance with the national and

subnational regulations, such as the standards established by the Secretariat of Government and Digital Transformation (SGTD) to further implement an interoperable system. It is composed of representatives from the Ministry of Housing and the Surquillo Municipality. In addition, the core enterprise architecture team is led by the principal researcher and municipal representatives from the Private Works and Cadastre Sub-management of the Surquillo Municipality who continuously participate in the design of the prototype. To guarantee a participatory design and validation stage, another advisory space is created to collect the end-users', both architects and engineers, experience in the licensing process by three organized focus groups.

Regarding the EA's key business drivers and objectives, to guarantee the alignment of the EA with the institutional goals, it is informed by the Institutional Strategic Plan of the Surquillo Municipality for 2018 to 2030, permitting the identification of two EA objectives that are compatible with the Municipality vision. On one hand, the Municipality determined for 2030, two Institutional Strategic Objectives (OEI) to consider: to promote the economic competitiveness of the district's economic agents by upgrading the local cadastre (OEI. 03), and to strengthen institutional management by information technologies (OEI. 07). The above-identified problem statements are aligned to the Institutional Strategic Plan of the Surquillo Municipality. Specifically, these constrains stem from technological gaps and operational inefficiencies in the current system, which motivate the introduction of ICT tools into the organisation in accordance with the Institutional Strategic Plan of the local government.

Institutional Strategic Objectives OEI	Surquillo Municipality Strategic Action	Surquillo Municipality constraints	Artifact requirements
Promote the economic competitiveness of the district's economic agents	Promote planned, sustainable, technological, systematic, and updated urban development with an efficient cadastre	The existence of information asymmetry between municipal authorities and applicants and citizens regarding regulatory requirements, procedural steps, and technical standards	Interactive digital guide that dynamically presents regulatory requirements based on the users' needs.
		Prevalence of informal practices and corruption among field stakeholders	Electronic form submission with automatic field validation and integrated with the municipal Document Management System (SGD)
Strengthen institutional management	Improve the effectiveness and quality of administrative management by simplifying administrative procedures using information technologies	Reliance on manual, paper-based procedures such as hand-filled forms and handwritten signatures	Status tracking functionality and SMS or email notifications
		Adoption of the Document Management System (SGD) as a substitute activity	

Table 6 Alignment of institutional objectives and the artifact requirements

Furthermore, in terms of the architecture principles, the selected principles that are going to guide the EA are related to the stakeholders' engagement in the Information Management. As the business principle determines, this task is *Everybody's Business* as all stakeholders must participate in the information management decisions, organized in interdisciplinary teams, including technical staff as well as public management experts and architects. They must determine what they are looking for with the system and accept responsibility for developing the information environment required to effectively adopt it.

Secondly, the Municipality must adopt it as *an application known and used by all the organisation members* to avoid duplicative applications within the organisation. Indeed, the extension of this principle must include the Ministry of Housing scope, as it is the national institution responsible for the design and implementation of political tools that can enhance the management of lands' use. The Ministry must ensure that other Municipalities adopt only one system as a reference to guarantee standardization and

interoperability. Notably, the organisation must follow *a service orientation*, including functionalities that are aligned to the demands of the context, including infrastructural requirements. And, of particular importance, it had to *comply with law, policies, and regulations* due to the technical topic and the nature of the government transaction.

In terms of the data principles, it is vital to consider it as a valuable resource for decision-making within the organisation. Equally significant, data is *shared and accessible for everyone*, two principles that are intertwined due to the impact on data availability. From one side, data had to be shared across the organisation promptly, which required its continued collection and standardization, to ensure an efficient sharing process across data islands. For this purpose, it is vital that the Ministry design policies and guidelines to be adopted by all the Peruvian municipalities. Thus, it will be possible to develop comparable analyses of building permit capacity across municipalities, reviewing the time and cost required to review and approve one building permit. *Data accessibility*, similarly, implies that it is easy to obtain and interpret.

These principles also frame the features of the application, mainly to guarantee it is *user-friendly*. The testimony of the interviewees pointed out to the difficulties encountered when trying to access information regarding the issuing of building permits. For that purpose, it is vital to ensure an intuitive access to information, without requiring technical knowledge for its adoption. Moreover, of particular importance, the technology must be *interoperable.* This implies that both software and hardware follow standards to promote interoperability of the data, the application, and technology. Interoperability also implies that the Municipality is going to require the standardization of the process, while ensuring the consistency of the information shared across the information channels, in-person and online.

6.2 Architecture vision

The architecture vision encompasses the changes expected for the Surquillo Municipality after successfully deploying the artifact. This vision must be presented to the stakeholders participating in the validation sessions for their formal agreement on the outcomes and to determine the feasibility of the proposal.

The overarching goal is *to transform the building permit process in Surquillo Municipality into a more transparent, efficient, user-friendly, and trustworthy service.* For that purpose, the building permit must align with the national regulation, enhance the administrative performance, and respond effectively to the citizens' needs. Thus, within five years, the expectation is that Surquillo Municipality could become a leader in e-permitting in Peru by implementing the designed functionalities. Following this

goal, the SMART (specific, measurable, achievable, relevant, and timebound) objectives are:

1. The interactive digital guide cover 90% of the license modalities standardized in the Supreme Decree No. 146-2023-PCM and provide a complete checklist of requirements per modality, within the first year of implementation.

2. Reduce the average building permit processing time by 70% within two years by introducing the electronic form submission, which include automatic field validation.

3. Ensure 100% of applicants receive real-time digital access to application status updates and regulatory notifications within the first year of implementation.

Another factor to consider when setting up the ADM cycle is the stakeholder management. For that purpose, it is vital to review the list of participants aligned to Law N 29090 that determines actors' involvement in the issuing of building permits. Furthermore, it is required to detail their knowledge, concern, and influence on the process. This list of stakeholders guides the identification of requirements, goals, and the priority among them, depending on what are the expectations of the stakeholders.

A pivotal actor to consider is the Ministry of Housing, as the leader of the sector, and specifically the General Directorate of Housing and Urbanism Policies (DGPRVU). This office is currently led by an architect with a specialization in Local Public Management and over 15 years of experience in both public and private entities (TS_02, 2025). Particularly interesting for this research, is the Directorate's role as Technical Secretariat of the Standing Committee for the Update of the National Building Regulations (CPARNE), which guarantees its deep understanding of the current regulatory framework but also reflects practical experience in supporting its implementation in local governments.

Particularly, during one of the interviews conducted at the General Directorate, the official pointed out the significant challenge involved in implementing the Supreme Decree No. 146-2023-PCM, which aims to unify and improve the building permit process. He also expressed a strong interest and commitment to promoting the adoption of ICT tools to ensure regulatory compliance, particularly supporting further updates to the Monitoring System for Procedures and Issued Licenses (SIMPLE) system. As a result, this stakeholder is positioned as a key decision-maker and a highly engaged actor in the digital transformation initiatives proposed in this research.

Similarly, the Commission to Eliminate Bureaucratic Barriers, as an oversight entity, has supported the first identified problem regarding the existence of information asymmetry between municipal authorities and applicants regarding regulatory requirements, procedural steps, and technical standards (PS_03, 2025). Specifically, the interviewee pointed out that it is required to conduct training among all municipalities to guarantee standardized compliance with the regulation (PS_03, 2025).

Furthermore, considering that the building permit process is implemented at a local level, the Mayor of the Surquillo Municipality is a pivotal actor with high decision-making power in terms of budget allocation and political will to guarantee the artefact implementation. As in the other stakeholders' case, the level of interest is proven to be high as the proposed prototype's requirements were aligned with the Institutional Strategic Objectives of the local government.

In the Municipality, two stakeholders to consider are the Urban Development Manager and the Deputy Manager of Private Works and Cadastre. Although their authority to increase budget allocations is limited, they exercise substantial decision-making power over how existing resources are managed. This includes discretion over public servant recruitment and the adoption of ICT tools within their departments. Both stakeholders demonstrate a high level of interest in the proposed project, particularly because the digital solution is aligned with the strategic goal of improving operational efficiency within their units. If the proposed artifact delivers tangible improvements without requiring significant financial investment, it is likely to receive strong support from both actors.

Other stakeholders are categorized into public and private actors. Among the public sector stakeholders, the most relevant include personnel from the Document Processing and Archiving Office and the Private Works and Cadastre Office. These units are directly responsible for the front-end services and would play a central role in the implementation of the proposed artifact. According to one interviewee, while the Private Works and Cadastre Office has limited decision-making power to promote the artefact, the Document Processing and Archiving Office holds greater influence over how documentation is managed into the organization (PS_02, 2025). Consequently, the latter has demonstrated stronger interest and involvement in the project, particularly due to its potential to reduce the large volume of building projects awaiting review.

Contrary to common assumptions in digital transformation initiatives, as these units have a limited number of public servants, they are actively seeking more efficient ways to manage their daily tasks. Furthermore, one pivotal feature of the artefact is its user-

friendly design, which is relevant given that many of these stakeholders belong to age groups with lower digital tool proficiency.

In the case of private stakeholders, two main groups are involved: project applicants, primarily architects and engineers, and the citizens acting as property owners. Both are considered end-users of the proposed prototype, though they exhibit differing levels of interest in its implementation. On one hand, the architects and engineers interviewed for this research expressed strong support for this proposal, viewing the introduction of ICT tools to enhance procedural, reducing the time spent accessing information and organizing the project file at a reduced cost. Nevertheless, their influence on the implementation of the prototype is limited, as none of them are residents of the district and therefore lack political leverage. On the other hand, the property owners, as district residents and voters, hold political influence to advocate for the digital transformation of the building permits procedures. Nonetheless, this does not necessarily translate into interest or engagement with the process. As reported by interviewees, property owners often delegate the permit application process to professionals due to its complexity (PC_01, 2025; PS_02). This is highly problematic, as many property owners lack knowledge of the project details and their legal rights, leaving them more vulnerable to engage in informal practices to expedite approvals and ensure their construction project proceeds as desired.

Type of participant	Participants	Skills	Decision-Making Power	Level of interest
Ministry of Housing	General Directorate of Housing and Urbanism Policies (DGPRVU)	Regulatory authority that establishes technical norms and supports local implementation.	High	High
Oversight Entities	Commission to Eliminate Bureaucratic Barriers	Legal analysis, monitoring bureaucratic barriers, and policy enforcement	High	High
Municipal Public Officers	The Mayor of the Surquillo Municipality	Budget allocation	High	High
Municipal Public Officers	Deputy Manager of Private Works and Cadastre	Regulatory interpretation and application, public administration, and policy implementation	High-Medium	High
Municipal Public Servants	Document Processing and Archiving Office	Knowledge of administrative procedures and document management	High	High
Municipal Public Servants	Private Works Sub-Management	Technical expertise in building permit regulation	Low-Medium	High
Project applicants	Architects and Engineers	Licensed professional with technical knowledge on designing a building project. Proficient in digital tools like AutoCAD	Low to Medium	High
Citizens	Property Owners	Individuals or entities holding property rights over urban or rural land who are not regularly technical experts. Vary in digital literacy and familiarity with procedures.	Low to Medium	Low

Table 7 Stakeholders Matrix

6.3 Business Architecture

In this section, the discussion is focused on describing the enterprise architecture (EA) required to optimally satisfy the research goal, specifically by reviewing the main activities represented by its business processes. For that purpose, a process flow diagram is represented, detailing the process participants, activity sequences and information exchanged and recorded throughout the issuing of a building permit process after introducing the three functionalities of the proposed artifact. Specifically, the process is categorized in three stages: pre-submission, submission, and post submission of the building permit application.

6.3.1 A tailored requirements guide in the pre-submission stage

Before submitting the building project, it is essential to address the information asymmetry previously described among the property owner and professionals regarding the requirements for obtaining a building permit. To overcome this challenge, the Enterprise Architecture (EA) proposes enhancing online channels by introducing a tailored requirements guide. This tool aims to ensure equitable access to information by providing project-specific requirements customized according to the features of the intended construction. Moreover, the prototype must follow the only once principle to avoid confusion and cognitive dissonance among applicants when searching for the building permit requirements. For that reason, as identified in the literature, it is paramount to pool all the forms and information on just one page (Schenk et al., 2024), managed by the national government, and determine the responsibility of municipalities to maintain the information updated. Thus, if all the modalities are presented on a separate website, the applicant will have to follow two different steps: first, identify the information about the process of building a permit, and then review the correct details for their property at the municipality website. To overcome this complexity, the guide delivers simplified, filtered information relevant for each user case and automatically generates customized responses to the users' inquiries.

Once the property owner decides to initiate a construction, they can access the Peruvian Unique Digital Platform (Gop.pe) and immediately interact with the guide. The system provides filter questions to guide the user through the regulation scenarios defined in the national building regulation. The first question determines whether the users plan to construct a new building. This response defines the user journey path, as requirements vary depending on what it is expected to construct. In case the user selects "new construction", the guide immediately prompts the user to verify the Urban and Building Parameters, which defines what type of construction are permitted based on the characteristics of the property. This includes the maximum number of floors permitted,

the minimum percentage of open area to comply with and the required number of parking spaces. If the user does not possess the information, the system guides them to another web page to initiate a parallel process at the Municipality, as data is not publicly accessible. While this functionality promotes regulatory compliance, it also highlights a significant barrier, access to information. As mentioned by interviewees, current building permit procedure does not require applicants to include the Certificate of Urban Parameters, and the associated costs further limit accessibility (PC_01, 2025).

As the user continues, the next step involves selecting the type of construction, differentiating between a single-family or multifamily housing, single-family or multifamily condominium, row housing, industrial building, commercial building, sport venues or a marketplace. Each construction type has been previously analysed to ensure descriptions are presented in a user-friendly manner, reducing reliance on technical language from the regulation.

The user's path is then refined based on the project's physical characteristics, such as height and area, which affects the application building permit modality. The system dynamically adjusts displaying the modalities fixed to the required project, based on these parameters. As a result, the user receives appropriate review of the building permit procedure, including the stakeholders involved and the requirements for submission at the municipality.

Furthermore, it is vital to mention that the design and implementation of the first functionality, does not imply to eliminate the pre-existing in-person channels. Thus, according to the literature, the preference for online or offline channels depends on the activity conducted by the citizens (Schenk et al., 2024). Thus, citizens prefer online channels such as websites or apps of authorities when searching for general information, but to solve a problem or decide, they prefer an in-person visit to the government office. In other words, the level of complexity of the process determines the type of channel preferred by the applicants. In the case of building permits, the literature suggests a preference for an in-person approach (Schenk et al., 2024). A study conducted in Spain, suggested that the replacement of in-person channels for entire online service is not efficient as the citizens remain demanding in-person channels as complementary to the new developed alternatives (Rey-Moreno, M. and Medina-Molina, C., 2016). This aligns with the testimony of one interviewee who mentioned that even though the access to information regarding the requirements do not need a visit to the Municipality; for the submission stage, it is paramount to, not only present the project file in person, but to check that all the requirements are registered by the public servant (PS_01, 2025). Considering this evidence, the designed prototype will be presented as a complement to

the traditional channel of accessing information by visiting the Municipality. For that reason, it is required an omnichannel approach to the applicant journey across both channels: online and in person one.

