

Methodology of the Turkey's National Geographic Information System Integration Project

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Abstract—With its spatial data reliability, interpretation and questioning capabilities, Geographical Information Systems make significant contributions to scientists, planners and practitioners. Geographic information systems have received great attention in today's digital world, growing rapidly, and increasing the efficiency of use. Access to and use of current and accurate geographical data, which are the most important components of the Geographical Information System, has become a necessity rather than a need for sustainable and economic development. This project aims to enable sharing of data collected by public institutions and organizations on a web-based platform. Within the scope of the project, INSPIRE (Infrastructure for Spatial Information in the European Community) data specifications are considered as a road-map. In this context, Turkey's National Geographic Information System (TUCBS) Integration Project supports sharing spatial data within 61 pilot public institutions as complied with defined national standards. In this paper, which is prepared by the project team members in the TUCBS Integration Project, the technical process with a detailed methodology is explained. In this context, the main technical processes of the Project consist of Geographic Data Analysis, Geographic Data Harmonization (Standardization), Web Service Creation (WMS, WFS) and Metadata Creation-Publication. In this paper, the integration process carried out to provide the data produced by 61 institutions to be shared from the National Geographic Data Portal (GEOPORTAL), have been trying to be conveyed with a detailed methodology.

Keywords—Data specification, geoportal, GIS, INSPIRE, TUCBS, Turkey's National Geographic Information System.

I. INTRODUCTION

A. INSPIRE – An European Case

BY May 2007, INSPIRE Directive has been developed to allow public sector organizations to exchange environmental spatial information, promote public access to geographic data in Europe and assist in cross-border policymaking. This European Spatial Data Infrastructure covers 34 spatial data themes needed for environmental applications [2]. INSPIRE data themes are listed in 3 different groups, as Annex1, Annex2 and Annex3 depending on the

volume of demand priority for geospatial datasets. As established and operated by the Member States of the European Union, the Directive will be fully implemented by 2021 [1].

In order to access the data provided by EU Member States and several EFTA (European Free Trade Association) countries under the INSPIRE Directive, INSPIRE Geoportal is in service for;

- monitoring the availability of INSPIRE data sets
- discovering suitable data sets based on the metadata
- accessing the selected data sets through their view or download services

The metadata used in Geoportal are regularly harvested from the discovery services of EU Member States and EFTA countries [2].

B. The Role of NSDI

National Spatial Data Infrastructure (NSDI) consists of technology, policies, standards and human resources to acquire, process, store, distribute, and improve utilization of geospatial data. In new century, rapid development of the information technology has resulted pushing the high demand on accessing spatial data. As a result, geospatial information becomes pivotal to helping communities, companies and governments synthesize the information in a timely and efficient manner. The core role of NSDI here is based on partnerships or collaborations among different agencies, corporations, institutions, and levels of government. Given the complexities of identifying, gathering and incorporating spatial data, which also reflect significant financial investments by each sector, the NSDI is designed nationally as a way to make the development, collaboration and use of geospatial data more available to all levels of society and government to facilitate a broad range of decisions [3].

The NSDI created by the Office of Management and Budget Circular A-16 in the United States is an example of an existing SDI since 2002. At the European side, INSPIRE is a European Commission initiative to build a European SDI beyond national boundaries and ultimately the United Nations Spatial Data Infrastructure (UNSDI) will do the same for over 30 UN Funds, Programs, Specialized Agencies and member countries [3].

C. TUCBS - A Case of Evolving NSDI

TUCBS, named as Turkey's National Geographic Information System, represents the process of geospatial infrastructure transformation within Turkey. This process has been led by different government levels; however, by 2015, General Directorate of Geographic Information Systems under Ministry of Environment and Urbanization was officially

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assigned as the government entity responsible for establishing the National Geographic Information System.

TUCBS is an authority as a decision maker for the duties legally defined in Presidential Decree on Geographic Information Systems, such as strategy and implementation plan, spatial data standards, feasibility studies, coordination and interoperability. It took decades for Turkey to utilize the benefits of geospatial data broadly, however by 2019, spatial data themes of Turkey have been studied within the scope of TUCBS and geospatial data standards have been released aiming to promote servicing spatial data among government levels. Basically, INSPIRE Directive remains a guide for Turkey's geospatial data infrastructure as an EFTA country and provides a considerable contribution on deciding the spatial data themes and their specifications [4].

Within the scope of TUCBS, the sharing process of spatial data initiates with production of spatial data fulfilling the defined standards, continues with uploading metadata of spatial data on National Spatial Data Portal (Geoportal) and ends with access to metadata and view or download service information over Geoportal. Now, TUCBS is ready for providing mutual benefit on sharing spatial data through Geoportal [4].

