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A Geoportal Supporting Spatial Planning in Poland: Concept and Pilot Version

Abstract: Due to the complexity of planning processes, as well as the desire to satisfy stakeholders and entities involved in spatial development and planning procedures, there is a clear need to create a platform for managing spatial development planning information. The aim of this paper is to present a project and pilot version of an urban platform (spatial planning geoportal), which is intended to be a solution used for the creation, analysis, and presentation of spatial data related to spatial planning. To implement the concept of the geoportal, one of the models used in systems and software engineering known as incremental execution was used, together with the language for documenting phases of an IT project – the Unified Modeling Language (UML). The concept includes a formal description of the geoportal functionalities using UML as well as the perspective of solution users and stakeholders. This paper also shows the functionality of the pilot version of the geoportal, which refers to spatial planning at the local level and local spatial development. The spatial planning geoportal presented in this paper adheres to the reform of spatial planning and is intended to help in conducting spatial policy, both at the local and central level. Establishment of the spatial planning geoportal may contribute to increasing the efficiency and quality of the spatial planning system in Poland, as well as other areas such as management of local government units, local and regional transport, and regional planning.

Keywords: spatial planning, local spatial development plan, urban platform, spatial data, spatial planning geoportal

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1. Introduction

Digital transformation in the area of spatial planning covers many different aspects and is related to the use of various information ana communication technologies, including among others geographic information systems (GIS), decision support systems, spatial information infrastructures, machine learning, volunteered geographic information (VGI) and social media data at the phase of planning documents elaboration [1], decision making process [2–4], or the participation of various stakeholders in spatial planning process [5, 6]. The perspectives of benefits for spatial planners, which derive from the use of technology [7, 8], and also digitisation [9], as well as social participation [10–12] are also discussed. As digitisation and digitalisation of spatial planning can be considered multi-dimensionally, many authors conduct more comprehensive analysis of that process taking into account the issues of both the spatial planning system, spatial policy and the structure of planning documents, and also the interoperability framework of public registries [13–15] and the e-government concept [16].

In Poland, a crucial issue concerning the digitisation of spatial planning is connected to the computerization of local spatial development plans [17–19], specifically the application of GIS technology in urban planning methods and planning processes [20–26]. Another important issue is the possibility of using digital tools in public consultations during the creation of planning documents [27–29]. The use of geoportals, including the commune ones and the main access point of national spatial data infrastructure, in various planning tasks has also been previously [30, 31]. In the context of digital planning information, considerable attention has been paid to reference data, which are necessary for preparing planning documents [32–36], and to the role of planning data sets in geoinformation systems [37]. After the entry into force of the Act of 4 March 2010 on spatial information infrastructure (Journal of Laws 2021, item 214) [38], there has been much focus on the issues of meeting the INSPIRE (Infrastructure for Spatial Information in Europe) requirements regarding land use in relation to planning studies [39–42].

A current problematic issue in the area of spatial planning digitisation in Poland is the lack of system solutions, including technological ones, that would support and integrate spatial policy at all levels (local, regional and central) of spatial planning and would be dedicated to various stakeholders in planning procedures. The digitization of spatial planning can also be considered multi-dimensionally and there is a need for more comprehensive analysis of that process taking into account the issues of both the spatial planning system, spatial policy and the structure of planning documents, and also the interoperability framework of public registries [43].

The use of applications and standards based on geoinformation technologies in planning-related decision-making might make it easier to pursue a spatial policy and ensure effective spatial management, contributing to achieving the primary goal of spatial development, namely spatial order.

The aim of this paper is to present a project and pilot version assumptions of an urban platform (spatial planning geoportal), which is to be a solution used for the creation, analysis and presentation of spatial data related to spatial planning in Poland. The concept includes a formal description of the geoportal functionalities using UML as well as the perspective of solution users and stakeholders. This paper also shows the functionality of the pilot version of the geoportal, which refers to spatial planning at the local level and local spatial development plans.

1.1. Catalogue of Land Uses

The need to develop a catalogue of land uses emerged almost immediately after the publication of the original version of the 2003 Regulation, and became even more apparent in the course of digitisation projects covering individual municipalities or single voivodeships. Gathering in one place local plans of various authors, in various municipalities, clearly showed that differences in names or symbols of designations prevented unambiguous interpretation or extended analysis. From the spatial information systems point of view, the difference between names referring to the same land use, e.g. 'single-family residential area' and 'residential area for single-families' prevented automatic analysis with the use of GIS software.

It is worth noting that the development of the finally adopted classification was an extremely complex and lengthy task. The first activity initiated by the author was the analysis of already elaborated classifications taking into account different time of elaboration, scope and authors. Some classifications were developed by geoinformation companies, scientific teams or for the needs of projects on a regional scale. In this way, not only classifications created on the basis of the current wording of the Act, but also classifications from several decades ago were taken into account (in order to find a point of reference and take into account different approaches to the problem).

As part of subsequent stages of work on the classification, the author decided on extended pre-consultation, which involved sending a cover sheet with a link to the current version and a link to the questionnaire in electronic form, both to mayors of municipalities, mayors, as well as to voivodes and representatives of interested institutions. The author used an application which makes it possible to prepare surveys of any level of detail. The questionnaire covered all classes and three levels – it was structured in such a way that the person filling it out could suggest the specific wording of his or her own proposal. In designing this survey, the author assumed that only precise counter-proposals would be considered. In this way, more than 500 questionnaires were completed, which translated into more than 4,550 individual proposals for each class. As a result of taking into account the comments made, it was decided, for example, not to supplement each class with the expression 'other', and also to specify specific types of services. Having developed such a version of the classification, which took into account a significant part of comments (although

sometimes mutually exclusive), the legislative process continued and proceeded to inter-ministerial arrangements and public consultations. This stage was particularly difficult due to the need to take into account the largest possible number of positions of institutions that, as a rule, have specialist knowledge in a narrow range. Once again, there was also a need to take into account various positions from the self-government side, including within the framework of the Joint Commission of the Government and Local Self-Government. The use of a questionnaire in the pre-consultation probably ultimately influenced the relatively lower number of comments in the official consultation – only 198 individual comments were received.

Finally, the signature of the Minister of Development and Technology was obtained for both regulations on 17 December 2021. A final assessment of the quality of the adopted classification and standards can only be formulated sometime after entry into force. Nevertheless, efforts have been made to find a 'happy medium' which is a compromise between the needs of urban planners, the expectations of municipalities and the possibilities of the ministry. Certainly, the current version of the classification is adopted in such a form as to enable its successive development. However, as part of further work in the department, it is planned to prepare definitions of designation in the near future, in order to ensure a uniform interpretation nationwide. The adopted level of detail of the classification seems to enable freedom in designing and, at the same time, enables the use of the classification also in other activities (which will be discussed later in this publication).

1.2. Application for Establishing the Location of a Public Purpose Investment or Land Development Conditions

In view of the need to shorten the procedures in the investment and construction process, efforts were made to develop a uniform form nationwide for decisions on land development conditions. The adoption of the form in the form of an ordinance enabled the use of the so-called simplified procedure when issuing the decision on land development conditions. The delegation is introduced by the Act of 17 September 2021 on amending the Act – Construction Law and the Act on planning and spatial development (Journal of Laws, item 1986) [47], which came into force on 3 January 2022. The scheme of action was replicated by the author using similar tools as in the organisation of work on land use classification. First, the legislation, case law and examples of existing documents were analysed, including applications from municipalities with different locations and specificities. In this way, a draft regulation was developed, which was subject to pre-consultation in September 2021 (also conducted through the same electronic survey). The pre-consultation received over 400 survey completions, including over 810 individual responses. In contrast, the formal consultation received only 68 individual comments.

In order to minimise the investors' involvement, including, for example, marking the investment area on separate maps, it was specified in the proposal that in

the case when the investment area covers the entire plot or all registered plots there will be no need to create an additional appendix. Simultaneously with the ongoing legislative process, works were carried out concerning implementation of the application in the service operated by the Main Office of Construction Supervision www.e-budownictwo.gunb.gov.pl. This service enables creation of the application on the basis of subsequent questions and fields to be filled in, including the possibility to select plots by indicating them on the map.

It seems that the quality of the adopted solutions is confirmed by the number of messages sent by interested parties to a dedicated e-mail box, which was created on the initiative of the author. Within two months of the entry into force of the legislation, the dedicated e-mail address received less than thirty questions, most of which were written by individual investors. Due to low interest in the need for additional clarification, the author decided to close the box.