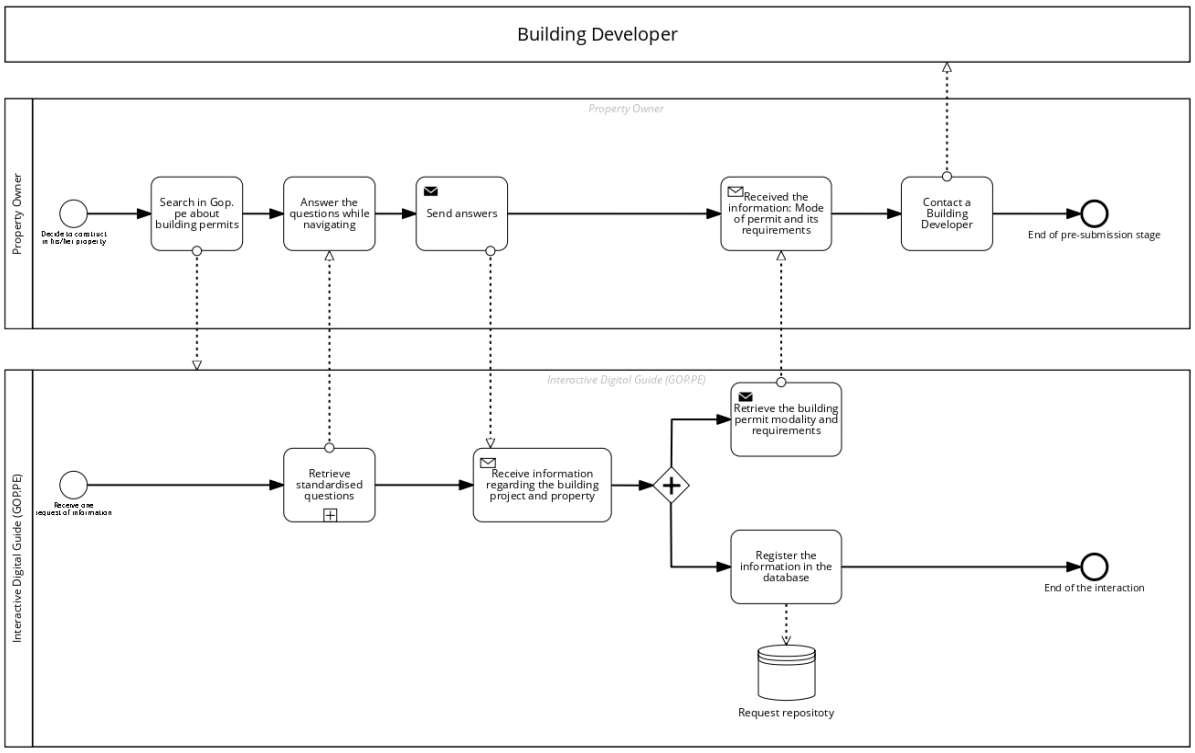


Figure 5 BPMN of the pre submission stage including functionality 1

6.3.2 Streamlining form management for the submission stage

Once the building developer has already designed the plans and compile the necessary documentation, they initiate formal interaction with the municipality authority to proceed with the building permit process. This interaction occurs during the "submission stage", when applicants officially present a comprehensive construction plan to the Municipality, specifically, to the Sub-Unit of Private Work and Cadastre.

According to the interviewees, this stage represents different challenges. Applicants must collect signed documentation, fill out the Unique Urban Planning Form (FUE), and undergo a manual review process to verify compliance with the legal requirements. As this review is typically performed by non-technical municipal staff, applicants often face delays and struggle to determine how to complete the FUE in an accurate manner (AP_01, AP_02, AP_03, AP_04, AP_05). This results in a process that is not only time-consuming and error-prone, but also vulnerable to missing documentation, miscommunication and applicants' frustration due to bureaucratic bottlenecks.

For those reasons, the to-be model introduced a second functionality to the process, the Streamlining Form Management with an electronic FUE, which looks to improve transparency and efficiency, while reducing errors in documentation handling. Drawing from the literature, a form is a structured interface that provide predefined labelled spaces for manual data input and allow data exchange among one or more legal persons (Scholta et al. 2020). Its main purpose is to exchange information among citizens and governments to facilitate service delivery (Scholta et al. 2020). Forms act as transactional artifacts, by providing the information required to determine citizens eligibility (input form); in response, the government review the requirements and issue documentation-based request (output form) (Scholta et al. 2020).

To optimize the interaction, while increasing the user satisfaction, the proposed solution integrates the meta-model for modular electronic forms, which was proposed by Scholta et al. to standardize forms in the German government (2020). It allows reusability of form components, dynamic field logic based on applicants' inputs, and legal compliance.

In practice, the submission stage is simplified by providing the building developers an online channel to upload the required documentation through the SIMPLE platform. It allows applicants to create personal accounts by entering basic identification and contact data- first name, middle name, last name, genre, email, phone number and a password. Within the SIMPLE platform, a new digital pathway titled "5.4 Muy requests" is introduced under the license section.

By clicking on the "New submission" bottom, applicants can access to the electronic version of the FUE, which offer dynamic and responsive features and modular form sections The top sections of the form allow a further filter feature to show or hide fields depending on the user selection of process type, construction type and building permit modality. Based on the answers, the system automatically adapts the visible modules, reducing cognitive resonance by ensuring users are only prompted to complete sections relevant to their specific case. It also performs real time validation, verifying data consistency in terms of format and completeness to avoid non complete information; cross- checking inputs via API with external sources such as RENIEC or Professional Colleges to ensure identification of the applicants and credential verification of the building developers.

Once the applicant finish filling the FUE, it also included a feature to upload links to supporting documentation- architecture plans for building or renovations, electrical plans, or even the environmental impact assessments. This information is automatically routed through the SIMPLE to the Document Management System (SGD) of the

Municipality, generating a unique tracking number. To close the submission process, it displays a tracking number and automatically send email notifications to both, the building developer and the property owner to confirm receipt and provide the tracking number.

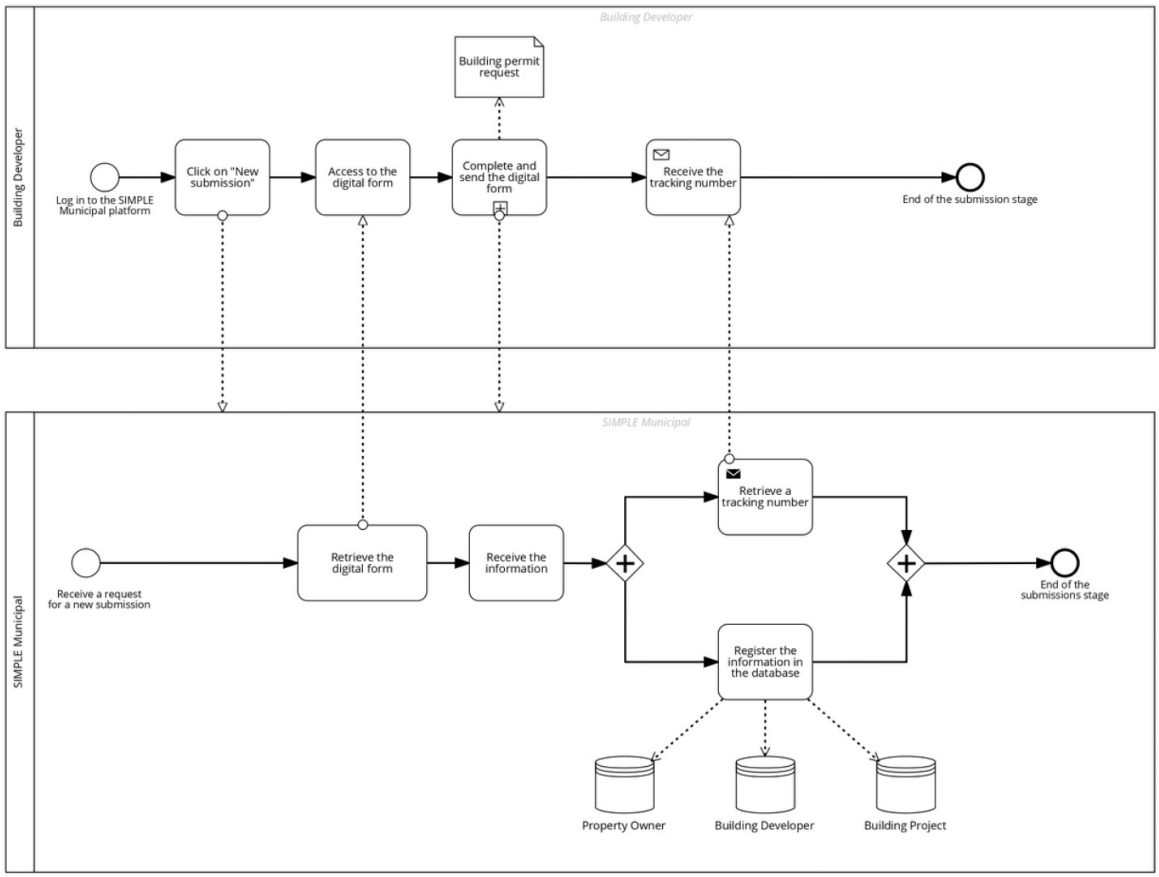


Figure 6 BPMN of the submission stage including functionality 2

6.3.3 A notification and tracking system for the post-submission stage

Once the application has been submitted through the SIMPLE platform, the third stage of the building permit process begins: application review. During this stage, the Office of Private Work and Cadastre of the Surquillo Municipality assess the submission. If observations or errors are identified, the Office communicates with the building developer and the property owner through the SIMPLE, providing feedback and requesting modifications and resubmission.

To reduce the time and cost associated with in person interactions and to mitigate informal practices such as bribe payments, the influence of informal brokers or clientelist networks, this third functionality proposes to implement a notification and tracking system. It will be integrated with SMS and email notifications, enabling timely, secure, and documented exchanges between stakeholders.

As illustrated in Figure 11, the SIMPLE platform acts as an intermediary between the municipal office and the building developer, also known as the applicant. Once the public officer requests to update the building permit status, the platform filter each request by the tracking code and enables modifications in their status- in progress, observed, approved, rejected. Automatically, the SIMPLE will send notifications to the property owner and the building developer.

This triggers a new interaction phase in which the building developers, often in coordination with architectural or technical specialist, reviews the feedback, updates the documentation and submits the revised version of the project. This typically occurs within 5 to 10 business days. Once a new submission is detected, the SIMPLE will notify the public officer in charge of the request, by sending a notification to the public servant in charge, closing the feedback loop.

In this way, the functionality assures to reduce the interaction among the actors od the process, the public officer and the building developer, modifying the scenario of the interaction to reduce the possibility of informal behaviours. By formalizing communication through the platform, the architecture improves transparency and institutional trust, while creating a traceable digital record of all process events.

In addition, since all the interactions occur in the SIMPLE, it will be possible to analyse and visualize the as-is process by extracting insights from the event logs generated by the IT system of the SIMPLE and the timestamps created. Thus, the opportunities of applying data-driven techniques, such as process mining, extended to assure conformance checking, measure processing delays or identify outlier periods of time invested on reviewing a request.

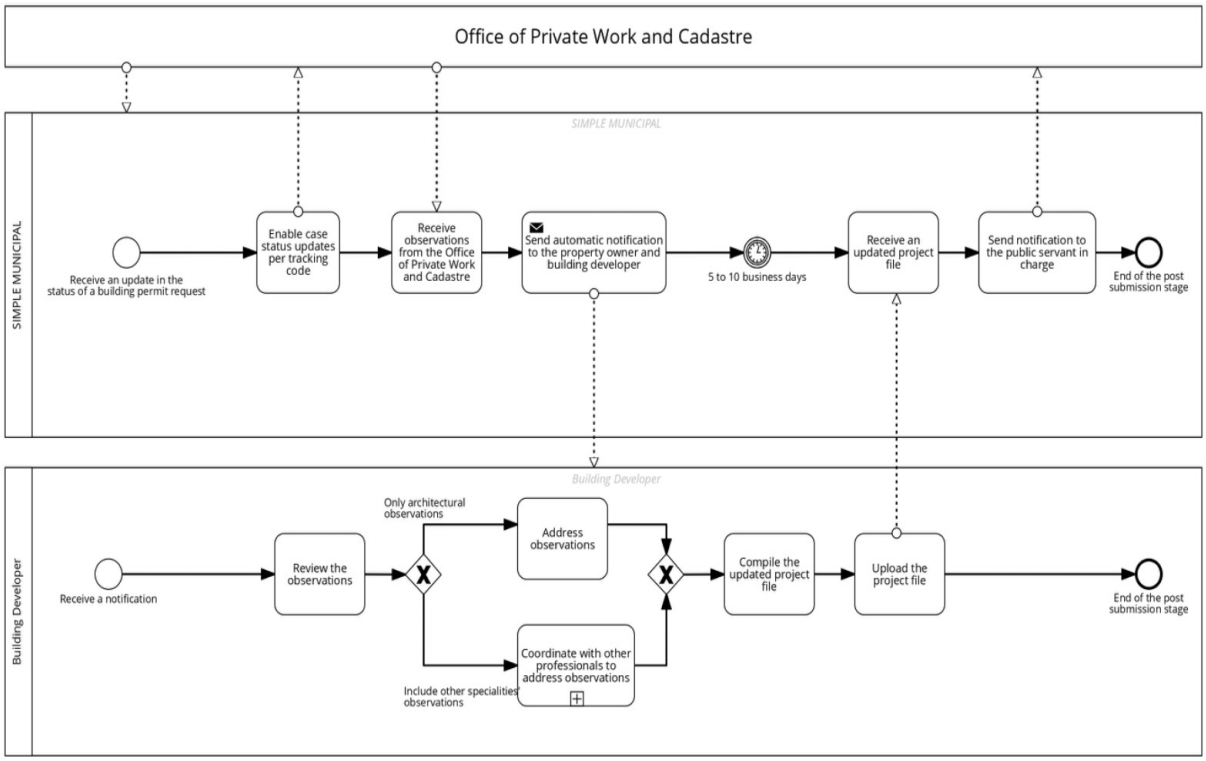


Figure 7 BPMN of the post submission stage including functionality 3

6.4 Phase C: Information Systems Architecture

This section presents a conceptual approach to analyse the functional aspect of the proposed prototype. To achieve this, a mapping of the required Information Systems (IS) was conducted to identify opportunities to leverage the current digital infrastructure and obtain a more efficient, traceable and legitimate building permit process.

6.4.1 The dynamic questionnaire engine behind the tailored requirements guides

The first functionality, the tailored requirement guide, is supported by a dynamic questionnaire engine within the Information System Architecture that supports the user experience when identifying which kind of building permits are needed for their projects. Its primary purpose is to generate a sequence of questions and informed responses based on a decision-tree-like rule-based engine informed by the National Building Regulations (RNE) and the Single Text of Administrative Procedures of the Surquillo Municipality (TUPA). To develop this questionnaire engine, the RNE was encoded to create conditional paths and rules to structure each of the conditions that

determine when a building permit request must be presented in a modality A, B, C, or D.

Furthermore, this core component considers the answers of the applicants to specific inquiries regarding the building project and its features (area or number of floors) to present a final list of requirements adapted to the building permit modality. The flow of questions is not static; on the contrary, it adjusts according to the previous answer of the applicant. This engineer has previously proposed designing smart pre-permit systems, cloud-based and applied to New York City, which assures its usability in the sector of building permits (Eirinaki et al. 2018). Moreover, it represents an early step in the broader effort to transform law into executable code, promoting regulatory clarity and automation in the issuing of building permits.

The decision logic for the dynamic questionnaire engine is presented in Figure 12. Thus, once the applicant interacts with Gop.pe looking for more information regarding building permits and clicks on “obtain a building permit” and “discover your modality”, the server calls the decision-making module to process the request. The questionnaire is displayed to the user question by question, filtering the answers based on the applicant’s answers. After recording all the responses, the system provides a list of possible modalities to the applicant, which can be further filtered considering the features of the building (area or number of floors), leading to a tailored list of requests according to the users’ needs.

