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Master Thesis

ICT Solution for Construction Permit Process in Slovakia

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Abstract

Context. The construction permit process in Slovakia is characterized as outdated, opaque, highly bureaucratic, and notoriously time-consuming. This research delves into the challenges faced by developers in obtaining construction permits in Slovakia, focusing on the need for enhanced efficiency and transparency in the construction permit process.

Goal. The goal of this research is to design a digital platform for Slovakia's construction permit process, integrating new legislative changes and analyzing current procedures. Centralized under the Office for Spatial Planning and Construction, the platform seeks to streamline processes, enhance transparency, and minimize corruption, ultimately improving efficiency and collaboration among stakeholders through a process-form approach.

Method. A potential ICT solution for the construction permit process in Slovakia was designed based on information gathered during a comprehensive literature review, identifying common pain points and areas for improvement. A prototype of the digital platform was developed and initially validated with a small sample of industry professionals. The results from this validation were used to refine the prototype and highlight opportunities for future development.

Results. The findings highlight several key pain points in the current process, including excessive bureaucracy, lack of transparency, inefficiencies due to complex procedures, and lack of digitalization. The prototype of the digital platform addressed these issues by incorporating features such as real-time tracking, a public log system for all changes and decisions made, easy submission of applications and objections, transparent submission rules, and a centralized location for all users to view applications and objections and interact with each other. The integration of new legislative requirements into the platform design ensured compliance and future-proofing of the system. User feedback indicated significant improvements in all these aspects. However, it is important to acknowledge the potential for biases in the feedback.

Conclusion. The study concludes that the use of ICT can significantly overcome the major challenges in Slovakia's construction permit process through digitization and centralization. The proposed digital platform improves transparency, minimizes bureaucratic obstacles, and fosters enhanced collaboration among stakeholders. Successfully implementing this platform is anticipated to result in a more efficient and transparent permit process, benefiting developers, authorities, and the general public. However, future work is needed to refine and bring the platform into perfection.

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1 Introduction

The construction permit process is a critical component in the development and urban planning landscape. Historically, Slovakia's construction permit process has been fraught with inefficiencies and bottlenecks, leading to high illegality, delays, and increased costs for developers. This thesis aims to explore how Information and Communication Technology (ICT) solutions can address these issues by designing a digital solution for construction permit process, enhancing efficiency, transparency, and reducing the administrative burden for all stakeholders involved. To gain a comprehensive understanding of the issue, we have designed research questions that guided the way through our investigation. The research questions can be found in Section 2.

The primary goal of this research is to design a process-form digital platform, that would address the key pain points of the construction permit process in Slovakia, considering the full implementation of the new construction legislation. Based on the innovations introduced by the new construction legislation, particularly the shift towards centralized authority, this research aims to merge these legislative advancements with a comprehensive analysis of the current construction permit procedures. By examining the practical challenges faced by stakeholders and the complexities within the existing system, the objective is to synthesize this knowledge, and based on that design the potential solution.

The summarized method of this research involves designing a digital platform that addresses the pain points of the construction permit system, building a prototype based on this design, validating the solution with a sample of industry professionals, and finally refining the prototype based on their feedback while proposing future work for further enhancements. The efforts of this research can serve as a valuable source of information for relevant parties involved in the construction permit process in Slovakia. Overall, the research and analysis conducted for this project have the potential to significantly improve the whole process, fostering innovation, efficiency, transparency, and collaboration among all stakeholders engaged in the process.

2 Research Questions

To gain a comprehensive understanding of the issue, we must first address research questions written below through an analysis of existing literature.

- **RQ1: How does the construction permit process operate in Slovakia?**

The first research question consists of 3 subquestions that help to thoroughly explore the main research topic from different angles. Each subquestion focuses on different aspect of our problematic, allowing us to get deeper insights. The section related to these research questions is Section 3.

The subquestions are:

- **RQ1.1: What are the bottlenecks and inefficiencies when applying for the construction permit?**
- **RQ1.2: What are the key factors influencing the efficiency and effectiveness of the construction permit process?**
- **RQ1.3: How do different stakeholders perceive and interact within the permit process?**

By answering the first research question, we will gain a comprehensive understanding of the current state of the construction permit process in Slovakia. Second research question is more oriented on the potential improvements of the process and it is formulated as follows:

- **RQ2: What are the potential areas for reform or improvement within the construction permit process?**

By answering the second research question, we will be able to identify key areas for improvement and propose recommendations for enhancing the efficiency and effectiveness of the construction permit process in Slovakia. The section related to these research questions is Section 4.

Based on these findings we then design a potential solution and answer the main research question:

- **Main RQ: How can ICT effectively address the key pain points of the construction permit process in Slovakia?**

This research question aims to investigate how modern technology can transform and improve the construction permit process in Slovakia by addressing its most significant challenges. The sections related to this research question are Section 5 and 6.

3 Context Analysis

In this section, we analyse Slovakia's current construction permit system landscape, offering an in-depth examination of current state, challenges, limitations and the pivotal stakeholders that are involved in this process.

3.1 Construction Permit Process in Slovakia

The issuance of a construction permit is a crucial step for every construction project as it is the official permission to begin construction work. In Slovakia, obtaining a construction permit is typically the final step for the builder to commence their construction project. Landowners (the developer/builder is usually the owner of the construction land in most cases, although it is not a requirement) must first and foremost respect the valid spatial plan, which may be the first obstacle in fulfilling their right to build. Therefore, the first step in obtaining a construction permit is ensuring that the proposed construction aligns with the spatial plan of the area. This involves verifying that the building's placement adheres to the designated land use regulations and conforms to the broader development goals outlined in the spatial plan. After confirming alignment with the spatial plan and obtaining the spatial decision can the process proceed to applying for a construction permit [9].

Construction permit is a document that you must obtain for any major construction of a property that has more than 25 m2. For more extensive renovations or structural changes, obtaining a permit is also necessary. To obtain a construction permit, several documents are required, which must be submitted to the building authority. Therefore, it is necessary to have them prepared in order to submit the application. After validation, the builder can commence construction upon receiving the permit, provided that they also make adjustments based on any necessary changes, which may be issued by possible third parties or other regulatory bodies [1].

When navigating the process of obtaining a construction permit, it's crucial to identify the specific type of building being proposed. Whether it is a residential building such as flat house, family house, dormitory for students, shelter for homeless people etc., or non-residential building such as hotel, motel, shop, school/university, administration building, transport station, industrial building, medical facility etc., each category entails its own set of regulations and requirements [5]. In this research, the primary focus will be solely on residential buildings. By focusing only on residential buildings, we aim to thoroughly examine the specific regulations, requirements, and processes involved in obtaining construction permits for these types of buildings. This approach allows us to gain a comprehensive understanding of the unique challenges and considerations associated with residential construction projects.

Required documents for construction permit application: [1, 12]:

- **Ownership certificate** - Proof of ownership for a particular property or piece of land.
- **Territorial decision** - Confirms that the project complies with zoning regulations and land use policies established by the municipality, ensuring its legality and alignment with the local development plans. In other words, it is the consent of the municipality where the construction is planned. Most municipalities have their own territorial plans outlining areas designated for construction activities. The land should be situated within the designated area for individual residential construction according to the municipality's territorial plan.
- **Statements from the administrators of engineering networks** - It is required to attach statements from administrators of engineering networks regarding the technical aspects of the construction.

  - **Electricity** - To connect the building to electricity, the necessary statement from the administrator of the distribution network must be obtained. In the application for the statement from the administrator of the distribution network, information about the required type of connection, power rating, tariff, and the type of heating must be provided.
  - **Gas** - If gas heating is desired, approval from the gas company is necessary. This involves confirming the availability of gas connections and ensuring compliance with safety and regulatory standards related to gas installations. It ensures that the construction project has access to gas supply lines for purposes such as heating, cooking, and other energy needs, while also adhering to legal requirements and safety protocols.
  - **Water** - Confirmation of access to potable water supply lines and ensuring compliance with regulations regarding water usage and infrastructure are crucial aspects for construction projects. Access to clean water is essential for various purposes including drinking, sanitation, and construction activities.
  - **Telecommunications** - It is essential to verify the availability of an optical network in the area and request a statement from the network administrator. This statement confirms the accessibility of telecommunications infrastructure necessary for services such as internet connectivity and telephone lines. Verifying the presence of an optical network ensures that the construction project can effectively integrate modern communication technology into its infrastructure, meeting the needs of occupants and adhering to contemporary standards.

- **Declaration of construction supervision** - Regardless of whether the construction will be carried out independently or by a selected construction company, a document providing the statement of construction supervision must be included. If a construction company will be involved, only their name needs to be mentioned in the application. The supervisor's name can be provided later. However, before starting construction, a contract for the work with the construction company must be submitted to the office. In the case of self-construction, a declaration from a qualified individual who will oversee the entire construction process must be attached to the application.

- **Statement from the road administrator and traffic inspectorate** - Ensuring the connection of the land and the building to the ground roads involves obtaining a statement from the road administrator. This is necessary as the access road from the land will need to be established. The road can be managed either by the municipality or the Slovak Road Administration. An application must also be submitted to the traffic inspectorate, and the necessary document is the entrance project.

- **Statement from the environmental authority** - The compliance with environmental regulations and standards needs to be satisfied throughout and after the construction process.

- **Certificate of competence of the designer** - Document attesting to the qualifications and expertise of the individual or firm responsible for designing a construction project. It serves as proof that the designer possesses the necessary knowledge, skills, and professional accreditation required to undertake the design responsibilities effectively.

- **Statement from the land office** - When building on a plot of land listed as a garden, arable land, or vineyard in the ownership certificate, obtaining the consent of the Land Office to withdraw agricultural land from the land fund is necessary. This effectively changes the land designation from agricultural to non-agricultural, permitting its use for construction purposes.

Applying for the Land Office's statement is possible only after the building authority merges the territorial and construction proceedings, a process initiated when building on a plot designated for individual residential construction in the municipality's territorial plan. Considerations such as soil quality and the balance of agricultural land cover must be taken into account.

- **Project documentation** - The project documentation includes the site plan, technical and accompanying reports, completed connections, structural engineering, electrical installations, plumbing, heating, gas installations, building energy efficiency, and fire protection project. Consultation with a designer or the building authority is advisable to determine all the necessary components to include in the project documentation.
- **Approval of the municipality or city for a small air pollution source** - Regulatory approval necessary for construction projects involving equipment that may emit pollutants into the air, such as boilers. This approval ensures compliance with environmental standards and regulations governing emissions control. It requires detailed documentation outlining the specifications of the pollution source and proposed pollution mitigation measures to safeguard air quality and public health.
- **Consent of neighbors** - Formal agreement or approval obtained from neighboring property owners or residents regarding a proposed construction project. This consent is required in situations where the construction plans deviate from the regulations or norms permitted by the Construction Act, such as building height restrictions etc. It ensures that neighboring stakeholders are informed about the proposed project and have the opportunity to voice any concerns or objections before construction begins.
- **Other documents** - The necessary requirements for obtaining a building permit can vary from region to region. Factors such as the size and location can influence the specific prerequisites.

3.2 Problem Statement

Slovakia ranks among the worst-rated countries in the EU (second worst ranking) in terms of the number of days required to obtain a construction permit, where on average, obtaining construction permits and completing construction procedures takes up to 300 days. The current state of construction presents several issues with approval processes. Among these challenges are issues such as the improper establishment of fiduciary administration, deficiencies in self-governance and competencies, and notably, the absence of digitalization in the proceedings [21, 22, 19, 23, 6, 17].

From the perspective of developers, the biggest shortcoming of the current legislation is the lack of transparency and the lengthy processes. The developers cannot predict the time it will take for their application to be approved and what application practice the relevant authorities will choose in the decision-making process. As a result, even with relatively simple construction, such as the construction of a family house, the duration of obtaining a building permit can take more than a year. Not to mention large residential or industrial projects where permitting processes take up to several years.

The current legislation of the Construction Act was adopted back in 1976 [1]. Therefore, it does not reflect the current trends and needs of society, and it is also complicated and administratively demanding. According to the amendment to the Construction Act in 2001, every municipality, regardless of its size, serves as the building authority [2]. This system is unfortunately uncontrollable, and mayors have often found themselves in situations where, due to political or other interests, they acted in contradiction to the applicable legislation. They are often motivated by "their voters" and introduce elements into the permitting processes that disadvantage some developers. Through various obstructions and especially inaction, they can enormously prolong processes and even thwart them, even if the developer meets all the conditions prescribed by law to obtain a permit. According to reports from the General Prosecutor's Office on the state of legality, the construction sector systematically ranked among the areas with the highest level of illegality [22]. Employees of building authorities are employees of municipalities, and all decisions - building permits - are signed by the mayor as statutory representatives. After every local election, in the event of a change in the position of mayor, the composition of the building authority completely changes, leading to a loss of continuity in proceedings and once again resulting in their prolongation. Unfortunately, in Slovakia, this mode of operation of building authorities has proven to be ineffective. From the perspective of predicting the duration of permitting processes and planning business ventures in construction, this is another significant uncertainty that does not contribute to its development. It must be said that the work of employees in building authorities is extremely thankless. Almost all building authorities are overwhelmed with files that employees cannot process in time, so they are under time pressure and stress. Contact and communication are often inadequate from the perspective of developers, leading to conflict situations during proceedings and local inspections.

In larger projects, another significant challenge begins for the developer - the process of assessment under the Environmental Impact Assessment (EIA). EIA is a process designed to inform the public about planned investment intentions. The EIA process involves assessing the investment intention or its proposed modification, which may have significant impacts on the environment. Both direct and indirect impacts of the investment intention on public health, the environment, natural resources, property, and cultural heritage are evaluated. The goal of EIA is to select the most environmentally friendly variant of the planned investment intention based on the assessment of potential impacts and to propose measures to reduce adverse effects on human health and the environment. Its purpose is to ensure a high level of environmental protection, to identify, describe, and evaluate the direct and indirect impacts of the proposed activity on the environment, including cross-border impacts, to clarify and compare the advantages and disadvantages of the proposed activity, includ-

ing its variants, to determine measures to prevent environmental pollution, mitigate pollution, or prevent damage, and to obtain expert support for issuing a decision on the authorization of the activity according to specific regulations [3, 11]. The law (unfortunately for the developers) provides the public with the opportunity to participate in the impact assessment process, practically at any stage, and that is its fundamental problem because the process is often abused to artificially prolong proceedings through nonsensical objections and appeals by various civic associations, disgruntled individuals, and groups, often motivated by financial rewards for concessions and non-interference in the process. There are also those who have turned such activities into a business and profit greatly from the system. Even if developers manage to obtain a final opinion from the EIA process after many months, all participants registered in this proceeding accompany them as participants in all subsequent permitting proceedings. This, in turn, creates room for complications in the form of objections and appeals, thus at least prolonging the process and delaying the possibility of implementing the construction project.

In the context of this thesis we will consider all the challenges the developers face while obtaining a construction permit, in order to improve the efficiency and transparency of the construction permitting procedures by designing possible digital platform and implementing a prototype.

Main reasons to improve efficiency in Slovakia's construction permitting procedures [21]:

- **Lengthy approval processes** – The average duration of the procedure, encompassing all construction procedures and approval processes along with comments from affected parties, is excessively long, taking up to 300 days.
- **Abuse of public participation** - The process allows public involvement at any stage is being exploited, leading to cause unnecessary delays through frivolous objections and appeals.
- **Low professional competence of construction authorities** - Current deficiencies in state administration are attributed to lower professional quality among officials responsible for constructions, highlighting the need for improved competence, capacity, and adherence to legal deadlines.
- **Ensuring opinions of concerned authorities** - Developers often bear the responsibility for ensuring the positions of affected organs, which should ideally be the responsibility of the authorities themselves or persons authorized by them.
- **Disproportionately long document delivery** - Document delivery via post is identified as a lengthy and unreliable process, contributing to delays in the permitting process.
- **Complex territorial regulation** – The regulations governing construction in different areas are confusing and difficult to understand, making it challenging for developers to navigate and comply with them efficiently.
- **Unsustainable current situation in construction and spatial planning** - The interpretation of laws by individual municipalities varies widely, leading to frequent violations within the framework of building permits, highlighting the need for greater consistency and adherence to regulations across municipalities.

3.3 Overview of the New Construction Legislation

In this section, we'll delve into the Slovak government's strategies for revolutionizing the spatial planning and construction system. This thesis draws inspiration from the provided information and will potentially develop its outcome based on these insights.

In April 2022, the National Council of the Slovak Republic approved a groundbreaking new construction law, signaling a significant shift in the country's regulatory landscape. This landmark legislation, comprising the Construction Act No. 201/2022 and the Spatial Planning Act 200/2022, was anticipated to revolutionize the construction sector upon its scheduled implementation on April 1, 2024. The aim of the law is to shorten the permitting process to 40 working days, while reducing the number of necessary steps for issuing a construction permit from the current 83 to 13. Whether such an assumption can be fulfilled will also depend on the implementation of the new legal regulations and, not least, on practical application. Practical application will also show whether the speed of the proceedings will not compromise the quality of constructions, the environment, public space, and ultimately the rights of the participants in the proceedings and the public [16, 9, 6].

Currently, municipalities have the authority to issue construction permits within the framework of delegated state administration. One of the main changes in the new legislation is the transfer of competencies exercised in construction proceedings from municipalities back to the state. As part of this change, a central authority of state administration, namely the Office for Spatial Planning and Construction of the Slovak Republic, will be established, which will act through subordinate construction offices with defined territorial jurisdiction. The powers of the former construction offices (municipalities) will thus be transferred to the regional offices of the newly established Office for Spatial Planning and Construction [16, 9, 18, 8, 7, 19, 23].

The new building legislation is supposed to bring several improvements in practice. Firstly, there will be a removal of the multi-stage nature of the permitting process. The territorial and construction proceedings, along with any environmental impact assessment proceedings, will be unified into a single permitting process – the procedure for a construction intent [8, 7]. The outcome of this process will be a decision on the construction permit, which will also serve as verification of the construction project, thereby enabling the developer to commence the construction process immediately. This means that in one permitting procedure, resulting in a decision to permit construction, the developer must justify the construction intent against all other regulations and public or private interests. If the developer's proposal is not in conflict with them, the process will proceed without unnecessary administrative delays [22, 6].

3.3.1 Digitalization

The most significant positive aspect of the construction reform is a promise that new procedures are fully based on the digitalization of processes, which means that all communication and processes take place electronically. Construction proceedings will be conducted in a unified information system created for the purpose of spatial planning and construction tasks. This is tied to changes in public administration, where the construction sector falls under specialized state administration. In the field of spatial planning, all municipalities, cities, and regions must have a digital spatial plan, and methodology must be unified, resulting in clearer and more readable spatial plans.