Importantly, the form already uses the catalogue of uses established in the above-described regulation, when determining the existing and planned development of the investment area.

2. Material and Methods

One of the models used in systems and software engineering, known as incremental execution [44], was used to design and implement the concept of the spatial planning geoportal (Fig. 1). The research consisted of the following stages: requirements specification, specification of the architecture of the system, functions and features selections, and specification of the architecture of the subsystem.

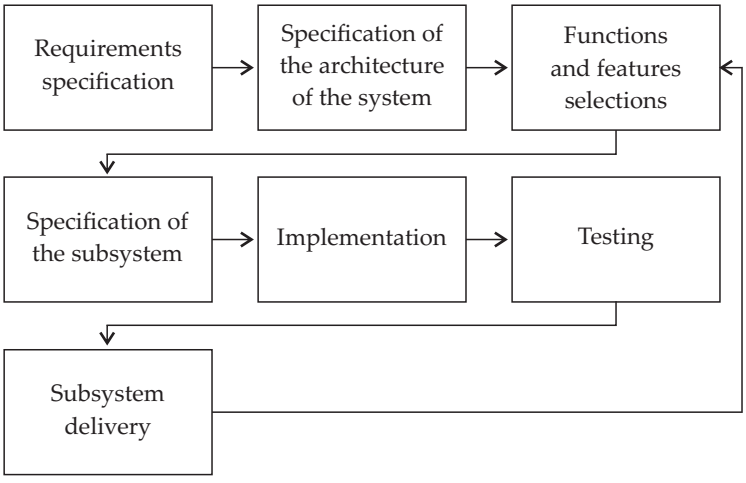

Fig. 1. Incremental model
Source: own study based on [44]

The first step (Fig. 1) was to define the requirements of the web portal (Section 3.1). The starting point was the expertise and practical experience of the authors of this paper in the field of preparing spatial planning studies. It was also questionnaire research (quantitative and qualitative) in the use of geoinformation web portals by spatial planners in tasks related to the protection of air and environment, which results were described in Zwirowicz-Rutkowska and Michalik [7]. The next step involved the development of the characteristics of the basic modules (Section 3.2). The developed functions constituted the overall design of the system. The Unified Modeling Language [45] was used to describe the architecture of the solution, including diagrams of use cases.

The model of the subsystem presented in this paper (Sections 3.3 and 3.4) was developed by the authors of this paper in cooperation with the Ministry of Economic Development and Technology and the Chancellery of the Prime Minister. The work was initiated in June 2021 by the Spatial Planning Department at the Ministry of Economic Development and Technology. The pilot version project is to be based on the current local plans (in the first place). The material for the first analyses was provided via an electronic form by the municipalities interested in cooperation. The questionnaire was prepared and specified the location, knowledge in the field of GIS and number of spatial planning acts in order to select municipalities representing various levels. As a result, the municipalities transferred the GML files with individual local Spatial development plans or the entire data sets containing these planning documents. The material collected in this way made it possible to carry out the first stages of the conceptual and programming tasks without the continuous involvement of municipalities. This was the basis for selecting the functions and features to be implemented in the pilot version (Section 3.3) and defining the Specification of the subsystem (Section 3.4).

3. Results

3.1. Requirements

The concept of the spatial planning geoportal included modules for the creation, analysis and presentation of spatial data related to spatial planning. The idea was to create a tool in the form of a web application accessible through a web browser, without installation of additional, paid software. Due to the problem of the poor quality of computer equipment in many government units, every effort should be made to ensure that all analyses are performed by the server, not the local workstation. The results of these analyses, as well as the raw spatial data, should be dynamically viewed (WMS) and retrieved (WFS), including by means of spatial data services. Access for at least two groups of users was assumed: logged users and unlogged users, and one of the main goals will be to make the platform functionalities available to users who are not logged in. Meanwhile, logged in users will obtain, for example, the ability to edit or view personal data. Taking into account the diverse knowledge and skills of people using the geoportal in the future, several modes are

planned for implementation, of which the basic mode will be limited to a relatively small number of layers and elements visible after loading from the so-called auto-click, while the advanced mode will allow users to activate individual functions, data, and even analyse and download selected data. It is assumed that the format, coordinate system and attributes will be unified, but at the same time, it will be possible to choose from several options. Of key importance, especially for the industry and advanced users, will be the automation of some operations e.g. for a town planner or a government employee.

3.2. Specification of the Architecture of the System Modes and Functionality

Figure 2 presents the UML use case (uc) diagram of the mode categories of the spatial planning geoportal. The default mode will be the basic mode, initiated automatically immediately after the opening of the spatial planning geoportal, whereas the advanced mode will be available to advanced users only.

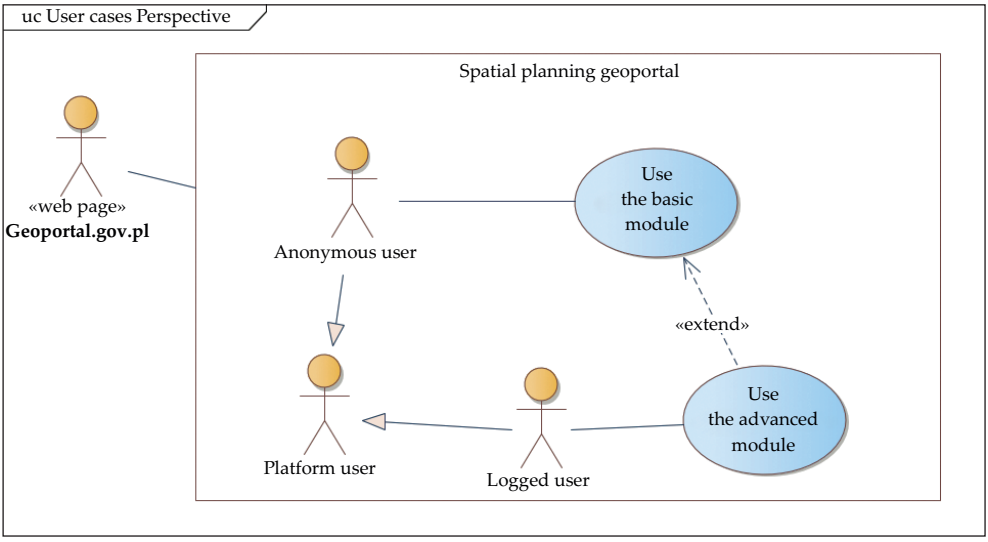

Fig. 2. The basic and advanced mode of the spatial planning geoportal

The spatial planning geoportal user will be able to perform a number of activities shown in Figure 3 and adapt the displayed spatial data to his or her own purposes. It is assumed that the data visualisation features will include the creation of maps, graphs, or tables. For more advanced users, it will be possible to create new data, export data and perform analysis. Users with no skills will probably focus on viewing or printing the available data. In addition, it is planned to give users entering the data the ability to enter and view personal data. As a rule, the idea of the authors is to make data available to as many users as possible, regardless of their privileges.

