Offering services and self-service in intelligent public administration

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Abstract: Self-service and offering services in public administration is a new concept that should be the basis of its service in the future. Here, we present a concept that should enable not only more efficient service but also the satisfaction of service users. Especially because it would provide them with the option to choose. To implement this concept effectively, it is necessary to implement intelligent public administration that can provide it. For this, we need knowledge bases and intelligent software agents. We will list some of the tools for implementing knowledge bases, and in one tool, we will create an appropriate database. We will use it to present the process of offering services. Here, we will mention the process of forwarding the "Birth Certificate" - a birth certificate that is part of self-service. We will mention offering a "Criminal Record Certificate" and "Title deed" as an example of offering services. These are a unique public administration data warehouse and a necessary means for user identification. There are also necessary legal prerequisites for implementing and using self-service and offering services in intelligent public administration.

We also mention some of the research we conducted at the beginning of 2023. The research relates to the use of new technologies in public administration. How interested are service users in the Balkan countries in digital services and new concepts?

Keywords: intelligent public administration, self-service, offering services, intelligent software agents.

1. Introduction

Under public administration, we understand units of local self-government (in municipalities and cities) as all ministries and all administrations and administrative organizations. Natural and legal persons in local self-government units receive most services. To receive services, users must go to a specific place at a specific time. New technologies enable different concepts, such as the self-service of users and the offering of digital services by public administration. This paper will discuss these new concepts more.

In this paper, we deal with offering services and self-service by users in public administration. We will follow how a public administration service user can serve themselves. We will give an example of how a user can forward their extract from the "Birth Register" - a birth certificate to the place where it is required of them.

The data contained in the birth certificate is kept in the appropriate birth register. Birth registers are the basis for recording the personal status of citizens in most Balkan countries. Usually, four registers are kept in these countries:

- Birth Register;
- Marriage Register;
- Death Register;
- Citizenship Book.

The management of birth registers is the responsibility of municipalities and cities (local self-government units).

New technologies enable digital services to be obtained anytime, not just when public administration operates physically. New technologies are insufficiently utilized in serving users (Radivojević, M., 2012). Employees in public administration use them to facilitate their work, but they are hardly used more efficiently. Here, we deal with new technological solutions that can offer users services or provide self-service. We will mention what is necessary for the user and what is necessary for the public administration to be able to implement these processes. We will observe all of this by forwarding the "Extract from the birth register" - a birth certificate, to the place where it is necessary. Such self-service would allow the user the option of choice and greater satisfaction. From the conducted research, it can be seen that 65% of service users would always use self-service, while up to 30 years of age, 86% of respondents would use self-service. More details about the research will be provided later in this paper.

2. Phases of digital services development

To improve service delivery in the Balkan countries, public administration should implement appropriate administrative reforms and increase efficiency by applying information and communication technologies in its work (Ivet, T. 2022). Significant steps have already been taken in modernizing and updating public administration (Basu, S., 2004).

Considerations are being made for software to implement artificial intelligence (Kamensky, J., 2018) and for the changes necessary to implement it. This would be a significant factor in improving electronic, mobile, and intelligent services (e-Services) (Radivojević, M., (2012)). Experiences and best practices are exchanged both nationally and internationally.

Public administration needs to carry out appropriate reforms. Part of these reforms is expected to be realized by introducing new technologies. This tool will increase the efficiency and transparency of its work.

In the mid-eighties of the last century, computers began to be intensively used in public administration (Ubaldi, B., 2020). Their use enabled public administration to offer appropriate services in digital form. Digital services have undergone five development phases (levels) (Figure 1).
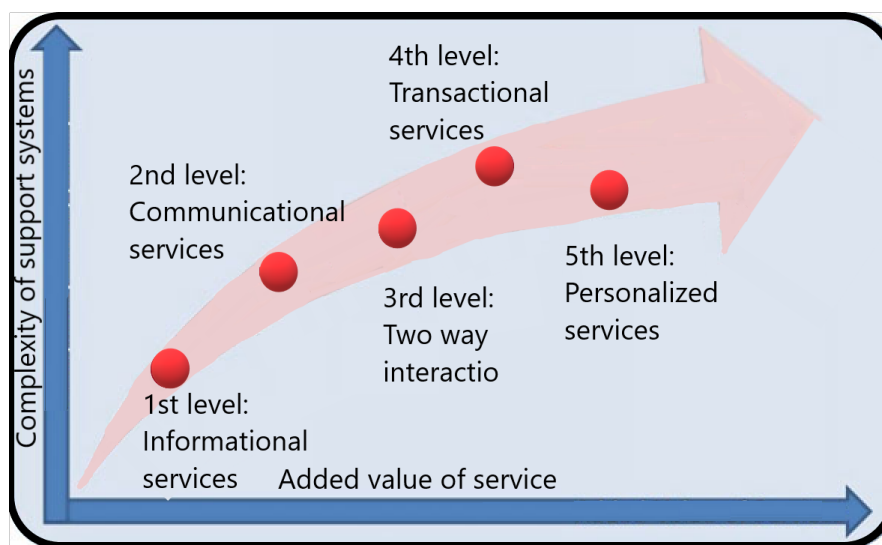