The information system will be built gradually in two stages. In the first stage, it will include a data layer, and in the second stage, it will also include a process-form layer. The process-form layer will ensure the effectiveness of official authority in the field of spatial planning and construction fully electronically in accordance with Act No. 305/2013 Coll. on electronic performance of public authority [4] and on amendments to certain laws (the e-Government Act) as amended. The data layer will include background layers of the existing state of the territory (especially landscape cover,

cadastral data, data on transportation and technical infrastructure, protected objects and areas, protective zones, and high-detail building objects) and simplified models of planned or implemented construction objects. Thanks to this innovation, the territorial proceedings can be almost fully removed. These layers and models will gradually create an integrated digital model of the territory of the Slovak republic [18, 23].

Efforts to develop the digital platform have already been initiated by the new Office for Spatial Planning and Construction of the Slovak Republic. Government established templates for forms used by the information system of spatial planning [13].

3.3.2 Challenges and Delays in Implementing the Legislation

Incorporating new legislation into practice necessitates a comprehensive overhaul of the existing state administrative infrastructure. This entails establishing a new framework for governmental bodies, including the recruitment of personnel and procurement of material and technical resources. Additionally, it involves restructuring processes and developing an advanced information system. Given the magnitude of these tasks, the introduction of the Construction Act No. 201/2022 and the Spatial Planning Act 200/2022 requires meticulous planning and coordination.

The reason for the postponement of the effectiveness of the law is, for example, the unpreparedness of the permitting processes for construction projects with the environmental impact assessment (EIA) process. The ministry also proposes to postpone the effectiveness of the Construction Act due to delays in preparing forms and digitalization in construction as well as issuing regulations, and due to the lack of adequately trained personnel [14].

Despite the law being approved, the subsequent election of a new government hasn't made things any easier. The new government wants to improve the effectiveness of the adopted construction legislation in order to gain time, according to them, for the necessary adjustment of construction rules. In their program, they stated that the new construction law is unenforceable as of the effective date, and its implementation would lead to significant difficulties in the preparation and permitting of constructions. The preparation of the new construction law has been ongoing since 1999, and postponing the effectiveness means that everything will be lost, and Slovakia will go back to 1999 again [15]. This political landscape, further complicates matters. Prioritizing different agendas, politicians may delay or derail initiatives like this law, making it uncertain when the digital platform will see the light of day and keeps the whole construction process outdated.

These challenges underscore the importance of research and analysis in designing a digital platform that can effectively integrate and streamline the new legislative requirements for obtaining construction permit, while also addressing the concerns and needs of developers, which will be further analyzed in the next sections. Therefore, the insights gained from studying the complexities of construction processes, parties involved, and the implementation of its innovations provide valuable guidance for the development of a digital platform for more efficient and transparent construction permitting procedures.

3.4 Main Stakeholders Identification

The construction permit process in Slovakia involves a variety of stakeholders, such as governmental bodies, private organizations, and individual contributors. This study focuses on the primary stakeholders who directly and significantly influence the construction permit process, which refers to the entities responsible for issuing permits, raising objections, enforcing regulations and other bodies that can influence or are related to construction projects in Slovakia.

Entity	Stakeholder type
Public	Individual/Private
Developer	Private
Municipality	Governmental
Office for Spatial Planning and Construction of the Slovak Republic	Governmental

3.4.1 Public

The construction can significantly affect its surroundings. It is essential for the permitting of constructions not to be solely in the hands of a narrow group of people - investors, landowners, officials, and politicians. The public can influence the future of construction in spatial and construction proceedings by submitting their opinions regarding the proposed construction activities during the environmental impact assessment (EIA) process [20].

The public includes [10, 20]:

- **Citizens** - Involves the public who are affected or likely to be affected by environmental activities or have an interest in such proceedings.
- **Civic initiatives** - At least three individuals over 18 years of age, who jointly sign a statement regarding the proposed activity or its change, which is subject to impact assessment or investigative proceedings under this law.
- **Civic associations** - These are formal organizations established to represent the interests of their members and the broader community in EIA processes. Civic associations often play a crucial role in providing input, advocating for community concerns, and ensuring that the voices of affected individuals are heard during EIA procedures.
- **Non-governmental organizations** - It can involve a civic association, non-investment fund, or non-profit organization that provides public services, not those established by the state. It can also involve a foundation whose goal is the creation or protection of the environment, or respectively the preservation of natural values.
- **Other** - For example experts from various fields of science, technology, and practice.

Public plays a crucial role in the construction permit process as they can directly influence decisions regarding proposed construction projects in their communities. Their input and feedback can shape the outcomes of permit applications by raising concerns, providing suggestions, or expressing support for specific projects.

3.4.2 Developer

It can be a natural person, legal entity, or company interested in implementing the proposed activity or its modification requiring a decision on the application for a construction permit under special regulations [10]. Developers are usually also the landowners, and hold a pivotal role in the construction permit process, serving as initiators and drivers of urban development projects. They carefully plan and evaluate their project ideas to ensure alignment with both the spatial plan and environmental considerations. Moreover, developers must ensure that their projects meet market demand, financial feasibility, and regulatory requirements.

Throughout the permit process, developers guide their projects by submitting detailed applications and adhering to regulations. They actively engage with stakeholders to address concerns and additional demands that may arise. During project execution, developers effectively manage resource allocation, mitigate risks, and supervise construction tasks to ensure compliance with approved plans and project timelines.

3.4.3 Municipality

Currently, the general building authority is the municipality, therefore the body responsible for building and land-use proceedings, issuing the spatial decision and building for most constructions. The highest executive authority of the municipality is the mayor, who decides on behalf of the municipality in both land-use and building proceedings – issuing the spatial decision and building permit [2, 20]. Responsible for implementing zoning regulations, land use plans, and building codes, the municipality ensures that proposed construction projects align with local development objectives and community needs. Through the review and approval of permit applications, the municipality facilitates responsible urban growth while safeguarding the interests of residents and businesses.

The proceedings are conducted by the building authority, which can be either within the municipality itself, or several municipalities may establish a joint office. The reason for this is, besides economy, also the necessity of prescribed qualification requirements for office staff. In some cases, the regional building authority may act as the building authority, for example, if it involves a technically demanding or unusual construction, or an action with significant or extensive effects on the environment in their surroundings. If the municipality is the applicant, builder, or owner of the construction, the regional building authority will determine which building authority will conduct the proceedings and issue the decision [20].

3.4.4 Office for Spatial Planning and Construction of the Slovak Republic

In the future, the Office for Spatial Planning and Construction of the Slovak Republic will substitute the municipalities, and will hold a central role in the construction permit process, overseeing regulatory compliance and strategic planning initiatives at the national level. It's task will be developing and implementing spatial planning policies, building regulations, and construction standards, the authority will ensure that proposed construction projects align with national development priorities and regulatory frameworks. By establishing clear guidelines and standardized procedures, the authority will promote transparency in the permit application and approval process, providing stakeholders with a clear understanding of requirements and expectations. Currently, the Office for Spatial Planning and Construction is setting up the system for spatial planning by establishing regional offices, and a new information system where each municipality should upload their spatial plan. Besides the huge improvement in spatial planing, the Office is unfortunately not even close in achieving the same results within the application for construction permit. This is still in the hands of the municipalities, which is one of the big issues that are causing the problems within this sector.

4 Need Assessments

In the previous section, we investigated the existing construction permit system in Slovakia, including its unique challenges, bottlenecks, and limitations, and the pressing need for change. In this section, the primary focus will be on understanding the perspectives and requirements of stakeholders involved in the construction procedures. The result of this analysis should comprise the requirements for solution.

4.1 Stakeholder Requirements and Needs

Mésároš, Ručinský, and Smetanková [21] conducted a research on this topic. They also analyzed how the current construction permit process in Slovakia works, and what are its issues. They managed to do this by conducting an online questionnaire survey to investigate the current state of building permits for constructions in Slovakia. Their aim was to address a wide professional and lay public, including all participants in the construction procedure. The survey analyzed the level of services provided, the expertise of the building authority staff, the average length of project approval, and the advantages or disadvantages of the existing building procedures. They contacted approximately 150 respondents with return rate of 48,67%.

The survey concluded by highlighting the biggest problems in the current construction procedure and key aspects for promoting or improving it. These insight can be further considered for designing our solution for the construction permit process. Respondents identified major issues such as the lack of expertise among construction authorities, lack of digitization, difficult administration, duplication of assessment, systemic bias, and outdated zoning plans. The results for this part of survey can be seen in Table 1.

Problem	% of respondents
Lack of expertise among construction authorities	53.42%
Lengthy procedures	53.42%
Lack of digitization	27.39%
Difficult administration	27.39%
Duplication of assessment	15.07%
Systemic bias	15.07%
Outdated zoning plans	15.07%

Table 1: Biggest problems of construction permit process based on answers of respondents

To enhance and streamline the construction procedure, the respondents have proposed a series of comprehensive measures. The respondents mainly suggested increasing the level of digitalization, enhancing transparency and supervision of activities, simplifying procedures, and reducing bureaucracy. The results for this part of survey can be seen in Table 2.

Improvement	% of respondents
Digitalization	60.28%
Enhance transparency and supervision of activities	42.47%
Simplify procedures	42.47%
Reduce bureaucracy	42.47%

Table 2: Improvements for construction permit process based on answers of respondents

From Table 2, it is evident that digitalization is the most desired enhancement among individuals involved in the construction permit process. They believe that adopting digital solutions would substantially improve the efficiency and effectiveness of the process. Furthermore, the table highlights several other improvements that received significant support from the respondents. These additional enhancements can be seamlessly incorporated into the proposed digital platform. By integrating these features, the digital platform would not only address the primary concern of digitalization but also offer a comprehensive solution that tackles multiple areas of improvement identified by the stakeholders.

4.2 Platform Requirements

Based on the analysis presented in the previous section, it is evident that the current construction permit process is hampered by inefficiencies, excessive bureaucracy, and a lack of transparency. These issues not only delay projects but also frustrate applicants and hinder overall industry progress. To overcome these challenges, this section outlines the key requirements for a platform designed to transform the construction permit process. The platform should aim to enhance the digitalization of the construction permit process by focusing on:

Increased Transparency: The platform should improve transparency and oversight in the construction permit process. By making data and decisions more accessible, stakeholders can monitor progress and hold relevant parties accountable, thereby enhancing trust in the system.

Implementing a feature that allows users to track their progress at any stage of the permit process is necessary. Real-time updates and notifications can help users stay informed about their application status, identify bottlenecks, and address areas needing attention promptly.

Transparency can also reduce the chances of corruption. The platform should make all actions and decisions open to public scrutiny, promoting a fair and accountable system where all stakeholders can observe and verify the integrity of the process.

Simplified Procedures: Simplifying the complex procedures involved in obtaining construction permits is essential. The platform should aim to make the process more user-friendly and straightforward, reducing the burden on applicants and facilitating smoother interactions with regulatory authorities.

The platform should offer an intuitive interface that is easy to navigate, ensuring a seamless experience for individuals seeking information and assistance. A well-designed interface can significantly enhance user satisfaction and engagement, promoting widespread adoption of the digital system.

Additionally, incorporating interactive tutorials, FAQ sections, and live support can further assist users in navigating the platform effectively. These features can address common queries and provide immediate assistance, enhancing the overall user experience and facilitating a smoother permit application process.

Serving as a centralized hub, the platform should provide all necessary guidelines, forms, and documents required for the construction permit process. This centralized approach will help users easily access and navigate through the information they need, reducing confusion and errors.

Reduced Bureaucracy: Efforts should be made to eliminate bureaucratic obstacles and unnecessary delays in the construction permit process. The platform should facilitate a more efficient and streamlined workflow, cutting down on redundant steps and accelerating the overall timeline for permit issuance.

4.3 Considered Legislation

To design the digital system proposed by industry stakeholders, we must clarify the legislation outlined in Section 3.3. It is crucial to determine whether our central reference point will be the municipalities or the Office for Spatial Planning and Construction of the Slovak Republic.

Historically, municipalities have served as the primary reference points. However, they represent an outdated solution and are slated to be fully replaced by the Office for Spatial Planning and Construction in the near future. This transition is part of a broader effort to modernize and streamline spatial planning and construction processes. Given this imminent shift, aligning our digital system with the Office for Spatial Planning and Construction is both logical and forward-thinking.

By focusing on the Office for Spatial Planning and Construction as our central point, we can ensure that our platform is not only current but also future-proof. This approach will facilitate smoother integration with upcoming regulatory frameworks and provide a more robust foundation for the system's ongoing development and scalability. Therefore, we will consider the Office for Spatial Planning and Construction as the central point for our platform design.

Furthermore, by centralizing the system within the Office for Spatial Planning and Construction, we simplify the adoption process. If each municipality were required to adopt the new digital system independently, it would present significant challenges due to the varying levels of resources, expertise, and existing infrastructure across different municipalities. By contrast, having a single, centralized office adopt and manage the system ensures consistency and reduces the complexity of implementation. This streamlined approach not only makes the system easier to adopt but also ensures uniformity in its application and enforcement.

Moreover, the interactions between various stakeholders will be significantly enhanced through this centralized approach. By consolidating processes and communication channels within the Office for Spatial Planning and Construction, we can create a more efficient and transparent system. This will enable better coordination, quicker approvals, and more effective compliance monitoring, ultimately benefiting all parties involved. The improved interaction capabilities will also help in addressing any issues promptly and ensuring that the platform evolves in line with stakeholder needs and legislative changes. A simple sketch of the interactions can be seen on Figure 1.

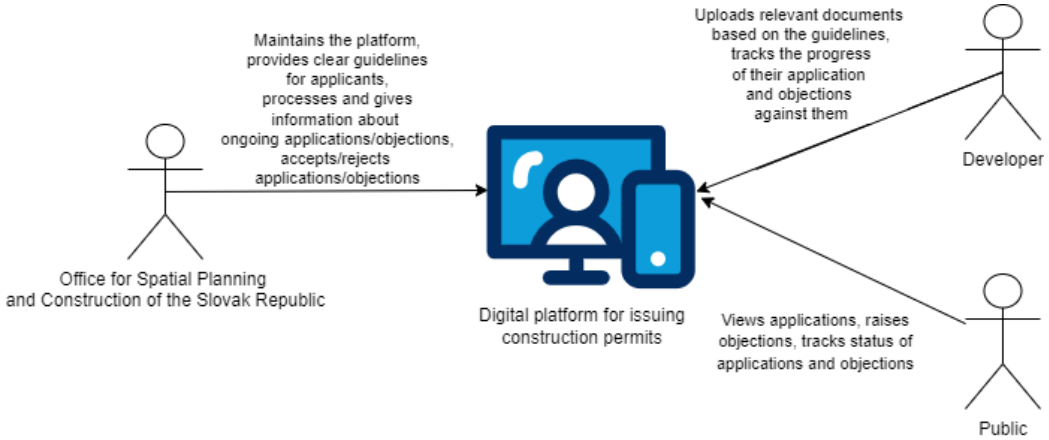

Figure 1: Interactions between builders and Office for Spatial Planning and Construction of the Slovak Republic

5 Design

In the previous section, we identified the needs and requirements that clarified how to improve the construction permit process in Slovakia. Considering the insights from the previous section, in this section we will dive into more detailed design of the proposed digital solution. The primary objective is to design a process-form application that meets the results outlined in Section 4.

5.1 Quality Requirements

The Quality Requirements section is dedicated to outlining the critical needs and expectations to achieve the goals of the digital solution for construction permit process in Slovakia. Identifying and defining these requirements is crucial to ensure that the platform not only meets its intended functional goals but also meet the user expectations. These requirements are derived from the Section 4.2, and linked to the results in the Section 4.1. Furthermore, the QRs represent a more detailed approach to effectively guide the platform's implementation. Additionally, we also incorporate other QRs related to more technical aspects such as security, performance, scalability, interoperability, and analytics.

QRs - Transparency:

1. The platform must provide clear visibility into the status and history of each application, including timestamps of each action taken and decisions made.
2. Any changes to submitted documents must be logged, including who made the change and when.
3. Users must have access to comprehensive audit trails that log all actions performed by stakeholders.
4. The platform must include a real-time tracking feature that allows users to see the current status of their application and any pending actions.
5. The platform must make all actions and decisions publicly accessible.
6. The platform must allow for public participation by enabling stakeholders to give objections or comments at a specific stage of the permit review process.
7. Automated notifications (via email and/or SMS) should be sent to users to update them on significant milestones and required actions in their application process.

QRs - Simplified Procedures:

1. The platform must incorporate a guided workflow to help users navigate through the application process step-by-step.
2. During the submission of applications, the system must automatically prevent the forwarding of incorrectly filled forms.
3. Form fields must include tool tips to assist users in completing applications accurately.
4. Forms and navigation must follow a logical flow to minimize user errors.

5. All necessary guidelines, forms, and documents must be accessible from a single, centralized location within the platform.
6. The platform must support advanced search and filter functionalities to help users quickly find the information they need.
7. The platform must include tools to effectively resolve disputes between the parties involved in the construction process.
8. The platform must allow for customization of forms, workflows, and notifications to meet the specific needs of different jurisdictions and user groups.
9. The platform must support in-platform messaging to facilitate communication between applicants and reviewers.
10. The platform must automatically calculate fees based on predefined rules.
11. The user interface must be intuitive and user-friendly, allowing users to complete tasks with minimal training.
12. Consistent design elements, such as buttons, icons, and color schemes, must be used to create a cohesive and easy-to-understand interface.
13. A comprehensive FAQ section and live chat support must be available to address common questions and provide real-time assistance.

QRs - Reduced Bureaucracy:

1. The platform must automate routine tasks, such as document verification and preliminary checks.
2. Redundant steps in the workflow must be identified and eliminated to streamline the overall permit issuance process.
3. Users must be able to upload, manage, and organize documents easily within the platform, with support for various file formats (PDF, DOCX, JPEG, etc.).
4. Workflow automation tools must route applications to the appropriate reviewers and decision-makers efficiently.
5. The platform must support electronic signatures.
6. The platform must enable online payment functionalities.
7. The platform must provide automated reminders for users to submit missing or additional documents as needed.

QRs - Security:

1. The platform must support multi-factor authentication (MFA) for all user logins to enhance security.

2. All data must be encrypted in transit using TLS 1.2 or higher and at rest using AES-256 encryption.
3. The platform must comply with all relevant data protection regulations, including GDPR, HIPAA, and local data protection laws.
4. User sessions must automatically time out after longer inactivity to prevent unauthorized access.

QRs - Performance:

1. The platform should be able to handle up to 1,000 concurrent users without performance degradation.
2. Page load times should not exceed 2 seconds under normal load conditions.

QRs - Scalability:

1. The platform must be able to scale horizontally to accommodate increased load during peak times.
2. The system must support load balancing to ensure even distribution of traffic and resources.