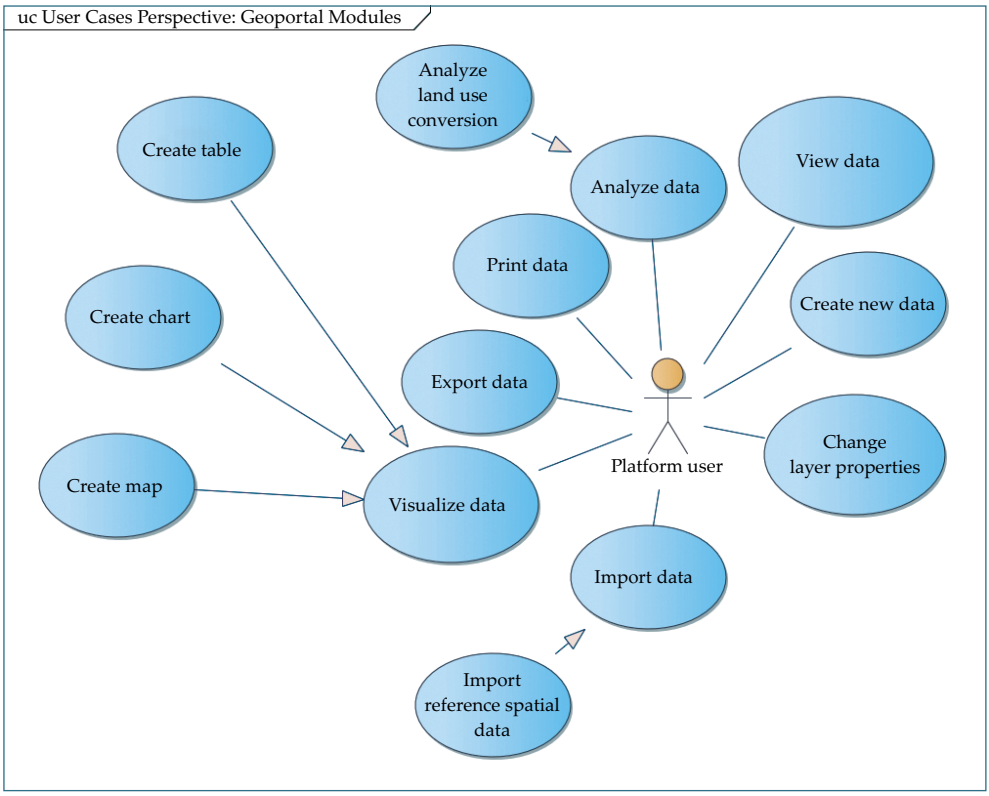

Fig. 3. Selected activities available to the urban platform users

Characteristics and relations between users and stakeholders of the spatial planning geoportal

One of important functionalities of the geoportal is data integration. Spatial data are scattered across many entities, in particular in 2,477 municipalities. The geoportal in question assumes that *wojts* and mayors as well as voivodeship authorities will supply the system with data and information (Fig. 4). Because the purpose is to enter data that are annexes to planning documents into spatial data sets, it is essential that the relevant authorities indicated in the Act on planning and spatial development [46, 47] as entities drawing up such documents are required to fill out the form and add geometry. The middle part of the graph shows two entities that will cooperate in creating and maintaining the geoportal. As per the assumptions, the register will be kept by the minister responsible for construction, spatial planning and development, and housing. The minister responsible for computerization will ensure the operation of the ICT system.

The geoportal will collect, update and provide two types of data. Firstly, sets of spatial data on spatial development (along with metadata). Secondly, the remaining

data and information on planning documents, including resolutions, decisions, applications and diagnoses.

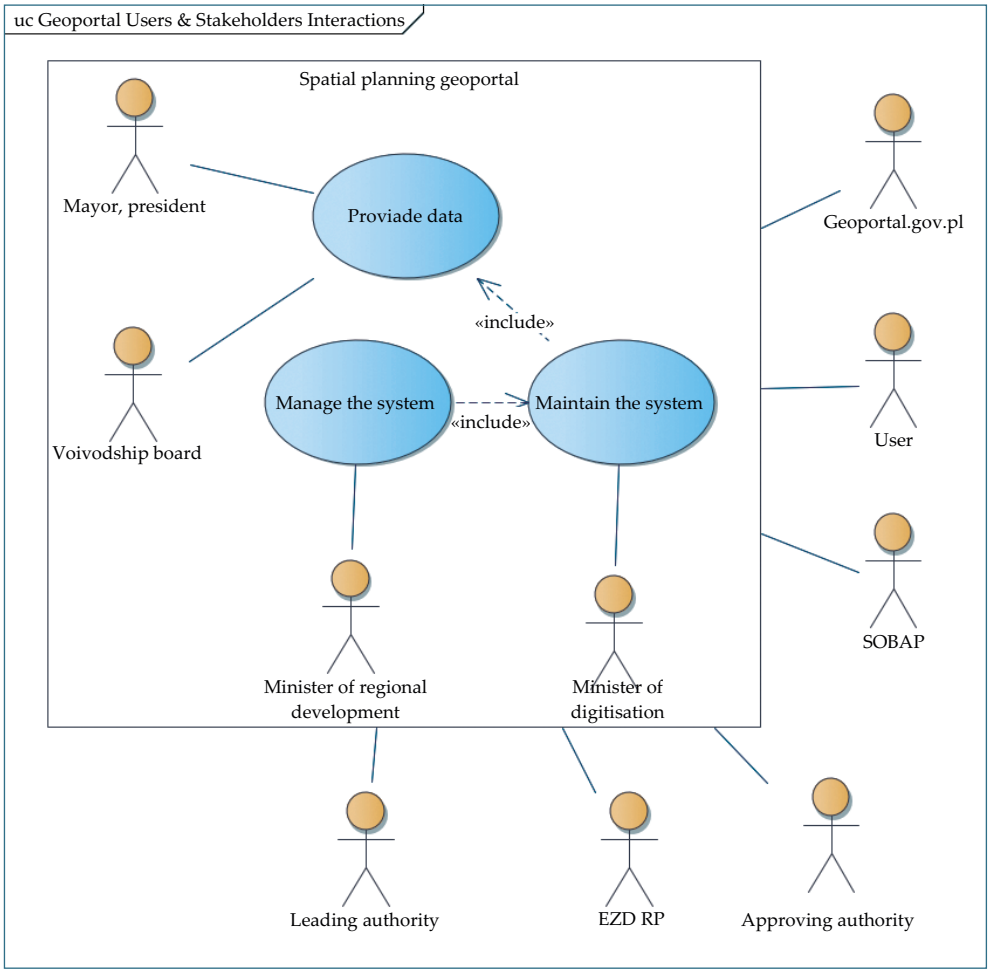

Fig. 4. Users and stakeholders of the spatial planning geoportal

On the right side of the graph, it is shown that an "ordinary" user will also be able to read the data and information of interest via the national geoportal – geoportal.gov.pl. From the perspective of the investment and construction process, each applicant will be sure that the SOPAB (System for Handling Administrative Procedures in Construction – in Polish: System do Obsługi Postępowań Administracyjnych w Budownictwie) planned right now at the General Office of Building Control will be associated with spatial planning data. Considerable participation of the approving and consulting authorities (within the meaning of the Act on planning

and spatial development) and leading authorities (within the meaning of the Act on spatial information infrastructure) is also expected. It is also assumed that the needs and interactions between other systems will be taken into account, one of which is the Electronic Document Management (in Polish: elektroniczne zarządzanie dokumentacją, EZD RP), which will be a free and universal system for electronic documentation management.

Functions and features selections of the pilot version

It is crucial to make the right choice concerning the scope and subject of the pilot version. Due to the ongoing reform of the spatial planning system, it was decided not to rely on the study of spatial development conditions and directions, since there are plans to remove this internal management act from the system. On the other hand, the schedule of work on amending the Act on planning and spatial development does not allow us to focus on the new document – the general plan of the municipality. This plan will only be based on spatial data, but their scope may be slightly changed in the course of legislative work. Given the above, the obvious choice was a sub-local document – the local spatial development plan. When it comes to the technological aspect, efforts were made to ensure that the pilot version is not only based on creation, but also on updating and sharing of data.

General overview

The development of the pilot version of the spatial planning geoportal for local spatial development plans is the first task. The geoportal should allow for manual filling as well as loading data in a form of GML files. It should also be possible to create geometry of spatial data in the platform, but until then "drawing" can be done in external programs only, such as the free to use QGIS for example.

In order to facilitate the gradual transition between the plug-in and the final version of the geoportal, the assumption was made to refer to the application (APP) plug-in appearance, although significant simplifications were introduced. First of all, the division into successive steps was taken into account, the most important of which concerns the description of the act and the option of adding spatial data. Additionally, after logging in, the system will know with which user the entered scope of spatial data should be associated, so there should be no problems with identification and association. A significant change will be the systematisation of "documents" related to the act of spatial planning. The documents are planned to be displayed on a timeline and the step of the procedure is to be denoted for better readability. For example, residents often do not know the difference between the application (before the project is developed) and comments (after the project is created). The final step, after entering all information and data, will be the final preview and verification.

From the standpoint of potential users, it is important to be able to easily read the content that is currently "hidden" in the GML file. People who do not have specialist knowledge have difficulty familiarising themselves with the attributes, as well as with reading and possibly verifying the boundary or raster files. The launch of

the platform will also enable the development of tools for drawing the boundaries of new planning acts at the stage of design data. The goal is to make the map window available in the browser with the possibility of dragging any polygon, line or point objects to selected points.

In the case of using the APP plug, the problem of ensuring the uniqueness and continuity of markings was raised several times. The Urban Register, without the knowledge and the need to engage the user, will independently generate, for example, unique identifiers – this way, unnecessary information will not need to be entered.