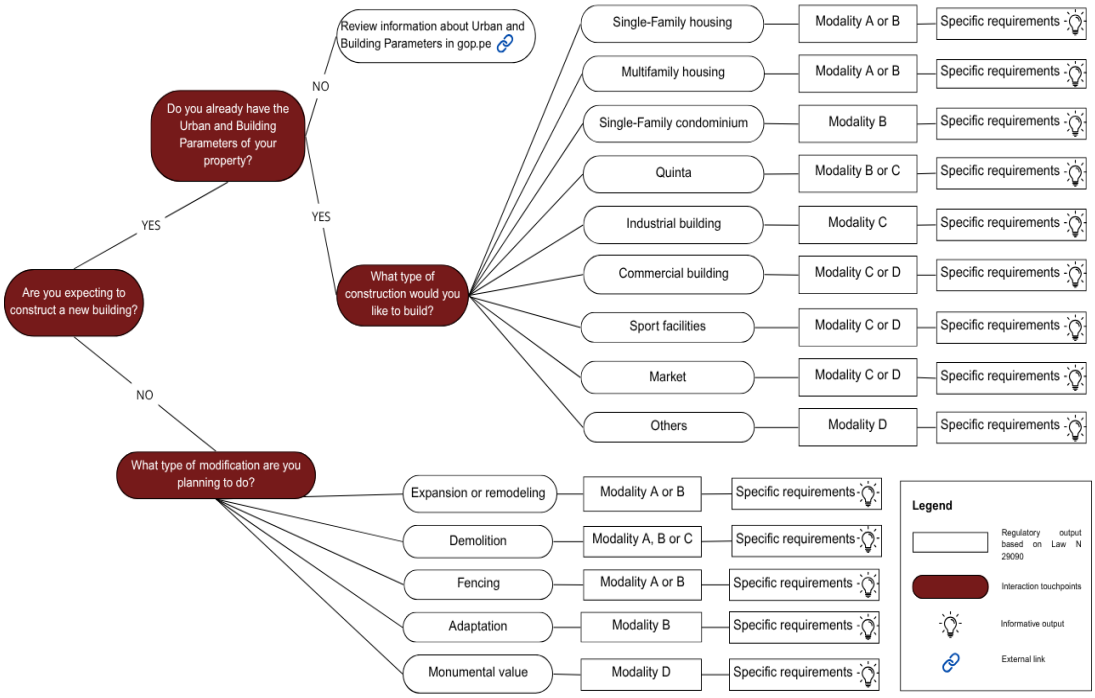


Figure 8 Decision Logic for Dynamic Questionnaire Engine

6.4.2 Streamlining form management with an electronic FUE

The second functionality is an electronic FUE, which looks to improve transparency and efficiency, while reducing errors in documentation handling. To ensure the flexibility and standardization of the FUE across building permit modalities or construction types, the electronic FUE will be grounded in the meta-model (Scholta et al. 2020) to guide the structure, evolution, and behaviour of digital forms in public sector services (Scholta et al. 2020). This approach implements a modular structure, which supports independence and reuse of the modules to dynamically assemble forms based on required regulatory changes, without affecting the entire structure of the FUE. In this way, it is possible to track legal changes and their effect on the FUE and the data collection process. To support the changeable structure, it is needed to filter the form's elements between the static ones- title, property owner identification- from the changeable ones, which vary according to regulation modifications. Furthermore, the third requirement introduced in the FUE is the electronic form, as it assures a dynamic behaviour of the modules, which are displayed or hidden depending on the users' input. For instance, in case the applicant selects remodelling, the form will hide the section related to the new building parameters.

As is presented in the diagram model (Figure 13), the rule-based architecture of the Electronic FUE is capable of adapting field visibility based on the selected type of work. To accomplish this feature, the FUE is composed by Module instances that capture areas of the forms that will be shown or hidden dynamically. Furthermore, each of the modules included a cardinality to show if it is optional or mandatory. The form is driven by a trigger field, *type_of_work*, which includes values such as new building, remodelling or heritage restoring, from a code list. This field affects the modules of the forms: approval modality, documentation uploaded, and existing building. Regarding the first field, approval modality, the filter works as is describe in the following table. Thus, in case the applicant selected an expansion as *type_of_work*, the approval modality list change accordingly, showing only available options: A and B. The same for the other eight categories of *type_of_work*.

Type of work	Approval_modality	Description
New Building	A, B,C,D	All approval modalities are valid.
Expansion	A, B	Only automatic approval or municipal/urban review.
Remodelling	A, B	Only automatic approval or municipal/urban review.
Demolition (Total or Partial)	A, B, C	Not allowed under modality D (technical commission + RU).
Fencing	A, B	Only automatic approval or municipal/urban review.
Adaptation	B	Requires evaluation by municipality or urban reviewers.
Repair	B	Requires evaluation by municipality or urban reviewers.
Heritage Restoration	D	Must be reviewed by technical commission + urban reviewers.

Table 8 Approval modalities per type of work

Furthermore, the *type_of_work* will also affect whether it is required to include information regarding the *existing building* group: *features_existing_building*- as it is only required in those cases where the applicant is requesting to expand, remodelling or demolish. The form is also considering the legal traceability to assure that each of the module instances responded to an updated rule based on legal tools. For example, the rule is grounded to Law 29090 and the Supreme Decree 018-2021 PCM. The rule also affects the list of requirements that the applicant must submitted to the Municipality, which could vary according to the type_of_work. Each legal foundation also included

information regarding since when the regulation is valid and determine if it is valid in the moment the applicant is submitting the information. This guarantees a real-time validation and legal traceability.

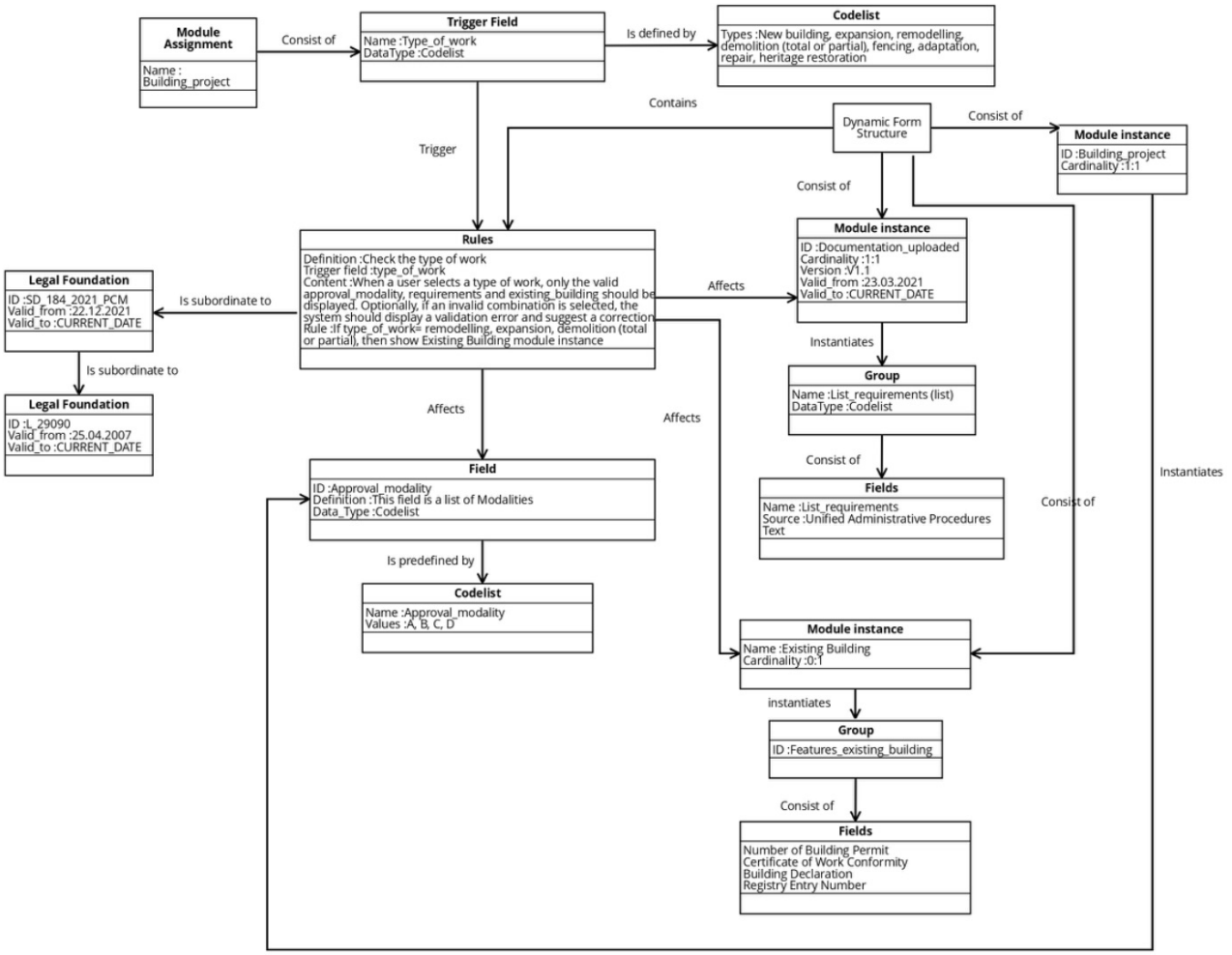


Figure 9 Excerpt of the dynamic form structure of the building permit application

To further support data completeness and reliability, the information systems architecture envisions real-time interoperability with external systems. Thus, the information collected through the FUE is complemented with external registries through API-based verification mechanisms, aiming to ensure reliable, standardized, and interoperable information exchange between building developers, property owners, and municipal authorities. In this way, the applicant access to a friendly form that gather all the required information in just one place, without the burden of review in other public databases to complete the information of the electronic FUE.

Through this integration, users are only required to provide foreign keys- such as their National ID (DNI), Property Code, and the Professional Registration ID- and the system automatically pre-fill the corresponding fields in the form modules. For instance, personal identification details- complete name, marital status and current address- are retrieved from the RENIEC identity registry by providing the number of ID. This reduces the time applicants otherwise spend manually filing the form and limits errors. The applicant only required to verify the prefilled data and add missing contact information, such as email and phone number.

Similarly, property details- total area and perimetric measurements- are pulled from the Public Registry (CRI) managed by the SUNARP using the property code. This reduces the complexity of looking at the SUNARP webpage and request the information by introducing the CRI tracking number. Plus, as interviewees mentioned, one challenge when filling the module Property on the FUE are errors in this section caused by manually entering the information, resulting in observations from the Municipality. Furthermore, by entering the Professional registration ID, the system connects to the Peruvian Architects' College database to very current professional's status. With this information, the electronic FUE automatically retrieve a simple enabled- not enabled status, eliminating the need for applicants to attach additional documentation such as signed declarations of eligibility.

This ensures a user-friendly, secure, and legally compliant data exchange process that reduces the burden on applicants and fosters consistency across institutional registries. The functional logic described here is enabled by the API-based interoperability mechanisms detailed in the Technology Architecture section.

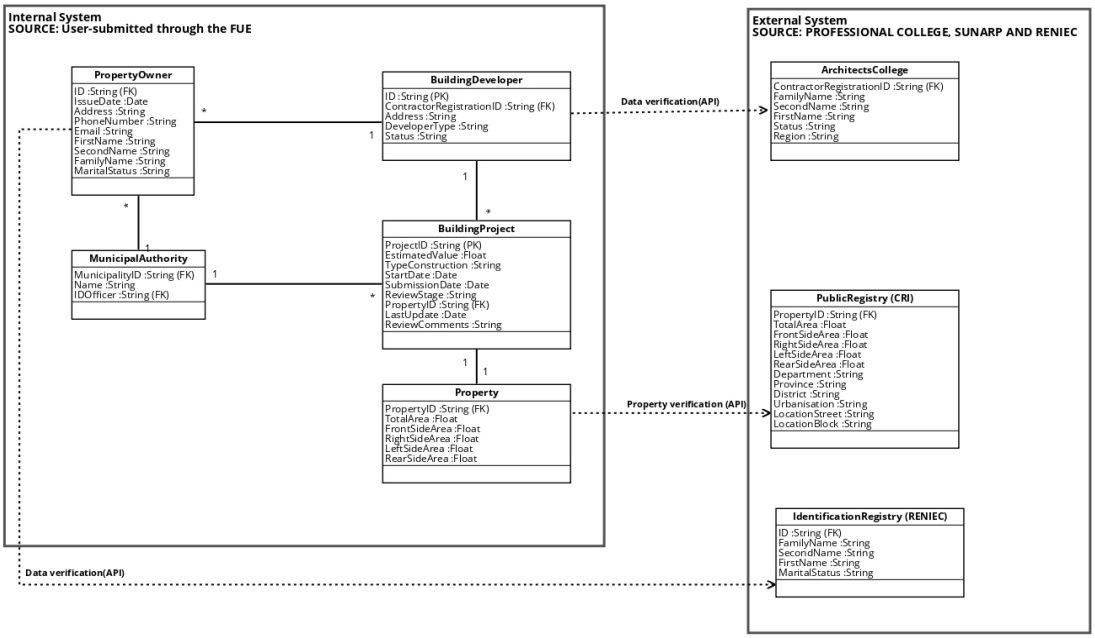


Figure 10 Logical Data Diagram of the Proposed Digital Building Permit Architecture

In addition, as part of the information system architecture, the electronic FUE incorporated a Document Reference Module that allow applicants to submit links to external cloud storage service- such as Google Drive or Dropbox- through a link. This method, as commented by one of the interviewees, has been previously applied in other Municipalities of Lima as a manner to guarantee simple submission of documentation through online channels, in a faster manner, facilitating the handling of large technical files and enabling applicants to manage access and updates the information from their cloud environment. Furthermore, any enabling traceability throughout the renew process.

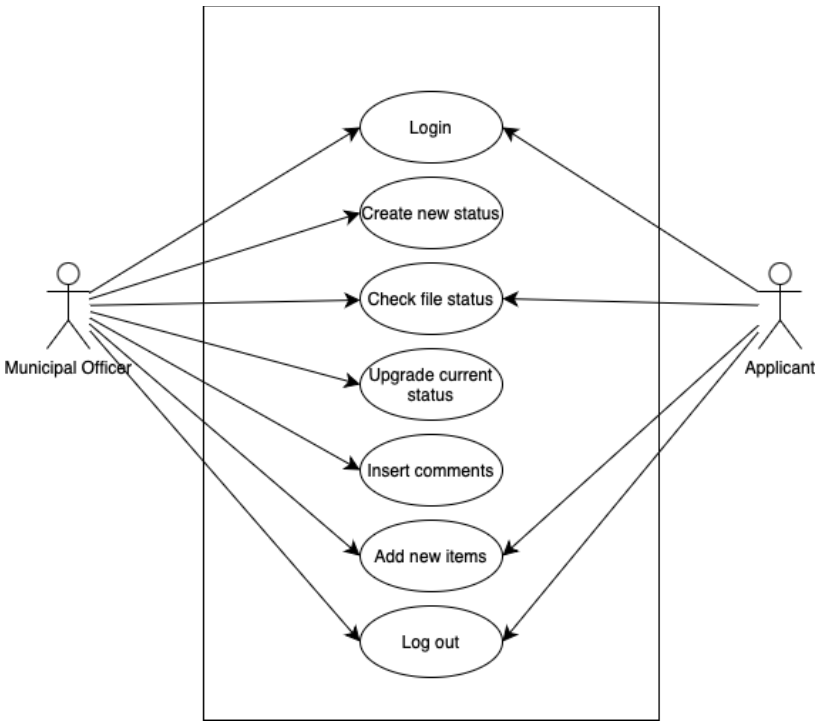
Finally, once the applicant finish filling the FUE, the information is automatically routed through the SIMPLE platform to the Document Management System (SGD) of the Municipality, where it is formally registered and assigned with a unique tracking number. This connection ensures that the Municipality formally registered the request, and follow the workflow of the administrative process, registering the request, reviewing that it fulfils all the requirements and then assigning it to a responsible official into the Subunit of Private Work and Cadastre.

6.4.3 Document tracking system and notification alerts

The third functionality covers the requirement three, status tracking functionality and SMS or email notifications to reduce the informal practices identified in the issuing of building permit requests. The proposed notification and tracking system, integrated with SMS or email notifications, required a tracking engine to enable real-time access to status changes in the application status. According to the literature, the document tracking requirement involves

recording and monitoring the status of documents that moves around different departments in the same organization, reducing employees' workload (Salleh et al. 2020).

Considering this trend in document management control, the information system architecture of this EA will be composed by a web-based document tracking system that centralized all the requests in a repository for further reviewal and revision control (Salleh et al. 2020). In this way, the system provides users with the possibility to online tracking the location of a document, in this case, the building permit request; while the municipal officer can manage the document by creating new status, updating its status and insert comments to further guide the applicant on the post submission stage. Consequently, the applicant can log-in into the SIMPLE, getting access to the document tracking system to review the file status, add new documents on the request and log out.



Source: Own elaboration based on Salleh et al., 2020

Figure 11 Use case diagram for Municipal Officer and applicant

Furthermore, this functionality is integrated with a notification service module that sends automatic alerts through SMS and email APIs when the public officer changes the status of the request. This version control will be supported by an upload timestamp and file version number, so guarantee the municipal staff is capable to track the application history. It will be gathered in the request database.