Figure 1. Phases of digital service development (Source: the authors)

- The first phase involved providing information about the service. In this phase, public administration provides its users with informational materials on accessing a particular service.
- The second phase includes communication services; users can download appropriate forms onto their computer, print them out, and use them when submitting a request for a service in the traditional way.
- The third phase involved two-way interaction, offering online forms to fill out and sending digital forms via the network to the public administration.
- The fourth phase includes transactional services and allows the user to perform a complete digital transaction for the received service, including mobile or electronic payment.

The fifth phase is increasingly used today and involves personalized services (personalization). In practice, personalized services are still hardly used. We believe personalized services should necessarily include self-service and offering services to users. These are precisely the services we are dealing with in this paper. If we look at public administration and its service provision, we can see that it currently provides a service to users. To receive a service, a user must go to a specific place at a specific time. Why shouldn't public administration provide the option of choosing services to the user with the concept of self-service or offering services? Self-service implies that the user sends a digital document to a specific place. Offering services implies that the public administration sends the document in paper or digital form to the user. For example, public administration could send a "Birth Certificate" in paper form to parents enrolling their child in primary school, even though the parents did not request it. Or it could send a digital "Birth Certificate" to the parents or the school where the child is enrolling. We have presented the services that public administration currently provides and should provide in Figure 2.
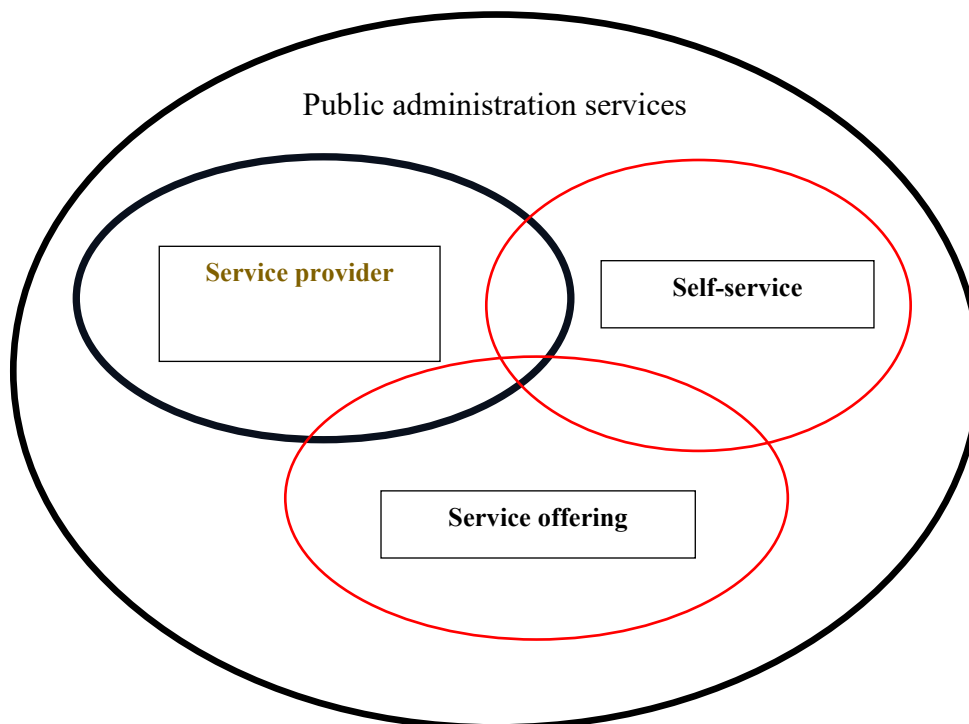

Figure 2. Public Administration Services (Source: the authors)

The first step that should be carried out in the phase of personalized services should aim to provide self-service to users of public administration services. Another step (phase) implies the necessity for public administration to offer services to the user at the right time and in the right place, which they need at that moment. This is a service that the user did not request but received in digital form. This should ensure that the concept of offering services is based on artificial intelligence (Marr, B., 2018). Under self-service, we understand that the user serves themselves. For example, they could take their "Birth Certificate" or "Title deed" or any other document, collect it themselves, and forward it to the place from where it is required of them.

Offering services implies that public administration offers the appropriate service to legal and natural persons when needed, even if they have not requested it. More efficient functioning of e-administration is related to the fifth level of development. Achieving this level requires further development of public administration, with the aim of integrating certain services. Their implementation is associated with adopting technologies and methodologies of intelligent systems. Providing personalized services will make online services more attractive to users.