QRs - Interoperability:

1. The platform must support import and export of data in commonly used formats such as XML, CSV, and JSON.
2. The platform must provide well documented and secure APIs.
3. The platform must be accessible and effective across different devices and operating systems, including mobile phones, tablets, and desktop computers.
4. The platform must ensure authorization mechanisms to control access levels and permissions based on roles.

QRs - Analytics:

1. The platform must provide real-time reporting capabilities to generate insights on application processing times, approval rates, and common issues.
2. Users must able to create custom reports and dashboards to monitor key performance indicators.

5.2 Use Case Diagram

We need a use case diagram to systematically outline how users (actors) will interact with a system and what specific functionalities (use cases) the system will provide. The actors we consider are Developer, Public (user), and Office for the Spatial Planning and Construction of the Slovak Republic (admin). All these actors play distinct roles within the system. Their interactions and respective functionalities are illustrated in Figures 2 and 3, highlighting how each actor contributes uniquely to the system's operations and overall functionality. The system is managed by an external party not displayed in the use case diagrams, who handles the technical maintenance.

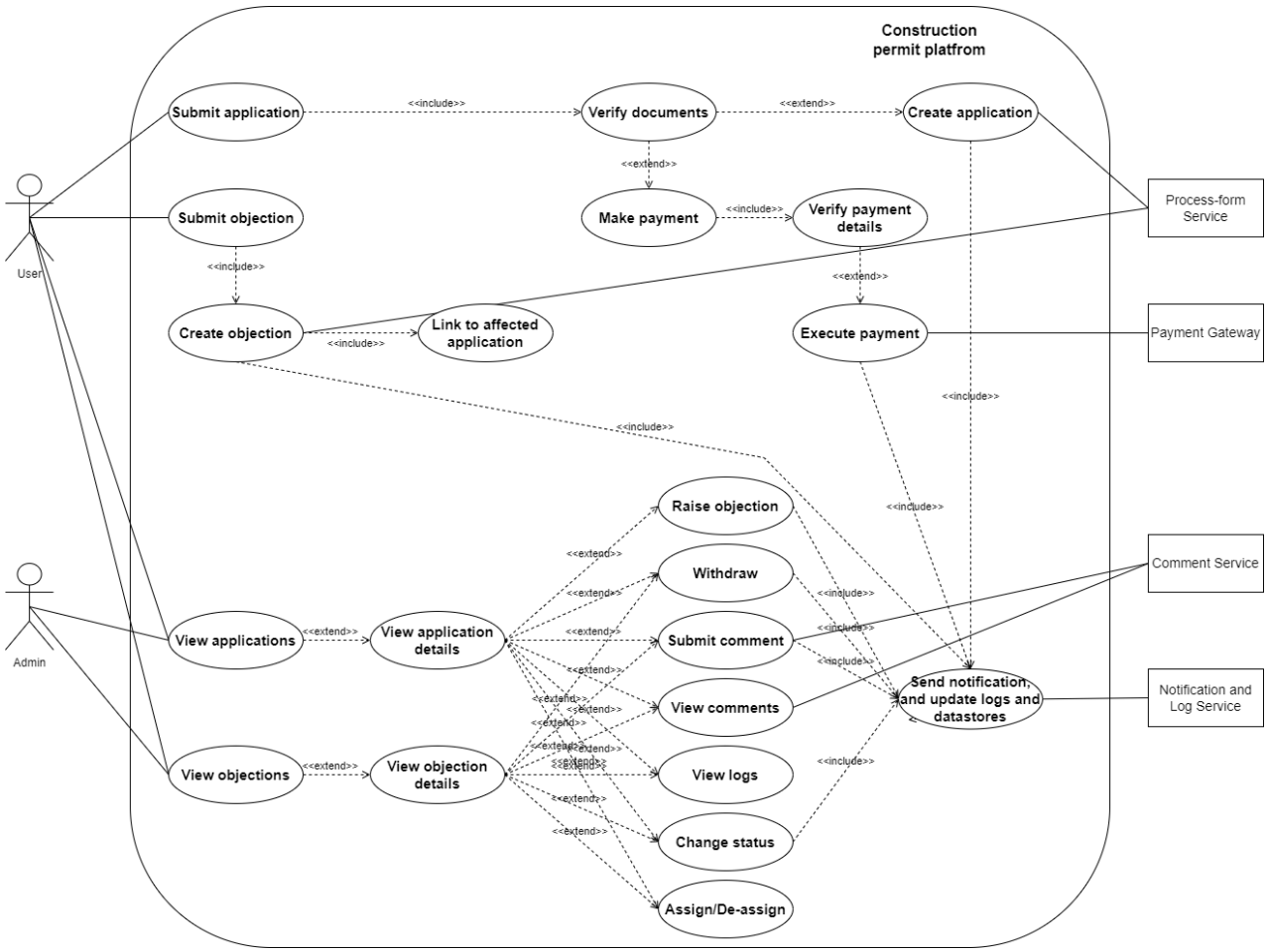

Figure 2: Use Case Diagram 1

In Figure 2, the use case diagram illustrates the primary functionalities available to the developer, public (users) and Office for the Spatial Planning and Construction of the Slovak Republic (admin) actors.

The developers can submit an application, which is a process that involves verifying submitted documents, and possibly Creating the application, with logging and notification functionalities in-

tegrated. This process aims to simplify the procedure and decrease bureaucracy. Upon submission, they can proceed to make a payment for the application process, which includes verifying the payment details and possibly executing the payment. Finally, they have the ability to view details of their application, view associated objections and comments, assigned admin, and access logs detailing all changes made to the application, enhancing the transparency of the process. If the developer wants to terminate their applications, they can withdraw it when the application is currently not under objection.

The public can submit objections, which are then associated with specific applications. These objections are reported to both the developer who submitted the application and the administrators. Similar to applications, the public can view the details of their objections, including related comments, logs, assigned admin, and the current status. If the public wishes to withdraw their objection, they can do so at any stage.

Both users and admins can view all applications and objections, and submit comments at any time. However, their permissions within the application/objection details differ. Only admins have the authority to change the status of an application or objection and to assign or de-assign themselves from them.

Furthermore, admins are tasked with reviewing both applications and objections within the system. They are responsible for providing resolutions by updating these submissions as necessary, with comprehensive logging and storage of all activities in relevant databases.

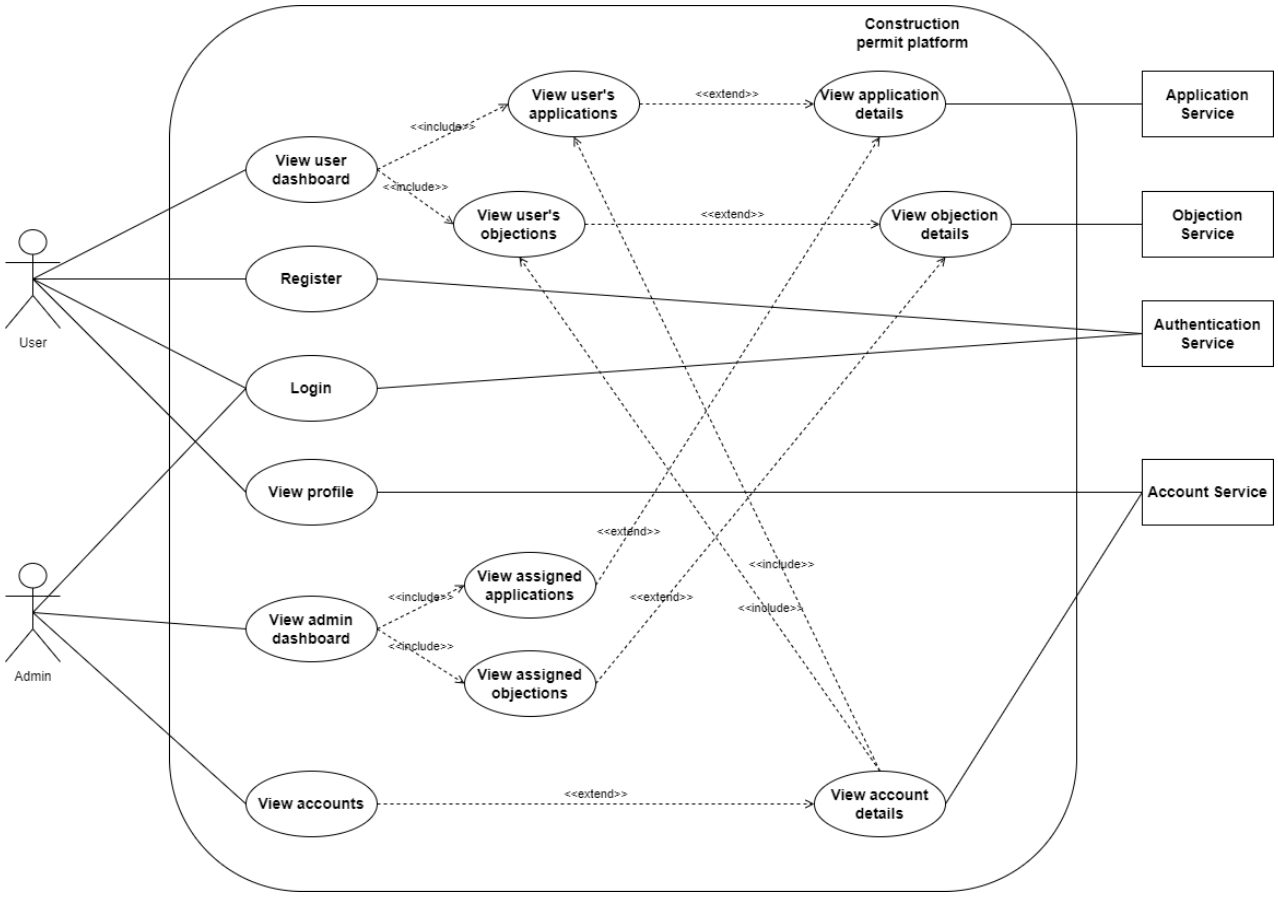

Figure 3: Use Case Diagram 2

In Figure 3, the use case diagram illustrates how users (both developers and the public) and admins (Office for the Spatial Planning and Construction of the Slovak Republic) can access information and data relevant to them.

Initially, developers and the public (users) can register and authenticate within the system. The Office for the Spatial Planning and Construction of the Slovak Republic (admins) is registered by manual insertion into the database, allowing them to log in afterward. The system's interface varies for users and admins. When admins view their dashboard, they can see the applications and objections assigned to them. Conversely, when users check their dashboard, they can find the applications and objections they have submitted.

However, admins have additional privileges. They can view all accounts registered in the system, along with their details and any submitted applications or objections.

5.3 Application and Objection Data Type

The system operates with two main data types: construction permit applications submitted by developers (see Section 5.3.1), and objections to these applications submitted by the public (see Section 5.3.2). In this section, we provide a detailed description of these two data types and explain all their attributes. Additionally, we describe also other data types that are necessary for the system. The relations between them and other system components can be seen in Section 4.

5.3.1 Application

An application is a data type created after the valid submission of information and documents by developers (either private person or organization). We describe this data type using Table 3.

Attributes of Application:

Attribute	Description
ID	Identification of the application.
Account ID	Reference key to account that submitted the application.
Admin ID	Reference key to assigned admin.
Role	Owner or Contractor
Submission date and time	Timestamp of when application was submitted.
Application Status	Submitted, Awaiting payment, Created, In progress, Incomplete, Expired, Open for objections, Under objection, Withdrawn, On hold, Denied, Approved.
Last Change	Timestamp of last change/update.

Table 3: Attributes of Application

Attributes of Property Information:

Attribute	Description
ID	Identification of the property information.
Application ID	Reference key to associated application.
Street	Street where the property is located.
House number	House number where the property is located.
City	City where the property is located.
Post code	Post code where the property is located.
Country	Country where the property is located.
Parcel number	Parcel number related to the property.
Zoning district	Zoning district where the property is located.
Current use	Current use of the property.
Proposed use	Proposed use of the property.

Table 4: Attributes of Property Information

In Table 4 we can see the property information associated with specific application that encompasses details about the location and zoning of the proposed construction site together with the current and proposed use.

Attributes of Project Information:

Attribute	Description
ID	Identification of the project information.
Application ID	Reference key to associated application.
Project Title	Short name of the project.
Project Description	Description of the proposed project.
Type	Construction, Renovation, Demolition.
Estimated Time	Approximate time it should take to finish the project.
Estimated Cost	Approximate cost of the project.

Table 5: Attributes of Project Information

In Table 5 we can see the project information associated with specific application that provides comprehensive project details such as type of construction, scope, timelines, and budget.

Attributes of Application Documents:

Attribute	Description
ID	Identification of the documents.
Application ID	Reference key to associated application.
Territorial Decision	Territorial decision issued by the land office.
Ownership certificate/Contractor Agreement	Declaration of ownership or deal with contractor.
Construction Specification	Detailed instructions for project.
Project Documentation	Project details.
Architectural Plan	Detailed blueprint for construction design.
Certificate of Competence of the Designer	Official recognition of designer's capability.

Attribute	Description
Certificate of Competence of the Designer	Official recognition of designer's capability.
Declaration of Construction Supervision	Formal oversight confirmation during construction.
Statement from Electricity Networks Administrator	Official communication from power utility authority.
Statement from Water Networks Administrator	Official communication from water utility authority.
Statement from Gas Networks Administrator	Official communication from gas utility authority.
Statement from Telecommunication Networks Administrator	Official communication from telecommunication utility authority.
Statement from Road Administrator	Official communication from road authority.
Statement from Traffic Inspectorate	Official communication from traffic regulators.
Statement from Environmental Authority	Official communication from environmental regulators.

Table 6: Attributes of Application Documents

In Table 6 we can see documents associated with specific application. This table serves as repository for all submitted documentation required for the application process.

Attributes of Application Supporting Document:

Attribute	Description
ID	Identification of the supporting document.
Documents ID	Reference key to associated documents.
Document	Supporting document.

Table 7: Attributes of Application Supporting Document

In Table 7 we can see the attributes relevant for supporting document that can be additionally submitted together with the rest of the documents needed for application process.

Attributes of Application Status:

Attribute	Description
ID	Identification of the status.
Status	Status description.

Table 8: Attributes of Application Status

In Table 8 we can see the attributes for application status that describes the current state of application. All the various applications statuses and their description can be found in Section 21.

Attributes of Application Comment:

Attribute	Description
ID	Identification of the comment.
Application ID	Reference key to associated application.
Account ID	Reference key to account that submitted comment.
Description	Description of the comment.
Timestamp	Timestamp of when the comment was created.

Table 9: Attributes of Application Comment

In Table 9 we can see the attributes of comment that can be submitted for a specific application. With this data type, users are given an opportunity to discuss their opinions about applications.

Attributes of Application Log:

Attribute	Description
ID	Identification of the log.
Application ID	Reference key to associated application.
Description	Description of the log.
Timestamp	Timestamp of when the log was created.

Table 10: Attributes of Application Log

In Table 10 we can see the attributes of log that is automatically generated and linked to a specific application that has been updated or commented.

5.3.2 Objection

Anyone has the right to raise an objection for any application that is currently in state "Open for objections" (see explanation of these statuses in Section 5.5). Detailed structure of objection can be seen in Table 11.

Attributes of Objection:

Attribute	Description
ID	Identification of the objection.
Application ID	Reference key to the associated application.
Account ID	Reference key to the account that submitted the objection.
Admin ID	Reference key to assigned admin.
Objection Status ID	Reference key to the current status of objection.
Brief Summary	Short summary of the objection.
Detailed Explanation	Justification of the objection
Affected Parties	Parties affected by the construction
Submission date and time	Timestamp of when objection was submitted.
Last Change	Timestamp of last change/update.

Table 11: Attributes of Objection

Attributes of Objection Supporting Document:

Attribute	Description
ID	Identification of the supporting document.
Objection ID	Reference key to associated objection.
Document	Supporting document.

Table 12: Attributes of Objection Supporting Document

In Table 12 we can see the attributes of supporting document submitted together with specific objection. This document serves as evidence relevant to the objection.

Attributes of Objection Status:

Attribute	Description
ID	Identification of the status.
Status	Status description.

Table 13: Attributes of Objection Status

In Table 13 we can see the attributes for objection status that describes the current state of objection. All the various objections statuses and their description can be found in Section 20.

Attributes of Objection Comment:

Attribute	Description
ID	Identification of the comment.
Objection ID	Reference key to associated objection.
Account ID	Reference key to account that submitted comment.
Description	Description of the comment.
Timestamp	Timestamp of when the comment was created.

Table 14: Attributes of Objection Comment

In Table 14 we can see the attributes of comment that can be submitted for a specific objection. With this data type, users are given an opportunity to discuss their opinions about objections.
Attributes of Objection Log:

Attribute	Description
ID	Identification of the log.
Objection ID	Reference key to associated objection.
Description	Description of the log.
Timestamp	Timestamp of when the log was created.

Table 15: Attributes of Objection Log

In Table **??** we can see the attributes of log that is automatically generated and linked to a specific objection that has been updated or commented.

5.4 Accounts

There are 3 types of accounts within the system: Admins (see Table 19), Private Persons (see Table 17), and Organizations (see Table 18). Each of these different accounts is associated with one centralised table that contains required authentication details and the role of the account. These details can be seen in Table 16.

Attributes of Account:

Attribute	Description
ID	Identification of the account.
Email	Email of the account.
Password	Hashed password of the account.
Role	Private person/Organization/Admin.

Table 16: Attributes of Account

Attributes of Private Person's Account:

Attribute	Description
ID	Identification of the private person.
Account ID	Reference key to associated account.
First Name	First name of the private person.
Last Name	Last name of the private person.
Email	Email of the private person.
Phone number	Phone number of the private person.
Street	Street where the private person lives.
House number	House number where the private person lives.
City	City where the private person lives.
Post code	Post code where the private person lives.
Country	Country where the private person lives.
Identification Number	Valid identification number of the private person.

Table 17: Attributes of Private Person's Account

In Table 17 we can see the attributes of each private person account within the system. These details ensure that the private person can be recognised and contacted when needed.

Attributes of Organization's Account:

Attribute	Description
ID	Identification of the organization.
Account ID	Reference key to associated account.
Name	Name of the organization.
First name of the Contact Person	First name of person responsible for communication with authority.
Last name of the Contact Person	Last name of person responsible for communication with authority.
Email	Email of the Contact Person.
Phone number	Phone number of the Contact Person.
Street	Street where the organization is located.
House number	House number where the organization is located.
City	City where the organization is located.
Post code	Post code where the organization is located.
Country	Country where the organization is located.
Registration number	Valid registration number of the organization.

Table 18: Attributes of Organization's Account

In Table 18 we can see the attributes of each organization account within the system. These details ensure that the organization can be recognised and contacted when needed.

Attributes of Admin's Account:

Attribute	Description
ID	Identification of the admin.
Account ID	Reference key to associated account.
Name	Name of the organization.
First name	First name of admin.
Last name	Last name of admin.