An additional advantage is the possibility of creating a dedicated subpage, e.g. for local authorities, also with selected filters turned on.

District employees are also interested in the integration of the portal with a filling system (the so-called EZD RP being currently developed), which will enable the entire procedure to be carried out electronically. It will be possible to indicate activities that require actions by the user, e.g. refusal to agree upon, as well as keeping a calendar with notifications on important events. Additionally, it is possible to automatically generate lists of, for example, conclusions or comments. The local governments officials' work will also be simplified by the planned advanced reporting without additional participation of district authorities, in particular with regard to the lack of the need for cyclical filling in, for example, the PZP1 GUS form (simultaneous reduction of the costs of preparing data and increasing the quality of data is panned). There are also plans for extended validation and precise indication of errors, including the errors related to the geometry of vector objects or the quality of raster data.

Another group of developed functionalities is support for the printing and generation of files of selected format. As a result of actions taken, it is assumed that the requirement of making extracts and sketches will be ultimately dropped, but until these actions are finalised, this option will still be developed. The aim is to be able to generate documents similar to the current map extracts and sketches, with the possibility of specifying the area and a specific date (it is assumed that the share of the districts authorities in this respect will be gradually reduced and limited). Advanced printing settings with the ability to choose the size of the sheet or dynamic shifting of the map fragment is critical.

From the standpoint of residents or investors' expectations, the components of expanded social participation are also important.

The concept of the stages of spatial planning act creation supported by dedicated geoportal

Selected activities related directly or indirectly to digitisation with regard to the planning procedure are presented in Figure 5. The preparation of an intentional resolution, i.e. commencing the procedure, should be preceded by an analysis of the justification for joining the resolution and (possibly) drafting appropriate agreements. In the near future, the authors plan to initiate the publication of model agreements and precise guidelines on the ministry's website, which should help especially

those municipalities, which are not advanced in digitisation processes. Within the framework of these guidelines, the requirements resulting from the current legal regulations, but also e.g. technical specifications, are particularly important. Gathering all the requirements, written in accordance with the concept of the so called 'simple language', will contribute to the increase of the quality of elaborations, but it will also indicate precisely which obligations belong to self-governments and which to contractors (if such a form of work has been chosen by the self-government). The authors have highlighted the great role of a clear division of responsibilities in the field of digitisation. At the stage of adopting an intentional resolution, it is crucial to correctly prepare spatial data concerning the act's boundary. Once determined boundaries in vector form should not be changed without amending the intention resolution. At this stage of the procedure it is also worth verifying materials which will constitute the basis for further works on the project. The very preparation of the project should focus on calculating and verifying the parameters and indicators which the act sets. After completion of the creative work, the transfer of spatial data, which is simply recording the relevant layers, should take place. Also not without significance is the process of agreeing and issuing opinions on the project, which should assume full cooperation between the designers, local governments, and relevant authorities. In the current legal system, this activity is not described precisely. However, ultimately, within the framework of the spatial planning geoportal (Urban Register), all the key stages of drafting a spatial planning act will have to be added to the spatial planning geoportal (Urban Register), and the system will automatically provide spatial data with attributes, while generating the relevant services. The entire procedure will also be linked to an electronic document workflow system, which will make all cover letters and the history of the procedure easy to reproduce and analyse. The next step, which is included in the chart, is public participation. However, according to the author's assumptions, public participation will begin already at the moment of the citizen's declaration in the spatial planning geoportal (Urban Register) of his or her willingness to receive the selected scope (temporal, spatial and thematic). As a consequence, the project will be made widely available at the stage of public inspection. Automatic generation and visualisation of received comments will certainly be a great facilitation for local governments.

Seemingly, the final of the procedure is the enactment of the act, and thus the signing of the spatial data and the transfer of the whole to the supervisory authorities. Nevertheless, it is important for the smooth functioning of industries not only to make the act available, but also to inform users about the legal effects in an understandable way. In order to optimise the investment and construction process, it is necessary to increase the possibilities of efficient and trouble-free updating, which is the result of e.g. processes in administration courts, but also of automatic checking of data in terms of topology – creating a final, continuously updated, valid version. All these elements are important for issuing construction decisions or monitoring changes in spatial development.

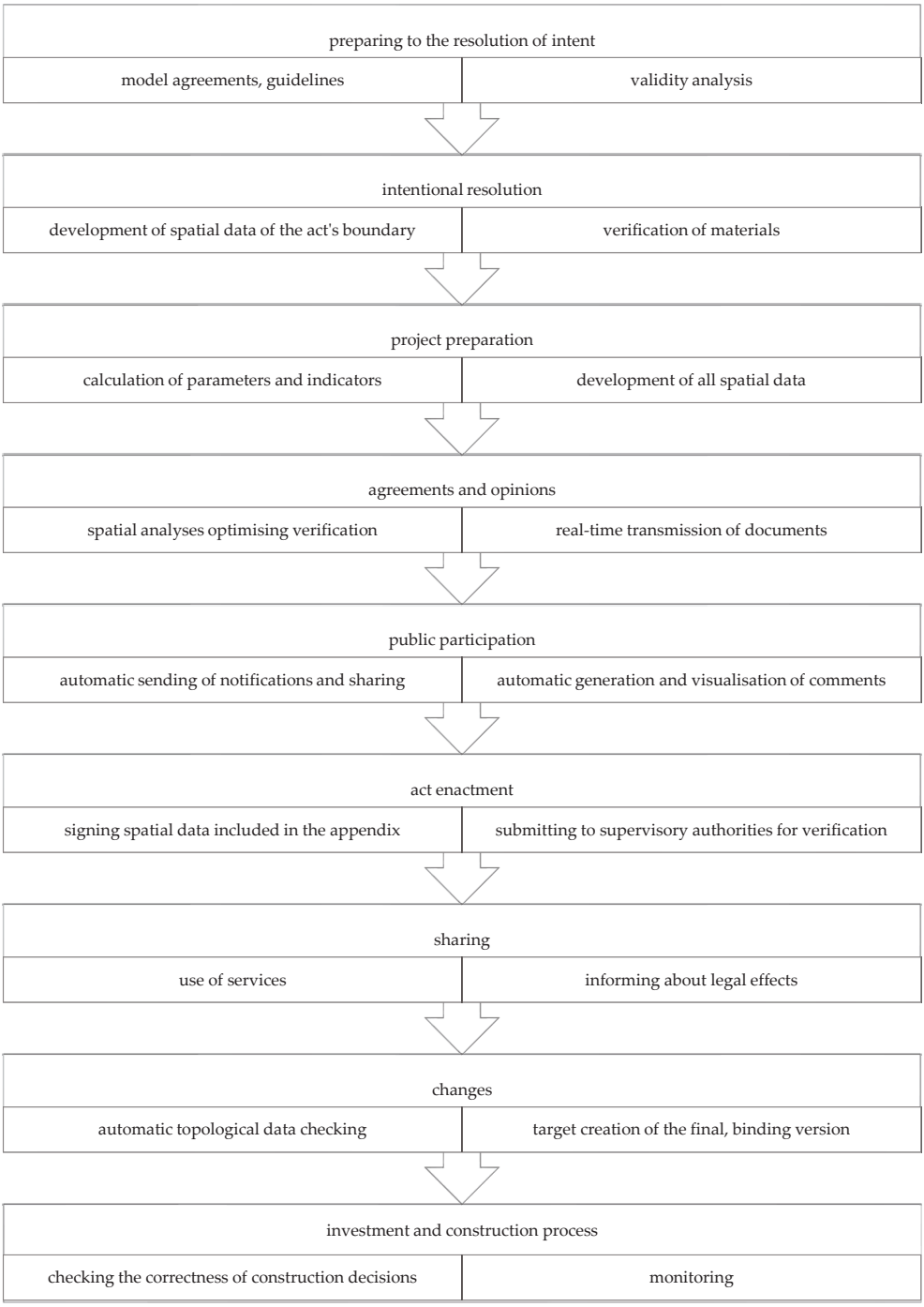

Fig. 5. Process of spatial planning act creation on the example of the local plan

3.3. Assumptions for the Pilot Version of the Spatial Planning Geoportal

It is assumed that the register of local plans is to be completed by filling in successive windows or by loading a single GML file or a set of spatial data including a GML file composed of many local plans (Fig. 6). The basic functionality involves logging changes, assigning version numbers and data archiving. The aim is to ensure that individual persons or entities will be able to use the portal, not only the local authorities' employees. Agreements of the Ministry of Economic Development and Technology will also be handled directly via the portal. In addition to supplementing the descriptive data, it will be possible to transfer a file with a border (GML or other file), as well as a raster file with georeference. After filling in all the required fields and adding the necessary files, a GML file will be generated and validated. The validation service will be gradually developed in order to include, for example, topological errors of spatial data already included in the portal maps. The generated file and spatial database will be made available to the Central Geodesy and Cartography Office for publication on the national geoportal – for example via WMS and WFS services. Searching and downloading functionalities are also planned to be implemented, both at the national geoportal level and the spatial planning portal level.