To realize services, it is necessary to implement intelligent public administration. The implementation of artificial intelligence in public administration is necessary. The next part will be directed towards achieving intelligent public administration.

3. Results of the conducted research: Self-service and offering services

The research was conducted at the beginning of 2023 in the Balkan countries. The sponsor of the conducted research was the "International University of Travnik" - Bosnia and Herzegovina. The research aimed to determine how interested respondents are in self-service, how ready they are to accept digital services that public administration can offer, and their satisfaction with the services provided so far. University graduates and final-year students mostly conducted the research. Data were collected using a survey questionnaire in both digital and paper forms. A total of 1267 valid questionnaires were collected, and the data was statistically processed using IBM SPSS and Microsoft Excel software tools.

The prepared questionnaire was adapted to all age groups, both those who had completed primary education and those who had higher education. Here, we list only a part of the collected and processed data.

The questions were dedicated to the age structure of respondents, who ranged from over 65 years, 50 to 64 years, 30 to 49 years, and 16 to 29 years. Of the 1267 respondents, 111 belonged to the age group above 65 years, 254 respondents were aged between 50 to 64 years, 414 were between 30 to 49 years, and 488 were between 16 to 29 years. Table 1 presents the opinions of service users about the work of employees in public administration. It followed the availability, competence, and kindness of the employees. From the table, it can be seen that 65 respondents were very satisfied with the availability of employees, and 73 respondents were very dissatisfied. As for kindness, 302 respondents were mostly satisfied, and for competence, 345 respondents were mostly satisfied.

Table 1. Relationship: satisfaction - employees (Source: the authors)

	Availability	Competence	Kindness
Very satisfied	65	104	154
Mostly satisfied	297	345	302
Adequate	545	389	356
Mostly dissatisfied	287	332	344
Very dissatisfied	73	97	11

Regarding the question of how the offered services are received, it can be seen that only 5% of respondents would like to receive it the "traditional way" by going for it, while 61% would prefer it through mobile phones (Figure 3).
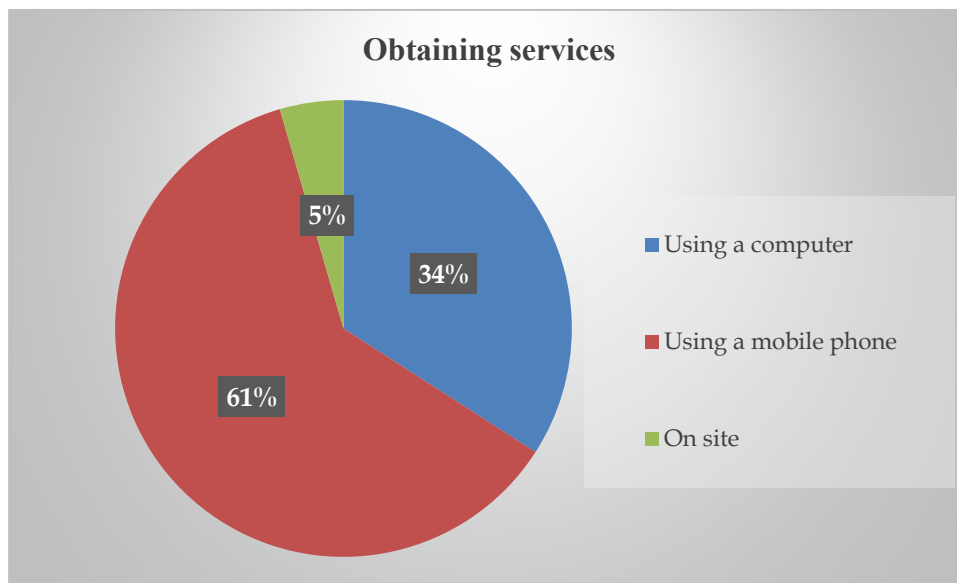

Figure 3. Devices for receiving offered services (Source: the authors)