Geoportal is a web-based platform and designed as a gate for reaching and sharing the national coverage of spatial data stored as metadata. There are two different levels of access to Geoportal, one is public access, the other is access through secured public network. The public sector entities are the members of a secured network and use this network to share and reach metadata and OGC service information of spatial data uploaded to Geoportal. It helps users search, view and download the metadata of any spatial data or dataset with a map interface. There is also harvest method in Geoportal enabling to update the metadata published by a catalogue service [4].

II. EVOLVING PROCESS OF TUCBS

A. Historical Background of TUCBS

The very first attempts to build a national geographic information system in Turkey started in the 1990s with the idea of designing a geodatabase for Turkey's spatial data. In this regard, the Geographic Information Systems Principles of Policy and Strategy document was prepared and establishing national data standards process started at the end of the 1990s.

In the 2000s, TUCBS studies started to continue in a more planned way, and it appeared in governmental reports as well. With the e-transformation process, in 2003, prior to a preliminary study done for the constitution of Turkey's National Geographic Information System published on Turkey's Short-Term Action Plan, action under No. 47 was released. This process was conducted by General Directorate of Land Registry and Cadastre; public institutions and organizations, municipalities, universities, and the private sector participated in the process as well [5].

Within the scope of the Turkey's e-transformation Project, in 2005, a new Action Plan promulgated. In this Plan, action

No.36 specified that the necessary preparations for establishing the TUCBS infrastructure would take place. Commissions for data standards, technical infrastructure, and administrative/legal infrastructure were built [6].

The INSPIRE (Infrastructure for Spatial Information in the European Community) Directives entered into force in 2007 and provided significant references and contributions to the TUCBS studies. The purpose of this directive defined as to ensure that any user in Europe has access to current spatial data in real-time. The implementation of this project took place between 2009 and 2017 [1].

In 2010, with the action number 75, the establishment of spatial data infrastructure, in other words, 'Establishment of TUCBS Infrastructure', was initiated under the responsibility of the General Directorate of Land Registry and Cadastre. Afterward, a year later, the Directorate General of Geographic Information Systems was established to carry out work towards establishing Turkey's geographic information system infrastructure by a different public institution. Following this, the National Geographic Data Portal (Geoportal) established in 2015, and the related regulation was published. This regulation stated that all responsible public institutions and municipalities have to share their related metadata within the next three years' period [7].

Responsibility for the establishment of the national geographic information system was defined among the duties of the Ministry of Environment and Urbanization. In the Presidential Decree No. 1 of 2018, this task was defined as: "To carry out and make works and procedures related to the establishment, use and development of the National Geographic Information System, to establish Information Systems for cities related to the activities of local administrations regarding planning, map, infrastructure and superstructure to support its use and integration with the National Geographic Information System." [8].

Finally, in 2019, Presidential Decree No. 49 on Geographical Information Systems was published. This decree aims to determine the production data themes which are under the responsibility of the institutions and to realize the data sharing according to the procedures and principles determined. TUCBS Integration studies will carry out at any time thereafter within the scope of this decree [8].

B. The Purpose of TUCBS

TUCBS aims to provide real time data sharing between public institutions and municipalities. The primary purposes are:

- As with INSPIRE, to construct a system based on storing the data locally,
- To establish a web portal for enabling public institutions and organizations to introduce spatial information they are responsible over common infrastructure,
- To ensure the establishment of data sharing standards to meet the needs of all user organizations of geographic data.

In this context, TUCBS Integration Project aims to provide integration with 31 public institutions and 30 metropolitan

municipalities. The project began with the analysis process and continued with the integration. In the analysis, all institutions were visited and their data existence and all the technical information about their data were searched. And in the second step integration process started according to given

the analysis period. The main objective of the project is to carry out all the necessary steps to ensure integration with TUCBS for the sample data sets given by the mentioned institutions and to explain the work done with visits to the institutions.

