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# USABILITY ANALYSIS AND IMPROVEMENT OF THE USER INTERFACE OF THE "ONLINE PORTAL OF LVIV CITIZEN"

Master Thesis

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Tallinn 2017

TALLINNA TEHNIKAÜLIKOOL

Infotehnoloogia teaduskond

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# LVIV (LINNA) ONLINE-KODANIKUPORTAALI KASUTATAVUSE ANALÜÜS NING ARENG.

Magistritöö

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# Author's declaration of originality

I hereby certify that I am the sole author of this thesis. All the used materials, references to the literature and the work of others have been referred to. This thesis has not been presented for examination anywhere else.

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10.05.2017

# Abstract

Usability of a website is extremely important nowadays. For the private companies, high website usability is a must. Public organizations, however, are just starting to recognize usability as a concern, even though the impact of usability is much more critical on the users of public websites.

This research objective is to analyze and improve usability the user interface of the "Online Portal of Lviv Citizen" developed by Lviv City Council as an online tool for Lviv citizens to receive public services. In order to reach this objective, the author presented an overview of usability evaluation and analysis methods as well as applied the methodology of design science to create an artifact – prototype of the improved user interface of the portal. The research focuses on the traditional user testing method to evaluate usability of the existing interface of the portal and identify usability errors. After that, these errors are analyzed and discussed and based on the analysis, prototype of the user interface is created. Finally, the same user testing method is applied to evaluate the usability of the prototype.

The main research outcome of this thesis is the prototype of the improved user interface of the portal. Additionally, recommendations for further improvement of the user interface are provided as well as contributions to the academia and IT community is discussed.

This thesis is written in English and is 56 pages long, including 7 chapters, 11 figures and 12 tables.

# Annotatsioon

Hästitoimiv veebilehe kasutajaliides on tänapäeval äärmiselt oluline. Kõrge veebija/või kodulehe kasutatavusmugavus on ettevõtete jaoks kriitiline. Ehkki avaliku sektori organisatsioonide puhul on tugev kasutajaliides veelgi olulisem, hakkavad avaliku sektori organisatsioonid alles nüüd teadvustama kasutajaliidese tähtsust.

Antud uurimistöö eesmärk on analüüsida ja pakkuda kasutajaliidese täiustusi Lviv`i online kodanikuportaalile, mis on Lviv`i linnavalitsuse poolt arendatud tööriist pakkumaks kodanikele avalikke teenuseid. Seatud eesmärgi saavutamiseks pakub autor esmalt ülevaate kasutajaliidese hinnangust ja analüüsi meetoditest. Samuti kasutab autor kasutajakesket disainiprotsessi metoodikat, et luua prototüüp täiustatud kasutajaliidesega Lviv`i online portaalile. Uurimistöö keskendub traditsioonilisele kasutaja vastuvõtu meetodile, et hinnata olemasoleva portaali kasutajaliidest ja identifitseerida vead, mille järel autor neid analüüsib ning mille põhjal prototüüp luuakse. Viimaseks rakendab autor kasutaja vastuvõtu meetodit, et hinnata loodud protüübi kasutajaliidest.

Magistritöö tulemusena valmib täiustatud kasutajaliidesega prototüüp Lviv`i online portaalile. Lisaks, antakse edasised soovitused kasutajaliidese parendamiseks ning arutletakse akadeemia ja IT-kommuuni panust sõnastatud probleemile.

Lõputöö on kirjutatud inglise keeles ning sisaldab teksti 56 leheküljel, 7 peatükki, 11 joonist, 12 tabelit.

# List of abbreviations and terms

| | |
|---|---|
| **ADSL** | Asymmetric Digital Subscriber Line |
| **CAS** | Centre of Administrative Services |
| **e-Governance** | Electronic Governance |
| **e-service** | Electronic service |
| **ISO** | International Organization for Standardization |
| **LCC** | Lviv City Council |
| **OPLC** | "Online Portal of Lviv Citizen" |

# Table of contents

# 1 Introduction and Context

The times when everybody was happy about the sole existence of the website. Usability of a website is extremely important nowadays. For the private companies, high website usability is a must. Public organizations, however, are just starting to recognize usability as a concern, even though the impact of usability is much more critical on the users of public websites

Aim of the thesis is to analyze and improve usability the user interface of the "Online Portal of Lviv Citizen" developed by Lviv City Council as an online tool for Lviv citizens to receive public services.

The first chapter of the thesis makes an introduction to general definitions, motivation and relevance. Additionally the chapter provides an contextual overview about Lviv City Council, digital situation in Lviv as well as information about the "Online Portal of Lviv Citizen". The second chapter provides the theoretical backgrounds on the previous research on usability as well as a literature review on usability evaluation methods. The third chapter presents usability evaluation of the "OPLC". The fourth chapter elaborates on the prototype development. Fifth chapter presents usability evaluation of the prototype. The sixth chapter discusses the results while the seventh chapter concludes the thesis,

## 1.1 Relevance and motivation

Usability of public websites is very important for good public service delivery. Nowadays, even governments are producing guidelines for their agencies for creating highly usable and efficient websites. There are British government standards (Government Digital Service, n.d.) and American government standards (U.S, Department of Health and Human Services, n.d.) as well as s ISO standards (Domingo, 2017). In 1998, ISO incorporates usability in ISO 9241 pt. 11 and it becomes an official standard (Sauro, A brief history of usability, 2013).

Usability is crucial for governments to provide better service delivery and to design for accessibility of all user categories, which is crucial in this sector.

Motivation for this research comes from personal experience of using municipal websites in Lviv as well as from professional interest.

The research problem comes from the lack of the existing research about doing user testing in Ukraine and Lviv in particular.

The main research questions of the thesis are the following:

- RQ-1.What kind of usability errors are in the "OPLC"
- RQ-2.What kind of solution to use in order to fix usability errors of the "OPLC"?
- RQ-3.Did the prototype result in a fewer number of usability errors or reduced severity of usability errors?
- RQ-4.What is the specificity of doing user testing in Ukraine?

Theoretical approaches of this thesis focuses on improving usability. In order to do so, one must understand the concept of usability and the usability of a specific website. For doing this, one has to evaluate usability by utilizing one of many usability evaluation techniques. Application of these techniques results in identification of usability errors of the website. In this research, improving usability of the website thus means fixing all usability errors.

Research methodology of the study is based on the Design Science Research methodology.

## 1.2 About Lviv City Council

Lviv City Council is a municipal authority, which represents the interests of Lviv community and provides local administration on behalf of the Lviv community. As an authority Lviv City Council is one the most innovative and progressive local administrations in Ukraine. It is constantly incorporating technological advances into its service provision as well as development of Lviv infrastructure.

City Councils' executive activities are performed mostly by the efforts of Executive committee led by the Major of Lviv, 7 departments, 35 sub-departments, 6 regional administrations and 15 communal enterprises.

Being an innovative authority, Lviv City Council was one of the first Ukrainian regional administrations to start implementation of the e-Governance initiatives in 2009. The first regional e-government project was launched in March that year in cooperation with the British embassy, and local IT companies. The external goal of this project was to provide citizens with an opportunity to access administrative services of the Lviv City Council online and to fix all administrative issues as well. Internally, the main goal was to create a system of internal communication between departments, sub-departments and their employee. (Lviv City Council, 2009)

In the recent years City Council introduced several e-Governance projects aimed at simplifying access to different public information for citizens, establishment of transparency and openness of local authorities, and possibility for people to communicate with Lviv officials via the Internet.

The municipal ICT system is forming, expanding and evolving every year. Today it includes several components:

- Official website of the LCC (Lviv City Council) and other web resources implemented to inform the public about the work of the executive authorities, providing access to the administrative services and other important municipal functions as well as for citizens-to-government interaction.
- electronic document management system;
- electronic services that simplify and accelerate communication system between local authorities and city residents as well as make the process open and transparent. Among the most recent services are: "Online Portal of Lviv Citizen", "Open Budget", "Lviv citizen ID card", online utilities payment portal "Infolviv", open data portal, etc.

One of the recent projects was "International e-Governance Forum 451 E" which was so far the biggest e-Governance event organized by the City Council on 25th of November 2016 (several previous were held since 2010). The Forum contributed largely to raising

awareness about e-governance in Ukraine, popularization of this topic on a regional level as well as to knowledge exchange on the topic. (Lviv City Council, 2016)

On March 17 2016, the latest Lviv Digital Transformation Programme for 2016 – 2020 was approved by the City Council. This programme declares an ambitious roadmap for the future e-Governance development in the Lviv region. Digital transformation of the Lviv City – 2016-2020. (Lviv City Council, 2016)

The approval decree of the City Council states that according to the Lviv's competitiveness increasing strategy, the IT industry is one of the main priorities of the City's development. E-Governance provides a new form of communication between citizens, business and government. It also grants free access to public information, encourages the participation of residents in the process of city management, improves the quality of public services and brings this services them closer to the residents' requirements.

According to the City Council (Lviv City Council, 2016), the main objectives of the Digital Transformation Programme for 2016 – 2020 are:

1. Updating, consolidation and unification of software and hardware resources to provide flexibility and reliability of the informational and communicational infrastructure.
2. Creation of information security system.
3. Automation of Lviv City Council's and municipal companies' activities.
4. Introduction of electronic services for optimization of communication between citizens and regional executives.
5. Introduction of IT projects for modernization of all aspects of the City life.
6. Development of partnership with IT companies.
7. Implementation of training programs for increasing computer literacy among citizens.

## 1.3 Statistical data about the digital situation in Lviv

On November 25th 2016 results of the survey "Digital transformation of the Lviv city" was presented at the Lviv e-Governance Forum.

Section below describes results of this survey to illustrate context of Lviv (City Institute, 2016).

As part of the Lviv Digital Transformation Programme in 2016 – 2020, the study was conducted from 4 to 11 of November 2016. It was commissioned by the Development Department of the Lviv City Council and held by the sociological agency "Fama" in cooperation with the City Institute (Lviv City Councils' analytical center). The sample size of the survey amounts at 800 people older than 16 years and the study itself facilitated the face-to-face interviewing methodology. The confidence probability of the sample is 0.954 while representativeness error does not exceed 3.5% in any cases. The methodology of the 2016th survey was already utilized in the previous year which allowed the results to be compared and the dynamics to be tracked.

To begin with, almost every fifth citizen of Lviv (18.9%) lives without an access to personal computer equipment (desktop computer or notebook). On the contrary, 42.4% of respondents indicated that they have access to computer equipment both at home and at work, while 37% have an opportunity to use computer only at home. In 2016 the amount of computer illiteracy among the Lviv citizens decreased nearly by third (20,8%).