6.5 Technology Architecture:

The technology architecture layer describes how the functionalities of the prototype would be doable based on technology components that are represented by software and hardware components. As illustrated in Figure 16, the environmental and location diagram, the system is hosted in an Application Hosting Environment located in the Ministry of Housing Data Centre, providing a centralized infrastructure to manage the building permit requests. Here, the national authorities will host the local data inputs and generate outputs as reports to analyse the performance of each Municipality that uses the platform as an intermediary to collect the applicants' requests. Furthermore, each Municipality, in this case the Surquillo Municipality, also has access to the database and feeds the system with notifications regarding the status and comments about the building permit requests. Finally, external organizations such as RENIEC, SUNAT and the Professional Colleges also have access to the platform as they provide vital information to automatically fill the electronic FUE.

The technology environment consists of components such as a web server which hosts the SIMPLE platform interface that is accessible via web browsers, and an applicant server that supports the three functionalities, and provides support logic and data models of the building permit workflow. It also hosts databases associated with three entities: the property owner, building project and the building developer, ensuring consistency through all the requests lifecycles. The latter is also linked to an external API integration, which guarantees that by data inputs, foreign keys of each of the entities, the electronic form is automatically filled with information of private and public national registries, which includes RENIEC, SUNARP and the Professional Colleges. Also, there is a request repository, which functions as a data layer that host all the submit applicants and associated metadata. Thus, this repository allows applicants and municipality officials to retrieve update, track and monitor the status of the building permit requests.

To assure a level of security in the access to the SIMPLE platform, a user authentication is included as a requirement to access the platform. It is represented with a login mechanism and encrypted data exchange protocol. In terms of the workstations, as presented in Figure 16, end users can access the platform from their own devices such as the public offices who can access from the devices located in the Surquillo Municipality. Furthermore, to guarantee a continuous improvement of the functionalities, a feedback loop is integrated from the municipal users to the Ministry of Housing server, to allow continue improvement of the system, while integrating participatory principles which also guide the design of these three functionalities.

In this way, by centralizing the application components and include interoperable modules, the architecture enables modular updates, policy compliance and scalability. It ensures that the system functionalities are aligned with the TOGAF Arquitecture Development Method (ADM).

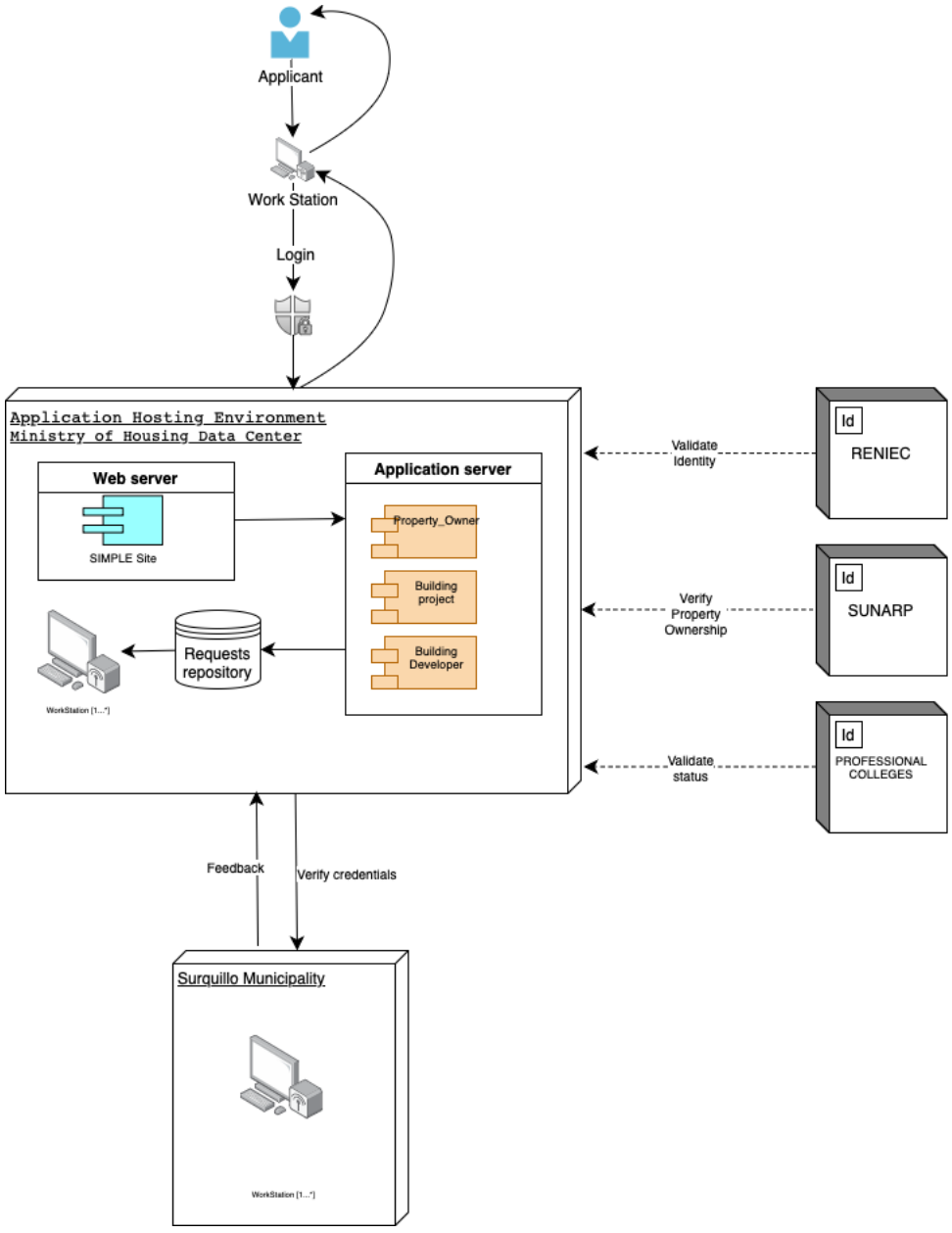


Figure 12 Environment and Location Diagram of the SIMPLE

Furthermore, to support the advanced functionalities previously escribed of the electronic FUE regarding the automatic pre-filling of user data, the technology architecture must incorporate an_API-driven integration layer._This is enabled by

Application Programming Interfaces (APIs), which are pivotal tools to incorporate data, services and processes of new and existing systems across organisations. Specifically, for the electronic FUE, API integration will support Surquillo Municipality to integrate databases that are currently isolated in different public and private organisations, including the National Registry of Identification and Civil State (RENIEC), the real Estate Registry Certificate (CRI) from SUNARP (National Superintendency of Public Registries), and the database of professional licensing for architects in Peru, through the College of Architects of Peru. To streamline the process, the system integrates instant data retrieval from external authorized public and private sources, increasing data accuracy and reliability. This integration allows entering manually only foreign keys such as IDs and the authorized data will be automatically pre-filled in the forms through a secure standard-based API.

Regarding the technical considerations, the analysis of previously designed API- driven solutions, which are mainly focused on the integration of Electronic Health Records, determine the relevance of introducing API integration over other traditional integration methods. Thus, point-to-point interfaces can result in complex web connections or even limit the integration of diverse systems and applications (Chitta et al. 2022). To overcome these technical limitations, API technology allows a modern approach to interoperability in the public sector, enabling different software applications to communicate and exchange data despite the diversity of systems that are involved (Chitta et al. 2022).

Furthermore, the integration of Representational State Transfer (REST) APIs is proposed, as this architectural style offers superior performance, flexibility and lower overhead. REST is characterized by its simplicity, ease of implementation and support for multiple data formats- JSON, XML or plain text- which enables developers to choose the format best suit to their systems. The use of compact formats such as JSON significantly reduces bandwidth consumption during request and response cycles, which is crucial when handling multiple and parallel users' interactions.

In addition, REST APIs are highly compatible with progressive digital transformation as they allow for seamless integration with legacy systems while remaining suitable for modern, state-of-the-art architectures (Chitta et al. 2022; Akilesh and Hallikar, 2022). The latter is pivotal for the public sector where systems evolve at different rates. Moreover, REST API has demonstrated superior performance in handling large file transfers, such as the architecture plans submitted through the electronic FUE, reducing upload time to enhancing the user adoption (Chitta et al. 2022; Akilesh and Hallikar, 2022)

The integration of APIs into the building permit process represents a security challenge given the data processes through the electronic FUE -including personal identification, property ownership and professional credentials. Thus, as APIs facilitate communication among the stakeholders of the process, it is also vulnerable to malicious actors looking for unauthorized data access. Consequently, implementing a secure authentication mechanism such as OATH 2.0, multi factor authentication for internal users and integrating the digital signature for the submission of the documents, while ensuring legal liability.

7 Validation

The validation of the artifact, and its three functionalities, was performed in three DSRM cycles, considering four main criteria for the evaluation: effectiveness, efficacy, feasibility and completeness. In this way, the questions were focused on determine if the solution was valuable to address the identified problems, the requirements were fulfilled and doable and determine if there are other requirements to be addressed.

The first cycle was conducted with three architects who participated in the exploratory stage of this research. For that reason, the session began with a presentation of the three critical issues identified during the exploratory stage: the information asymmetry, the reliance on manual and paper-procedure, and the prevalence of informal practices once the submission has been uploaded. Then, the participants were questioned regarding their perception of this problems, reinforcing the perception of inefficiencies and discretion remain embedded in the public administration system.

On the second part of the validation session, the requirements were introduced by presenting the FIGMA, as an interactive tool to visualize and interact with the core requirements of the proposed digital solution. The main objective was to determine their effectiveness to countermine the prevalence of the above-mentioned problems. Even though participants expressed scepticism regarding the idea that structural problems, such as local governments' inefficiency and corruption, could be fully addressed through technology alone, they responded positively to the first functionality: the interactive requirements guide. They unanimously recognize the clarity and ease of use of the questions flow, as well as the definitions of each of the building categories and modalities. One of the participants mentioned that the guide provided a user-friendly manner to share regulations that normally are complex to understand.

On the other hand, one critical observation emerges: simplifying the legal criteria too much could lead to interpretative inconsistencies. For that reason, participants noted that the complexity and subjectivity of the process required the judgment of a qualified professional. To address this limitation, the discussion led to proposing rethinking the guide not only as an informational tool, but also a proposal to nudge citizens, encouraging them to approach a professional when the case exceeds basic or standard conditions.

The second functionality received positive feedback, particularly in terms of its capacity to overcome logistic and bureaucratic barriers when submitting a request. Participants find relevant the reduction of paper-based-tasks and the automatic validation of fields

involved in a request. Nevertheless, one of the participants mentioned the importance of maintaining an in-person submission option alongside the digital platform. This, since some property owners, specifically older ones, associate legitimacy and trust with paper and handmade signatures. For that reason, the transition must be gradual and inclusive, rather than abrupt, to avoid alienating users who may be less familiar or comfortable with digital tools. Other observation to consider is related to the submission of the documentation, as participants expressed concern about the potential loss of architecture details or resolution when submitting information online. For that reason, it is vital to ensure good visualisation with high quality file uploads and effective on-screen visualization. The latter introduce more requirements to consider in the technology architecture, particularly in terms of hardware and the infrastructure that support digitisation at the local level.

In terms of the third functionality, the participants recognized the vital role of getting up-dated and open information regarding the building permit requests even if it is only reported from the Subunit of Private Work, and not the professional college committees in the case of modality C and D. They also mentioned how this tool could be used by property owners to check the status of their processes by themselves, empowering them to not only follow up the work of the Municipality but also be informed about the quality of the hired professional work. They also suggest considering WhatsApp messages as it is a more used tool by property owners to received notifications.

In this way, all participants confirm that three requirements fit on the presented problems, in a simple and fast manner. They also proposed the further development of the proposal to consider other types of licenses. Notwithstanding, their main concern is to determine if the proposal is completely doable from the point of view of the national and local authorities.

For that reason, the functionalities were presented in a second focus group to municipal officers and two representatives of the Ministry of Housing, with primary focus on evaluating the feasibility of implementing the proposed prototype functionalities. Contrary to the results of the first session, where participants focused on the effectiveness and citizen-facing improvements, the discussion centred on the technical, institutional and regulatory limitations of the prototype.

Thus, the presentation of the requirements raised concerns regarding the implementation of the prototype, mainly focused on the internal capacity of the Municipalities in Lima, the limited resources and the lack of technology assets. The first two participants, who currently worked as municipal officers, expressed strong scepticism regarding the electronic FUE and the digital submission of building permit documentation.

Specifically, they pointed out several limitations based on their experience during the COVID-19 pandemic and the implemented digital tools to continue with the public services. First, concerns were regarding the volume and complexity of submitting required documentations with specific visual formats and over the image quality and resolution as they do not consider that Municipalities have the required computers to conduct the review of the documentation. Furthermore, they presented security concerns regarding the verification of the digital signatures, as physical handwritten signatures have traditionally provided legal validity and confidence in document authenticity. These concerns were focused on the infrastructure gap within municipalities in Lima, where there is not only limited technical capacity and scarce human resources, but outdated technology assets which could require the further print of the documentation to assure an accurate review of the documentation.

Complementary, the two representatives of the Ministry of Housing raised conceptual concern about the functionality 1 and 2. They emphasized that all building projects must be overseen by a certified professional and therefore questioned the necessity of offering property owners information about building permit modalities. From their point of view, an unintentional effect could be to encourage owners to bypass professional guidance, which is risky and contrary to the regulation. For that reason, they argued that the functionality 2 and 3 should be restricted to professionals, not property owners. Only certified professionals should be able to complete a request or to monitor the application status.

Despite their concern, participants offered valuable recommendations to strengthen the proposal by contributing from the point of view of public servants and the need of an internal monitoring feature. They suggested incorporating alerts for municipal officers so they can be aware of deadlines for responding to applications. The performance tracking functionality could ensure regulatory compliance and timely processing.

This shift in emphasis- from the citizens' point of view to the internal accountability- reflects a border institutional interest on promoting efficiency within municipal officers. As final remarks, the Ministry of Housing representatives concluded the session acknowledging that SIMPLE, is an initiative for digital transformation in the housing sector that is currently under their leadership, and it is scheduled to be fully implemented by 2030. For that purpose, they count with clear political mandate and resource commitment, which strengthens the long-term feasibility of the proposed architecture. For that reason, it is vital to assure an underlying vision, albeit with modifications, that ensure the research alignment with the national digital government objectives.

As a result of the first DSRM cycle, the solution was evaluated, and the provided feedback permit the refinement of the solution for the news cycle of validation. It's vital to mention that the comments of first DSRM cycle were evaluated to determine how feasible was to introduce the modifications considering the approach of the proposal, that is guided by user-centred principles. Moreover, the approach conducted to the building permit is focused on analysing the process as a government transaction that guarantee the access to citizens right to construct on their property, which justify the need to include them in the decision-making process of the building permit, as a manner to empower them through the process. For that reason, the list of improvements introduced to the proposal included:

- A behaviourally informed message was incorporated into the interactive guide (Functionality 1) to nudge citizens towards consulting a certified professional before proceeding with the building permit request. The message aims to promote regulatory compliance by emphasizing that, in case the result of the guide is to request a building license, they must require an expert evaluation.