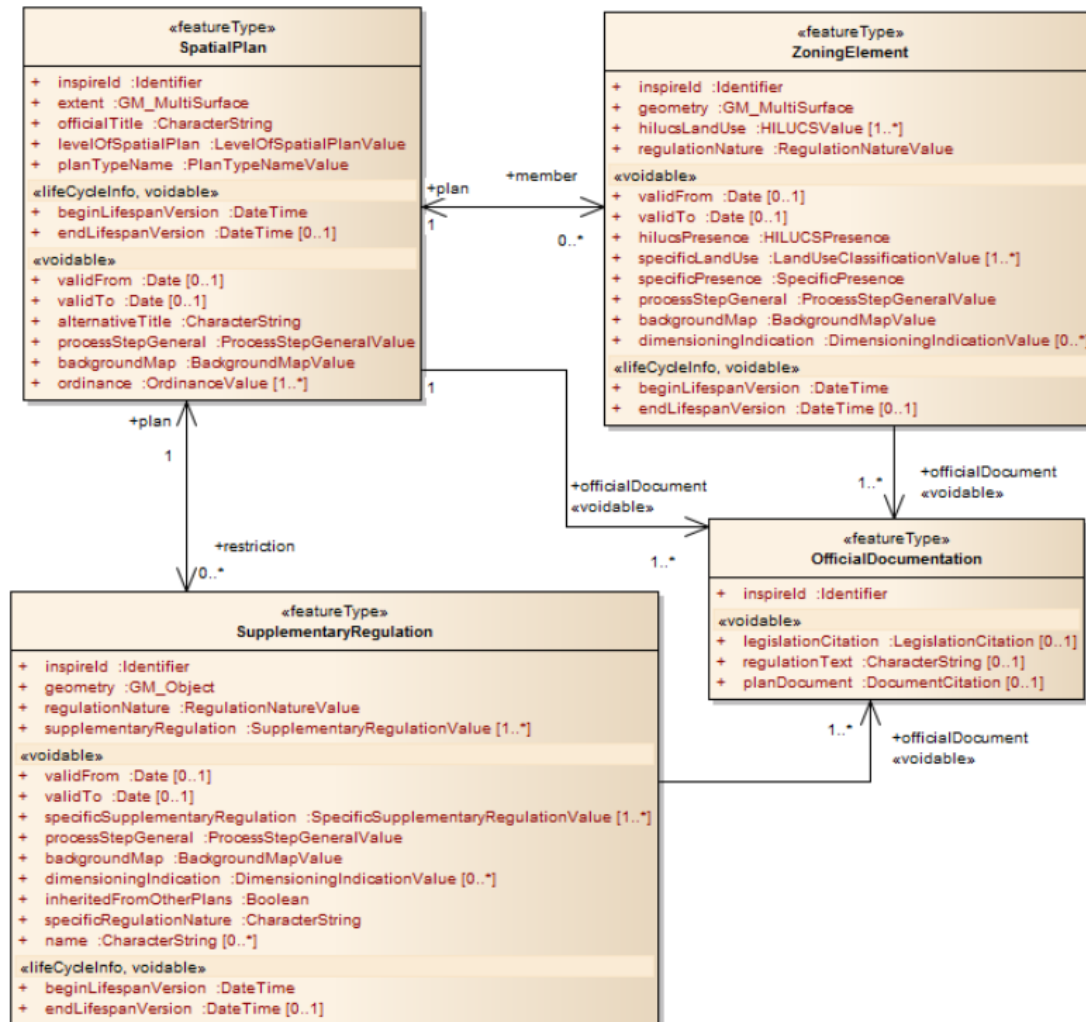


Fig. 1 Planned land use data specification [1]

In the following periods of the project, it is expected that the studies carried out within the scope of the project with sample data sets will be applied by the institution for all data considering sharing policy decided by the institution.

C. Data Sharing Standards

Within the scope of the defined responsibilities, the General Directorate of Geographic Information Systems has led all the necessary works related to the data themes. At the beginning of these activities, cooperation, and coordination with different institutions, organizations, and municipalities come first. In this regard, data sharing standards are generated as a conclusion of 'National Geographical Data Themes Working Groups,' which includes attendants from related public

institutions and municipalities. The necessary practice on determining data sharing standards started in 2012 including 12 main data themes for Turkey. Those themes are Coordinate Reference Systems, Administrative Units, Geographical Names, Cadastral Parcels, Buildings, Addresses, Elevation, Orthoimagery, Transport Networks, Hydrography, Geology, Land Cover. After the working groups' study in 2012, for renewing the related themes, in 2018, new working groups focused on the same themes. In 2019, in addition to 12 themes, 8 new themes are studied by related working groups: Land Use, Soil, Protected Sites, Natural Risk Zones, Utility and Governmental Services, Energy Resources, Mineral Resources, Human Health and Safety [8].

UML (Unified Modeling Language) and XSD (XML

schema definition) schemes were used in the system established for the determination of data sharing standards. Each theme contains feature types with geometry elements and data types with other features. These elements indicate which column structures should be present when serving the data produced, and which themes are interrelated to each other. In some cases, some of the specified column structures may contain values from code tables. In such cases, database designs should be made considering this situation. The related column is filled by selecting the appropriate value from the code table. For example, data specification for the Planned Land Use application scheme as consisting of four different feature types can be seen in Fig. 1. These feature types are Spatial Plan, Zoning Element, Supplementary Regulation, and Official Documentation. Four different feature types have a relation to each other, and they compose an application scheme together. The scheme shows that Spatial Plan and Official Documentation feature types are mandatory when sharing a land-use data. Besides, those elements have a relationship with other elements; Zoning Element and Supplementary Regulation. This UML Diagram shows us how to interpret a plan according to data standards defined by TUCBS. In this specific example:

- 'Spatial Plan' means the bounding geometry of the related land-use plan information,
- 'Zoning Element' means the land-use decisions made in plan (housing, commercial areas, open spaces),
- 'Supplementary Regulation' shows restricted areas with limited usage in the plan (protected sites, fault lines),
- 'Official Documentation' means plan documents and related reports about land-use decisions.