While the opportunity to use computer at home or at work may exist, it does not necessarily mean that people are definitely going to use computer. For example, 6.7% of those with access to the computer technology at home or at work do not actually use it. However, it is worth mentioning that in comparison with 2015 the percentage of such people decreased almost by half (11.7% in 2015).

To determine the level of computer skills among Lviv citizens The Digital Skills Indicator 2015 methodology was used. This exact methodology was previously used in studies conducted by Estonian statistical office. Respondents were offered a list of 20 practices of the computer technology usage. Depending on the number of practices in each of the four groups, the methodology offers a determination of the basic skillset as well as the above-basic skillset level. However, during the data analysis it was proved that the category of respondents who either have no relevant skills or very limited skillset should be distinguished as well. Such division better reflects the level of computer skills of Lviv citizens. Subsequently, these data was used to complement the The Digital Skills Indicator 2015 methodology and context-specific consolidated

indicator called "Level of computer skills" was created. It has four dimensions: no computer skills, low skill level, basic skill level and above basic skill level.

Those part of Lviv citizens who possess no computer skills have decreased almost by third (19,5%). In addition, the part of people who have almost professional computer skillset (above basic level) have increased in comparison with 2015 (28,5%). The 34.7% of respondents have basic skill level and the rest 17.2% have a low computer skills level.

Around 75.6% of all respondents have Internet connection at their homes. Most of them (66.2%) use broadband Internet. Another 20.9% use ADSL connection, 10.4% - high-speed mobile Internet, 1.8% - satellite Internet. Additionally, 0.8% of the respondents could not specify the type of Internet connection they use at home. If taken into account the answers of all respondents (regardless of the availability of the home Internet connection), the half of the respondents use broadband connection to the Internet (at home, work, etc.).

More than three quarters of the respondents who have any Internet connection at home use it every day. Among all respondents, this number amounts slightly more than a half (59.9%).

Usage of the mobile Internet is more and more becoming a part of everyday life. Almost every third citizen of Lviv enjoys benefits of mobile Internet every day (29% in 2016, 23% in 2015). Even greater growth can be observed in usage of the 3G-Internet – around 40% of all respondents interviewed, which is 17% more than in 2015.

Electronic services in general as well as online services of the Lviv City Council are becoming more recognizable. For example, 65% of Lviv residents reported having previous experiences of using electronic services (for instance Internet banking, online invoicing, utilities payment via the Internet, purchasing goods or services online, etc.). As for electronic services of Lviv City Council, every fourth citizen of Lviv had an experience of using those (26%) as of 2016 which is 9% more than in the previous year.

## 1.4 Information about "OPLC"

Lviv was the first city in Ukraine that offers e-services (electronic services) to its citizens. In June 2015 LCC announced the service called "Online Portal of Lviv

Citizen". At that time the portal was launched in trial mode (until April 2017) and contained more than 20 e-services. Since the launch, new e-services were updated constantly.

According to the LCC, "OPLC" provides them with an online access to administrative as well as electronic services offered by the City Council. With this service, Lviv residents do not have to waste time for ordering the service instead it can be done in a much faster way – via the Internet so they only have to pick up the certificate in the corresponding department. (Lviv City Council, 2016)

The identification mechanism in the "OPLC" was implemented using another important e-Governance initiative called Bank-ID (an innovative mechanism, implemented in partnership with a number of the largest Ukrainian banks) as well as digital signature .

Since the announcement of the online portal for administrative services until the end of 2015, around 16 thousands of citizens have registered with corresponding citizen identification mechanisms. In addition to that, the services provided via the "OPLC" were ordered  more than 5 thousand times (Lviv Cilty Council, 2015).

As of 7th of March 2017 the web-portal contained 56 administrative services which are provided by the structural elements of the Lviv City Council. They were focused mostly on the opportunity to request specific governmental certificate or paper, arrange an appointment with the specific LCC official, register suggestion, application or complaint to the LCC, etc.

On the 3rd of April 2017 the updated version of the portal was presented. Several enhancements were introduced to the interface of the portal, but most importantly, it received major increase in the e-services and now 158 services are available online to all registered citizens.

# 2 Theoretical backgrounds

## 2.1 Usability studies development

Approach to usability varied over time. At first, usability was perceived as something that is extremely case-specific. The extensive research done by Whiteside et al. (Whiteside, Bennet, & Holtzblatt, 1988) claim that there simply are no universal usability indicators or evaluation techniques that can be applied to all software project in the need for design.

Although in 2000s, universal usability concept emerged along to the universal access concept. Universal usability can be defined as "having more than 90% of all households as successful users of information and communications services at least once a week" (Schneiderman, 2000). The goal of universal usability is to improve usability of universally accessible products.

Whitney Quesenbery

Jeff Sauro provides an excellent overview of major events in the usability history, from 1911 till 2012 (Sauro, A brief history of usability, 2013). In addition, he provides an overview of the most influential research papers in usability (Sauro, The Five Most Influential Papers in Usability, 2010).

Most influential modern practitioners of usability studies include Jacob Nielsen, Don Norman, David Travis, Gilbert Cockton, Luke Wroblewski, Whitney Quesenbery, Jeff Sauro, etc.

## 2.2 Usability evaluation methods

Comprehensive analysis on types of usability evaluation methods was done by Mads Soegaard and even more in-depth analysis was done by Gilbert Cockton (Cockton).

Usability methods can be quite diverse, though there are some distinction between analytical and empirical evaluation methods (Soegaard, 2012):

- Analytical evaluation methods are based analysis of the system itself or analysis of the interaction with the system.

- Empirical evaluation methods, on the other hand, are based on actual usage data.

Analytical evaluation methods may be system-centred, like Jakob Nielsen's Heuristic Evaluation or interaction-centred, like the Cognitive Walkthrough method. Design teams use the resources provided by a method (e.g. heuristics) to identify strong and weak elements of a design from a usability perspective.

Three types of analytical evaluation methods (Soegaard, 2012) are as follows:

- Inspection methods tend to focus on the causes of good or poor usability.

- System-centered inspection methods focus solely on software and hardware features regarding attributes that will promote or obstruct usability.

- Interaction-centered methods focus on two or more causal factors (i.e. software features, user characteristics, task demands, or other contextual factors).

In addition, usability evaluation types are otherwise being classified into formative (applicable in the design or development stage) and summative (deal with assessing achievement of the usability goals) (Usability evaluation methods, n.d.).

Ivory and Hearst present a survey of usability evaluation methods and their classification with the emphasis on their automation (Ivory & Hearst, 2001).

Most popular usability analysis techniques are discussed below.

**Traditional usability testing** – one of the most popular and most used methods. It is done by observing users who test product or service to identify usability errors.

Researchers argue whether it is one of the most effective technique. Usability testing was researched by many influential scholars in the field. Their contributions are widely popular in the academia, for example Jacob Nielsen's "Usability Engineering" (Nielsen J. , Usability engineering, 1993), "A practical guide to usability testing" (Dumas & Redish, 1999), "Handbook of usability testing: How to plan, design, and conduct effective tests" (Rubin & Chisnell, 2008), and many others.

**Heuristic evaluation** – method based on ten usability heuristics developed by Jacob Nielsen and Rolf Molich in 1990 (Nielsen & Molich, Heuristic evaluation of user interfaces, 1990). Expert evaluation of the website based on the specific criteria.

**RITE usability testing** – it is similar to the traditional usability testing method with the exception of the iterations that are being made after each and every consecutive testing that were held. Another difference is that after each test is done, iterations are being implemented.

**SUS method** –method allows researcher to develop a rough usability score based on the ten-question questionnaire.

**A/B testing** – experiment-based method due to which researcher creates alternative versions of the interface and using specific technological solutions figures out statistically which version is better.

**Video session analysis** – technology-based method which allows researcher to record a real-time video of the actual user without him/her knowing that they are being recorded.

**Heat map analysis** – statistical method that analyses behavioral patterns by creating the "heat map" of the most clicked or watched interface content.

**Card Sorting** – method used to evaluate informational structure of the website Quite specifically purposed, it solves efficiently problems with structuring complex content on the website.

**Eye Movement Tracking** – tracking where user looks to determine his behavior.

Finally, it is worth mentioning that new methods and techniques are being created constantly by the practitioners.allaboutux.org website provides an extensive review of various usability testing methods (All UX evaluation methods, n.d.).

# 3 Usability evaluation of the "Online Portal of Lviv Citizen"

Following Chapter deals with usability evaluation of the existing version of the user interface of OPLC. In order to do this, traditional user testing was conducted and usability errors were identified. Than these errors were prioritized according to their severity level.

According to Jacob Nielsen, proper usability study (Nielsen J. , How Many Test Users in a Usability Study?, 2012), including user testing should be conducted minimum with 5 users. Another research develops a mathematical model of finding usability problems and examines the correlation between number of test users and percentage of usability
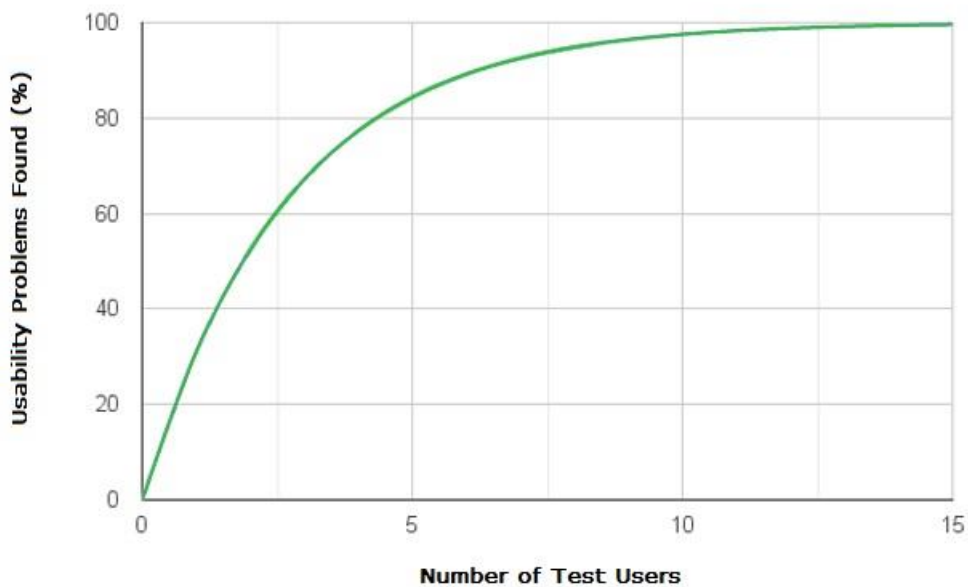


Figure 1 Relation of the number of test users to the percentage of usability problems identified

problems found (Nielsen & Thomas , 1993). This correlation is depicted in the Figure 1.