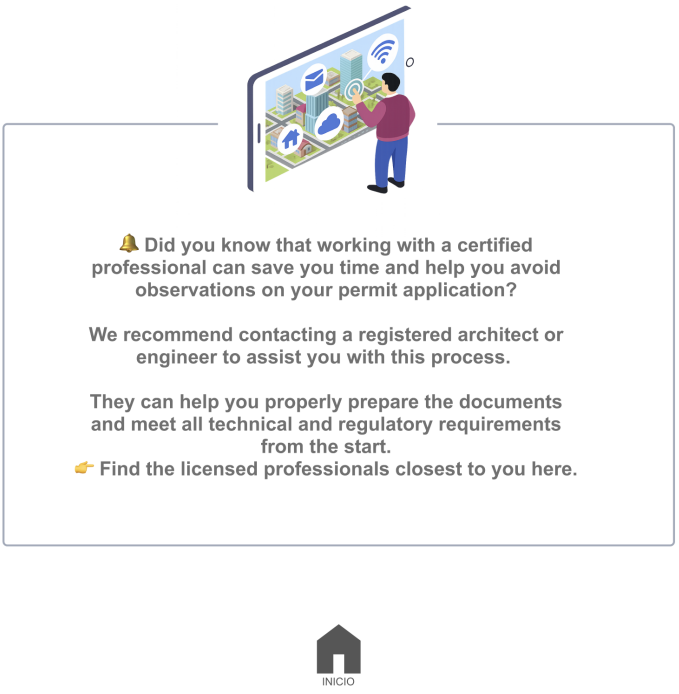


Figure 13 Behavioural informed message (Functionality 1)

- To ensure a streamlined and high-quality documentation upload process, a meeting was held with a representative of the Presidency of the Council of Ministers (PCM), specifically from the Secretariat of Government and Digital Transformation, to determine the most suitable method of submitting supporting documentation. The proposed solution allows applicants to share a link to a cloud storage folder, such as

Google Drive, and grant access permissions to municipal officers to review the project files. This functionality is incorporate into the functionality 2, through the electronic FUE.

- To strengthen trust and interoperability, the proposal includes a strategy to foster collaboration with professional associations such as the College of Arquitects and Engineers. This would enable the system to integrate automatic validation of professionals' certification status, ensuring that only authorized individuals can submit building permit applications to the municipalities (Functionality 2).

- The presentation for further validation sessions must highlight the alignment of the functionality 1, 2 and 3 with strategic planning instruments, including the Institutional Strategic Plan (PEI) of the municipality and the National Policy for Housing and Urbanism 2030. This alignment reinforces the feasibility of the proposal by aligning the existing political commitments and financial frameworks with the proposed requirements.

In the second cycle, the validation counts with the participation of one representative of the Architects' College and three architects with experience requesting building permits from the Municipality of Surquillo. The main objective of the focus group was to validate the effectiveness and efficacy of the functionalities in addressing the identified problems.

First, participants agreed that both citizens and, in some cases, professionals lack awareness of the current requirements for requesting building permits. Align to this observation, the representative of the Architects' College mentioned that since the certificate of urban parameters is no longer mandatory, most property owners are unaware of it, even though it remains critical to determining what can be built in a property. For this reason, the four participants endorsed the guide's usability, emphasizing its capacity to empower citizens and improve communication between the municipality and the citizens. They highlighted the interactive design, describing it as having a conversation, and not overloaded, increasing engagement with the questions.

However, one participant raised concern over the risk of oversimplification, especially when addressing complex or hybrid cases that do not fit into predefined categories. For that reason, there was unanimous support for the behavioural-informed messages to nudge citizens to seek professional advice when their case does not match with existing modalities.

When questioned regarding the functionality 2, the focus of the conversation switched to the digital divide and the resistance to change among age groups. While participants acknowledged the form's potential to reduce errors and save time, they also mentioned that some architects are reluctant about digital tools and prefer to conduct their businesses in person. This includes activities like going to the Municipality as they know someone inside the institution that is willing to help them with their requests. Therefore, participants stressed the importance of institutional enforcement to ensure municipal adoption, recommending the use of regulatory instruments to mandate its implementation. In one optimistic note, participants mentioned the potential for data analytics enabled by electronic forms, including the use digital signatures and the analyse of patterns on building permits modalities.

Furthermore, once the attention came to the functionality 3, the discussion pointed to the role of property owners and the importance of provide open data to contrast their vulnerable position when hiring a professional to building in their properties without basic knowledge about the process. From the point of the professional, participants manifest total agreement with the notification system that is a huge time-saver—especially for those handling multiple permits. Thus, functionality 3 allow easier tracking of all the processes in parallel, accessing to evidence in case it is necessary to present an inquiry to the Municipality.

To sum up, during the second cycle of evaluation, the participants confirm the effectiveness of the proposed functionalities to address the identified problems. They also reinforced the approach of the prototype which consider as end users both, the professionals and the property owner. In this way, the functionalities were described as multipurpose, addressing simultaneously the level of informality on the process, cutting administrative costs, enhancing transparency while informing citizens about the process. On one hand, the participants were agreeing about the capacity of technology to reduce human discretion and personal favouritism presented when applicants interact with the municipal officers. In this way, automation and digital channels promote equitable, transparency and reduce corruption related to the process. On the other hand, and as a not expected value of the requirements, they could also democratize access to formal processes among high informal districts and bring technical guidance closer to unserved population. From a pedagogical standpoint, the interactive guide was seen as a foundational resource that could support informational campaigns in other municipalities across Peru, promising formality and addressing the gap of knowledge regarding this government transaction.

The last DSRM cycle was conducted with the participation of three architects from the Surquillo Municipality, including the Directorate of the Subunit and Private Work, and two specialists responsible for evaluating Modality A-B and C-D building permit requests. This session focused on evaluating the feasibility and completeness of the three proposed requirements, which had already been refined based on feedback from previous validation cycles.

The Directorate of the Unit recognized that the functionality 1 accurately tackle the ongoing information asymmetry experienced by property owners. She mentioned that property owners often remain uninformed because professionals do not consistently communicate updates. This dynamic contributes to the perception that the Municipality is underperforming, even when the delays and issues are consequences of the applicants.

In consequence, municipal officers are overburdened performing as the facto advisors, dedicating significant time to guide applicants through the process. For that reason, participants strongly supported integrating the functionality 1 as part of the SIMPLE, not only to support regulation compliance, but also as a long-term tool for public education strategy to help citizens understand technical regulations like building permits. They further confirm the necessity to design public services for citizens, and not only professionals such as architects or engineers. Plus, to assure that the instructions remain contextually accurate, they recommended including district-specific regulatory filters in any future expansion of the guide beyond Surquillo district.

Furthermore, functionality 2 was evaluated from a technical and operational point of view. The participants reiterated the importance of adopting a hybrid implementation strategy, acknowledging that a full digital transition could be constrained by citizens' habits and institutional capabilities. This aligns to concerns raised in the second focus group, particularly regarding technical, infrastructure and economic limitations. The architects also emphasized that legal constraints imposed by external institutions, particularly SUNARP, hinder the digitization process. As reported, SUNARP continues requesting for property registration printed documentation, which forces municipalities to maintain paper-based-steps despite their willingness to adopt digital procedures. This highlights the need for cross-institutional coordination to enable full digital transformation.

Finally, the functionality 3 was evaluated considering its capacity to bridge the communication gap between the property owner, the professional, and the municipality. While participants recognized its practical value, they expressed uncertainty about its capacity to enhance legitimacy or perception of transparency on its own. Thus, according to the participants, the requirements must be understood and implemented in

a coherent and integrated solution. Only by addressing interdependent limitations within the procedural and technological layer, the building permit process can be reform meaningfully as was presented in the main objective of the research.

8 Discussion

This research supports the design of a user-centred enterprise architecture (EA) model, which addresses procedural and technological barriers encountered in the issuing of building permit processes at a local municipality in Peru.

First, by applying a conceptual framework aligning a systemic approach of the building permits and the Open Group Architecture Framework (TOGAF), specifically its Architecture Development Method (ADM), it was possible to desegregate the layers of the studied process. Then, informed by the testimonies of interviewed applicants and public officers, it was possible to determine that the main problems encounter when accessing to this government transaction were in its technology and procedure sub-system.

Based on the provided insights, it was proposed three functionalities aligned to the Municipality objectives, and to the national policy to assure political and economic support for a further implementation. For that reason, the functionalities were introduced as recommendations to improve the service provided by the Monitoring System for Procedures and Issued Licenses (SIMPLE), a digital tool that is in designing process, projecting its launch by 2030.

Regarding the proposed functionalities, during the validation cycles, the functionalities 1 and 2 effectively address the key challenges identified within the organizational and technology layer of the building permit process, thereby confirming its effectiveness. Specifically, the discussion around the functionality 1 emphasized its dual role as an informative tool that could also perform as a pedagogical tool. From a long-term perspective, participants underscore the need to transform the social perception of building permits, not merely as a bureaucratic obligation, but as a civic responsibility inherently tied to property ownership.

The latter is presented as an insight of the research as it was identified the need to rethink the design of digital public services in the sector of Housing. Traditionally, digital solutions have focused primarily on supporting professionals (architects or engineers) to comply with the technical requirements in municipal procedures. However, this approach overlooks the importance of the property owner, who initiates the construction process and ultimately determines whether it is carried out formally or informally (without a building permit). These actors are holders of property rights and political agency, as voters in their districts, holding a high degree of decision-making power in urban development policy. If they are properly informed, they are more likely to engage professionals and comply with the national regulations regarding permitting

regulations. On the contrary, when this segment of the population remains unaware of their legal responsibilities, they may opt to informal construction practices, often bypassing the technical validation altogether and opting for informal methods to assure the future registry of their property.

For that reason, improving the effectiveness and legitimacy of the building permit process requires a user centred shift: focusing on the property owner at the centre of the policy and service design. Doing so not only promotes formality and transparency in the sector but also enhances long-term outcomes in sustainable and controlled urban development. Thus, an informed citizen could also become a city supervisor, informing authorities when constructions are not fulfilling all the requirements.

In this way, the analysis also confirms the artifact's efficacy in provisioning this interactive digital guide which dynamically presents regulatory requirements based on the users' needs. Furthermore, functionality 1 introduced one more criterion to the analysis, inclusiveness, promoting user-centred approach in the design of public services.

In the case of the functionality 2, the identified challenge was correctly countermine by the electronic form providing a complete proposal to overcome the reliance on manual and paper-based procedures at least within the Surquillo Municipality. Nevertheless, it is vital to recognize some limitations in terms of its implementation at other municipalities or national level. As described during the last validation cycle, the pandemic shows architects that the willingness of adopting digital solutions into one unit of a local government is not enough to guarantee a long-standing adoption. Thus, a digital transformation required the whole organisation, including the Document Management Office at the other Municipality, which oversee managing documentation regarding public services. Furthermore, as participants reported, even if the Municipality participates in the proposal, the final stage of the license process is the registry of the property at a Public Registry of SUNARP, which requires the submission of all documentation in physical formality. This implies that once digital tools are introduced into the building permit process, it must be supported by a stronger digital transformation strategy.

In addition, the third functionality focuses on the implementation of a tracking system that reinforces the transparency and operation efficiency of the building permit process. From an implementation standpoint, during the validations session, the system highlights due to its minimal training for municipal staff and mitigates the most reported procedure risk, the informal channels to track the application progress by providing updated information about the request status, regardless of the personal connections of

the applicant. Plus, this requirement enhances the SIMPLE capacity to support end-to-end digital service delivery by closing the process by providing information about the post submission stage. Furthermore, its implementation could set the foundation for further analytical tools such as dashboards or chatbots, as recommended by participants of the validation sessions, to continue improving the service experience.

In terms of the adoption path of these three requirements, participants consistently emphasized the importance of a hybrid and incremental implementation strategy. The discussion highlighted the limitations of pursuing a radical approach, all at once transformation, particularly within the constraints of a public organisation. From a business process management perspective, radical transformations require long-winded planning, sustained political will and strong managerial capabilities', which are limited within the local governments. This research contributes to the discussion regarding digital transformation by underscoring the value of phased, step-by-step implementation, in context like Peru, where economic barriers, infrastructure gaps, and limited human resources hinder the large-scale deployment of ICT tools. Accordingly, the case study reinforces the need to implement incremental learning and iterative design methodological frameworks, ensuring that digital innovations are technically, socially and institutionally viable.

The latter is vital for further implementation of the requirements in other municipalities. Thus, as the EA was validated by stakeholders with experience working at different local governments and national organisations, and that the design of the EA is aligned to the national regulation context, it is possible to propose its' scalability to other municipalities. To accomplish this, it is vital to consider some pre requirements that must be assess before any implementation such as political willingness and the presence of a director that assume the leadership of the project from the point of view of the organisation, guaranteeing the inter-office collaboration with units. Beyond its technical features, the proposed system fosters a shift when referring to the design of digital public procedures. From technical and fragmented services to proactive, inclusive, and transparent governance in urban development.

9 Conclusion

This research conducted an analysis of the building permit process as a transactional public service, aiming to assess how strategically implemented ICT tools, guided by user experience and systemic framework, can generate high social value. The research was first informed by the literature that argues that the core of an efficient government is to simplify and streamline government transactions. For that reason, one process that is particularly known as cumbersome and prone to informality was selected, expecting that digital tools can increase transparency and efficiency of the process.

A literature view regarding the issuing of a building permit as a government transaction focuses the research on the procedure as a point of contact between the local governments and the citizens, a responsibility of all property owners and a tool to guarantee the exercise of ownership rights. Furthermore, it was determined that the most accurate manner to study this administrative process was from a systemic approach, recognizing the interdependence and influence performed by the legislative, organizational, technological, and procedural sub systems (Fauth et al., 2024a). The complexity of issuing a permit in Peru stems from the multiplicity of regulations, across national, regional and municipal level, and their interdependence with organisational, procedural, and technological dynamics. Moreover, the technological subsystem is also vital when considering the information flow embedded in the process, and the procedural sub system to further dive into the way the process takes place into each organisation. All these layers were interdependent to the other, in a way that any irregularity identified in the organisational sub system affects the others. That is, for instance, the case of one of the identified problems: the information asymmetry regarding when and how to access a building permit. As the organisation did not provide all the information in a complete and friendly manner into the Municipality Hall, it affected the way the complete processes were performed. Increasing the queues of applicants looking for advice about the building permit request, causing a high number of violations to the regulation because of miscommunication and the reduced transparency of the process. Thus, it has become a common practice to overcome these limitations by contracting external actors that are connected to some public officers to assure a faster and more efficient process.

There is when the ICT tools are presented as a possible solution. As identified in the literature, the e-permitting systems has been implemented throughout Europe and Asia with outstanding results in terms of accountability, efficiency, transparency and, ultimately, improving both, the back end, internal administrative process, and the front-end service (Ivanova et al., 2020; Rey-Moreno & Medina-Molina, 2016; González et

al., 2024; De Lima-Omorog et al. 2018). At this point the discussion turned into cutting-edge technology innovations such as the Building Information Modelling (BIM) software for 3D representations of buildings and guarantee interoperability among the specialists while they are designing the building projects. Other innovative practices were presented such as online payment, communication, notification, and submission features; auto-code check, auto-generated checklist, and remote monitoring (World Bank Malaysia Hub, 2020).

However, the first exploratory interview pointed out that the current state of the building permit process in Peru was a Level 0 or traditional paper-based permit. As described in the literature, this kind of process is characterized by the lack of automation, dependency on paper copies and drawings, which reduces the quality of collaboration among responsible agencies, mostly if local governments oversee reviewing the requests (Shahi et al., 2019). Furthermore, repetitive tasks, paper-based and in-person steps, lack of complete and accessible information and informal practices emerge as a way of going over the complexity of the process. Then, when exploring the conditions of the selected organisation, Surquillo Municipality, these problems were linked to causes such as the lack of human resources, mainly as there are only two architects in charge of evaluating the fourth modalities of building permits.

For that reason, to introduce a step-by-step proposal that can take advantage of existing innovative practices at local and national level; while assuring institutional alignment with policy planification, it was proposed three functionalities to integrate a digital submission of 2D drawings supported by online channels of information and a tracking system. These ICT tools were proposed as complementary to be allocated between digital and human providers. In this way the requirements look to harness the respective comparative advantage of each resource, ICT and human, to determine which tasks can be automated, and which not.

Thus, considering the characteristics of the building permit process, which has demonstrated to be highly technical and complex, it is possible to separate the tasks that are knowledge-based, such as the review of the building projects, from those that are repetitive such as the pre-submission activities that required to instruct the applicant about how to field the FUE, or post submission ones, related to informing the status of a request. In this way, by delegating the performance of these repetitive and not knowledge-based tasks to the ICT tools, it is possible to increase the efficiency of the process.