Table 19: Attributes of Admin's Account

In Table 19 we can see the attributes of each admin account within the system. Their account is manually created in the database.

5.5 Application and Objection Status

Applications and objections can have multiple statuses within the system, depending on their current stage. In this section, we outline the various statuses they can hold and explain their meanings. The various statuses of application can be seen in Table 21, and the statuses of objection can be seen in Table 20.

Status	Description
Submitted and Created	After submitting the objection form, the initial status is set as "Submitted and Created".
In Progress	When authority picks the objection for review, the status is set to "In Progress".
Withdrawn	When the user decides to cancel their objection, the status is set to "Withdrawn".
On Hold	If the objection requires inputs from other parties, its status is set to "On Hold".
Denied	If the authority decides to deny the objection, its status is set to "Denied".
Approved	If the authority decides to approve the objection, its status is set to "Approved" and the related application is denied.

Table 20: Objection Status

Status	Description
Submitted	After submitting the application form, the initial status is set as "Submitted".
Awaiting Payment	After document verification, the payment is triggered and status is set to "Awaiting Payment".
Created	After successful payment the application is officially created and the status is set to "Created".
In Progress	When authority picks the application for review, the status is set to "In Progress".
Incomplete	In special cases when the application requires and is missing special documents etc., the status is set to "Incomplete".
Expired	If the applicant fails to submit the required documents within the specified timeframe, their status is set to "Expired," resulting in the cancellation of their application.
Open for Objections	After the application has been reviewed, the status is changed to "Open for Objections" for a specified period. During this time, the public can submit objections.
Under Objection	If an objections against the application is submitted, the status off application is set to "Under Objection".
Withdrawn	When applicant decides to cancel their application (can be done only if the application is not under objection), the status is set to "Withdrawn".
On Hold	If the application requires inputs from other parties, its status is set to "On Hold".
Denied	If the authority decides to deny the application, its status is set to "Denied".
Approved	If the authority decides to approve the application, its status is set to "Approved" and applicant receives the permit.

Table 21: Application Status

5.6 Entity Relations

In this section, we delve into how entities interact within the system, and the system architecture. The Figure 4 illustrates the proposed entity relationship diagram, highlighting key interactions and dependencies.

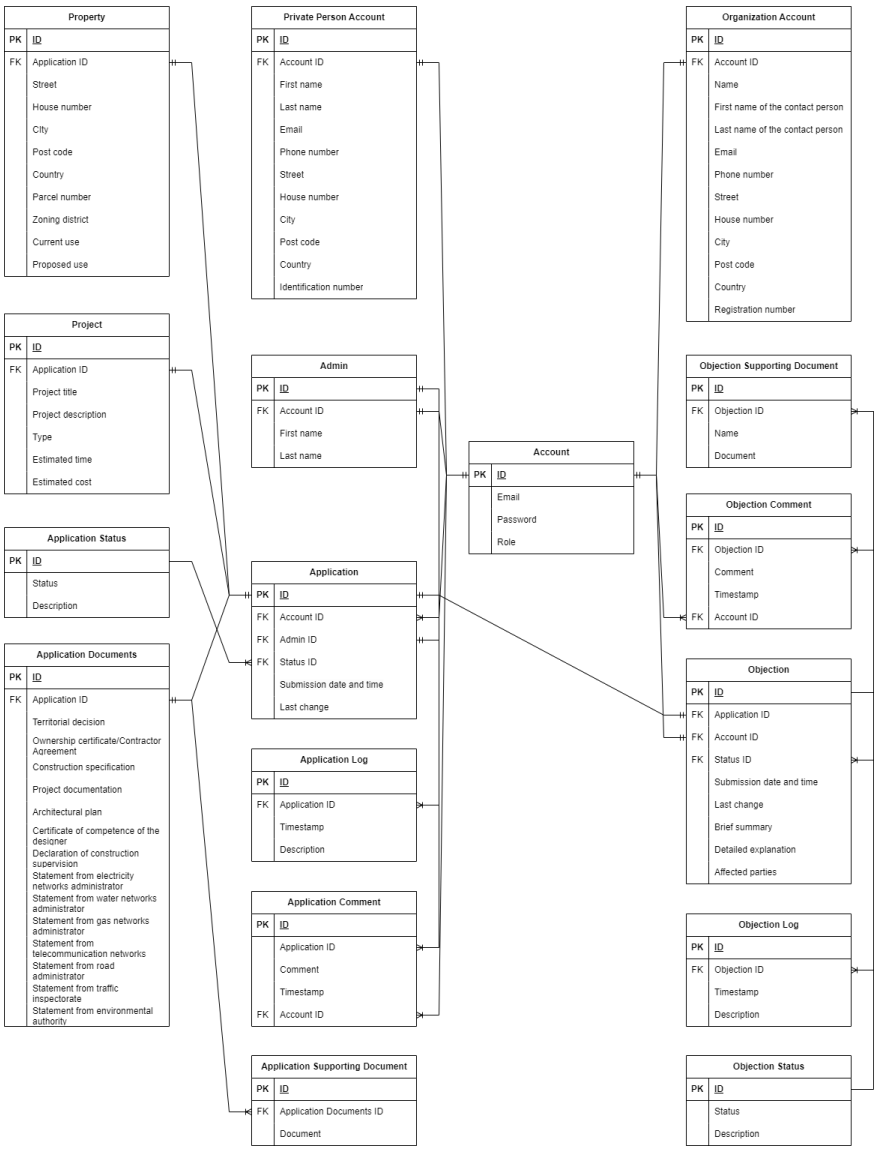

Figure 4: Entity Relations

5.7 Data Flow Diagram

To better understand and visualize the proposed digitalized construction permit process, we have created a Data Flow Diagram (DFD). This DFD illustrates how data flows through the system, depicting the interactions between various entities, processes, and data stores.

5.7.1 Level 0 DFD

The Level 0 DFD, also known as a context diagram, offers a broad overview of the entire system, depicting the primary entities and the flow of data between them and the central process. Figure 5 displays this diagram, illustrating the Developer, Public, and Office for Spatial Planning and Construction of the Slovak Republic as the main entities. It visually represents their principal interactions with the Construction Permit Platform.

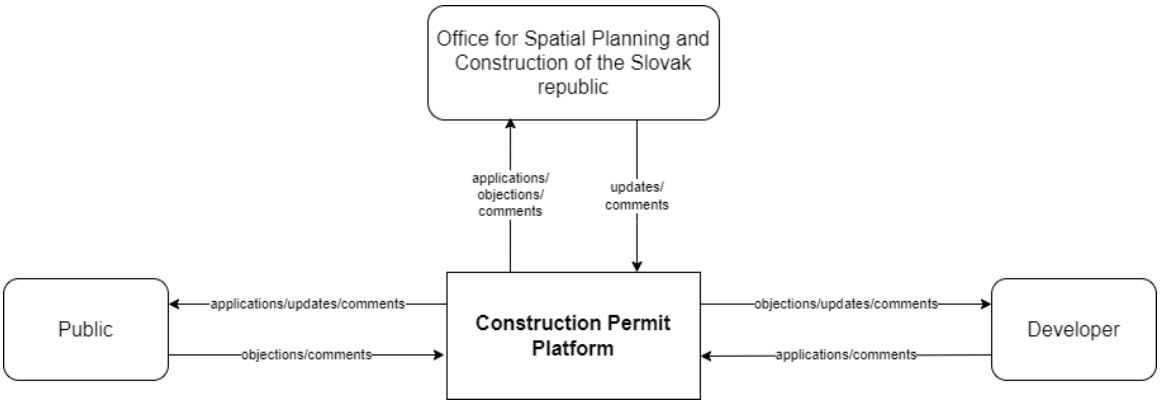

Figure 5: Level 0 DFD

5.7.2 Level 1 DFDs

The Level 1 DFD decomposes the core process into its primary subprocesses, highlighting essential interactions and data flows within the system. This level of DFD necessitates the creation of five distinct diagrams. These diagrams outline various processes: registration and authentication within the system (see Figures 6 and 7), submission of construction permit applications (see Figure 8), payment procedures for construction permit proposals (see Figure 9), and submission of objections (see Figure 10). Both the application and objection submission processes involve numerous flows, including tracking, logging, and saving processes.

Registration Process:

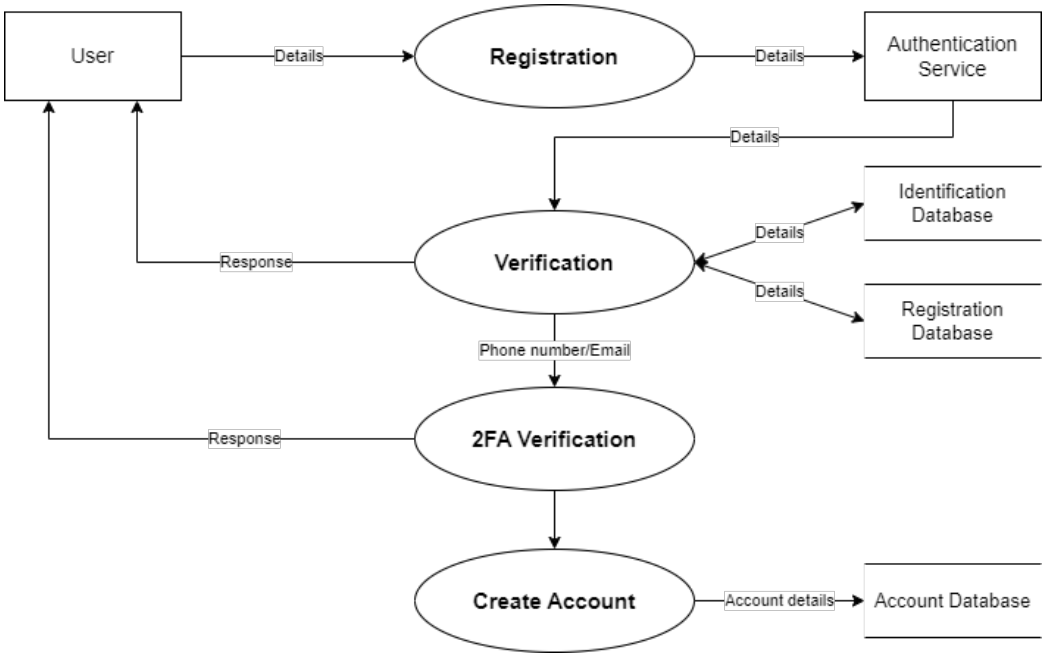

Figure 6: Level 1 DFD: Registration Process

In Figure 6, the registration process is depicted. This process is managed by the Authentication Service, which verifies user details against the National Identification Database (for private person) or Registration Database (for organization) to ensure to ensure the authenticity of registrations. Following successful verification, the next crucial step involves setting up Two-Factor Authentication (2FA) for added security, offering options such as SMS or email verification.

Upon successful completion of these steps, the system proceeds to create the user account. All pertinent details associated with the account, including personal/organizational information and authentication preferences, are securely stored in the Account Database. This ensures that the system maintains accurate records and enables seamless access management for registered users. Only registered users are granted the ability to submit applications and objections, ensuring that all interactions within the system are carried out by authenticated individuals.

Login Process:

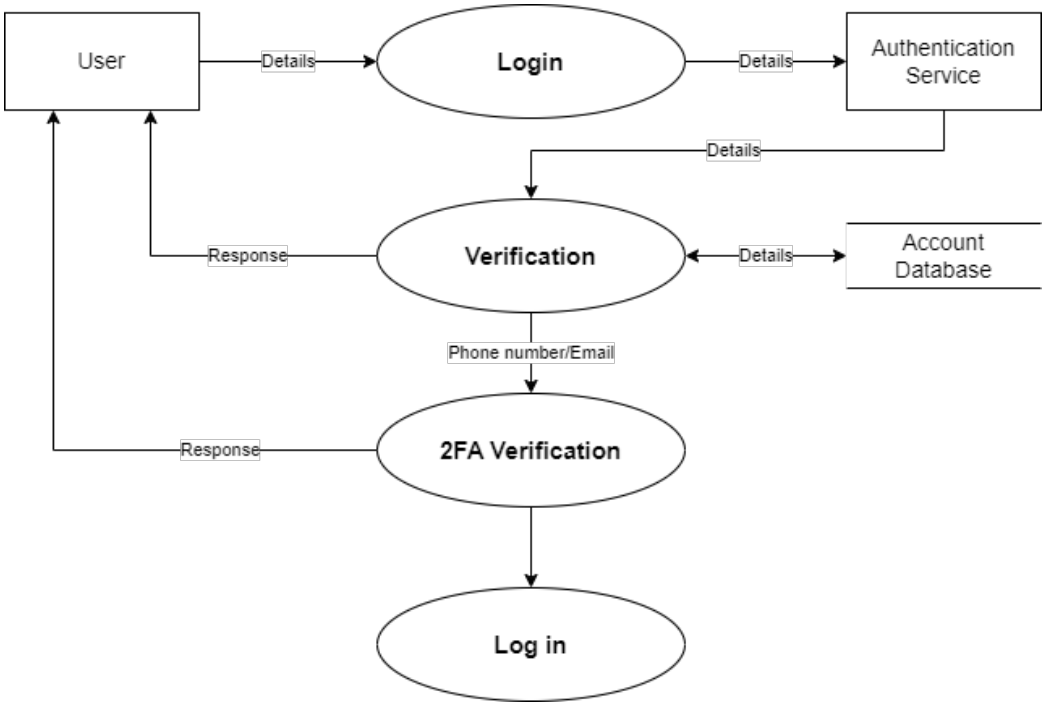

Figure 7: Level 1 DFD: Login Process

In Figure 7, the login process is illustrated. This process is managed by the Authentication Service, which verifies the login details with the Account Database and then triggers the 2FA Verification method selected by the user. Upon successful verification, the user is logged in. After a successful login, the user gains the ability to submit new applications or objections.

Application Process:

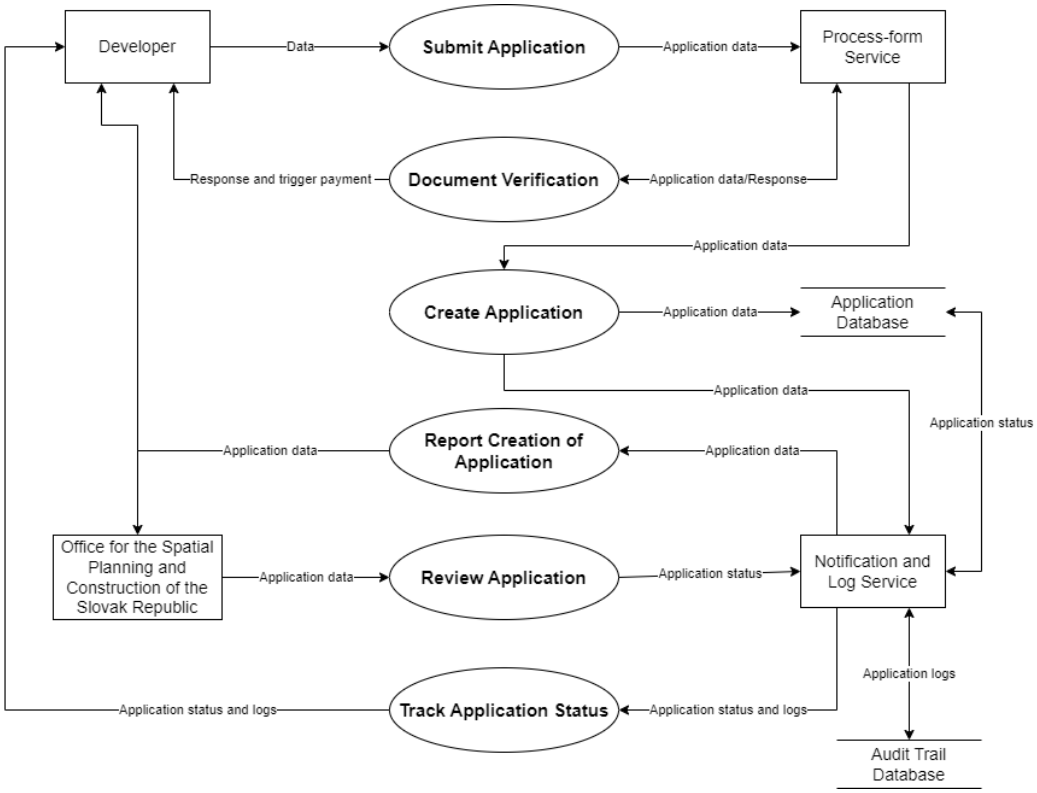

Figure 8: Level 1 DFD: Application Process

In Figure 8, the process of submitting and creating a new application for a construction permit is visualized. The developer completes a form and uploads the necessary documents before submitting the application. The Process-form Service then manages this data, verifying the documents and triggering payment if the documents are legitimate.

Upon successful verification, a new application is automatically created, and its details are saved in a datastore named the Application Database. The flow continues with the Notification and Log Service, ensuring that both the Developer and the Office for Spatial Planning and Construction of the Slovak Republic are informed. This service also handles fetching and saving all logs from and to the Audit Trail Database, as well as updating the application status in the Application Database. The Office for Spatial Planning and Construction of the Slovak Republic is tasked with reviewing the application. Upon completing their review, they designate the application status as "Open for objections." If no objections related to the application are submitted within a specified time frame, the application is automatically approved.

Additionally, the Notification and Log Service ensures that users can view all logs and the status of their applications in real-time, providing transparency and keeping all parties informed throughout the application process.