Respondents were also asked, "What advantages can be gained by offering services?" Less than 1% of respondents believe that offering services provides no benefits, while 682 respondents, or 53%, believe that offering services provides significant benefits - Figure 4.
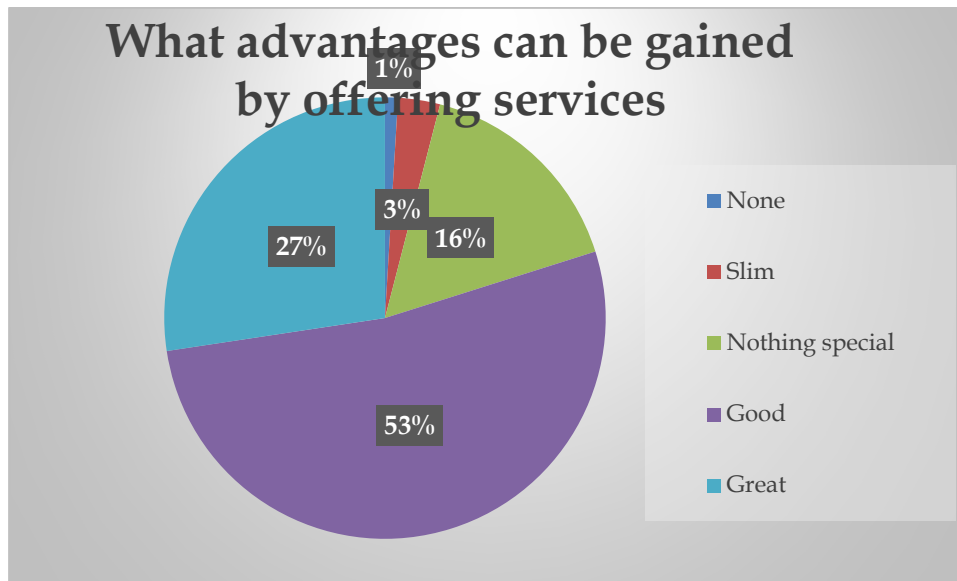
Figure 4. Effects of offering services (Source: the authors)

Of the 604 surveyed women, 79% would like to receive the service on their mobile phone. From the research results, it can be seen that the younger population prefers self-service 86% of the time, while middle-aged respondents prefer the offering of services 74% of the time. Due to the scope of work, many research results will not be listed in this paper. We fully achieved the goal we set at the beginning of the research. The results we obtained could not be compared with the results from research in other countries of the world because we did not find similar research anywhere. Results from some other research show:

- More staff are employed in public administration than is necessary,
- Digital and mobile technologies are still underused in public administration and
- Legal and natural persons can only get some information about services via mobile phone (Srivastava, S.K., 2023).

4. Knowledge base

Knowledge bases are organized collections of data, information, and knowledge. They are stored in a digital form that facilitates access, management, and their search. These bases usually contain structured information that can be used to solve certain problems, make decisions, or support research. A knowledge base is a collection of information, principles, concepts, and relationships between them. It is focused on supporting certain scientific, technical, or business areas (Tiwari, S., 2022). In this paper, we use them to store information and knowledge necessary for self-service and offering services in public administration.

The basis for using knowledge bases is not just to store data and information but to facilitate their understanding and provide better insight. We will use them in the intelligent system of public administration for self-service and offering services to users.

There are different types of knowledge bases, and some of them are:

- Ontologies: These are formal systems that describe relationships between entities, concepts, or ideas. They are used to model knowledge in a specific domain. They are used in the field of artificial intelligence to ensure machine understanding and interpretation of information. They also have applications in the field of the semantic web to improve the interoperability between different computer systems.
- Semantic networks: These are graphical models that display relationships between entities in the form of directed edges. Each node represents a concept, and the edges represent connections between those concepts. They are used for organizing and representing knowledge. They are applied in information systems, internet search, artificial intelligence, and other areas. They help model and transfer the meaning of information.
- Wikis: These are editable knowledge bases that allow users to contribute, edit, and review content together. Wikipedia is one of the most well-known examples of wikis. In business environments, they are used for maintaining internal knowledge bases. They offer easy text editing, change tracking, and content organization.
- Digital libraries: These contain digital copies of books, articles, journals, and other sources. They provide access to knowledge through digital media.
- Content Management Systems (CMS) - CMSs enable organizing, editing, and publishing digital content on the web.

Knowledge bases play a significant role in organizing information and facilitating access to knowledge needed for various purposes. When choosing tools for a knowledge base, it is important to consider the needs of the company, public administration, customer support capabilities, security aspects, and integration with other tools used. In this paper, we used the Protégé tool to update knowledge. We consider it an appropriate choice in the concept of self-service and offering services in public administration.

As we emphasized in the introduction of this paper, four registers are maintained in the Balkan countries. We updated the necessary information in the knowledge base using the Protégé tool for knowledge updating (Figure 3.).

We updated the knowledge base about births using the Protégé tool. This base was updated with:

- Birth data: name and surname, sex of the child, day, month, year, hour, place of birth of the child, unique personal identification number (JMBG), citizenship, nationality, religion.
- Data about the child's parents: name and surname, date of birth, place of birth, JMBG of the parents, citizenship, residence, address of residence (figure 6.).

We updated the knowledge base of married individuals with data about:

- Concluding of marriage, name, and surname of the spouses; day, month, year of marriage; place of marriage; residence and address of the apartment of the spouses; declaration of the spouses about their surname.

- Data for the bride: day, month, year of birth, place of birth, social security number, citizenship, nationality, religion.
- Data for the groom: day, month, year of birth, place of birth, social security number, citizenship, nationality, religion (figure 7).