In addition to the UML diagrams, data definition documents were prepared separately for each theme and shared with all stakeholder institutions. These documents include the information about how to read UML diagrams and all info about themes (which layers are included in this theme, code lists of the feature types, different style information about layers).

D. Target Groups/Users

There are about 150 institutions producing geographic data in Turkey. Currently, the number of institutions included in the TUCBS Integration Project is 61. This is due to the fact that the project is referred as a pilot project and the dissemination will be realized in the future [8].

There are four main steps in the project process (Fig. 2). The first one is the production stage of spatial data. The institutions produce the data in the desired format according to the needs, but they are required to share in a standardized format according to TUCBS schemes. Secondly, web services and metadata are produced by data providers in defined standards. As third, the metadata is registered to Geoportal. In this way, users can query metadata via Geoportal to access the owner of the data, and web service information of the related data. In the fourth and final stage, users connected to the system utilize the metadata they query within the defined authorizations.

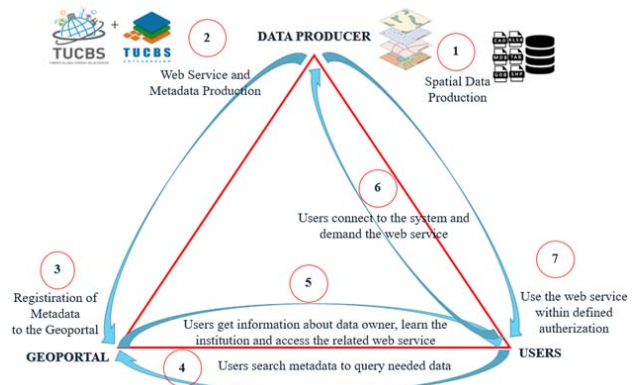


Fig. 2 Operation of TUCBS process [9]

III. METHODOLOGY OF THE PROJECT

In this chapter, the methodology of the TUCBS Integration Project will be examined in detail. First, spatial data analysis and data digitization will be discussed; conversions between different data formats will be explained. Second, the spatial data harmonization process step will be described. The use of UML and XSD schemes and the transformations performed in the database for harmonization operations will be summarized. In the subsection C, OGC Standards and web service publishing operations will be mentioned. Finally, the process of creating and publishing metadata will be explained in detail.

A. Spatial Data Analysis/Data Digitalization

Within the scope of the project, sample data in different formats were provided from various institutions. These formats are mostly; .SHP, .TIFF, .KML, .CSV, .XML, .LAS and .CAD. Data content and data structure were examined. The data were controlled topologically. Based on the data content, the theme and detail type were decided within the scope of the standards.

For the related data formats NetcadGIS (National CAD and GIS Production), QGIS, ArcGIS GIS Software Programs were used. Data were digitized and exported in a single database by providing a connection through the software.

As a database PostgreSQL was used to provide open-source database server in this project. Data received from data providers were transferred to the PostgreSQL and data were prepared for the harmonization process.

B. Spatial Data Harmonization

Determining standard sharing policies for data sourced by different institutions is the main factor regarding interoperability of institutions. Regardless of the nature of the data, nationally defined standards should be taken into account for data sharing. Therefore, one of the most fundamental steps in the integration part of the project is the data harmonization process step. In this context, the main objective is to share only harmonized data without interfering with the existing data structures of the institutions. In this context, the general operation is to export the data to the database complying with

the target schema structure through the views created in the database.

1) UML Diagrams & XSD Schemes

UML diagrams are the basic materials for understanding the data structures. By examining a UML diagram, we can understand the column structure of the data being produced, the values that are required to be present in the data, the fields that are voidable, the data types, if any, and the code tables (Fig. 1).

Like UML diagrams, XSD schemas are used to read the standard data structure. These schemes, which are output from UML diagrams, are generally structures that are interpreted by computers. A licensed software called 'Enterprise Architect' is used to create these diagrams. Themes are shown in a tree structure by this software. For more information, see the website where the UML diagrams are shared [14].

2) Data Harmonization in PostgreSQL

During INSPIRE studies, some programs (such as Hale Studio) were used for data transformation. In this study, on the contrary, the harmonization process was realized by using the features in PostgreSQL database without using any data conversion tool.

Spatial data harmonization process starts with the determination of the themes of spatial data within the context of TUCBS or INSPIRE. In the next step, the determination of required column structures and geometries according to UML diagrams are occurred. Afterwards, the transformation of the source schema (institutions' local data structure) to the target schema (defined data structure) conversion and creation of style files are realized [9].

In the harmonization process, as a reference, Turkey's National Geographic Information System Infrastructure Project, which was completed in 2018 and 2019, was taken into account. For 12 themes, TUCBS studies are used, and the rest of the themes are referenced from the INSPIRE directive [9].