Payment Process:

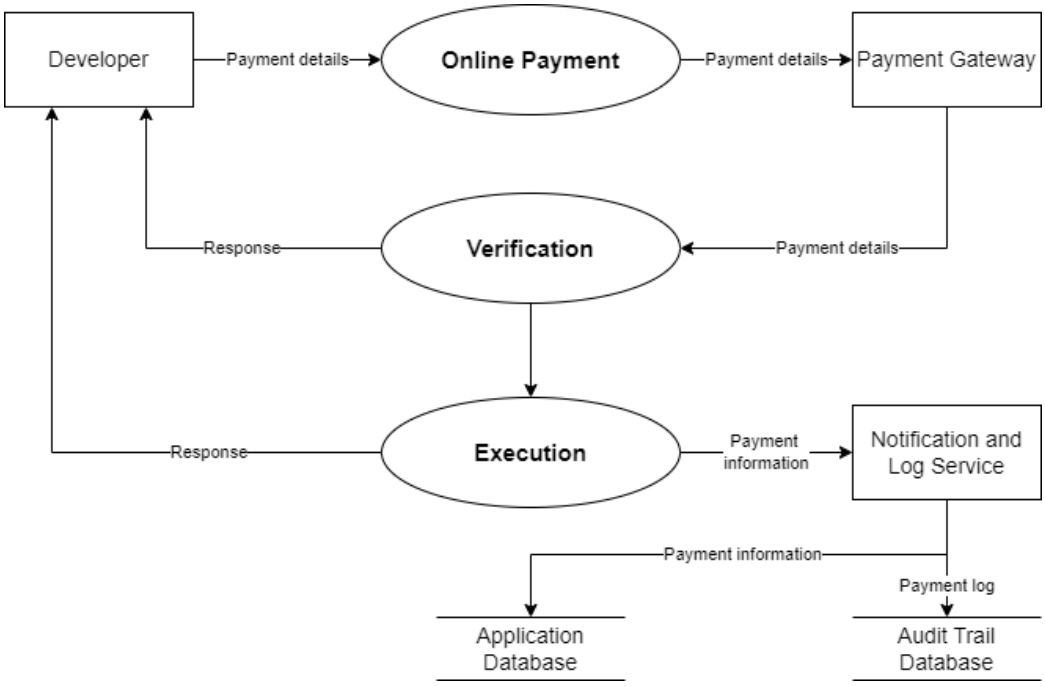

Figure 9: Level 1 DFD: Payment Process

In Figure 9, the payment process is illustrated. After submitting the application, the payment for the application process is triggered. Through a payment gateway, the payment details are verified, and upon a successful response, the payment is executed. The payment information is then linked with the application in the Application Database and logged in the Audit Trail Database, ensuring both the transaction and the application are properly recorded and traceable.

Objection Process:

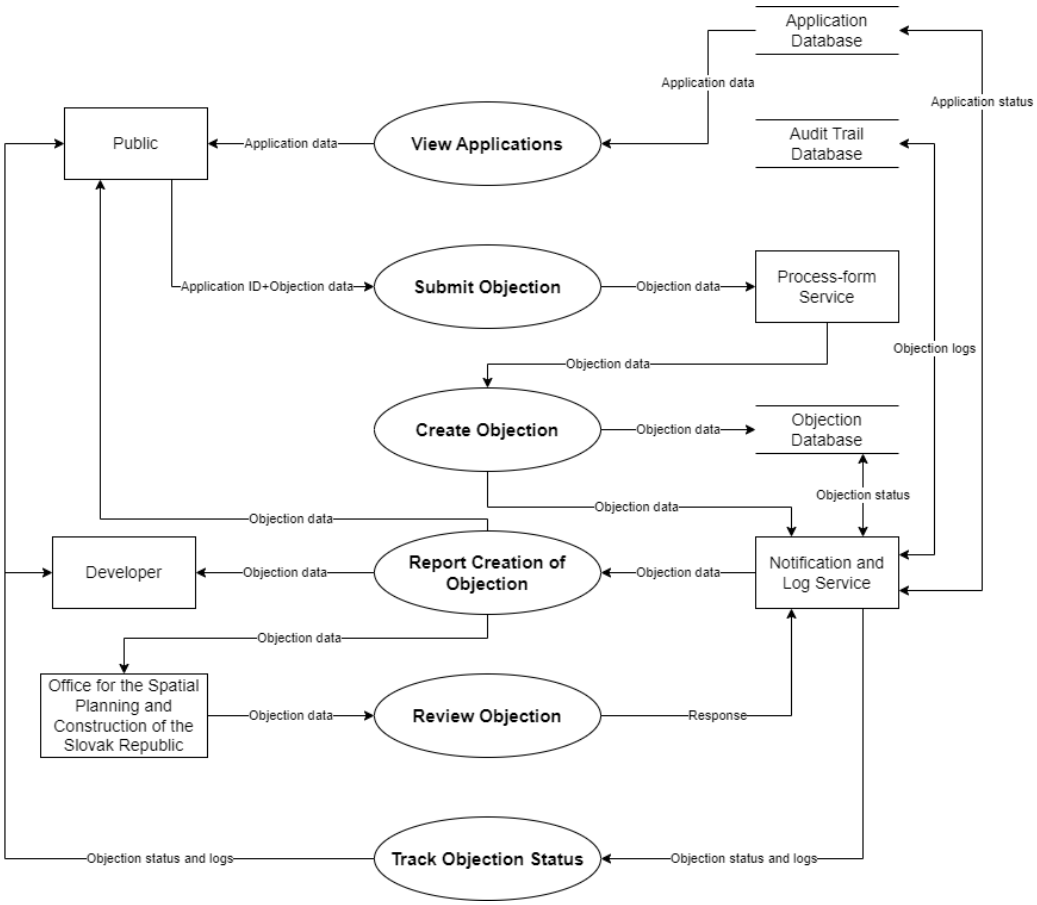

Figure 10: Level 1 DFD: Objection Process

Lastly, in Figure 10, the process of submitting an objection by the public is illustrated. The public can view all applications at any time, and if they believe an application contradicts their rights or causes issues, they can submit an objection regarding that specific application. This is done through a form where they must provide all necessary information. The Process-form Service handles this, creating the objection in the system and saving its details in the Objection Database, linking it to the specific application in question.

The Notification and Log Service stores all logs detailing every change to the objection in Audit Trail Database, updates the objection status as needed in Objection Database, and provides a way to track it. It also updates the affected application's status to "Under Objection" in Application Database and logs it. Additionally, all relevant parties are informed, and the Office for Spatial Planning and Construction of the Slovak Republic reviews the objection, engages with interested parties, and provides a resolution.

5.8 Form Flowcharts

Flowcharts are essential because they simplify complex processes, making them easier to understand and analyze. They provide a visual representation that clarifies the sequence of steps. In our scenario, we depict the process for registration (see Section 5.8.1), and submitting a new application by developers (see Section 5.8.2) and new objections by the public (see Section 5.8.3).

5.8.1 Registration Flowchart

When registering in the system, the user must choose whether they are signing up as an individual or an organization. This selection determines the specific input fields that will be displayed.

Private person/Organization Registration Form Flowchart:

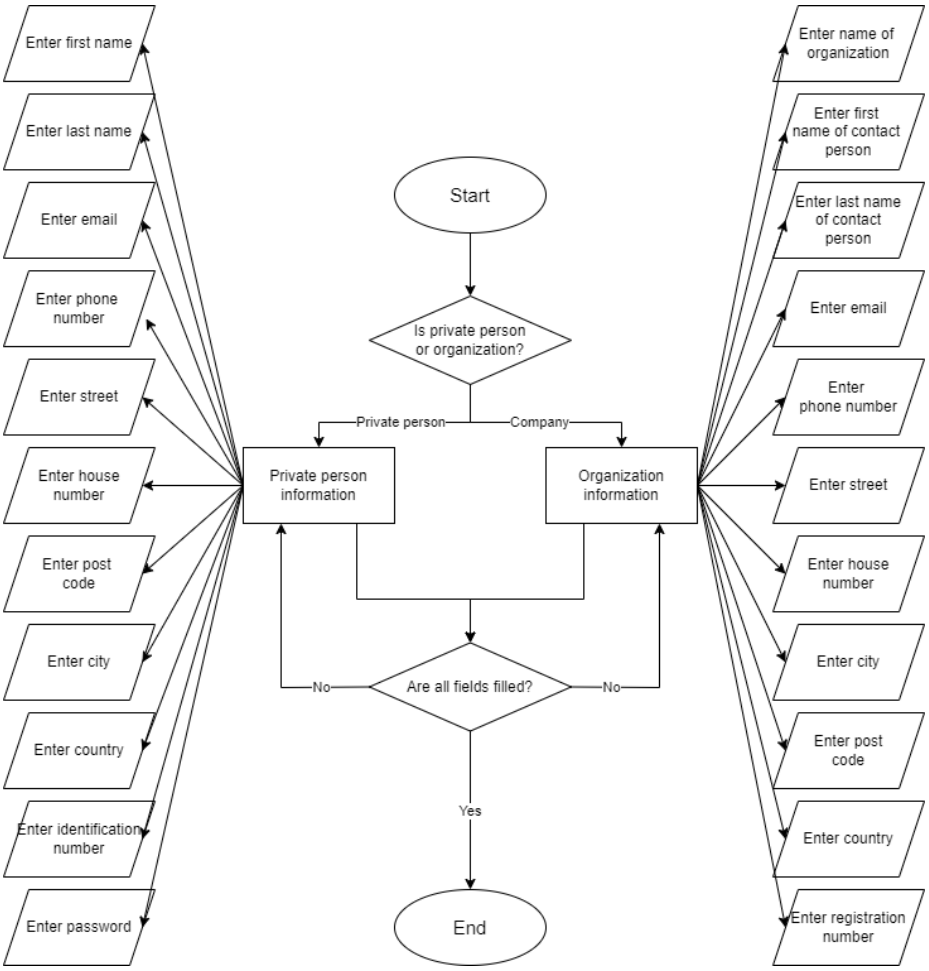

Figure 11: Private person/Organization Registration Form Flowchart

5.8.2 Submit New Application Flowcharts

In this section, we explore the structure and flow of the form required for submitting a new application for a construction permit. The form is divided into four flowcharts that follow each other for clarity and to enhance the visual appeal of this thesis.

Select Role Form Flowchart:

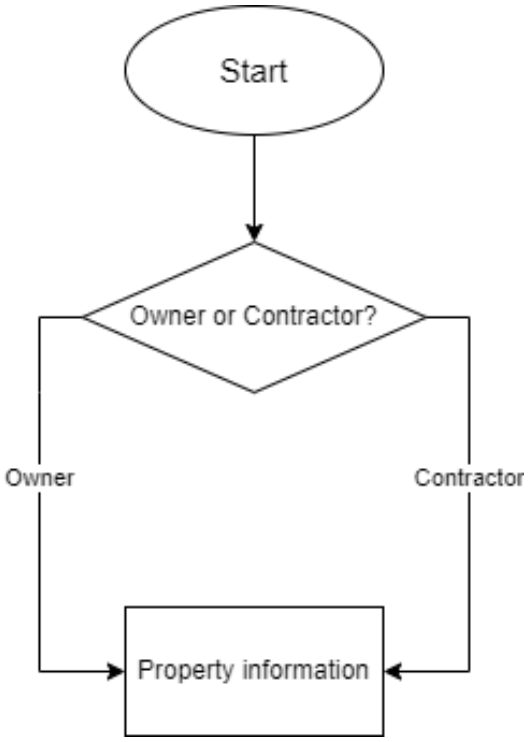

Figure 12: Select Role Form Flowchart

In Figure 12, we observe the initial stage of the form process where users select whether they are Owner or Contractor within the proposed construction.

Property Information Form Flowchart:

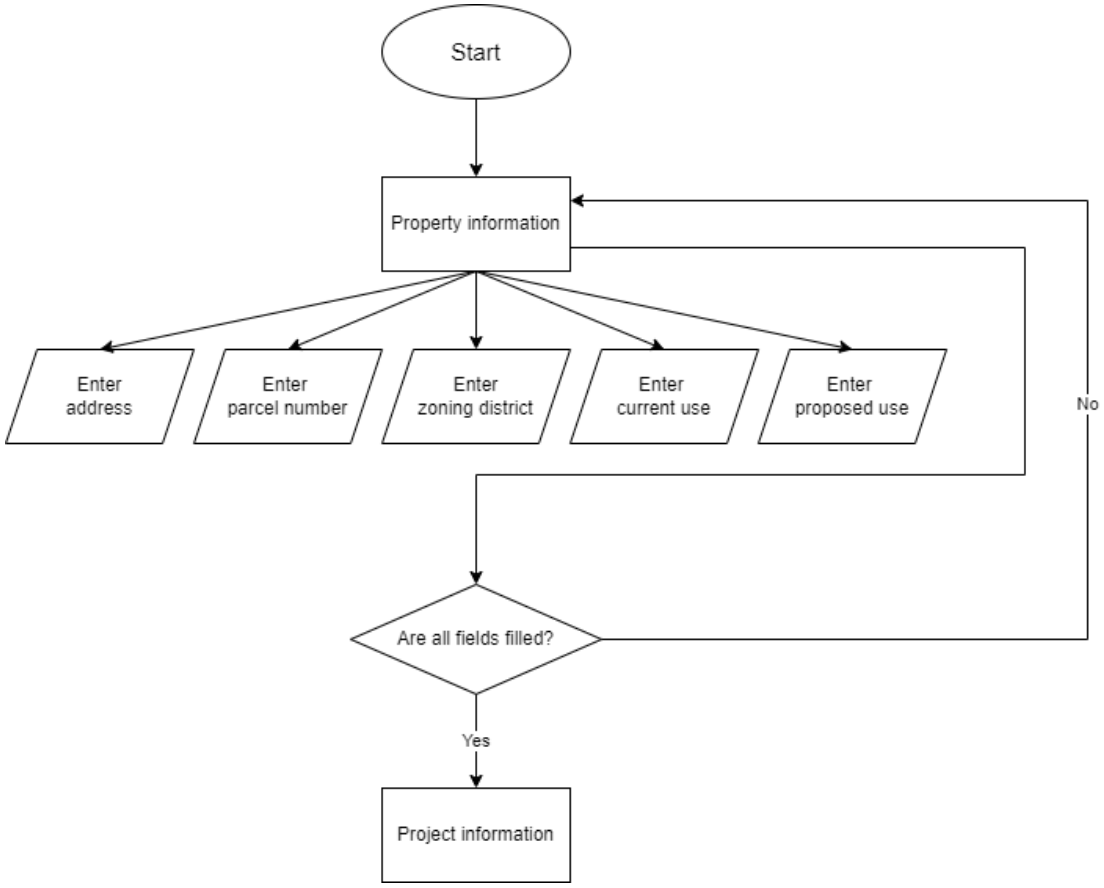

Figure 13: Property Information Form Flowchart

In Figure 13, we can see the subsequent step that involves entering property information. Here, developers are required to provide essential details about the property or land they intend to develop, including the address, parcel number, zoning district, and current and proposed use. Once all necessary fields are completed, the form progresses to the next stage.

Project Information Form Flowchart:

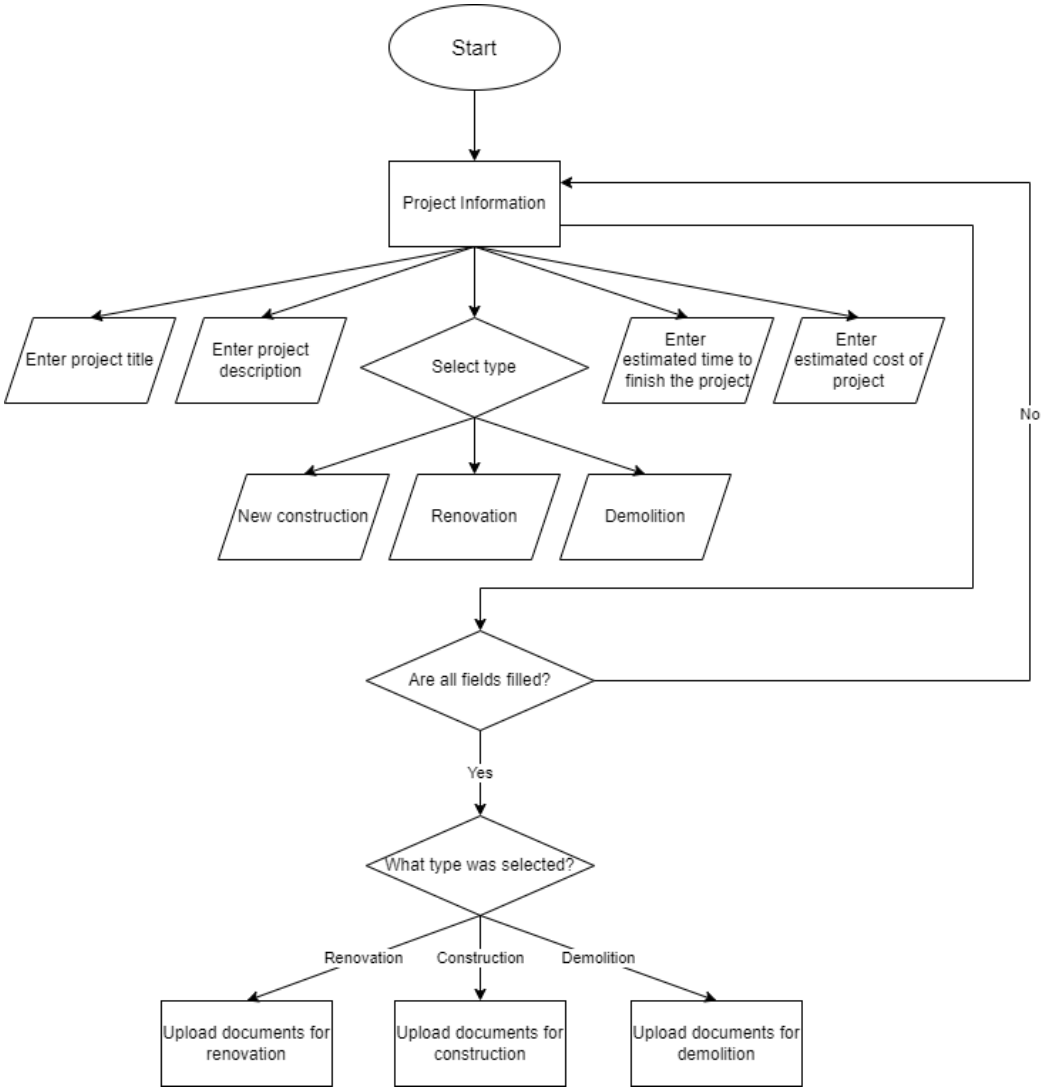

Figure 14: Project Information Form Flowchart

In Figure 14, the flowchart outlines the process where developers fill out a form pertaining to project information. This includes describing their project, providing estimated costs and completion time, and selecting the project type (new construction, renovation, or demolition). Depending on the selected type, the form then directs the user to the next specific stage for uploading relevant documents.