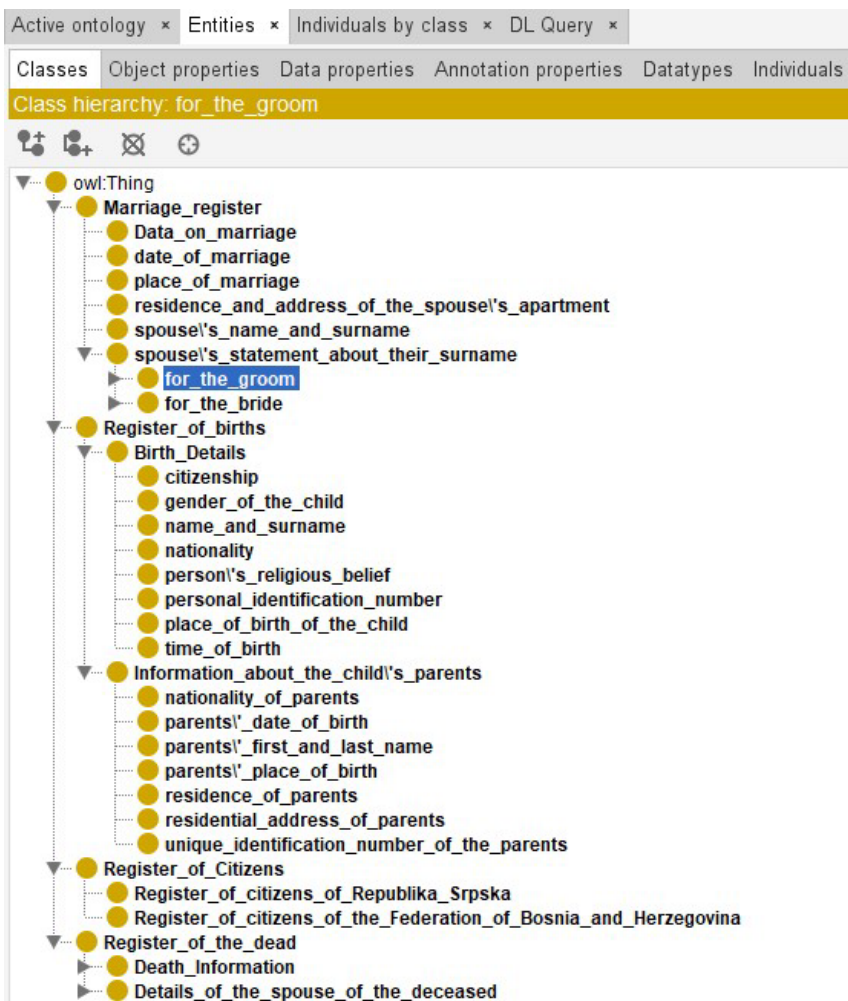We will use these knowledge bases in the process of offering services and self-service.