Within the scope of the project, UML diagrams are determined by examining whether the data of the institution correspond to the TUCBS theme and detail types. Data which are not considered in the context of TUCBS themes, are examined in the context of INSPIRE theme and detail types.

```
CREATE OR REPLACE VIEW public."SpatialPlan" AS
SELECT plan.objectid AS "inspireid",
       plan.geometry AS extent,
       'Official Title of the Plan'::character varying(255) AS "officialTitle",
       'infra-local'::character varying(50) AS "levelOfSpatialPlan",
       'Plan Type Name'::character varying(50) AS "planTypeName",
       'Date and Time'::timestamp with time zone AS "beginLifespanVersion",
       'Validity Begin Time'::date AS "validFrom",
       'Validity End Time'::date AS "validTo",
       'Alternative Title of the Plan'::character varying(255) AS "alternativeTitle",
       'under elaboration'::character varying(255) AS "processStepGeneral",
       'Background Map Connection if Exists'::character varying(255) AS "backgroundMap",
       'Ordinance Value if Exists'::character varying(255) AS "ordinance"
FROM plan;
```

Fig. 3 Data Transformation in PostgreSQL

As can be seen in Fig. 3, a view creation script is given as above for the transformation of the data structure. The values in the cells on the left side indicate the column structure in the

source schema and the values on the right side show the column structure that the target schema has. As a result of running the script in the PostgreSQL database, a spatial data table conforming to the standards is created.

C. Publishing Web Service (WMS / WFS)

1) OGC and OGC Standards

OGC is an international service which cooperates in geographical studies and locations. OGC is an international consortium of industry comprising 521 companies, government agencies and universities involved in a consensus-based process for developing open interface standards [10].

Today, many institutions and commercial organizations work on the creation, sharing, distribution and use of geographical data. The data are shared with different production and distribution methods. In this context, OGC was established to set standards in all geographical data subjects.

OGC sets direct industry-oriented standards for geographic information sharing and interoperability across different software and hardware platforms.

The main recognized standard institution in the world is ISO, which is referred to as the International Organization for Standardization. ISO/TC 211 sets standards for digital data acquisition, processing, analysis, access and presentation of digital data among different users. The ISO/TC211 Geographical Information/Geomatics committee was established in 1994 with the support of the CEN/TC 287 Geographical Information committee of the European Standard Committee (Comité Européen des Normes).

ISO/TC211 Standards determine how components of geographic information will be harmonized, providing a common basis for data sharing and communication, they also contain the definitions to be used in assessing the quality of geographical data. It allows detailed cataloging and metadata identification. It is about how to define geometry model of spatial objects.

OGC and ISO/TC 211 Geographic Information/Geomatics working groups, which have been operating since 1994, are at the top of these organizations. Their main purpose is to ensure that the geo-processing services and the geographic data are in a certain standard. This makes the data exchangeable and interoperable with the data from different resources.

OGC Web Service standards related to the TUCBS Integration Project scope, which have a significant place in terms of web based geographic information systems, are:

- Web Map Service (WMS)
- Web Feature Service (WFS)
- Web Coverage Service (WCS)
- Catalogue Service for the Web (CS/W)
- Web Map Tile Service (WMTS)
- Keyhole Markup Language (KML)
- Styled Layer Descriptor (SLD)

Fig. 4 shows the relationship between OGC standards. PostgreSQL, an open source database server, was used in this project. After the geographic data from various institutions were transferred to the database, they were published as WMS/WFS using Geoserver which is an open source web

service server.

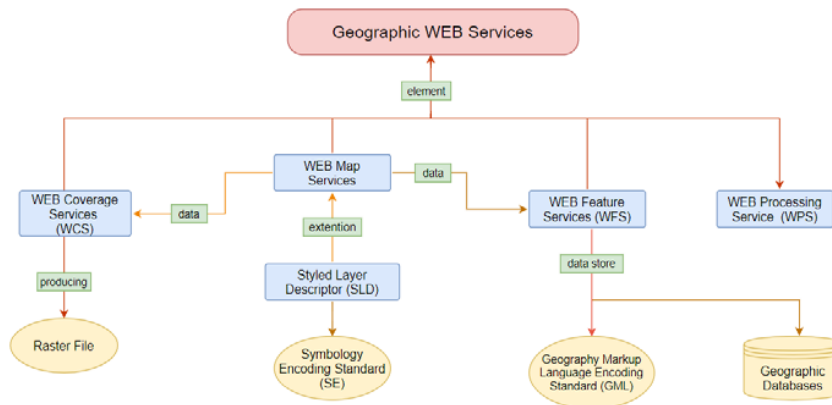


Fig. 4 Relation between OGC Standards

a) WMS

OGC's Web Map Service (WMS versions 1.1.1 and 1.3; ISO 19128) supports the application and display of maps derived from data accessed by the service, which is by far the most popular and extensively applied geospatial standards. Maps can be requested from one or more WMS overlays in browsers or client applications, supplied as graphical images (GIF, JPEG, TIFF). Features "behind" to the map can also be consulted and clients can view their properties [10].