Upload Documents Form Flowchart:

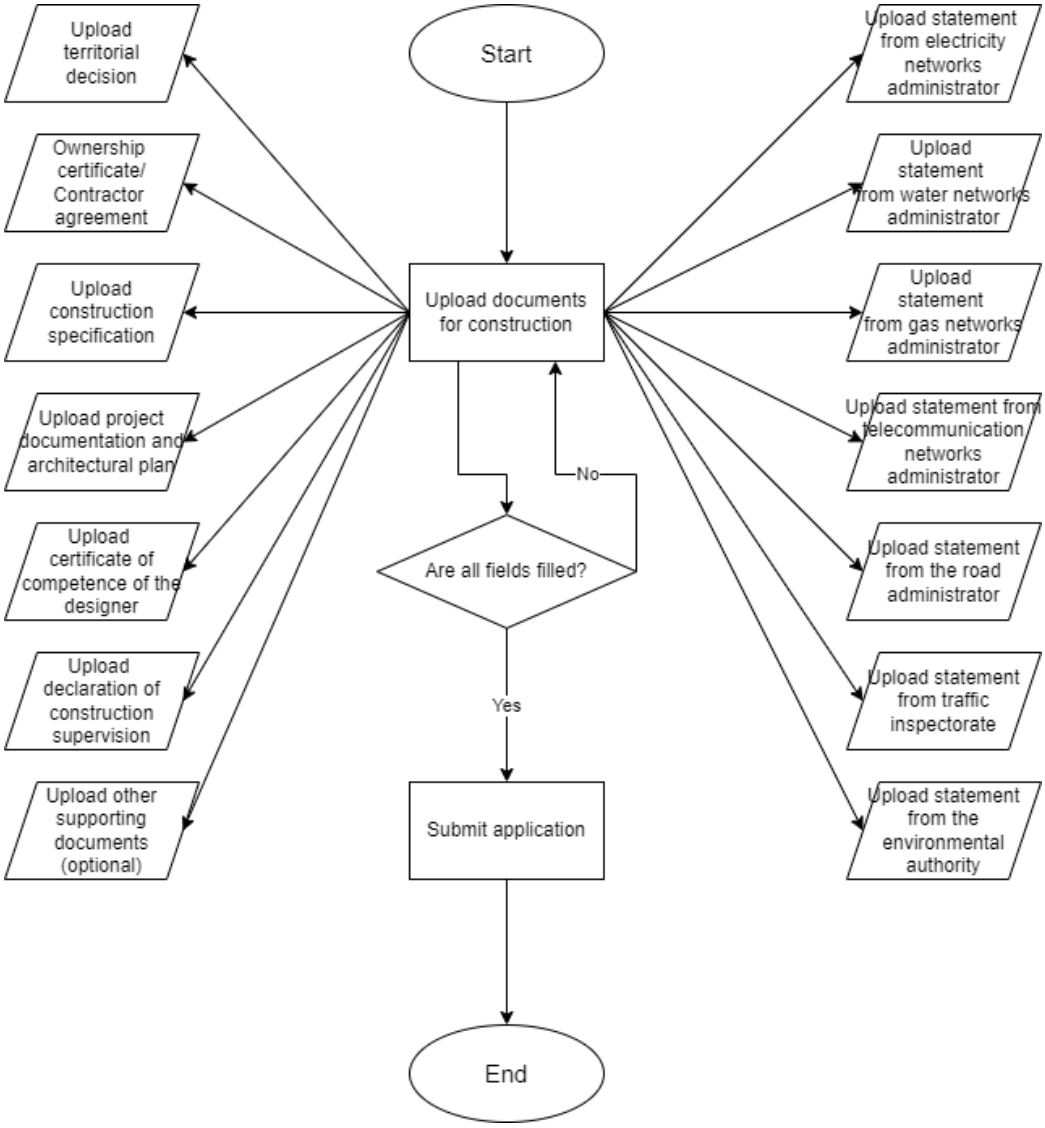

Figure 15: Upload Documents Form Flowchart

In Figure 15, the final step of the form process is depicted. Here, users upload all relevant documents required for the approval of their proposal. As this thesis primarily focuses on construction permits, it excludes the processes for renovation and demolition projects. Once all documents are uploaded, the application's completeness will be verified and reviewed by the relevant authority (Office for the Spatial Planning and Construction of the Slovak Republic).

5.8.3 Submit New Objection Flowcharts

Once applications are created and undergoing processing, the public has an opportunity to submit objections at specific stages of the process. If valid arguments are submitted, these objections can potentially halt the application's progress.

Objection Information Form Flowchart:

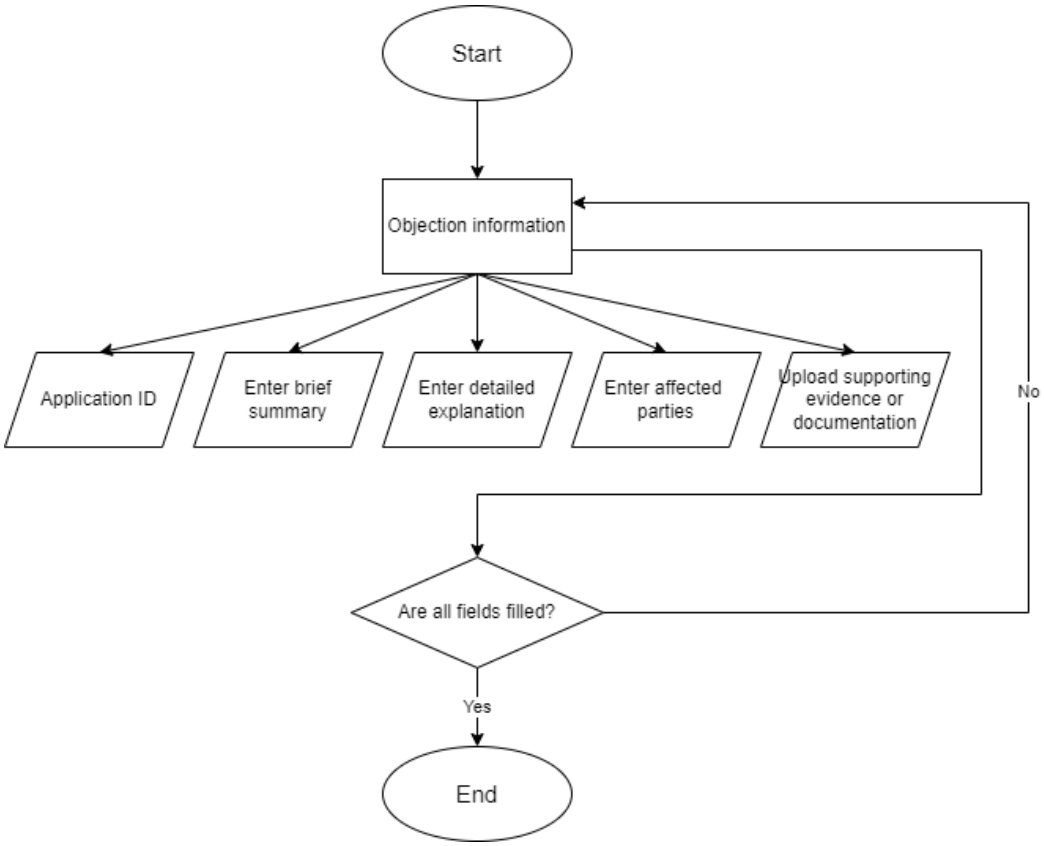

Figure 16: Objection Information Form Flowchart

In Figure 16, the second and final step of submitting an objection is described. Here, the reason for the objection must be justified. By entering the application ID, the objection will be linked to the specific application. A brief summary, detailed explanation, and a list of all affected parties must be included. Finally, any supporting evidence, such as photos, videos, or relevant documentation, needs to be submitted.

6 Prototype

Based on the proposed design detailed in Section 5, a prototype was implemented. This prototype serves as a tangible representation of the intended construction permit platform, which is expected to streamline the construction permit process in Slovakia. By providing a centralized system for managing applications and objections, the platform aims to enhance transparency and efficiency. The source code of the prototype can be found in Construction Permit Platform GitHub Repository.

6.1 Technology Infrastructure

The programming languages selected for the implementation of the prototype were HTML, CSS, and JavaScript for the frontend, and PHP for the backend. The database used is MySQL, and queries are executed using SQL. This technology stack was chosen to ensure a responsive and interactive user interface while maintaining a robust and efficient backend. The combination of these tools provides a solid foundation for developing a scalable and user-friendly construction permit platform.

The backend is managed by PDO managers, which are responsible for passing data to endpoints. This ensures secure and efficient database interactions, leveraging PHP Data Objects (PDO) for prepared statements and transactions. The list of PDO managers can be seen in list below:

PDO managers:

- PDOAccountManager
- PDOAdminManager
- PDOApplicationManager
- PDOObjectionManager
- PDOCommentManager
- PDOAuthenticationManager
- PDOLogManager

One PDO manager worth mentioning is the PDOLogManager. This manager handles only two specific endpoints to retrieve all application and objection logs. Otherwise, logs are created by other managers whenever there is a change in the system.

Below is a list of endpoints that are being fetched by the frontend. The purpose of each endpoint can be inferred from its name:

Account endpoints:

- GET / account / getAccountDetailsByAccountId (admin only)
- GET / account / getAllAccounts (admin only)

Authentication endpoints:

- POST / authentication / register (user only)
- POST / authentication / login
- POST / authentication / logout

Application endpoints:

- GET / application / getAllClosedApplications
- GET / application / getAllClosedApplicationsByAccountId
- GET / application / getAllCommentsByApplicationId
- GET / application / getAllOpenApplications
- GET / application / getAllOpenApplicationsByAccountId
- GET / application / getApplicationDetailsById
- GET / application / getAllClosedAssignedApplicationsByAdminId (admin only)
- GET / application / getAllOpenAssignedApplicationsByAdminId (admin only)
- POST / application / postApplication
- POST / application / postCommentByApplicationId
- PUT / application / withdrawApplication
- PUT / application / assignAdminToApplication (admin only)
- PUT / application / setApplicationStatus (admin only)
- PUT / application / unassignAdminFromApplication (admin only)

Objection endpoints:

- GET / objection / getAllClosedObjections
- GET / objection / getAllClosedObjectionsByAccountId
- GET / objection / getAllCommentsByObjectionId
- GET / objection / getAllOpenObjections
- GET / objection / getAllOpenObjectionsByAccountId
- GET / objection / getObjectionDetailsById
- GET / objection / getAllClosedAssignedObjectionsByAdminId (admin only)
- GET / objection / getAllOpenAssignedObjectionsByAdminId (admin only)
- POST / objection / postObjection
- POST / objection / postCommentByObjectionId
- PUT / objection / withdrawObjection
- PUT / objection / assignAdminToObjection (admin only)
- PUT / objection / setObjectionStatus (admin only)
- PUT / objection/ unassignAdminFromObjection (admin only)

Log endpoints:

- GET / application / getAllLogsByApplicationId
- GET / objection / getAllLogsByObjectionId

Additionally, we utilized XAMPP to run Apache and MySQL locally for our system. XAMPP, developed by Apache Friends, is an open-source, cross-platform web server solution stack package that includes Apache HTTP Server, MySQL, and interpreters for PHP scripts. This choice allowed us to quickly establish a local development environment, making it easier to test and develop the prototype. This setup enabled rapid development and debugging, ensuring efficient integration and testing of all system components in a controlled environment.

6.2 Visual Overview of the Prototype

In this section, we will showcase the implemented prototype through a series of screenshots, providing a visual tour of the platform's features and functionality.

6.2.1 Authentication

Here, the authentication process within the prototype is illustrated. The registration form is displayed in Figure 17, while the login form is shown in Figure 18.

Registration form:

When registering, users can choose to sign up as either a private individual or an organization and then provide the required information accordingly.

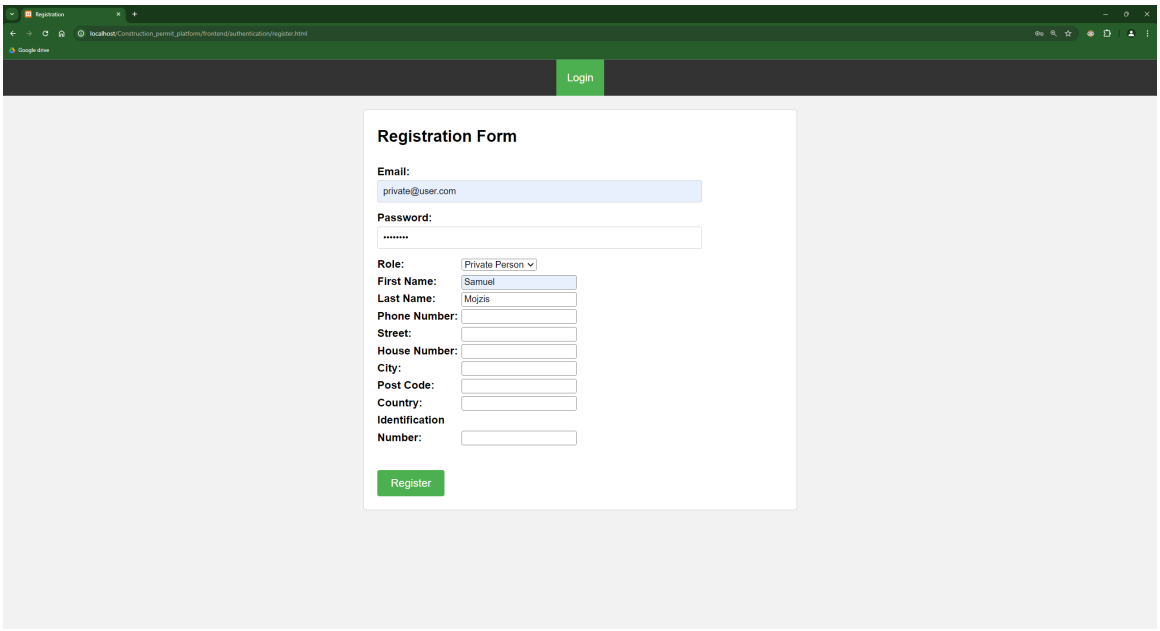

Figure 17: Prototype - Register

Login form:

Here, users enter the email address and password they provided during registration.

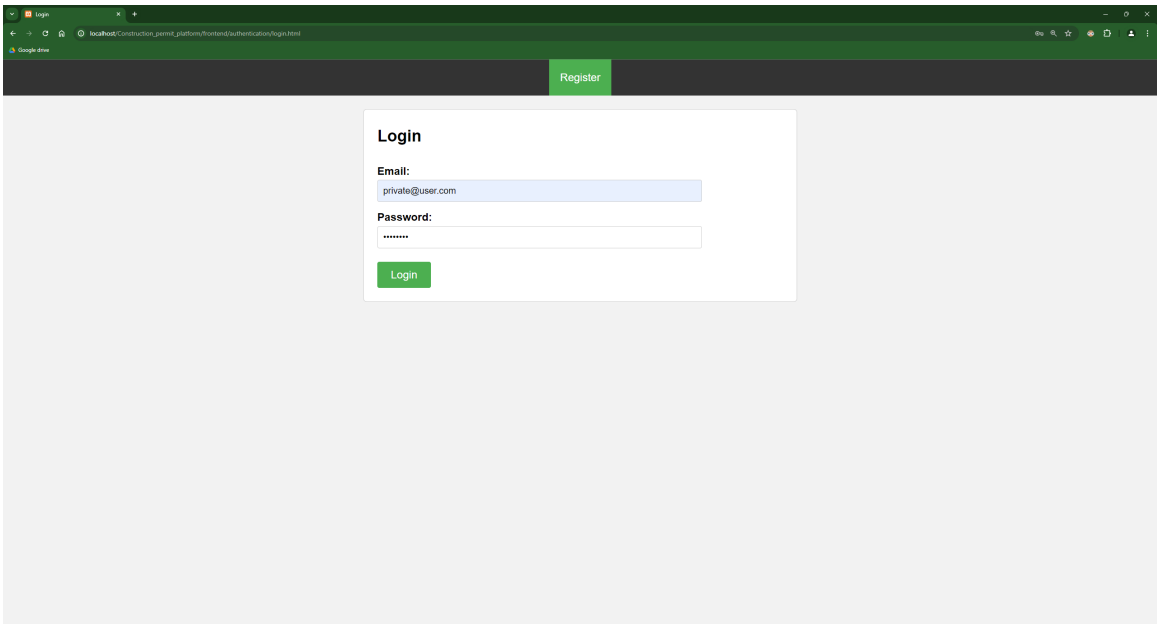

Figure 18: Prototype - Login

6.2.2 User UI

When a non-admin user logs into their personal or organizational account, they encounter a user interface distinct from that of admins. This interface includes additional functionalities, such as the ability to submit applications and objections. Every possible page that the user can access is listed on next pages.

User profile and dashboard:

Users can view the details of their profile, which contains the information provided during registration. Additionally, users can view their own personal dashboard where they can find all information about their submitted applications and objections that are either open or closed.

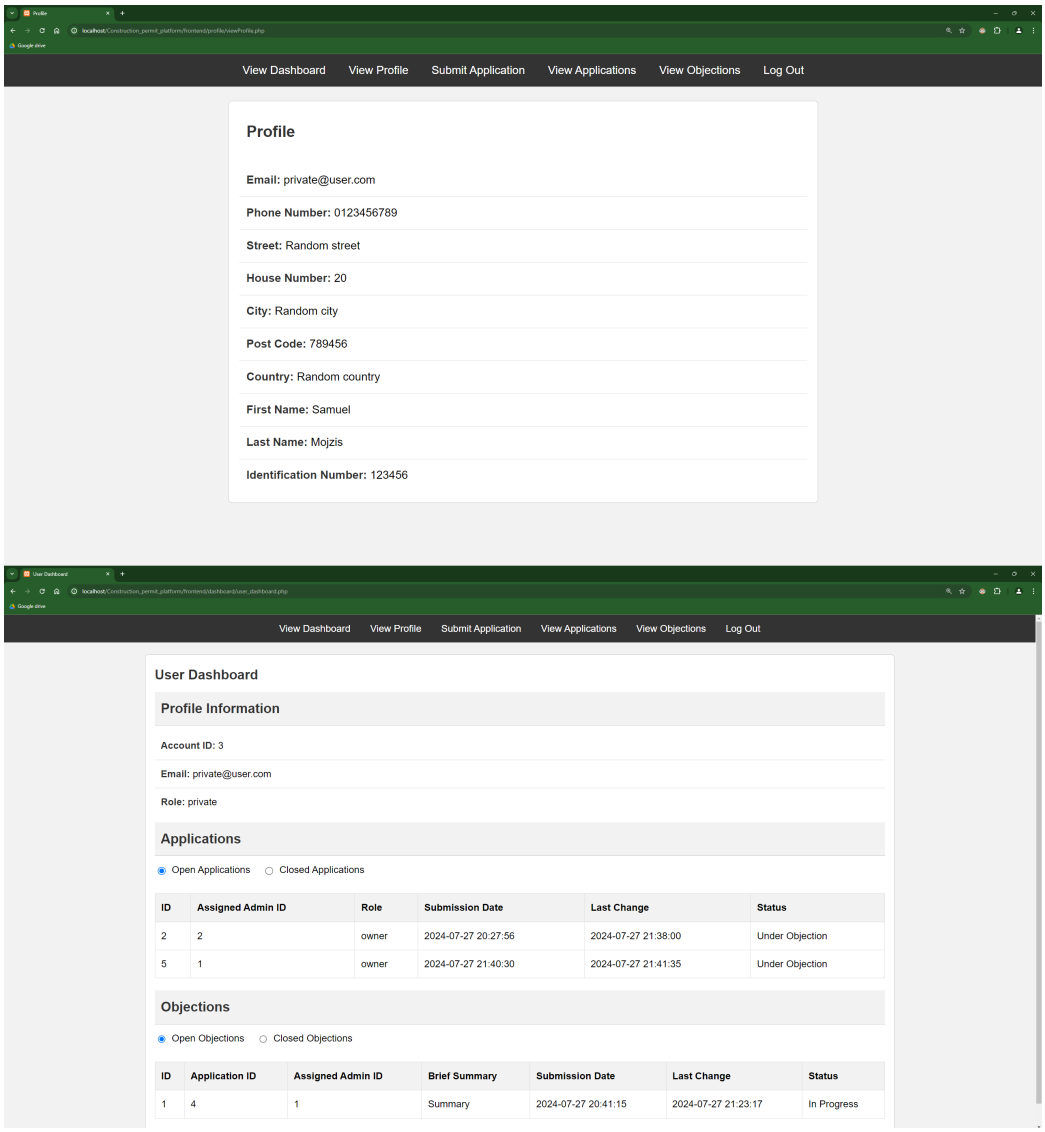

Figure 19: Prototype - User profile and dashboard

Submit application form:

The prototype includes four sequential forms for submitting an application, as shown in Figures 20 and 21. The input fields in the final form, intended for submitting documents, accept only VARCHAR(255) since this is just a prototype and there is no need to process actual documents in PDF format.