Figure 5. Knowledge base of registers of births, marriages, deaths, and citizens
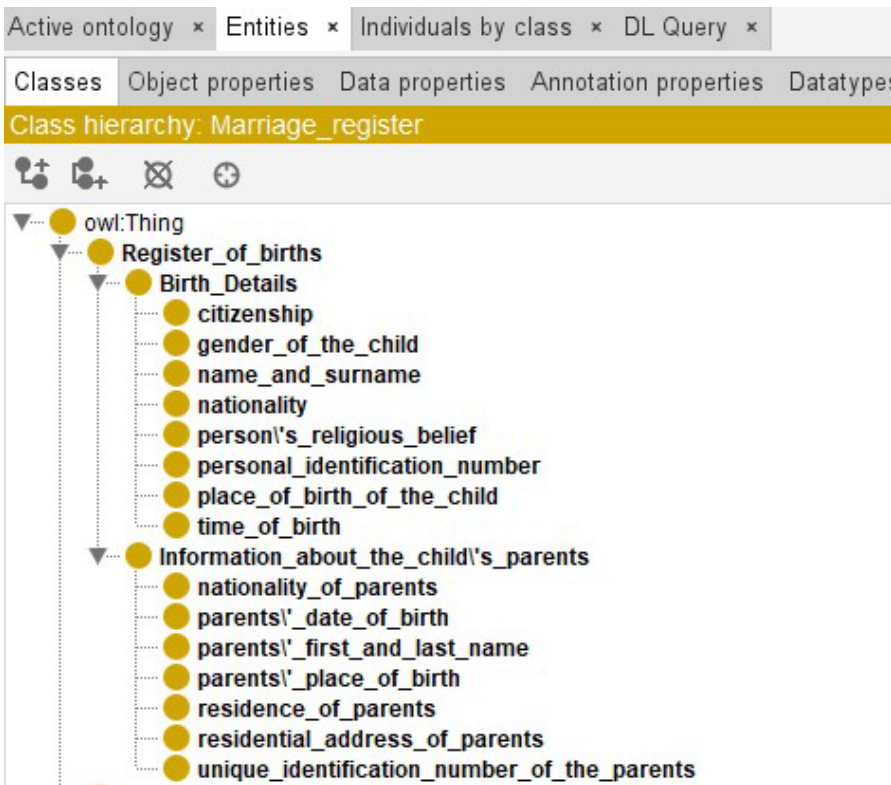
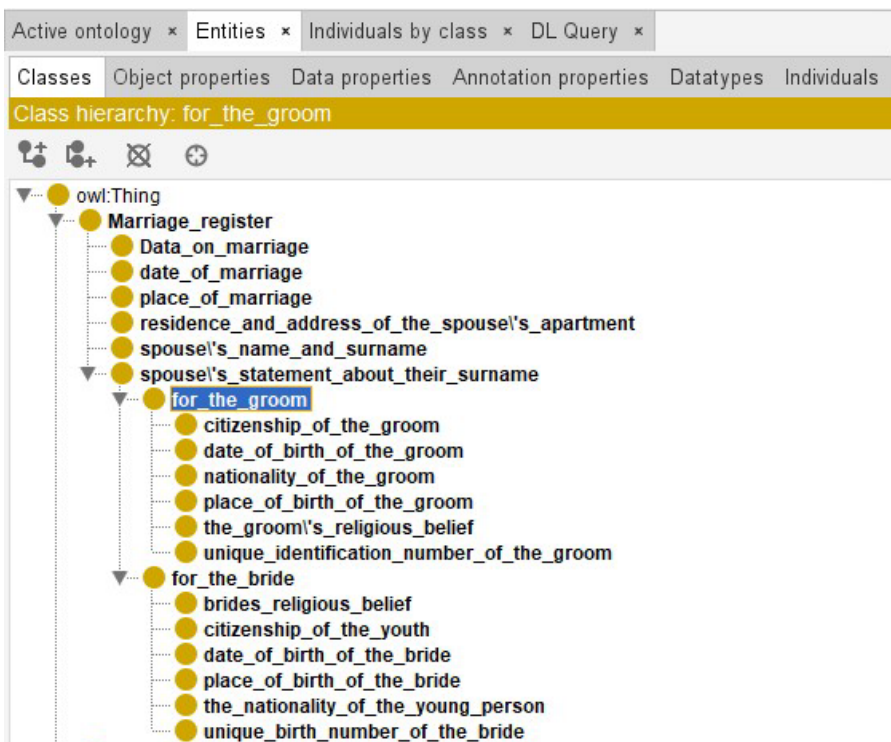*Figure 6. Knowledge base about the born child and the child's parents.*

Figure 7. The knowledge base of married couples.

All civil registers in most Balkan countries are maintained in both paper and digital forms. Based on these civil registers, extracts, such as the "Extract from the Birth Register," "Extract from the Marriage Register," and "Extract from the Death Register" are issued. These extracts are currently available only in written - paper form. Since all the data in the civil registers are also in digital form, the

"Law on Civil Registers" should allow the issuance of digital extracts. A certificate containing specific data entered in the civil registers or certain facts about the personal status of citizens can also be issued.

The authority issuing extracts and certificates (the registrar of the respective local self-government unit) is obliged to issue an extract or certificate upon a party's request based on the civil registers, but currently, they are in paper form.

An extract from the civil register or a certificate about specific data is issued at the request of the person to whom the data refers: their legal representative, a member of their immediate family, adopters, or guardians. A child who has reached 15 years of age and is capable of reasoning may inspect the birth register.

To use self-service and send their "Extract from the Birth Register" to the necessary location, the public administration must provide users with an appropriate web portal – an access point.

5. Self-service and offerings services: A new approach to services

New technologies and everything accompanying them have spurred new ideas for improving current technological capabilities (Pitoura, E., 2017). Work is being done to enhance web browsing using the semantic web. The semantic web aims to offer more intelligent searching, reflected in understanding online content's meaning. It should consider the purpose and context of queries. Semantic searching in public administration is not a new, separate search but rather a continuation of the development of existing search engines (Srivastava, P., 2016). Semantic searching in public administration is expected to improve service functionality in the coming period. This should ensure that computers become more efficient in processing, understanding, and presenting data and information that are currently only displayed.

For the new search to become a reality, it is very important that a large amount of different data, information, and inference rules in the data storage and knowledge bases of public administration be available in the appropriate format. They can be managed using the appropriate semantic search technology (Atarodi, S., 2019). We used to need access to data and information, but now we must be able to access extracts, decisions, solutions, certificates, consents, permits, and confirmations to use the concept of self-service and offer services more effectively.

The semantic web is expected to contribute to a more intelligent approach to managing information circulating in public administration. We need new technologies and appropriate new applications (Bostrom, N., 2016). The idea is to move from existing static government pages to a network of dynamic public service providers (Web services). It involves the automatic discovery of information or services that users seek or intend to seek. The semantic web should collect information from various sources and then combine them into homogeneous forms with the ultimate goal of sharing and interacting with other systems.