A simple HTTP interface to request geo-registered map images on one or more distributed geo-spatial databases is provided with the WMS Interface Standard. The geographical layer(s) and area of interest to be handled are specified by a WMS. The response on the request is one or more map images which can be found in a browser app (returned as JPEG, PNG, etc.) [10].

It is the published service standard for processes such as making GetMap and GetFeatureInfo URL requests with standard web browsers and the server is responding to these requests as a map or data.

b) WFS

Through specifying data access and manipulation interfaces to geographical features using HTTP as the distributed computing framework, the OGC WFS takes the next logical step. As we know, WMS only returns an image that cannot be edited or spatially analyzed by end-users [10].

It is the standard that provides access, viewing and editing of data stored in vector format on servers with WMS-like URL requests. As the data format, formats such as Geographical Markup Language (GML) or GeoJSON, which are the OGC standard, are used.

Including geographical features with HTTP as the distributed computing platform, the WFS supports INSERT, UPDATE, DELETE, LOCK, QUERY and DISCOVERY operations. It is the function of a web application provider to ensure that data changes are compatible through its interaction with the data storage system used to persistently store features [11].

WFS operations are GetCapabilities, DescribeFeatureType, GetFeature, Transaction, LockFeature. After the geographic data from various institutions were transferred to the database, it was published as WMS/WFS using Geoserver which is an open source web service server.

2) SLD Creation

SLD profile of the WMS encoding standard defines an encoding that extends the WMS standard to allow user-defined symbolization and coloring of geographic feature and coverage data. SLD tackles the need for the visual imagery of geospatial data to be regulated by users and applications. To be able to define rules of design allows the client and the server to understand the language of styling [12].

It is the standard that enables the use of user-defined markings for layers containing vector or raster data published with WMS. It provides visualization. It is XML-based and performs cartographic representations using the specific rule definitions in Sign Code (SE).

Within the scope of TUCBS Integration Project, SLD files created in accordance with themes and details types were published in TUCBS Standardization studies.

For themes and layers without SLD files, QGIS, an open source GIS program, is used. SLD files have been created according to the specifications specified in the documents.

3) Web Service Publication

The Geoserver is an open source software server written in Java that can be used to share and edit geospatial data. It represents a web service deployment for interoperability; it publishes data from any major spatial data source using open standards based on Open Geospatial Consortium (OGC). It can read data from over a multiple spatial data sources and can produce output in many different formats to make spatial data more accessible to all [13].

Fig. 5 shows the data sources used in Geoserver and the service types that can be created. WMS and WFS are created because it is one of the 12 mandatory fields of metadata. It is the online resource section in metadata.

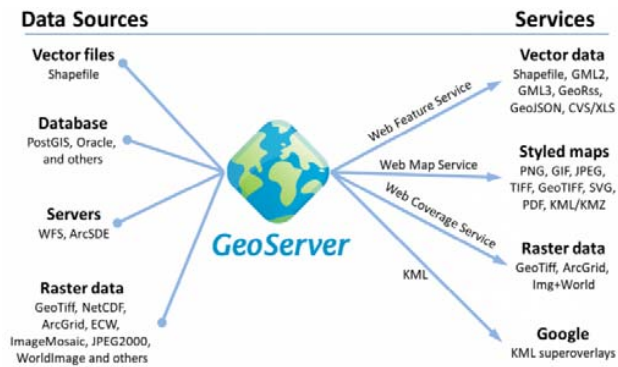


Fig. 5 Input and Output of GeoServer

Once the published WMS is added to the metadata, it is displayed in Geoportal. The results of the query are displayed on the screen. Different institutions can use these service addresses on a single platform and use them as a base map for various studies.

While creating WMS/WFS within the scope of this project, vector sample datasets, data transferred to PostgreSQL (PostGIS) database were used as data source. Style definition was made using SLD files specified by the standards. The data provided as raster format are published by using GeoTIFF data source.

D. Metadata

Metadata creation is a critical issue that is needed in today's world of technology to find and manage the data, to be able to manage, to associate and to monitor information effectively by navigating on many data sources such as text, video and pictures. The same requirement naturally applies to data within the scope of Geographical Information Systems. Metadata comes into prominence in many areas from ecology to security in order to define, organize, associate and use data effectively and efficiently.

In our case, "metadata" is the data of the spatial data. The aim here is to create the metadata of the spatial data, using the required information about the geospatial object. In this chapter, metadata standards, metadata creation, metadata publication and metadata access will be discussed.