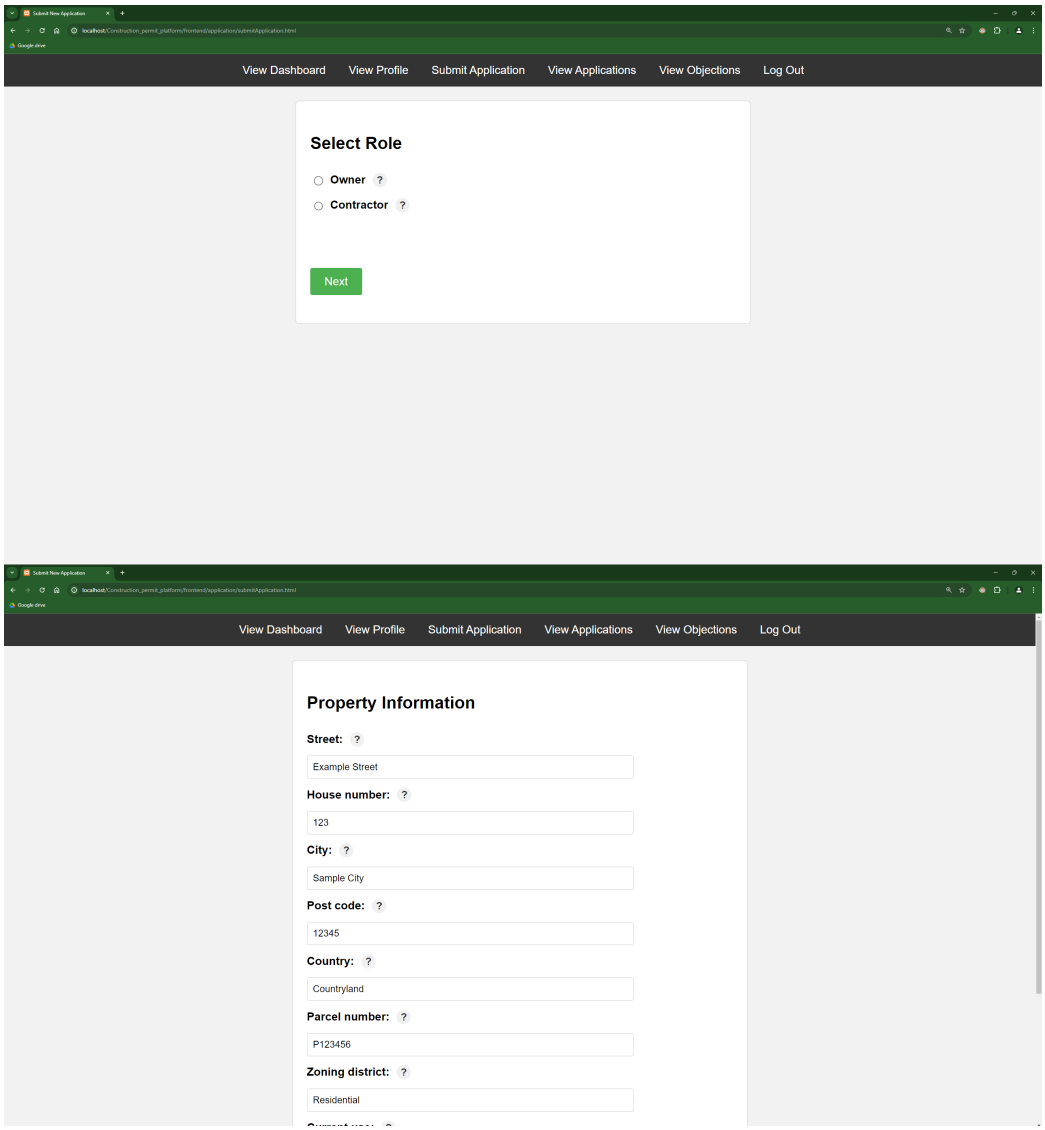

Figure 20: Prototype - Submit application - Select role/Property information

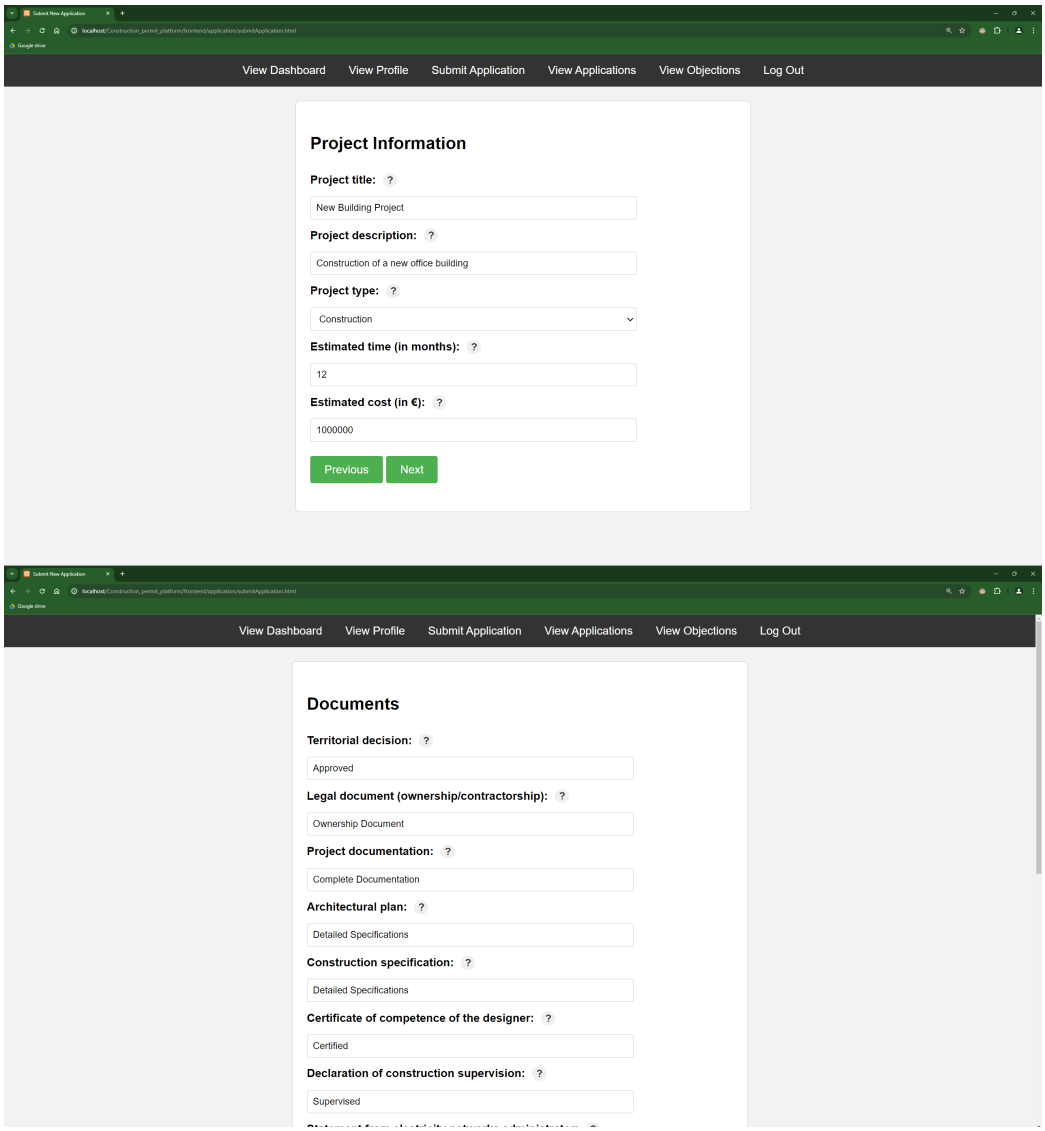

Figure 21: Prototype - Submit application - Project information/Documents

View applications and objections:

Users can view all open and closed applications and objections processed by the system. By clicking on any of them, they can see the details. Admins have the same functionality, so it will not be repeated in their section.

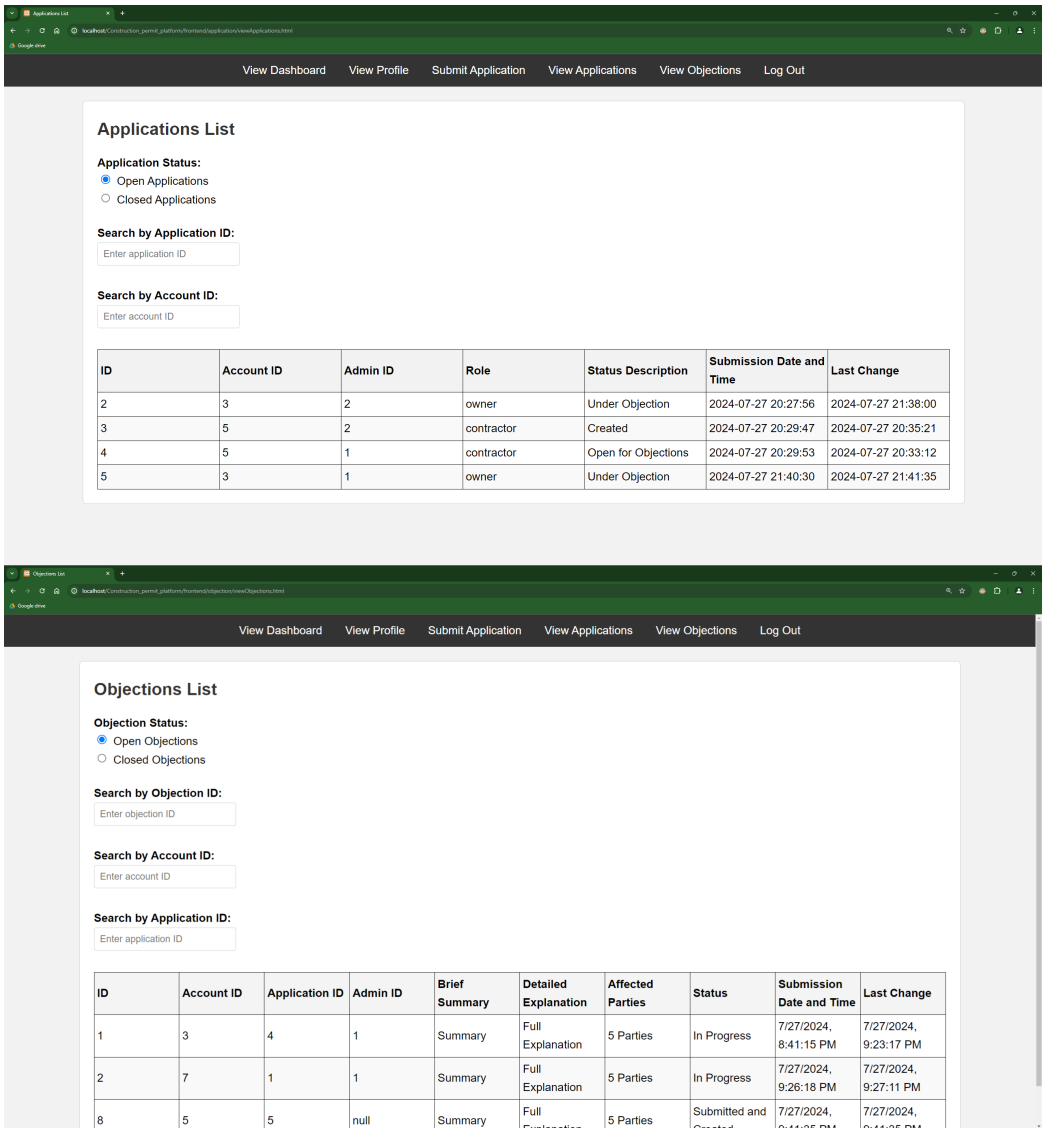

Figure 22: Prototype - View applications and objections

Raise objection and see objection details:

Users can raise an objection when viewing application details. If the application's status is "Open for Objections," a "Raise Objection" button will appear in the top right corner. Clicking this button directs the user to the objection form. Once the objection is successfully submitted, it will appear on their dashboard, where they can view its details. If they choose to withdraw the objection, they can do so by clicking the "Withdraw Objection" button in the top right corner of the objection details.

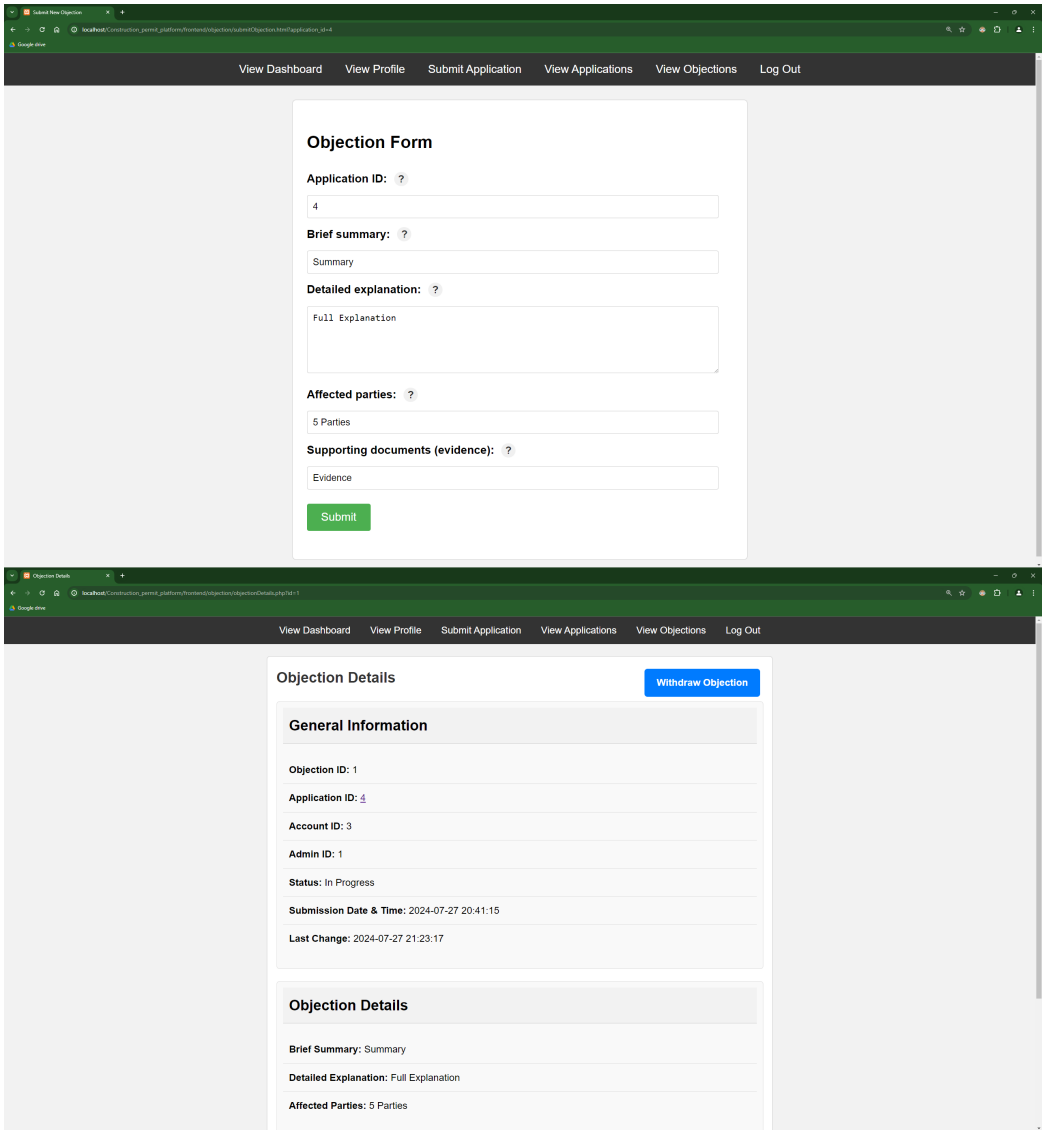

Figure 23: Prototype - Raise objection and see objection details

View application details:

Users can view application details of any application. If the user is not creator of the application and if the application's status is "Open for Objections," a "Raise Objection" button will appear in the top right corner. If user wants to withdraw their application, they can do so by clicking the "Withdraw Application" button in the top right corner of the application details. This button will be there only if the application is currently not under objection.