Tools and technologies of the semantic web (Goudos, SK., 2020) can help solve certain problems such as:

- A large number of different systems do not communicate with each other because they do not support existing interoperability standards.
- A large number of administrative bodies store the same data in different places, ignoring the existence of duplicates, leading to a waste of resources and conflicts in their use.
- As for the organizational structure, similar but not entirely the same terminology is used to name organizational units with the same goal.

The data available on the websites of public administration bodies and local self-government units are of different structures, formats, and contents. The problem is that there is currently no unified organizational scheme that would enable easier access to extracts, decisions, solutions, certificates, and other necessary documents in the self-service process. Such a framework would make searching a unique repository of public administration data more accessible and simpler to use and manage (Dixon, Brian E. 2022).

- Semantic searching in public administration can enable self-service.
- Self-service in public administration implies that the users serve themselves with the service they need at that moment (Chernykh, S., 2020). The user obtains the necessary extract, solution, certificate, permit, or other necessary document in digital form.
- Using self-service, users would access a unique service portal and a unique public administration data warehouse. In the process of offering services, intelligent software agents would offer users a digital service (Kaka, S., 2015). They would use shared public administration data and appropriate knowledge bases when needed and from where they are located. The service would be offered to them on their computer, tablet, or any smart device (Pitoura, E., 2017).

Figure 8 shows the self-service process, where the user accesses the unique service web portal of the public administration through their digital communication devices. Using semantic search, they ensure for themselves the "Extract from the Birth Register" or any other allowed document.

The unique service portal should provide users with all the necessary data (DB) and digital documents they can download. The user should be able to see all the services they can get from the public administration and all the web services on offer. It needs to enable the user to obtain the necessary digital service (digitally signed document) and send it where needed.

For the concept of self-service to function effectively, the service user must be identified on the public administration's unique service portal. This identification can be ensured using an electronic signature, an appropriate access card or token, or suitable access software.
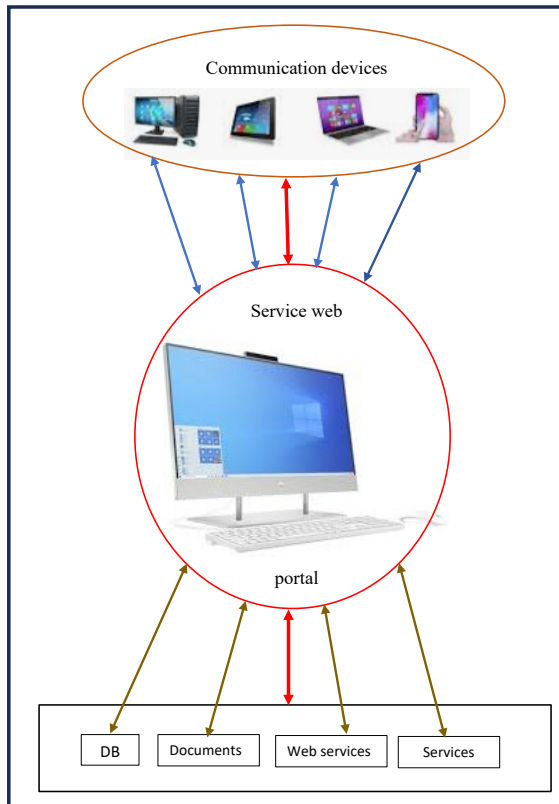
Figure 8. The concept of self-service (Source: the authors)

- After the identification is conducted, the public administration's service portal can enable the user to use semantic search engines to secure the appropriate document they want to forward to a specific body, requesting it from the user.
- For public administration to ensure self-service, it must have the appropriate legal basis for which services (requested documents) provide self-service.
- Offering services implies that the public administration offers a service to the user that they have not requested but is necessary for them. To offer the user a "Certificate of No Criminal Conviction" or "Property Sheet," the public administration must recognize such a need for the service by the user.
- In most Balkan countries, the Certificate of No Criminal Conviction is kept in courts and issued by the Ministry of Interior. It is often required as a document during employment.
- An intelligent public administration can offer this to the user based on the "unique data warehouse of public administration," appropriate "knowledge bases about services, and first on service." In addition to the necessary data and knowledge, intelligent public administration must also have intelligent software agents.

6. Intelligent software agents

Intelligent software agents require a certain level of functional "intelligence" where they will perform tasks on behalf of the user. Here we provide an overview of the current state of intelligent agent technology. We especially monitor their application in public administration and the new concept of self-service and offering services. We will describe the basic mechanisms of intelligent agents' operation and the challenges they face within the networked computing environment of the unified public administration (Hidirova, B., 2020). This discussion should open some important questions about the work and services of public administration, with a special emphasis on offering services to legal and natural persons. Some of these questions relate to new technological solutions, others to the legal basis, and a third to digital service and the user's relationship to it. For example:

- Does the process of self-service and offering services in public administration require special technology of intelligent agents?
- What laws are needed, and which laws need to be adapted to digital servicing?
- How could intelligent agents be used in self-service and offering services in public administration?