The above-mentioned research and correlation justifies the number of test users in both user testing of the OPLC and the prototype.

## 3.1 User testing process

User testing was conducted with eight people of different gender and age group. Five of them are men and three are women. The age group of the participants varies from 20 to 45 years old. It was physical testing of the existing version of the web-portal and consisted of seven tasks. Implementation of the tasks was observed by the researcher as well as recorded using Active Presenter screen recording software for further examination and analysis. Physical presence enabled researcher not only to understand the user's behavior on the website better but also receive some feedback directly from the users. Other tools that were used in the testing were: Lenovo notebook, Windows 7 operating system, Google Chrome browser and free Wi-Fi hotspot.

All of the participants were approached randomly, without exclusion of age, gender, professional or any other group or factor. The only requirement for the participants was the need of receiving (regularly, occasionally or potentially) public services from Lviv City Council. In addition, participation was on a voluntary basis. To find and involve people to the testing, it was needed to understand where these people turn to in order to receive the services in a non-digital way. To do so, researcher targeted potential testers at the Lviv City Center of Administrative Services (CAS). CAS is and administrative authority of the Lviv City Council that was created in order to provide efficient administrative services as well as consultations for Lviv citizens. The participants were approached in the central office of the CAS and the user testing was held at the same office. All participants of the survey were unfamiliar with the testing tasks until the testing itself has begun, so the background information of the test users could vary only in terms of their professional background or personal interests which are defining factors in understanding Lviv citizens' specific characteristics.

For the testing purposes, a number of tasks were developed. Total amount of seven tasks were created to identify usability errors in various aspects of the online-cabinet. The aim was to explore main features of the portal with users rather than to focus on different

aspects of one feature. Consequently, tasks tested the navigation of the website, simplicity and clarity of the structure as well as clarity of the design patterns used. In order for the testing to be anonymous, the test account in the portal was used and the fake data required for tasks completion was given to the users.

An average user testing lasted for 16 minutes, the fastest completion of the test took 8 minutes 32 seconds, while the longest user testing lasted for 28 minutes.

**List of the tasks:**

1. Create an e-request to the Lviv City Council official about pavement replacement on Kopernyka street.
2. Order a Certificate of the family composition (F-2 form).
   Data: Hazova str. 26, 5
3. Register for the appointment with LCC official (Sadovyi Andrii Ivanovytsch). Purpose: some suggestions on improving service delivery process of the LCC.
4. Check the status of request to LCC, previously submitted physically.
   Document №: 7485
   Code: 2640
5. Check the user profile data; check the connected web-identification services.
6. Use the utility payment service (visit the partner website).
7. Find the service called "Provision of the passport of the public summer playground".

## 3.2 Usability errors identified

During the user testing, a set of usability errors were identified (Table 1). All the errors were divided into three categories: task-related usability errors, general usability errors (these two categories will be the focus of this thesis) and system design errors. In this section below researcher lists the errors identified and describes them in details.

Table 1. Quantity of usability errors

| | |
|---|---|
| Task-related usability errors | **21** |
| General usability errors | **5** |

22

| System design errors | 2 |
|---|---|
| Total number | 31 |

Further exploration and analysis is focused on the **26 task-related and general usability errors** because system design errors depend as well as are influenced by the system design process, which is not the core aim of the thesis. Consequently, these 26 usability errors are hereinafter referred to as "all errors".

**Task-related errors**. These errors were revealed while test users were performing specific tasks and they are related to the specific parts of the user interface as well as to specific tasks.

**Task № 1**

a) **Users were confused about what type of the request they need to pick from the drop-down menu.** The form requires Users to specify the exact request type from various types in the drop-down menu, but the Users (№ 1, 2, 4, 5, 6, 7) did not know exactly, how to choose the proper type.

b) **User № 3 skipped the drop-down menu with the type of request.** While performing the task, User was required to fill up all the necessary information to complete the request. Upon doing so and concentrating on other input forms, he often did not pay attention to the "type of request" drop-down menu and left it on the default stage, which was incorrect in this situation.

c) **Users did not provide any information in the mandatory text field called "Summary of the question".** This happened due to the fact that test Users (№ 1, 6, 7) did not notice that this field is compulsory. Additionally, upon receiving input error message, which stated the need to provide input in this particular mandatory field, User № 6 was confused what does the message mean. This means that the input error message is composed improperly.

d) **Users did not provide any information about contact telephone number and address in the mandatory fields**. The test user data was pre-filled partially, while some of the mandatory contact data still needed to be filled by the user. As a result, Users (№ 2, 4, 5, 7) did not notice compulsory fields and ignored them until the system pointed out the mistake.

e) **User encountered a broken link on the home page.** Upon logging in the system, the home page of the website appears, which describes the essence of the web-portal and some of the services that can be accessed via this web-portal. In addition, the links were attached to the names of these services (supposedly for the matter of fast navigation). However, when the User № 3 tried to choose the respective service and clicked on the link in order to complete the Task № 1, the link did not work and the error notification occurred in the top left corner (Figure 2).
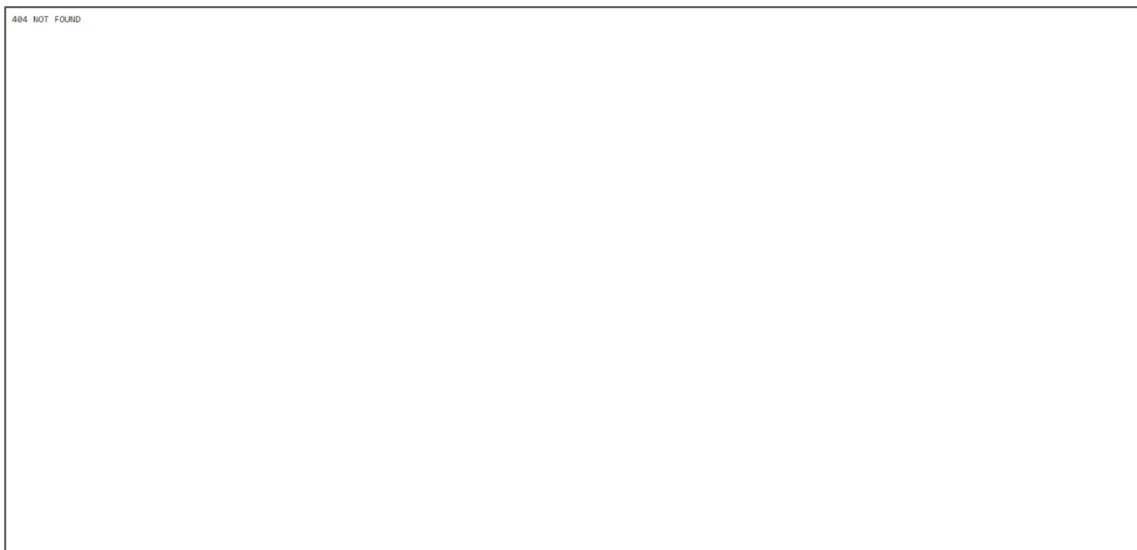


Figure 2 Fragment of the screen with error message.

It is evident that, the error message is non-informative and has poor accessibility – it is not in the Ukrainian language, the font of error message is very small and the message is generally hard to notice, especially for people with bad eyesight.

f) **User № 5 could not identify input fields.** Due to the large gap between the name of the input field and the field itself, User № 5 was confused about where to provide the data.

g) **Unexplained "add files" option.** User № 5 pointed out that the option to add files to the request was without description thus confusing. He could not understand which files he should add to the request.

**Task № 2**

a) **Users could not find the direct path to complete the task.** Some users (№ 2, 5, 7) could not locate the service of requesting Certificate of the family composition, instead they started clicking on every side-menu item.

b) **User № 7 filled the wrong form.** User thought that the Certificate of the family composition could be ordered through the "e-request to LCC" side menu item.

**Task № 3**

a) **Schedule issues.** Task № 3 required users to make an appointment with certain City Council official and to do so, users had to check the calendar for available dates of the corresponding official and set the proper date (when this official has office hours). While completing this Task, **all users** did not pay attention to the availability of the officials but rather stated the date, which suits them the best. Although, the problem might be occurring because users were poorly informed that they need to check the available dates by themselves as well as bout the place where to check these dates. User № 8 pointed out that, the whole schedule checking system was bad, because it leads user to an external website with the list of LCC officials and their schedules and it takes too much time to find the needed official there.

b) **User № 3 could not find the correct menu item from one of the options in the side-menu.** User could not find the direct path to complete the task despite the fact that it was a separate menu item.

c) **User № 3 did not provide any information about contact telephone number and address in the mandatory fields**. The test user data was pre-filled partially, while some of the mandatory contact data still needed to be filled by the user. As a result, User № 3 did not notice compulsory fields and ignored them until the system pointed out the mistake.

d) **Users ignored drop-down menu that specifies an official needed.** The Task № 3 requires a user to fill the form to make an appointment with the specific City Council official. The form itself consists of the two parts and a drop-down menu with the names of the certain City Council officials. Sometimes users (№ 3, 6) focused more on the other parts of the form and did not pay attention to this drop-down menu, which ended up being unchanged. This has resulted in the ordering an appointment with the wrong official.

e) **User № 5 pointed out on the problem with the list of officials in the drop-down menu.** He stated that most citizens do not know City Council officials by their name, but they are rather familiar with the title of these officials. Thus, the drop-down menu provides not enough information for such citizens.

f) **User № 4 tried to type in the drop-down menu for faster search in the drop-down menu.** When picking correct official in the drop down-menu, User № 4 tried to type in the first letters of the officials' name to go straight to him/her. He was unpleasantly surprised when this function did not work and suggested for it to be added.

**Task № 4**

a) **Users could not find the direct path to complete the task.** Some users (№ 1, 2, 7) could not locate the service of checking the status of the request, previously submitted physically, instead they started clicking on every side-menu item.

b) **Users filled data in the not relevant to the task fields.** While completing the task, some users (№ 1, 3, 4) filled the non-relevant fields that, in case of the non-simulated situation, leads to the misinformation of the user.

**Task № 5**

a) **Users could not locate the user profile page in the web site.** Several users (№ 3, 5, 6) could not find the direct path to complete the task. For example, even though user № 5 completed the task, he stated that he just guessed about the location of the user profile page. User № 6 expected the profile to be on the side menu and when she did not find it there, she failed to complete the task. This means that the path to the profile is not clear and several buttons on the path to user profile need to be renamed.

b) **User № 3 accidentally logged out of the web portal.** Instead of reviewing user profile details, User № 3 logged out of the web-portal by accident.