Regarding the contributions of the research, first, from a conceptual perspective, by aligning a systemic view of the permitting process with the TOGAF ADM framework,

the research enabled a layered diagnosis of institutional, procedural, and technological shortcomings. Thus, by aligning the identified challenges with the ADM phases such as the Architecture Vision, Business Architecture, and Opportunities & Solutions, it was possible to propose a phased design strategy that aligned to the institutional objectives, stakeholder inputs, and implementation feasibility. Also, the ADM's emphasis on interaction and stakeholder engagement during the design of the requirements was reflected on the participatory validation cycles to refine the requirements. The relevance of this experience is that participants not only provided information regarding their experiences dealing with this process, helping with the validation of the identified problems, but also contributed redefine the proposed functionalities considering the technology, organisational, procedure and regulation subsystem of the process. Thus, the 11 interviewees plus the 17 participants of the focus groups ensured that the EA was technically feasible, institutionally grounded and politically legitimated by the local authorities. In this way, the TOGAF ADM not only served as a technical modelling tool, but it also performs as an instrument to bridge the technical ambitions of an EA, with the policy objectives and operational reality of a local government.

For that reason, there are two expectations regarding the results of this research. On one hand, the research provides a scalable and adaptable proposal to other local governments that face same technology and procedure limitations as the ones described in this analysis. On the other hand, the theoretical and design framework can also be presented as a toolkit to design target solutions to local governments challenges, by assuring a systemic approach to the problem backed by an iterative designing process.

Second, the research contributes to the discussion regarding the role of digital tools to enhance government operations' transparency, reducing bribery and corruption. Thus, during the design stage of the DSR process, it was proposed that by monitoring the issuing of building permit processes and reducing the interaction among the public officer and the applicants, it is possible to prevent the corrupt behaviour. However, contrary to what was expected from the literature, during the validation cycles participants manifested their scepticism with this proposal. As a module to track the status of a request, by itself, cannot be presented as the solution to corrupted and informal practices in the issuing of building permits. For that reason, the discussion turns into the role of technology, not only as a complementary tool to a public process, but as educational tool that can communicate in a friendly manner regulations that are pretty much complex for citizens. This implies not only to rethink the manner of using functionality 1 during the pre-submission stage, but to argue that the implementation of ICT tools into the public sector must be research considering its short- and long-term impact. The immediate digital functionalities are related to the use of the interactive

guide as an informative tool to support current applicants to determine if they require or not a building permit, and which modality. The broader implications are related to the governance of AEC sector, fostering long-term transparency and civic responsibility by designing communication campaigns focus on school students to support their knowledge about the property owner's responsibilities. Both applications are aligned to the goal of the functionality 1, to reduce informal practices and corruption among field stakeholders.

Third, as identified previously in the literature, one barrier to consider when analysing the implementation of ICT tools into public administration is the level of fragmentation of the public ecosystem. Thus, it increases the level of complexity when referring to implementing interoperable systems that must be aligned to different regulations and rules regarding the AEC industry (Fronk, 2021). For that reason, it is vital to analyse, as a recommendation, the need of designing an interoperability governance framework to define shared forms, enforce digital policy and standardised procedures. This is the only manner of assuring a long-standing implementation of the SIMPLE, while promoting its continuous improvement. Furthermore, other barriers to consider are related to the cultural resistance to change, mainly among specific age groups. As mentioned by participants, in countries like Peru, there is a conception regarding legitimacy and legality embedded in the in-person processes. For instance, concerns regarding the use of the digital signature indicated that legitimacy is still related to face-to face procedures as most of the comments against this functionality were related to the levels of insecurity and its vulnerability to scams.

Despite its grounded contributions, one limitation identified during the validation sessions is related to the scope of the process, which focuses exclusively on the issuing of building permits, without extending to linked procedures such as the Construction Compliance Certificate. This certificate guarantees that the construction has been executed according to the project plans evaluated to approve the building permit. As highlighted by one of the participants, many of the bureaucratic and procedural challenges identified in the analysis are also prevalent in the subsequent process. Furthermore, as it required in-situ verification and supervision, it is even more complex as it depends on human discretion and institutional resources. For that reason, while the proposed EA addresses initial problems of the permitting process, it does not include the whole cycle of a building project which requires a comprehensive digital transformation strategy.

As this research applied the TOGAF ADM, the latter underscores the importance of extending the research to design the Phase H: Architecture Change Management, which

highlighted the need of continuous monitoring to evaluate possible emerging operations of the digital architecture. For this reason, future iterations of this model could extend the scope of the digital transformation to encompass additional services to assure a complete end-to-end scope of the construction lifecycle.

Finally, this research opens the research agenda to analyse the feasibility of integrating other national-level platforms such as pagalo.pe. This is a digital payment platform that registered 8.6 million of transactions in 2022 and integrated 27 different public entities in its catalogue of alliances. Thus, according to the literature, online payment has proved to increase transparency and accountability, contributing to reducing corruption in public transactions (World Bank Group 2020). Ultimately, this research offers a roadmap for scalable and user-centred digital building permit for Latin American municipalities, tailored to the specific national and local regulation of the Peruvian case study. This proposal was designed responding to institutional, cultural and organisational realities, aiming to promote a formal urban development of the future of this country.

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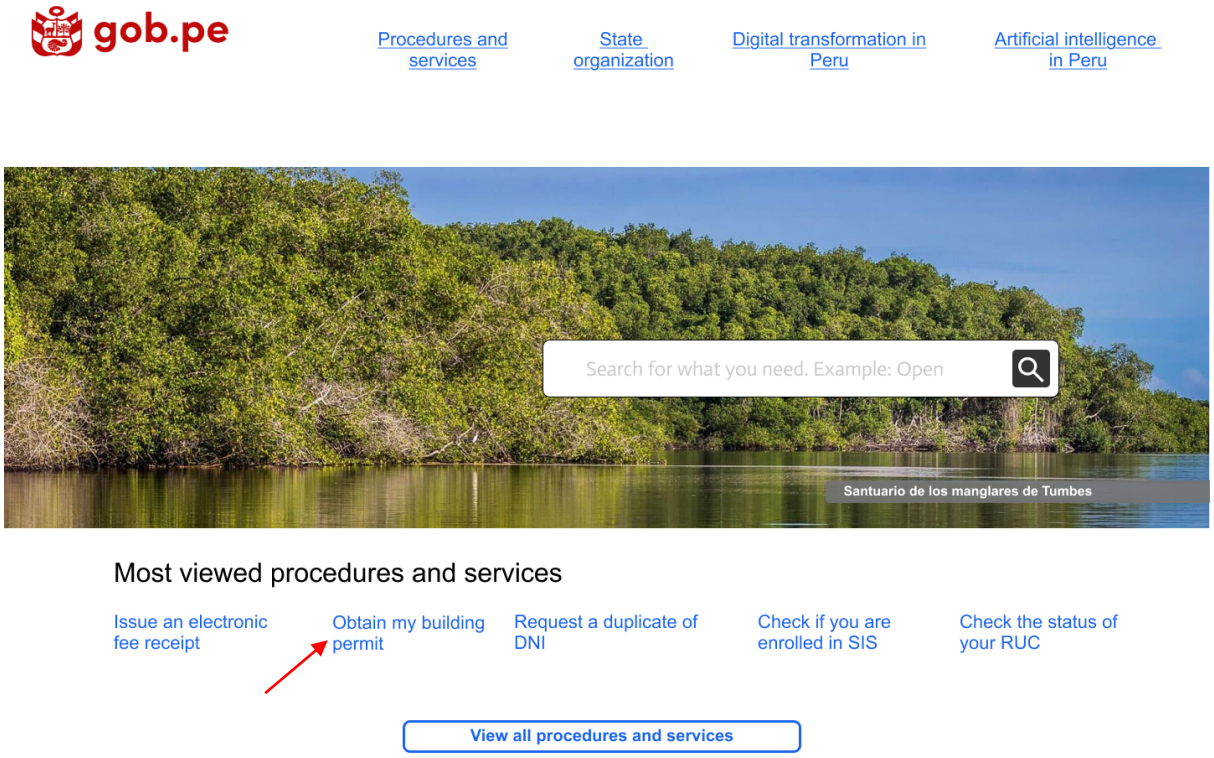
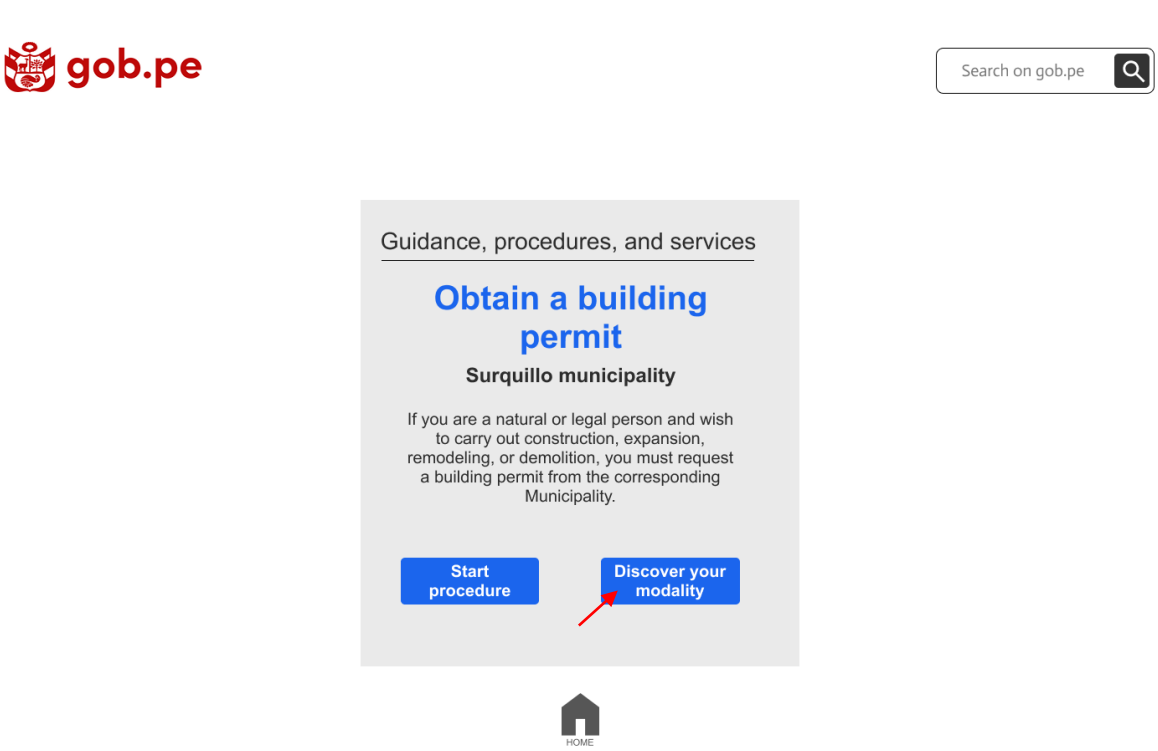
Appendix

A. Appendix 1: Workflow of the as-is process (FIGMA artifact)

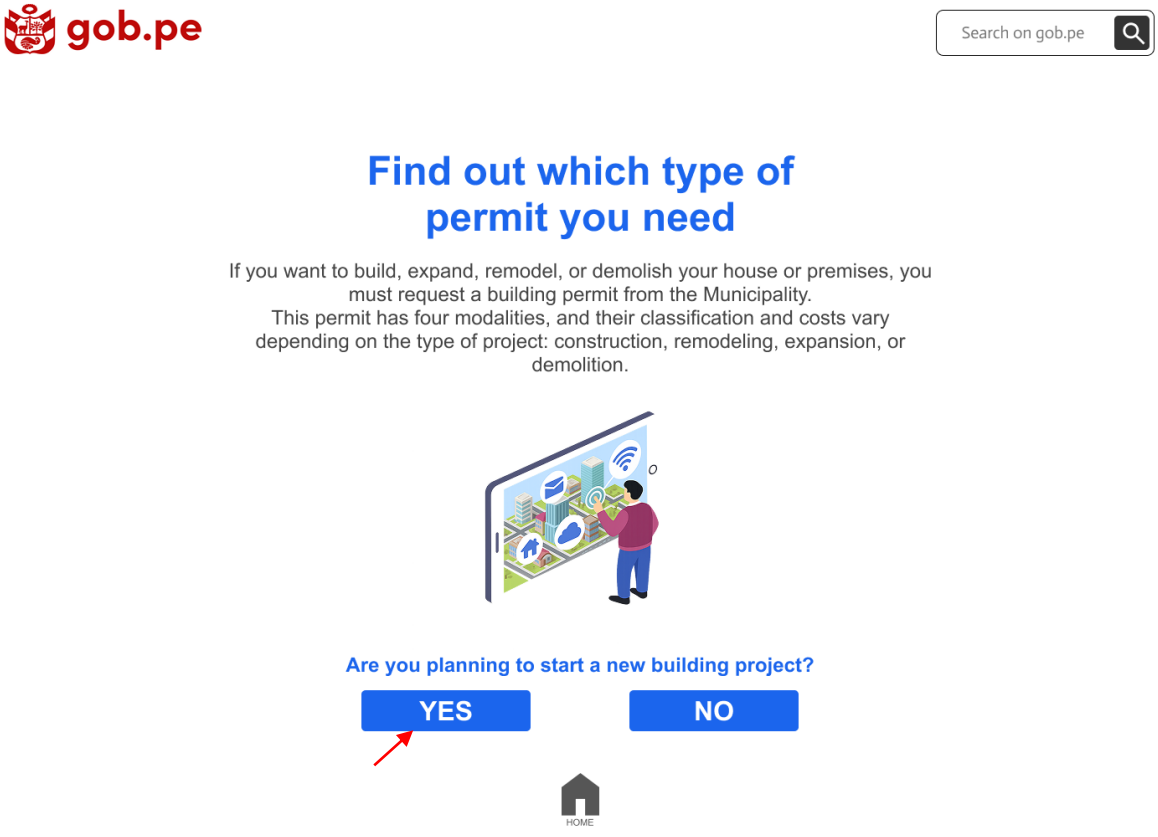
I. Looking for information at Gop.pe



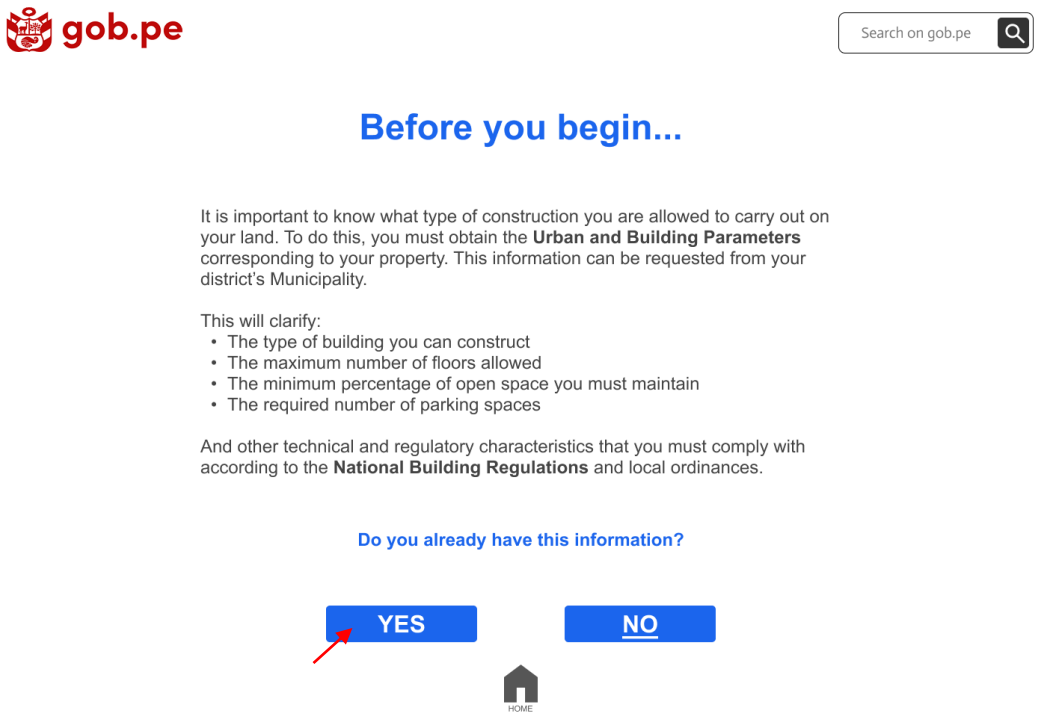
14. Click on: "discover your modality"