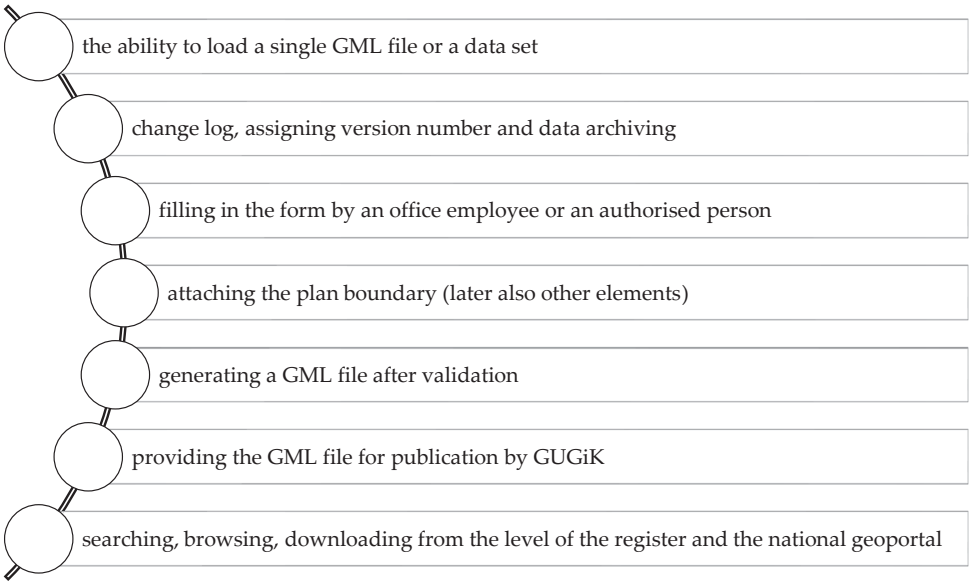

Fig. 6. Assumptions for the pilot version of the spatial planning geoportal

Figure 7 presents a selected example of a working view of the model, the final form of which will be developed under the cooperation of the Department of Spatial Planning of the Ministry of Economic Development and Technology and the

Chancellery of the Prime Minister. The graphic shows how to add a description of the local plan, along with the steps shown at the top of the screen in the form of an axis.

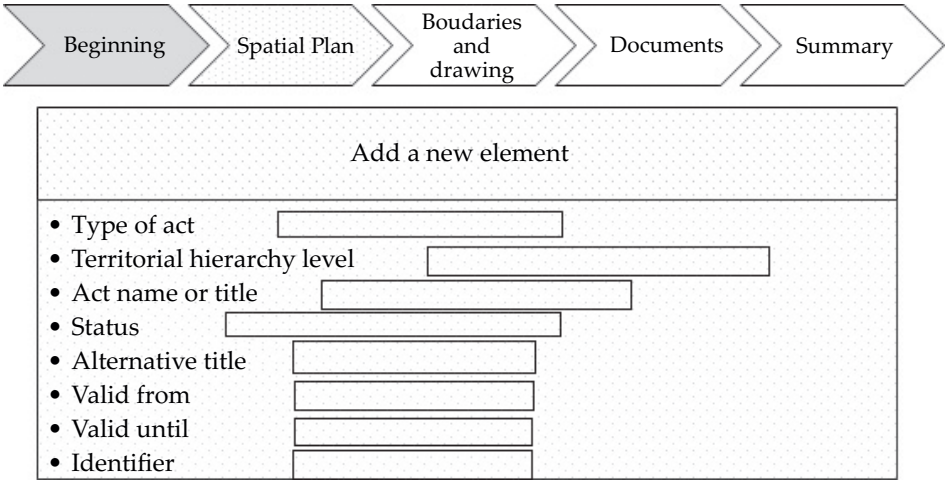

Fig. 7. Example of the GUI: adding a description of the local plan (the model was developed in cooperation with the Ministry of Economic Development and Technology and the Chancellery of the Prime Minister)

4. Discussion

The establishment of the spatial planning geoportal may contribute to increasing the efficiency and quality of the spatial planning system in Poland, as well as other areas, such as management of local government units, local and regional transport and regional planning.

For users and institutions involved in the infrastructure of spatial information in Poland, it is important to promote various methods of data exchange, and instead of WMS, to promote, for example, WFS, which enables independent analyses.

Even the pilot version can support multiple activities of local government units. The municipalities incorporated into the pilot project will be able to arrange in its course both the spatial data and the set together with the describing metadata. A major difference can be discerned especially by the units that carry out most of the tasks related to managing the spatial information infrastructure independently. Collecting all spatial data, in particular those regarding the boundaries of local plans, will make it possible to appropriately prepare the analysis of the legitimacy of participation as well as the boundaries of subsequent resolutions of intent. It will also be important to be able to compare parameters and indicators in the spatial planning acts already in force. Furthermore, the option of adding spatial planning acts at an early stage of

the procedure might not only help optimize arrangements and opinions, but most of all social participation. Naturally, the other elements will also be much simpler: signing spatial data with an electronic signature, gathering planning documentation and finally sharing the spatial data.

The implemented and planned proposals discussed in this publication are particularly important in view of the need to standardise and normalise all the components of the digitisation of spatial planning.

When comparing Figures 3 and 4 it should be emphasized that the pilot solution supports only export data, view data, create new data and import data on the example of local spatial development. The remaining elements will be added successively as the system is developed. However, before further development is done thanks to funding, it is important to analyze the current assumptions in 80 test municipalities.

As part of the work to prepare the training, it was assumed that it should start with the development of material which focused on the verification of the quality of spatial data as appendices to the resolutions in the already published local spatial development plans. The result of checking the files made it possible not only to verify some of the assumptions made earlier, but it was also an excellent material showing the most frequent mistakes made. For the needs of the meetings, a checklist for verification of GML files was also developed, taking into account both the validator and those actions which should be performed by the office employee on his/her own. The trainings started with a meeting with voivodeship supervisory bodies, which work to check local plans before publication. During this meeting, due to relatively small number of participants, there was a possibility to exchange views in a freeway. This comfort was not present during the organisation of the next webinar, which was attended by employees of municipalities and urban planners dealing with digitisation in the broad sense. At the meeting, which was attended by almost a thousand people, during the four-hour training, there was a simultaneous discussion on the so-called chat. It is worth emphasising that the discussion took place not only with the employees of the Ministry of Development and Technology, but also among the participants of the meeting. Frequently, the participants themselves answered questions, often surprising us with their high level of knowledge and the multitude of practical examples. The diverse level of skills was clearly evident during this meeting. It is worth noting that the COVID-19 pandemic, on the one hand, made it almost impossible to conduct training in a stationary form, on the other hand, it popularised remote forms of training.

Another extremely important aspect is the work on the final version of the "Spatial Planning" data specification. A draft of this document was prepared in cooperation with the contractor, while in addition the author organised a discussion with representatives of geoinformation companies, during which plans for the near and distant future were presented. In this way, companies were able to consider the proposed regulations in their organisational and business plans. During this meeting, the deadline for a second round of comments was also indicated.

Other non-legislative activities such as official recommendations, good practices and competitions are also in the pipeline.

All activities, whether legislative or non-legislative, aim to increase the quality of spatial planning data. By quality we mean a range of data characteristics that can influence subsequent operational or strategic decisions. The successive stages of digitisation are a significant development and detailing of previous intentions. Starting with the obligation to add pre-zonal data concerning the boundary to the resolution, through extension with other spatial objects, development of coherent and uniform symbolisation, to the development of assumptions for a new form of an extract and an extract (and ultimately resignation from the extract and an extract in favour of a public register). All these activities reflect the idea that, without the participation of an office employee, every citizen should be able to obtain precise data as automatically as possible, almost "on the spot". Work devoted to the proper creation of data, including spatial data, will mean that the work related to handling enquiries, requests, and phone calls should be eliminated (or significantly reduced).