**Task № 6**

a) **Users expressed hesitation on how to complete the task.** While performing the task, users (№ 5, 7) did not know at first where to find the utilities payment service. User № 5 also noted that the side menu is poorly named and he could not understand what features the menu items contained.

**Task № 7**

a) **Users failed to complete the task.** Several users (№ 3, 4, 5, 6, 8) have failed to find the service on the web-portal and required help to complete the task. User № 6 could not understand that the service was under the "Architecture" category. It happened because there were mix of links to categories of services as well as links to specific services under the "Services of the LCC" menu.

Furthermore, there was no visual division between categories and specific services.

**General usability errors.** These errors were often revealed when test users provided feedback of their experience of usage of the portal. These errors affect usability of the portal in general and thus almost all of them affect critical features of the portal.

a) **User № 7 stated that the accessibility of the web-portal is quite poor.** He claimed that for him and for some other people it might be useful to have an opportunity to increase the font size or just to zoom in and out.

b) **Some users (№ 1, 2, 5, 6, 7, 8) could not understand which input fields are mandatory to fill and which are not.** Mandatory fields were marked with small red star after the title of the every mandatory input field, although the definition of this red stars was not explained to the user anywhere.

c) **User № 8 pointed out that having telephone and address information in the profile by default would ease the usage of the web-portal.** He stated that, the phone is a primary mean of contact nowadays and most of the tasks required user to fill the phone number anyway. Thus, having this information pre-filled like the other basic pre-filled data will benefit the usability of the web-portal.

d) **Poor functionality of the search bar.** While trying to proceed with tasks, some Users (№ 4, 8) were confused about where to find the corresponding service and tried to get use of the search bar in the top right corner. The search engine analyzed the request but produced outcome displayed results from all across the website of the City Council and this means that user is taken away from the portal instead of the expected navigational help. This makes the search irrelevant or poorly designed.

e) **Calendar issues.** Upon opening the built-in calendar to set the date of the appointment, Users happened to be rapidly redirected to the top of the page. To come back to the calendar, they have to scroll down again. This sometimes created confusion among test Users, because they think that they made a mistake.

**System design errors.** These errors were revealed while test users were performing specific tasks, they affect the usability of the portal but they are caused by the technological failure.

a) **Bank-ID logging out suddenly and unnoticeably.** This is quite technical aspect of the web-portal but it does have an important impact on the usability of the portal. After logging in via Bank-ID identification to fully benefit from the web-portal users may be inactive on the portal for more than 10 minutes. In this case, Bank-ID session expires and user happens to be logged out at the same time not receiving any notification about it. This can lead to the confusion that the problem occurs with the Bank-ID system itself. Even though the logging out and identification mechanisms were not tested with the users, the problem was identified by the researcher while preparing and preforming for user testing.

b) **Poor functionality of the search bar.** The search led out of the portal and worked as a search on the whole LCC website. This prevented users from completing their tasks.

## 3.3 Prioritization of the errors

Usually, usability testing produces a lot of data and it is quite easy to get flooded by it and lose your focus. Thus, after stating and discussing usability errors identified during usability testing, it is crucial to understand severity of the impact of every usability error. To do so in a consistent manner, usability errors have to be prioritized and severity level analyzed utilizing a standard process.

There are quite many usability prioritization and severity level models developed through years of the usability research. One of the first and most famous model was created by Jacob Nielsen. It described a 0 to 4 rating scale based on which the severity of the usability errors should be rated (Nielsen J. , Usability engineering, 1993).

This model is quite old and it was largely used among the practitioners, but since then several other usability prioritization and severity level models were developed. For example, David Travis's method (Travis, 2009) of usability error prioritization, which is used in this thesis to prioritize usability errors and analyze their severity. The description of the method can be found below.

Firstly, the model, proposed by Travis classifies usability errors (or as the author refers to it – problems) severity by asking only three questions:

1. **Does the problem occur on a "red route"?**

Red routes are defined by David Travis as critical and frequent tasks, which are the most crucial tasks that the system has to support by default. Problems that occur on the "red route" are the most severe ones because they affect largest user group.

2. **Is the problem difficult for users to overcome?**

If the problem prevents users from proceeding further or prevents them from discovering certain functionalities of the website, it is extremely hard for a user to overcome and solve this type of problems. These problems are quite severe because they directly affect the completion rate (the percentage of users that can complete a task).

3. **Is the problem persistent?**

Persistent problems are those that happen with the users repeatedly, throughout the whole interface. Users face these problems multiple times on different screens or pages of the website. Persistent problems are severe because they have great effect on consumer satisfaction as well as on the time on task (time needed for a person to complete a task)

Secondly, Travis's model provides the model to interpret severity levels:

- **Critical.** This type of usability problem will make some customers unwilling or unable to complete a common task. In needs to be fixed urgently.

- **Serious.** This type of usability problem will significantly slow down some customers while completing a common task and may cause customers to find an alternative ways to achieve their tasks. It needs to be fixed as soon as possible.

- **Medium.** This type of usability problem will create frustration or irritation among some customers but it will not affect task completion. It can be fixed during the next update scheduled.

- **Low.** This type is a quality problem, for example a cosmetic issue or a spelling error. Despite being a minor isolated issue, too many "lows" will negatively affect credibility and may damage brand of the organization.

Figure 3 perfectly depicts the merge between two sides of the model described above.

Further in this section, previously identified 26 usability errors are being prioritized and analyzed using David Travis's method. In order to evaluate and compare user interfaces of both "OPLC" and prototype, each severity level was granted its own numerical value from 0 to 3 according to their severity impact.

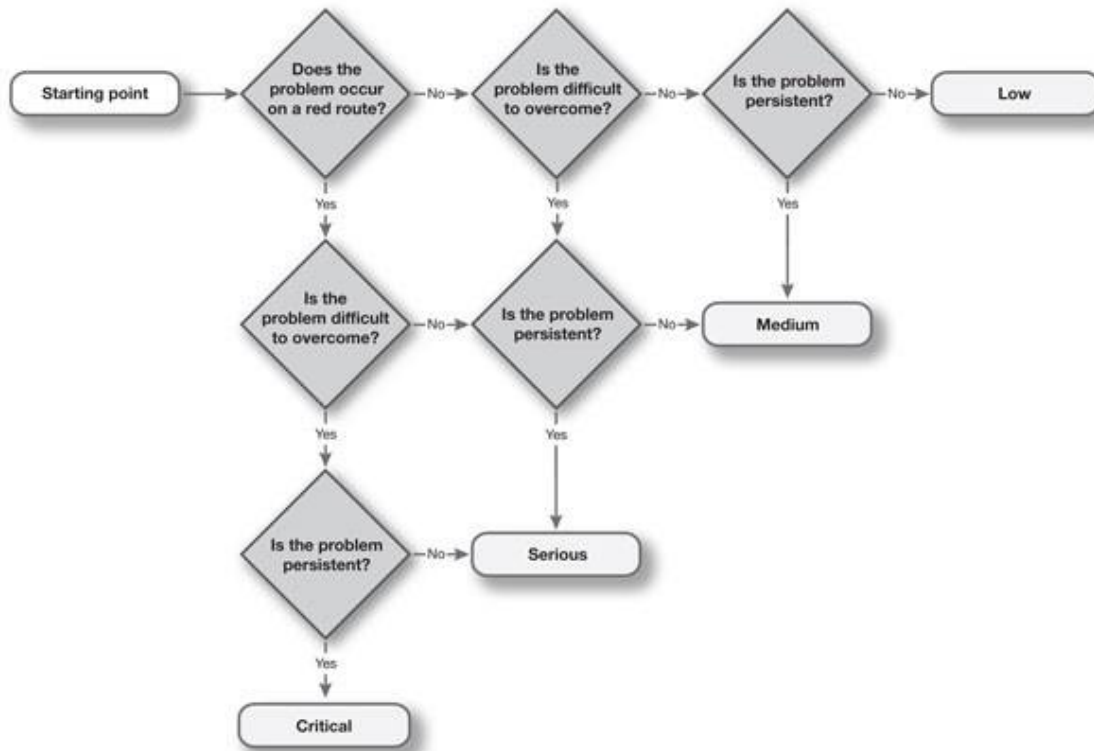Task 1 (Table 2) happened to be one of the most error-productive. It produced errors of



Figure 3. Usability errors prioritization diagram

all severity levels including one out of three critical errors.

Table 2. Usability errors analysis of the Task 1

| The problem: | Occurs on the red route | Difficult to overcome | Persistent | **Sum** |
|---|---|---|---|---|
| Users were confused about what type of the request they need to pick from the drop-down menu. | 0 | 0 | 1 | **1** |
| User № 3 skipped the drop-down menu with the type of request. | 0 | 0 | 0 | **0** |

| | | | | |
|---|---|---|---|---|
| Users did not provide any information in the mandatory text field called "Summary of the question". | 1 | 1 | 1 | **3** |
| Users did not provide any information about contact telephone number and address in the mandatory fields. | 0 | 1 | 1 | **2** |
| User encountered a broken link on the home page. | 0 | 1 | 0 | **1** |
| User № 5 could not identify input fields. | 1 | 1 | 0 | **2** |
| Unexplained "add files" option. | 0 | 0 | 0 | **0** |

Task 2 (Table 3) produced small number of errors but of a serious severity level.

Table 3. Usability errors analysis of the Task 2

| The problem: | Occurs on the red route | Difficult to overcome | Persistent | **Sum** |
|---|---|---|---|---|
| Users could not find the direct path to complete the task. | 1 | 0 | 1 | **2** |
| User № 7 filled the wrong form. | 1 | 1 | 0 | **2** |

Task 3 (Table 4) produced the biggest amount of errors. In addition, it contained errors of various severity levels except critical level errors.

Table 4. Usability errors analysis of the Task 3

| The problem: | Occurs on the red route | Difficult to overcome | Persistent | **Sum** |
|---|---|---|---|---|
| Schedule issues. | 1 | 0 | 1 | **2** |
| User № 3 could not find the correct menu item from one of the options | 1 | 0 | 0 | **1** |

| | | | | |
|---|---|---|---|---|
| in the side-menu. | | | | |
| User № 3 did not provide any information about contact telephone number and address in the mandatory fields. | 0 | 1 | 0 | **1** |
| Users ignored drop-down menu that specifies an official needed. | 1 | 1 | 0 | **2** |
| User № 5 pointed out on the problem with the list of officials in the drop-down menu. | 0 | 0 | 0 | **0** |
| User № 4 tried to type in the drop-down menu for raster search in the drop-down menu. | 0 | 0 | 0 | **0** |

Task 4 (Table 5) appeared to be similar to Task 2 with two serious level errors.