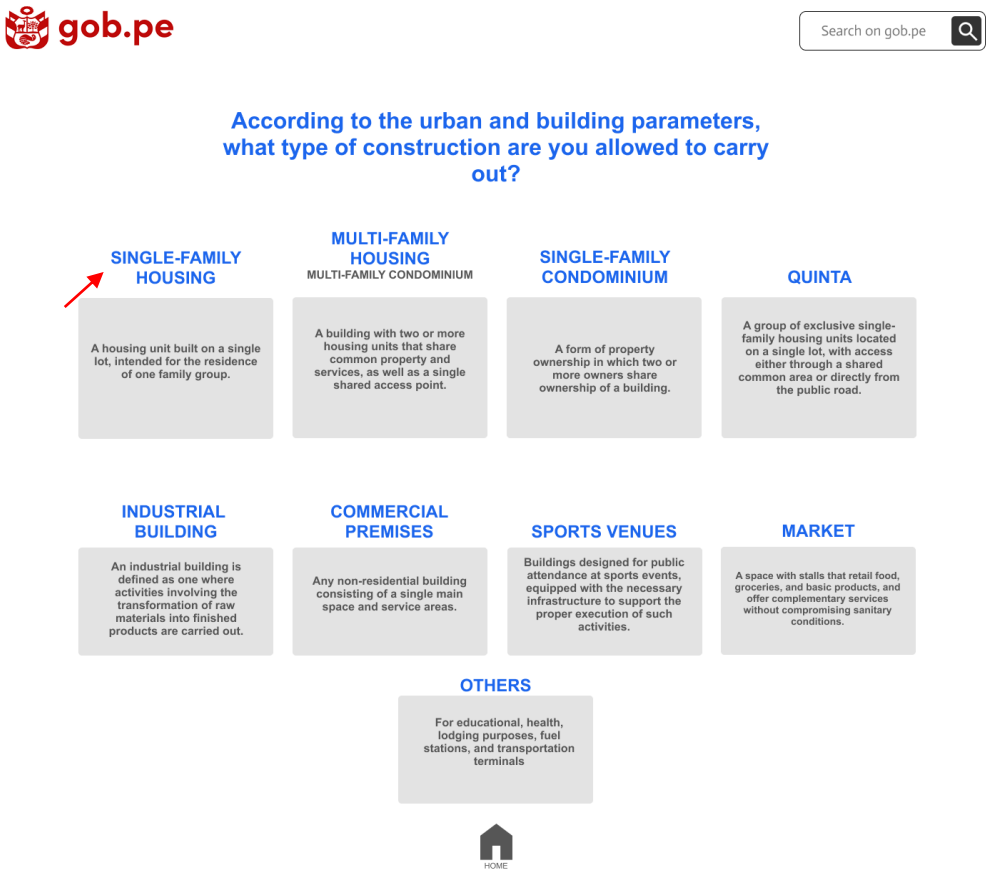
15. Click on: "yes"



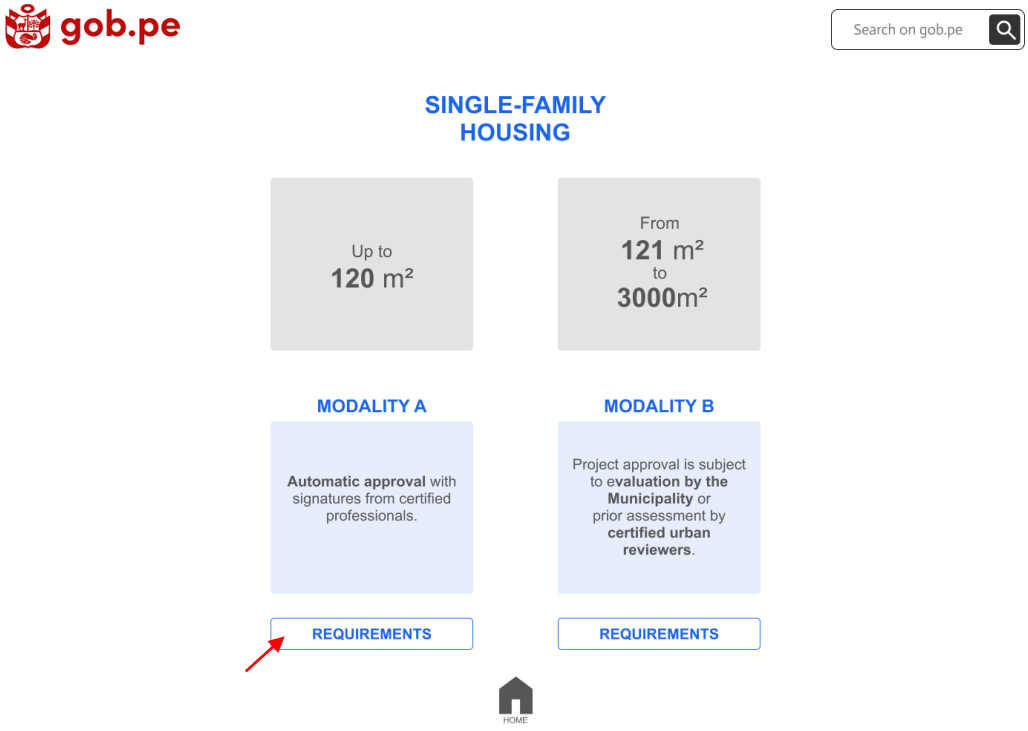
16 Click on: "yes"



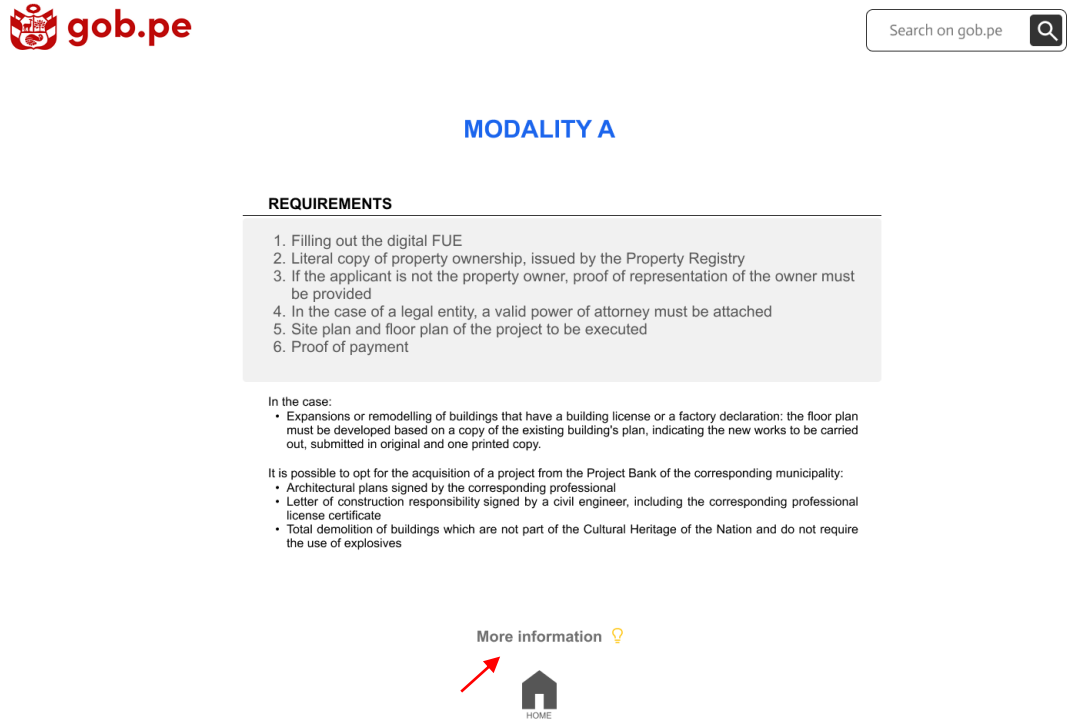
17. Select the type of construction: "single family housing"



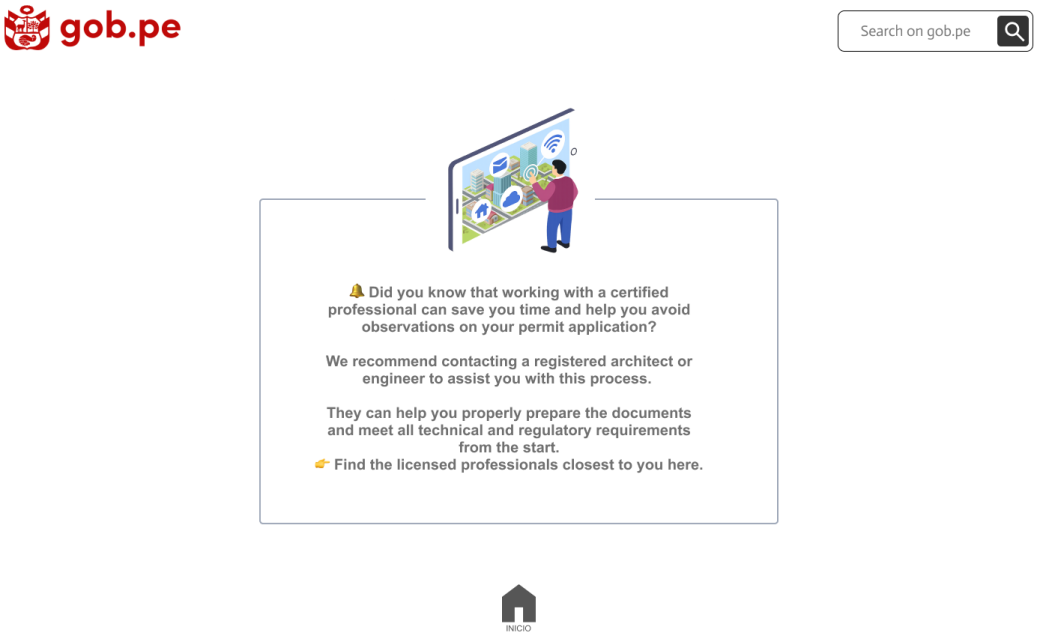
18. Information about single-family housing



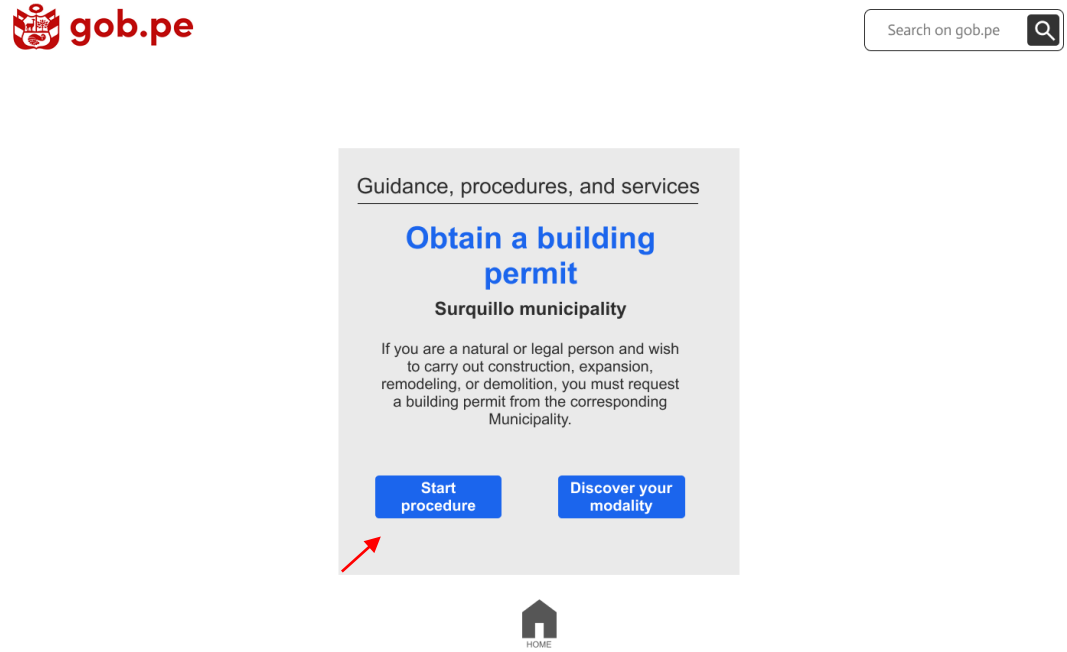
19. In case of Modality A



20. Automatic message

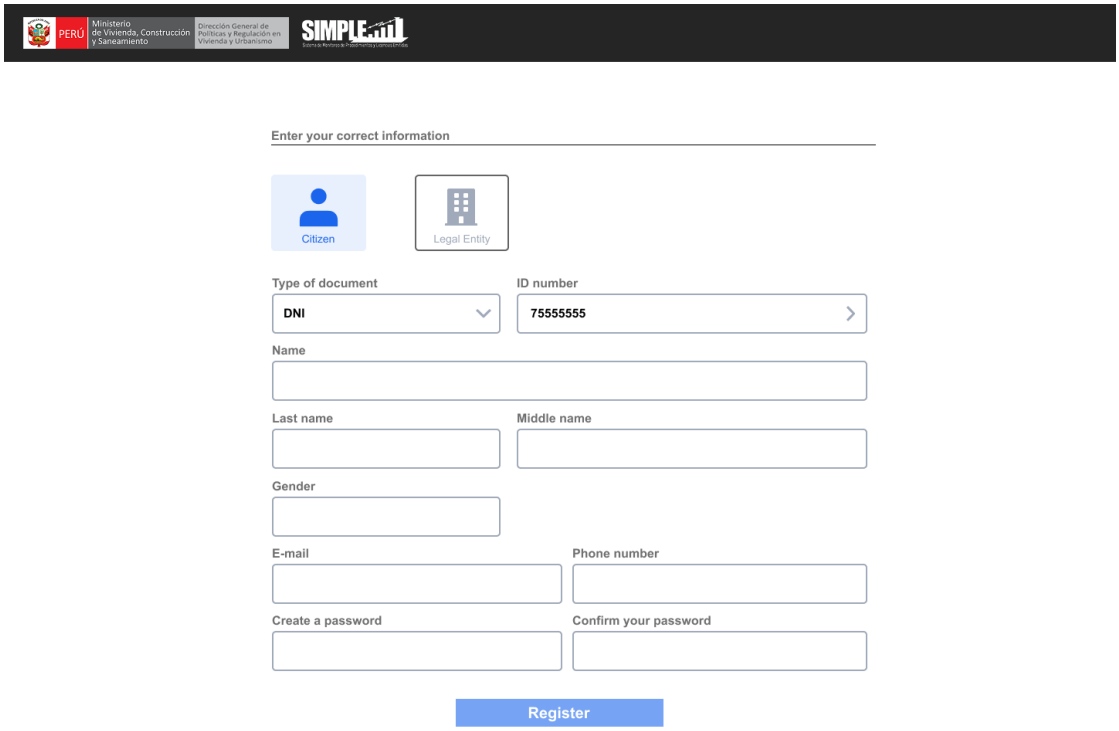


21. *Track when selecting: "start a procedure"*

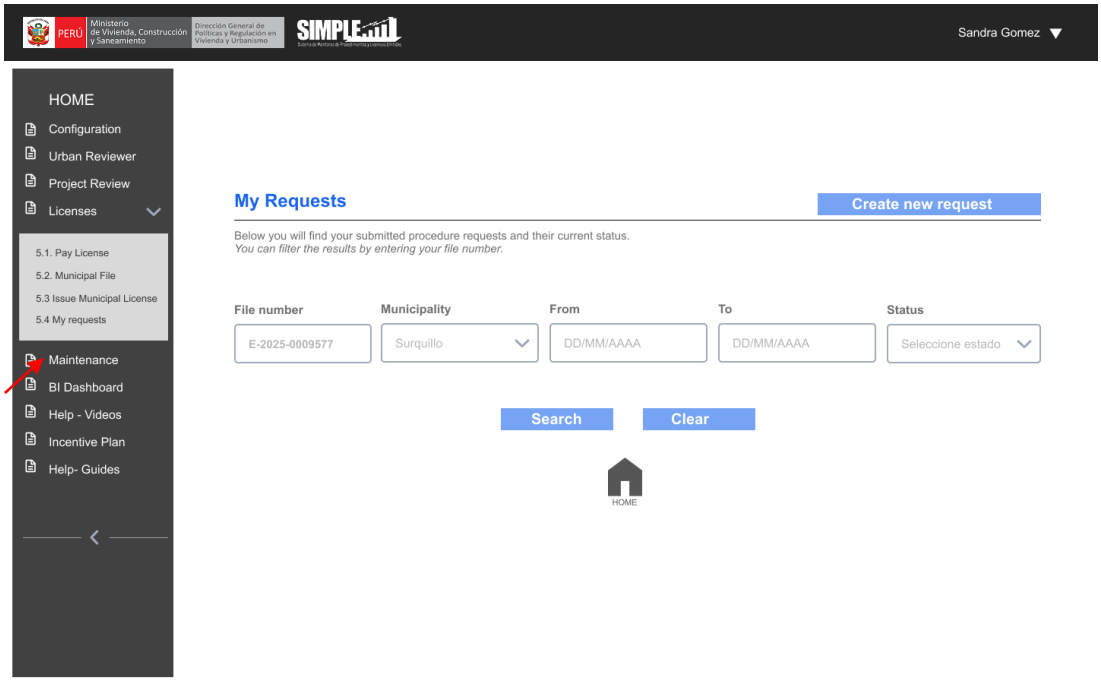


22. Log in at SIMPLE

23. Create your account



24. SIMPLE dashboard



25. Electronic FUE to submit a request

Electronic FUE

PERÚ | Ministerio de Vivienda, Construcción y Saneamiento | Dirección General de Políticas y Regulación en Vivienda y Urbanismo | SIMPLE.mil | Sandra Gomez ▼