In the perspective of the next few years, the role of land use monitoring in Poland is also expected to increase. However, before this objective can be achieved, the stage relating to the identification and classification of objects linked directly or indirectly to spatial planning must be completed. Apparently monitoring involves simple principles: comparing the existing state with the planned one. However, in the course of the work a number of problems are encountered, for example with the proper interpretation of the planning documents. And this is where properly planned digitisation of spatial planning is essential. A systemic approach to this issue will enable semi-automatic, and ultimately fully automatic analysis of changes in spatial development.

Two main objectives have been identified in the Polish spatial planning system: spatial order and sustainable development. The urban model of cities of the future is closely linked to the concept of sustainability which implies the capacity of the system to achieve the balance between consuming and regenerating resources connected to the growth of cities but also the capacity to pursue social and economic equity, while taking into account that citizens are active elements in the management and protection processes of their living environment [13]. The aim of the reform of the spatial planning system in Poland, awaited by many communities, is to actually protect spatial order and enable multidimensional development. However, this development has the potential to become sustainable if a compromise is reached between the objectives of different stakeholders. Digitalisation of spatial planning has ceased to be only a tool to achieve selected objectives, it is becoming a much broader concept, which co-creates and enables the implementation of many tasks, including those indicated in the 2003 Act. The author highlighted these issues (presenting details of the spatial planning system reform in Poland) at a press conference during which the Secretary of State in the Ministry of Development and Technology, Piotr Uściński, presented the main assumptions of the reform. The meeting was organised

immediately prior to the start of official public consultations, on 24 March 2022 in Warsaw. Providing the public with the broadest possible information is of particular importance, also in the context of popularising further digitisation of spatial planning.

The implemented and planned proposals discussed in this publication are particularly important in view of the need to standardise and normalise all the components of the digitisation of spatial planning. The entire process seems to be like a system of communicating vessels, in which even one activity carried out in a wrong way can become a cause of problems for the whole. The activities selected in the article are focused on an established timetable, the smooth implementation of which allows to successively close subsequent issues and focus on the next ones. The relevance of these actions is multidimensional, as was exemplified by the reading of the reports submitted during the three broad pre-consultations. Due to both the possible volume of the article and the specificity of work in public administration, the author decided to describe only selected activities.

Apart from the author's activities in the ministry since June 2021, it is worth noting the elements which are a continuation of the adopted assumptions. Particularly noteworthy is the significantly modified idea of the Urban Register and the Register of Additional Regulations. The next publication of the author will certainly deal with detailed solutions of the Urban Register taking into account specific activities related to the pilot scheme. In further research works, the author will continue and develop the topic of digitisation, starting with the determination of arrangements resulting from the municipality's planning authority, unification of the textual part of spatial planning acts, and in the further perspective, automatic generation of resolutions (based on templates and attributes specified in spatial data).

The proposed geoportal may contribute to the improvement of the efficiency of spatial planning, as in the case of other geoinformation portals used by spatial planners [7].

The proposed spatial planning geoportal offers a functionality for the integration of planning data with data from other sources, and also their analysis and processing. An important role in data analysis for the purposes of planning processes is played by reference data, in particular geodetic and cartographic data collected in various databases kept in ICT systems (e.g. the Integrated Real Estate Information System) and integrated at the main access point for the spatial information infrastructure (geoportal.gov.pl), among others. The technical standards described in this paper are to be the basis for implementing the spatial planning geoportal and are sufficient to meet [48] the interoperability requirements.

On the one hand, the spatial planning geoportal allows users to create and update specialist spatial data in connection with spatial planning, but on the other, it is also closely related to the conducted procedure and the reinforcement of the information society's role through extensive social participation. Undoubtedly, all spatial planning data sets may ultimately enrich other systems, for example Integrated Real

Estate Information System (in Polish: Zintegrowany System Informacji o Nieruchomościach – ZSiN). In accordance with the idea of interoperability [48], one of the main goals is not to copy solutions at any level, in particular at the national level, but to integrate data.

The geoportal proposed in this publication can be implemented thanks to the earlier stages of spatial planning digitization, which were accompanied by legislative changes. The implementation of assumptions regarding the spatial planning digitization was divided into stages, while using all the possibilities related to legislative changes [44]. Regardless of the work on the spatial planning reform, it was necessary to amend the regulation, including those concerning draft local plans and the possibility of creating a new regulation on a nationally uniform application form for establishing the location of a public-purpose investment project or development [49]. A coherent classification of land use in the first regulation, obligatory for planners, and standardization of the form in terms of investment parameters are in a way the grounds for the following steps that bring the planning data model closer to the spatial data model [37, 41].

The introduction of all changes at the same time, as part of the system reform, could lead to a radical inhibition of the ongoing procedures or the initiation of new procedures for the preparation of spatial planning acts. The entry into force of these two regulations [47, 48] in 2021/2022 enabled a gradual transition to the next stage of spatial planning digitization. The next step towards a fully digital local plan planned for 2025 will rely on the above-mentioned classification and parameters. In this way, the model will be considerably expanded, including another type of object, spatial attributes (geometry), descriptive attributes and relations between other types of objects. The attributes describing the purpose of the area will be closely connected to such planning parameters as the density, height or share of biologically active area.

The solutions proposed in this publication tackle the problems identified in other scientific studies. Śleszyński [50] repeatedly emphasizes the need to begin monitoring of changes in spatial development, in particular changes in land use. However, in order to monitor changes, it is first necessary to standardize the model of data on the planned spatial development, so as to try to map it to the existing spatial development and to propose relevant technological solutions in this respect. The proposed element of urban platform (the spatial planning geoportal) will also be ultimately implemented in the platform, and its prototype is presented in this paper – component for automatic monitoring of changes.

On the other hand, Izdebski and Malinowski [18] have identified the following basic problems related to the computerization of spatial development plans: the current condition of legal regulations, the discrepancy between a plan drawing and the current state of the data in land and building records, the differences in the scales of individual plans within the same unit, and the lack of uniform planning standards, including the symbols and rules for creating map. The data integration module proposed in this paper, implemented by such use cases (Fig. 3) Data import, including

reference data import, and Data analysis as well as the presented description of standards, will bring a practical solution to the problems in connection with the computerization of spatial planning. A major issue is still the preparation and then introduction of the relevant provisions on the geoportal on the idea of the spatial planning geoportal presented in this paper.

5. Conclusions

The aim of this paper was to present a proposal for a spatial planning geoportal intended to be a solution used for the creation, analysis and presentation of spatial data related to spatial planning (spatial database). The concept includes a formal description of the geoportal functionalities using UML as well as the perspective of solution users and stakeholders. This paper also shows the functionality of the pilot version of the geoportal, which refers to spatial planning at the local level and local spatial development plans.

The spatial planning geoportal presented in this paper adheres to the proposed reforms of spatial planning and is intended to help in conducting spatial policy, both at the local and central level. The web portal will also enable the management of thematic data necessary in the process of spatial planning. In the spatial planning reform, it is assumed that the new planning document, i.e. the general local spatial development plan of the district, will contain an annex only in the form of spatial data including: planning zones, building supplementation area, city centre development areas and the range of standards' applications. The main part of this resource will be broadly understood environmental data.

The geoportal concept presented in this paper and its pilot version implemented by the Ministry of Economic Development and Technology are the next stage in the process of spatial planning digitization in Poland, which is to streamline the planning processes, among others things. The literature so far has identified problem areas related to spatial policy, also at the local level, for which the formulated proposals were primarily legislative solutions. The concepts described herein are proposals for geoinformation technology-based solutions to these problem issues. The technological aspects of spatial planning digitization discussed so far have applied mainly to the publication of local spatial development plans in digital form. From the perspective of the solution proposed in this paper, it is one of the functionalities of the geoportal, which is assumed to be a point integrating not only local plans, but also data and information on planning documents, including resolutions, decisions, applications and diagnoses of all levels of spatial planning in Poland. The proposed geoportal is to be a tool supporting the development of spatial policy and improving the planning processes.

The geoportal functionality can be expanded. A separate, but important component of the spatial planning geoportal may become the Register of Additional

Regulations, which will constitute a register related to the registers of planning acts, containing only data resulting from separate provisions. A practical example can be the need to identify e.g. a protection zone of a water reservoir, apart from the border of the protected landscape area. However, the creation of such a component requires the cooperation of many, often independent institutions, a factor which may significantly extend its implementation.