Table 5. Usability errors analysis of the Task 4

| The problem: | Occurs on the red route | Difficult to overcome | Persistent | **Sum** |
|---|---|---|---|---|
| Users could not find the direct path to complete the task. | 1 | 0 | 1 | **2** |
| Users filled data in the not relevant to the task fields. | 0 | 1 | 1 | **2** |

Task 5 (Table 6) produced two errors of serious and critical level.

Table 6. Usability errors analysis of the Task 5

| The problem: | Occurs on the red route | Difficult to overcome | Persistent | **Sum** |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Users could not locate the user profile page in the web site. | 1 | 1 | 1 | **3** |
| User № 3 accidentally logged out of the web portal. | 1 | 1 | 0 | **2** |

Task 6 (Table 7) produced one serious error.

Table 7. Usability errors analysis of the Task 6

| The problem: | Occurs on the red route | Difficult to overcome | Persistent | **Sum** |
|---|---|---|---|---|
| Users expressed hesitation on how to complete the task. | 1 | 0 | 1 | **2** |

Task 7 (Table 8) produced one error which happened to be the most severe error identified.

Table 8. Usability errors analysis of the Task 7

| The problem: | Occurs on the red route | Difficult to overcome | Persistent | **Sum** |
|---|---|---|---|---|
| Users failed to complete the task. | 1 | 1 | 1 | 3 |

General usability category of errors (Table 9) included five errors of all severity level except critical level.

Table 9. Usability errors analysis of the general usability

| The problem: | Occurs on the red route | Difficult to overcome | Persistent | **Sum** |
|---|---|---|---|---|
| User № 7 stated that the | 1 | 0 | 0 | **1** |

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| accessibility of the web-portal is quite poor | | | | |
|---|---|---|---|---|
| | 34 | | | |
| Some users (№ 1, 2, 5, 6, 7, 8) could not understand which input fields are mandatory to fill and which are not. | 1 | 0 | 1 | **2** |
| User № 8 pointed out that having telephone and address information in the profile by default would ease the usage of the web-portal. | 1 | 0 | 0 | **1** |
| Poor functionality of the search bar. | 1 | 0 | 1 | **2** |
| Calendar issues. | 0 | 0 | 0 | **0** |
| User № 7 stated that the accessibility of the web-portal is quite poor | 1 | 0 | 0 | **1** |

Finally, to conclude the analysis, the severity breakdown of the all usability errors is presented.

Таблиця 1Table 10. Severity of usability errors

| Issue severity | Point value | Quantity of issues |
|---|---|---|
| Low | 0 points | 5 |
| Medium | 1 point | 6 |
| Serious | 2 points | 12 |
| Critical | 3 points | 3 |

# 4 Development of the prototype

In the following chapter, the researcher reviews and analyzes possible solutions to all of usability errors identified previously, states the solutions that were chosen to be implemented in the user interface model of the "OPLC" (hereinafter referred to as "prototype") and finally, describes prototyping process and prototype limitations.

## 4.1 Analysis of the possible solutions

After identifying and prioritizing usability errors, researcher provides further discussion and analysis of the possible solutions to all errors identified. In this section below researcher lists the possible solutions to the errors identified.

**Task № 1**

a) **Users were confused about what type of the request they need to pick from the drop-down menu.**

   o *Remove the "Type of Request" drop-down menu.* The aim of this drop-down menu is to categorize and sort all received e-requests automatically, based on the citizen input. The researcher however received information from Lviv City Council officials that despite citizens' input, all e-requests are being sorted manually by a technical employee of the City Council. Considering the fact that this drop-down menu is not only creating one extra step for the user (which contradicts with the efficiency dimension of usability), but also appears to be confusing for the users who tested the portal, it might be more efficient to remove this drop-down menu from the page.

   o *Provide short description of the specific type of request (in the separate section below) after choosing one of the request types suggested.* This can possibly reduce or eliminate confusion about the "type of request" drop-down menu at the same time, keeping the menu on the page, should the necessity arise.

b) **User № 3 skipped the drop-down menu with the type of request.**

   o *Remove the "Type of Request" drop-down menu.* The aim of this drop-down menu is to categorize and sort all received e-requests

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automatically, based on the citizen input. The researcher however received information from Lviv City Council officials that despite citizens' input, all e-requests are being sorted manually by a technical employee of the City Council. Considering the fact that this drop-down menu is not only creating one extra step for the user (which contradicts with the efficiency dimension of usability), but also appears to be confusing for the users who tested the portal, it might be more efficient to remove this drop-down menu from the page.

- o *Remove the division between personal information block and request details block, to maintain consistent form sequence*. Removing division between personal information block and request details block should make the form filling process more monotonous so that users would start from the beginning and end correspondently. Although, this has a downside – information grouped into logical blocks provide dialog-based interaction and makes the whole form more clear to the user (Babich, Designing More Efficient Forms: Structure, Inputs, Labels and Actions, 2016).

- o *Explain that there are mandatory input fields in the beginning of the form and emphasize each of them*. Emphasizing on the mandatory fields and explaining this in the beginning of the form should make them more noticeable and attract user attention to them.

- o *Switch from left-aligned to right- aligned or top labels*. Providing left-aligned labels can emphasize on the connection of the labels and input forms, while providing top labels can contribute to faster form completion (Penzo, 2006).

c) **Users did not provide any information in the mandatory text field called "Summary of the question*".***
- o *Explain that there are mandatory input fields and emphasize them*. Emphasizing on the mandatory fields and explaining this in the beginning of the form should make them more noticeable and attract user attention to them.

- o *Correct wording of the input error message*. Rephrasing wording in the error message can contribute to better error feedback to the user.

d) **Users did not provide any information about contact telephone number and address in the mandatory fields**.

  o *Explain that there are mandatory input fields and emphasize them*. Emphasizing on the mandatory fields and explaining this in the beginning of the form should make them more noticeable and attract user attention to them.

e) **User encountered a broken link on the home page.**

  o *Fix the broken link*. Simply making the link work can solve this issue.

  o *Change the home page layout and remove the broken link*. Changing home page layout instead of fixing the broken link can contribute to usability by redirecting the user flow to the relevant pages. This eliminates the split in the user flow and contributes to the overall simplicity.

f) **User № 5 could not identify input fields.**

  o *Switch from left-aligned to right-aligned or top labels*. Providing left-aligned labels can emphasize on the connection of the labels and input forms, while providing top labels can contribute to faster form completion (Penzo, 2006).

  o *Visually emphasize the input fields*. This can bring attraction to the input fields but at the same time, it can distract users from their tasks or other important user interface elements.

g) **Unexplained "add files" option.**

  o *Remove "add files" option*. Removing the "add files" button can eliminate user confusion, but the functionality will be lost.

  o *Illustrate what content can be attached to the forms, how to do it as well as to provide examples of when one should attach the content*. Alternatively, providing a block with descriptions and guidelines for file uploading can reduce or eliminate user confusion while keeping the functionality.

**Task № 2**

a) **Users could not find the direct path to complete the task.**

  o *Put the service on the main navigation menu section*. This can emphasize the service, but at the same time, it can break the overall navigation structure and logic and, consequently, create confusion among users.

- *Highlight this service with contrasting color for it to be easily noticed.* This can bring attraction to the service but at the same time, it can distract users from their tasks or other important user interface elements.
- *Restructure the main navigation menu and improve wording.* Restructuring the navigational menu and improving its wording can contribute to smoother navigation and make the service easier to discover.

b) **User № 7 filled the wrong form.**

- *Provide a special section with "similar services".* Providing alternatives can be good to encourage the user to order more services but the concept of similarity is based on associations that vary greatly from person to person. Also, additional options can confuse the users and create uncertainty.
- *Provide detailed explanation of the service at the beginning of the form.* While some names of the services can be complex and hard to comprehend, providing a detailed description of the service in a form of an inline help box can make users understand the essence of the specific services better.

**Task № 3**

a) **Schedule issues.**

- *After choosing the needed official, provide the schedule of this official below.* Providing the schedule of the official can improve the situation, but it does not guarantee that the users will use this information while picking a date, especially those users who scan the form instead of reading it.
- *Disable every date except those available in the schedule of the chosen official.* This option eliminates user errors as well as a possibility of booking irrelevant date by simply not allowing user to pick irrelevant date in the calendar.
- *Highlight the schedule link with contrasting color for it to be easily noticed.* This can attract some attention towards the link, but additional steps that user has to take in order to pick a date provide poor efficiency.

b) **User № 3 could not find the correct menu item from one of the options in the side-menu.**

- o *Restructure the main navigation menu and improve wording.* Restructuring the navigational menu and improving its wording can contribute to smoother navigation and make the menu easy to understand and use.

c) **User № 3 did not provide any information about contact telephone number and address in the mandatory fields**.

- o *Explain that there are mandatory input fields and emphasize them.* Emphasizing on the mandatory fields and explaining this in the beginning of the form should make them more noticeable and attract user attention to them.

- o *Correct wording of the input error message.* Rephrasing wording in the error message can contribute to better error feedback to the user.

d) **Users ignored drop-down menu that specifies an official needed.**

- o *Remove the division between personal information and request details, to maintain consistent form sequence.* Removing division between personal information block and request details block should make the form filling process more monotonous so that users would start from the beginning and end correspondently. Although, this has a downside – information grouped into logical blocks provide dialog-based interaction and makes the whole form more clear to the user (Babich, Designing More Efficient Forms: Structure, Inputs, Labels and Actions, 2016).

- o *Switch from left-aligned to right- or top aligned labels.* Providing left-aligned labels can emphasize on the connection of the labels and input forms, while providing top labels can contribute to faster form completion (Penzo, 2006).

e) **User № 5 pointed out on the problem with the list of officials in the drop-down menu.**

- o *Provide position of the official next to his/her name.* This can enable the user with a brief additional information on the officials available.

f) **User № 4 tried to type for faster search in the drop-down menu.**

- o *Make drop-down menus keyboard-friendly.* By enabling users to type in the drop-down menu, faster and more efficient form completion can be achieved.