Will service users trust the ability of intelligent agents to provide them with new concepts? Research related to the technology of intelligent software agents is one of the fastest-growing areas and endeavors related to their application (Morabito, V., 2017). In this period, a relatively small number of applications are available for self-service and offering services. For further development in this area, it is necessary to operationally define the scope of the application, understand the existing scope of the application, and emphasize the research and development program of intelligent service software applications (Ubaldi, B., 2020). This work should be part of the roadmap and help for a new area of research.

6.1. The Role of Software Agents

An intelligent software agent is a software program that performs tasks for each user within a computer environment. The software performs hundreds of different tasks at any given time to help users achieve their goals. Software agents differ from other applications in their autonomy, mobility, and ability to make independent decisions (Tiwari, S., 2022). An intelligent agent is a program that can enable users to offer services. In doing so, it uses data from public administration and corresponding knowledge bases about service rights. They can search shared public administration data and knowledge bases about services and service rights. A characteristic of intelligent software agents is the ability to adapt based on experiences. They can solve problems in real-time using knowledge from appropriate knowledge bases and public administration data. The need to describe or model "intelligent" software agents arises in many areas (Wirtz, B., 2019). In this paper, we consider them in the context of self-service and offering services in public administration. The basic characteristics of intelligent software agents in public administration are:

- They must have the ability to perceive the environment.
- The observation they possess must serve to make decisions.
- The decision should result in an action-signing a specific digital document, for example, an "Extract from the Birth Register."

The action taken must be rational and user-oriented. Interactions between intelligent software agents and service users must be fully present. In such interactions, intelligent agents mediate the access of public administration users to its services. They are guided by service goals, make autonomous decisions, and can learn from experience (Tung-Hsiang, C. 2009). Such agents direct the behavior of intelligent public administration towards outcomes that ensure the offering of services. The software is what drives the various aspects of the public administration network. It plays an important role in shaping the offering of services to individual users. Engaging in these activities requires interaction with intelligent software agents mediating between public administration and users (Dixon, Brian E., 2010). Intelligent software agents are used to undertake actions that enable the achievement of certain goals (Hidirova, B., 2020). In the cases we consider, the environment of intelligent software agents is shared data of public administration and knowledge bases about public administration services, and it includes service users with their needs. It has the ability to provide the user with the necessary service. Searches are conducted from knowledge bases about service users and knowledge bases about rights to the service. Thus, they can provide and forward the appropriate service to a specific user. It could be a specific extract, solution, certificate, decision, etc., but all in digital form. Intelligent software agents in the self-service process for forwarding the "Extract from the Birth Register" do the following:

- Conduct identification of the user on the access portal.
- From the database about the birth (Birth Register), check if there is a specific person for whom the "Extract from the Birth Register" is requested.
- From the knowledge base about the conditions for obtaining the service, check if the user can obtain that service.
- If they can obtain it, they need to select the required service.
- The user chooses - a digital document: "Extract from the Birth Register" for the specific user.
- The appropriate intelligent software agent digitally signs the digital document.
- The user enters data about where they want to send the digitally signed document.
- The software agent checks which of the intelligent devices is possessed by the institution to which the digital document is being forwarded (smartphone, computer, tablet, or any "smart device").
- Ensure that the user can self-serve and forward the digital document.

The recipient of the "Extract from the Birth Register" immediately notifies the sender about the received document. The most important task of intelligent software agents is to carry out certain activities that depend on the state of the environment. They can collaborate with other intelligent software agents. They can provide self-service and offer services to the user if they work in an intelligent information system of public administration. In the intelligent information system of public administration, intelligent software agents are designed to monitor their environment, make decisions, and take action to achieve a specific goal or set of goals. The agent operates autonomously, which means a person does not directly manage it. During the achievement of their goals, they access data and information from third-party sources, as well as the current "state" of the external environment. This requires the ability to communicate with other agents, data storage, and knowledge bases (Suray I., 2019). Their natural area of operation is collaboration, and they work together on perform-

ing mutually beneficial but complex tasks. It is necessary to trust that the agent can correctly represent the user. The user must be convinced that intelligent software agents will act serviceably towards them. It should be kept in mind that intelligent software agents do not represent one software but several. They are designed to work together to achieve a common goal. They are capable of monitoring their environment. They can make decisions and take actions to ensure the intelligent information system achieves a certain goal.

7. Conclusion

In this paper, we present part of the research that was conducted related to the use of public administration services. We proposed two new, previously unused concepts: self-service and offering services. We indicated the need for knowledge bases that could be one of the very important components in offering services. We presented the necessity of implementing intelligent public administration to provide service users with a choice in servicing. We listed some necessary software agents essential for intelligent public administration to expand digital servicing.

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