At the planning stage, there are still components related to the generation of resolutions and decisions based on the spatial data added (including those based on the planning arrangements or the register of additional regulations). One of the developmental elements is also the assumed possibility of making spatial analyses adapted to the new spatial planning system. One of the components primarily desired by the urban planners is the real support of calculations, e.g. development area capacity. One of them could be to monitor spatial absorbency assessment which is still a new element in Polish land management practice. Due to the existing regulations, municipalities can realize this obligation in different ways, without really supporting their decisions in the land development process [12].

Separate consideration should be given with regard to how to proceed in the case of institutions that are not able to create and share spatial data on their own. In this case, substantive and technical support should be provided.

To guarantee the highest quality of spatial data, it is worth considering the possibility of reporting errors by stakeholders, including identifying the specific location of the error. At present, it is the author of the planning act that is responsible for obtaining and properly labelling data held by many different institutions. Even if it is possible to use the portal, in the event of an error, it is usually corrected directly in the draft of the planning act and relatively rarely in the original data. Adequate procedures must be introduced to ensure higher level of consistency. This is important in the case of a significant increase in the importance and role of spatial data services, assumed in the reform of the spatial planning system. The project assumes the necessity to use the geometry of spatial data made available in collections through web services.

Implementing the geoportal and making full use of its capabilities will require the introduction of the obligation to create spatial data in a way which forces municipalities or urban planners (who have often not used spatial information systems before) to acquire knowledge and skills in geoinformation and GIS software. According to the legal status in March 2022, spatial data on spatial development shall include, in addition to the spatial location of the area covered by the act in vector form, attributes containing information about the act and the graphic part of the act in digital representation form with assigned georeferencing. All data must be in a valid state spatial reference system. The introduction of the obligation to create spatial data, in a way, forced municipalities or urban planners (who often did not use widely understood spatial information systems before) to acquire knowledge and skills in geoinformation and GIS software.

Author Contributions

Author 1: conceptualization, formal analysis, investigation, writing – original draft preparation.

Author 2: writing – review and editing, supervision validation, supervision.

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References

[1] Kaczmarek I., Iwaniak A., Świetlicka A., Piwowarczyk M., Nadolny A.: *A machine learning approach for integration of spatial development plans based on natural language processing*. Sustainable Cities and Society, vol. 76, 2022, 103479. https://doi.org/10.1016/j.scs.2021.103479.

[2] Venter Z.S., Barton D.N., Martinez-Izquierdo L., Langemeyer J., Baró F., McPearson T.: *Interactive spatial planning of urban green infrastructure – Retrofitting green roofs where ecosystem services are most needed in Oslo*. Ecosystem Services, vol. 50, 2021, 101314. https://doi.org/10.1016/j.ecoser.2021.101314.

[3] Grecea C., Herban S., Vilceanu C.-B.: *WebGIS Solution for urban planning strategies*. Procedia Engineering, vol. 161, 2016, pp. 1625–1630. https://doi.org/10.1016/j.proeng.2016.08.637.

[4] Badach J., Voordeckers D., Nyka L., Van Acker M.: *A framework for Air Quality management zones – useful GIS-based tool for urban planning: Case studies in Antwerp and Gdańsk*. Building and Environment, vol. 174, 2020, 106743. https://doi.org/10.1016/j.buildenv.2020.106743.

[5] Vișan M.: *Spatial and territorial development planning: digital challenge and reinvention using a multi-disciplinary approach to support collaborative work*. Procedia Computer Science, vol. 162, 2019, pp. 795–802. https://doi.org/10.1016/j.procs.2019.12.052.

[6] Carsjens G.J., Ligtenberg A.: *A GIS-based support tool for sustainable spatial planning in metropolitan areas*. Landscape and Urban Planning, vol. 80(1–2), 2006, pp. 72–83. https://doi.org/10.1016/j.landurbplan.2006.06.004.

[7] Zwirowicz-Rutkowska A., Michalik A.: *The use of spatial data infrastructure in environmental management: an example from the spatial planning practice*

in Poland. Environmental Management, vol. 58, 2016, pp. 619–635. https://doi.org/10.1007/s00267-016-0732-0.

[8] ul Hussnaina M.Q., Waheed A., Anjum G.A., Naeem M.A., Hussain E., Wakil K., Pettit Ch.J.: *A framework to bridge digital planning tools' utilization gap in peri-urban spatial planning; lessons from Pakistan*. Computers, Environment and Urban Systems, vol. 80, 2020, 101451. https://doi.org/10.1016/j.compenvurbsys.2019.101451.

[9] Hersperger A.M., Thurnheer-Wittenwiler C., Tobias S., Folvig S., Fertner Ch.: *Digitalization in land-use planning: effects of digital plan data on efficiently, transparency and innovation*. European Planning Studies, vol. 30(12), pp. 2537–2553, 2021. https://doi.org/10.1080/09654313.2021.2016640.

[10] Anaafo D., Takyi S.A.: *Spatial planning in the digital age: the role of emerging technologies in democratising participation in spatial planning in Ghana*. International Planning Studies, vol. 26(2), 2020, pp. 117–129. https://doi.org/10.1080/13563475.2020.1752159.

[11] Ghavami S.M., Taleai M., Arentze T.: *An intelligent web-based spatial group decision support system to investigate the role of the opponents' modeling in urban land use planning*. Land Use Policy, vol. 120, 2022, 106256. https://doi.org/10.1016/j.landusepol.2022.106256.

[12] Olszewski R., Wendland A.: *Digital Agora – Knowledge acquisition from spatial databases, geoinformation society VGI and social media data.* Land Use Policy, vol. 109, 2021, 105614. https://doi.org/10.1016/j.landusepol.2021.105614.

[13] Potts R.: *Is a new 'Planning 3.0' paradigm emerging? Exploring the relationship between digital technologies and planning theory and practice*. Planning Theory & Practice, vol. 21(2), 2020, pp. 272–289. https://doi.org/10.1080/14649357.2020.1748699.

[14] Boland P., Durrant A., McHenry J., McKay S., Wilson A.: *A 'planning revolution' or an 'attack on planning' in England: digitization, digitalization, and democratization*. International Planning Studies, vol. 27(2), 2021, pp. 155–172. https://doi.org/10.1080/13563475.2021.1979942.

[15] Devlin C., Coaffee J.: *Planning and technological innovation: the governance challenges faced by English local authorities in adopting planning technologies*. International Journal of Urban Sciences, 2021. https://doi.org/10.1080/12265934.2021.1997632.

[16] Voss A., Roeder S., Märker O.: *Optimizing cooperation in spatial planning for eGovernment*. [in:] Wimmer M.A. (ed.), *Knowledge management in electronic government*, Lecture Notes in Computer Science, vol. 3035, Springer, Berlin, Heidelberg 2003, pp. 239–249. https://doi.org/10.1007/3-540-44836-5_25.

[17] Izdebski W., Michalik A., Zwirowicz-Rutkowska A., Malinowski Z.: *Wybrane aspekty opracowania miejscowych planów zagospodarowania przestrzennego w postaci wektorowej*. Roczniki Geomatyki, t. 18, z. 2(89), 2020, pp. 141–150.

[18] Izdebski W., Malinowski Z.: *Podstawowe problemy związane z informatyzacją planów zagospodarowania przestrzennego*. [in:] Maciejewska A. (red.), *Współczesne uwarunkowania gospodarowania przestrzenią – szanse i zagrożenia dla zrównoważonego rozwoju: organizacja gospodarowania przestrzenią*, Monografie Naukowe – Wydział Geodezji i Kartografii Politechniki Warszawskiej. Gospodarka Przestrzenna, t. 5, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 2004, pp. 199–212.

[19] Korpetta D.: *Zastosowanie technik geomatyki w planowaniu i zagospodarowaniu przestrzennym*. Wiadomości / Izba Projektowania Budowlanego, nr 12, 2004, pp. 10–12.

[20] Ogrodnik K.: *Możliwość zastosowania analizy wielokryterialnej do diagnozy procesu planowania przestrzennego na poziomie lokalnym: przykład teoretyczny*. Architecturae et Artibus, t. 7(1), 2015, pp. 44–52.

[21] Bazan-Krzywoszańska A.: *GIS technology as a tool for protecting landscape and cultural values in spatial planning*. Structure and Environment, vol. 10(2), 2018, pp. 129–137. https://doi.org/10.30540/sae-2018-013.