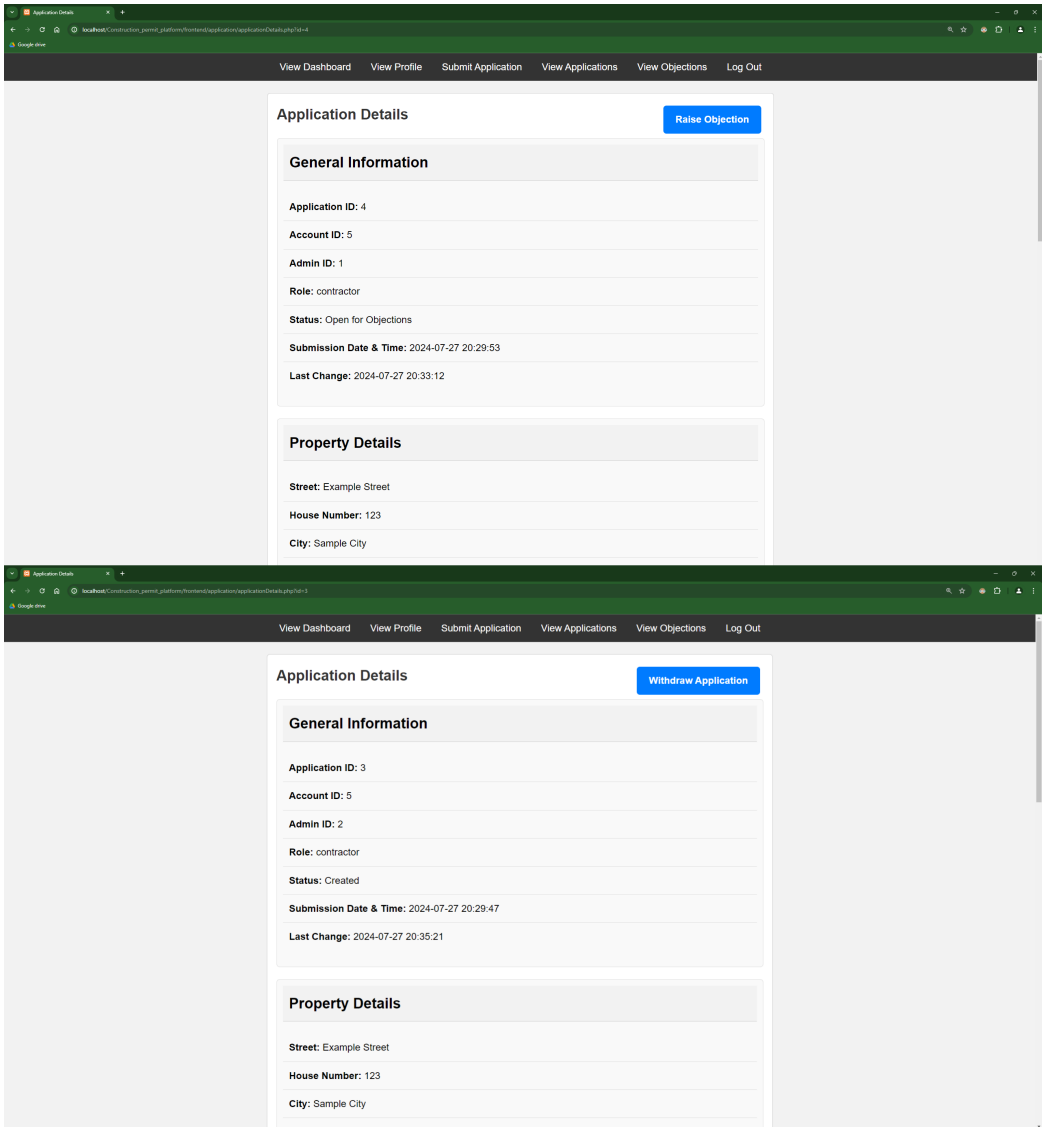

Figure 24: Prototype - Application details (User perspective)

View logs and comments:

When viewing the details of an application or objection, users can find logs and comments at the bottom of the page. The logs and comments are hidden by default, by pressing the toggle button they can be either shown. The users can also add their own comments. This functionality is available to both users and admins, so it will be displayed only once.

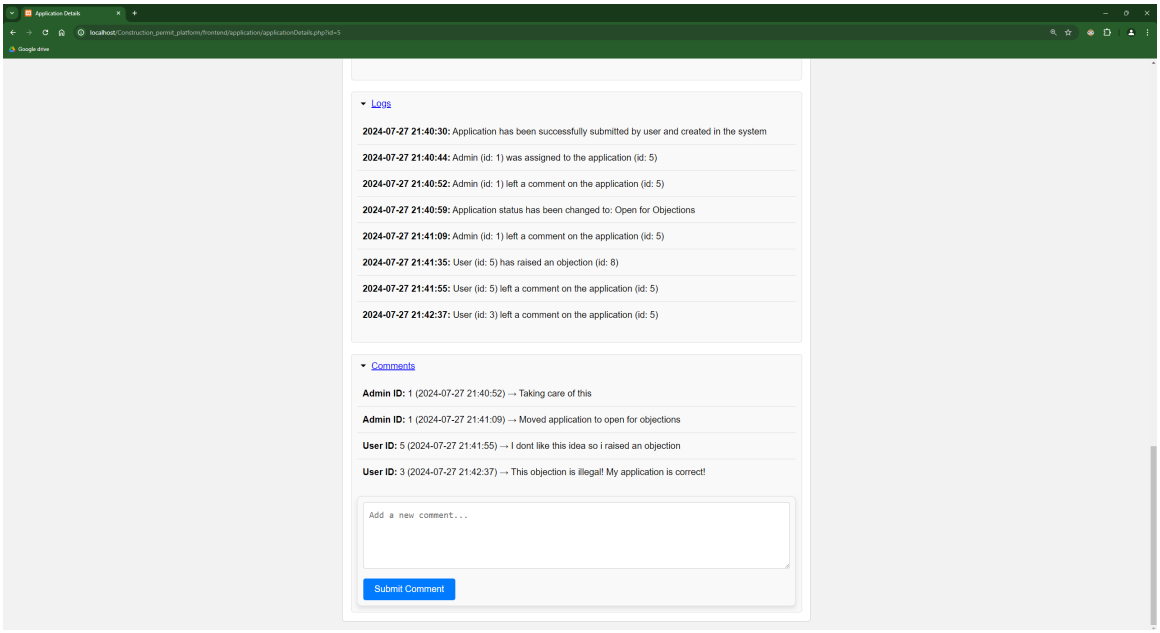

Figure 25: Prototype - View logs and comments

6.2.3 Admin UI

Admins are responsible for processing and updating the status of applications and objections. Therefore, their user interface is tailored to support these tasks. Some functionalities available to admins are also accessible to users, as shown in Figures 22 and 25. The rest of their functionalities is displayed on next pages.

View admin dashboard:

Admins can view their dashboard, where they can browse through the applications and objections assigned to them.

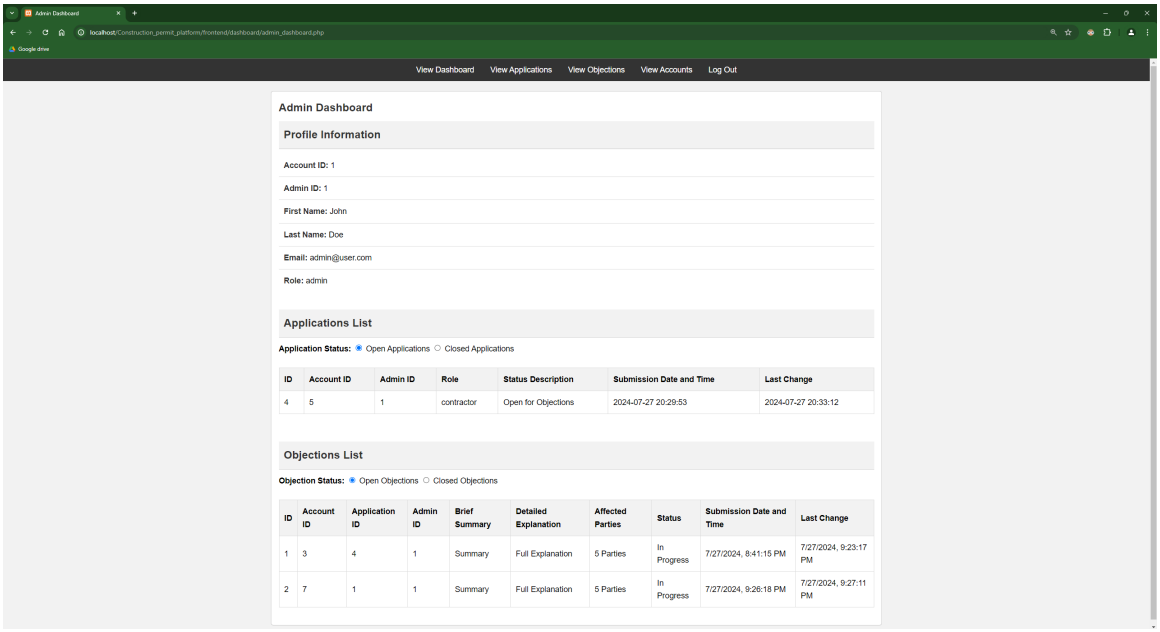

Figure 26: Prototype - Admin dashboard

Application and objection details:

When viewing the details of applications and objections, admins can press a special button in the top right corner to either assign or deassign themselves from them. Additionally, there is a special section in the details where they can change the current status of the application or objection.

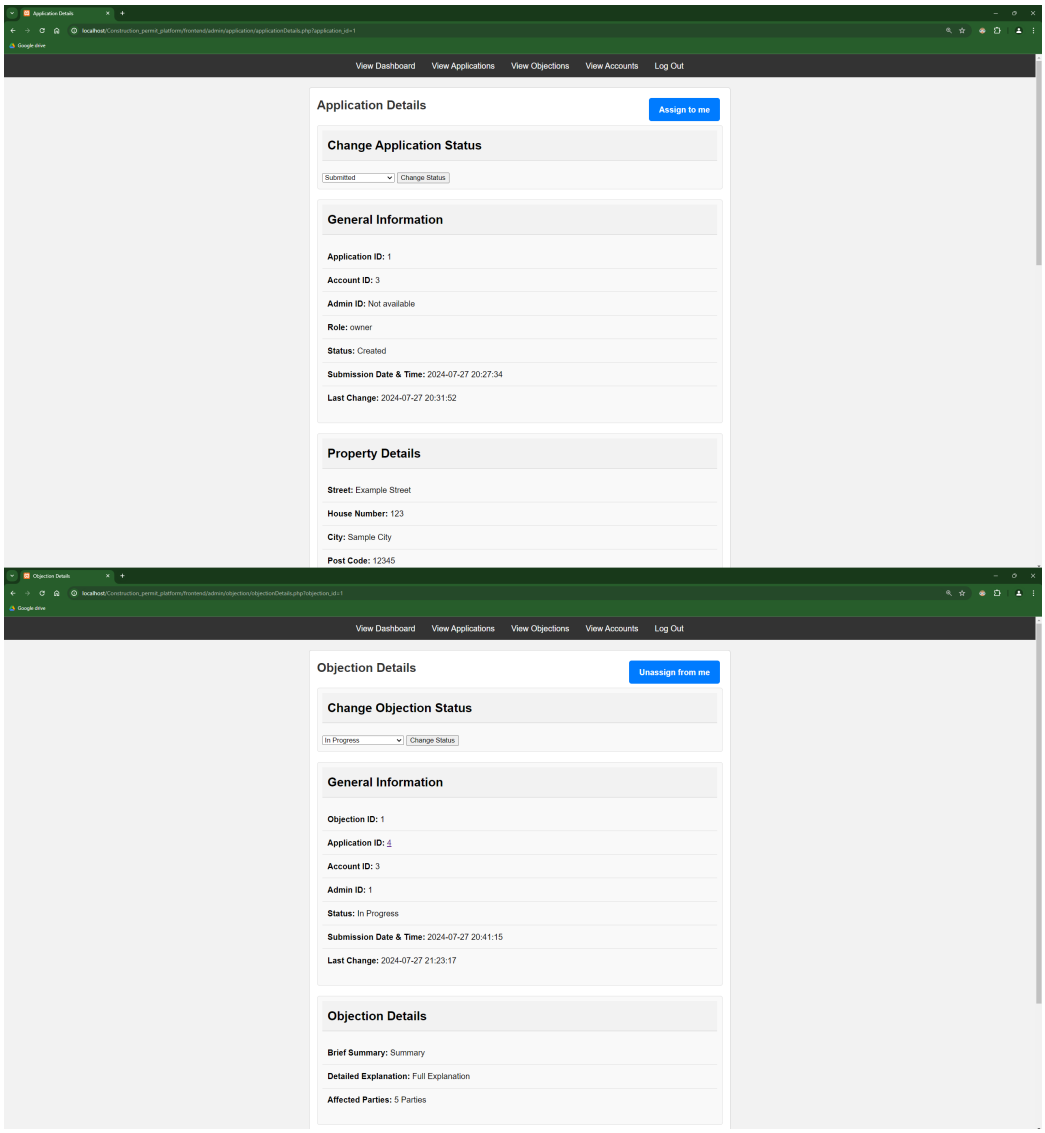

Figure 27: Prototype - Application and objection details (Admin perspective)

6.3 Addressed Requirements

In this section we will talk about the addressed requirements for the platform mentioned in Section 4. We will map specific system functionalities to the requirements they fulfill.

Increased Transparency:

- Access to all applications and objections.
- Detailed visibility of any application or objection.
- Clear status updates on the progress of applications or objections available to users.
- An accessible log system for tracking the history of changes and updates to specific applications or objections.
- Effective collaboration features through a comment system, to facilitate communication between users.

Simplified Procedures:

- An intuitive user interface for ease of navigation.
- Simplified submission process for applications and objections via a digital form.
- Guided form completion with tooltips to assist users through each step.
- Clear submission guidelines with warnings for any errors or issues encountered.
- Efficient management of applications and objections using searchable databases.

Reduced Bureaucracy:

- A digital form for the submission of new applications or objections.
- Management of documents exclusively in digital format for both users and administrators.
- A streamlined submission process with no hidden steps.

6.4 Limitations

In this section, we will discuss the limitations of the implemented prototype. Certain functionalities were either simplified or not included as designed in Section 5 because they were not necessary for the presentational purposes of the prototype:

- For the authentication process, we did not include any security measures such as hashing passwords or multi-factor authentication, as we are not working with real data or real users at this stage.
- The payment for the application process was not included because it is irrelevant at this stage and would only complicate testing and implementation.
- The guidelines and tutorial were not included, as the relevant authority should design them to ensure proper alignment.
- The prototype doesn't support the submission of any documents except text inputs to facilitate simplified testing.
- The verification of documents only involves checking if all necessary documents and fields are completed.

6.5 Validation

This prototype was shown to a developer company operating in and around Bratislava, Slovakia. We gathered a few of their insights on how they liked using this prototype. A total of 15 people tested it and answered a few questions. These insights are considered highly valuable since all the participants are industry professionals. Each respondent was asked about the intuitiveness of the user interface, the management of applications and objections, the effectiveness of streamlining the process compared to the current system, the transparency of the process, the collaboration with other users/stakeholders, and their overall experience. They were given the opportunity to provide their answers in the form of points from 1 to 10, where 10 represents the best score. Any answer that received 7 or more points was considered positive. All the responses were transformed into a statistical view, which can be found in Table 22.

Aspect	% of positive responses of respondents
Intuitiveness of the user interface	80%
Management of applications and objections	86.6%
Effectiveness of streamlining the process	93.3%
Transparency of the process	93.3%
Collaboration with other users/stakeholders	86.6%
Overall experience	93.3%

Table 22: Prototype validation

The validation results are highly optimistic, but we must consider potential bias in the questionnaire due to cultural factors. The user interface's intuitiveness received the fewest positive points, likely because there are no tutorials included on how to navigate the platform. To address this issue, we have implemented changes in the forms by adding tooltips. When a user hovers over a tooltip next to an input field, it provides a broader description of the required information or data to be inserted into that field. This enhancement aims to improve the intuitiveness of the user interface, helping users better understand how to navigate and use the platform effectively. Furthermore, future work should include the development of comprehensive tutorials to teach users how to use the platform for each specific task before they begin. These tutorials will provide step-by-step guidance, ensuring users are well-prepared and can navigate the platform with confidence and ease. Other measures have been implemented for the management of applications and objections. Based on validation feedback, some users found it challenging to manage their applications and objections. To address this, we introduced a radio button within the applications/objections section of the dashboard and for viewing all applications and objections within the system. This radio button allows users to easily select whether they want to see open or closed applications or objections, simplifying the management process and improving overall user experience. Additionally, users can search for specific application or objection IDs or search by account ID to see applications or objections submitted by a particular user. It is important to note that the only information about the user visible to others is their ID, which helps prevent any systemic bias. Despite this, the overall outcomes are very positive, and the primary objective is to find a larger sample of industry professionals. This approach should enhance the validity of our findings. The questionnaire could also consider other stakeholders such as the public and relevant authorities to see the platform from their point of view. Another proposals for future development can be found in Section 7.

7 Future Work

Despite the progress made in this research towards improving the construction permit process in Slovakia by addressing inefficiencies and transparency issues, there remain several avenues for further exploration and development.

One key area for future research is the integration with additional stakeholders, including utility companies, environmental agencies etc. Engaging these parties will help develop a better approach to permit management and ensure compliance across the construction sector.

Another promising direction is the utilization of machine learning to boost the digital platform's efficiency. Predictive analytics could help anticipate potential delays or problems in the permit approval process. Additionally, machine learning algorithms could automate some decision-making tasks. For instance, machine learning can be used to validate documents submitted during the permit application, ensuring completeness and accuracy, thus reducing the need for manual verification and minimizing errors.

Future work should also include the development of guidelines and tutorials to assist users in navigating the platform effectively. This will make the platform more accessible to a wider range of users, including those with limited technical expertise.

Furthermore, as laws and regulations change, the platform must remain adaptable. Future research should aim to create a flexible framework capable of quickly incorporating changes in legislation and policy, ensuring the platform remains compliant and relevant.

Additionally, given the sensitive nature of the data involved in the construction permit process, continuous improvement of security measures is vital. Future work should investigate more robust encryption methods, user authentication protocols, and other cybersecurity practices to protect against emerging threats. Following this approach should ensure that sensitive data will be safeguarded against potential breaches and attacks.

Lastly, the platform should be validated with a larger sample of industry professionals, as well as other stakeholders, including the public and relevant authorities, to enhance its overall validity.

Addressing these challenges is expected to significantly improve the system. To increase the chances of success, we maintain the platform as open source on GitHub, allowing potential developers to contribute to and implement the proposed features.

8 Conclusion

This research highlights the challenges faced by the construction permit process in Slovakia. The process is characterized by excessive bureaucracy, lack of transparency, illegality, and inefficiencies. The proposed ICT solution, addresses these issues by streamlining procedures, enhancing transparency, and facilitating better collaboration among stakeholders. The developed prototype, incorporating real-time tracking, a public log system, easy submission of applications and objections, and transparent submission rules, shows promising improvements in efficiency and user satisfaction.

The study emphasizes the potential of digitalization and centralization in overcoming the existing problems in Slovakia's construction permit process. The integration of new legislative requirements into the platform design ensures compliance and future-proofing, while user feedback has highlighted significant enhancements in all targeted areas. However, the feedback also indicated potential biases, suggesting the need for broader validation.

Future research should focus on integrating additional stakeholders, utilizing machine learning for predictive analytics and automated decision-making, and developing user guidelines and tutorials. Moreover, ensuring the platform's adaptability to legislative changes and enhancing security measures are crucial for its long-term success. Validation with a larger sample of industry professionals and other stakeholders will further refine the platform and increase its overall validity.

By maintaining the platform as open source on GitHub, the research invites contributions from potential developers, fostering continuous improvement and successful implementation. Furthermore, the digital platform is anticipated to result in a more efficient and transparent construction permit process, benefiting developers, authorities, and the general public in Slovakia.

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