1) Metadata Standards

Metadata, the only method for searching and retrieving geographic data, has been detailed in many standards published by ISO (International Organization for Standardization). Within the scope of INSPIRE studies, which started on the basis of ISO 19115 standards, the metadata required elements for the geographical data sets and services of the member states of the European Union were determined in the metadata principles adopted in 2008. ISO 19157 was published by ISO in December 2013 under the heading of "data quality". This standard has been accepted as the Turkish Standard by TSE (Turkish Standards Institute) with the number of TS EN ISO 19157 on 2 April 2014 [9]. According to these base standards, an adaptation of metadata standards was implemented in TUCBS. Metadata context being the

same; there are some mandatory components for a metadata in TUCBS:

- Language
- Contact Person (Institution Name, Contact e-mail)
- Resource Information (Resource Title, Resource Abstract)
- Web Service Link
- Unique Identifier
- Title Category
- Keyword
- Bounding Box
- Access Restrictions
- Terms of Access and Use
- Responsible Unit

2) Metadata Creation and Publication

In this methodology there are 2 main methods for metadata creation in general; manual and automatic methods. Manual methods include manual metadata entry and submission, manual submission of pre-existing metadata; both depending on manual approval. Automatic method on the other hand, is applied by creating and publishing metadata from the real-time data.

a) Manuel Method

(1) Manuel Metadata Entry

This method is to create metadata manually by a web interface owned and operated by The Ministry of Environment and Urbanization (<https://metaveri.geportal.gov.tr>). The procedure includes logging in with the provided username and password, filling in the required fields manually, and submitting. This procedure is highly human source consuming and should only be used in exceptional cases in which the data set can be described with very few metadata. Metadata is created directly in portal, admitted to the portal and manually controlled by administrators to check if it is valid. If it is valid, it is approved and published, if it is not, then it is returned to the user to check and re-admit.

(2) XML Upload

Pre-existed metadata in XML file format can be uploaded to metadata portal. Uploaded file can be checked and edited by the user, then admitted to the system for administration check. Manually publishing automatically created metadata follows the same principle also. Creating metadata by any means, but publishing it manually by submitting to metadata portal requires workforce both in uploading the files and in approving the metadata.

b) Automatic Method

Mostly, dynamic metadata generation is preferred to represent the real-time metadata. With automatic method, metadata is created automatically or created and published automatically. This way, the changes in the data can be reflected with the desired frequency. To create metadata automatically, our project team has developed a basic program in C#: Metadata Generator which is open source and can be accessed in GitHub: <https://github.com/ctnkyrd/metadata-generator-core>.

Metadata Generator has the capability to create metadata in ISO 19115 standards, adapted for TUCBS required fields. A parameter file (Fig. 6) attached to the program in JSON file format is used for the needed parameters. All the fixed institution information and database connection credentials are to be provided in this file. When started, metadata generator checks the parameter file related with any criteria. Besides, by catalog server parameter settings, metadata will be written into the catalog service account. At this point, metadata written into catalog server can be harvested by The Geographic Information Systems Directorate of the Ministry of Environment and Urbanization. Metadata owner institution can set this procedure and inform The Directorate to harvest fresh metadata hourly, daily, weekly or by any other frequency.

```
{
  "General": {
    "MetadataFolder": "{t@column_name}",
    "PostgresqlConnectionString": "PORT=5432;DATABASE=dbname;HOST=hostinfo;PASSWORD=dbpassword;USER ID=dbusername",
    "TopicCategory": "location",
    "OrganizationURL": "{T@logo}",
    "OnlineResources": [
      {
        "Name": "{T@vms}",
        "Name": "{T@wfs}"
      }
    ],
    "Language": "tur",
    "userLimitation": "user limitation provided in text",
    "otherConstraints": "constraints provided in text"
  },
  "CatalogServer": {
    "saveToCatalog": "true",
    "url": "URL to CatalogServer",
    "username": "username",
    "password": "admin",
    "p_catalogOverwriteSameUUID": "true"
  },
  "Institution": {
    "Name": "{t@kw1}",
    "OrganizationEmail": "{t@mail}",
    "Role": "pointOfContact"
  },
  "Table": {
    "TableName": "table with metadata information",
    "Criteria": "any criteria for DB",
    "KeywordsColumns": [
      {
        "Name": "{t@kw1}"
      },
      {
        "Name": "{t@kw2}"
      },
      {
        "Name": "{t@kw3}"
      },
      {
        "Name": "{T@kw4}"
      }
    ],
    "Abstract": "{t@abstract}",
    "GUID": "{T@guid}",
    "MetadataName": "{T@metaveri_adı}",
    "ResponsibleMail": "{T@mail2}",
    "BBOX": {
      "westLongitude": "{T@est_xmin}",
      "eastLongitude": "{T@est_xmax}",
      "northLatitude": "{T@est_ymax}",
      "southLatitude": "{T@est_ymin}"
    }
  }
}
```

Fig. 6 Parameter Configuration File of Metadata Generator

Creating and publishing metadata automatically increase metadata accuracy dramatically by removing the operator factor from the procedure. Approval procedure is also easy, since the metadata represents the database entries of the geographical data directly. Easing the procedure both in

creation and publication; regardless of the count of row in data, metadata level can be set as desired. Since TUCBS requires certain level of metadata for every data set, automatic method is almost a must for cases when the institution asked to present metadata in neighborhood or row level.