[22] Michalik A.: *GIS w pracy urbanisty – konieczność czy szansa?* Roczniki Geomatyki, t. 16, z. 2(81), 2018, pp. 131–140.

[23] Głowacka A., Pluta M.: *The application of GIS in spatial planning*. Geomatics, Landmanagement and Landscape, no. 3, 2016, pp. 49–56. https://doi.org/10.15576/GLL/2016.3.49.

[24] Michalik A., Załuski D., Zwirowicz-Rutkowska A.: *Rozważania nad intensywnością zabudowy w kontekście praktyki urbanistycznej oraz potencjału technologii GIS*. Roczniki Geomatyki, t. 13, z. 2(68), 2015, pp. 133–145.

[25] Juchniewicz-Piotrowska K.: *Wykorzystanie systemu informacji przestrzennej do ulepszenia miejscowego planowania przestrzennego.* Materiały Budowlane, t. 11(495), 2013, pp. 62–64.

[26] Hanzl M.: *Wykorzystanie oprogramowania arcview GIS 8.3 dla nauczania rysunku planistycznego na kierunku gospodarka przestrzenna w Uniwersytecie Łódzkim*. Roczniki Geomatyki, t. 2(3), 2004, pp. 83–88.

[27] Hanzl M.: *Technologie informacyjne jako narzędzie udziału społecznego w kształtowaniu przestrzeni*. Roczniki Geomatyki, t. 6(3), 2008, pp. 87–99.

[28] Bąkowska-Waldmann E., Kaczmarek T.: *The use of PPGIS: Towards reaching a meaningful public participation in spatial planning.* ISPRS International Journal of Geo-Information, vol. 10(9), 2021, 581. https://doi.org/10.3390/ijgi10090581.

[29] Jaroszewicz J., Kowalski P.: *Requirements for a website supporting social participation in spatial planning at the commune level*. [in:] *Informatics, Geoinformatics and Remote Sensing. Conference Proceedings V. III, Photogrammetry and Remote Sensing, Cartography and GIS*, International Multidisciplinary Scientific GeoConference & EXPO SGEM, vol. 3, International Multidisciplinary Scientific GeoConference SGEM 2014, pp. 815–821.

[30] Glanowska M., Hanus P.: *Możliwości wykorzystania geoportali w planowaniu przestrzennym*. Infrastruktura i Ekologia Terenów Wiejskich, nr 2(1), 2016, pp. 457–471. https://doi.org/10.14597/infraeco.2016.2.1.032.

[31] Michalik A., Zwirowicz-Rutkowska A., Wojtkiewicz A.: *Problematyka przeciwdziałania zanieczyszczeniom powietrza w pracach projektowych urbanistów i architektów w kontekście wykorzystania infrastruktur i systemów informacji przestrzennej*. Acta Scientiarum Polonorum. Administratio Locorum, vol. 16(4), 2017, pp. 263–275.

[32] Jaroszewicz J., Parzyński Z.: *Informacja referencyjna dla planów zagospodarowania przestrzennego w systemach geoinfomacyjnych* [sic!]. Roczniki Geomatyki, t. 14, z. 3(73), 2016, pp. 331–342.

[33] Kurnatowski M.: *Local spatial information systems as tools for spatial planning and urbanization.* Przestrzeń i Forma, nr 27, 2016, pp. 141–156. https://doi.org/10.21005/pif.2016.27.C-07.

[34] Salata T., Prus B., Gawroński K.: *Ocena rozwiązań planistycznych z wykorzystaniem przestrzennych baz danych w aspekcie skalowalności rozwoju zabudowy*. Czasopismo Inżynierii Lądowej, Środowiska i Architektury, t. 33, z. 63(3/16), 2016, pp. 399–411. https://doi.org/10.7862/rb.2016.223.

[35] Dzikowska T., Nowak R.: *Założenia integracji baz danych ewidencji gruntów i budynków oraz rejestru planów miejscowych dla gminy*, Archiwum Fotogrametrii, Kartografii i Teledetekcji, vol. 19, 2009, pp. 81–89.

[36] Kowalczyk A., Kowalczyk K.: *Dane w planowaniu przestrzennym.* Acta Scientiarum Polonorum. Geodesia et Descriptio Terrarum, vol. 7(2), 2008, pp. 49–55.

[37] Hycner R., Maślanka J.: *Plan zagospodarowania przestrzennego jako podstawa lokalnego systemu informacji o terenie*. Geomatics and Environmental Engineering, vol. 1(2), 2007, pp. 31–43.

[38] *Ustawa z dnia 4 marca 2010 r. o infrastrukturze informacji przestrzennej*. Tekst jednolity: Dz.U. 2021 poz. 214 [*Act of 4 March 2010 on spatial information infrastructure*. Conspolidated text: Journal of Laws of 2021, item 214].

[39] Izdebski W., Malinowski Z.: *Analiza wpływu ustawy o infrastrukturze informacji przestrzennej na proces tworzenia włączania do infrastruktury informacji przestrzennej miejscowych planów zagospodarowania przestrzennego*. Zeszyty Naukowe Uniwersytetu Zielonogórskiego. Inżynieria Środowiska, nr 165(45), 2017, pp. 76–85.

[40] Jaroszewicz J., Piotrowska L.: *Implementation of the inspire directive in Poland in the scope of spatial data 'land use' theme*. Geomatics, Landmanagement and Landscape, no. 4, 2016, pp. 125–157. https://doi.org/10.15576/GLL/2016.4.125.

[41] Jaroszewicz J., Kowalski P., Głażewski A.: *Plany zagospodarowania przestrzennego w systemie geoinformacyjnym – INSPIRE i co dalej?* Roczniki Geomatyki, t. 14, z. 3(73), 2016, pp. 319–330.

[42] Jaroszewicz J., Denis M., Zwirowicz-Rutkowska A.: *Koncepcja katalogu obiektów planistycznych zagospodarowania przestrzennego*. Roczniki Geomatyki, t. 11, z. 1(58), 2013, pp. 85–95.
[43] Michalik A.*: Selected aspect of the digitization of spatial planning in the context of legislative changes in Poland*. Acta Scientiarum Polonorum. Architectura, z. 21(2) 2022, pp. 63–73. https://doi.org/10.22630/ASPA.2022.21.2.15.
[44] Jaszkiewicz A.: *Inżynieria oprogramowania*. Helion, Gliwice 1997.
[45] OMG: *Unified Modeling Language, version 2.5.1*, 2017.
[46] *Ustawa z dnia 27 marca 2003 r. o planowaniu i zagospodarowaniu przestrzennym*. Dz.U. 2003 nr 80, poz. 717 [*Act of 27 March 2003 on planning and spatial development*. Journal of Laws of 2003 no. 80, item 717].
[47] *Ustawa z dnia 17 września 2021 r. o zmianie ustawy – Prawo budowlane oraz ustawy o planowaniu i zagospodarowaniu przestrzennym*. Dz.U. 2021 poz. 1986 [*Act of 17 September 2021 on amending the Act – Construction Law and the Act on planning and spatial development*. Journal of Laws of 2021 item 1986].
[48] *Rozporządzenie Rady Ministrów z dnia 12 kwietnia 2012 r. w sprawie Krajowych Ram Interoperacyjności, minimalnych wymagań dla rejestrów publicznych i wymiany informacji w postaci elektronicznej oraz minimalnych wymagań dla systemów teleinformatycznych*. Dz.U. 2012 poz. 526, tekst jednolity: Dz.U. 2017 poz. 2247 [*Regulation of the Council of Ministers of 12 April 2012 on the National Interoperability Framework, minimum requirements for public registers and electronic information exchange as well as minimum requirements for ICT systems*. Journal of Laws of 2012, item 526, consolidated text: Journal of Laws of 2017, item 2247].
[49] *Rozporządzenie Ministra Rozwoju i Technologii z dnia 20 grudnia 2021 r. w sprawie określenia wzoru formularza wniosku o ustalenie lokalizacji inwestycji celu publicznego albo warunków zabudowy*. Dz.U. 2021 poz. 2462 [*Regulation of the Minister of Development and Technology of 20 December 2021 on specifying the application form for establishing the location of a public-purpose investment project or development conditions*. Journal of Laws of 2021 item 2462].
[50] Śleszyński P.: *Błędy polskiej polityki przestrzennej i krajobrazowej oraz propozycje ich naprawy*. Problemy Ekologii Krajobrazu, t. 40, 2015, pp. 27–44.