**Task № 4**

a) **Users could not find the direct path to complete the task.**

- o *Put the service on the main menu section.* This can emphasize the service, but at the same time, it can break the overall navigation structure and logic and, consequently, create confusion among users.
- o *Restructure the main navigation menu and improve wording.* Restructuring the navigational menu and improving its wording can contribute to smoother navigation and make the service easier to discover.

b) **Users filled data in the not relevant to the task fields.**

- o *Separate the two blocks visually.* Separating the blocks can prevent users from misinterpret them.

- o *Make the "Send" buttons of each block center-aligned.* This allows buttons to be more noticeable and function as an additional separation element.

**Task № 5**

a) **Users could not locate the user profile page in the web site.**
- o *Emphasize on the user profile button visually and improve wording.* Visual emphasis on the user profile button can distinguish it from the menu items, links and other interface elements. Improved wording can clarify the button meaning.
- o *Incorporate user profile button in the main navigation menu.* Including user profile button into the main navigation menu can put an emphasis on the profile section of the website as well as manifest it as one of the central elements of the interface.

b) **User № 3 accidentally logged out of the web portal.**
- o *Separate the "Log out" button from the user profile button.* Locating these two buttons within a relative distance from each other can prevent accidental logging out of the website.
- o *Visually emphasize the "Log out" button.* Coloring the "Log out" button in a distinctive color can prevent accidental logging out of the website.
- o *Create the new "Log out" button/icon next to user profile vertical dropdown menu.* This is a way of distinguishing the "Log out" button,

although the close placement of this two elements can cause reoccurrence of the above-mentioned usability error.

**Task № 6**

a) **Users expressed hesitation on how to complete the task.**

o *Restructure the main navigation menu and improve wording.* Restructuring the navigational menu and improving its wording can contribute to smoother navigation and make the service easier to discover.

**Task № 7**

a) **Users failed to complete the task.**

o *Restructure all available services and categorize them hierarchically.* Restructuring and hierarchical categorization of the services can benefit to smoother navigation and service finding.

o *Card-based design and visual grouping.* These methods can benefit to creating much more clear structure and categorization of the services as well as contribute to smoother navigation. (Babich, Using Card-Based Design To Enhance UX, 2016)

o *Utilize search engine.* Search engine can help to find the needed services but in case user knows correct name of the service needed. Additionally, it requires a lot of technical and financial efforts.

**General**

a) **User № 7 stated that the accessibility of the web-portal is quite poor.**

o *Utilize accessibility techniques.* Accessibility techniques can helm to make the user audience broader.

b) **Some users (№ 1, 2, 5, 6, 7, 8) could not understand which input fields are mandatory to fill and which are not.**

o *Explain that there are mandatory input fields and emphasize them.* Emphasizing on the mandatory fields and explaining this in the beginning of the form should make them more noticeable and attract user attention to them.

c) **User № 8 pointed out that having telephone and address information in the profile by default would ease the usage of the web-portal.**

o *Include telephone and address information data into the basic profile info in order to be pre-filled in the future.* These data is widely required

thought the portal and filling it up every time can lead to longer task completion time.

d) **Poor functionality of the search bar.**

   o *Remove the search bar.* Removing search bar can correct user flow to the navigational menu and avoid poor functionality of the search bar.

   o *Fix the search bar.* Search engine can help to find the needed services but in case user knows correct name of the service needed. Additionally, it requires a lot of technical and financial efforts.

e) **Calendar issues.**

   o *Fix the calendar issue.* Fixing this issue should reduce confusion among users but it should be done by the technical means.

## 4.2 Implemented solutions

In the following section researcher states the solutions that were chosen to be implemented in the prototype.

Solutions chosen for implementation in the prototype:

1. Remove the "Type of Request" drop-down menu
2. Explain that there are mandatory input fields and emphasize them.
3. Change the home page layout and remove the broken link from it.
4. Switch from left-aligned to right-aligned or top labels
5. Illustrate what content can be attached to the forms, how to do it as well as to provide examples of when one should attach the content
6. Restructure the main navigation menu and improve wording.
7. Provide detailed explanation of the service at the beginning of the form. Inline help box.
8. In the calendar section of the form disable every date except those available in the schedule of the chosen official.
9. In the drop-down menu with LCC officials provide position of the official next to his/her name.
10. Make drop-down menus keyboard-friendly.
11. In the Task 4 forms, separate the two blocks visually
12. Make the "Send" buttons of each block center-aligned.

13. Emphasize on the user profile button visually and improve wording.
14. Incorporate user profile button in the main navigation menu.
15. Separate the "Log out" button from the user profile button.
16. Visually emphasize the "Log out" button.
17. Restructure all available services and categorize them hierarchically.
18. Utilize card-based design and visual grouping.
19. Include telephone and address information data into the basic profile info in order to be pre-filled in the future.
20. Remove the search bar.

Some of the solutions that were previously chosen for implementation could not be implemented in the prototype due to the limitations of the prototyping software. Thus, such solutions can be implemented in the programmed version of the prototype.

## 4.3 Prototyping process and limitations

Prototyping of the user interface was done utilizing a software called Axure RP (Ezra Schwartz, 2014). This software allows simulating user interface and some interactions in it without knowledge of programming.

Prototyping process was partially based on the throwaway prototyping model (Mohammad Kanan, 2017). The process intended to incorporate all solutions previously chosen for implementation in order to fix all 26 usability issues that occurred during testing of the OPLC, but at least three of them (wording correction of the input error messages, utilization of accessibility techniques and fixing the calendar issue) were omitted due to the Axure software limitations.

While designing the prototype, researcher utilized atomic design approach in order to bring order into design process (Frost, 2013).

Additionally, the core focus of the prototype was to improve usability of the user interface, thus in-depth attention to the graphical design of the user interface was omitted.

# 5 Usability evaluation of the prototype

Following Chapter deals with usability evaluation of the prototype developed. In order to do so, user testing of the prototype was conducted, than the results were represented as usability errors. After that, usability errors were prioritized according to their severity level. To provide an answer for the RQ-3, the Chapter concludes with the comparison of two usability evaluation studies, presented in Chapters 3 and 5 respectively.

At this stage of the research, the developed prototype was tested with real users to identify usability errors and evaluate the effectiveness of the prototype. To evaluate the prototype, the same methodology was used (traditional user testing) that was previously applied to the evaluation of the existing portal. In this chapter, traditional user testing is aimed to identify the effectiveness of the prototype developed and find out existing usability errors as well as other aspects that might need attention in the future. The structure of this chapter reflects on the structure of the chapter 3 in order to provide a parallel on the two usability evaluation processes.

## 5.1 User testing process

User testing was conducted with six people of different gender and age groups. Two of them are men and four are women. The age group of the participants varies from 20 to 30 years old. User testing of the prototype was designed in the way that it replicated user testing of the portal as close as possible. It was done to achieve the maximum objectiveness for the evaluation. Same physical testing approach was applied to the testing of the prototype and same number (seven) of tasks was created for prototype testing. Implementation of the tasks was monitored identically as well as the same tools were used in the process of testing.

For the testing purposes, a number of tasks were developed. Total amount of seven tasks were created. They were designed in a way to maximally replicate the tasks from the previous user testing. Consequently, tasks tested the navigation of the website, simplicity and clarity of the structure as well as clarity of the design patterns used. In order for the testing to be anonymous, the test account in the prototype was used and fake data required for tasks completion was given to the users.

An average user testing lasted for 12 minutes, the fastest completion of the test took 8 minutes, while the longest user testing lasted for almost 17 minutes.

**List of the tasks:**

1. Create an e-request to the Lviv City Council official about pavement replacement on Kopernyka street.
2. Create an application for receiving certified copy of Lviv City Council's Decrees, Executive Committee Resolutions and City Major Commands.
3. Register for the appointment with LCC official (Sadovyi Andrii Ivanovytsch). Purpose: some suggestions on improving service delivery process of the LCC.
4. Check the status of request to LCC, which was previously submitted physically.
   Document №: 7485
   Code: 2640
5. Check the user profile data; check the connected web-identification services.
6. Use the utility payment service (visit the partner website).
7. Find the service called "Approval of the land plot location".

## 5.2 Usability errors identified

**Usability errors:**

**Task № 1**

a) **User № 1 stated that after confirmation of sending the e-request, user was not redirected from the e-request creation form.** After completing the form and pressing "Send the request" button as well as receiving confirmation in the dialog box user was expecting an automatic redirection from the page.

b) **User № 4 did not notice the top navigation menu.** For some time, User № 4 struggled to find the e-request button on the top navigation bar.

c) **User № 6 could not find the direct path to complete the task**. At first, User № 6 headed to and explored the "Appointment registration" page. Only after some exploration occurred, the User № 6 was able to find the service needed.

**Task № 2**

a) **User № 1 stated that after confirmation of sending the application, user was not redirected from the application form.** After completing the form and pressing "Register an appointment" button as well as receiving confirmation in the dialog box user was expecting an automatic redirection from the page.

b) **User № 5 could not find the direct path to complete the task.** At first, User № 5 headed to and explored the "My profile" page. Only after some exploration occurred, the User № 5 was able to find the service needed.

**Task № 3**

a) **Users (№1, № 5) skipped the drop-down menu that specifies an official needed.** The Task № 3 requires a user to fill the form to make an appointment with the specific City Council official. The form itself consists of the two parts and a drop-down menu with names of the certain City Council officials. Sometimes users (№ 1, 5) focused more on the other parts of the form and did not pay attention to this drop-down menu, which ended up being unchanged. This has resulted in making an appointment with the wrong official.

b) **Confusing redirection**. After completion of the task, User № 6 was automatically redirected to the home page. Because of that, User № 6 was confused for a while because she thought that the redirection happened due to the technological failure.

**Task № 4**

a) **User № 1 could not find the direct path to complete the task.** At first, User № 1 headed to and explored the "E-request" page. Only after some exploration occurred, the User № 1 was able to find the service needed.

During the user testing of the prototype, there were no errors related to the **Task № 5, Task № 6** as well as **Task № 7** discovered. In addition, **User № 2, User № 3** and **User № 4** were able to complete all the tasks needed without facing any usability errors. That is why neither of these Tasks nor Users are mentioned in this section.

Overall, user testing of the prototype identified 8 usability errors in it.

## 5.3 Prioritization of the errors

Following the established procedure, this section prioritizes and analyzes 8 previously identified usability errors utilizing David Travis's method (Travis, 2009). In order to evaluate and compare user interfaces of both "OPLC" and prototype, each severity level was granted its own numerical value from 0 to 3 according to their severity impact.

Relatively small total number of errors in the prototype allowed for them to be placed into a one unified Table .