3) Metadata Access in Geoportal

Metadata is the path to the data. All this work of data digitalization, harmonization, web service publication, metadata creation, metadata publication processes are pointless unless the metadata provides the route to the data, to whom it may concern. At this point, Turkey National Geographic Data Portal (<https://www.geoportal.gov.tr/>) provides the metadata.

Authentication is a critical issue in metadata access. As provided in metadata creation and publication, access restrictions apply here. Every data set, therefore the metadata, may have its own privacy settings like accessibility, visibility, availability. Most of the metadata is public without any privacy settings.

IV. CONCLUSION

To sum up, with TUCBS Integration Project, site visits of 31 public institutions and 30 metropolitan municipalities took place to ensure the sharing of standardized spatial data in national standards. The study is a pilot one, and in the coming years, works will continue with more data providers for the dissemination of the project. During the project all the steps have been carried out on sample data sets of the data analyzed in the first stage of the process. Integration for all the data that institutions will share in Geoportal is expected to provide standardization and allow data providers to publish metadata and web service.

Metadata generator source codes, one of the critical outputs of the mentioned project, were shared with stakeholder institutions within the scope of the project. This resulted fruitful implementation and positive result. One of the most notable cases of using metadata generator is that; the Ministry of Culture and Tourism published data web services and produced 46,135 metadata by automatic method; the metadata was transferred to Geoportal with catalog service, and the publication process was realized.

REFERENCES

- [1] Inspire official web site, *About Inspire*, Retrieved January 15, 2020, from <https://inspire.ec.europa.eu/about-inspire/563>, <https://nsdi.gov.lk/reference-standards>
- [2] Inspire official web site, *Inspire Geoportal*, Retrieved January 15, 2020 <https://inspire-geoportal.ec.europa.eu>
- [3] National Research Council, "National Spatial Data Infrastructure Partnership Programs: Rethinking the Focus" in *PDF*, 2001, ch.3. <https://www.fws.gov/wetlands/Documents/Wetlands-Layer-National-Spatial-Data-Infrastructure-A-Phased-Approach-to-Completion-and-Modernization.pdf>
- [4] T.C. Çevre ve Şehircilik Bakanlığı, "TUCBS Entegrasyon Projesi Proje Bilgilendirme Kitapçığı, (submitted for publication)", 2019
- [5] Tapu ve Kadastro Genel Müdürlüğü, "Türkiye Ulusal Coğrafi Bilgi Sistemi Oluşturulabilmesi İçin Ön Çalışma Raporu, Eylem 47", 2005.
- [6] Tapu ve Kadastro Genel Müdürlüğü, "Türkiye Ulusal Coğrafi Bilgi Sistemi (TUCBS) Oluşturmaya Yönelik Altyapı Hazırlık Çalışmaları Raporu, Eylem 36", 2006.

- [7] Tapu ve Kadastro Genel Müdürlüğü, “Coğrafi Bilgi Sistemi Altyapısının Kurulumu, Eylem 75”, 2009.
- [8] T.C. Çevre ve Şehircilik Bakanlığı official website, Retrieved January 20, 2020, from <https://cbs.csb.gov.tr/>
- [9] T.C. Çevre ve Şehircilik Bakanlığı, Coğrafi Bilgi Sistemleri Genel Müdürlüğü, Türkiye Ulusal Coğrafi Bilgi Sistemi (TUCBS) Entegrasyon Projesi Proje Doküman Seti (submitted for publication)”, 2019.
- [10] M. Varol and I. Sanlıoğlu, “Open Geospatial Consortium Web Map and Feature Services and Free/Open Source Server/Client Software”, International Journal of Engineering and Geosciences (IJEG), Vol; 2, Issue; 01, pp. 17-26, February, 2017, ISSN 2548-0960, Retrieved January 15, 2020, from <https://dergipark.org.tr/tr/download/article-file/310266> Turkey, 2017.
- [11] Chathura H. W., “Intorduction to WEB-GIS”, 2015, Retrieved January 20, 2020, from <https://www.unescap.org/sites/default/files/5.%20Introduction%20to%20webGIS.pdf>
- [12] Retrieved January 20, 2020, from <https://www.opengeospatial.org/pressroom/pressreleases/761>
- [13] C. Cipolloni, “Architecture of Spatial Data Infrastructure (SDI)”. European Environment Agency, 2018.
- [14] Inspire official web site, INSPIRE Consolidated UML Model, Retrieved January 15, 2020, from <https://inspire.ec.europa.eu/data-model/approved/>