Applicant Information				
Document Type	DNI/RUC	75555555		
Role	☐	Property Owner		
	☐	Building Developer		
		Registration Number	Authorized	
Type of Procedure	☐	Preliminary project for consultation		
	☐	Building permit		
	☐	Project modification		
	☐	License regularization		
Building Project				
Type of Work	☐		Phased	Yes ☐ No ☐
			Number of phases	
			Phase	
	☐	New construction		
	☐	Expansion		
	☐	Conditioning		
	☐	Fencing		
	☐	Remodelling		
	☐	Total or partial demolition		
	☐	Repaining		
	☐	Heritage restoration/ Monumental value (*)		
Type of Modality	☐	A	Automatic approval with signature of professionals	
	☐	B	Automatic approval with evaluation by:	
	☐	B.1 Municipality		
	☐	B.2 Urban reviewers		
	☐	C	Project approval with prior evaluation by:	
	☐	C.1 Municipality		
	☐	C.2 Urban reviewers		
	☐	D	Project approval with prior evaluation by:	
	☐	D.1 Municipality		
	☐	D.2 Urban reviewers		
Department	Lima			
Province	Lima			
District	Surquillo			
Property				
Location				
☐			99 99	
☐	Search by address	1. Location	Urbanización/A.H./Otro	Santa Rosa
			Block	5
			Lot(s):	150
			Sub-lot(s):	3A
			Ave./Jr./Street/Passage:	Jose Castillo
			No.	15
			Apt.	5
		2. Areas and Perimetric Measurements (allow two decimal places)		335.60
				15
				23
				22.10
			Depth (m):	14.80

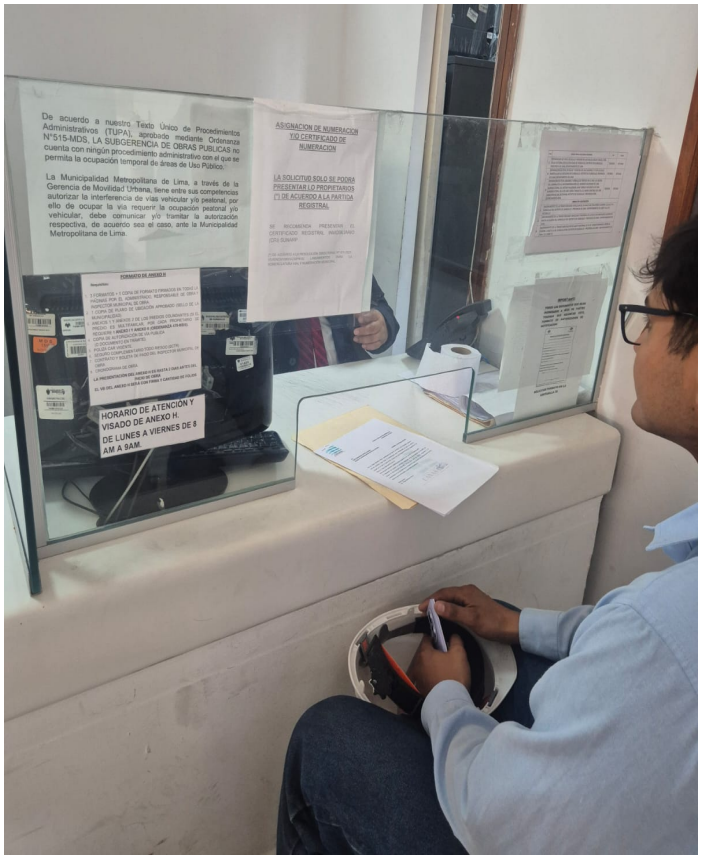
Existing building				
☐				
Project				
Cuadro de areas				
☐		3		
☐		Area	335.60	
		Estimated budget	464,226.57	
☐		Area		
		Estimated budget		
☐				
☐				
☐	Open area	% 36.08%	m² 121.09	
☐	Demolition	Area		
		Estimated budget		
				☁
				☁
				☁
				☁
				☁

Print form | Sign doc. | Submit

HOME

26. Final message including tracking code

B. Appendix 2: Physical setup of the in-person information channel at the Municipality



Source: Participant observation conducted at the Sub-Unit of Private Works and Cadastre, March 2025

C. Appendix 3: Applicant Waiting Area of the Sub-Unit of Private Works and Cadastre

Source: Participant observation conducted at the Sub-Unit of Private Works and Cadastre, March 2025

D. Appendix 4: Informed Consent

Purpose of the Research

The purpose of this interview is to gather information regarding the experience of [architects, engineers or public servants] in the process of applying or managing the building permits process in Peru. This research aims to identify bureaucratic barriers and opportunities for digitalization, intending to improve traceability, standardization, and transparency of these administrative procedures.

Procedure

- You will be asked about your experience as [architects, engineers or public servants].
- The interview will last approximately 30 minutes.
- With your consent, the conversation will be recorded for subsequent analysis.

Use of Information and Confidentiality

- The information provided will be used exclusively for academic research purposes.
- Your responses may be cited in publications, reports, or presentations, with confidentiality preserved by assigning an identification code.
- You may choose whether your name is mentioned or remains anonymous in the study's results.
- The audio recording will be used solely for transcription and data analysis and will not be shared with third parties without your consent.

Participant Rights

- Participation in this interview is voluntary. You may withdraw at any time without justification.
- You may choose not to answer any question.

Consent

Please indicate your preferences by marking the appropriate options:

☐ I authorize the mention of my testimony in this research.

☐ I prefer to remain anonymous.

☐ I authorize the recording of this conversation, understanding that the audio will be used exclusively for research purposes.

☐ I do not authorize the recording of this interview.

I declare that I have read and understood the information provided in this document. All my questions have been clarified, and I give my consent to participate in this research.

Participant's Name: _____

Signature: _____

Date: _____

E. Appendix 5: Questionnaire designed for public servants

Section 1: Professional Background

- How many years of experience do you have in the construction or public infrastructure sector?
- How long have you held the position of [...] in this Municipality?
- What was the initial state of the Sub-Unit when you joined the Municipality (e.g., challenges, available resources, organizational structure)?

Section 2: Characteristics of the Sub-unit

- How many people currently work in the Sub-unit?
- Out of the total staff, how many are responsible for reviewing Building Permit applications under modalities A and B?
- What is the academic and professional background of the team members (e.g., architects, engineers, technicians)?

- Does each team member have access to a dedicated work computer?
- Do staff members have access to professional software such as AutoCAD?
- How would you describe the current workload of your team (e.g., excessive, manageable, low)?
- What types of building permit applications are most frequently received (e.g., A, B, C, D)?
- Among these, have you identified any bottlenecks in the review process?

Section 3: Issuance Process

- Can applicants access the requirements for each permit modality online?
- How are building permit applications officially registered upon submission?
  a. Which systems or platforms are used for this registration?
  b. Which actors are involved in this stage (e.g., Document Management Office)?
- Are applicants required to submit both the original and a copy of each document? If yes, why is this a requirement?
- Does the Sub-unit currently use digital or electronic signatures internally?
  a. If not, what are the reasons for this limitation?
- How is the payment for the building permit process completed?
  a. Is there an option for cash payment at the window?
  b. Is the Pago.pe platform used?
- Where is the information about submitted building permit files stored (physically or digitally)?

Section 4: Technical Review Process

- What are the main challenges or bottlenecks identified during the technical review stage?
- How can an applicant track the progress or status of their application?
- What type of inputs, tools, or resources would you require to enhance the efficiency of the license issuance process?

Final section:

Thank you very much for your time and valuable insights. Your contributions are essential to understanding the current challenges and opportunities in the building permit process at the municipal level.

As part of this research, I am conducting interviews with professionals who have experience in the issuance, review, or request of building permits in Peru. If you know other colleagues who might be willing to share their perspectives and experiences, I would greatly appreciate it if you could share their contact information or forward this invitation to them.

Thank you for your support.

F. Appendix 6: Questionnaire designed for applicants

Section 1: Professional background and municipal experience

- How many years of professional experience do you have in preparing and submitting building permit applications in Lima, Peru?
- Do you currently manage or work within an architectural or engineering firm? If so, what services does your firm provide?
- In which Municipalities have you submitted building permit applications?
- Based on your experience, which Municipalities have the most efficient or organized building permit procedures? Why?
- Have you experienced delays due to outdated property records or cadastral systems in some Municipalities? Could you elaborate?

Section 2: Access to information and standardization efforts

- How has your experience been with accessing requirements for permit applications in different districts?
- Have you noticed inconsistencies between the online information and what is requested during the process?
- Since the approval of Supreme Decree No. 146-2023-PCM (ASME Tables) in 2023, have you observed improvements or changes in the standardization of requirements across Municipalities?

- Do you believe these changes are equally implementable in Municipalities outside Lima or in less consolidated districts? Why or why not?
- What recommendations would you make to improve the uniformity and accuracy of information provided to applicants?

Section 3: Pre-Submission stage (preliminary project and FUE form)

- How would you describe your experience preparing the preliminary project before the formal submission?
- How has your experience been with the Unified Building Form (Formato Único de Edificación – FUE)?
- How would you describe the process of assembling the technical file?
  a. Do property owners usually provide sufficient documentation?
  b. Is there clarity on how many copies of documents must be submitted and when?
- Are digital signatures currently accepted in the Municipalities you work with?
- Do you have any experience or training in using BIM for permit submissions? If not, what barriers exist?
- Recommendations to improve this stage

Section 4: Submission stage

- Please describe your experience submitting your application at the Document Submission
- Have you encountered issues with personnel who lack architectural or construction-related training?
- Are there designated roles for the prequalification of documents?
- Would a more differentiated staffing system based on project type (e.g., new construction vs. remodelling) be beneficial?
- Recommendations to improve this stage:

Section 5: Post-submission stage

- How would you describe the review and feedback process after submitting your application?
- Was the communication regarding technical review and license issuance timely and transparent?
- Are there opportunities for dialogue with reviewers or decision-makers?
- Recommendations to improve this stage:

Section 6: Reflections and recommendations

- From your perspective, what tools, practices, or policy changes would facilitate and streamline the building permit process at each stage?
- Do you believe that improving institutional continuity and technical training could reduce bureaucratic inefficiencies and unethical practices?

Section 7: Additional contacts (snowball sampling)

- Would you be willing to refer other architects, engineers, or stakeholders who also have relevant experience with building permit applications? Please share their names or emails (if available)

G. Appendix 7: Validation Session Guide – Focus groups

Welcome Speech

Thank you very much for joining us today. This activity is part of an applied research project for a master's program in Public Sector Innovation. My name is Claudia Villena-Tagle, I am a Peruvian political scientist currently enrolled in the Erasmus Mundus master's in public Sector Innovation and eGovernance.

The project we will present today is a proposal of three functionalities to digitalize the building permit issuance process in local governments in Peru, with the goal of making it more efficient, transparent, and accessible for citizens. This session is exploratory and participatory in nature. I'm very interested in hearing about your experiences and perspectives as architects and engineers, as your contributions will help validate and improve this prototype.

Moreover, your feedback will be shared with the Sub-management of Private Works and Cadastre of the Municipality of Surquillo and with the General Directorate of Housing and Urban Development Policies and Regulation (DGPRVU) of the Ministry of Housing, Construction and Sanitation.

I truly appreciate your active participation and your willingness to contribute to this initiative.

Informed Consent Form

You have been invited to participate in a validation session for the SIMPLE Municipal prototype. Your participation is voluntary. This session will be recorded for academic purposes only, and the testimonies collected may be cited in the master's thesis that supports this study.

The confidentiality of your personal data is guaranteed, and you may request the removal of your comments from the analysis at any time. By continuing with this session, you voluntarily agree to participate, to the recording of the session, and to the inclusion of your input in the study. If you prefer not to be cited, please indicate this below.

Do you agree to the recording and use of your testimony in the study?
☐ Yes ☐ No

Questionnaire

- Do you think the functionalities proposed in SIMPLE Municipal address the real needs of the process?
- How viable is it to integrate tools such as dynamic forms, online tracking, or automatic alerts into your current workflow?
- Do you foresee any institutional risks or resistance to implementing this prototype?

Pre-Submission Stage

- Do you find the interactive guide useful for accessing the required information?
- Is the segmentation by building type and permit modality clear and sufficient?
- Does the guide address the current difficulties you face in understanding the requirements?

Submission Stage

- What is your opinion on the standardized digital form? Does it facilitate or complicate the evaluation of the application?
- Do you think this functionality would reduce the administrative burden inherent in the process?
- What improvements would you suggest for the form?

Tracking and Notification

- Do you find the tracking and notification module useful?

Scalability and Replicability

- What conditions must be met for this prototype to be scaled to other municipalities in the country?
- Would you use this platform as a tool for daily operations in the Sub-management?
- What key elements do you think are necessary to ensure it is actually used, from your point of view as a [public official/applicant]?
- What types of resistance do you think might emerge among stakeholders involved in the process?

- What role should the Ministry play in the deployment and monitoring of this type of solution?

Perceived Impact

- Do you believe this prototype could reduce the time required to process building permits?
- Do you think it could help reduce corruption or informal arrangements?
- Do you believe it would improve transparency and trust in the process?

H. Appendix 8: Overview of focus group participants

Type	Description of the participants	Date	Code
Applicants	Individuals who have gone through the municipal building permit process	13/05/2025	A_01
		13/05/2025	A_02
		13/05/2025	A_03
		13/05/2025	A_04
Public servant 1	Representatives with expertise in construction regulation and policy from the Ministry of Housing, Construction and Sanitation	14/05/2025	P_03
		14/05/2025	P_04
Public servant 2	Public servants from municipalities other than Surquillo	14/05/2025	P_05
		14/05/2025	P_06
		14/05/2025	P_08
		14/05/2025	P_09
Applicants	Representative from the Architects' College	27/05/2025	A_08
Public servant 3	Public servants currently working within the Surquillo Municipality	27/05/2025	P_01
		27/05/2025	P_02
		27/05/2025	P_07
Applicants	Individuals who have gone through the municipal building permit process	29/05/2025	A_05
		29/05/2025	A_06
		29/05/2025	A_07

I. Appendix 9: Declaration of Authorship

I hereby declare that, to the best of my knowledge and belief, this Master Thesis titled "A user-centred Enterprise Architecture for Digital Building Permit in Peru" is my own work. I confirm that each significant contribution to and quotation in this thesis that originates from the work or works of others is indicated by proper use of citation and references.

Lima, 15 June 2025

Claudia Adriana Villena-Tagle

J. Appendix 10: Consent Form

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Given Name: Claudia Adriana
Student number: 123456

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