Table 11. Prototype usability errors analysis

| The problem: | Occurs on the red route | Difficult to overcome | Persistent | Sum |
|---|---|---|---|---|
| User № 1 stated that after confirmation of sending the e-request, user was not redirected from the e-request creation form. | 1 | 0 | 1 | 2 |
| User № 4 did not notice the top navigation menu. | 1 | 0 | 0 | 1 |
| User № 6 could not find the direct path to complete the task 1. | 0 | 0 | 1 | 1 |
| User № 1 stated that after confirmation of sending the application, user was not redirected from the application form. | 1 | 0 | 1 | 2 |
| User № 5 could not find the direct path to complete the task 2. | 0 | 0 | 1 | 1 |
| Users (№1, № 5) skipped the drop-down menu that specifies an official needed. | 1 | 1 | 0 | 2 |
| Confusing redirection after completion of the task 3 | 0 | 0 | 0 | 0 |

| User № 1 could not find the direct path to complete the task 4. | 0 | 0 | 1 | **1** |
|---|---|---|---|---|

Finally, to conclude the analysis, the severity breakdown of the 8 above-mentioned usability errors is presented.

Table 12. Severity of usability errors of the prototype

| **Issue severity** | **Point value** | **Quantity of issues** |
|---|---|---|
| Low | 0 points | 1 |
| Medium | 1 point | 4 |
| Serious | 2 points | 3 |
| Critical | 3 points | 0 |

## 5.4 Comparison of outcomes of the two usability evaluation studies.

Two usability evaluation studies were performed in the same way to be able to identify usability errors, prioritize these errors and produce comparison of existing and prototype versions of the user interface of the "OPLC".

Comparison of user interface versions is done based on prioritization of usability errors.

To benefit the research and answer RQ-3 quantity of usability errors and severity level of usability errors are being used. User testing of the "OPLC" identified 26 usability errors, while user testing of the prototype showed only 8 existing errors. Prioritization of usability errors of the "OPLC" identified 5 low severity level errors, 6 medium severity level errors, 12 serious severity level errors and 3 critical severity level errors. At the same time, prioritization of usability errors of the prototype identified 1 low severity level error, 4 medium severity level errors, 3 serious severity level errors and no critical severity level errors.

Consequently, user interface of the prototype resulted in less usability errors as well as in reduced severity of usability errors. Thus, applying the theoretical approach, conclusion can be drawn that suggested in the prototype version of the user interface has proved to have better usability.

# 6 Results, conclusions and discussion

Prototype testing resulted in various outcomes. Some of the Users provided feedback of the prototype. For example, User № 3 complemented the prototype and referred to it as the one "having a good usability".

Additionally, some feedback was actually silent – the fact that Users № 2, № 3, № 4 completed all the tasks without identifying usability errors, by itself is very good compliment to usability of the prototype.

Another feedback is not that positive. For example, the same usability error (during the Task № 3 Users skipped the drop-down menu that specifies an official needed) occurred in the user interface (UI) of "OPLC" as well as the prototype. This means that the solution for this specific error (discussed in the prototype development chapter) was not effective and it needs to be revised in the future developments. In addition, User № 4 managed to find the service needed in the task, but he could not understand the essence of the service.

In terms of future developments of the prototype, these are the main actions that can be done:

- Incorporate accessibility features

- Use card-sorting methodology to design better services sorting

- Upon clicking the button to order a service, provide the dialog box to reassure that all data was written correctly

- Providing an e-mail confirmation of the service ordered, e-request created or appointment made

- Supply all service pages with detailed description of the essence of this services.

Another important topic that needs to be mentioned is doing user testing in Ukraine and Lviv in particular. During the process of conducting user testing in Lviv, researcher gathered some valuable observations that contribute to answering the RQ-4 as well as

describe the input of the thesis to the research community. So the specificity of doing user testing can be summarized into these main points:

- Sometimes, doing user testing inside public organizations (like Centre of Administrative Services) can alter the testing process. For example, in case of this master, during the user testing performed in CAS, users were always interrupted by the surrounding environment and thus not always focused on the test itself.

- Changing environment of the user testing usually however helps to tackle the above-mentioned problem. For example, when the user testing was performed at home, users were much more calm, provided feedback and the testing itself lasted longer.

- Tester should expect great resistance and confusion among the potential test users (especially from elderly people), because user testing practices are not very common in Lviv region. Sometimes people get

- Generally, practice showed that the researcher usually has to provide comprehensive explanation not only about the testing process itself, but about the background of research (for example, Lviv citizens are not widely familiar with e-governance services, portals, initiatives or the notion at all).

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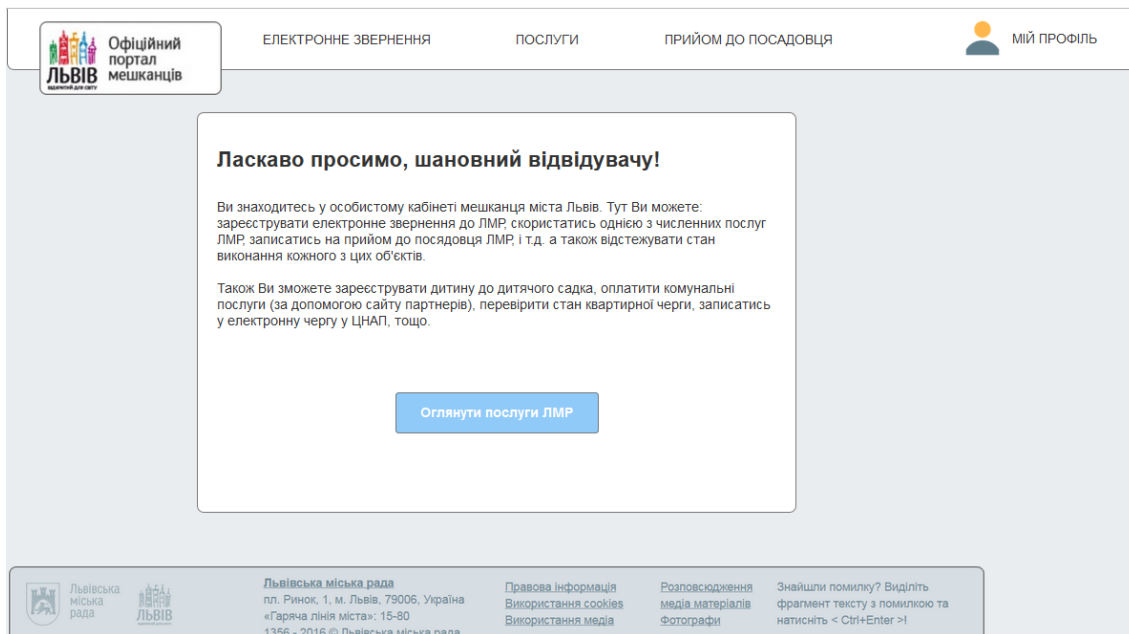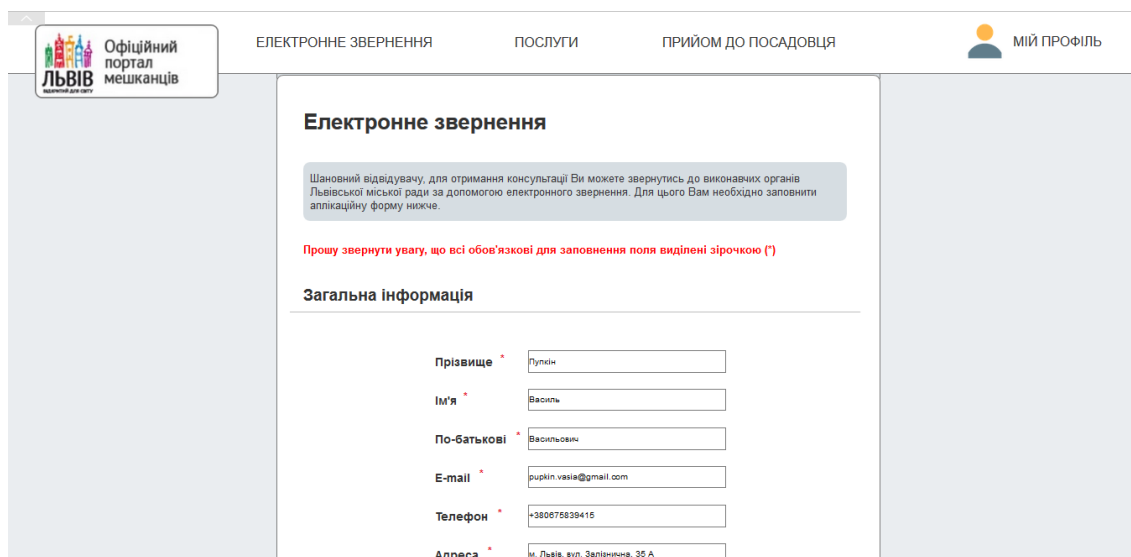# Appendix A – User interface of the prototype
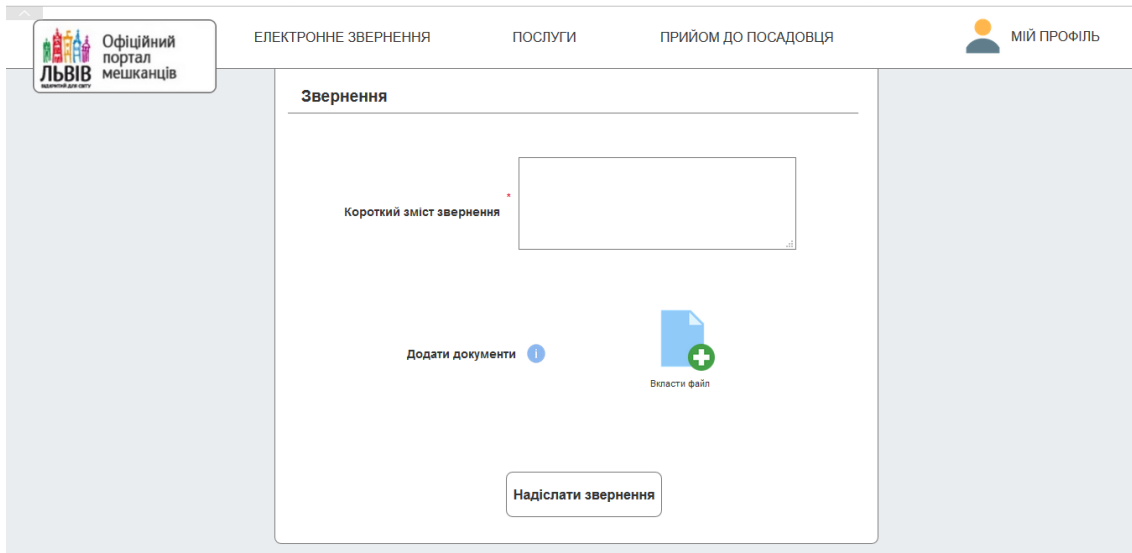


Figure 4 Home Page



Figure 5 E-Request creation
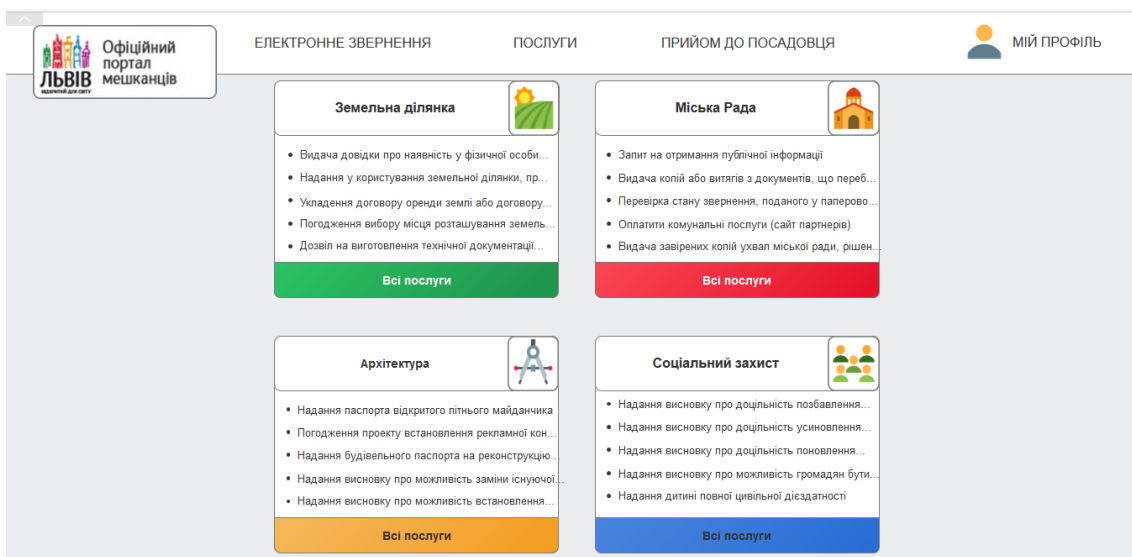
Figure 6 E-Request. Add File option
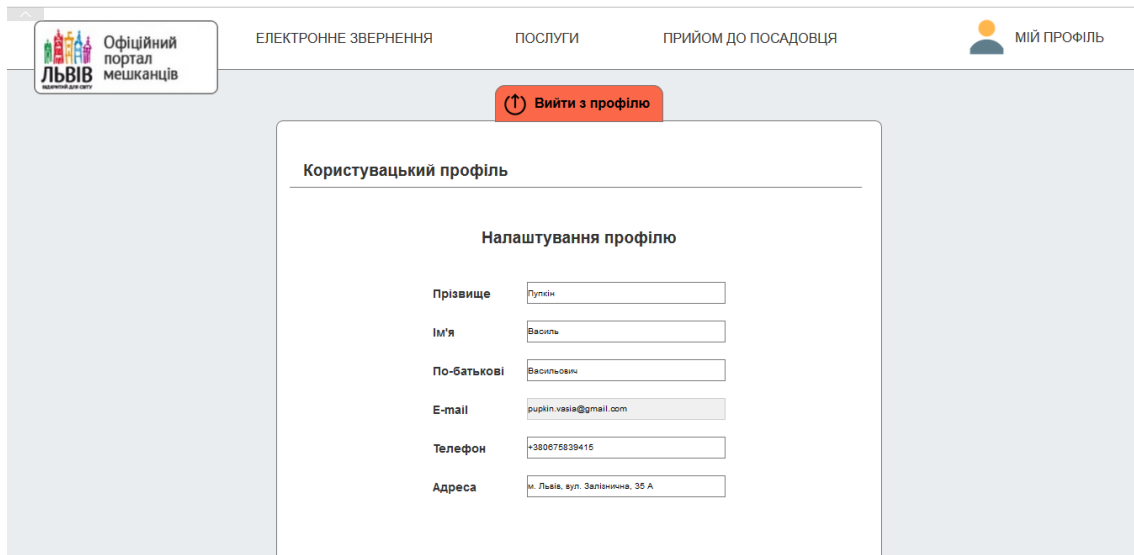


Figure 7 Services Categorization
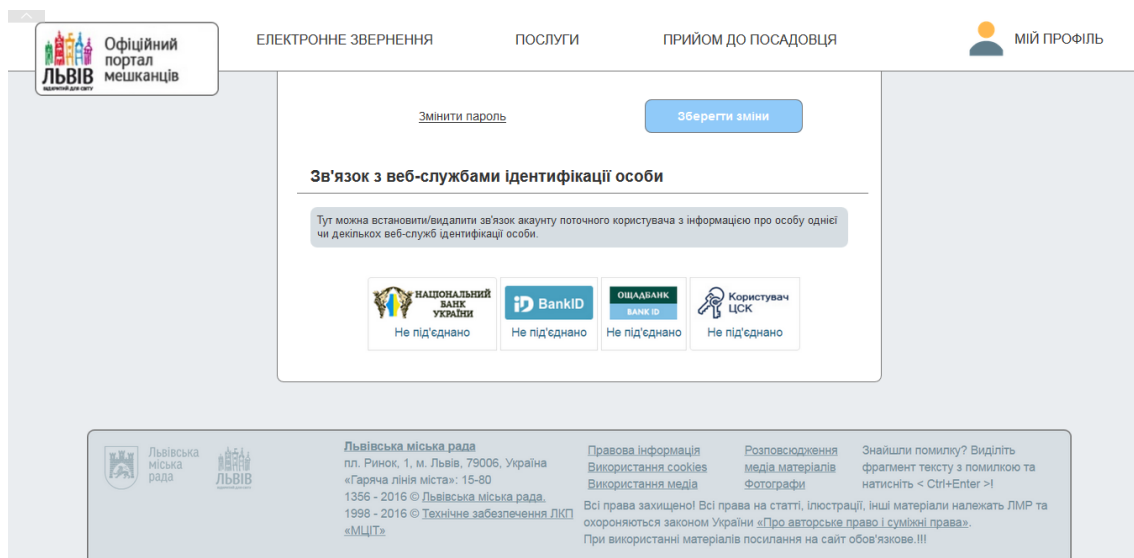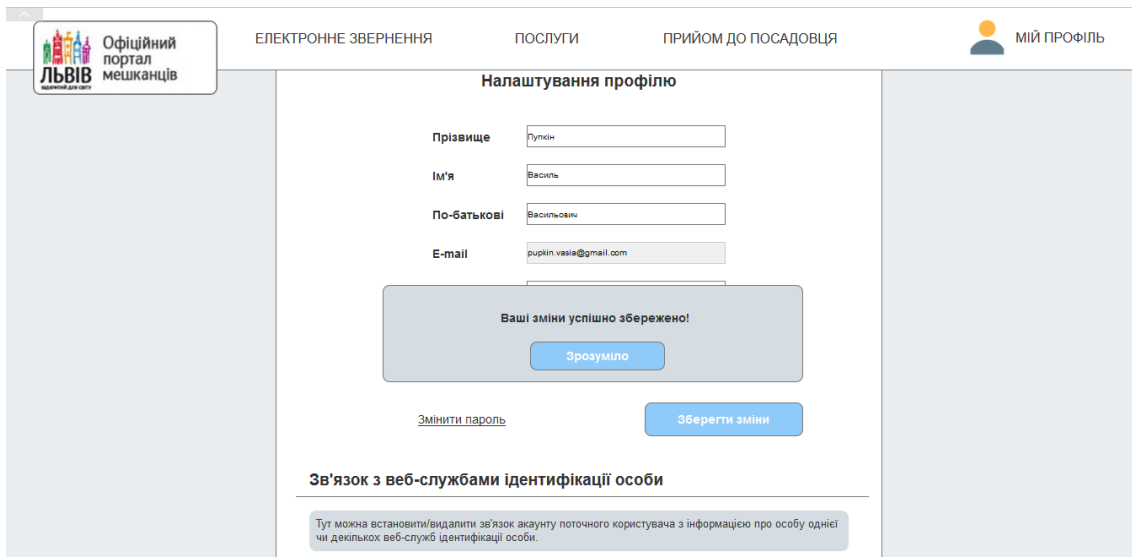
Figure 8 User Profile



Figure 9 Web-Identification Services
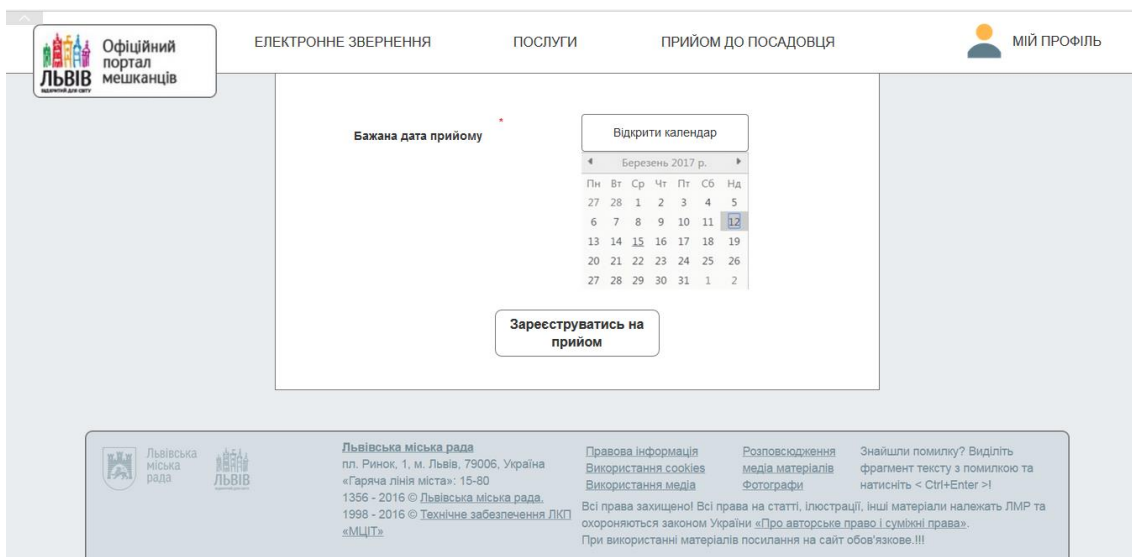
Figure 10 Dialog Menu



Figure 11 Calendar